edexcel

GCSE (9-1) Combined Science

Sample Assessment Materials

Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Combined Science (1SC0)

First teaching from September 2016

First certification from 2018

Issue 2

Pearson

Edexcel, BTEC and LCCI qualifications

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These sample assessment materials are Issue 2. Key changes are sidelined. We will inform centres of any changes to this issue. The latest issue can be found on our website qualifications.pearson.com

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Summary of Pearson Edexcel GCSE in Combined Science (1SC0) sample assessment materials Issue 2 changes

Summary of changes made between previous issue and this current issue	Page number
The mark scheme for Paper 4 C2F has been replaced with the correct version.	109-115
For Paper 1: Biology 1 Higher tier, in question 4(a)(i) answer D has been replaced with an alternative arrangement of the sugar, phosphate and the base in a DNA nucleotide, as the previous answer was not incorrect. This new answer D is incorrect.	186
The equations sheet for: Paper 5: Physics 1 Foundation tier Paper 5: Physics 1 Higher tier Paper 6: Physics 2 Foundation tier Paper 6: Physics 2 Higher tier have been amended to include the correct equations for combined science and for the correct tier.	132, 161, 299, 332
The title for Paper 6: Physics 2 Higher tier has been corrected, as it previously was titled paper 2.	309

If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html

Introduction

The Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Combined Science is designed for use in schools and colleges. It is part of a suite of GCSE qualifications offered by Pearson.

These sample assessment materials have been developed to support this qualification and will be used as the benchmark to develop the assessment students will take.

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than be penalised for omissions.
- Examiners should mark according to the mark scheme – not according to their perception of where the grade boundaries may lie.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification/indicative content will not be exhaustive.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, a senior examiner must be consulted before a mark is given.
- Crossed-out work should be marked **unless** the candidate has replaced it with an alternative response.

Subject specific marking guidance

Symbols, terms used in the mark scheme

- Round brackets ( ): words inside round brackets are to aid understanding of the marking point but are not required to award the point
- Curly brackets { }: indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion
- Oblique /: words or phrases separated by an oblique are alternatives to each other and either answer should receive full credit.
- ecf: indicates error carried forward which means that a wrong answer given in an early part of a question is used correctly to a later part of a question.

You will not see 'owtte' (or words to that effect). Alternative correct wording should be credited in every answer unless the ms has specified specific.

The Additional Guidance column is used for extra guidance to clarify any points in the mark scheme. It may be used to indicate:

- what will not be accepted for that marking point in which case the phrase 'do not accept' will be alongside the relevant marking point
- it might have examples of possible acceptable answers which will be adjacent to that marking point

Specific Marking Guidance for Levels Based Mark Schemes

Step 1 – Finding the right level

The first stage is to decide which level the answer should be placed in. Examiners should first make a holistic judgement on which level most closely matches the student response and place it within that level. Students will be placed in the level that best describes their answer.

Answers can display characteristics from more than one level, and where this happens examiners must use their professional judgement to decide which level is most appropriate using a 'best-fit' approach. For example if a student's work mainly evidences the skills of level 2 but has some level 3 skills present the response would be placed in level 2 but the mark awarded would be towards the top of level 2, reflecting the evidence given from level 3.

Step 2 – Determining the mark

After a level has been decided on, the next stage is to decide on the mark within the level. The instructions below tell you how to reward responses within a level. Examiners should be prepared to use the full range of marks available in a level and not restrict marks to the middle.

Examiners should start at the middle of the level (or the upper middle mark if there is an even number of marks) and then move the mark up or down to find the best mark.

To do this, you should take into account how far the answer meets the requirements of the level:

- If it meets the requirements fully, you should be prepared to award full marks within the level. The top mark in the level is used for answers that are as good as can realistically be expected within that level.
- If it only barely meets the requirements of the level, examiners should consider awarding marks at the bottom of the level. The bottom mark in the level is used for answers that are the weakest that can be expected within that level.
- The middle marks of the level are used for answers that have a reasonable match to the descriptor. This might represent a balance between some characteristics of the level that are fully met and others that are only barely met.

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number	Candidate Number

Combined Science

Paper 1: Biology 1

Foundation Tier

Sample Assessment Materials for first teaching September 2016	Paper Reference
Time: 1 hour 10 minutes	**1SC0/1BF**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1/1/1/1/2/1/

S 5 0 0 5 3 A 0 1 2 0

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Eye colour is controlled by genes.

The allele for brown eyes, B, is dominant to the allele for blue eyes, b.

(a) A female with blue eyes and a male with brown eyes are about to have a child.

Complete the Punnett square to determine the phenotype of the child.

(2)

		man	
		B	B
woman	b		
	b		

Phenotype of child .....

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(b) A scientist recorded the eye colour of 30 people.

The results are shown in Figure 1.

blue	green	blue	brown	brown	brown	hazel	blue	
brown	hazel	blue	blue	hazel	green	brown	brown	
blue	green	brown	brown	blue	hazel	blue	brown	brown
brown	blue	brown	brown	brown				

Figure 1

(i) Complete the tally chart, in Figure 2, for this data.

(2)

eye colour			
blue	brown	green	hazel
total.....	total.....	total.....	total.....

Figure 2

(ii) Give another appropriate method of displaying this information.

(1)

.....

.....

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A section of one allele for eye colour has the following DNA sequence:

ATGGCTAAGTA

(c) (i) Which sequence is the complementary DNA strand?

(1)

- ☒ **A** ATGGCTAAGTA
- ☒ **B** CGTTAGCCTGC
- ☒ **C** TACCGATTCAT
- ☒ **D** GCAATGGACG

(ii) Give **one** way in which a second allele for eye colour might be different.

(1)

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Figure 3 outlines a method that can be used to extract DNA from fruit.

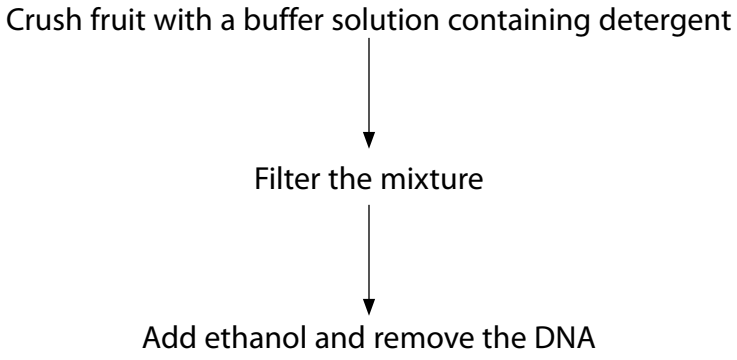

Figure 3

(d) (i) Give a reason for filtering the mixture.

(1)

.....

.....

(ii) What is the role of the ethanol?

(1)

- ☒ **A** denature the enzymes
- ☒ **B** disrupt cell membranes
- ☒ **C** supercoil the DNA
- ☒ **D** to precipitate the DNA

(Total for Question 1 = 9 marks)

2 Antibiotics can be used to treat Chlamydia, which is a sexually transmitted infection.

(a) What type of pathogen causes Chlamydia?

(1)

☒ **A** bacteria

☒ **B** fungus

☒ **C** protist

☒ **D** virus

Figure 4 shows the number of new cases of Chlamydia diagnosed each year, in a region of the UK, between 2000 and 2008.

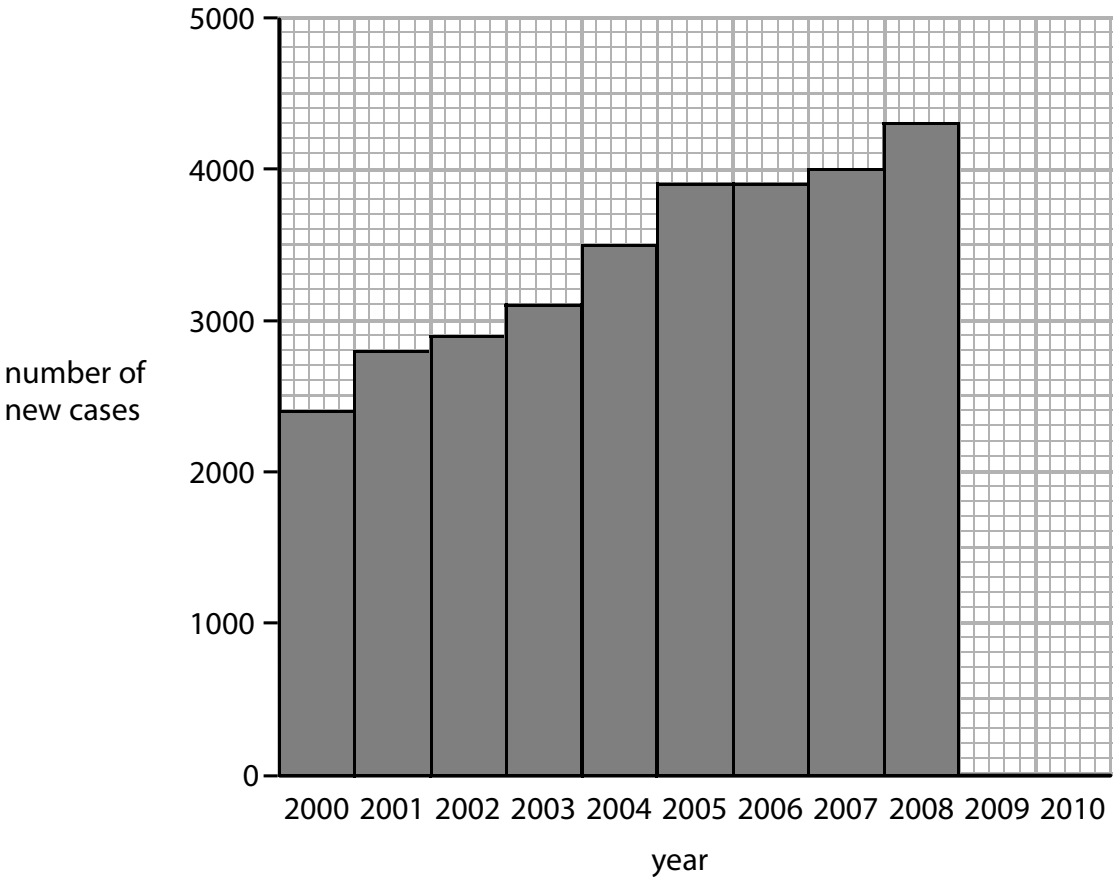

Figure 4

(b) (i) In 2009 there were 4800 new cases diagnosed.

In 2010 there were 4100 new cases diagnosed.

Plot this data on the graph in Figure 4.

(1)

(ii) Describe the trend in cases between 2000 and 2010.

(2)

People infected with Chlamydia are more likely to be infected with the STI Gonorrhoea.

(iii) Explain how people become infected with both Chlamydia and Gonorrhoea.

(2)

HIV is a sexually transmitted infection.

(c) Explain how infection with HIV can lead to AIDS.

(2)

(Total for Question 2 = 8 marks)

3 Figure 6 shows a diagram of a cell.

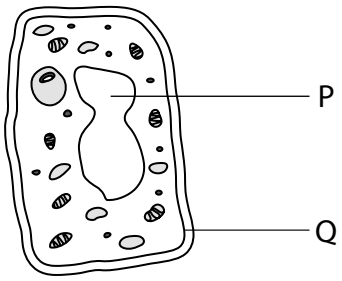

Figure 5

(a) (i) Which row of the table identifies both structure P and structure Q?

(1)

		structure P	structure Q
☒	**A**	nucleus	cell membrane
☒	**B**	nucleus	cell wall
☒	**C**	vacuole	cell membrane
☒	**D**	vacuole	cell wall

(ii) Plant cells have a cell wall and a large vacuole.

Draw one straight line from each structure to its function.

(2)

structure	**function**
	where respiration occurs
cell wall	contains cellulose to provide support
	where photosynthesis occurs
large vacuole	controls the cell
	stores cell sap

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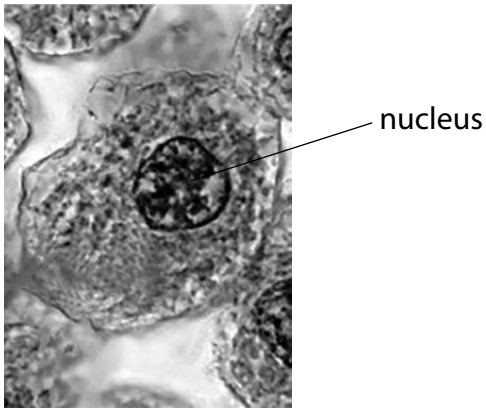
Figure 6 shows an image of an animal cell taken using a microscope with a 10× eyepiece lens and a 40× objective lens.



(Source: © Ed Reschke/Getty Images)

Figure 6

(b) (i) The total magnification of the animal cell is

(1)

- ☒ **A** ×50
- ☒ **B** ×140
- ☒ **C** ×400
- ☒ **D** ×4000

(ii) The diameter of the cell is 15 μm.

Use Figure 7 to estimate the diameter of the cell nucleus.

(1)

diameter of nucleus = ... μm

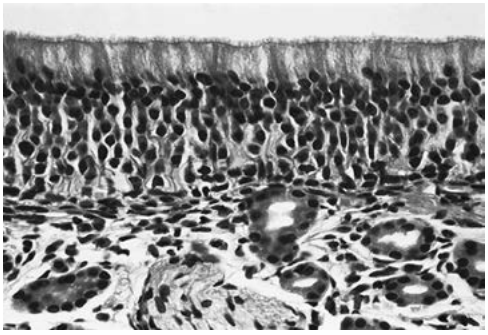
(iii) Give the measurement of 15 μm in mm.

(1)

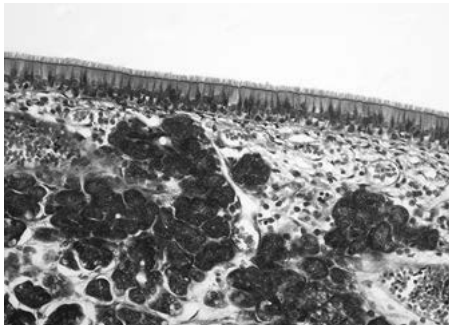
..... mm

The development of electron microscopes has increased our understanding of cells and their features.

Figure 7 shows two images of ciliated epithelium, one taken using a light microscope and one using an electron microscope.



Light microscope



Electron microscope

(Science photolibrary Epithelium C022/2228 C023/4048)

Figure 7

(c) Explain how the electron microscope image helps us to understand more about ciliated epithelium.

(3)

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(Total for Question 3 = 9 marks)

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4 Cell division processes are used to produce body cells and gametes.

The nucleus of a daffodil cell has 46 chromosomes.

(a) (i) State the number of chromosomes in each pollen grain from this daffodil.

(1)

.....

.....

(ii) Humans share 35% of their DNA with a daffodil.

The human genome contains 6600 million bases.

Calculate the number of bases that are the same as a daffodil.

(2)

number of bases = ... million

Figure 8 shows the development of a human embryo from a fertilised egg.

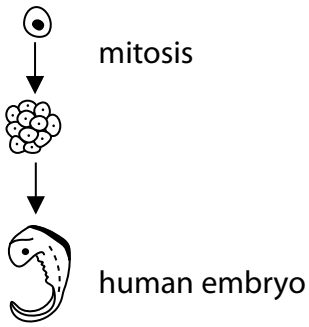

Figure 8

(b) (i) Explain how many cells are produced from one fertilised egg, after two cell divisions by mitosis.

(2)

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(ii) Which process occurs causing the divided cells to become specialised?

(1)

- ☒ **A** meiosis
- ☒ **B** cloning
- ☒ **C** differentiation
- ☒ **D** cytokinesis

A student wanted to observe dividing cells under a microscope.

The student squashed the root tip of an onion plant on a microscope slide.

(c) (i) Describe how the student should use a light microscope to view the squashed root tip.

(3)

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(ii) Even though the slide was at the correct magnification, the student could not see the chromosomes in the dividing cells.

State what could be done to the slide to make the chromosomes more visible.

(1)

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(Total for Question 4 = 10 marks)

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5 Figure 9 shows the times when *Homo sapiens* and some of their ancestral species are thought to have lived.

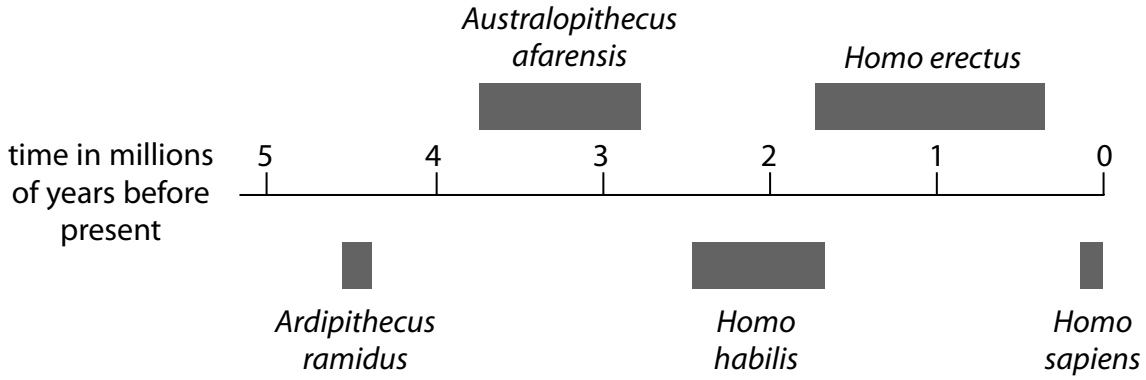

Figure 9

(a) Fossil remains of *Ardipithecus ramidus* were discovered in Ethiopia.

(i) Calculate the number of years *Ardipithecus ramidus* is thought to have inhabited the Earth.

(2)

Answer .....

(ii) Describe the evidence that scientists might have used to show that *Ardipithecus ramidus* inhabited the Earth earlier than *Homo habilis.*

(2)

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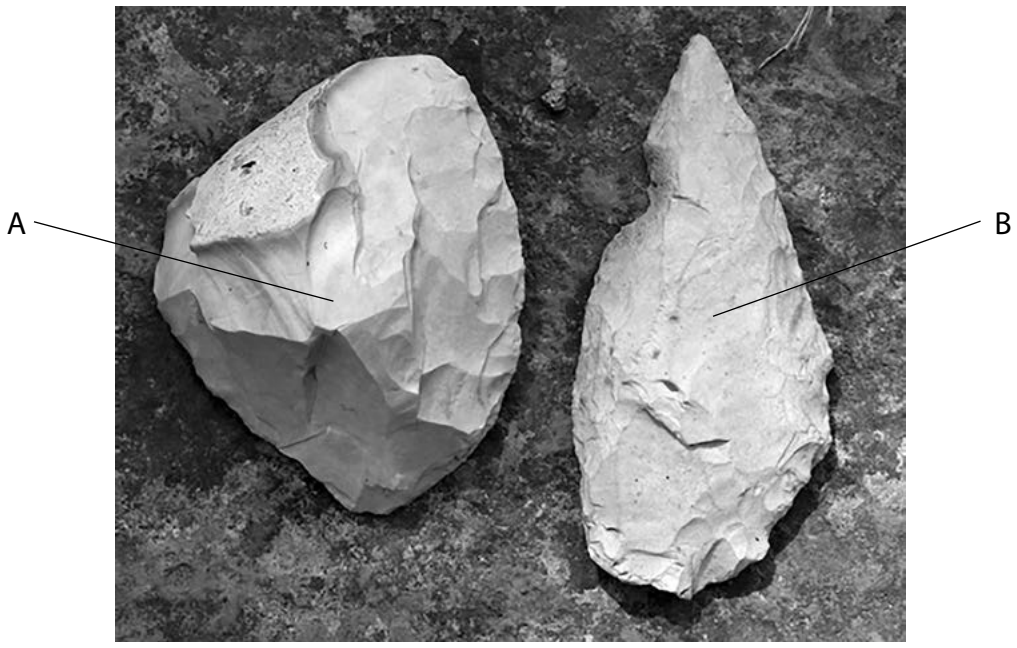
(iii) Suggest an explanation for the extinction of *Homo habilis*.

Use information from Figure 9.

(2)

Figure 10 shows two stone tools, one used by *Homo habilis* and one used by *Homo erectus*.



(Source: Frederic Surmely/look at sciences/Science Photo Library)

Figure 10

(iv) Explain which stone tool was most likely to be used by *Homo erectus*.

Use information from Figure 9 and Figure 10.

(2)

(b) The population of humans on Earth has increased significantly, leading to food shortages.

The growth of drought-resistant crop plants could lead to an increase in food supply.

Describe how drought-resistant crop plants can be produced.

(3)

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(Total for Question 5 = 11 marks)

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6 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to two decimal places.

(2)

Answer = ...

Dieting can reduce the effects of cardiovascular disease.

A scientist is planning to test a new diet for weight loss.

She selects 40 obese people to take part in the test.

All the obese people are between 20 and 30 years of age.

(b) (i) State **two** other factors the scientist should control when selecting the people.

(2)

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(ii) Devise a plan the scientist could use to test the effectiveness of the new diet using the 40 obese people.

(3)

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Smoking is a lifestyle factor that can cause many diseases.

Figure 11 shows the trends in smoking between 1960 and 2010 for men and women.

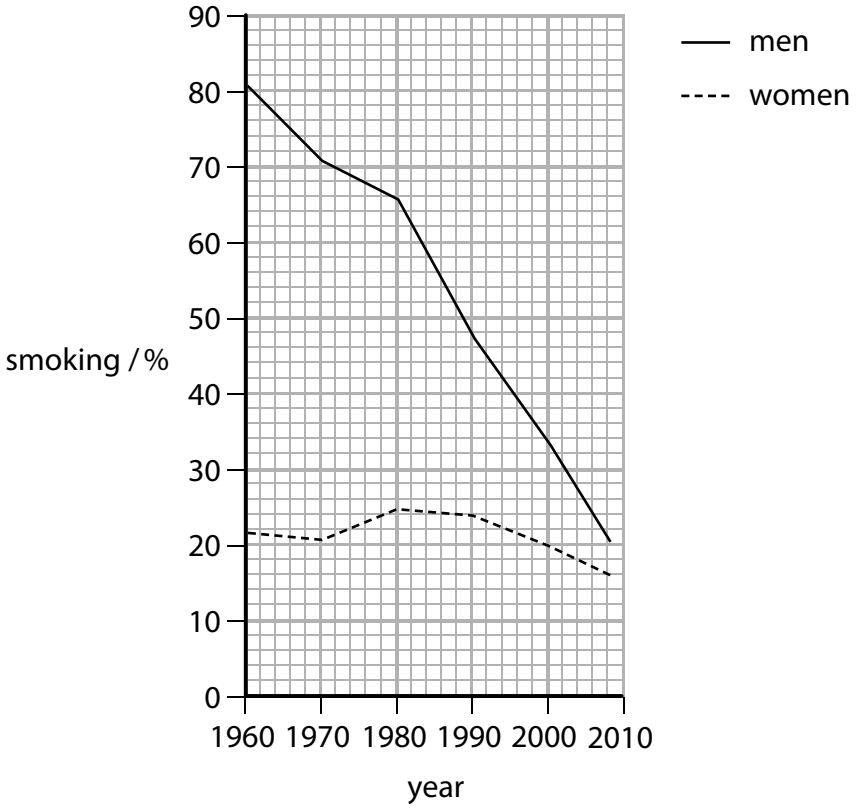

Figure 11

*(c) Explain how the changes in the trends for smoking may affect the occurrence of cardiovascular disease.

(6)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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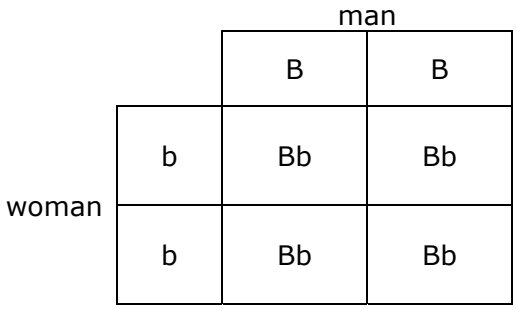
Paper 1 B1F Mark scheme

Question number	Answer	Mark
1(a)	A completed Punnett square, including: • offspring alleles correct (1)  • phenotype of child: brown eyes (1)	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	• All four columns correct (tally and total) (2) • One or two correct columns (1)	blue: 9 brown: 14 green: 3 hazel: 4	**(2)**

Question number	Answer	Mark
1(b)(ii)	Could be displayed as a bar chart/pie chart	**(1)**

Question number	Answer	Mark
1(c)(i)	C	**(1)**

Question number	Answer	Additional guidance	Mark
1(c)(ii)	Any one from: • mutation in the base sequence (1) • different base sequence (1) • different sequence length (1)	different amino acid sequence	**(1)**

Question number	Answer	Mark
1(d)(i)	To remove insoluble material	**(1)**

Question number	Answer	Mark
1(d)(ii)	D	**(1)**

Question number	Answer	Mark
2(a)	A	**(1)**

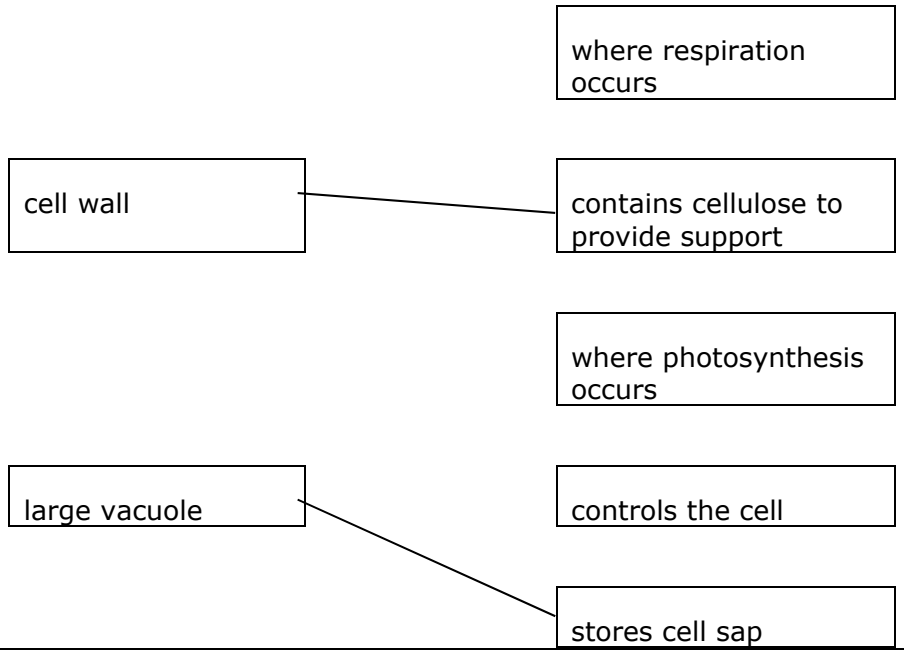
Question number	Answer	Mark
2(b)(i)	2009 bar plotted at 4800 and 2010 bar plotted at 4100	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	An answer that combines points of interpretation/evaluation to provide a logical description: • overall trend increases until 2009 (1) • decrease in the number of cases in 2010/correct manipulation of the data (1)	e.g. in 2010 it decreased by 700 cases (1)	**(2)**

Question number	Answer	Mark
2(b)(iii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • chlamydia and gonorrhoea are STI infections spread by the same mechanism (1) • individuals aren't using a barrier contraception method (1)	**(2)**

Question number	Answer	Mark
2(c)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (1 mark): • HIV destroys white blood cells/cells of the immune system (1) • therefore a reduced immune response makes the individual more susceptible to other communicable diseases (1)	**(2)**

Question number	Answer	Mark
3(a)(i)	C	(1)

Question number	Answer	Mark
3(a)(ii)	One mark for each correct line  	(2)

Question number	Answer	Mark
3(b)(i)	C	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	5 (μm) ± 1.5	approximately a third of the diameter of the cell	(1)

Question number	Answer	Mark
3(b)(iii)	0.015 (mm)	(1)

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • higher magnification can be used (1) • so the cilia are more visible (1) • and the sub-cellular structures are visible (1)		**(3)**

Question number	Answer	Mark
4(a)(i)	23 (chromosomes)	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	6600 million ÷ 100 (1) × 35 = 2310 million (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
4(b)(i)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • one cell produces two daughter cells for every division by mitosis (1) • two cell division steps produces four cells (1)	**(2)**

Question number	Answer	Mark
4(b)(ii)	C	**(1)**

Question number	Answer	Mark
4(c)(i)	An answer that combines knowledge (1 mark) and understanding (2 marks) to provide a logical description: • place the slide on the stage of the microscope and look through the eyepiece lens (1) Plus two from: • turning the focusing wheel/knob will obtain a clear image (when looking through the eyepiece lens) (1) • start by using the lowest objective lens magnification (1) • increase the magnification of the objective lens and refocus (1)	**(3)**

Question number	Answer	Mark
4(c)(ii)	Use a stain (1)	**(1)**

Question number	Answer	Mark
5(a)(i)	• 4.6 million – 4.4 million (1) • 0.2 million years/200 000 years (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An answer that combines knowledge (1 mark) and understanding (1 mark) to provide a logical description: • (scientists might look for) differences in the structural features of the fossil (1) • and *Ardipithecus ramidus* would be deeper in the rock layer than *Homo* {*habilis*/stone tools} (1)	e.g. *Ardipithecus ramidus* smaller cranial capacity	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • likely to be out-competed by *Homo erectus* (1) • {for resources essential for survival/due to the presence of a new selection pressure} (1)	accept: named resources accept: named selection pressure, e.g. climate change, environmental change, disease	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(iv)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • stone tool B because it is more {sophisticated/worked} (1) • and *Homo erectus* lived more recently than *Homo habilis* (1)	accept: data quoted from the timeline	**(2)**

Question number	Answer	Mark
5(b)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • genetic variation means that some plants will be tolerant of drought conditions and these can be selected (1) • cross-pollinate these plants and grow the seeds under drought conditions (1) • select offspring and repeat over several generations (1)	**(3)**

Question number	Answer	Additional guidance	Mark
6(a)	• 830 mm = 0.83 m (1) • 0.83/0.99 = 0.8383… = 0.84 to two d.p. (1) OR • 0.99 m = 990 mm (1) • 830/990 = 0.8383… = 0.84 to two d.p. (1) Answer must be given to 2 decimal places	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
6(b)(i)	Any two of the following points: • similar BMI (1) • same gender profile (1) • similar amount (and type) of exercise (1)	**(2)**

Question number	Answer	Mark
6(b)(ii)	An answer that combines the following points to provide a plan: • weigh the 40 obese people (1) • half follow the new diet and half keep their normal diet (1) • after a fixed time period re-weigh the 40 people (1)	**(3)**

Question number	Indicative content	Mark
***6(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (3 marks) and AO3 (3 marks)** AO3: Interpretation and evaluation from the graph • the trend is downwards • women are less likely to smoke than men • the trend for men is decreasing more steeply than for women • the decreasing trend in smoking should lead to a decrease in the occurrence in cardiovascular disease • the decrease of cardiovascular disease in men would be greater than in women AO2: Link between reducing smoking and cardiovascular disease: • less damage to alveoli so reduced effect on surface area of lungs • less fatty deposits build up in arteries so less chance of a heart attack or stroke • effect of nicotine raising heart rate and blood pressure is reduced • the risk of blood clotting is reduced so lower chance of heart attack or stroke	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Combined Science

Paper 2: Biology 2

Foundation Tier

Sample Assessment Materials for first teaching September 2016 **Time: 1 hour 10 minutes**	Paper Reference **1SC0/2BF**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Plants need light for photosynthesis.

Part of the photosynthesis equation is shown below.

..... + carbon dioxide → glucose + ...

(a) Which of the following would complete the photosynthesis equation?

(1)

		reactant	product
☒	**A**	water	chlorophyll
☒	**B**	chlorophyll	oxygen
☒	**C**	water	oxygen
☒	**D**	oxygen	water

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A scientist investigates the effect of light intensity on photosynthesis.

He sets up the equipment shown in Figure 1.

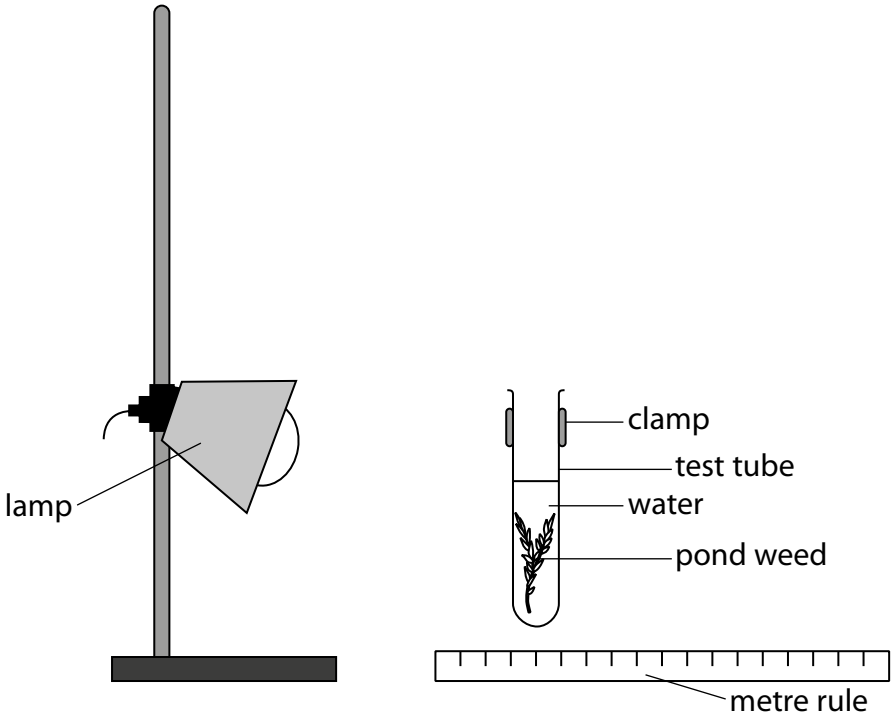

Figure 1

He positions the lamp 10 cm from the test tube and records the number of bubbles produced in five minutes.

He repeats the procedure with the lamp at a distance of 20 cm and 30 cm away from the test tube.

The scientist wants to repeat his investigation at each distance.

(b) (i) State **three** variables that should be kept constant to improve the results.

(3)

1 .....

.....

2 .....

.....

3 .....

.....

The scientist noticed that the temperature of water near the light increased.

(ii) Give **one** improvement the scientist could make to reduce the effect of this increase in temperature.

(1)

.....

.....

(c) Figure 2 shows the results of the investigation.

distance (cm)	number of bubbles counted			
	test 1	test 2	test 3	mean
10	42	37	44	41
20	23	24	22	
30	10	11	12	11

Figure 2

(i) Calculate the mean result for a distance of 20 cm.

(1)

.....

The number of bubbles counted for test 2 at 10 cm was anomalous.

(ii) State how the scientist could deal with this anomaly.

(1)

.....

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(iii) Give a conclusion about the effect of light intensity on photosynthesis.

(1)

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(Total for Question 1 = 8 marks)

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2 Figure 3 shows a pair of human lungs.

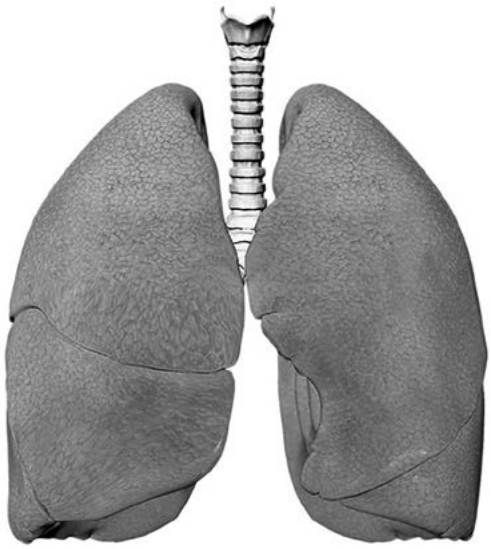

Figure 3

(a) (i) Where does gas exchange take place in the lungs?

(1)

- ☒ **A** alveolus
- ☒ **B** bronchus
- ☒ **C** bronchiole
- ☒ **D** trachea

A person had emphysema. This reduces the number of alveoli in the lungs.

(ii) Explain how emphysema would affect the amount of oxygen carried in the bloodstream.

(2)

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(b) Figure 4 is a table that shows the surface area (SA) to volume (V) ratio in three different sized cubes.

cube size (cm)	surface area / SA (cm^2)	volume / V (cm^3)	SA : V ratio
2	24	8	
4	96	64	1.5 : 1
6	216	216	1 : 1

Figure 4

(i) Calculate the SA : V ratio for the 2 cm cube.

(2)

.....

(ii) Give **one** reason why it is important that human lungs have a high surface area to volume ratio.

(1)

.....

.....

Oxygen is involved with aerobic respiration in cells.

(iii) Which is the correct equation for aerobic respiration?

(1)

☐ **A** oxygen + carbon dioxide → glucose + lactic acid

☐ **B** carbon dioxide + water → oxygen + lactic acid

☐ **C** glucose + oxygen → carbon dioxide + water

☐ **D** glucose + water → carbon dioxide + oxygen

(Total for Question 2 = 7 marks)

3 Scientists can measure how much water is lost by the leaves of a plant.

(a) (i) What is the movement of water molecules from an area with a low solute concentration to an area with a high solute concentration called?

(1)

- ☒ **A** active transport
- ☒ **B** diffusion
- ☒ **C** osmosis
- ☒ **D** transpiration

(ii) What structure transports water through the stem of the plant?

(1)

- ☒ **A** guard cell
- ☒ **B** phloem
- ☒ **C** stomata
- ☒ **D** xylem

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(b) A scientist measured the rate of water loss from a plant shoot using a potometer.

Figure 5 shows the equipment used in the experiment.

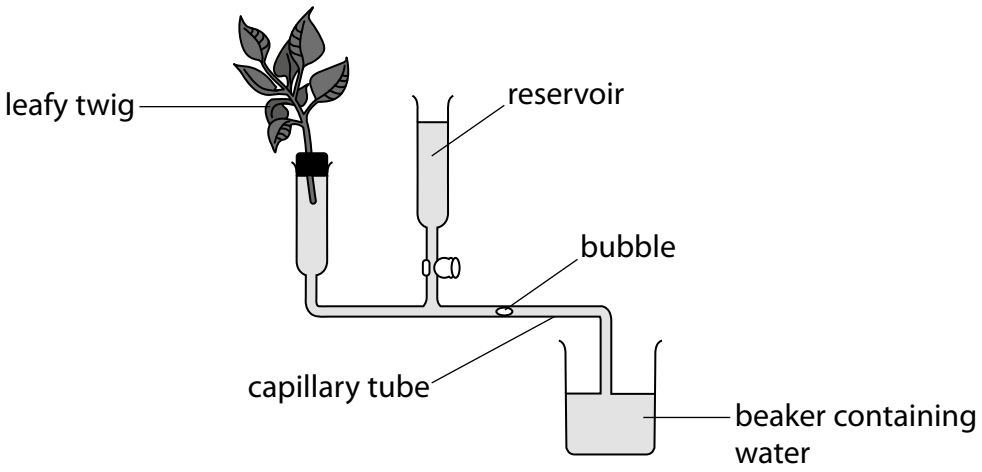

Figure 5

The volume of water lost from the plant can be calculated by measuring the distance a bubble moves along the capillary tubing.

(i) Calculate the rate of water loss from the plant in mm^3/s if the volume of water lost was 12 mm^3 in 10 minutes.

(3)

rate of water loss = ... mm^3/s

(ii) Explain how the water loss would change if the plant only had one leaf.

(2)

The scientist wants to extend the investigation by considering other factors that affect transpiration rate.

(iii) State **two** variables, other than temperature, that she could investigate.

(2)

1

2

(c) Explain the effect of increasing air temperature on the rate of transpiration in a plant.

(2)

(Total for Question 3 = 11 marks)

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4 (a) A scientist wanted to estimate the number of earthworms in a field using a quadrat.

The scientist placed the quadrats at random on the surface of the area being sampled and then watered the area with a very dilute solution of mustard.

This causes the earthworms to come to the surface to be counted.

(i) Give a reason why the quadrats were placed at random.

(1)

.....

.....

The skin of the earthworm acts as a gas exchange surface.

(ii) Describe the gases that are exchanged across the skin of the earthworm as a result of the earthworm respiring.

(2)

.....

.....

.....

(iii) What is the method in which gases are exchanged across the skin of the earthworm?

(1)

☒ **A** active transport

☐ **B** diffusion

☒ **C** osmosis

☐ **D** transpiration

(b) A student wants to estimate the number of daisy plants in a 500 m^2 field.

She uses a 1 m^2 quadrat to sample the field.

Figure 6 shows the results for the number of daisy plants counted in six areas sampled with the quadrat.

sample number	number of daisy plants	mean diameter of daisy plants / cm
1	5	7
2	2	2
3	6	9
4	3	3
5	4	5
6	4	6

Figure 6

(i) Calculate the mean number of daisy plants for the six samples.

(1)

mean number of daisy plants = ...

(ii) Describe how the student could use this calculated mean to estimate the total number of daisy plants in this field.

(2)

.....

.....

.....

.....

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Sample 2 was taken in an area where there were many overhanging trees.

(iii) Explain how these trees may have affected the distribution of daisy plants growing in this area.

(2)

.....

.....

.....

.....

(iv) Give **two** abiotic factors that could affect the distribution and size of daisies growing in this field.

(2)

.....

.....

.....

.....

(Total for Question 4 = 11 marks)

5 Figure 7 shows a diagram of the heart.

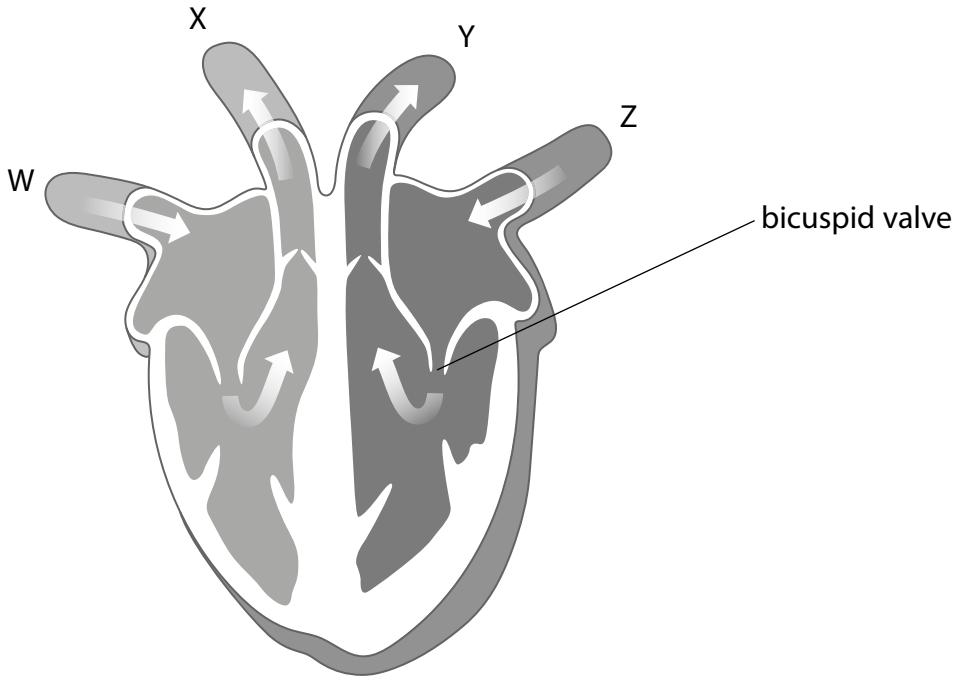


Figure 7

(a) (i) Vessel X takes

(1)

- ☒ **A** deoxygenated blood to the body
- ☒ **B** deoxygenated blood to the lungs
- ☒ **C** oxygenated blood to the body
- ☒ **D** oxygenated blood to the lungs

(ii) Give one reason why the wall of the left ventricle is thicker than the right.

(1)

.....

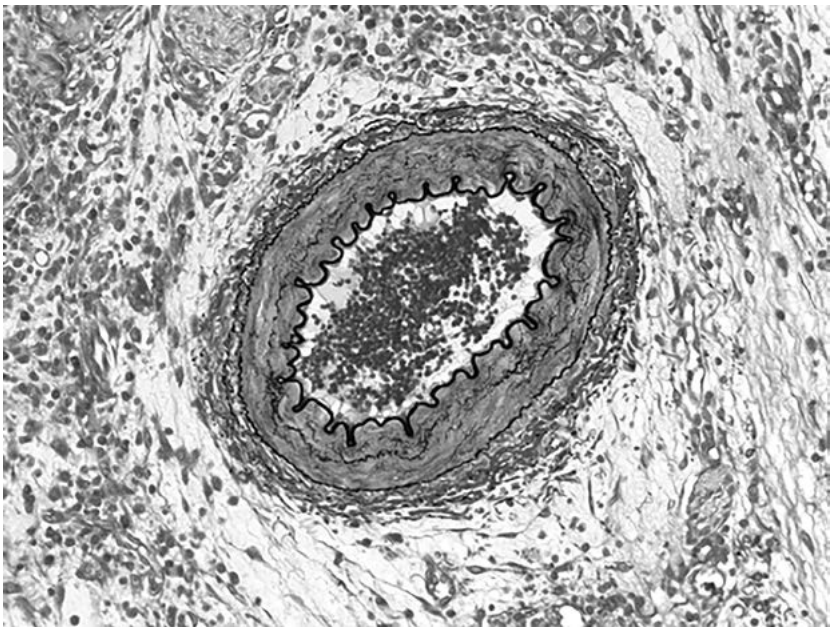
.....

Valves in the human heart may become damaged and no longer function.

(iii) Describe what would happen to the flow of blood in the left side of the heart if the bicuspid valve did not function effectively.

(2)

(b) Figure 8 shows a photomicrograph of a blood vessel.



(Source: Microscape/Science Photo Library)

Figure 8

Explain how the structure of this blood vessel is related to its function.

(2)

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(c) Figure 9 shows a diagram of the circulatory system of a fish.

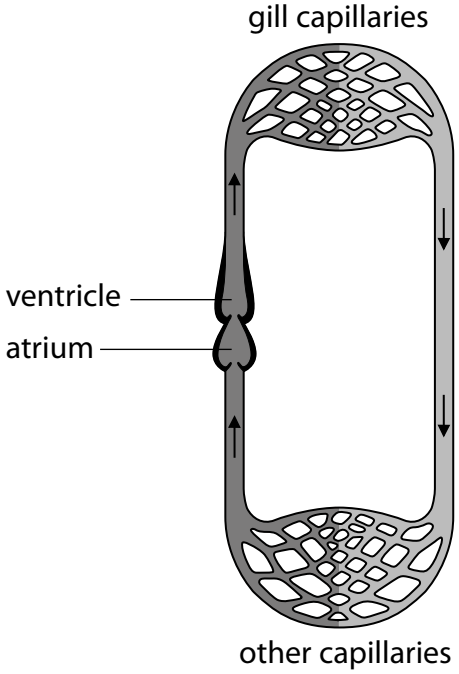

Figure 9

Describe the differences between the structure of the circulatory system of a fish and the human circulatory system.

(4)

(Total for Question 5 = 10 marks)

6 (a) Blood tests can be used to check a person's blood glucose and hormone levels.

Figure 10 shows the results of two blood tests done on three people to check their blood glucose levels. Person 1 is healthy.

	blood glucose level (mmols/l)	
	after fasting for 12 hours	**two hours after drinking 75 g glucose**
person 1	5.4	6.4
person 2	5.6	9.0
person 3	7.8	12.1

Figure 10

(i) Compare the glucose levels of person 1 with the glucose levels of person 2 after fasting for 12 hours.

(1)

.....

.....

(ii) Compare the glucose levels of person 2 with the glucose levels of person 1, two hours after drinking 75 g glucose.

(1)

.....

.....

(iii) Person 3 cannot produce the hormone that controls blood glucose levels.

State the hormone that person 3 cannot produce.

(1)

.....

.....

(b) Figure 11 shows the level of progesterone for a female during five different stages of the menstrual cycle.

days in the menstrual cycle	progesterone level (nmol/l)
1–9	1.85
10–14	1.48
15–17	14.28
18–23	35.27
24–28	17.11

Figure 11

(i) Describe the changes in progesterone levels over the 28-day cycle.

(2)

(ii) Explain why progesterone levels changed following day 14.

(2)

Figure 12 shows the effectiveness of different methods of contraception in the prevention of pregnancy during their first year of use.

It shows percentages for typical use (some mistakes when used) and perfect use (no mistakes when used).

		percentage of women with unintended pregnancies within the first year of use (%)	
contraceptive method	**type of contraceptive**	**typical use**	**perfect use**
diaphragm	barrier	16	6
female condom	barrier	21	5
male condom	barrier	15	2
intra uterine device	hormonal	8	0.3
combined pill	hormonal	8	0.2
mini pill	hormonal	8	0.3
combined patch	hormonal	8	0.2

Figure 12

*(c) Compare and contrast the data for different contraceptive methods and types, to advise a young adult as to the best method of contraception to avoid pregnancy.

(6)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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Paper 2 B2F Mark scheme

Question number	Answer	Mark
1(a)	C	(1)

Question number	Answer	Mark
1(b)(i)	• temperature of water (1) • Start each experiment with the same amount of carbon dioxide (1) • Start each experiment with the same amount of water (1)	(3)

Question number	Answer	Mark
1(b)(ii)	Any one improvement from: • Use a heat shield (1) • Use a water bath (1)	(1)

Question number	Answer	Additional guidance	Mark
1(c)(i)	• $\frac{23+24+22}{3}$ (1) • $69 \div 3 = 23$ (1)	award full marks for correct numerical answer without working	(1)

Question number	Answer	Mark
1(c)(ii)	Repeat the reading to get concordant results/calculate the mean without the anomalous result	(1)

Question number	Answer	Mark
1(c)(iii)	{as light intensity decreases/distance from the lamp increases} the rate of photosynthesis decreases	(1)

Question number	Answer	Mark
2(a)(i)	A	(1)

Question number	Answer	Mark
2(a)(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): • emphysema will reduce the amount of oxygen carried into the bloodstream (1) • because there is reduced alveoli, which are the gas exchange surface between the lungs and blood capillaries (1)	(2)

Question number	Answer	Additional guidance	Mark
2(b)(i)	24 ÷ 8 (1) 3 : 1 (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
2(b)(ii)	Maximise gas exchange/maximise oxygen uptake	**(1)**

Question number	Answer	Mark
2(b)(iii)	C	**(1)**

Question number	Answer	Mark
3(d)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (2 marks): • shivering stops the body temperature falling when external temperature drops (1) • because increased muscle contraction (1) • generates heat via respiration/friction (1)	**(3)**

Question number	Answer	Mark
3(a)(i)	C	**(1)**

Question number	Answer	Mark
3(a)(ii)	D	**(1)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	10 mins = 600 s (1) 12 ÷ 600 (1) 0.02 (mm^3/s) (1)	award full marks for correct numerical answer without working maximum of 2 marks if conversion not completed	**(3)**

Question number	Answer	Mark
3(b)(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): • transpiration would be reduced (1) • as less evaporation from the surface of the leaf (1)	**(2)**

Question number	Answer	Mark
3(b)(iii)	Any two of the following points: • humidity (1) • air speed (1) • light intensity (1)	**(2)**

Question number	Answer	Mark
3(c)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • transpiration rate is increased (1) • because water molecules have more energy/move faster (1)	**(2)**

Question number	Answer	Mark
4(a)(i)	To obtain a representative sample of the field (1)	**(1)**

Question number	Answer	Mark
4(a)(ii)	An answer that combines the following points of understanding to provide a logical description: • Oxygen moves from the air across the skin in the worm/bloodstream (1) • Carbon dioxide move from inside the worm/bloodstream to the air (1)	**(2)**

Question number	Answer	Mark
4(a)(iii)	B	**(1)**

Question number	Answer	Mark
4(b)(i)	$\frac{5+2+6+3+4+4}{6} = 4$ (1)	**(1)**

Question number	Answer	Mark
4(b)(ii)	An answer that combines the following points of understanding to provide a logical description: • divide the field area by the quadrat size (1) • multiply by the number of daisies (1)	**(2)**

Question number	Answer	Mark
4(b)(iii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): • less daisy plants are likely to be growing in this area (1) • because the trees would cause lower light levels for photosynthesis/lower mineral levels for growth/less water available for photosynthesis (1)	**(2)**

Question number	Answer	Mark
4(b)(iv)	Any two of the following: Temperature (1) pH (1) pollutants (1) water (1)	**(2)**

Question number	Answer	Mark
5(a)(i)	B	**(1)**

Question number	Answer	Mark
5(a)(ii)	To pump blood around the body under higher pressure	**(1)**

Question number	Answer	Mark
5(a)(iii)	An answer that combines the following points of understanding to provide a logical description: • blood would flow backwards from ventricle to atria/blood will leak through (1) • less (oxygenated) blood would be pumped to the body (1)	**(2)**

Question number	Answer	Mark
5(b)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): • the blood vessel has thick walls/small lumen (1) • to carry oxygenated blood/to carry blood under higher pressure (1)	**(2)**

Question number	Answer	Mark
5(c)	• the fish heart has two chambers rather than four chambers (1) • the fish heart only has one ventricle and one atria rather than two ventricles and two atria (1) • only deoxygenated blood flows through the fish heart (1) • the fish heart shows a single circulatory system rather than a double circulatory system (1)	**(4)**

Question number	Answer	Mark
6(a)(i)	• person 2 had a slightly higher blood glucose level than person 1 after fasting (by up to 0.2 mmols/l) (1)	**(1)**

Question number	Answer	Mark
6(a)(ii)	• person 2 had a much higher blood glucose level than person 1 two hours after taking glucose (by 2.6 mmols/l) (1)	**(1)**

Question number	Answer	Mark
6(a)(iii)	Insulin (1)	**(1)**

Question number	Answer	Mark
6(b)(i)	An answer that combines points of interpretation/evaluation to provide a logical description: • levels remain low up until day 15 then rise (1) • they continue to rise to day 23 and drop at day 24 (1)	**(2)**

Question number	Answer	Mark
6(b)(ii)	An explanation that combines identification - understanding (1 mark) and reasoning/justification - understanding (1 mark): • As ovulation occurs (1) • The levels of progesterone released from the corpus luteum increases to maintain the lining of the uterus (1)	**(2)**

Question number	Indicative content	Mark
6(c)*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO3 (6 marks)** • During typical use the barrier methods are considerably less effective than hormonal methods • During perfect use the barrier methods are less effective than hormonal methods • Manipulation of data from the table to show these relationships • Perfect use of both barrier and hormonal methods are significantly more effective • Manipulation of data from the table to show this relationship • The use of the combined pill and combined patch are the most effective contraceptive method • With perfect use only 0.2% result in pregnancy pregnancies and with typical use 8% result in pregnancy • The least effective contraceptive method is the female condom • 21% pregnancy with typical use and 16% pregnancy with perfect use • The most effective method of contraception is a hormonal method • The combined pill or combined patch are the most effective • Perfect use is more effective than typical use • It may be easier to use the combined patch rather than the combined pill as it is less effected by digestive problems	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. • Judgements are supported by limited evidence. (AO3)
Level 2	3-4	• Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently. • Judgements are supported by evidence occasionally. (AO3)
Level 3	5-6	• Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant understanding coherently. • Judgements are supported by evidence throughout. (AO3)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number	Candidate Number

Combined Science

Paper 3: Chemistry 1

Foundation Tier

Sample Assessment Materials for first teaching September 2016

Time: 1 hour 10 minutes

Paper Reference
1SC0/1CF

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 There are three states of matter: solid, liquid and gas.

(a) The three boxes in Figure 1 show the arrangement of particles in different states.

(i) Under each box write the name of the state of matter shown.

(2)

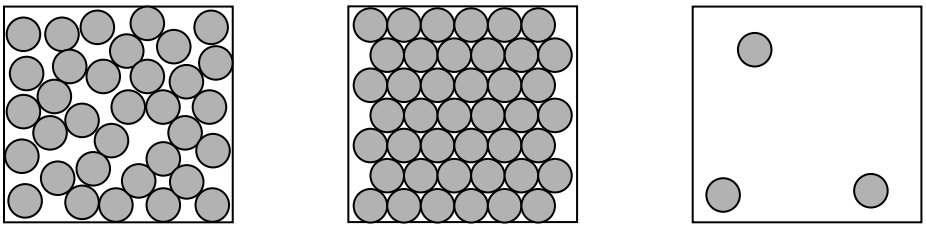

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Figure 1

(ii) A student is given some solid wax.

Use words from the box to name **two** pieces of equipment that the student should use to convert the solid wax into a liquid.

Bunsen burner	test tube	filter funnel
burette	pipette	

(2)

1 .....

2 .....

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(b) Some liquid is left in a warm room.

After a few days no liquid can be seen.

Give the name of the process that has occurred.

(1)

.....

(c) The freezing point of water is 0 °C.

(i) Describe how the movement and arrangement of water particles changes when water is cooled from 10 °C to –10 °C.

(2)

.....

.....

.....

.....

(ii) What is the structure of water?

(1)

☒ **A** ionic

☒ **B** simple molecular (covalent)

☒ **C** giant covalent

☒ **D** metallic

(Total for Question 1 = 8 marks)

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2 Unreactive metals are found as uncombined metals in the Earth's crust.

(a) Which of the following metals is found uncombined in the Earth's crust?

(1)

☒ **A** aluminium

☒ **B** gold

☒ **C** sodium

☒ **D** zinc

(b) When iron oxide is heated with carbon, iron is produced.

(i) Complete the word equation for the reaction.

(2)

iron oxide + carbon → ..... + ...

(ii) What happens to the iron oxide during this reaction?

(1)

☒ **A** the iron oxide burns

☒ **B** the iron oxide is neutralised

☒ **C** the iron oxide is oxidised

☒ **D** the iron oxide is reduced

(c) Copper ore contains copper carbonate, $CuCO_3$.

In the first stage of the extraction process, the copper carbonate is decomposed by heating to form copper oxide, CuO, and carbon dioxide.

$$CuCO_3 \rightarrow CuO + CO_2$$

When 100 g of copper carbonate is decomposed completely in this way, it is found that the total mass of products is 100 g.

Give a reason why the starting mass of copper carbonate is **always** the same as the mass of the products formed.

(1)

.....

.....

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(d) Zinc can be extracted from its ore by electrolysis or by heating the ore with carbon.

Give a reason for the method that is used.

(1)

.....

.....

(e) Figure 2 gives information about aluminium and tin.

metal	cost of 1 kg / £	amount in Earth's crust / %
aluminium	1.31	8
tin	12.60	0.0002

Figure 2

Give **two** reasons why it could be more important to recycle tin than to recycle aluminium. Use the information in Figure 2.

(2)

Reason 1

.....

.....

Reason 2

.....

.....

(Total for Question 2 = 8 marks)

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3 An electrolysis experiment is carried out on different solutions, **J**, **K** and **L**.

Electricity is passed through each solution as shown in Figure 3.

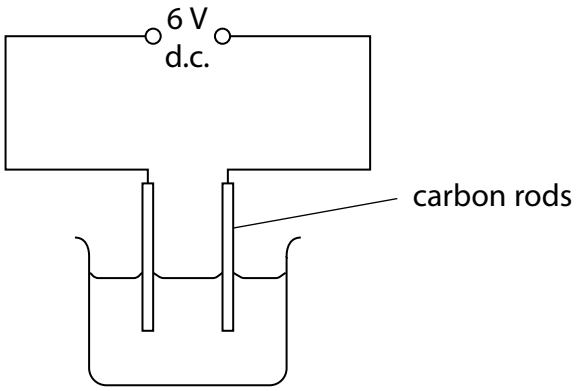

Figure 3

Any products formed at the electrodes are identified.

The results are given in Figure 4.

solution	solution conducts electricity	product at cathode	product at anode
J	yes	copper	chlorine
K	no	none	none
L	yes	hydrogen	chlorine

Figure 4

(a) (i) State an improvement that can be made to the circuit to show that a current is flowing during the electrolysis.

(1)

.....

Some of these solutions are electrolytes.

(ii) State what is meant by the term **electrolyte**.

(2)

.....

.....

.....

.....

(iii) Which of **J**, **K** and **L** are electrolytes?

(1)

- ☒ **A** **K** only
- ☒ **B** **J** and **L** only
- ☒ **C** **K** and **L** only
- ☒ **D** **J**, **K** and **L**

(b) Copper sulfate solution was electrolysed for five minutes using copper electrodes.

Figure 5 shows the mass of the anode and of the cathode before electrolysis and after electrolysis.

	anode	**cathode**
mass of electrode before electrolysis / g	1.16	1.28
mass of electrode after electrolysis / g	0.85	1.57

Figure 5

Calculate the mass of copper deposited.

(2)

mass of copper deposited = ... g

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(c) Identify the products formed at the anode and cathode when molten potassium iodide is electrolysed.

(2)

Anode .....

Cathode .....

(d) In a different electrolysis, molten sodium fluoride is decomposed.

$$2NaF \rightarrow 2Na + F_2$$

(relative masses: NaF = 42, Na = 23, F_2 = 38)

Calculate the maximum mass of sodium that could be formed from 168 g of sodium fluoride.

(2)

mass = ... g

(Total for Question 3 = 10 marks)

4 The apparatus in Figure 6 shows a piece of magnesium ribbon being heated.

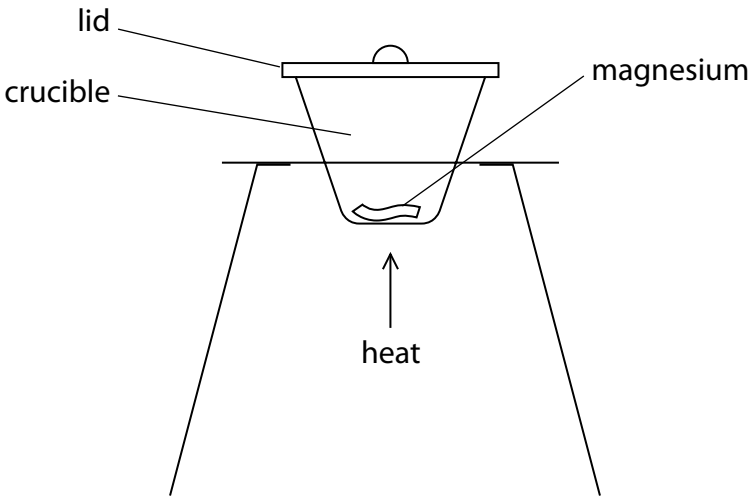


Figure 6

During the heating, the magnesium reacts with oxygen from the air. The lid of the crucible was raised slightly from time to time. Magnesium oxide was formed as a white powder.

The experiment was repeated with different masses of magnesium.

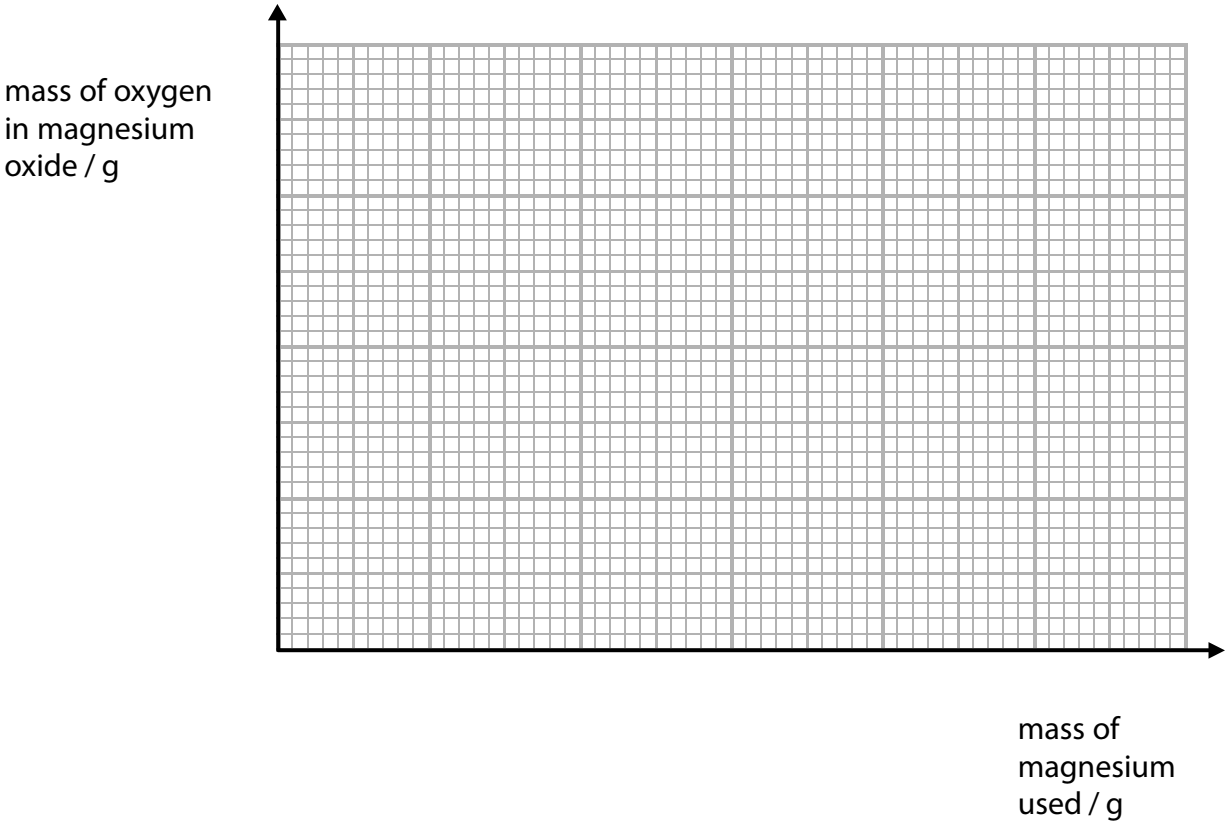
The results are shown in Figure 7.

experiment	mass of magnesium used / g	mass of magnesium oxide formed / g	mass of oxygen in magnesium oxide / g
1	0.10	0.16	0.06
2	0.15	0.24	0.09
3	0.25	0.40	0.15
4	0.30	0.48	0.18
5	0.35	0.49	0.14
6	0.50	0.80	0.30

Figure 7

(a) (i) Draw a graph of the mass of oxygen in magnesium oxide against the mass of magnesium used.

(3)



(ii) The result for experiment 5 is anomalous.
The masses were all measured accurately.

Suggest a reason for this anomalous result.

(1)

.....

.....

(b) Balance the equation for the reaction of magnesium with oxygen to form magnesium oxide.

(1)

..... Mg + ... O_2 → ..... MgO

(c) Calcium nitrate contains calcium ions and nitrate ions.

Calculate the relative formula mass of calcium nitrate, $Ca(NO_3)_2$.
(relative atomic masses: Ca = 40, N = 14, O = 16)

(2)

relative formula mass = ...

(d) Two oxides of lead, **R** and **S**, were analysed.

The empirical formula of oxide **R** was found to be PbO.

The results of the analysis of oxide **S** showed it contained 0.207 g of lead combined with 0.032 g of oxygen.

Show, by calculation, that the two oxides had different empirical formulae.
(relative atomic masses: O = 16, Pb = 207)

(3)

(Total for Question 4 = 10 marks)

5 Substances can be pure or they can be mixtures.

(a) Which of these is a mixture?

(1)

☒ **A** chlorine

☒ **B** sodium

☒ **C** sodium chloride

☒ **D** sodium chloride solution

(b) Figure 8 shows some mixtures to be separated and possible methods of separation.

Place a tick (✓) in one box in each row of the table to show the best method to separate the first named substance from each of the mixtures.

(3)

substance to separate	method of separation			
	crystallisation	filtration	simple distillation	fractional distillation
sand from a mixture of sand and sodium chloride solution				
copper sulfate crystals from copper sulfate solution				
useful liquids from crude oil				

Figure 8

(c) Paper chromatography was used to separate a mixture of blue and red inks.
A spot of the mixture was placed on chromatography paper as shown in Figure 9.

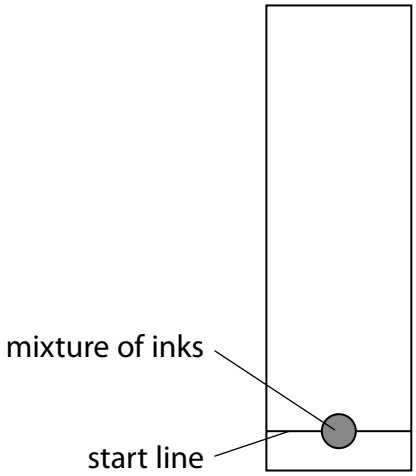


Figure 9

(i) Give a reason why the start line is drawn in pencil rather than in ink.

(1)

.....

.....

(ii) The chromatography paper, with the spot of mixture on it, was placed in a beaker with the bottom of the paper in water.

On Figure 10, complete the diagram showing the position of the chromatography paper with the spot of mixture at the start of the experiment.

(1)

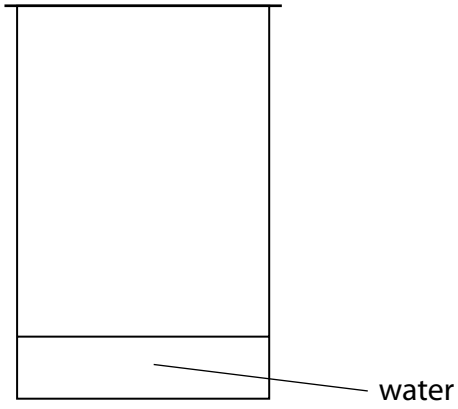


Figure 10

(iii) The chromatography was carried out and the result is shown in Figure 11.

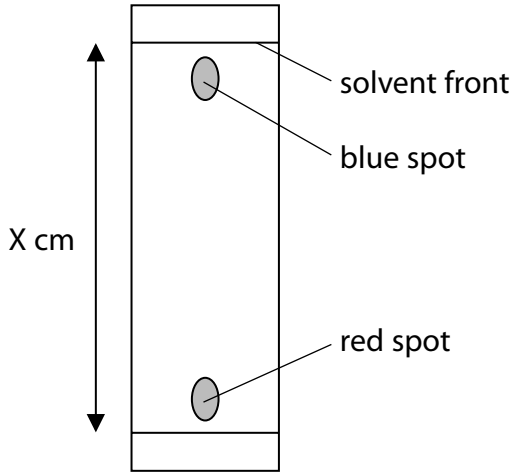


Figure 11

The blue spot had moved 14.5 cm and the solvent front had moved 15.3 cm

Calculate the R_f value of the substance in the blue spot, giving your answer to 2 significant figures.

$$R_f \text{ value} = \frac{\text{distance travelled by a dye}}{\text{distance travelled by solvent front}}$$

(2)

R_f value = ...

(d) **P**, **Q**, **R** and **S** are mixtures of food colourings.

They are investigated using paper chromatography.

Figure 12 shows the chromatogram at the end of the experiment.

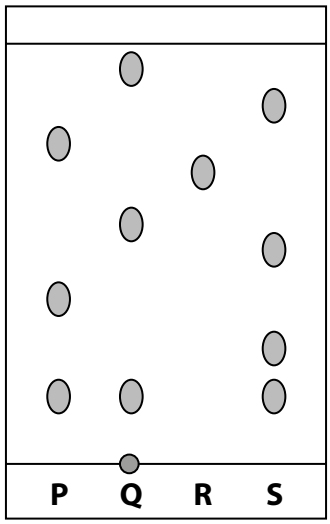


Figure 12

(i) Which mixture contains an insoluble food colouring?

(1)

- ☒ **A** mixture **P**
- ☒ **B** mixture **Q**
- ☒ **C** mixture **R**
- ☒ **D** mixture **S**

(ii) Give a change that could be made to the experiment to obtain an R_f value for the insoluble colouring.

(1)

.....

.....

(iii) Explain, by referring to Figure 12, which mixture is separated into the greatest number of soluble food colourings by this chromatography experiment.

(2)

.....

.....

.....

.....

(Total for Question 5 = 12 marks)

6 Ionic compounds contain ions.

(a) The numbers of electrons, neutrons and protons in four particles, **W**, **X**, **Y** and **Z**, are shown in Figure 13.

particle	electrons	neutrons	protons
W	9	10	9
X	10	14	12
Y	16	16	16
Z	18	18	16

Figure 13

Explain which particle, **W**, **X**, **Y** or **Z**, is a negative ion.

(2)

(b) The electronic configurations of a lithium atom and of a fluorine atom are shown in Figure 14.

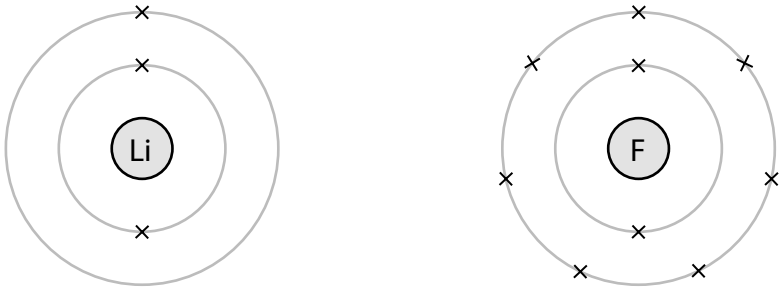


Figure 14

Lithium fluoride, LiF, is an ionic compound.

It contains lithium cations and fluoride anions.

Complete Figure 15 to show the electronic configurations and charges of the ions in lithium fluoride.

(4)

charge on ion ..... charge on ion .....

Figure 15

*(c) Figure 16 shows the ability of different substances to conduct electricity.

substance	conducts electricity
solid calcium chloride	no
molten calcium chloride	yes
diamond	no
zinc	yes

Figure 16

Explain these results by referring to the structures of the substances.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Paper 3 C1F Foundation

Question number	Answer	Mark
1(a)(i)	liquid solid gas • All three correct (2) • One/two correct (1)	(2)

Question number	Answer	Mark
1(a)(ii)	• Bunsen burner (1) • test tube (1)	(2)

Question number	Answer	Additional guidance	Mark
1(b)	evaporation	do not accept 'boiling'	(1)

Question number	Answer	Mark
1(c)(i)	An answer that provides a description by making reference to **two** of the following points: • molecules become closer (1) • molecules lose energy (1) • molecules slow down (1)	(2)

Question number	Answer	Mark
1(c)(ii)	B	(1)

Question number	Answer	Mark
2(a)	**B**	(1)

Question number	Answer	Mark
2(b)(i)	iron (1) carbon dioxide/carbon monoxide (1)	(2)

Question number	Answer	Mark
2(b)(ii)	D	(1)

Question number	Answer	Mark
2(c)	All the original atoms have simply been rearranged in the products.	(1)

Question number	Answer	Mark
2(d)	Heating with carbon is used as it is cheaper than using electrolysis.	(1)

Question number	Answer	Mark
2(e)	• Tin costs {much/about 10 times more} than aluminium (1) • Amount of tin in Earth much smaller than the amount of aluminium (1)	**(2)**

Question number	Answer	Mark
3(a)(i)	• connect {lamp/ammeter} in series (1)	**(1)**

Question number	Answer	Mark
3(a)(ii)	• a substance that conducts electricity (1) • when molten or in aqueous solution (1)	**(2)**

Question number	Answer	Mark
3(a)(iii)	B	**(1)**

Question number	Answer	Additional guidance	Mark
3(b)	• Copper is deposited on the cathode, therefore mass deposited = 1.57 – 1.28 (1) • = 0.29 (g) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
3(c)	• iodine at the anode (1) • potassium at the cathode (1)	**(2)**

Question number	Answer	Mark
3(d)	• 84 g sodium fluoride $\rightarrow$ 46 g of sodium (1) • so 168 g sodium fluoride $\rightarrow$ 92 g of sodium (1) **or** • 168 ÷ 42 = 4 (mol NaF) (1) • 4 × 23 = 92 (g) (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(a)(i)	• Axes with linear scale that use more than half of each edge of the grid (1) • All points correctly plotted to ± half a square (1) • Single straight line passing through all points except result 5 (1)	5 points plotted correctly (i.e. one error) allow ecf from plotting error	**(3)**

Question number	Answer	Mark
4(a)(ii)	Any **one** reason from: • not all magnesium reacted • incomplete reaction • some magnesium oxide lost	**(1)**

Question number	Answer	Mark
4(b)	**2**Mg + O_2 → **2**MgO/Mg + $\frac{\mathbf{1}}{\mathbf{2}}$ O_2 → MgO	**(1)**

Question number	Answer	Additional guidance	Mark
4(c)	40 + 2 × (14 + 16 × 3) (1) = 164 (1)	Award full marks for correct numerical answer without working.	**(2)**

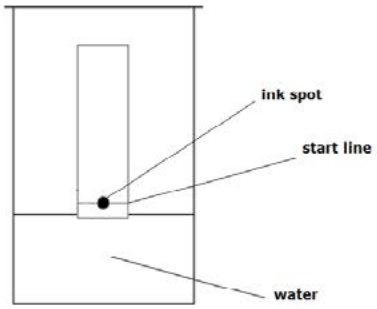
Question number	Answer	Mark
4(d)	• divide mass by relative atomic mass (1) — lead $\frac{0.207}{207} = 0.001$; oxygen $\frac{0.032}{16} = 0.002$ • divide by the smaller (1) — $\frac{0.001}{0.001} = 1$; $\frac{0.002}{0.001} = 2$ empirical formula PbO_2 which is different to that of compound R (1)	**(3)**

Question number	Answer	Mark
5(a)	D	**(1)**

Question number	Answer	Mark
5(b)	One mark for each correct row.	(3)

substance to separate	method of separation			
	crystallisation	filtration	simple distillation	fractional distillation
sand from a mixture of sand and sodium chloride solution		✓		
copper sulfate crystals from copper sulfate solution	✓			
useful liquids from crude oil				✓

Question number	Answer	Mark
5(c)(i)	Pencil is insoluble in the solvent (but chromatography would separate the ink in an ink line)	(1)

Question number	Answer	Mark
5(c)(ii)	Correct position of chromatography paper with start line and ink spot above surface of water 	(1)

Question number	Answer	Additional guidance	Mark
5(c)(iii)	• R_f = 14.5 / 15.3 = 0.9477 (1) • = 0.95 answer to 2 significant figures (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
5(d)(i)	B	**(1)**

Question number	Answer	Mark
5(d)(ii)	use a different solvent.	**(1)**

Question number	Answer	Mark
5(d)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • mixture S (1) • because it gives the greatest number of spots/gives four spots (1)	**(2)**

Question number	Answer	Additional guidance	Mark
6(a)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • a negative ion must have more electrons than protons in the particle (1) • therefore Z will have a 2– charge (1)	Do not allow any comparison involving neutrons.	**(2)**

Question number	Answer	Mark
6(b)	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	**(4)**

Question number	Indicative content
***6(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • solid calcium chloride contains ions/cations/anions which are charged particles • solid calcium chloride does not conduct because charged particles are not free to move because they are held together by strong electrostatic forces/ionic bonds in lattice • molten calcium chloride solution conducts because ions/cations/anions are present which are charged particles and are free to move • the ions have separated and move to electrode of opposite charge • diamond does not conduct because it is giant molecular covalent with no free electrons • outer electrons of carbon atoms used in bonding • zinc metallic structure consists of delocalised free electrons which can move between layers of metals atoms/cations

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO4) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number	Candidate Number

Combined Science

Paper 4: Chemistry 2

Foundation Tier

Sample Assessment Material for first teaching September 2016	Paper Reference
Time: 1 hour 10 minutes	**1SC0/2CF**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S50059A

1/1/1/2/1/

S 5 0 0 5 9 A 0 1 2 0

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The Earth's early atmosphere was different from that of the Earth's atmosphere today.

(a) The Earth's early atmosphere was formed by

(1)

☒ **A** animals breathing.

☒ **B** global warming.

☒ **C** plants growing.

☒ **D** volcanic activity.

(b) Figure 1 shows some data about the composition of gases present in the Earth's early atmosphere and today's atmosphere.

	composition (%)	
gas	**Earth's early atmosphere**	**today's atmosphere**
nitrogen	4	78
oxygen	<0.01	21
argon	<0.01	0.9
gas X	95	0.04
ammonia	0.5	<0.001
sulfur dioxide	0.5	<0.001

Figure 1

Explain, using the data, the identity of gas X.

(2)

.....

.....

.....

.....

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(c) Figure 2 shows the concentration of carbon dioxide in the atmosphere above Hawaii from 1960 to 2010.

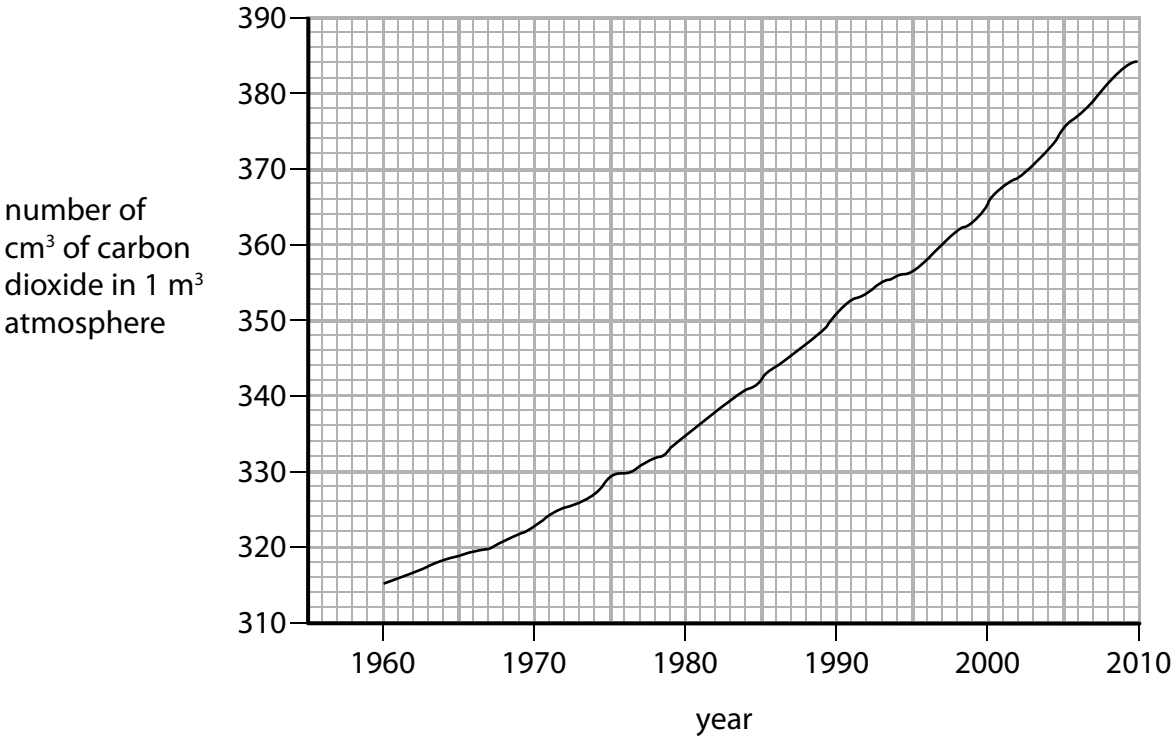

Figure 2

(i) Use the graph to calculate the increase in the volume of carbon dioxide in 1 m^3 of atmosphere from 1960 to 2010.

(2)

increase in volume of carbon dioxide = ... cm^3

(ii) Describe how carbon dioxide is released into today's atmosphere.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

2 (a) The atomic symbols of the first twenty elements in the periodic table are shown in Figure 3.

						H											He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca																

Figure 3

(i) From the position of beryllium, Be, in the periodic table, beryllium is most likely to be a

(1)

☒ **A** metal

☒ **B** halogen

☒ **C** compound

☒ **D** gas at room temperature

(ii) Give the symbol of the element that is in period 2 and in group 3.

(1)

.....

(iii) State the number of electron shells in an atom of potassium, K.

(1)

.....

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(b) Figure 4 shows information about some of the elements in group 7 of the periodic table.

element	melting point/°C	boiling point/°C
fluorine	−220	−188
chlorine	−101	−35
bromine	7	59
iodine	114	184

Figure 4

Astatine is below iodine in group 7 of the periodic table.

Estimate the boiling point of astatine.

(1)

boiling point of astatine = ... °C

(c) Chlorine reacts with potassium iodide to form iodine and potassium chloride.

Complete the word equation for the reaction between bromine and potassium astatide.

(2)

bromine + potassium astatide → +

(d) Hydrogen reacts with chlorine to form hydrogen chloride.

$$H—H + Cl—Cl \rightarrow 2H—Cl$$

The symbol — is used to show a covalent bond.

The electronic configuration of hydrogen is 1.
The electronic configuration of chlorine is 2.8.7.

Draw the dot-and-cross diagram for the molecule of hydrogen chloride.
Show outer electrons only.

(2)

(Total for Question 2 = 8 marks)

3 (a) When a solid amount of ammonium chloride is shaken with water, a colourless solution forms and the temperature changes from 20 °C to 16 °C.

Give the name of the type of heat change occurring.

(1)

.....

(b) A student carries out an experiment to measure accurately the temperature changes when different metals are added to iron(II) sulfate solution.

The method for the experiment is:

- measure 25 cm^3 of iron(II) sulfate solution and pour into a container
- record the initial temperature of the solution
- add excess magnesium ribbon
- record the highest temperature of the mixture
- repeat the experiment using excess copper turnings, then using excess zinc foil.

(i) State a suitable container for the iron(II) sulfate solution in this experiment.

(1)

.....

(ii) State what the student should do to the mixtures during the experiment.

(1)

.....

(iii) Figure 5 shows the results obtained by the student.

metal added to iron(II) sulfate solution	temperature rise/°C
magnesium	6.0
copper	0.0
zinc	2.8

Figure 5

Use the results to explain the order of reactivity of the metals magnesium, copper and zinc.

(2)

(iv) Explain how the student could improve the method to make a fairer comparison of the temperature change produced by the different metals.

(2)

(v) The iron(II) sulfate solution contained 6.2 g of iron(II) sulfate in 50 cm^3 of solution.

Calculate the concentration of the iron(II) sulfate solution in g dm^{-3}.

(2)

concentration = ... g dm^{-3}

(Total for Question 3 = 9 marks)

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4 A student used the equipment in Figure 6 to investigate the rate of reaction between zinc and excess dilute hydrochloric acid.

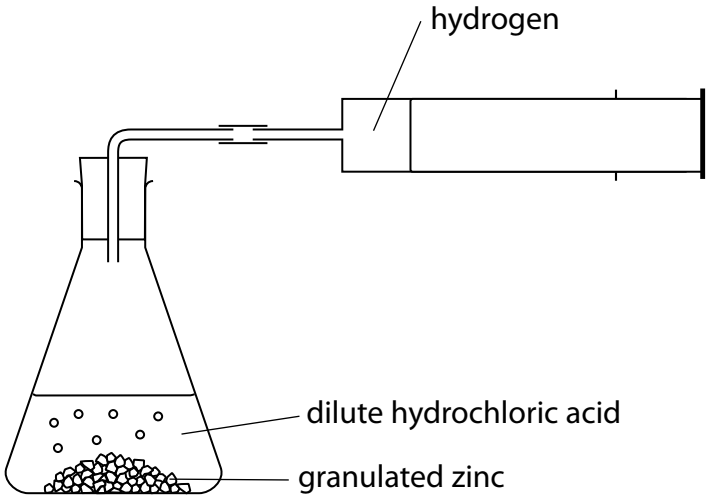


Figure 6

The student uses the following method:

- place a known mass of granulated zinc into the conical flask
- pour 25 cm^3 of dilute hydrochloric acid (an excess) into the conical flask and fit the bung quickly into the neck of the flask
- measure the volume of gas produced every 20 seconds until after the reaction finishes.

Figure 7 shows the results.

time/s	volume of hydrogen/cm^3
0	0
20	42
40	66
60	75
80	80
100	82
120	82
140	82

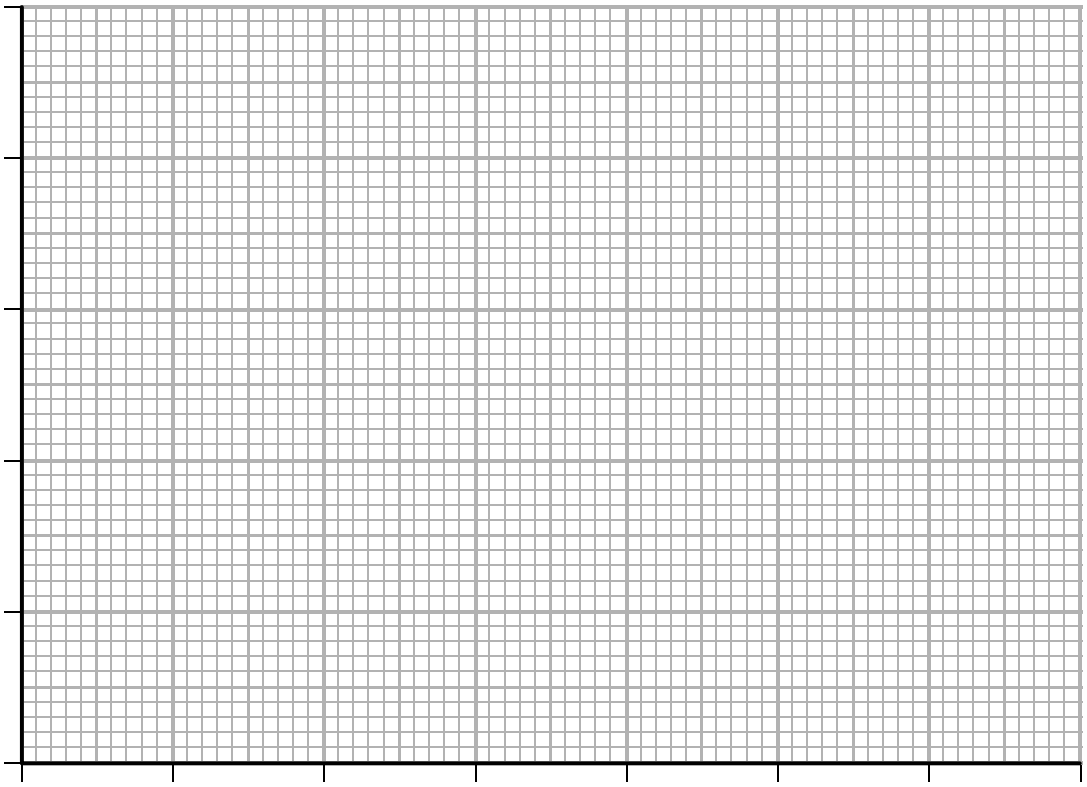
Figure 7

(a) Give the name of a piece of equipment that can be used to measure 25 cm^3 of dilute hydrochloric acid accurately.

(1)

(b) Draw a graph of the volume of hydrogen gas produced against time using the grid.

(3)



(c) The average rate of reaction in the first 20 seconds in cm^3 of hydrogen produced per second is

(1)

☒ **A** 2.1

☒ **B** 8.4

☒ **C** 21

☒ **D** 84

(d) The student repeated the experiment keeping all conditions the same but using the same mass of powdered zinc instead of granulated zinc.

On the grid above sketch the graph you would expect when the experiment is repeated using powdered zinc.
Label your line **A**.

(2)

(e) Sodium thiosulfate solution, $Na_2S_2O_3$, reacts with dilute hydrochloric acid as shown in the equation.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(s) + H_2O(l) + S(s) + SO_2(g)$$

The rate of this reaction can be investigated by mixing the reactants and finding the time taken for a precipitate of sulfur to become visible.

A student wants to investigate the effect of changing the temperature on the rate of this reaction.

Devise a method the student could use to find out how the time taken for the precipitate of sulfur to become visible changes with temperature.

(3)

(Total for Question 4 = 10 marks)

5 This question is about some of the elements in groups 1 and 2 of the periodic table.

(a) The atomic number of lithium is 3.
The mass number of a lithium atom is 7.

Which row of the table shows the number of protons, neutrons and electrons in an atom of lithium-7?

(1)

	number of protons	number of neutrons	number of electrons
☐ **A**	3	3	4
☐ **B**	3	4	3
☐ **C**	4	3	7
☐ **D**	7	4	3

(b) Lithium, sodium and potassium are in group 1 of the periodic table.

State, in terms of the electrons in their atoms, what the atoms of lithium, sodium and potassium have in common.

(1)

.....

(c) Magnesium has atomic number 12.
Magnesium exists as magnesium-24, magnesium-25 and magnesium-26 atoms.

Explain, in terms of protons and neutrons, why these atoms are isotopes of magnesium.

(2)

.....

.....

.....

.....

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(d) Magnesium and calcium are in group 2 of the periodic table. They are less reactive than the metals in group 1.

Calcium reacts with water to form calcium hydroxide, $Ca(OH)_2$, and hydrogen, H_2.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$$

Describe what would be **seen** when a piece of calcium is dropped into a container of water.

(2)

(e) Magnesium reacts very slowly with cold water but it reacts faster with steam, H_2O, to form magnesium oxide, MgO, and hydrogen.

Write the balanced equation for the reaction between magnesium and steam.

(2)

(f) The electronic configurations of magnesium and calcium are

magnesium 2.8.2
calcium 2.8.8.2

When magnesium and calcium react with water they form positive ions.

Suggest an explanation, in terms of their electronic configurations, why calcium is more reactive than magnesium.

(2)

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(g) A sample of calcium bromide contains 0.2 g calcium and 0.8 g bromine by mass.

Calculate the empirical formula of calcium bromide.

(relative atomic masses: Ca = 40, Br = 80)

(3)

empirical formula = ...

(Total for Question 5 = 13 marks)

6 Crude oil is a mixture of hydrocarbons.

It can be separated into fractions.

(a) Which of these mixtures shows formulae of substances that could be in the gaseous fraction of crude oil?

(1)

☒ **A** C_2H_4, C_3H_8, $C_4H_{10}O$

☒ **B** C_2H_4, C_3H_7Br, C_4H_{10}

☒ **C** C_2H_6, C_3H_8, C_4H_{10}

☒ **D** C_2H_6, C_3H_7Br, $C_4H_{10}O$

(b) Figure 8 shows the percentages of the fractions in crude oil from three different oil wells.

	percentage of fraction in crude oil from		
fraction	**oil well A**	**oil well B**	**oil well C**
gases	1	6	9
petrol	2	15	24
kerosene	6	14	20
diesel oil	7	10	16
fuel oil	26	28	30
bitumen	58	27	1

Figure 8

(i) State which oil well produces a crude oil containing the highest percentage of the high boiling point fractions.

(1)

.....

(ii) A barrel of crude oil from oil well B weighs 130 kg.

Calculate the mass of kerosene in this barrel.

(1)

..... kg

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*(c) Diesel is the fuel used in most bus engines.

Research is being carried out into the use of hydrogen, instead of diesel, as a fuel for buses.

Discuss the advantages and disadvantages of using hydrogen, rather than diesel, as a fuel for buses.

(6)

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(d) Fractions of crude oil contain alkanes.

A sample of decane, $C_{10}H_{22}$, was cracked using the apparatus in Figure 9.

This produced a mixture of products, including ethene.

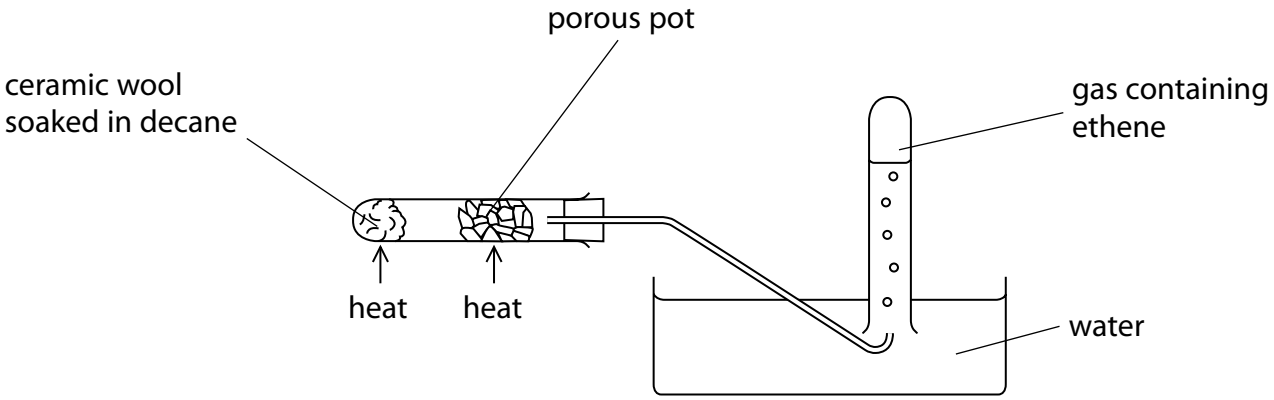

Figure 9

(i) Explain how ethene is produced using the apparatus in Figure 9.

(3)

(ii) One molecule of decane produced two molecules of propene, C_3H_6, and one molecule of product **Z**.

$C_{10}H_{22} \rightarrow 2C_3H_6 +$ product **Z**

What is the formula of product **Z**?

(1)

- ☒ **A** C_4H_8
- ☒ **B** C_4H_{10}
- ☒ **C** C_7H_{14}
- ☒ **D** C_7H_{16}

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Paper 4 C2F Mark scheme

Question number	Answer	Mark
1(a)	D	(1)

Question number	Answer	Mark
1(b)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • gas X is carbon dioxide (1) • because the percentage of gas has fallen markedly (1)	(2)

Question number	Answer	Additional guidance	Mark
1(c)(i)	• 384 and 315 used from graph (1) • 384 − 315 = 69 (cm^3) (1)	Allow 384 to 385 in 2010 and 314 to 316 in 1960. 2nd mark consequential on values read from graph. Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Additional guidance	Mark
1(c)(ii)	An answer that provides a description by making reference to one of the following linked pairs: • burning/(complete) combustion (1) • of carbon compounds/(fossil) fuels/wood/rubbish/plastic (1) OR • respiration/gas exhaled/breathing/ decaying (1) • from plants/animals/organisms (1) OR • eruption (releases gas) (1) • from volcanic activity/volcanoes (1)	Allow any type of fuel except hydrogen Allow heating limestone.	(2)

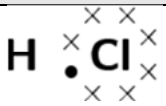
Question number	Answer	Mark
2(a)(i)	A	(1)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	B	Allow boron.	(1)

Question number	Answer	Mark
2(a)(iii)	4	(1)

Question number	Answer	Additional guidance	Mark
2(b)	Any temperature > 184 (°C).	Ignore units.	(1)

Question number	Answer	Additional guidance	Mark
2(c)	astatine (1) + potassium bromide (1)	Allow products in either order.	(2)

Question number	Answer	Additional guidance	Mark
2(d)	 • One shared pair of electrons in molecule (1) • Rest of molecule correct, conditional on shared pair (1)	Allow any combination of dots and crosses.	(2)

Question number	Answer	Mark
3(a)	endothermic	(1)

Question number	Answer	Mark
3(b)(i)	Any one from: • beaker (1) • polystyrene cup (1) • conical flask (1)	(1)

Question number	Answer	Mark
3(b)(ii)	Stir the mixtures with the thermometer	(1)

Question number	Answer	Mark
3(b)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • order of reactivity from most reactive to least reactive magnesium, zinc, (iron), copper (1) • because the most reactive shows biggest temperature rise/least reactive shows lowest temperature rise (1)	(2)

Question number	Answer	Additional guidance	Mark
3(b)(iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • use magnesium, zinc and copper as powders (1) • so they have the same/similar size particles/surface area/shape (1)	allow other acceptable answers, e.g. use same mass / no moles of each	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(v)	1000 cm^3 contain $\frac{6.2 \times 1000}{50}$ (1) 1 dm^3 contains 124 ($g\,dm^{-3}$) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
4(a)	Measuring cylinder/burette/pipette	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)	• axes with linear scale that use more than half of each edge of the grid and labelled with units from the table (1). • all points correctly plotted to ± half a square (1). • single straight line passing through all points and the origin (1).	7 points plotted correctly (i.e. one error) (1) allow ecf from plotting error.	**(3)**

Question number	Answer	Mark
4(c)	A	**(1)**

Question number	Answer	Mark
4(d)	Line A on graph: • steeper curve / curve drawn to left of original (1) • levelling off at 82 cm^3 (1)	**(2)**

Question number	Answer	Mark
4(e)	An answer that combines the following points to provide a method: • suitable method of warming the solutions, e.g. water bath, Bunsen burner with tripod and gauze and measure the temperature of each solution using a thermometer (1) • use the same volumes of the solutions in each experiment (1) • measure the time for the precipitate to form (and obscure a cross placed under the reaction vessel) using a stop watch/clock (1)	**(3)**

Question number	Answer	Mark
5(a)	B	**(1)**

Question number	Answer	Mark
5(b)	• They (contain) same number of outer shell electrons/all have 1 electron in outer shell.	**(1)**

Question number	Answer	Additional guidance	Mark
5(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • all magnesium atoms have 12 protons (1) • however Mg-24 has 12 neutrons, Mg-25 has 13 neutrons, Mg-26 has 14 neutrons (1)	Ignore references to atomic number and to mass number/relative atomic mass. Allow magnesium atoms contain same number of protons but different numbers of neutrons (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(d)	An answer that combines the following points of understanding to provide a logical description: • (hydrogen produced as a gas so) there would be {effervescence/fizzing/ bubbles} (1) • calcium hydroxide produced as a solid so the water would {go cloudy/a white precipitate would form} (1)	Allow: • calcium would move (around) (1) • calcium would decrease in size/disappears/dissolves (1)	**(2)**

Question number	Answer	Mark
5(e)	$Mg + H_2O \rightarrow MgO + H_2$ • LHS (1) • RHS (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(f)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • in calcium the outermost electron(s) {are further away from nucleus/experience(s) greater shielding} (from the nucleus) (as shown by the electronic configuration) (1) • therefore less attraction between nucleus and electron(s)/the electron(s) is/are easier to remove (1)	Allow answers in terms of why reactivity of magnesium is less than that of calcium.	**(2)**

Question number	Answer	Additional guidance	Mark
5(g)	• divides mass by relative atomic mass (1) • calculates simplest ratio (1) • expresses ratio correctly as empirical formula (1)	Example of calculation Ca : Br $\frac{0.2}{40}$: $\frac{0.8}{80}$ 0.005 : 0.01 1 : 2 empirical formula CaBr2 formula alone scores max	**(3)**

Question number	Answer	Mark
6(a)	C	**(1)**

Question number	Answer	Mark
6(b)(i)	(oil well) A	**(1)**

Question number	Answer	Mark
6(b)(ii)	14% of the barrel is kerosene $\frac{14}{100} \times 130 = 18.2 \text{ kg}$ (1)	**(1)**

Question number	Indicative content
***6(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** Answers must compare advantages of using hydrogen instead of diesel • plenty of water/raw material • limited supplies of crude oil • hydrogen produces only water as waste • diesel also produces carbon dioxide • carbon dioxide emissions may cause global warming • diesel undergoes incomplete combustion • diesel also produces carbon and/or carbon monoxide • carbon is formed as soot and makes objects dirty • carbon monoxide is a toxic gas • hydrogen can be obtained from the water produced. with disadvantages of using hydrogen instead of diesel • hydrogen gas has to be manufactured • energy/electricity is needed to produce hydrogen • producing electricity from non-renewable resources produces carbon dioxide • hydrogen is expensive to produce • problems of storage of large volumes of flammable gas • stronger/heavier/bigger fuel tanks needed • hydrogen is a gas and leaks easily if the fuel system is damaged • there are limited outlets for buying hydrogen.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents a discussion with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents a discussion that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents a discussion that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
6(d)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • when the decane is heated it vaporises /turns to a gas (1) • decane vapour/gas breaks down as it comes in contact with hot porous pot (1) • large molecules of decane produce smaller molecules, including ethene (1)	Do not allow this point if ethene passes over hot porous pot.	**(3)**

Question number	Answer	Mark
6(d)(ii)	B	**(1)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Combined Science

Paper 5: Physics 1

Foundation Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 10 minutes

Paper Reference
1SC0/1PF

You must have:
Calculator, ruler, protractor

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S50061A

1/1/1/1/2/1/1/

S 5 0 0 6 1 A 0 1 1 6

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) Figure 1 shows a solar-powered charger for a mobile phone.

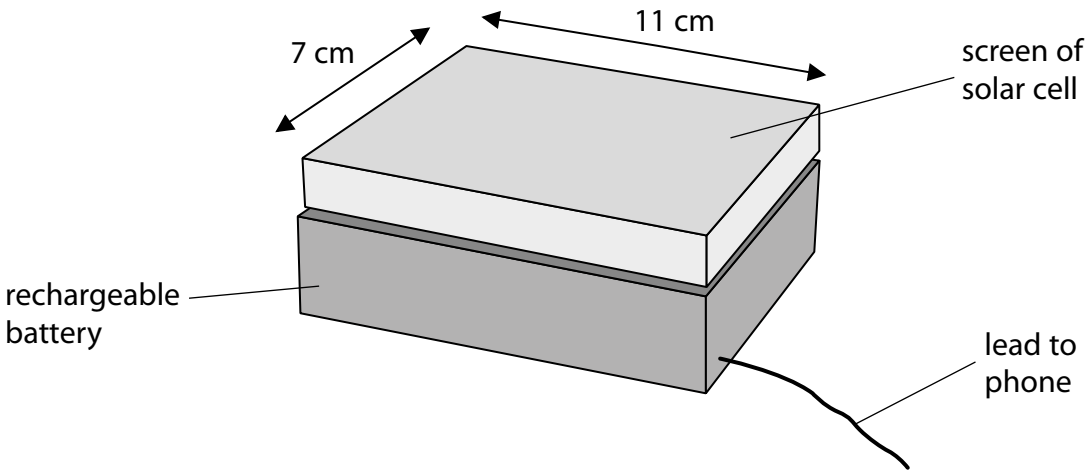


Figure 1

The screen of the solar cell takes in energy from the Sun.

(i) State how energy gets from the Sun to the screen.

(1)

.....

.....

(ii) State how energy is stored in the charger.

(1)

.....

.....

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DO NOT WRITE IN THIS AREA

(iii) Each second, 0.12 J of energy from the Sun reaches 1 cm^2 of the screen.

Calculate the total amount of energy reaching the whole screen in 1 second.

(3)

energy = ... J

(b) Mobile phones emit microwaves.

Microwave ovens emit microwaves.

Explain why a mobile phone does not have the same heating effect as a microwave oven.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

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2 (a) A student is standing 600 m from a firework display.

A firework explodes with a loud bang, and a flash of light is seen.

Describe how a student can measure the time it takes for the sound wave from the loud bang to travel 600 m.

(2)

.....

.....

.....

.....

(b) Figure 2 shows a water wave.

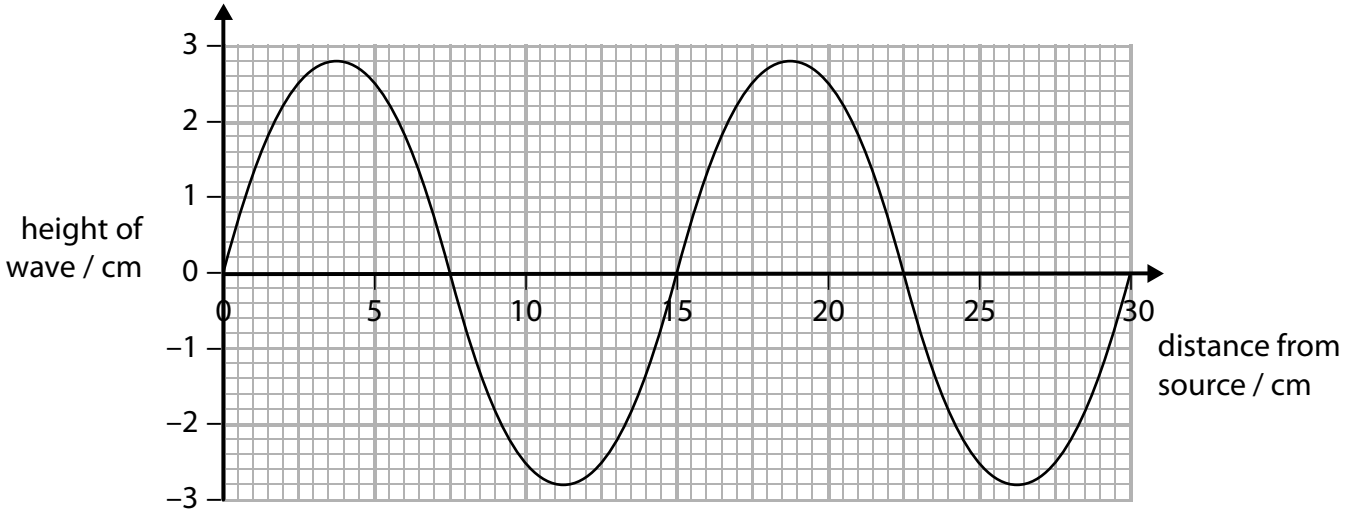

Figure 2

(i) What is the amplitude of this wave?

(1)

☒ **A** 2.8 cm

☒ **B** 5.6 cm

☒ **C** 7.5 cm

☒ **D** 15 cm

(ii) What is the wavelength of this wave?

(1)

☒ **A** 2.8 cm

☒ **B** 7.5 cm

☒ **C** 15 cm

☒ **D** 30 cm

(c) Water waves are transverse waves.

(i) Give **one** other example of a transverse wave.

(1)

.....

(ii) Give **one** example of a longitudinal wave.

(1)

.....

(d) An earthquake causes a sea wave.

This sea wave travels 26 400 m in two minutes.

Calculate the speed of the wave.

Use the equation

$$\text{wave speed} = \frac{\text{distance}}{\text{time}}$$

(3)

speed = ... m/s

(Total for Question 2 = 9 marks)

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3 (a) Figure 3 shows the structure of an oxygen-14 atom.

(i) Complete the four labels on Figure 3.

(4)

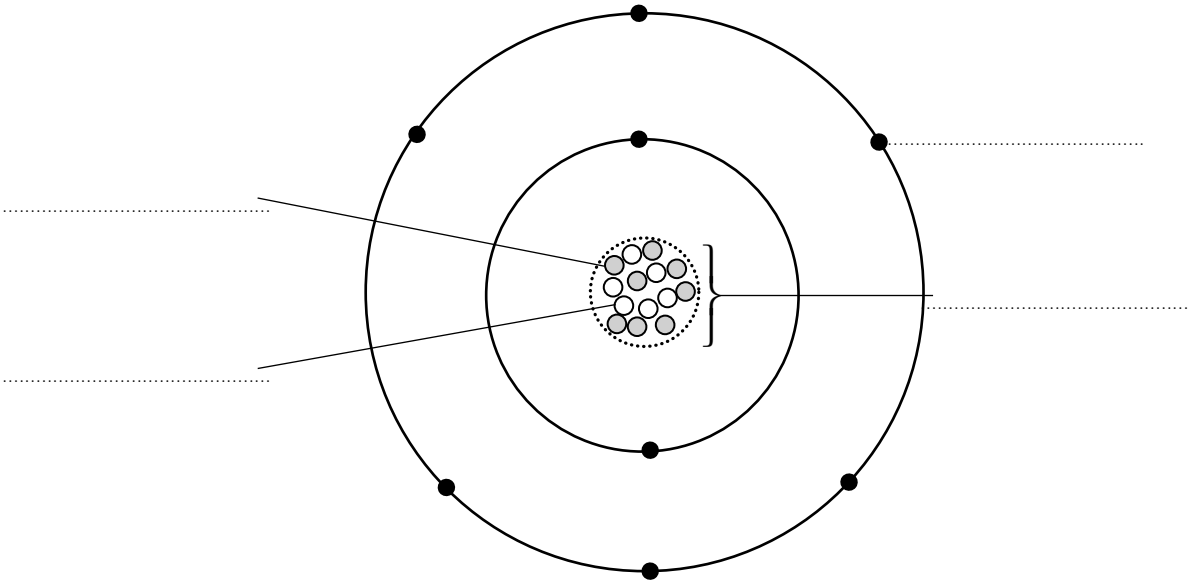

Figure 3

(ii) Which of these particles has a negative charge?

(1)

- ☒ **A** alpha particle
- ☒ **B** electron
- ☒ **C** neutron
- ☒ **D** nucleus

(iii) State the overall charge of the oxygen-14 atom.

(1)

.....

.....

(b) A teacher uses a Geiger-Müller tube and a counter to measure background radiation.

The reading on the counter tube is 34 counts per minute.

(i) The teacher puts a source of beta radiation 15 cm in front of the same Geiger-Müller tube.

The reading on the counter tube is now 468 counts per minute.

Calculate how much radiation detected by the Geiger-Müller tube comes from the source of beta radiation.

(1)

..... counts per minute

(ii) The teacher puts a thick sheet of aluminium between the source of beta radiation and the Geiger-Müller tube.

Estimate the reading on the counter.

(1)

..... counts per minute

(iii) Give a reason why the answer to (ii) is only an estimate.

(1)

.....

.....

(Total for Question 3 = 9 marks)

4 (a) A car driver sees a rabbit on the road.

The driver makes an emergency stop after he sees the rabbit.

Figure 4 shows the speed of the car from the time the driver sees the rabbit until the car stops.

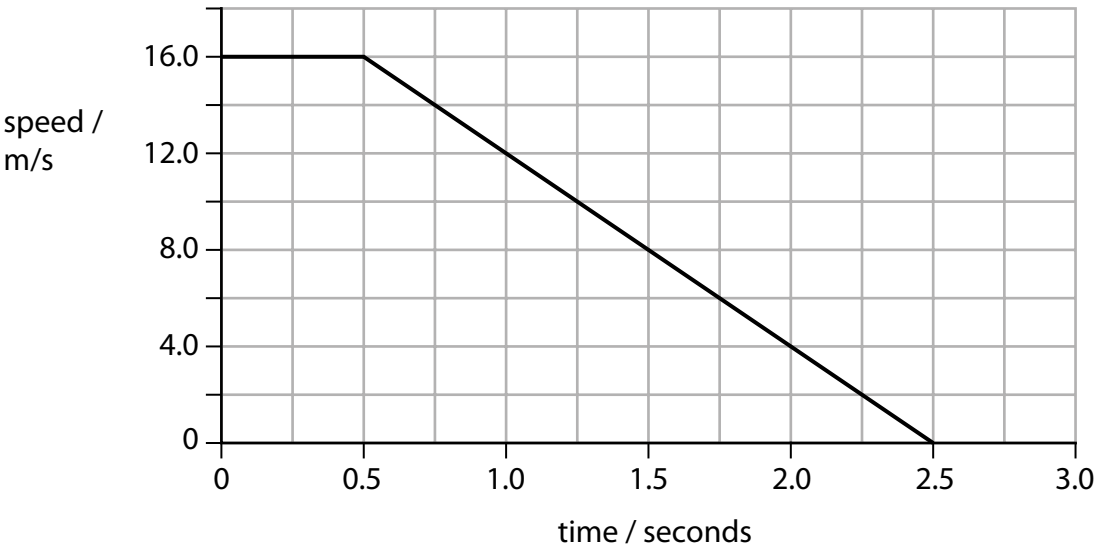

Figure 4

(i) The distance travelled by the car from the time the driver first sees the rabbit to when car starts to slow down is the

(1)

- ☒ **A** average distance
- ☒ **B** braking distance
- ☒ **C** stopping distance
- ☒ **D** thinking distance

(ii) Calculate the distance that the car travels in the first 0.5 seconds.

(3)

distance = ... m

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(iii) Which equation relates acceleration to change in velocity and time?

(1)

☒ **A** $a = \frac{(v - u)}{t}$

☒ **B** $a = \frac{t}{(v - u)}$

☒ **C** $a = t(v - u)$

☒ **D** $a = v - \frac{u}{t}$

(iv) Calculate the deceleration of the car.

(3)

deceleration = ... m/s^2

(b) Two students, Alice and Bob, carry out an experiment to measure the speed of cars.

Alice paces out the distance between two lamp posts.

She records:

'*Distance between lamp posts = 20 paces*'

Bob starts to count when a car passes the first lamp post. He stops counting when he thinks it has passed the second lamp post.

He records:

'My estimate for the time taken for the car to pass between the two lamp posts = 3'

Give **three** ways the students could improve their experimental procedure.

(3)

1 .....

.....

2 .....

.....

3 .....

.....

(Total for Question 4 = 11 marks)

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5 Figure 5 shows two students investigating reaction times.

Student B supports his left hand on a desk.

Student A holds a ruler so that the bottom end of the ruler is between the finger and thumb of student B.

When student A releases the ruler, student B catches the ruler as quickly as he can with his left hand.

The investigation is repeated with the right hand of student B.

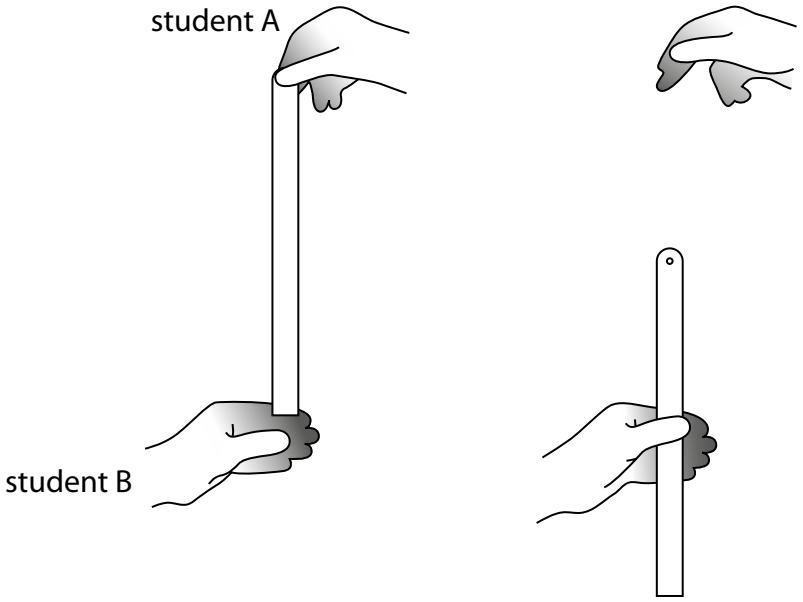

Figure 5

(a) Give a reason why it is better to have the 0 cm mark at the bottom of the ruler rather than at the top.

(1)

.....

.....

(b) Give a reason why two students are needed for this investigation.

(1)

.....

.....

(c) The students took five results for the left hand and five results for the right hand.

Figure 6 shows their results.

which hand	distance dropped (cm)					
	trial 1	trial 2	trial 3	trial 4	trial 5	average
left	10.1	25.5	18.4	14.6	11.7	14
right	17.5	16.1	19.4	18.6	20.2	.....

Figure 6

(i) Calculate the average distance dropped for the right hand.

Give your answer correct to two significant figures.

(2)

distance = ... cm

(ii) Calculate the average time for the left hand.

Use the equation

$$\text{time}^2 = \frac{\text{distance}}{500}$$

(2)

average time = ... s

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(d) Explain whether any of the readings are anomalous.

(2)

(e) Give **two** ways that the students can improve the quality of their data, other than ignoring anomalous results.

(2)

1

2

(f) Describe how the students could develop their investigation to investigate how reaction time changes with another variable.

(2)

(Total for Question 5 = 12 marks)

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6 A car accelerates at a constant rate of 1.83 m/s^2 along a flat straight road.

(a) The force acting on the car is 1.870 kN.

Calculate the mass of the car.

Give your answer to three significant figures.

(3)

mass = ... kg

(b) The car accelerates from rest for 16 s.

Calculate the speed of the car after 16 s.

(3)

speed = ... m/s

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*(c) Figure 7 is a speed-time graph for a different car moving along a horizontal road.

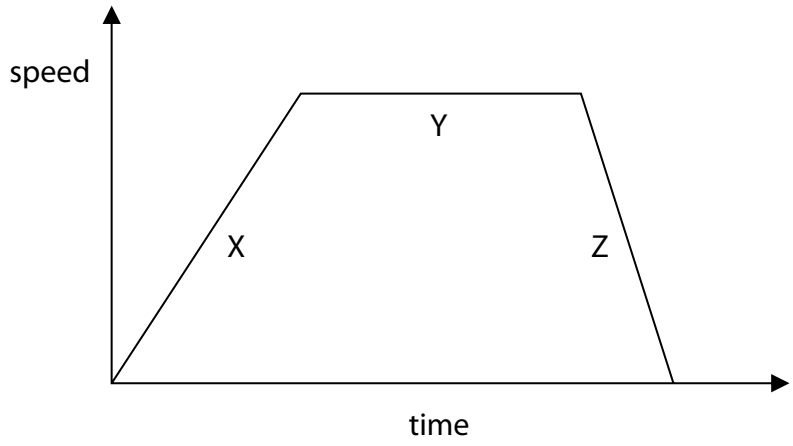


Figure 7

Describe the energy transfers taking place during the movement of the car.

You should refer to energy stores as well as transfers between energy stores for all three sections of the graph.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Equations

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
energy transferred = current × potential difference × time $E = I \times V \times t$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = ½ \times k \times x^2$

Paper 5 P1F Mark scheme

Question number	Answer	Mark
1(a)(i)	(Carried by) electromagnetic wave	**(1)**

Question number	Answer	Mark
1(a)(ii)	As chemical energy in the battery	**(1)**

Question number	Answer	Additional guidance	Mark
1(a)(iii)	Calculation of area (1) 7 × 11 Substitution (1) 77 × 0.12 Answer (1) 9.2 (J)	77 ecf area award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
1(b)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the heating effect for the oven and the phone depends on their power (1) • and since the power of an oven is much greater than the power of a phone, the oven produces a greater heating effect (1)	allow not the same wavelength/microwaves cover a range in wavelengths	**(2)**

Question number	Answer	Mark
2(a)	An answer that combines the following points of understanding to provide a logical description: • use a stopwatch (1) • start timing when flash is seen and stop when bang is heard (1)	**(2)**

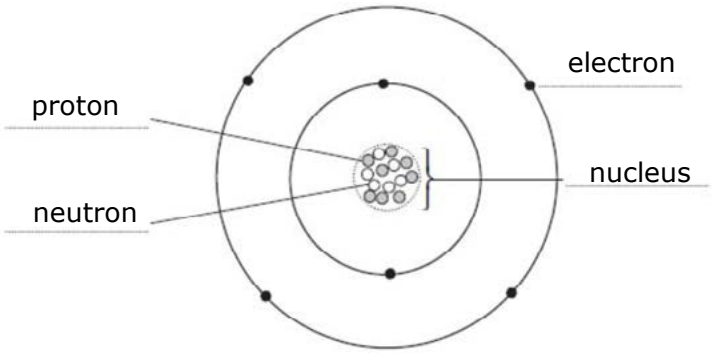
Question number	Answer	Mark
2(b)(i)	A	**(1)**

Question number	Answer	Mark
2(b)(ii)	C	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	Electromagnetic wave	allow any named e.m. wave/seismic S wave	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	Sound wave	allow ultrasound/infrasound/ seismic P wave	**(1)**

Question number	Answer	Additional guidance	Mark
2(d)	two minutes = 120 s (1) Substitution (1) 26 400 ÷ 120 Answer (1) 220 (m/s)	 ecf unit change award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Mark
3(a)(i)	One mark for each correct label (4)  	(4)

Question number	Answer	Mark
3(a)(ii)	B	(1)

Question number	Answer	Mark
3(a)(iii)	zero/0/no charge	(1)

Question number	Answer	Mark
3(b)(i)	434	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	34	allow 29 to 39	(1)

Question number	Answer	Additional guidance	Mark
3(b)(iii)	Radioactive decay is a random process	allow because background count changes every time	(1)

Question number	Answer	Mark
4(a)(i)	D	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	16.0 (m/s) read from graph (1) Substitution (1) (distance travelled =) 16 × 0.5 Answer (1) 8.0 (m) (1)	award full marks for correct numerical answer without working ecf for substitution and answer using wrong speed value	**(3)**

Question number	Answer	Mark
4(a)(iii)	A	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(iv)	Obtain readings from graph (1) Substitution (1) $\frac{16}{2.0}$ Answer (1) 8.0 (m/s^2)	award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
4(b)	Any three improvements from: • suitable instrument to measure distance (1) • using a greater distance (to reduce effect of reaction times) (1) • suitable instrument to measure time (1) • use of one student at the {first/second} lamp post to signal when to {start/stop} timing (1) • two of three sets of students taking readings for the same car (1)	allow tape measure, trundle wheel allow stop watch/clock or timing app. on phone	**(3)**

Question number	Answer	Mark
5(a)	Idea of a direct reading (without calculation)	**(1)**

Question number	Answer	Mark
5(b)	If student B drops the ruler, they are not really measuring their own reaction time as they know when ruler has been dropped	**(1)**

Question number	Answer	Additional guidance	Mark
5(c)(i)	Calculating the mean (1) 18.36 Rounding to 2 s.f. (1) 18 (cm)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)(ii)	Rearrangement (1) $t = \sqrt{\frac{\text{distance}}{500}}$ Substitution and answer (1) time = 0.17 (s)	award full marks for correct numerical answer without working allow answers which round to 0.17, e.g. 0.1673	**(2)**

Question number	Answer	Additional guidance	Mark
5(d)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • 25.5 is an anomalous result (1) • (because) it is much further away from the mean than the other results (1)	ignore 19	**(2)**

Question number	Answer	Mark
5(e)	• Take more readings (1) • Idea that a third student should also measure the reaction time (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(f)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • using a larger group of students/large population of students (1) • and measure how their reaction time varies with age/height (1)	allow any suitable variable	**(2)**

Question number	Answer	Additional guidance	Mark
6(a)	Rearrangement (1) $m = \frac{f}{a}$ Substitution and conversion (1) $m = \frac{1870}{1.83}$ Answer and rounding to 3 s.f. (1) 1020 (kg)	maximum 2 marks if kN not converted to N award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
6(b)	Rearrangement of $\frac{(v-u)}{t} = a$ (1) $v = u + at$ Substitution (1) $v = 0 + 1.83 \times 16$ Answer (1) 29.3 (m/s)	award full marks for correct numerical answer without working	**(3)**

Question number	Indicative content	Mark
*6(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2** • fuel forms a store of chemical (potential) energy • chemical energy is transferred to kinetic energy and thermal when the car moves • kinetic energy transferred to thermal as the car slows down **AO3** • during X, kinetic energy increases as the car's speed increases/car accelerates and the increase in kinetic energy is provided by the chemical energy store • during all three sections, work is done against frictional forces in the moving parts of the car and against the drag from the air • during Y, kinetic energy stays constant when the car moves at constant speed but energy is still transferred to thermal energy • during Z, kinetic energy decreases as the car slows down	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The description attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The description is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The description is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number	Candidate Number

Combined Science

Paper 6: Physics 2

Foundation Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 10 minutes

Paper Reference
1SC0/2PF

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 6 3 A 0 1 2 4

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) (i) Complete each box in Figure 1 to show how particles are arranged in a solid, liquid and gas.

One particle in each box has been drawn for you.

(3)

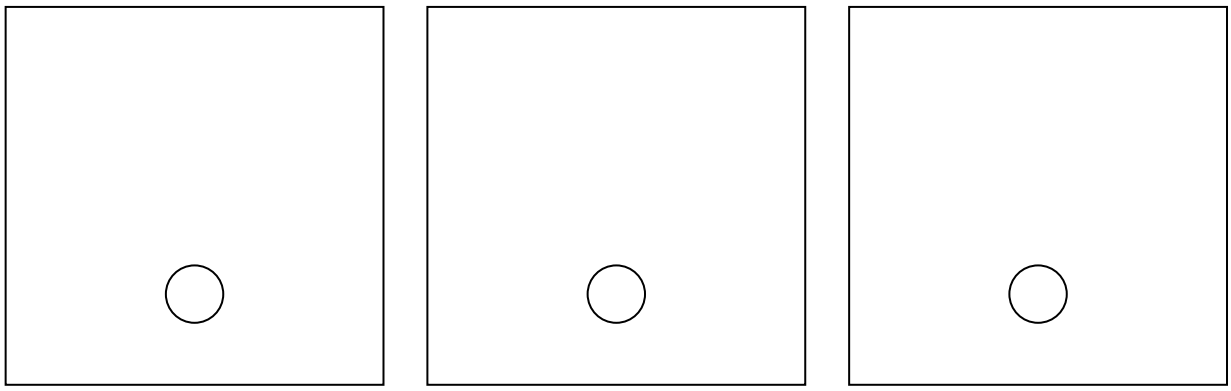

Figure 1

(ii) Which row of the table is correct for water compared to steam?

(1)

		the density of water is	the water molecules are
☒	**A**	bigger	smaller
☒	**B**	smaller	bigger
☒	**C**	bigger	closer together
☒	**D**	smaller	further apart

(b) A student investigates the density of a copper block and the density of a small stone, as shown in Figure 2.

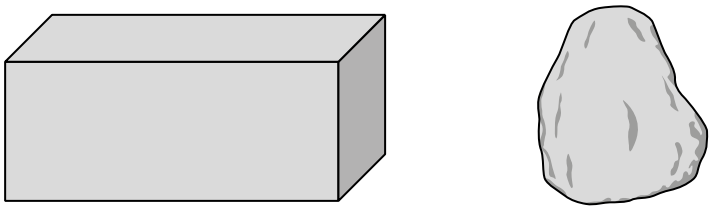

Figure 2

(i) The student calculates the volume of the block as 13 cm^3.

She finds that the mass of the block is 100 g.

Calculate the density of the block.

Use the equation

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

(2)

density = ... g/cm^3

(ii) The student found the volume of the copper block by multiplying the area of its base by its height.

The small stone does not have straight sides.

Describe how the student could measure the volume of the small stone.
You may use a diagram if it helps your answer.

(3)

.....

.....

.....

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(Total for Question 1 = 9 marks)

2 An electric heater is used to heat some water.

Figure 3 shows the experimental setup used.

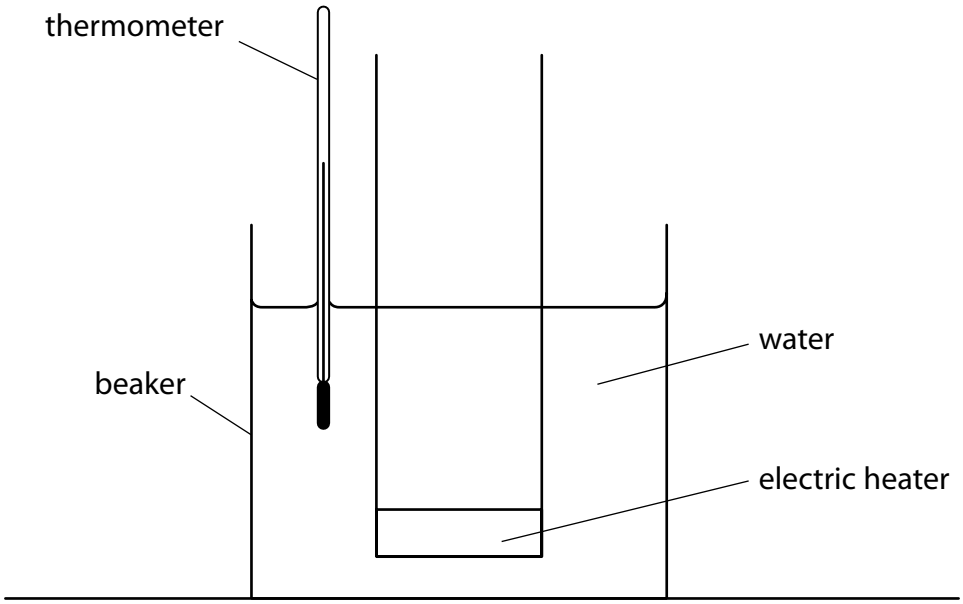


Figure 3

(a) Figure 4 shows the energy transferred by the electric heater in 1 second.

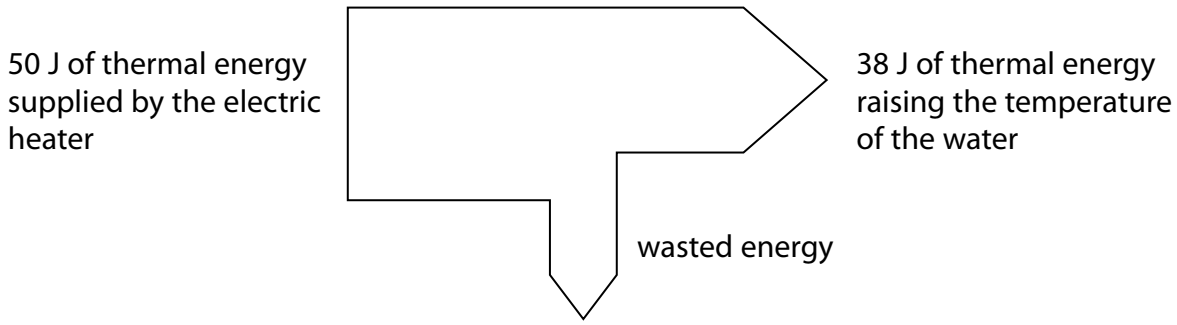


Figure 4

(i) How much energy is wasted each second?

(1)

☒ **A** 12 J

☒ **B** 38 J

☒ **C** 50 J

☒ **D** 88 J

(ii) Describe what happens to the wasted energy.

(2)

(b) Explain **one** way the experiment can be improved to reduce the amount of wasted energy.

(2)

(c) The initial mass of the water in the beaker is 0.72 kg.

The electric heater is switched on for some time and the water boils.

The mass of the water after the heater is switched off is 0.60 kg.

The thermal energy transferred to the water while it boils is 270 000 J.

Use an equation from the formula sheet to calculate the specific latent heat of the water.

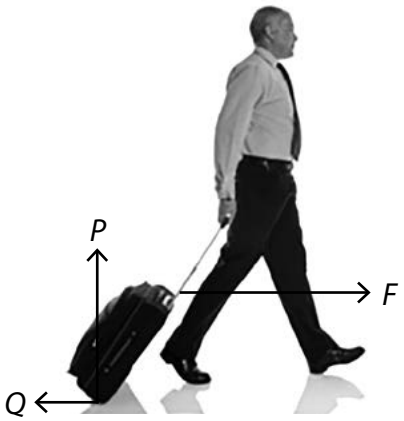
(3)

specific latent heat = ... J/kg °C

(Total for Question 2 = 8 marks)

3 A man pulls a suitcase with a horizontal force, *F*, as shown in Figure 5.

Two other forces acting on the suitcase are labelled *P* and *Q*.



Not to scale

Figure 5

(a) (i) Which of these gives the correct names for the forces *P* and *Q*?

(1)

	name of	
	force *P*	**force *Q***
☒ **A**	upthrust	reaction
☒ **B**	reaction	friction
☒ **C**	reaction	reaction
☒ **D**	friction	upthrust

(ii) Draw an arrow on the diagram to represent the weight of the suitcase.

(1)

(b) The man pulls the suitcase for 80 m along a horizontal path.

The mass of the man and the suitcase is 85 kg.

The man does 1200 J of work on the suitcase as he pulls the suitcase along.

He walks with an average velocity of 1.5 m / s.

(i) Calculate the kinetic energy of the man and the suitcase.

(2)

kinetic energy = ... J

(ii) Calculate the horizontal force, *F*, that the man exerts on the suitcase.

Use the equation:

work done = force × distance moved in the direction of the force

(2)

force = ... N

(c) The man runs up a set of stairs carrying his suitcase.

Explain whether he does more total work if he walks up the same stairs instead of running.

(2)

.....

.....

.....

.....

(d) The man lifts his suitcase.

The increase in gravitational potential energy of the suitcase is 264 J.

The mass of the suitcase is 12 kg.

Calculate the vertical height the suitcase is raised.

(gravitational field strength, g = 10 N/kg)

Use the equation:

change in gravitational potential energy = mass $\times$ g $\times$ change in vertical height

(2)

height raised = ... m

(Total for Question 3 = 10 marks)

4 The efficiency of an electric motor is investigated as shown in Figure 6.

The motor lifts a mass at a constant speed.

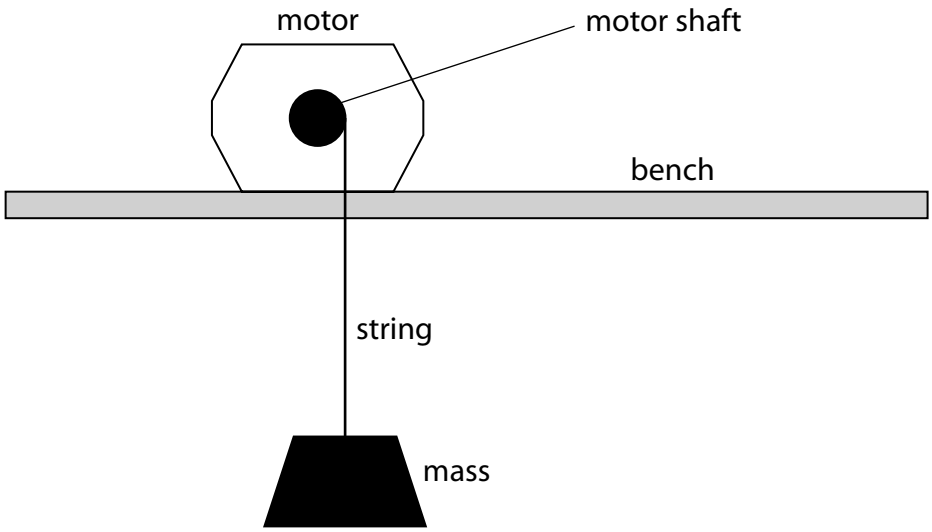


Figure 6

The results are shown in Figure 7.

current in motor	1.9 A
voltage across motor	10.0 V
time taken to lift mass	9.0 s

Figure 7

(a) (i) Which of these changes would improve the **reliability** of these results?

(1)

- ☒ **A** Repeating the investigation with different masses
- ☒ **B** Repeating the readings and calculating averages
- ☒ **C** Using a motor that works with a higher voltage
- ☒ **D** Using a shorter piece of string to lift the mass

(ii) Which of these best shows the energy stores as the mass is lifted?

(1)

	kinetic energy of the mass	potential energy of the mass
☒ **A**	constant	increasing
☐ **B**	constant	decreasing
☐ **C**	decreasing	increasing
☐ **D**	decreasing	decreasing

(b) (i) Show that the total energy supplied to the motor in the 9 s is about 170 J.

(2)

(ii) During the 9 s the efficiency of the motor is 70%.

Calculate the amount of useful energy transferred in the 9 s.

Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred}}{\text{total energy supplied}}$$

(3)

useful energy = ... J

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(c) Which row of the table is correct for the resistance of the motor?

(1)

	resistance of motor =	resistance of motor =
☒ **A**	$I \div V$	$I^2 \div P$
☒ **B**	$V \div I$	$P \div I^2$
☒ **C**	$V \div I$	$P \times I^2$
☒ **D**	$I \times V$	$P \div I^2$

(d) When the motor lifts the mass, the coil in the motor becomes warm.

Explain why the coil becomes warm.

(3)

(Total for Question 4 = 11 marks)

5 A student investigates how the resistance of a thermistor varies with temperature.

(a) The student uses the equipment shown in Figure 8 to measure the temperature of the thermistor.

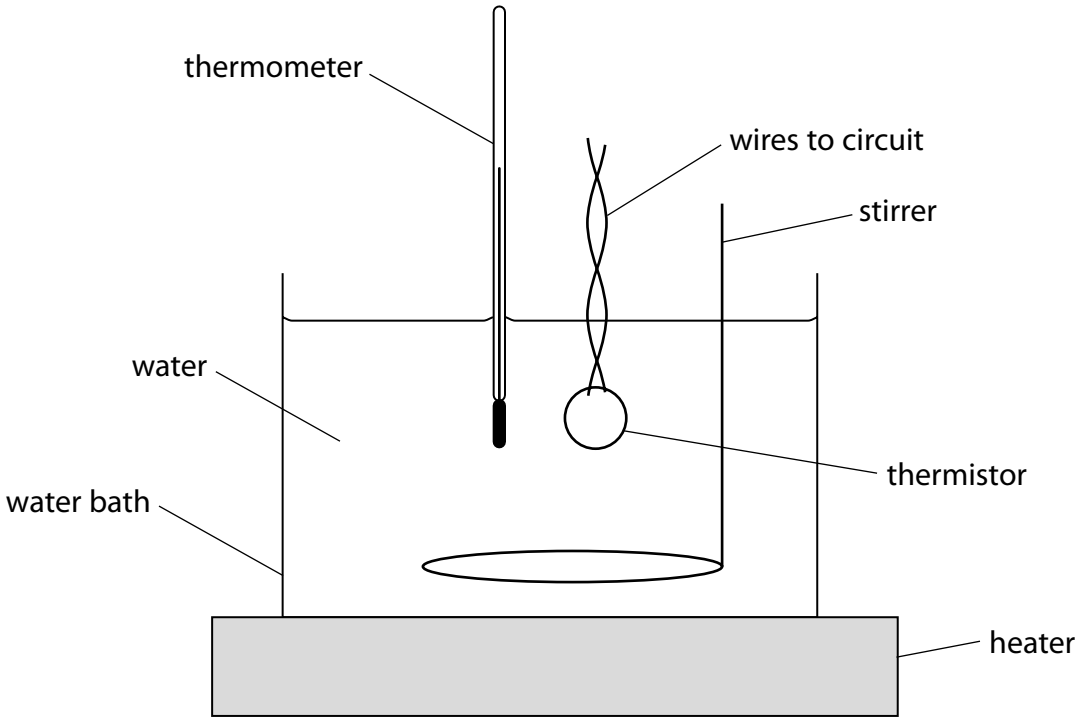


Figure 8

(i) Give **one** reason for using the water bath.

(1)

.....

.....

(ii) The equipment shown in Figure 8 is for investigations in the temperature range from 20 °C to 100 °C.

State **one** way the student could develop this experimental procedure to investigate temperatures outside this range.

(1)

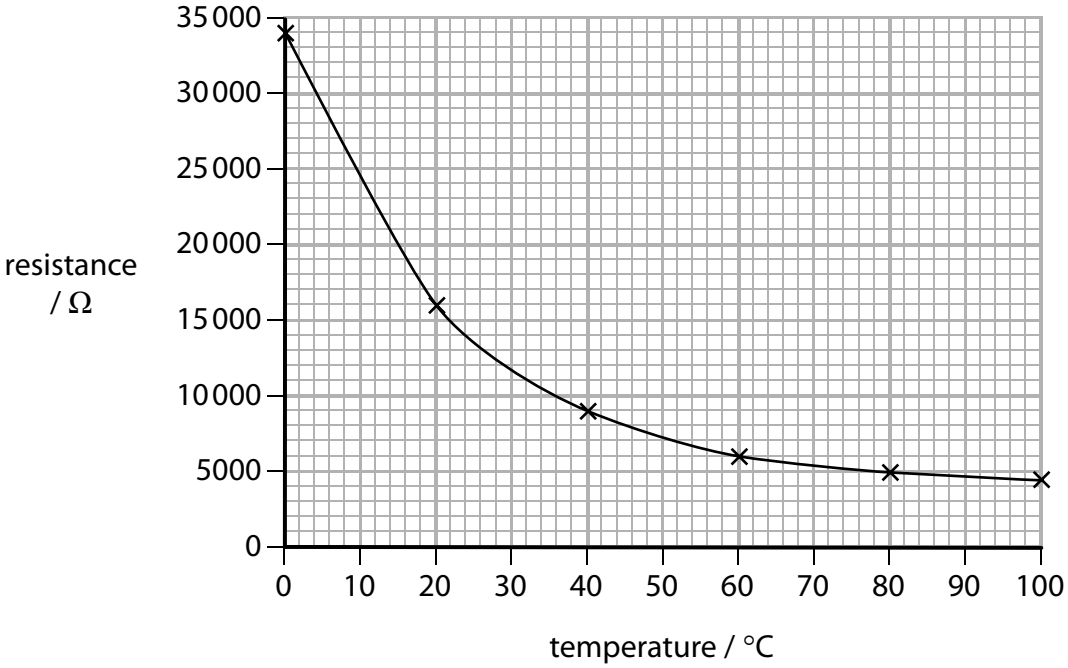
.....

.....

(b) The student takes measurements for two other components, **A** and **B**.

The results for both these components are shown in Figure 9.

Component A



Component B

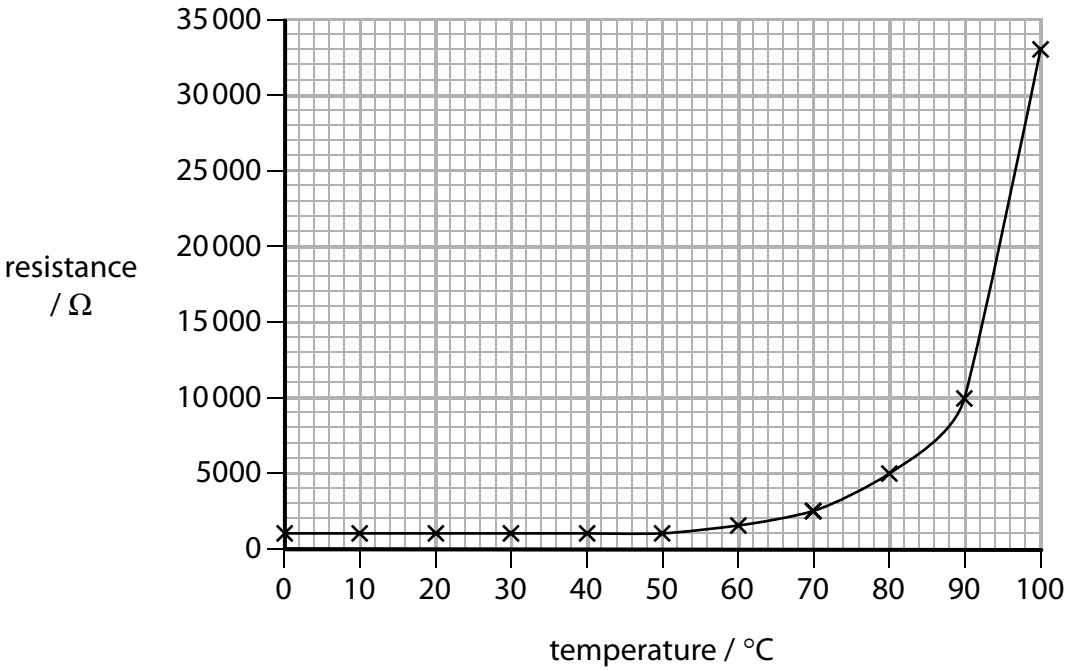


Figure 9

Compare and contrast how the resistances of component **A** and component **B** vary with temperature.

(3)

*(c) Describe how the student should carry out an experiment to determine the specific heat capacity of water.

(6)

(Total for Question 5 = 11 marks)

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6 A student uses a digital calliper to measure the length of a spring, as shown in Figure 10.

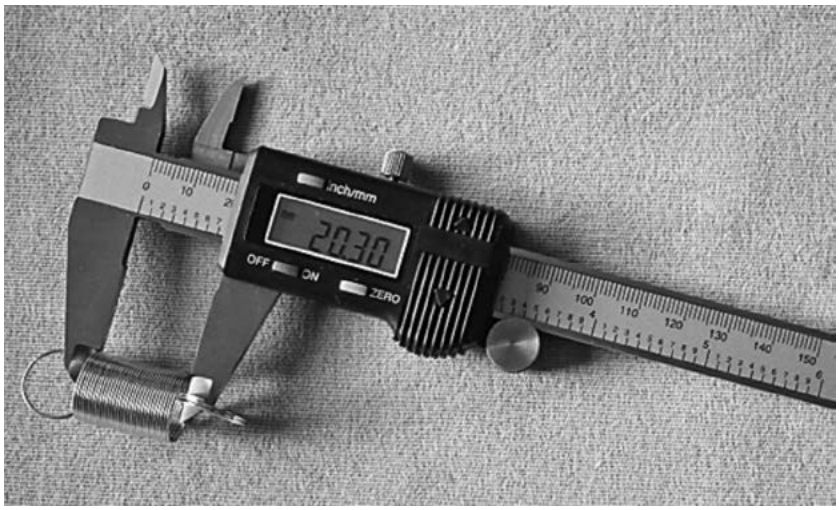


Figure 10

The spring is bendy and difficult to measure.

The student takes the six readings shown in Figure 11.

Figure 11

(a) Calculate the average length of the spring.

(2)

average length = ... mm

(b) The student investigates the stretching of a spring with the equipment shown in Figure 12.

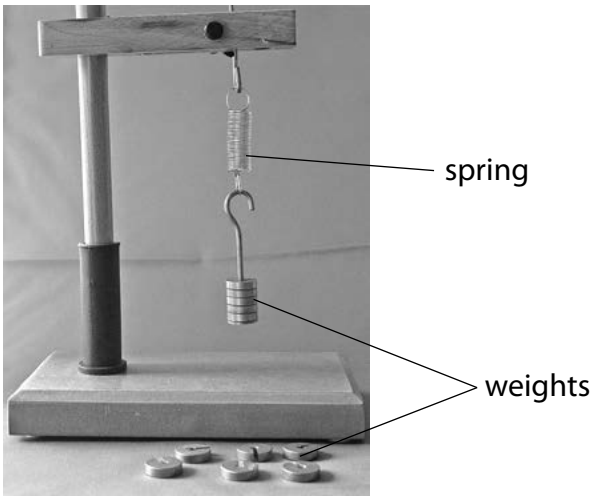


Figure 12

The student investigates the extension of the spring using six different weights.

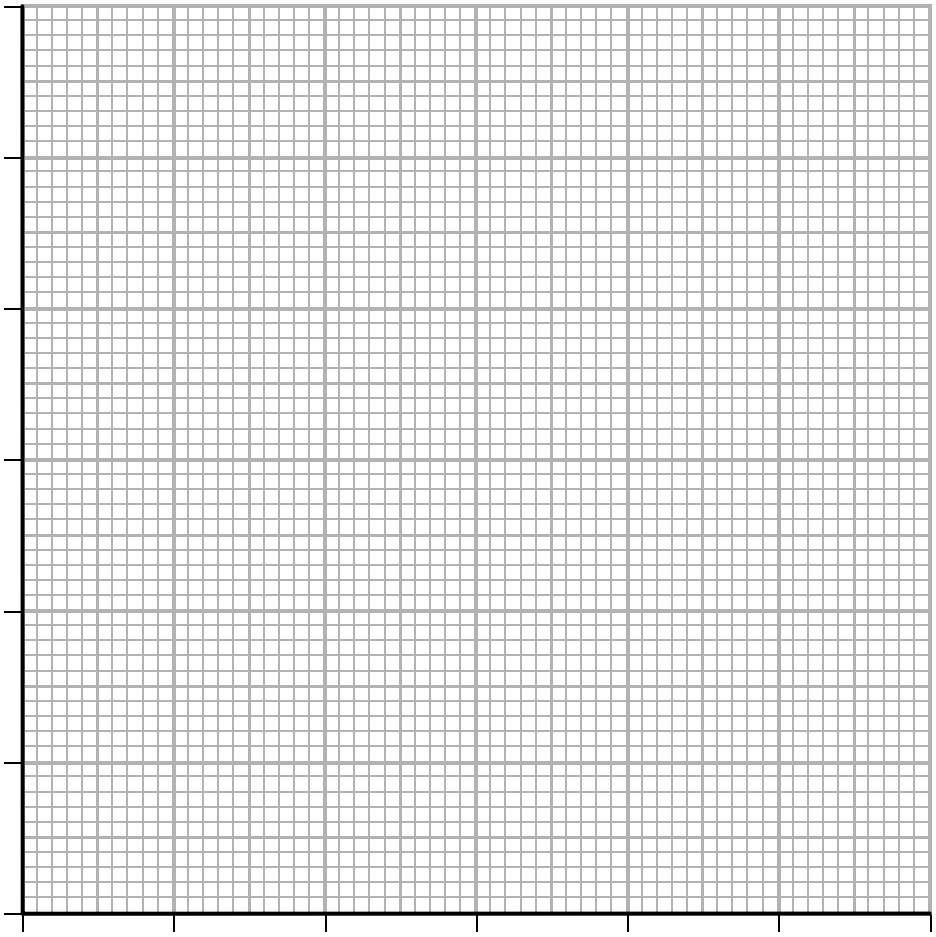
The results are shown in Figure 13.

weight (N)	extension (mm)
0.20	4.0
0.40	8.0
0.60	12.0
0.80	16.0
1.00	20.0
1.20	24.0

Figure 13

(i) Draw a graph for the readings, using the grid shown.

(3)



(ii) The student writes this conclusion:

'*The extension of the spring is directly proportional to the weight stretching the spring.*'

Comment on the student's conclusion.

(3)

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(c) The student extends the investigation by finding information about the stretching of wires.

The student finds the graph shown in Figure 14 for the stretching of a wire.

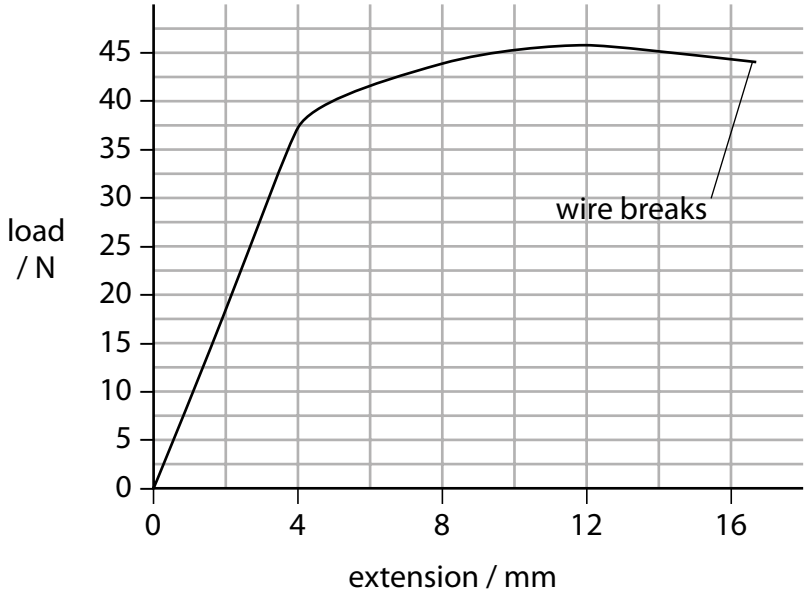

Figure 14

Describe the non-linear stretching of the wire shown in Figure 14.

(3)

(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS

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Equations

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
energy transferred = current × potential difference × time $E = I \times V \times t$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = ½ \times k \times x^2$

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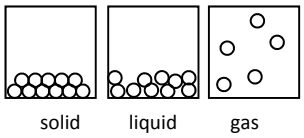
Paper 6 P2F Mark scheme

Question number	Answer	Additional guidance	Mark
1(a)(i)	In the solid box: regular arrangement and particles touching (1) In the liquid box: irregular arrangement and most particles touching (1) In the gas box: random and spaced (compared to liquid) (1)	ignore variation in particle size ignore arrows/lines indicating movement allow solid and liquid arrangements that do not fill the box  	**(3)**

Question number	Answer	Mark
1(a)(ii)	C	**(1)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	Substitution (1) 100 ÷ 13 Answer (1) 7.7 (g/cm^3)	award full marks for correct numerical answer without working allow 7.692 (g/cm^3)	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	An answer that provides a description by making reference to: • part fill a measuring cylinder with water and record the starting volume (1) • completely immerse the stone in the water and record the final volume of water and stone (1) • volume of stone = final volume – initial volume (1)	accept valid alternative methods, e.g. fill a displacement can until some water overflows/flows out of spout completely immerse the stone in the displacement can and collect the displaced water in a measuring cylinder volume of water displaced = volume of stone	**(3)**

Question number	Answer	Mark
2(a)(i)	A	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An answer that provides a description by making reference to: • thermal/heat energy (1) • dissipated in/transferred to air/surroundings (1)	allow heat 'lost' to surroundings	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • place the beaker on an insulator (1) • so this (material) will reduce rate of energy transfer (1) OR • wrap the beaker in an insulator (1) • so this (material) will reduce the rate of energy transfer (1) OR • reduce the surface areas of the water (1) • to give less evaporation (1)	allow named insulator, e.g. cork mat put a lid on the beaker/make the beaker taller and narrower	**(2)**

Question number	Answer	Additional guidance	Mark
2(c)	Rearrangement (1) $(l =) \frac{\Delta Q}{\Delta m}$ Substitution (1) $l = \frac{270\,000}{0.12}$ Answer (1) 2 250 000 (J/kg °C)	award full marks for correct numerical answer without working 2250 (J/kg °C) gains 2 marks as power of 10 error	**(3)**

Question number	Answer	Mark
3(a)(i)	C	(1)

Question number	Answer	Mark
3(a)(ii)	Vertical arrow, acting downward through the suitcase	(1)

Question number	Answer	Additional guidance	Mark
3(b)(i)	Substitution (1) $(KE =) \frac{1}{2} \times 85 \times (1.5)^2$ Answer (1) 96 (J)	award full marks for correct numerical answer without working allow 95.625 (J)	(2)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	Rearrange (1) force = work done ÷ distance Answer (1) (force) = 15 (N)	accept rearrangement with values subst., i.e. (force) = 1200 ÷ 80 award full marks for correct numerical answer without working	(2)

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the work done is the same for walking and running (1) • because work done depends on force and distance only, not time (1)	allow energy for work done because work done ÷ time is power	(2)

Question number	Answer	Additional guidance	Mark
3(d)	Rearrangement (1) (height) = change in GPE ÷ (mass × g) Answer (1) 2.2 (m)	accept rearrangement with values, i.e. (h) = 264 ÷ (12 × 10) OR = 264 ÷ 120 award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
4(a)(i)	B	**(1)**

Question number	Answer	Mark
4(a)(ii)	A	**(1)**

Question number	Answer	Mark
4(b)(i)	Substitution into correct equation (1) = 1.9 × 10.0 × 9.0 Answer (1) 171 (J) (which is about 170 J) answer must be shown to 3 s.f.	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	Rearrangement (1) (useful energy transferred) = efficiency × total energy supplied Substitution (1) = (70 × 170)÷100 Answer (1) 119 (J)	award full marks for correct numerical answer without working accept (useful energy transferred) = 170 × 0.7 OR = 171 × 0.7 accept alternative answer from 171 (J), i.e. 120 (J)	**(3)**

Question number	Answer	Mark
4(c)	B	**(1)**

Question number	Answer	Mark
4(d)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • the coil contains wires which have a resistance (1) • and current in the wire is due to movement of electrons through (close-packed) lattice of positive ions (1) • hence collisions between electrons and ions in the lattice transfer energy from electrons to the lattice (causing the temperature of the wires/coil to rise) (1)	**(3)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	Any one reason from: • the thermistor and the water are at the same temperature (1) • large volume of water gives a steady temperature rise (1)	accept idea that only small part of thermometer would be in contact with a thermistor in air accept difficult to control change in temperature of thermistor when heated in air	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	Any one of the following developments to the procedure: • add ice to increase lower limit of temperature range (1) • use liquid with higher boiling point to increase upper limit of temperature range (1)	accept named liquid with higher boiling point, e.g. oil	**(1)**

Question number	Answer	Additional guidance	Mark
5(b)	A comparison and contrast that must include at least **one** similarity and **one** difference from the following points to a maximum of three marks: Similarities • resistance of both changes with temperature (1) • both graphs show a non-linear relationship (1) • data comparison, e.g. both have the same resistance at 80 °C (1) Differences • resistance of A decreases with temperature but resistance of B increases with temperature (1) • for A, (largest slope/rate of change) is at lower temperature but for B, (largest slope/rate of change) is at higher temperature(s) (1) • for B, resistance is constant below 50 °C but for A resistance is roughly constant above 60 °C (1)	accept (smallest slope/rate of change) for A is at higher temperature but (smallest slope/rate of change) for B is at lower temperature	**(3)**

Question number	Indicative content	Mark
***5(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • use of top pan balance to measure mass • insulate beaker to reduce heat loss • ammeter connected in series with heater • voltmeter connected in parallel with heater • use of $E = I \times V \times t$ to determine energy supplied to the water • accept use of joule-meter to measure energy supplied • use of $E = m \times c \times \theta$ to determine specific latent heat for the water • measure p.d. across heater • use stopwatch to measure time liquid is heating • measure current in heater • determine mass of water as mass of (beaker and water) – mass of beaker • measure temperature before and after heating	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
6(a)	Evidence that anomalous reading excluded (1) Answer (1) average length = 20.31 (mm)	accept 101.57 (÷5) for first mark accept 20.314 (mm)	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(i)	• Axes with linear scales that use more than half of each edge of the grid and labelled with units from table (1) • All points correctly plotted to ± half a square (1) • Single straight line passing through all points and the origin (1)	allow 1 mark if only one plotting error and correct line drawn for points plotted	**(3)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	A comment that makes reference to the following points: (using table) • idea that equal increments of force/weight/mass cause equal increments of extension (1) • correct reference to figures in the table (1) OR (using graph) • the graph line is straight (1) • the graph line passes through the origin (1) AND therefore the student's conclusion is correct (1)	last marking point can only be achieved if at least one of the other two marks is awarded	**(3)**

Question number	Answer	Additional guidance	Mark
6(c)	An answer that combines points of interpretation/ evaluation to provide a logical description: • above 37.5 N/4 mm there are large increases of extension for small increases in load (1) • the maximum extension of the wire is about 16.5 mm before it breaks (1) • above 12 mm the wire keeps on extending when the load is reduced below 46 N (1)	accept extension is (much) greater for each 1 N increase in load above 37.5 N	**(3)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number	Candidate Number

Combined Science

Paper 1: Biology 1

Higher Tier

Sample Assessment Materials for first teaching September 2016

Time: 1 hour 10 minutes

Paper Reference
1SC0/1BH

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows the times when *Homo sapiens* and some of their ancestral species are thought to have lived.

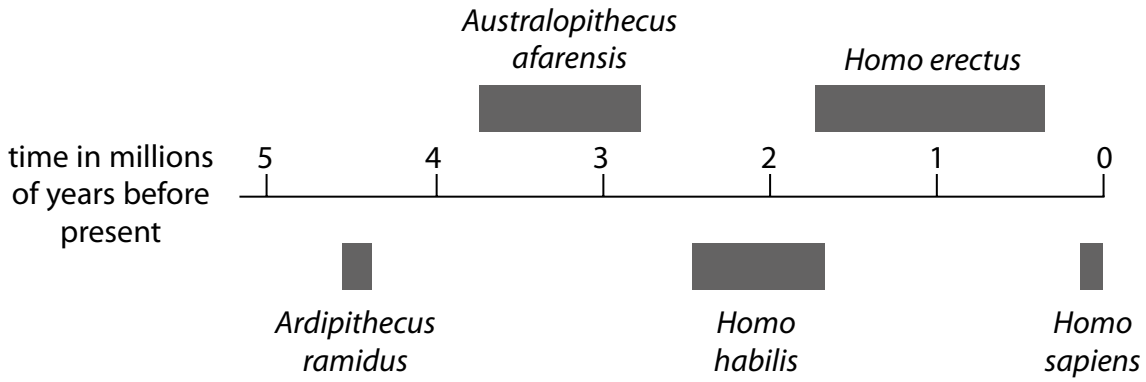

Figure 1

(a) Fossil remains of *Ardipithecus ramidus* were discovered in Ethiopia.

(i) Describe the evidence that scientists might have used to show that *Ardipithecus ramidus* inhabited the Earth earlier than *Homo habilis.*

(2)

(ii) Suggest an explanation for the extinction of *Homo habilis*.

(2)

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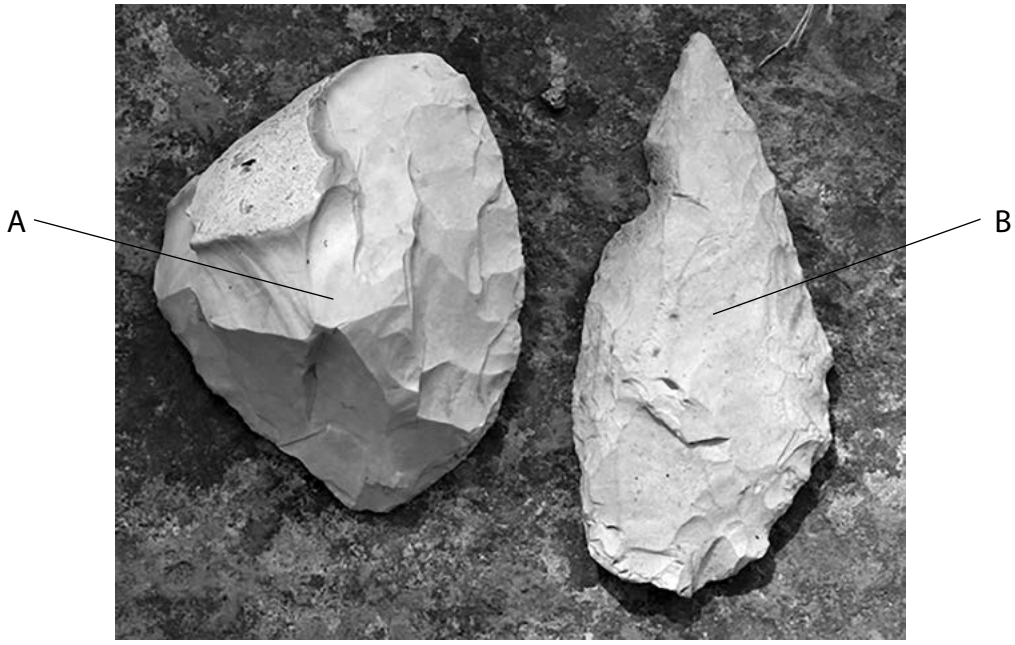
(iii) Figure 2 shows two stone tools, one used by *Homo habilis* and one used by *Homo erectus*.



(Source: Frederic Surmely/look at sciences/Science Photo Library)

Figure 2

Explain which stone tool was most likely to be used by *Homo erectus*.

Use the information from Figure 1 and Figure 2.

(2)

(b) The population of humans on Earth has increased significantly leading to food shortages.

The growth of drought-resistant crop plants could lead to an increase in food supply.

Describe how drought-resistant crop plants can be produced.

(3)

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(Total for Question 1 = 9 marks)

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2 The ratio of waist-to-hip measurements can be used to determine the risk of a person developing cardiovascular disease.

(a) Calculate the waist-to-hip ratio for a person with a waist measurement of 830 mm and a hip measurement of 0.99 m.

Give your answer to two decimal places.

(2)

Answer = ...

(b) Dieting can reduce the effects of cardiovascular disease.

(i) Which statement gives a reason why dieting can be used to reduce weight in obese people?

(1)

☒ **A** Dieting increases metabolism and growth rate

☒ **B** Dieting reduces energy consumption

☒ **C** Dieting decreases metabolism

☒ **D** Dieting increases energy consumption

(ii) A scientist is planning to test a new diet for weight loss.

She selects 40 obese people to take part in the test.

All the obese people are between 20 and 30 years of age.

State **two** other factors the scientist should control when selecting the people.

(2)

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(iii) Devise a plan the scientist could use to test the effectiveness of the new diet using the 40 obese people.

(3)

(Total for Question 2 = 8 marks)

3 Diffusion, active transport and osmosis can be used to move substances into and out of cells.

(a) A student was investigating osmosis in potato cubes.

He used the following method:

- cut a potato into equal-sized cubes
- recorded the mass of each potato cube
- placed each potato cube into different concentrations of salt solution
- removed the potato cubes after 30 minutes
- dried the potato cubes and recorded the final mass of each cube.

He plots his results on a graph shown in Figure 3.

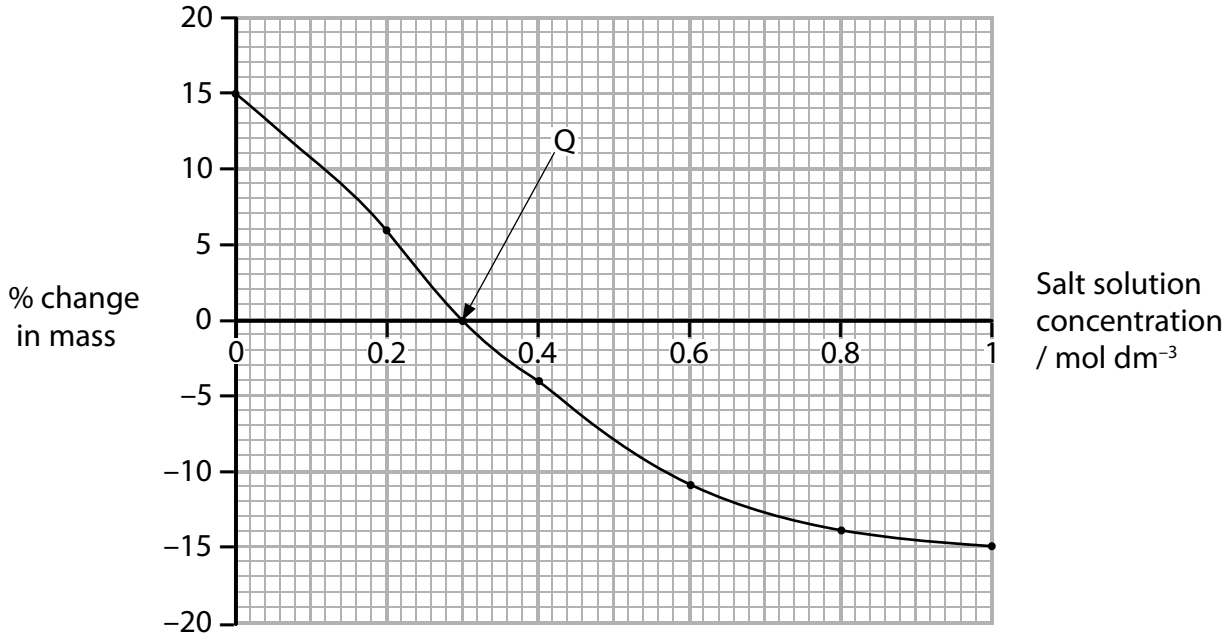

Figure 3

The method controls a number of variables.

(i) Name **one** other variable that needs to be controlled during the student's investigation.

(1)

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.....

(ii) Give a reason why the potato cube must be dried.

(1)

.....

.....

(iii) Explain the conclusion that can be made about point Q on Figure 3.

(2)

(iv) Give one way that the student could obtain more data to increase the accuracy of point Q.

(1)

(b) Osmosis is one method that single-celled organisms, such as bacteria, use to obtain molecules from their environment.

Which of the following is a correct description of a process involving the transport of molecules?

(1)

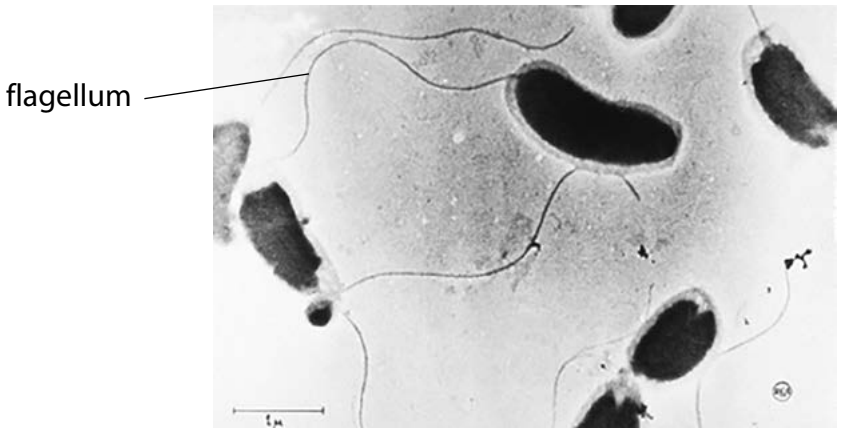
☒ **A** Diffusion is used to transport molecules against the concentration gradient

☒ **B** Active transport is used to obtain molecules in a low concentration environment

☒ **C** Active transport moves substances along the concentration gradient

☒ **D** Diffusion uses energy to transport molecules into cells

(c) Figure 4 shows some *Vibrio cholerae*, the bacteria that cause cholera.



Magnification ×8000

(Source: Corbis)

Figure 4

The length of one flagellum on Figure 4 is 68 mm.

Calculate the length of the flagellum in μm.

(3)

..... μm

(Total for Question 3 = 9 marks)

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4 (a) DNA is composed of four different DNA nucleotides.

(i) Which diagram represents the arrangement of the sugar, phosphate and the base in a DNA nucleotide?

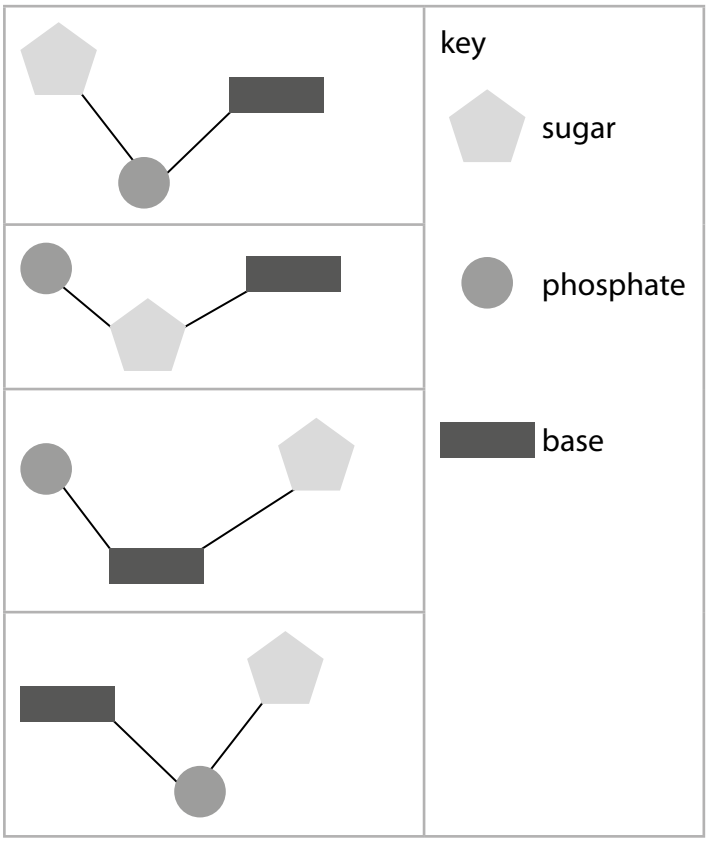
(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**



(ii) An allele starts with the DNA sequence ATGCATGTACCG.

Give the sequence of the complementary DNA sequence.

(1)

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(iii) The length of one DNA nucleotide was measured at 3.3×10^{-10} metres.

Calculate the approximate length of a gene containing 250 nucleotides in nanometres.

(2)

..... nm

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(b) The DNA of an organism determines its phenotype.

White tigers are produced because of a mutation of a single allele which usually produces the normal orange and yellow fur pigmentation.

The mutated allele is recessive.

Samba, a male white tiger, was bred with Rani. They had three offspring; two offspring have white fur and one has a normal fur pigmentation.

(i) State the genotype of Rani.

(1)

.....

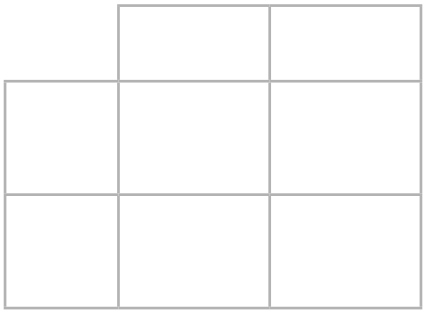
.....

(ii) The offspring with normal fur pigmentation was bred with a tiger that was heterozygous.

Use A/a to represent the alleles for fur pigmentation.

Predict, using the Punnett square, the percentage probability of the offspring from this cross having normal fur pigmentation.

(2)



percentage probability = ... %

(c) Explain how two parents with a dominant phenotype can produce offspring expressing a recessive characteristic.

(2)

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(Total for Question 4 = 9 marks)

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5 Phenolphthalein is an indicator. It is pink in alkaline solutions and turns colourless as the pH decreases.

It can be used to measure the activity of the enzyme lipase on the breakdown of lipids.

Samples of milk containing phenolphthalein were incubated with lipase at different temperatures.

The time taken for the phenolphthalein to turn colourless was recorded and used to calculate the rate of enzyme activity.

Figure 5 shows these results.

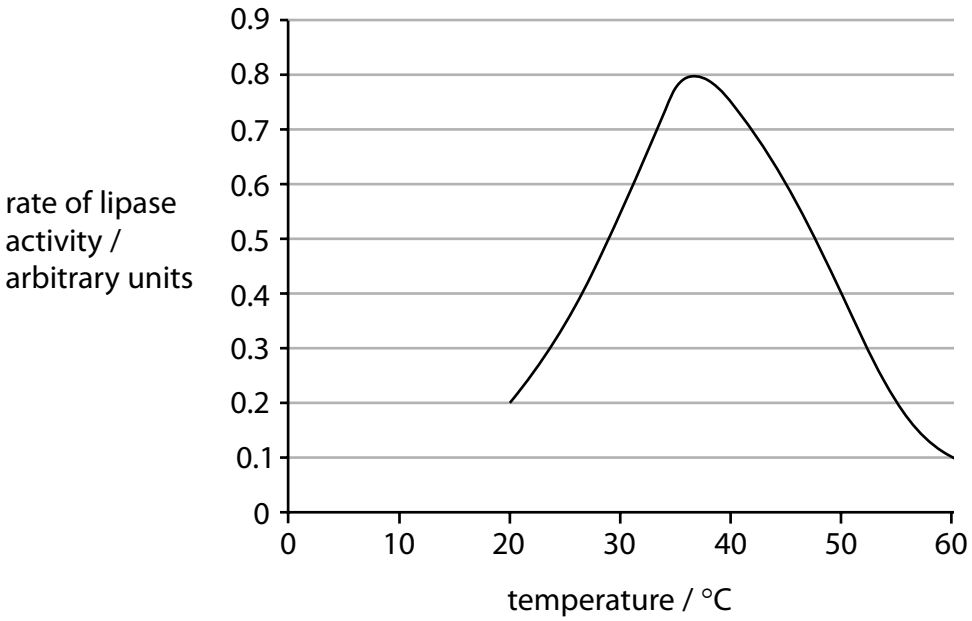

Figure 5

(a) (i) Explain why phenolphthalein turns colourless when lipase breaks down the lipids in milk.

(2)

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(ii) Describe the effect of temperature on the activity of lipase, as shown in Figure 5.

(2)

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(iii) Explain why the activity of lipase changes above a temperature of 40 °C.

(2)

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(b) A student investigated the time taken for amylase to breakdown a 10% starch solution into glucose at 37 °C. The student repeated the investigation five times.

Figure 6 shows the results.

time taken for amylase to produce glucose (s)				
test 1	**test 2**	**test 3**	**test 4**	**test 5**
120	125	110	115	118

Figure 6

(i) Calculate the rate of amylase enzyme activity for the 10% starch solution.

(3)

rate = ... s^{-1}

The investigation was done at 37 °C.

(ii) State **one** other variable that the student should have controlled during this investigation.

(1)

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(c) Different enzymes catalyse specific reactions.

Explain why enzymes can only catalyse specific reactions.

(2)

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(Total for Question 5 = 12 marks)

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6 When bacteria divide they replicate their genome and synthesise their cell wall.

Figure 7 outlines the stages of bacterial replication.

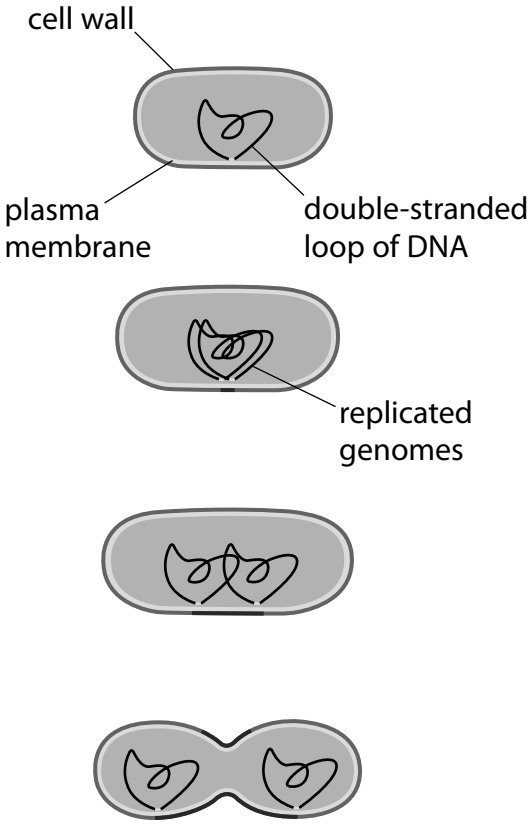

Figure 7

(a) Penicillin inhibits the synthesis of the cell wall in bacteria.

Explain the effect of penicillin on bacterial and human cells.

(3)

(b) Penicillin, isolated from a fungus, was the first antibiotic used to treat bacterial infections and is still widely used today.

Scientists have genetically engineered bacteria to produce large amounts of penicillin.

Describe how scientists would produce a genetically modified bacterium that produces penicillin.

(4)

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*(c) MRSA is a bacterium that has evolved to become resistant to antibiotics.

With reference to Darwin's theory of evolution by natural selection, explain how MRSA bacteria have evolved to become resistant to antibiotics.

(6)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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Paper 1 B1H Mark Scheme

Question number	Answer	Additional guidance	Mark
1(a)(i)	An answer that combines knowledge (1 mark) and understanding (1 mark) to provide a logical description: • (scientists might look for) differences in the structural features of the fossil (1) • and *Ardipithecus ramidus* would be deeper in the rock layer than *Homo* {*habilis*/stone tools} (1)	e.g. *Ardipithecus ramidus* smaller cranial capacity	**(2)**

Question number	Answer	Additional guidance	Mark
1(a)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • likely to be out-competed by *Homo erectus* (1) • {for resources essential for survival/due to the presence of a new selection pressure} (1)	accept: named resources accept: named selection pressure, e.g. climate change, environmental change, disease	**(2)**

Question number	Answer	Additional guidance	Mark
1(a)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 marks): • stone tool B because it is more {sophisticated/worked} (1) • and *Homo erectus* lived more recently than *Homo habilis* (1)	accept: data quoted from the timeline	**(2)**

Question number	Answer	Mark
1(b)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • genetic variation means that some plants will be tolerant of drought conditions and these can be selected (1) • cross-pollinate these plants and grow the seeds under drought conditions (1) • select offspring and repeat over several generations (1)	**(3)**

Question number	Answer	Additional guidance	Mark
2(a)	• 830 mm = 0.83 m (1) • 0.83/0.99 = 0.8383… = 0.84 to two d.p. (1) OR • 0.99 m = 990 mm (1) • 830/990 = 0.8383… = 0.84 to two d.p. (1) • Answer must be given to two decimal places.	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
2(b)(i)	B	**(1)**

Question number	Answer	Mark
2(b)(ii)	Any two of the following points: • similar BMI (1) • same gender profile (1) • similar amount (and type) of exercise (1)	**(2)**

Question number	Answer	Mark
2(b)(iii)	An answer that combines the following points to provide a plan: • weigh the 40 obese people (1) • half follow the new diet and half keep their normal diet (1) • after a fixed time period re-weigh the 40 people (1)	**(3)**

Question number	Answer	Mark
3(a)(i)	Any one variable from • temperature • amount of drying • type of potato • age of potato	**(1)**

Question number	Answer	Mark
3(a)(ii)	to get an accurate reading of mass	**(1)**

Question number	Answer	Mark
3(a)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): any **one** identification point from: • there is no change in mass at 0.3 mol dm^{-3} (check once drawn) (1) • this is the isotonic salt concentration in the potato (1) **Plus** reasoning/justification • because there is no net movement of water/no salt concentration gradient (1)	**(2)**

Question number	Answer	Mark
3(a)(iv)	• Repeat the test using intermediate concentrations (between 0.2 and 0.4 mol dm^{-3})	**(1)**

Question number	Answer	Mark
3(b)	B	**(1)**

Question number	Answer	Additional guidance	Mark
3(c)	• 68 ÷ 8000 (1) • 0.0085 (1) • 8.5 (μm) (1)	award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Mark
4(a)(i)	B	**(1)**

Question number	Answer	Mark
4(a)(ii)	TACGTACATGGC	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(iii)	• 3.33×10^{-10} equals 0.33 nm (1) • $0.33 \times 250 = 82.5$ (nm) (1)	maximum one mark if no conversion to nm award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	• heterozygous	accept alleles showing heterozygous genotype	**(1)**

Question number	Answer	Mark
4(b)(ii)	• correct Punnett square (1) • 75% normal fur pigmentation (1)	**(2)**

	A	a
A	AA	Aa
a	Aa	aa

Question number	Answer	Mark
4(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • both parents must be heterozygous for the recessive allele (1) • so the offspring must inherit the recessive allele from each parent (1)	**(2)**

Question number	Answer	Mark
5(a)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • fatty acids are formed when the lipids are broken down by lipase (1) • and fatty acids are acidic (so the pH decreases) (1)	**(2)**

Question number	Answer	Mark
5(a)(ii)	An answer that combines up to a maximum of **two** points to provide a logical description: • as the temperature increases from 20 °C to 37 °C the rate of lipase activity increases (from 0.2 to 0.8) (1) • the rate of lipase activity is optimal at 37 °C (1) • above 37°C the rate of lipase activity decreases (from 0.8 to 0.1) (1)	**(2)**

Question number	Answer	Mark
5(a)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • an increase in temperature above 40 °C causes changes in the shape of the active site of the enzyme (1) • therefore the enzyme becomes denatured and no longer functions (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	• mean= 588/5 = 117.6 (1) • rate = 1 ÷ 117.6 (1) • 0.0085 (1)	award full marks for correct numerical answer without working accept $1000/t$ accept $10/t$	**(3)**

Question number	Answer	Mark
5(b)(ii)	Any one variable from: • concentration of the enzyme • volume of enzyme solution • volume of starch solution • pH of the solutions	**(1)**

Question number	Answer Additional guidance	Mark
5(c)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • the active site of an enzyme has a specific shape because of the order of the amino acids (1) • the substrate must have a shape which is complementary to the active site (1)	**(2)**

Question number	Answer	Mark
6(a)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • penicillin prevents the bacteria from dividing as they cannot make a new cell wall (1) • because humans cells do not have a cell wall (1) • they are unaffected by penicillin (1)	**(3)**

Question number	Answer	Mark
6(b)	An answer that combines knowledge (2 marks) and understanding (2 marks) to provide a logical description: • use restriction enzymes to remove the gene and cut the plasmid (1) • use of ligase to join DNA molecules together (1) • cut the gene from the genome of the fungus and extract a plasmid from the bacteria (1) • insert the recombinant plasmid back into the bacteria (1)	**(4)**

Question number	Indicative content	Mark
***6(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • bacteria reproduce rapidly generating a large population • there is variation among a bacterial population • some bacteria develop a resistance to antibiotics through mutation • antibiotic treatment exerts a selection pressure • bacteria resistant to antibiotics survive • antibiotic resistance inherited • non-resistant bacteria do not survive • levels of antibiotic resistance in a population of bacteria increase	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure that is clear, coherent and logical. (AO1)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Combined Science

Paper 2: Biology 2

Higher Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 10 minutes

Paper Reference
1SC0/2BH

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 5 6 A 0 1 2 0

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows a diagram of the heart.

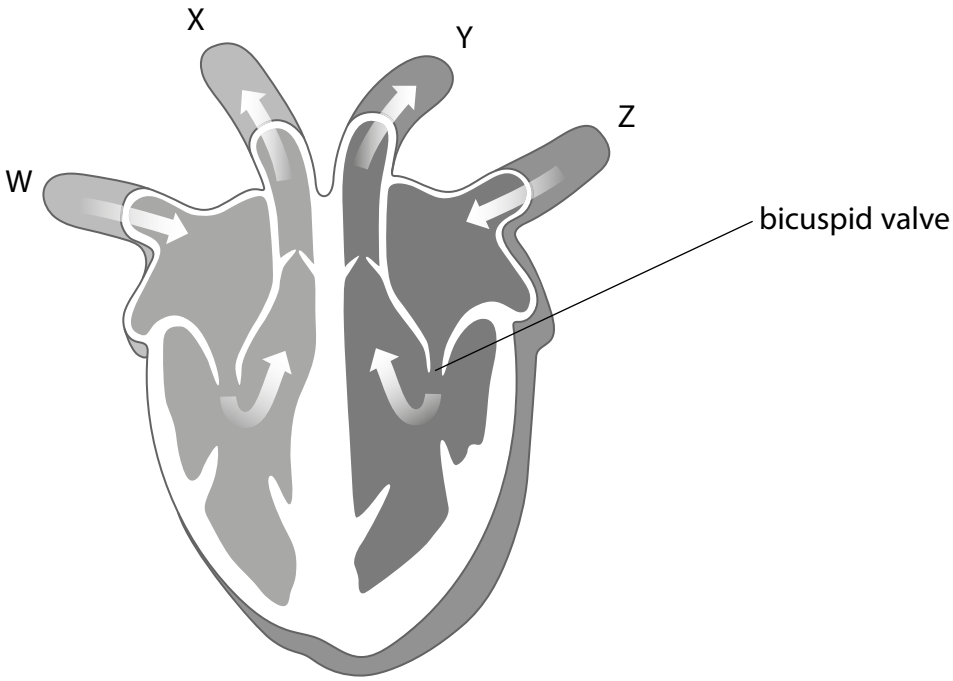

Figure 1

(a) (i) Vessel X takes

(1)

- ☒ **A** deoxygenated blood to the body
- ☒ **B** deoxygenated blood to the lungs
- ☒ **C** oxygenated blood to the body
- ☒ **D** oxygenated blood to the lungs

(ii) Give one reason why the wall of the left ventricle is thicker than the right.

(1)

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Valves in the human heart may become damaged and no longer function.

(iii) Describe what would happen to the flow of blood in the left side of the heart if the bicuspid valve did not function effectively.

(2)

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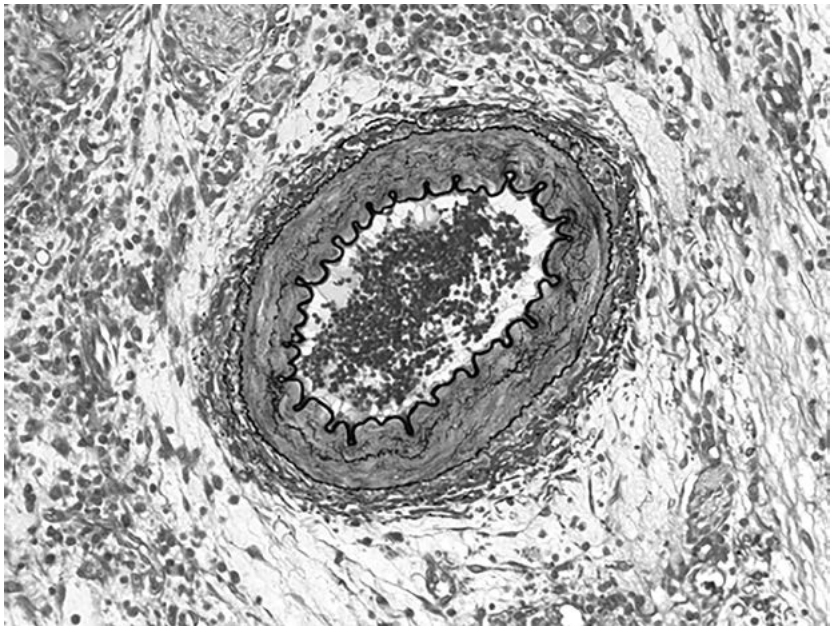
Figure 2 shows a photomicrograph of a blood vessel.



(Source: Microscape/Science Photo Library)

Figure 2

(b) Explain how the structure of this blood vessel is related to its function.

(2)

Figure 3 shows a diagram of the circulatory system of a fish.

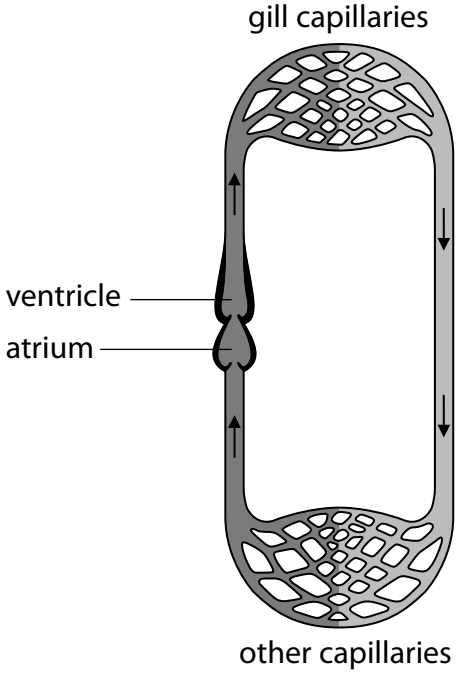


Figure 3

(c) Compare the differences between the structure of the circulatory system of a fish and the human circulatory system.

(4)

(Total for Question 1 = 10 marks)

2 Blood tests can be used to check a person's blood glucose and hormone levels.

Figure 4 shows the results of two blood tests carried out on three people to check their blood glucose levels. Person 1 is healthy.

	blood glucose level (mmols/l)	
	after fasting for 12 hours	**two hours after drinking 75 g glucose**
person 1	5.4	6.4
person 2	5.6	9.0
person 3	7.8	12.1

Figure 4

(a) (i) Compare the glucose levels of person 1 with the glucose levels of person 2 after fasting for 12 hours.

(1)

.....

.....

(ii) Compare the glucose levels of person 3 with the glucose levels of person 1, two hours after drinking 75 g glucose.

(1)

.....

.....

Person 3 cannot produce the hormone that controls blood glucose levels.

(iii) State the hormone that person 3 cannot produce.

(1)

.....

.....

(b) Figure 5 shows the level of progesterone for a female during five different stages of the menstrual cycle.

days in the menstrual cycle	progesterone level (nmol/l)
1–9	1.85
10–14	1.48
15–17	14.28
18–23	35.27
24–28	17.11

Figure 5

(i) Describe the changes in progesterone levels during the 28-day cycle.

(2)

(ii) Explain why progesterone levels changed following day 14.

(2)

(iii) Use Figure 5 to explain if the female is pregnant.

(2)

(Total for Question 2 = 9 marks)

3 A scientist investigated the effect of light intensity on the rate of photosynthesis of the aquatic *Cabomba* plant.

A lamp was used as a source of light. The lamp was placed at different distances (*d*) from the *Cabomba* plant, and the number of bubbles produced in 60 seconds was counted.

The number of bubbles produced in 60 seconds was used to calculate the rate of photosynthesis.

The light intensity was then calculated using the inverse square law $\left(\frac{1}{d^2}\right)$.

Figure 6 shows the scientist's results.

distance (*d*) of lamp from *Cabomba* (cm)	light intensity (arbitrary units)	bubbles produced in 60 seconds
5	0.0400	79
10	0.0100	21
15	0.0044	12
20	0.0025	7
25		5
30	0.0011	4

Figure 6

(a) (i) Calculate the light intensity when the lamp is 25 cm from the *Cabomba* plant.

(2)

light intensity = ... arbitrary units

(ii) Use information from Figure 6 to describe the effect of light intensity on the rate of photosynthesis.

(2)

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(iii) Give another method of measuring light intensity rather than calculating it.

(1)

(iv) The scientist counted the number of bubbles produced by the *Cabomba* plant.

Another scientist stated that this was not the best method of measuring the volume of gas produced.

Explain how you could improve the method to measure the volume of gas released more accurately.

(2)

(b) Explain what would happen to the levels of gas produced if the light intensity decreased to 0.0001 arbitrary units.

(2)

(Total for Question 3 = 9 marks)

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4 Figure 7 shows the equipment used for measuring respiration in peas.

A B C

(Source: Martin Shields/Science Photo Library)

Figure 7

- Respirometer A contains germinating peas.
- Respirometer B contains peas that are not germinating.
- Respirometer C contains glass beads.

All three respirometers are placed in a water bath at 25 °C for 30 minutes.
The reduction in oxygen levels in each respirometer is measured using a data logger.

(a) Explain why the respirometers are placed in a water bath at 25 °C.

(2)

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.....

(b) A student recorded the change in oxygen levels in the germinating peas over a 30-minute period.

The results are shown below.

A 10 mins (–0.8) ml, 20 mins (–1.6) ml, 30 mins (–2.4) ml

B 10 mins (–0.1) ml, 20 mins (–0.1) ml, 30 mins (–0.1) ml

C No change

(i) Complete the table for these results.

(2)

(ii) Calculate the rate of oxygen consumption per second for the results in respirometer A.

(2)

..... ml/second

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(iii) Explain why respirometer A has the highest rate of oxygen consumption.

(2)

.....

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.....

(c) Some respirometers read the movement of a bubble along capillary tubing.

Carbon dioxide can affect the measuring of oxygen used in this type of respirometer.

State a chemical that could be placed in the respirometer that would stop carbon dioxide affecting the experiment.

(1)

.....

.....

(Total for Question 4 = 9 marks)

5 A diabetic athlete is advised to estimate the number of grams of carbohydrate in his meals in order to calculate the number of units of insulin he will need to inject to lower his blood glucose concentration.

Each unit of insulin he injects reduces his blood glucose concentration by 1.5 mmol dm^{-3}.

He needs to inject 1 unit for every 10 grams of carbohydrate he consumes.

Figure 8 shows the estimated carbohydrates in the breakfast eaten by the athlete.

food consumed	estimated carbohydrate /grams
orange juice	25
2 slices brown toast	68
350 grams baked beans	38
tea with sugar	25

Figure 8

(a) (i) Calculate how many units of insulin the athlete would need to inject to control the rise in blood glucose levels.

Give your answer to two significant figures.

(2)

..... units of insulin

(ii) The athlete miscalculated his carbohydrate intake to be greater than his actual intake.

Explain how the increase in the number of units injected would affect his blood glucose concentrations.

(2)

.....

.....

.....

.....

(b) (i) A patient visits his doctor because he is putting on weight but does not think he is increasing his calorie intake.

The patient has a height of 1.9 m and a body mass of 120 kg.

What is his BMI?

(1)

- ☒ **A** 0.0083
- ☒ **B** 33.2
- ☒ **C** 0.016
- ☒ **D** 66.4

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The doctor diagnosed this person with an underactive thyroid gland.

*(ii) Explain why an underactive thyroid could cause this patient to have an increased body mass.

(6)

(Total for Question 5 = 11 marks)

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6 Tropical fish excrete ammonia, which is an alkali.

The pH level of water in a tropical fish tank needs to be maintained between 6.6 and 7.4 for the fish to survive.

This is the optimum pH range for the bacteria that are responsible for the conversion of ammonia into nitrites and then nitrates.

Nitrosomonas bacteria convert ammonia into nitrites.

Nitrobacter bacteria convert nitrites into nitrates.

(a) (i) *Nitrosomonas* bacteria are an example of

(1)

- ☒ **A** nitrogen fixing bacteria
- ☒ **B** nitrifying bacteria
- ☒ **C** denitrifying bacteria
- ☒ **D** *Helicobacter* bacteria

(ii) Explain why *Nitrosomonas* and *Nitrobacter* bacteria are needed in tropical fish tanks.

(2)

An aquatic plant in the fish tank had a concentration of nitrates higher than the water in the fish tank.

(iii) Explain how this aquatic plant can uptake nitrates from the water in the fish tank.

(2)

Leguminous plants have nodules on their roots that have colonies of nitrogen-fixing bacteria.

Clover is a leguminous plant.

(b) Describe how a quadrat could be used to sample the population of clover in a 500 m^2 field.

(3)

The nitrogen-fixing bacteria provide nitrates for the plants and release any excess into the soil.

(c) Explain how leguminous plants such as clover could be used to reduce the amount of artificial fertilisers.

(4)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Paper 2 B2H Higher

Question number	Answer	Mark
1(a)(i)	B	(1)

Question number	Answer	Mark
1(a)(ii)	To pump blood around the body under higher pressure	(1)

Question number	Answer	Mark
1(a)(iii)	An answer that combines the following points of understanding to provide a logical description: • blood would flow backwards from ventricle to atria/blood will leak through (1) • less (oxygenated) blood would be pumped to the body (1)	(2)

Question number	Answer	Mark
1(b)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the blood vessel has thick walls/small lumen (1) • to carry oxygenated blood/to carry blood under higher pressure (1)	(2)

Question number	Answer	Mark
1(c)	• the fish heart has two chambers rather than four chambers (1) • the fish heart only has one ventricle and one atria rather than two ventricles and two atria (1) • only deoxygenated blood flows through the fish heart (1) • the fish heart shows a single circulatory system rather than a double circulatory system (1)	(4)

Question number	Answer	Mark
2(a)(i)	• person 2 had a slightly higher blood glucose level than person 1 after fasting (by up to 0.2 mmols/l) (1)	(1)

Question number	Answer	Mark
2(a)(ii)	• person 3 had a much higher blood glucose level than person 1 two hours after taking glucose (by up to 5.6 mmols/l) (1)	(1)

Question number	Answer	Mark
2(a)(iii)	Insulin	(1)

Question number	Answer	Mark
2(b)(i)	An answer that combines points of interpretation/evaluation to provide a logical description: • levels remain low up until day 14 then rise (1) • they continue to rise to day 23 and drop at day 24 (1)	(2)

Question number	Answer	Mark
2(b)(ii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • as ovulation occurs (1) • the levels of progesterone released from the corpus luteum increases to maintain the lining of the uterus (1)	(2)

Question number	Answer	Mark
2(b) (iii)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • progesterone levels fall after day 23 to 17.11 (1) • so uterus wall thickness is not maintained and therefore pregnancy has not occurred (1)	(2)

Question number	Answer	Additional guidance	Mark
3(a)(i)	25 × 25 = 625 (1) 1 ÷ 625 = 0.0016 (1)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
3(a)(ii)	An answer that combines points of interpretation/evaluation to provide a logical description: • as light intensity decreases the rate of photosynthesis also decreases (1) • after 20 cm away when light intensity appears to have little effect on the rate of photosynthesis (1)	**(2)**

Question number	Answer	Mark
3(a)(iii)	Use a light meter/lux meter	**(1)**

Question number	Answer	Additional guidance	Mark
3(a)(iv)	An explanation that combines identification – improvement of the experimental procedure (1 mark) and justification/reasoning which must be linked to the improvement (1 mark): • collect the gas/oxygen produced in a graduated gas syringe (1) • to reduce the errors generated when counting bubbles maybe of different sizes (1)	accept alternative gas collection method with measuring cylinder and beehive shelf accept leave the apparatus for a longer amount of time	**(2)**

Question number	Answer	Mark
3(b)	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark): • the volume of gas produced would decrease to below four bubbles (1) • because light is needed for photosynthesis (1)	**(2)**

Question number	Answer	Mark
4(a)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • same temperature to act as control (1) • to provide the optimum temperature for enzyme action in the peas (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	• Headed table with units (1) • Accurately completed table (1) A | B | C O_2 used /ml at 10 mins: 0.8 | 0.1 | 0.0 O_2 used /ml at 20 mins: 1.6 | 0.1 | 0.0 O_2 used /ml at 30 mins: 2.4 | 0.1 | 0.0	negative values do not need to be shown if table heading states oxygen used/lost accept time in row 1 as an alternative	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	2.4 ÷ (30 × 60) (1) = 0.0013 (ml/second) (1)	accept 1.6 ÷ (20 × 60) accept 0.8 ÷ (10 × 60) award full marks for correct numerical answer without working maximum one mark if no unit conversion	**(2)**

Question number	Answer	Mark
4(b)(iii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • the peas in respirometer A are germinating so using up oxygen (1) • during the process of respiration to release energy for growth (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(c)	Any one improvement from: • soda lime (1) • cotton wool soaked with potassium hydroxide (1)	accept other relevant chemical that would remove carbon dioxide	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	• 156 ÷ 10 (1) • 16 units (1) Answer to two significant figures	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Mark
5(a)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • an increase in the units of insulin injected would cause more blood glucose to be converted to glycogen and stored in the liver/muscles (1) • leading to blood glucose levels becoming critically low/person would become hypoglycemic (1)	**(2)**

Question number	Answer	Mark
5(b)(i)	B	**(1)**

Question Number	Indicative content	Mark
***5(b)(ii)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • The thyroid gland produces thyroxine • Thyroxine helps to regulate metabolic rate • Low levels of thyroxine should stimulate the production of TRH • TSH being produced and more thyroxine being released • An underactive thyroid would cause less thyroxine to be produced • Metabolic rate to drops • Less energy (calories) are needed for tasks • More fat storage so the person gains body mass	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well–developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Mark
6(a)(i)	B	**(1)**

Question number	Answer		Mark
6(a)(ii)	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • fish produce ammonia as a waste product which the bacteria convert (into nitrites then nitrates) (1) • this prevents the pH from getting too high and prevents the fish from dying (1)	accept pH above 7.4	**(2)**

Question number	Answer	Mark
6(a)(iii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the aquatic plant will take up nitrates by active transport (1) • against the concentration gradient/from where there is a low concentration to where there is a high concentration of nitrates (1)	**(2)**

Question number	Answer	Additional guidance	Marks
6(b)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • a description of the use of a quadrat either by random sampling or using a belt transect (1) • a sample size 10–100 and count the number of clover plants in each quadrat (1) • multiplication factor dependent on the number of quadrats sampled (1)	to gain maximum marks steps must be in a logical sequence	**(3)**

Question number	Answer	Mark
6(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • clover/leguminous plants could be used in crop rotation (1) • where at intervals (2–3 years) a field is planted with clover/leguminous plants and left fallow (1) • the clover/leguminous plants will have colonies of nitrogen fixing bacteria which will produce nitrates (1) • the nitrates will increase the fertility of the soil and negate the need for atrificial fertilisers (1)	**(4)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number	Candidate Number

Combined Science

Paper 3: Chemistry 1

Higher Tier

Sample Assessment Materials for first teaching September 2016	Paper Reference
Time: 1 hour 10 minutes	**1SC0/1CH**

You must have:	Total Marks
Calculator, ruler	

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 5 8 A 0 1 1 6

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Mixtures of coloured substances can be separated by paper chromatography.

(a) Paper chromatography was used to separate a mixture of blue and red inks.
A spot of the mixture was placed on chromatography paper as shown in Figure 1.

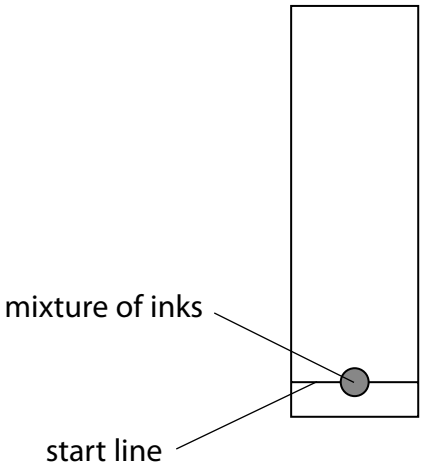

Figure 1

(i) Give a reason why the start line is drawn in pencil rather than in ink.

(1)

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(ii) The chromatography paper, with the spot of mixture on it, was placed in a beaker with the bottom of the paper in water.

On Figure 2, complete the diagram showing the position of the chromatography paper with the spot of mixture at the start of the experiment.

(1)

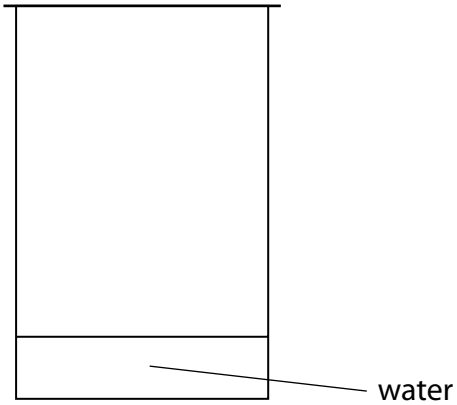

Figure 2

(iii) The chromatography was carried out and the result is shown in Figure 3.

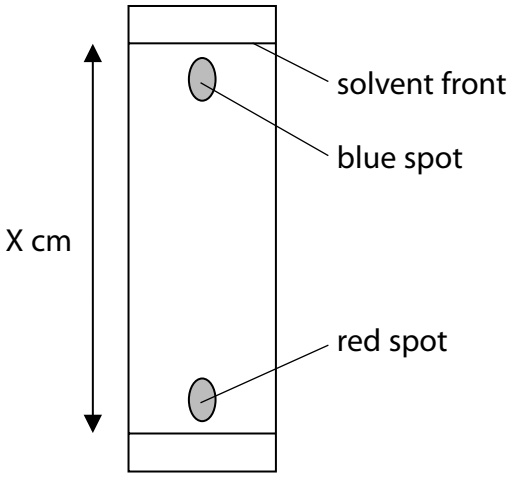

Figure 3

The blue spot had moved 14.5 cm and the solvent front had moved 15.3 cm

Calculate the R_f value of the substance in the blue spot, giving your answer to 2 significant figures.

$$R_f \text{ value} = \frac{\text{distance travelled by a dye}}{\text{distance travelled by solvent front}}$$

(2)

R_f value = ...

(b) **P**, **Q**, **R** and **S** are mixtures of food colourings.

They are investigated using paper chromatography.

Figure 4 shows the chromatogram at the end of the experiment.

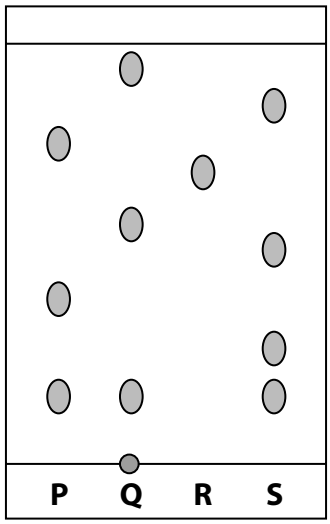

Figure 4

(i) Which mixture contains an insoluble food colouring?

(1)

- ☒ **A** mixture **P**
- ☒ **B** mixture **Q**
- ☒ **C** mixture **R**
- ☒ **D** mixture **S**

(ii) Give a change that could be made to the experiment to obtain an R_f value for the insoluble colouring.

(1)

.....

.....

(iii) Explain, by referring to Figure 4, which mixture is separated into the greatest number of soluble food colourings by this chromatography experiment.

(2)

.....

.....

.....

.....

(Total for Question 1 = 8 marks)

2 Ionic compounds contain ions.

(a) The numbers of electrons, neutrons and protons in four particles, **W**, **X**, **Y** and **Z**, are shown in Figure 5.

particle	electrons	neutrons	protons
W	9	10	9
X	10	14	12
Y	16	16	16
Z	18	18	16

Figure 5

Explain which particle, **W**, **X**, **Y** or **Z**, is a negative ion.

(2)

.....

.....

.....

.....

(b) Calcium nitrate contains calcium ions and nitrate ions.

Calculate the relative formula mass of calcium nitrate, $Ca(NO_3)_2$.
(relative atomic masses: Ca = 40, N = 14, O = 16)

(2)

relative formula mass = ...

(c) The electronic configurations of a lithium atom and of a fluorine atom are shown in Figure 6.

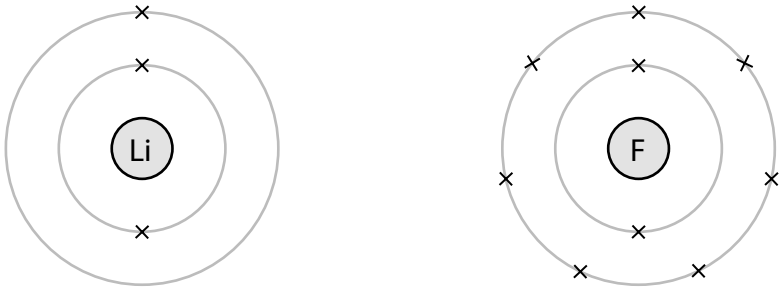

Figure 6

Lithium fluoride, LiF, is an ionic compound.

It contains lithium cations and fluoride anions.

Complete Figure 7 to show the electronic configurations and charges of the ions in lithium fluoride.

(4)

charge on ion ..... charge on ion .....

Figure 7

(Total for Question 2 = 8 marks)

3 A student carried out an experiment to see how reactive different metals are when they are placed in dilute hydrochloric acid.

A sample of each metal was placed in a separate test tube of acid.

(a) When zinc reacts with dilute hydrochloric acid, a gas is given off and zinc chloride is formed.

(i) Which gas is given off?

(1)

☐ **A** carbon dioxide

☐ **B** chlorine

☐ **C** hydrogen

☐ **D** oxygen

(ii) What is the formula of zinc chloride?

(1)

☐ **A** ZnCl

☐ **B** Zn_2Cl

☐ **C** $ZnCl_2$

☐ **D** Zn_2Cl_2

(b) In the experiment, the student used the same amount of each metal in a finely powdered form.

State **two** factors, concerning the hydrochloric acid, which should also be controlled to produce valid results.

(2)

1 .....

.....

2 .....

.....

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(c) Part of the reactivity series is shown in Figure 8.

most reactive	magnesium
	aluminium
	iron
least reactive	silver

Figure 8

Iron is extracted from its ore by heating with carbon.
Aluminium is extracted from its ore using a different method.

(i) Give the name of the method used to extract aluminium.

(1)

.....

(ii) Explain why aluminium is extracted by a different method rather than heating the ore with carbon.

(2)

.....

.....

.....

.....

(d) The extraction of iron involves the reduction of iron oxide, Fe_2O_3, by carbon monoxide, CO. During this reaction, the iron oxide is reduced to iron, Fe, and the carbon monoxide is oxidised to carbon dioxide.

Write the balanced equation for the reaction.

(2)

.....

(Total for Question 3 = 9 marks)

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4 Electrodes are placed in three different solutions, **J**, **K** and **L**.

A 6 V direct current source is connected to the electrodes.

Any products formed at the electrodes are identified.

The results are given in Figure 9.

solution	solution conducts electricity	product at cathode	product at anode
J	yes	copper	chlorine
K	yes	hydrogen	oxygen
L	no	none	none

Figure 9

(a) Explain which solutions are electrolytes.

(2)

.....

.....

.....

.....

(b) Which material is most suitable to make the electrodes for the electrolysis of a dilute acid?

(1)

☒ **A** zinc

☒ **B** sulfur

☒ **C** iron

☒ **D** graphite

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(c) When a solution of sodium sulfate, Na_2SO_4, is electrolysed, the products formed at the electrodes are hydrogen and oxygen.

Explain the formation of the products at the electrodes.

(4)

(d) Copper is purified by the electrolysis of copper sulfate solution using an impure copper anode and a pure copper cathode.

Write the half-equation for the formation of a copper atom from a copper ion.

(2)

(Total for Question 4 = 9 marks)

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5 Figure 10 shows a model of how particles are arranged in a solid.

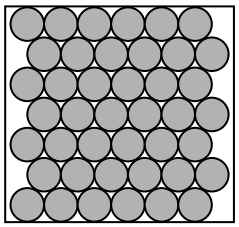

Figure 10

(a) (i) State **two** ways in which this model fails to accurately represent a crystal of sodium chloride.

(2)

1 .....

.....

2 .....

.....

(ii) Magnesium oxide has a melting point of 2852 °C.

Explain why magnesium oxide has such a high melting point.

(3)

.....

.....

.....

.....

.....

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(b) (i) Carbon dioxide can be formed by the reaction of calcium carbonate, $CaCO_3$, with dilute hydrochloric acid.

Write the balanced equation for this reaction.

(3)

.....

(ii) The thermal decomposition of copper carbonate forms copper oxide and carbon dioxide.

$$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$$

15.0 g of pure copper carbonate is decomposed completely.

Calculate the mass of solid produced.

(relative atomic masses: C = 12.0; O = 16.0; Cu = 63.5)

Give your answer to two significant figures.

(2)

mass of solid = ... g

(c) Magnesium reacts with water in the form of steam as shown in the equation.

$$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$$

2.4 g of magnesium reacts with sufficient steam for a complete reaction to form 5.8 g of magnesium hydroxide and 0.2 g of hydrogen.

Show, by calculation, that the law of conservation of mass applies to this reaction.

(relative atomic masses: H = 1.0, O = 16, Mg = 24)

(3)

(Total for Question 5 = 13 marks)

6 Some acids such as hydrochloric acid are described as strong acids.
Some acids such as ethanoic acid are described as weak acids.

(a) (i) Explain the difference between a strong acid and a weak acid.

(2)

.....

.....

.....

.....

(ii) Give a reason why adding hydroxide ions to an acid solution leads to an increase in pH.

(1)

.....

.....

(b) The salt zinc nitrate can be made by reacting zinc oxide, ZnO, with dilute nitric acid, HNO_3.

Write the balanced equation for this reaction.

(2)

.....

(c) 50 cm^3 of potassium hydroxide solution of concentration 40 g dm^{-3} is needed for an experiment.

Calculate the mass of potassium hydroxide that must be dissolved in water to make 50 cm^3 of solution of this concentration.

(2)

mass of potassium hydroxide = ... g

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*(d) Salts of metals can be made by reacting one of the metal's compounds with the appropriate acid.

Plan an experiment to prepare pure, dry crystals of magnesium sulfate, $MgSO_4$, by reacting a suitable magnesium compound with a suitable acid.

You may use equations if you wish.

(6)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

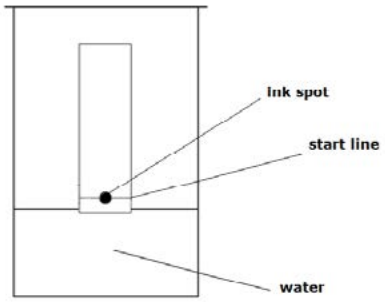
relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Paper 3 C1H Mark scheme

Question number	Answer	Mark
1(a)(i)	Pencil is insoluble in the solvent (but chromatography would separate the ink in an ink line).	(1)

Question number	Answer	Mark
1(a)(ii)	Correct position of chromatography paper with start line and ink spot above surface of water.  	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iii)	• Rf = 14.5 / 15.3 = 0.9477 (1) • = 0.95 answer to 2 significant figures (1)	Award full marks for correct numerical answer without working.	(2)

Question number	Answer	Mark
1(b)(i)	B	(1)

Question number	Answer	Mark
1(b)(ii)	use a different solvent.	(1)

Question number	Answer	Mark
1(b)(iii)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • mixture S (1) • because it gives the greatest number of spots/gives four spots (1)	(2)

Question number	Answer	Additional guidance	Mark
2(a)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • a negative ion must have more electrons than protons in the particle (1) • therefore Z will have a 2– charge (1)	Do not allow any comparison involving neutrons.	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)	40 + 2 × (14 + 16 × 3) (1) = 164 (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
2(c)	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	**(4)**

Question number	Answer	Mark
3(a)(i)	C	**(1)**

Question number	Answer	Mark
3(a)(ii)	C	**(1)**

Question number	Answer	Mark
3(b)	Any two of the following points. For the acid, use the same: • volume (1) • concentration (1) • temperature (1)	**(2)**

Question number	Answer	Mark
3(c)(i)	electrolysis (1)	**(1)**

Question number	Answer	Mark
3(c)(ii)	An answer that combines identification- knowledge (1 mark) and understanding (1 mark) and reasoning/justification-understanding (1 mark). • aluminium compounds are more stable than iron compounds (1) • so carbon is not a strong enough reducing agent to produce aluminium from its ore (1)	**(2)**

Question number	Answer	Mark
3(d)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ • Correct formulae (1) • Balancing of correct formulae (1)	**(2)**

Question number	Answer	Mark
4(a)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • **J** and **K** are electrolytes (1) • because their solutions conduct electricity and are decomposed (1)	**(2)**

Question number	Answer	Mark
4(b)	D	**(1)**

Question number	Answer	Mark
4(c)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • hydrogen (H^+) and sodium (Na^+) ions attracted to cathode, hydroxide (OH^-) ions and sulfate (SO_4^{2-}) ions attracted to anode (1) • because the ions are attracted to the oppositely charged electrode (1) • 2 hydrogen ions/2 H^+ accept 2 e^- to form hydrogen molecule/H_2 (1) • 4 hydroxide ions/4 OH^- lose 4 e to form oxygen molecule/O_2 (1)	**(4)**

Question number	Answer	Mark
4(d)	$Cu^{2+} + 2e \rightarrow Cu$ • all species (1) • balancing (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)(i)	• Particles are same size when they should be different sizes (1) • Model is in 2D but crystal is 3D (1)	Allow reverse statements giving correct information.	**(2)**

Question number	Answer	Mark
5(a)(ii)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (2 marks): • very strong bonds/ionically bonded (1) • between 2+ cations and 2– anions (1) • so requires lot of energy to separate magnesium and oxide ions to melt the solid (1)	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ • all formulae on correct side (2) • balancing (1)	Allow 3/4 formulae (1)	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	relative formula mass copper carbonate = 63.5 +12.0 +(3 × 16.0) = 123.5 relative formula mass copper oxide = 63.5 + 16.0 = 79.5 (1) mass copper oxide $= \frac{15.0 \times 79.5}{123.5}$ = 9.7 g to 2 s.f. (1) Answer must be to two significant figures OR moles of copper carbonate $= \frac{15.0}{123.5} = 0.121\,45$ (1) mass of copper oxide = moles $CuCO_3$ × 79.5 = 9.7 g to 2sf (1) Answer must be to two significant figures	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)	2.4/24 moles Mg = 0.1 mol (1) and 0.2 moles H_2O has mass 0.2 × formula mass H_2O = 3.6 g (1) total mass reactants = 2.4 + 3.6 = 6.0 g is the same as total mass products = 5.8 + 0.2 = 6.0 g (1)	Award full marks for correct numerical answer without working.	**(3)**

Question number	Answer	Mark
6(a)(i)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • a strong acid is completely ionised in solution/exists completely as ions (1) • but a weak acid is only partly ionised/exists mainly as molecules with very few ions present (1)	**(2)**

Question number	Answer	Mark
6(a)(ii)	hydroxide ions react with hydrogen ions and reduce the hydrogen ion concentration therefore increase pH (1)	**(1)**

Question number	Answer	Mark
6(b)	$ZnO + 2HNO_3 \rightarrow Zn(NO_3)_2 + 2H_2O$ • zinc nitrate formula (1) • full, balanced equation (1)	**(2)**

Question number	Answer	Additional guidance	Mark
6(c)	mass = $50 \times \frac{40}{1000}$ (1) = 2 (g) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question Number	Indicative content
6(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (3 marks)** • suitable acid: sulfuric acid • suitable substance : magnesium oxide / magnesium carbonate / magnesium hydroxide / magnesium • equation for reaction: $MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O$/ $Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$/ $MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$/ $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$ **AO3 (3 marks)** • add solid to warmed acid until in excess solid remains (oxide and hydroxide) / add solid a little at a time until no more bubbles (carbonate/metal) • filter off the excess solid, pour remaining solution into an evaporating basin • {heat solution / leave the water to evaporate} • until pure salt crystals form and then dry salt crystals with absorbent paper/leave to dry.

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) • Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) • Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number	Candidate Number

Combined Science

Paper 4: Chemistry 2

Higher Tier

Sample Assessment Material for first teaching September 2016	Paper Reference
Time: 1 hour 10 minutes	**1SC0/2CH**

You must have:	Total Marks
Calculator, ruler	

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1/1/1/2/1/

S 5 0 0 6 0 A 0 1 2 0

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 This question is about changes to the Earth's atmosphere.

(a) Which of the following is a correct statement about the relative amounts of carbon dioxide and oxygen in the Earth's early atmosphere?

(1)

☒ **A** large amount of carbon dioxide and large amount of oxygen

☒ **B** large amount of carbon dioxide and small amount of oxygen

☒ **C** small amount of carbon dioxide and large amount of oxygen

☒ **D** small amount of carbon dioxide and small amount of oxygen

(b) Several processes change the composition of the Earth's atmosphere.

Describe how the composition of the atmosphere is affected by burning fossil fuels.

(2)

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(c) The graphs in Figure 1 and Figure 2 show the concentration of carbon dioxide in the atmosphere and the mean global temperature, between 1960 and 2000.

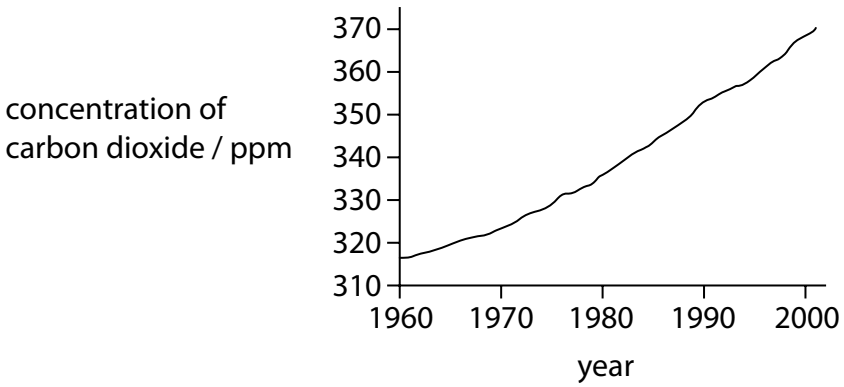

Figure 1

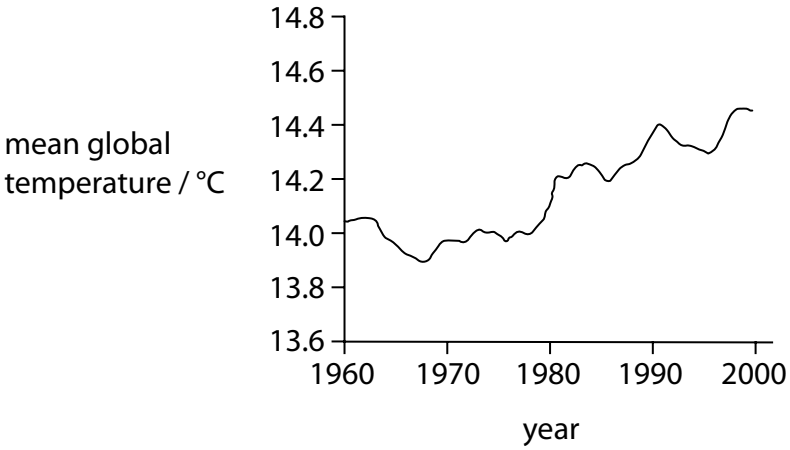

Figure 2

Explain whether these graphs provide evidence that an increase in carbon dioxide is causing the Earth's temperature to rise.

(2)

.....

.....

.....

.....

(d) Which of these pairs of gases are both greenhouse gases?

(1)

☒ **A** nitrogen and methane

☒ **B** nitrogen and oxygen

☒ **C** oxygen and water vapour

☒ **D** water vapour and methane

(Total for Question 1 = 6 marks)

2 Magnesium and calcium are in group 2 of the periodic table.
They are less reactive than the metals in group 1.

(a) Calcium reacts with water to form calcium hydroxide, $Ca(OH)_2$, and hydrogen, H_2.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$$

Describe what would be **seen** when a piece of calcium is dropped into a container of water.

(2)

(b) Magnesium reacts very slowly with cold water but it reacts faster with steam, H_2O, and forms magnesium oxide, MgO, and hydrogen.

Write the balanced equation for the reaction between magnesium and steam.

(2)

(c) The electronic configurations of magnesium and calcium are

magnesium	2.8.2
calcium	2.8.8.2

When magnesium and calcium react with water they form positive ions.

Suggest an explanation, in terms of their electronic configurations, why calcium is more reactive than magnesium.

(2)

(d) A sample of calcium bromide contains 0.2 g calcium and 0.8 g bromine by mass.

Calculate the empirical formula of calcium bromide.
(relative atomic masses: Ca = 40, Br = 80)

(3)

empirical formula = ...

(Total for Question 2 = 9 marks)

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3 Crude oil is a mixture of hydrocarbons.

It can be separated into fractions.

(a) Which of these mixtures shows formulae of substances that could be in the gaseous fraction of crude oil?

(1)

☒ **A** C_2H_4, C_3H_8, $C_4H_{10}O$

☒ **B** C_2H_4, C_3H_7Br, C_4H_{10}

☒ **C** C_2H_6, C_3H_8, C_4H_{10}

☒ **D** C_2H_6, C_3H_7Br, $C_4H_{10}O$

(b) Figure 3 shows the percentages of the fractions in crude oil from three different oil wells.

	percentage of fraction in crude oil from		
fraction	**oil well A**	**oil well B**	**oil well C**
gases	1	6	9
petrol	2	15	24
kerosene	6	14	20
diesel oil	7	10	16
fuel oil	26	28	30
bitumen	58	27	1

Figure 3

(i) State which oil well contains the greatest combined total of diesel oil and fuel oil.

(1)

.....

(ii) State which oil well produces a crude oil containing the highest percentage of high boiling point fractions.

(1)

.....

(c) Fractions of crude oil contain alkanes.

A sample of decane, $C_{10}H_{22}$, was cracked using the apparatus in Figure 4.
This produced a mixture of products, including ethene.

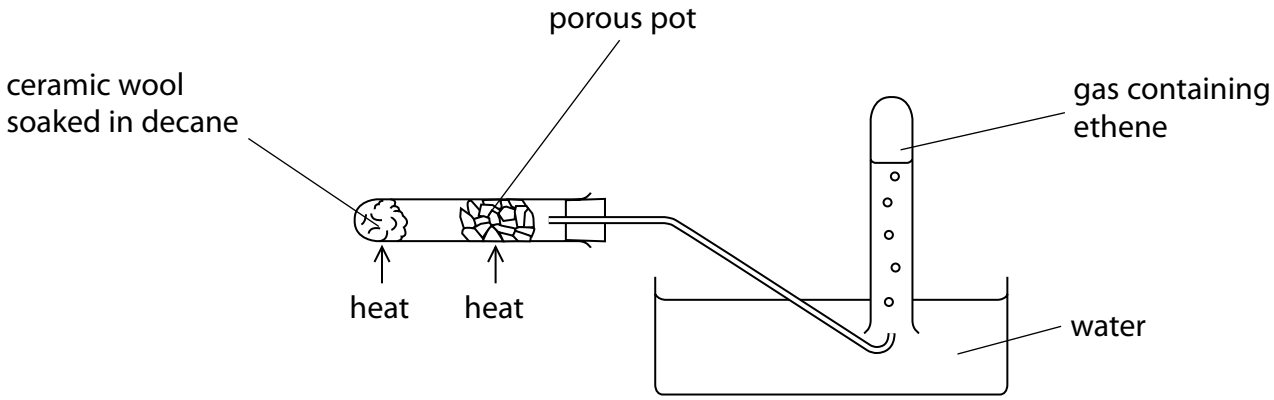

Figure 4

(i) Explain how ethene is produced using the apparatus in Figure 4.

(3)

(ii) One molecule of decane produced two molecules of propene, C_3H_6, and one molecule of product **Z**.

$$C_{10}H_{22} \rightarrow 2C_3H_6 + \text{product } \mathbf{Z}$$

What is the formula of product **Z**?

(1)

☐ **A** C_4H_8

☐ **B** C_4H_{10}

☐ **C** C_7H_{14}

☐ **D** C_7H_{16}

(iii) When decane undergoes complete combustion, a mixture of carbon dioxide and water is formed.

Complete the balanced equation for this reaction.

(2)

$$2C_{10}H_{22} + \ldots\ldots O_2 \rightarrow \ldots\ldots CO_2 + \ldots\ldots H_2O$$

(Total for Question 3 = 9 marks)

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4 A student investigated the rate of reaction between dilute hydrochloric acid and marble chips (calcium carbonate).

Calcium chloride, carbon dioxide and water are formed.

(a) Complete and balance the equation for the reaction.

(2)

$CaCO_3$ + HCl → ..... + ... + ...

(b) The student investigated the rate by using different sizes of marble chips. In their investigation, the same mass of marble chips was used in each experiment.

The volume of gas given off was measured.

The graph in Figure 5 shows the results.

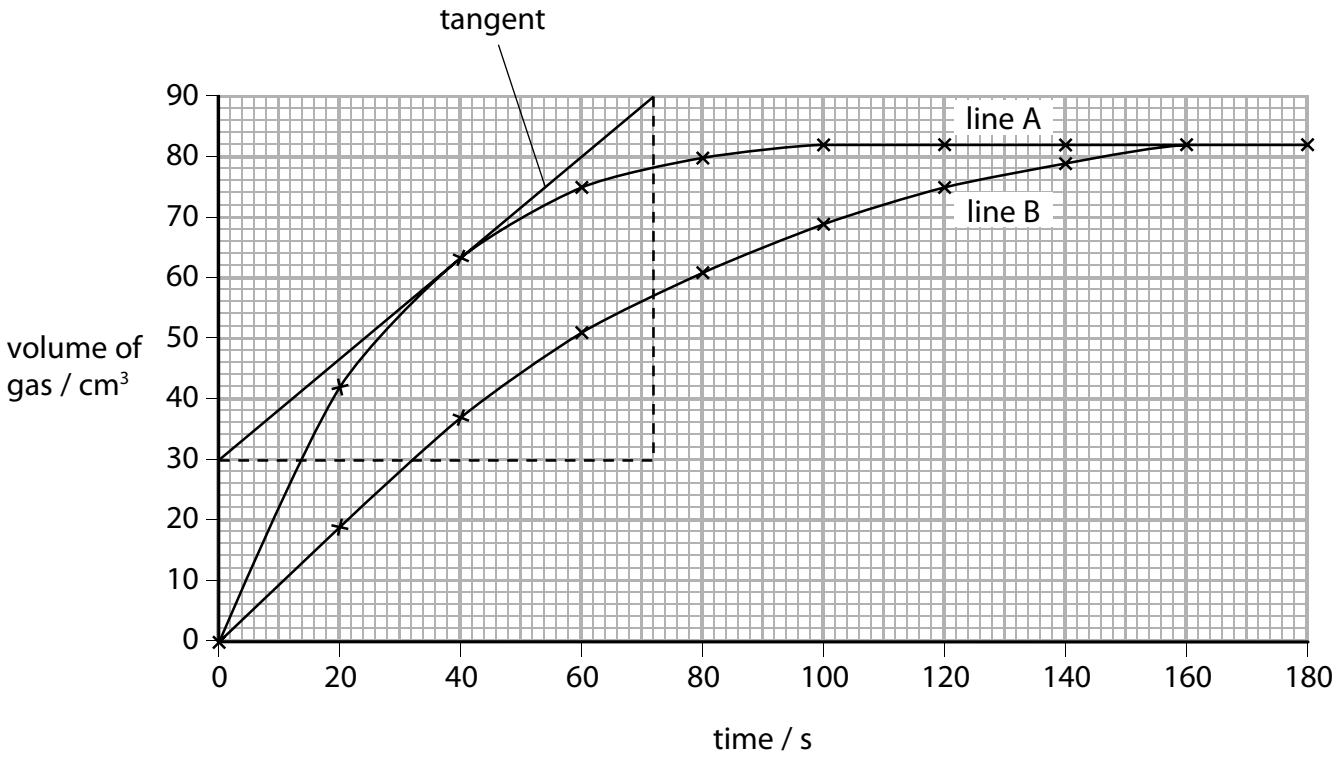

Figure 5

(i) State how the graph shows that line B gives the results for the larger marble chips.

(1)

.....

.....

(ii) A tangent has been drawn on line A.

Calculate the rate of reaction at this point.

(2)

rate of reaction = ... cm^3s^{-1}

(c) During any reaction, reactants are used up and the rate of reaction decreases.

Explain, in terms of particles, why the rate of reaction decreases.

(2)

.....

.....

.....

.....

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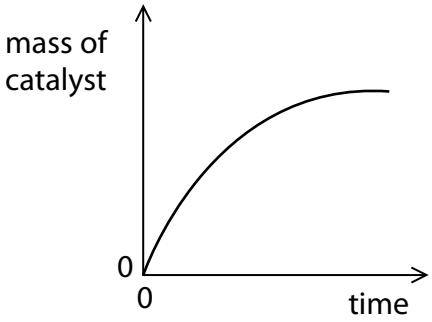
(d) The decomposition of hydrogen peroxide is catalysed by adding a small amount of manganese(IV) oxide.

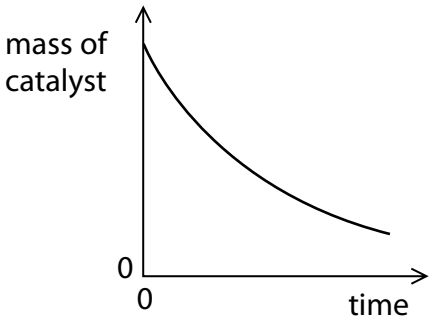
Which of these graphs shows the mass of the catalyst as the reaction takes place?

(1)

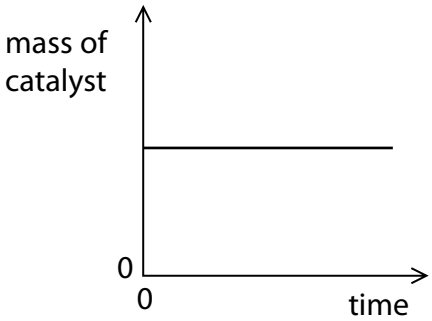
☒ **A**



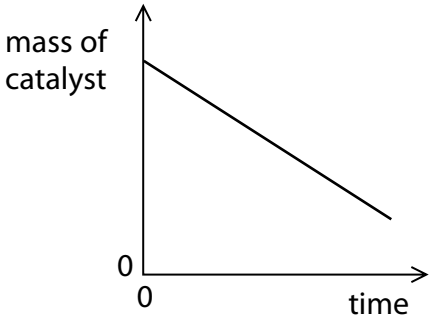
☒ **B**



☒ **C**



☒ **D**



(e) Two gases, **X** and **Y**, react to give a gaseous product **Z**.

The reaction is carried out under two different sets of conditions in experiments 1 and 2 as shown in Figure 6.

condition	experiment 1	experiment 2
temperature / °C	30	20
pressure / atm	1	2

Figure 6

Explain why it is not possible to predict what the rate of Experiment 2 will be compared with Experiment 1.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 4 = 11 marks)

5 The elements chlorine, bromine and iodine are part of group 7 in the periodic table.

(a) The appearances of chlorine, bromine and iodine at room temperature are shown in Figure 7.

halogen	appearance
chlorine	green gas
bromine	red-brown liquid
iodine	grey solid

Figure 7

Astatine is the element below iodine in group 7.

Predict the appearance of astatine.

(1)

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*(b) The order of reactivity of chlorine, bromine and iodine can be determined by carrying out displacement reactions.

Explain how displacement reactions can be used to show the reactivity of these three elements.

(6)

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(c) When iron wool is heated in bromine vapour, it reacts to form iron bromide.

(i) In an experiment, 5.60 g of iron reacted exactly with 24.0 g of bromine, Br_2.

[relative atomic masses: Fe = 56.0, Br = 80.0]

Determine, using this information, the balanced equation for the reaction between iron and bromine.
You must show your working.

(4)

(ii) When iron reacts with bromine, bromide ions are formed.

Explain the type of reaction bromine atoms undergo when they are converted to bromide ions.

(2)

(Total for Question 5 = 13 marks)

6 (a) Each of these substances forms ions in solution.

One mole of the following substances is dissolved in 1 dm^3 of water.

Which solution contains the greatest number of ions?

(1)

☒ **A** ammonium sulfate, $(NH_4)_2SO_4$

☒ **B** iron(III) chloride, $FeCl_3$

☒ **C** magnesium nitrate, $Mg(NO_3)_2$

☒ **D** potassium bromide, KBr

(b) When sodium hydroxide solution is neutralised with an acid there is a temperature change.

A student is given dilute hydrochloric acid and dilute ethanoic acid of the same concentration in mol dm^{-3}.

Devise a plan to compare the temperature changes produced when sodium hydroxide solution is neutralised with each of these two acids.

(4)

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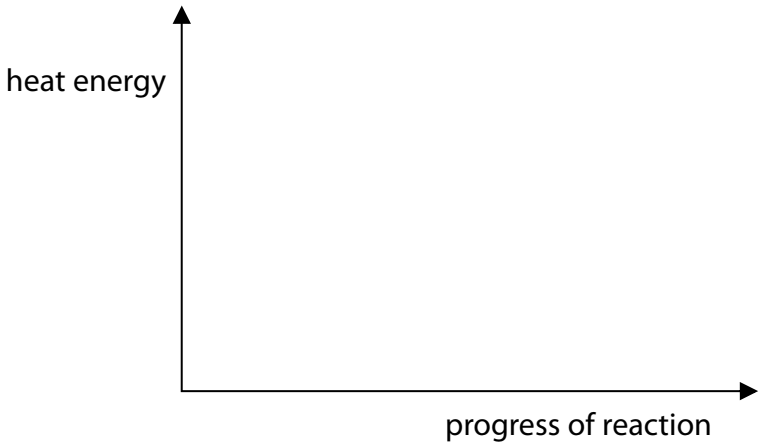
(c) Hydrogen reacts with chlorine to form hydrogen chloride.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

The reaction is exothermic.

Draw and label the reaction profile diagram for this reaction, identifying the activation energy.

(3)



(d) The energies of some bonds are shown in Figure 8.

bond	energy of bond / kJ mol^{-1}
H—H	436
Cl—Cl	243
H—Cl	432

Figure 8

Hydrogen reacts with chlorine to form hydrogen chloride.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

Calculate the energy change, in kJ mol^{-1}, for the reaction of 1 mol of hydrogen gas, H_2, with 1 mol of chlorine gas, Cl_2, to form 2 mol of hydrogen chloride gas, HCl.

(4)

energy change = ... kJ mol^{-1}

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Paper 4 C2H Mark scheme

Question number	Answer	Mark
1(a)	B	**(1)**

Question number	Answer	Mark
1(b)	An answer that provides a description by making reference to: • adds carbon dioxide/adds water vapour (1) • removes oxygen (1)	**(2)**

Question number	Answer	Additional guidance	Mark
1(c)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • as concentration of carbon dioxide increases the (mean global) temperature increases (overall) (1) • {but there is no evidence that the increase in (mean global) temperature is caused by the increase in concentration of carbon dioxide/other factors may cause the increase in (mean global) temperature} (1) OR • as concentration of carbon dioxide increases the (mean global) temperature increases (1) • so this does provide evidence that an increase in carbon dioxide is causing the Earth's temperature to rise (1) OR • as concentration of carbon dioxide increases the (mean global) temperature overall increases but {fluctuates/increases and decreases} (1) • so this does not provide evidence that an increase in carbon dioxide is causing the Earth's temperature to rise (1)	Award for conclusion (second mark) only given if reason given	**(2)**

Question number	Answer	Mark
1(d)	D	(1)

Question number	Answer	Additional guidance	Mark
2(a)	An answer that combines the following points of understanding to provide a logical description: • (hydrogen produced as a gas so) there would be {effervescence/fizzing/ bubbles} (1) • and (calcium hydroxide produced as a solid so) the water would {go cloudy/a white precipitate would form} (1)	Allow: calcium moves (around) (1) calcium decreases in size/disappears/dissolves (1)	(2)

Question number	Answer	Mark
2(b)	$Mg + H_2O \rightarrow MgO + H_2$ • LHS (1) • RHS (1)	(2)

Question number	Answer	Additional guidance	Mark
2(c)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • in calcium the outermost electron(s) {are further away from nucleus /experience(s) greater shielding} (from the nucleus) (as shown by the electronic configuration) (1) • therefore less attraction between nucleus and electron(s)/ the electron(s) is/are easier to remove (1)	Allow answers in terms of why reactivity of magnesium is less than that of calcium	(2)

Question number	Answer	Additional guidance	Mark
2(d)	• divides mass by relative atomic mass (1) • calculates simplest ratio (1) • expresses ratio correctly as empirical formula (1)	Example of calculation Ca : Br $\frac{0.2}{40}$: $\frac{0.8}{80}$ 0.005 : 0.01 1 : 2 empirical formula $CaBr_2$ Formula alone scores max 1	**(3)**

Question number	Answer	Mark
3(a)	C	**(1)**

Question number	Answer	Mark
3(b)(i)	(oil well) C	**(1)**

Question number	Answer	Mark
3(b)(ii)	(oil well) A	**(1)**

Question number	Answer	Additional guidance	Mark
3(c)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (2 marks): • when the decane is heated it vaporises/turns to a gas (1) • decane vapour/gas breaks down as it comes in contact with hot porous pot (1) • large molecules of decane produce smaller molecules, including ethene (1)	Do not allow this point if ethane passes over hot porous pot	**(3)**

Question number	Answer	Mark
3(c)(ii)	B	**(1)**

Question number	Answer	Mark
3(c)(iii)	$2C_{10}H_{22}$ + **31**O_2 → **20**CO_2 + **22**H_2O • LHS (1) • RHS both numbers correct (1)	**(2)**

Question number	Answer	Additional guidance	Mark
4(a)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ • LHS (1) • RHS (1)	Allow products in any order	**(2)**

Question number	Answer	Mark
4(b)(i)	(line B) less steep/(line B) flattens later (1)	**(1)**

Question number	Answer	Mark
4(b)(ii)	• Slope = 60 ÷ 72 (1) • = 0.83(3) ($cm^3\ s^{-1}$) (1)	**(2)**

Question number	Answer	Mark
4(c)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning/justification – knowledge (1 mark): • fewer particles/as the reactants are used up there will be fewer particles to react/lower concentration of particles (1) • this will result in a lower frequency of collisions so fewer particles reacting in a given time (1)	**(2)**

Question number	Answer	Mark
4(d)	C	**(1)**

Question number	Answer	Mark
4(e)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • the decrease in temperature will cause a decrease in rate of reaction (1) • and the increase in pressure will cause an increase in rate of reaction (1) • because the changes have opposite effects on the rate it is not possible which has the greater effect (1)	**(3)**

Question number	Answer	Mark
5(a)	Candidates relate information given to order of elements in the periodic table to predict: dark grey/black **and** solid/crystals	**(1)**

Question number	Indicative content	Mark
***5(b)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • order of reactivity: chlorine > bromine > iodine The order of reactivity supported by suitable experiments from: • add (aqueous) chlorine to a solution of potassium bromide • the solution turns orange/yellow • bromine is produced / $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$ / $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ • (so) chlorine is more reactive than/displaces bromine /oxidises bromide ions • add (aqueous) bromine to a solution of potassium iodide • the solution turns brown • iodine is produced / $Br_2 + 2KI \rightarrow I_2 + 2KBr$ / $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$ • (so) bromine is more reactive than/displaces iodine/ oxidises iodide ions • add (aqueous) chlorine to a solution of potassium iodide • the solution turns brown • iodine is produced / $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ / $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$ • (so) chlorine is more reactive than/displaces iodine/oxidises iodide ions Allow use of suggested reactions which do not produce a displacement reaction, e.g. add (aqueous) bromine to a solution of a potassium chloride with suitable conclusion/explanation	**(6)**

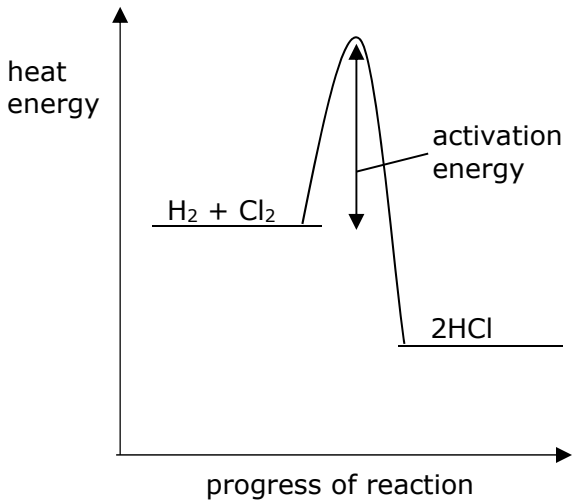
Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas, enquiry, techniques and procedures lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
5(c)(i)	• calculates mol of Fe (1) • calculates mol of Br_2 (1) • determines simplest ratio/LHS of equation (1) • deduces formula of iron bromide produced/RHS of equation (1) OR • divides mass by relative atomic mass (1) • simplest ratio (1) • empirical formula (1) • deduces LHS to obtain balanced equation (1)	<u>Example of calculation</u> mol Fe = $\frac{5.6}{56}$ = 0.1 mol Br_2 = $\frac{24}{(2 \times 80)}$ = 0.15 ratio Fe:Br_2 = 2 : 3/ 2Fe + 3Br_2 2$FeBr_3$/Fe_2Br_6 Fe : Br $\frac{5.6}{56}$: $\frac{24}{80}$ 0.1 : 0.3 1 : 3 $FeBr_3$ 2Fe + 3Br_2 → 2$FeBr_3$	**(4)**

Question number	Answer	Mark
5(c)(ii)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • bromine atoms are reduced (1) • because electrons are gained to form bromide ions (1)	**(2)**

Question number	Answer	Mark
6(a)	B	**(1)**

Question number	Answer	Marks
6(b)	An answer that combines the following points to provide a plan: • measure known volume of sodium hydroxide solution (1) • add same volume of each of the acids (1) • stir the mixture (1) • record the initial and final temperatures/temperature change (1)	**(4)**

Question number	Answer	Mark
6(c)	 • Product line, labelled (2) HCl/product(s), to right of and lower than reactant line, labelled $H_2 + Cl_2$/reactants (1) • Curve drawn on diagram (1) • Activation energy labelled (1)	**(3)**

Question number	Answer	Additional guidance	Mark
6(d)	• Calculates energy needed to break bonds (1) • Calculates energy released in forming bonds (1) • Calculates energy change (1) • Evaluation of final answer with negative sign (1)	<u>Example of calculation</u> Bonds broken = 436 + 243 = 679 ($kJ\ mol^{-1}$) Bonds formed = 2 × 432 = 864 ($kJ\ mol^{-1}$) Energy change = 679 – 864 = −185 ($kJ\ mol^{-1}$) Award full marks for correct numerical answer without working	**(4)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number	Candidate Number

Combined Science

Paper 5: Physics 1

Higher Tier

Sample Assessment Materials for first teaching September 2016	Paper Reference
Time: 1 hour 10 minutes	**1SC0/1PH**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1/1/1/2/1/1/

S 5 0 0 6 2 A 0 1 2 0

PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 There are many different types of waves.

(a) Waves on the surface of water are transverse waves.

Sound waves are longitudinal waves.

Describe the difference between transverse waves and longitudinal waves.

(2)

.....

.....

.....

.....

(b) Figure 1 shows a ripple tank.

This is used to study the behaviour of water waves.

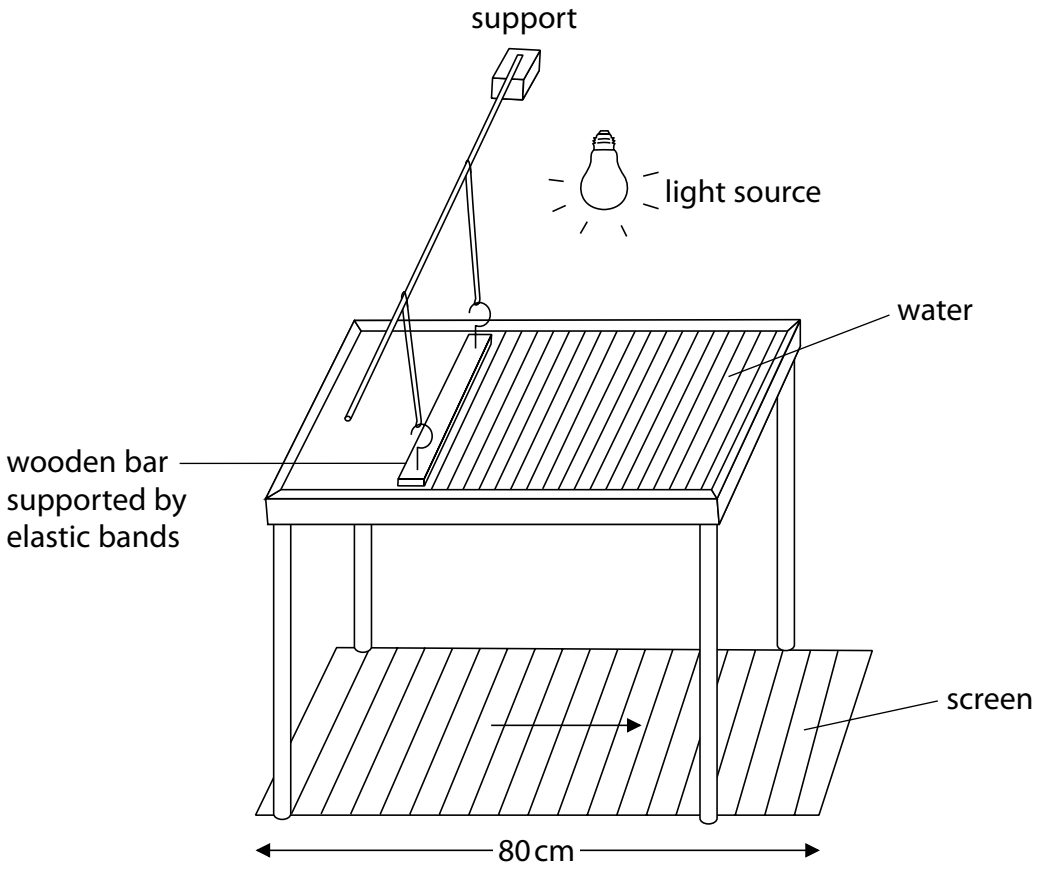

Figure 1

Water waves are produced in the tank.

The shadow of the waves is projected onto the screen below the tank.

The waves appear to move in the direction of the arrow.

(i) Describe how to determine the frequency of the waves.

(2)

.....

.....

.....

.....

(ii) The screen is 80 cm long.

What is the approximate wavelength of the waves as seen on the screen?

(1)

☒ **A** 4 cm

☒ **B** 8 cm

☒ **C** 40 cm

☒ **D** 80 cm

(iii) A student uses the image to estimate the speed of the water wave as 75 cm/s.

Which of these is a reason why the estimate is not correct?

(1)

☒ **A** the student used a ruler without mm markings

☒ **B** the light was not bright enough

☒ **C** the student's measurement was inaccurate

☒ **D** the wave seen on the screen is magnified

(Total for Question 1 = 6 marks)

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2 Figure 2 shows two students investigating reaction times.

Student B supports his left hand on a desk.

Student A holds a ruler so that the bottom end of the ruler is between the finger and thumb of student B.

When student A releases the ruler, student B catches the ruler as quickly as he can with his left hand.

The investigation is repeated with the right hand of student B.

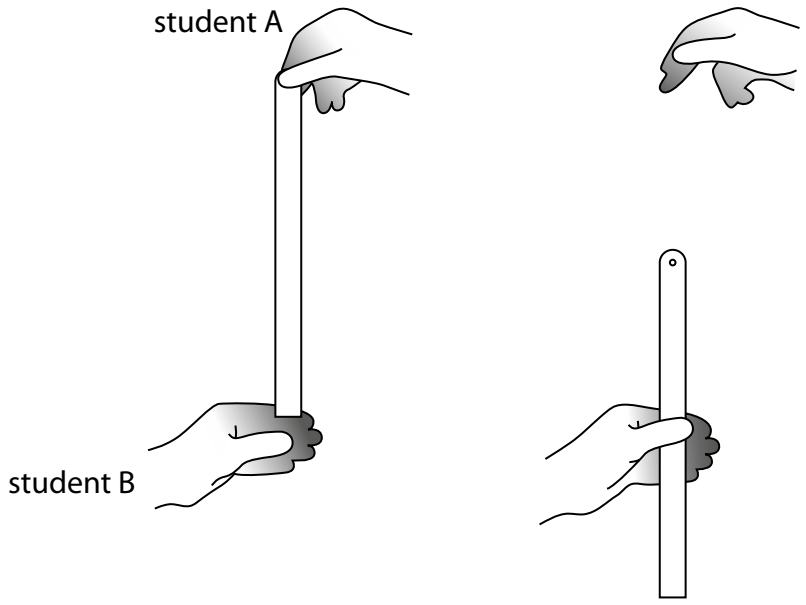

Figure 2

(a) The students took five results for the left hand and five results for the right hand.

Figure 3 shows their results.

which hand	distance dropped (cm)					
	trial 1	trial 2	trial 3	trial 4	trial 5	average
left	10.1	25.5	18.4	14.6	11.7	14
right	17.5	16.1	19.4	18.6	20.2	.....

Figure 3

(i) Calculate the average distance dropped for the right hand.

Give your answer correct to two significant figures.

(2)

distance = ... cm

(iii) Calculate the average time for the left hand.

Use the equation

$$\text{time}^2 = \frac{\text{distance}}{500}$$

(2)

average time = ... s

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DO NOT WRITE IN THIS AREA

(b) Explain whether any of the readings are anomalous.

(2)

(c) Give **two** ways that the students can improve the quality of their data other than ignoring anomalous results.

(2)

1

2

(d) Describe how the students could develop their investigation to investigate how reaction time changes with another variable.

(2)

(Total for Question 2 = 10 marks)

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3 (a) A car accelerates at a constant rate of 1.83 m/s^2 along a flat, straight road.

The force acting on the car is 1.870 kN.

Calculate the mass of the car.

Give your answer to three significant figures.

(3)

mass = ... kg

(b) The car accelerates from rest for 16 s.

Calculate the speed of the car after 16 s.

(3)

speed = ... m/s

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DO NOT WRITE IN THIS AREA

(c) The car starts on another journey.

Figure 4 shows the graph of the car's movement.

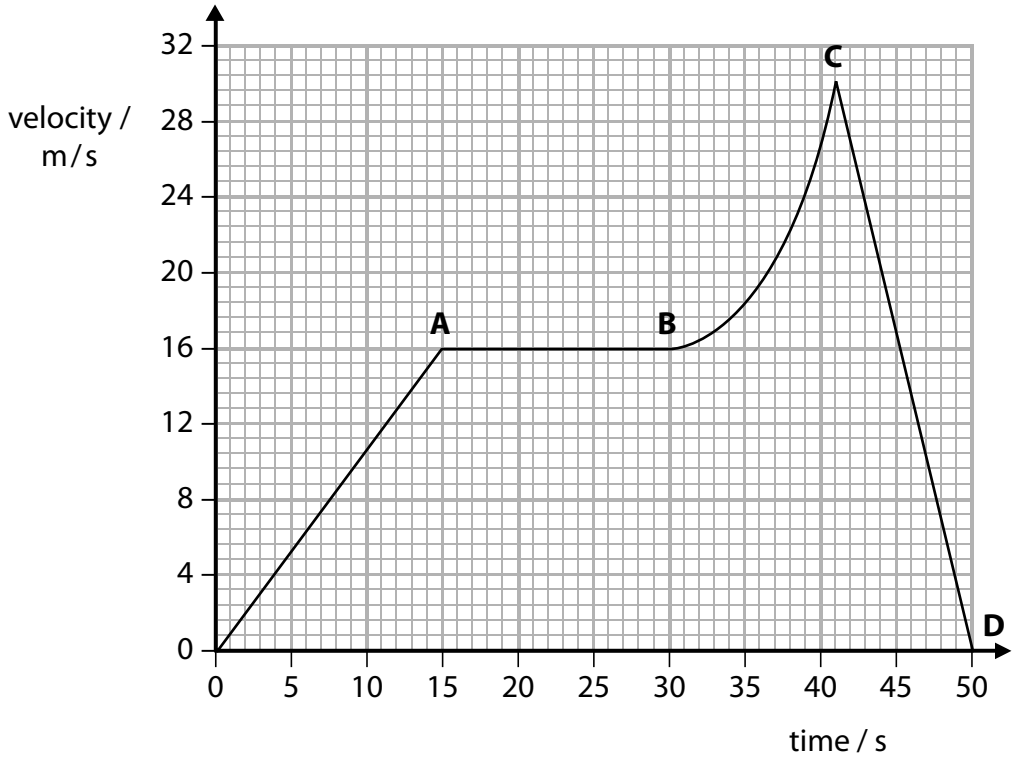

Figure 4

Show that the distance travelled when the car is moving at a constant speed is greater than the distance travelled when the car is slowing down.

(4)

(Total for Question 3 = 10 marks)

4 Figure 5 shows the nuclei of four atoms.

$^{234}_{92}U$	$^{235}_{92}U$	$^{238}_{94}Pu$	$^{238}_{95}Am$
uranium-234	uranium-235	plutonium-238	americium-238

Figure 5

(a) Which two nuclei have the same number of neutrons?

(1)

☒ **A** plutonium-238 and uranium-235

☒ **B** uranium-235 and americium-238

☒ **C** uranium-234 and americium-238

☒ **D** americium-238 and plutonium-238

(b) (i) State what is meant by the term 'half-life'.

(1)

.....

.....

(ii) Plutonium-238 is used in spacecraft to provide heat to power generators.

One of these generators contains 925 g of plutonium-238 when it is manufactured.

One gram of plutonium-238 has a power density of 0.54 W/g.

Plutonium-238 has a half-life of 87.7 years.

Calculate the average energy released per second by the generator after 263 years.

(4)

average energy released per second = ... (J)

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(c) The nucleus of americium-238 can absorb an electron.

When this happens, one of the protons in the nucleus becomes a neutron, as shown in Figure 6.

$$ {}^{1}_{1}\mathrm{p} + {}^{0}_{-1}\mathrm{e} \longrightarrow {}^{1}_{0}\mathrm{n} $$

Figure 6

(i) Describe how absorbing an electron affects the proton number and the nucleon number of a nucleus.

(2)

.....

.....

.....

.....

(ii) Deduce which nucleus is formed when americium-238 absorbs an electron.

(1)

☐ **A** uranium-234

☐ **B** uranium-235

☐ **C** plutonium-238

☐ **D** americium-238

(Total for Question 4 = 9 marks)

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5 A student investigates how the average speed of the trolley varies with starting height.

Figure 7 shows the trolley and runway.

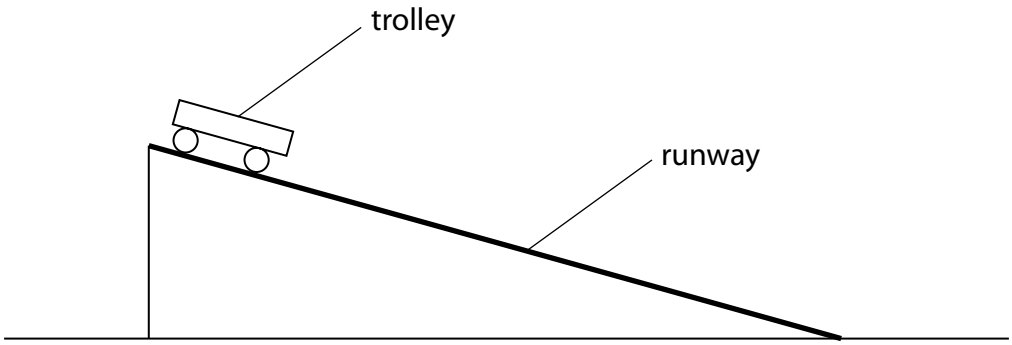

Figure 7

(a) Describe how the student can determine the average speed of the trolley.

(4)

(b) Figure 8 shows his results.

starting height / m	v / ms^{-1}
0.01	0.22
0.02	0.31
0.04	0.44
0.09	0.66
0.12	0.77
0.14	0.83
0.18	0.94

Figure 8

Figure 9 shows the student's graph.

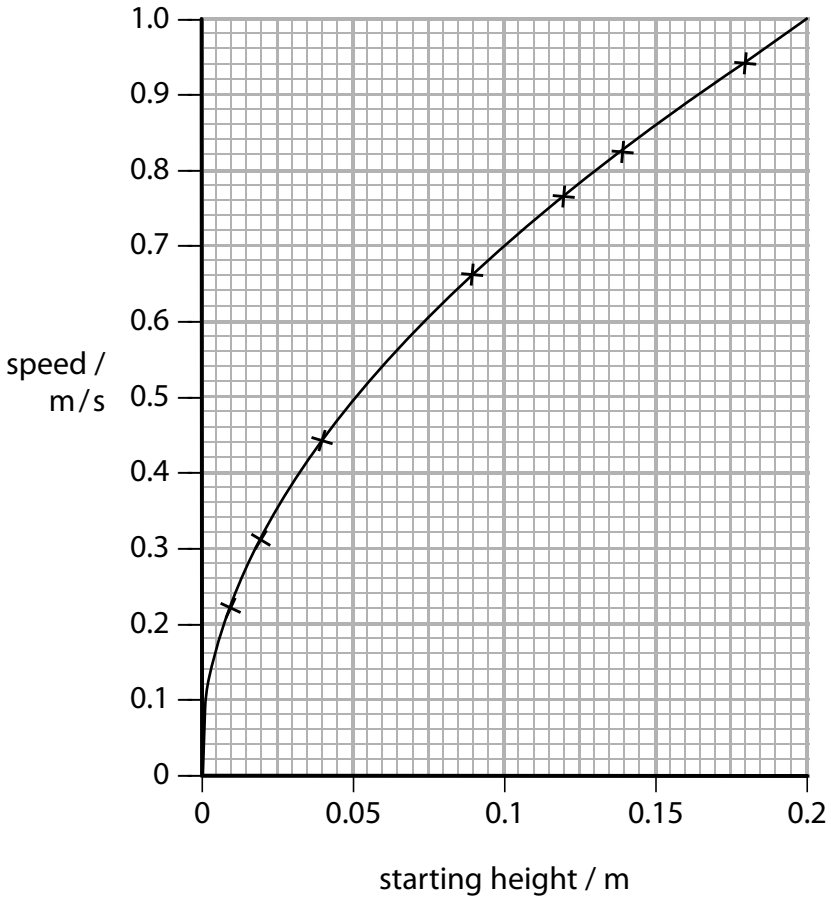

Figure 9

(i) The trolley has a mass of 650 g.

Calculate the average kinetic energy of the trolley which had a starting height of 0.075 m.

(2)

average kinetic energy = ... J

(ii) Determine the gradient of the graph when the height is 0.1 m.

(2)

gradient = ...

(iii) Describe how the speed of the trolley varies with the changes in height made by the student between 0.04 m and 0.12 m.

(2)

.....

.....

.....

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(c) The student wants to change his experiment to investigate how different surfaces of the runway affect the speed of the trolley down the slope.

Devise an experiment that would allow him to investigate the effect of different surfaces on the average speed of the trolley.

(3)

.....

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(Total for Question 5 = 13 marks)

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6 (a) Explain what happens to the wavelength of light when it passes from air into glass.

(2)

*(b) Figure 10 shows a beam of red light approaching one side of a rectangular glass block.

The beam of light will pass through the block and leave through the opposite side.

AB is a wavefront.

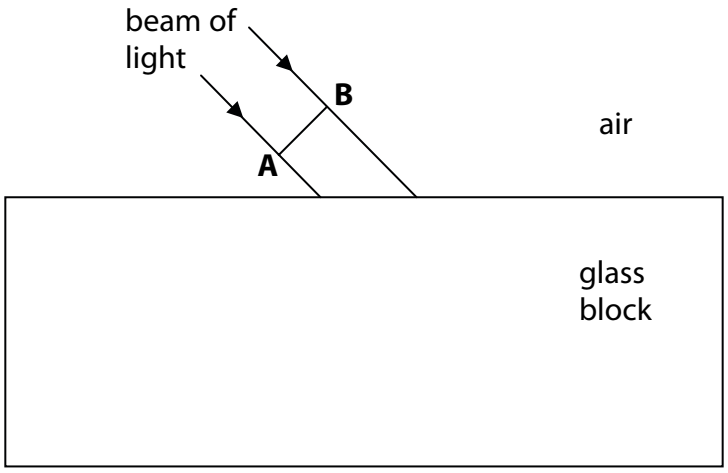

Figure 10

Discuss the path of the wavefront **AB** as it enters and leaves the glass block.

(6)

(c) The distance between the Earth and the Sun is 1.50×10^{11} m.

Light takes 500 s to travel from the Sun to the Earth.

The wavelength of red light is 670 nm.

Calculate the frequency of red light, using only the data provided.

(4)

frequency = ... Hz

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Equations

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
force = change in momentum ÷ time $F = \frac{(mv - mu)}{t}$
energy transferred = current × potential difference × time $E = I \times V \times t$
force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length $F = B \times I \times l$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = ½ \times k \times x^2$

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Paper 5 P1H Mark scheme

Question number	Answer	Mark
1(a)	An answer that provides a description by making reference to: • transverse waves have oscillations perpendicular to direction of travel of the wave (1) • whereas longitudinal waves have oscillations in the same direction as the direction of travel of the wave (1)	**(2)**

Question number	Answer	Mark
1(b)(i)	An answer that combines the following points of understanding to provide a logical description: • take time T for waves to pass a fixed point (1) • and frequency = $\frac{\text{number of waves}}{\text{time taken}}$ (1)	**(2)**

Question number	Answer	Mark
1(b)(ii)	A	**(1)**

Question number	Answer	Mark
1(b)(iii)	D	**(1)**

Question number	Answer	Additional guidance	Mark
2(a)(i)	Calculating the mean (1) 18.36 Rounding to 2 s.f. (1) 18 (cm)	award full marks for correct numerical answer without working	**(2)**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	Rearrangement (1) $t = \sqrt{\frac{\text{distance}}{500}}$ Substitution and answer (1) time = 0.17 (s)	award full marks for correct numerical answer without working allow answers which round to 0.17, e.g. 0.1673	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • 25.5 is an anomalous result (1) • (because) it is much further away from the mean than the other results (1)	ignore 19	**(2)**

Question number	Answer	Mark
2(c)	• Take more readings (1) • Idea that a third student should also measure the reaction time (1)	**(2)**

Question number	Answer	Additional guidance	Mark
2(d)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • using a larger group of students / large population of students (1) • and measure how their reaction time varies with age/height (1)	allow any suitable variable	**(2)**

Question number	Answer	Additional guidance	Mark
3(a)	Rearrangement (1) $m = \frac{f}{a}$ substitution and conversion (1) $m = \frac{1870}{1.83}$ answer and rounding to 3 s.f. (1) 1020 (kg)	maximum 2 marks if kN not converted to N award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
3(b)	Rearrangement of $\frac{(v-u)}{t} = a$ (1) $v = u + at$ Substitution (1) $v = 0 + 1.83 \times 16$ Answer (1) 29.3 (m/s)	award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Mark
3(c)	Correctly identifies data points from the graph to calculate areas (1) Calculates area under AB (1) 240 m Calculates area under CD (1) 135 m distance travelled at constant speed = 240 m is greater than distance travelled when slowing down = 135 m (1)	**(4)**

Question number	Answer	Mark
4(a)	B	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)(i)	The time taken for the activity of a radioactive nuclide to halve (1)	accept for nuclide: isotope sample	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)(ii)	Determines number of half-lives and rounds (1) 263/87.7 = 3 Determines that 3 half-lives is 1/2 × 1/2 ×1/2 = 1/8 (1) Determines mass of Pu-238 after 3 half-lives (1) 925/8 = 115.625 (g) Determines average energy released per second (1) 115.625 × 0.54 = 62.4 (J)	 allow repeated division by 2 allow ecf from step 2 for 1 mark (mass of Pu-238 after1 half-life 925/2 = 462.5 (g)) allow ecf from 1 half-life or from step 3	**(4)**

Question number	Answer	Mark
4(c)(i)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • proton number/atomic number decreases by 1 (1) • nucleon number/mass number remains unchanged (as p and n have same mass and mass of electron is (assumed) negligible) (1)	**(2)**

Question number	Answer	Mark
4(c)(ii)	C	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)	An answer that combines the following points of understanding to provide a logical description: • measurement of time between(or at) two positions using suitable timing equipment (1) • measurement of suitable distance along the runway with metre rule (1) • measurement of vertical height to starting position (1) • repeats AND averages AND use of a correct equation (1)	allow stopwatch, light gates minimum is 0.5 m metal tape measure average speed = distance/time OR average speed = (speed at A − speed at B)/2	**(4)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	Substitution of correct data from graph and mass conversion (1) $0.5 \times 0.65 \times (0.61)^2$ Answer (1) 0.12 (J)	maximum of 1 mark if mass in g used allow tolerance of ±0.2 for speed	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	• Tangent to the graph at h = 0.1 (1) • Answer in the region 3.5 to 3.6	either seen on graph or suitable pairs of values of Δv and Δh	**(2)**

Question number	Answer	Mark
5(b)(iii)	An answer that combines points of interpretation/evaluation to provide a logical description: • for each change in height, as the height increases the speed of the trolley increases • the greatest change in speed is between the change in height from 0.04 m to 0.9 m	**(2)**

Question number	Answer	Additional guidance	Mark
5(c)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • identifies control variables (1) • uses at least 3 different surfaces (1) • calculates average speed for each surface and repeats (1)	constant height, constant slope, constant starting points and same length of surface	**(3)**

Question number	Answer	Additional guidance	Mark
6(a)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • the wavelength decreases because wavelength is the ratio of wave velocity to frequency (1) • and the wave velocity reduces at the boundary but the frequency remains the same (1)	allow the same number of waves per second arrive at the boundary as leave it for no change in frequency at the boundary	**(2)**

Question number	Indicative content	Mark
6(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • point A reaches the glass block before point B • A moves into the glass block and slows down • as light travels more slowly in glass than in air • B is still in air so is travelling faster than A • this causes part of the wavefront to change direction/refract • by the time B reaches the block it will have travelled further than A • therefore, the whole wavefront changes direction/refracts towards the normal • at the other face, A exits first so the process is reversed • the wavefront changes direction again so it is parallel to its original direction/refracts away from the normal	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
6(c)	Substitution into $v = \frac{s}{t}$ to find v (1) $v = \frac{1.5 \times 10^{11}}{500}$ Substitution into $v = f \times \lambda$ and unit conversion (1) $v = \frac{1.5 \times 10^{11}}{500} = f \times 670 \times 10^{-9}$ Transposition (1) Rearrangement (1) $f = \frac{\left(1.50 \times 10^{11}\right)}{500 \times \left(670 \times 10^{-9}\right)}$ Answer (1) 4.5 × 10^{14} (Hz)	s is distance award full marks for correct numerical answer without working maximum 3 marks if λ in nm 4.4776 × 10^{14} (Hz)	**(4)**

Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number	Candidate Number

Combined Science

Paper 6: Physics 2

Higher Tier

Sample Assessment Materials for first teaching September 2016	Paper Reference
Time: 1 hour 10 minutes	**1SC0/2PH**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an asterisk (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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S 5 0 0 6 4 A 0 1 2 4

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Figure 1 shows part of a roller coaster ride seen from the side.

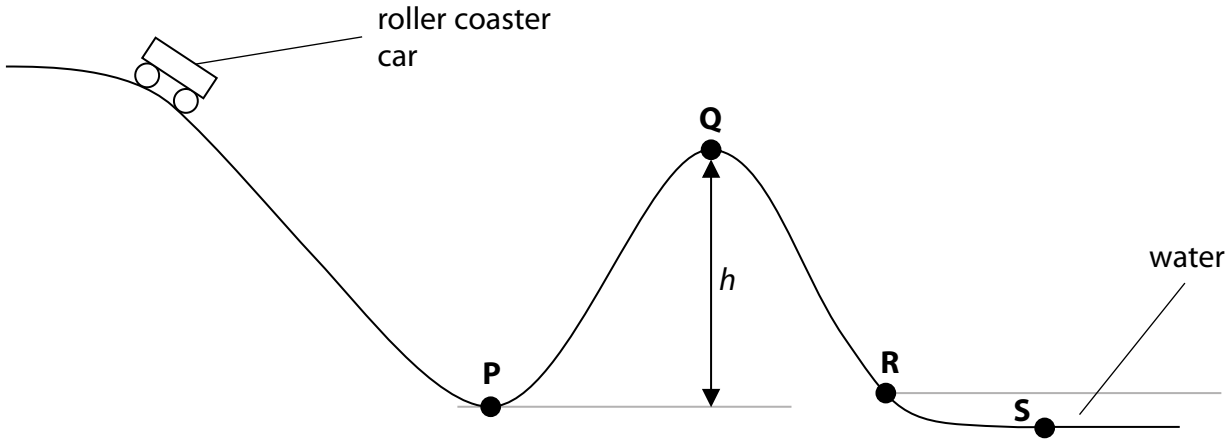

Figure 1

(a) The roller coaster car rolls down towards **P**. The car has mass, *m* kg and velocity, *v* m/s.

Which of these is the correct equation for calculating the kinetic energy of the car?

(1)

☒ **A** $KE = mv$

☒ **B** $KE = mv^2$

☒ **C** $KE = ½mv^2$

☒ **D** $KE = 2mv^2$

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(b) The mass of the car is 580 kg.

The car gains 39 000 J of gravitational potential energy as it climbs from **P** to **Q**.

(i) State the equation relating change in gravitational potential energy, mass, gravitational field strength and change in vertical height.

(1)

(ii) Calculate the height *h*, shown in Figure 1.

(gravitational field strength, g = 10 N/kg)

(3)

h = ... m

(c) The car enters a pool of water at **R**. It slows down and stops at **S**.

Describe how the total energy of the system is conserved as the car travels between **R** and **S**.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

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2 A student investigates how the resistance of a thermistor varies with temperature.

(a) The student sets up the circuit shown in Figure 2 to measure current and voltage.

He finds that it does not work.

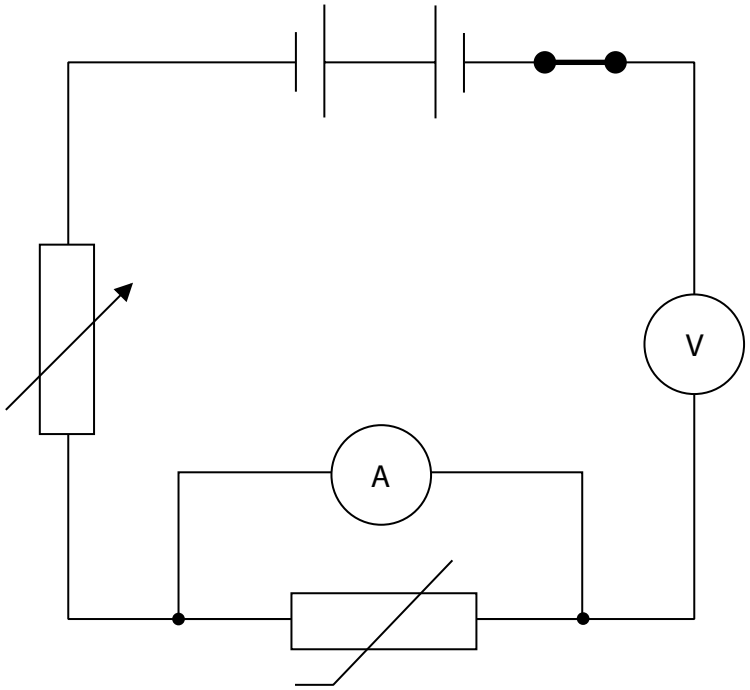

Figure 2

Give **three** modifications the student should make to the circuit so that the circuit works correctly.

(3)

1 .....

.....

2 .....

.....

3 .....

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(b) The student uses the equipment shown in Figure 3 to measure the temperature of the thermistor.

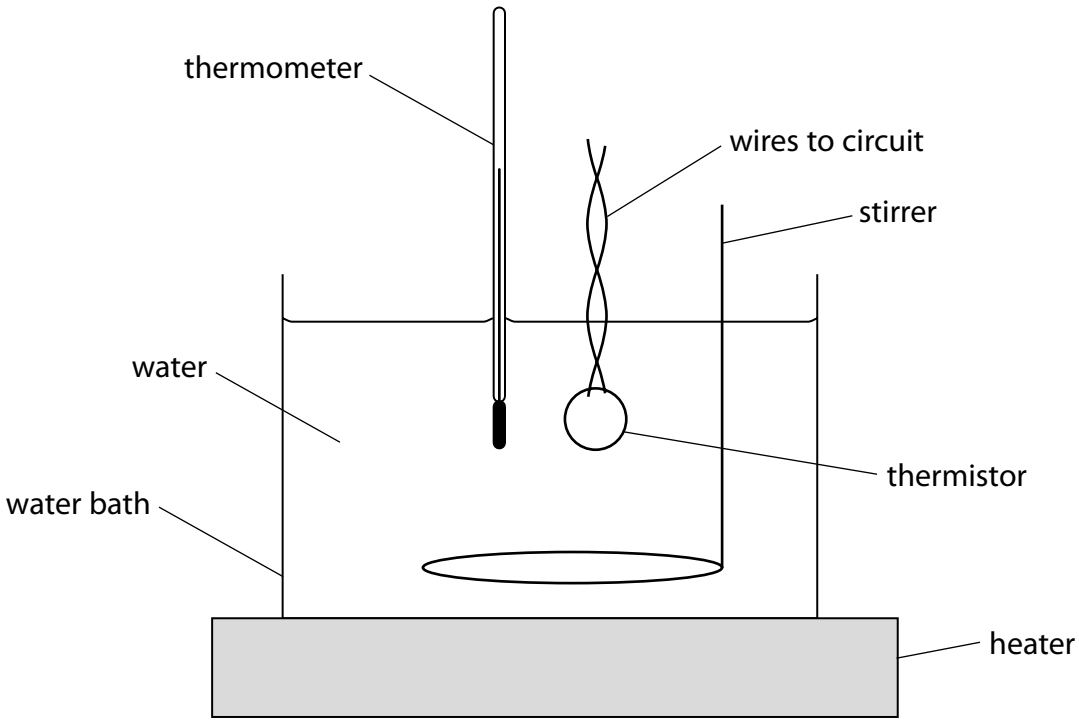


Figure 3

(i) Give **one** reason for using the water bath.

(1)

.....

.....

(ii) The equipment shown in Figure 3 is for investigations in the temperature range from 20 °C to 100 °C.

State **one** way the student could develop this experimental procedure to investigate temperatures outside this range.

(1)

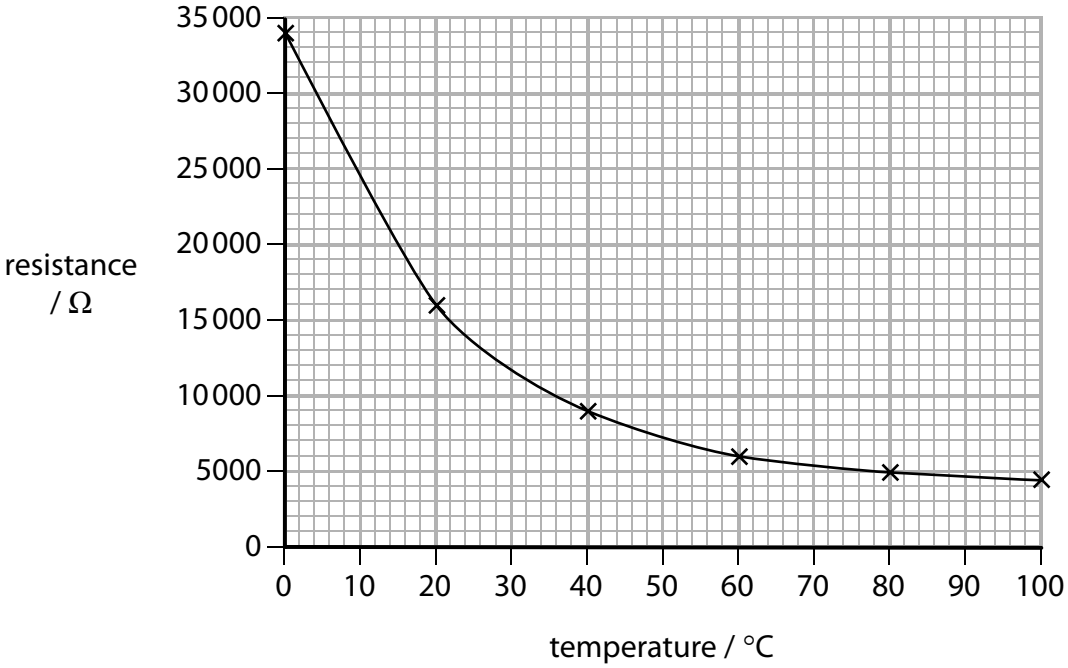
.....

.....

(c) The student takes measurements for two other components, **A** and **B**.

The results for both these components are shown in Figure 4.

Component A



Component B

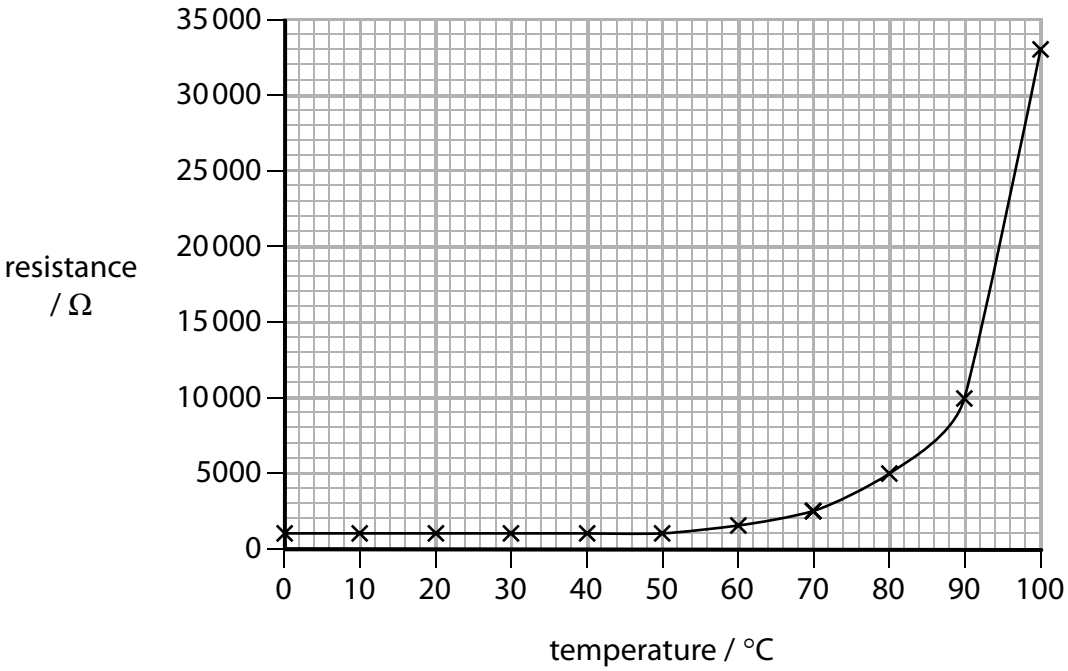


Figure 4

(i) Compare and contrast how the resistances of component **A** and component **B** vary with temperature.

(3)

(ii) Component **A** is connected to a 12V supply.

Which of these is the current in component **A** when the temperature is 80 °C?

(1)

☒ **A** $I = 12 \times 5000$

☒ **B** $I = \frac{12}{5000}$

☒ **C** $I = \frac{12^2}{5000}$

☒ **D** $I = \sqrt{\left(\frac{12}{5000}\right)}$

(Total for Question 2 = 9 marks)

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3 A student uses a digital calliper to measure the length of a spring, as shown in Figure 5.

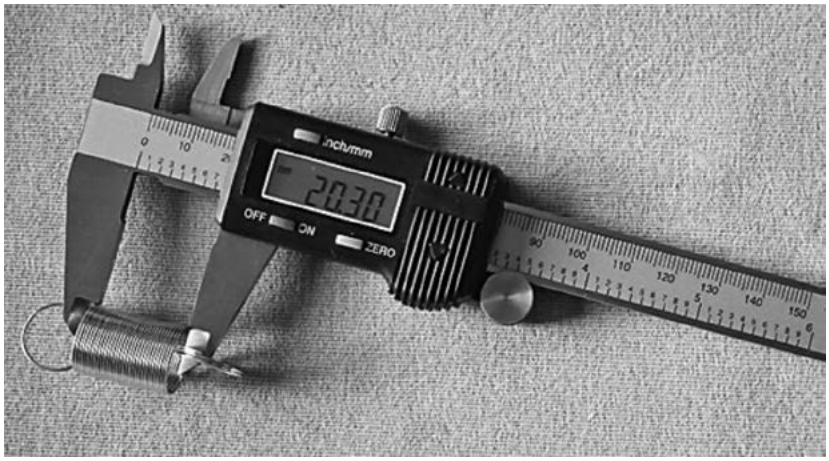


Figure 5

The spring is bendy and difficult to measure.

The student takes the six readings shown in Figure 6.

Figure 6

(a) Calculate the average length of the spring.

(2)

average length = ... mm

(b) The student investigates the stretching of a spring with the equipment shown in Figure 7.

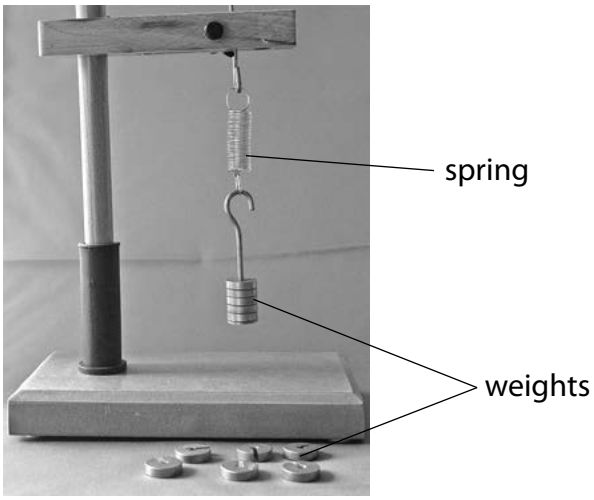


Figure 7

The student investigates the extension of the spring using six different weights.

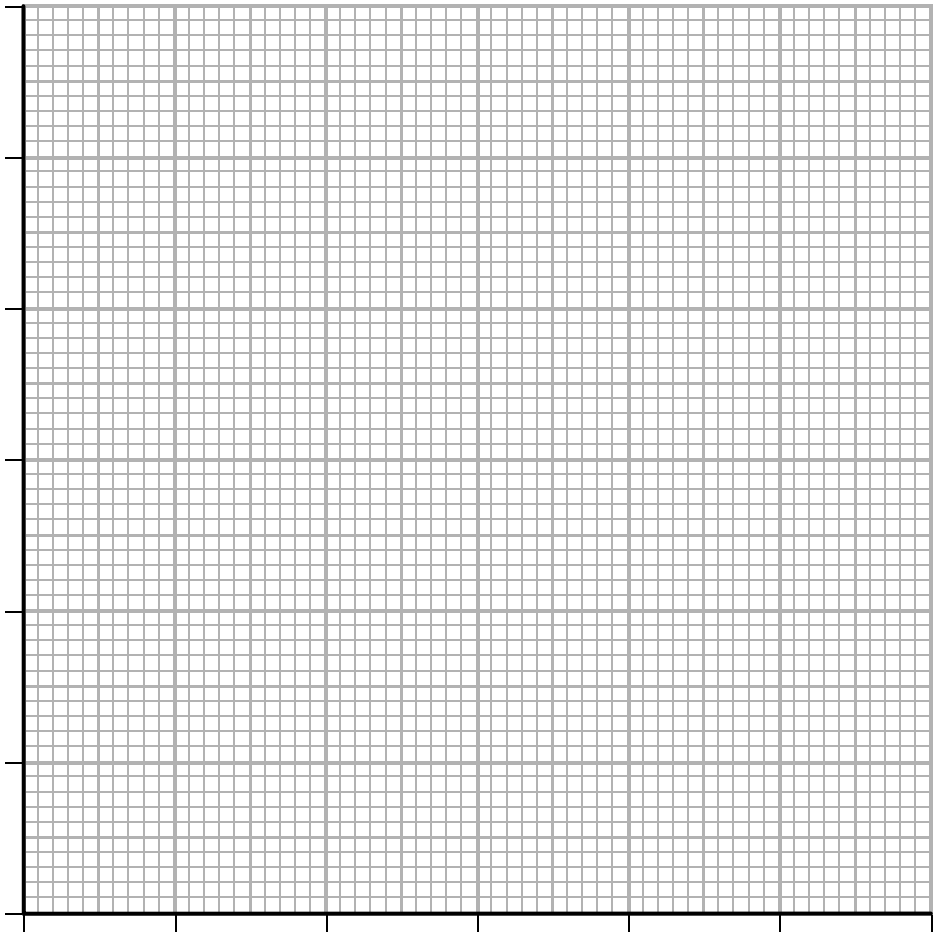
The results are shown in Figure 8.

weight (N)	extension (mm)
0.20	4.0
0.40	8.0
0.60	12.0
0.80	16.0
1.00	20.0
1.20	24.0

Figure 8

(i) Draw a graph for the readings, using the grid shown.

(3)



(ii) The student writes this conclusion:

'*The extension of the spring is directly proportional to the weight stretching the spring.*'

Comment on the student's conclusion.

(3)

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(c) The student extends the investigation by finding information about the stretching of wires.

The student finds the graph shown in Figure 9 for the stretching of a wire.

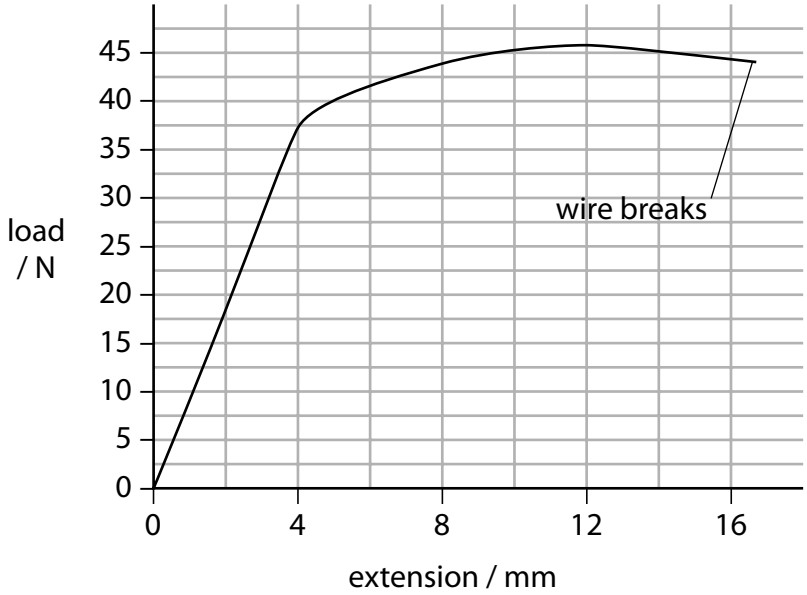


Figure 9

Describe the non-linear stretching of the wire shown in Figure 9.

(3)

(Total for Question 3 = 11 marks)

4 Wooden trucks on a toy railway have permanent magnets that hold the train together.

The magnets are arranged so that an N-pole touches an S-pole between each truck, as shown in Figure 10.

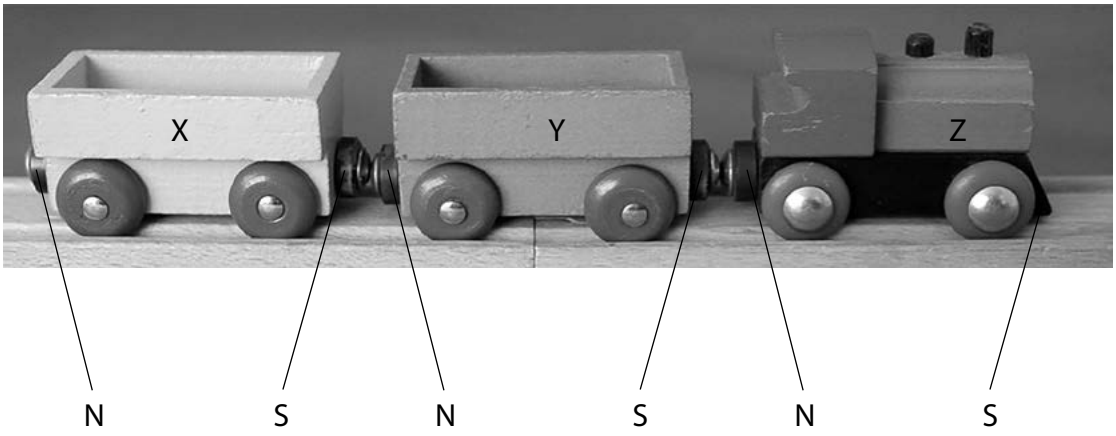


Figure 10

(a) Truck Y is removed from the train, turned through 180° and is then replaced between truck X and Z.

How does this affect the train?

(1)

☒ **A** Y attracts both X and Z as before

☒ **B** Y still attracts X but now repels Z

☒ **C** Y still attracts Z but now repels X

☒ **D** Y now repels both X and Z

(b) The structure of a truck, seen from above, is shown in Figure 11.

The permanent magnets cause a magnetic field both inside and outside the truck.

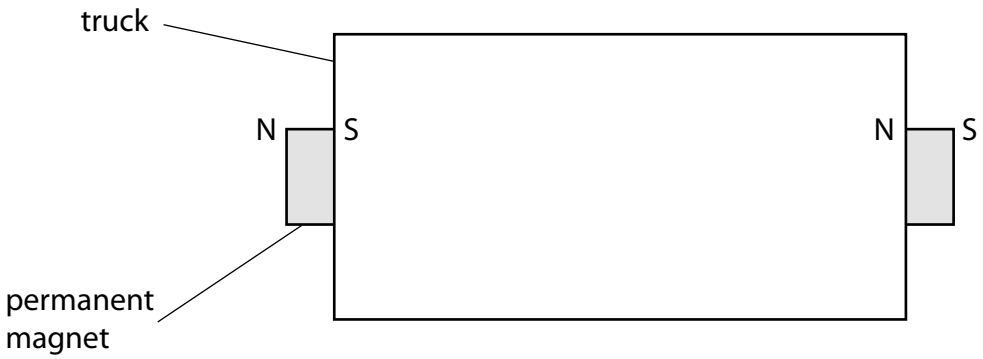
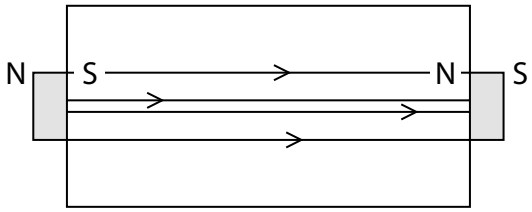


Figure 11

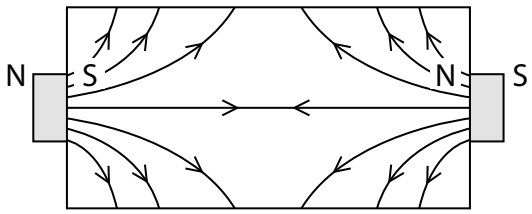
Which of these correctly shows the field inside the truck?

(1)

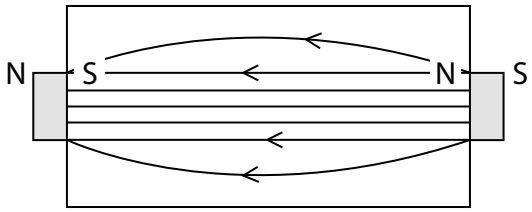
☒ **A**



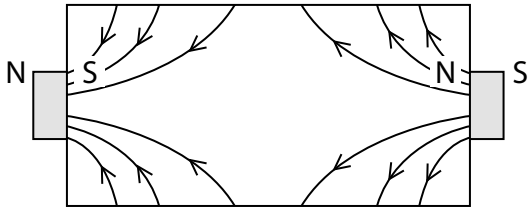
☒ **B**



☒ **C**



☒ **D**



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(c) A student investigates the forces between the trucks in the toy railway.

She places another truck, **W**, next to truck **X**.

She pulls truck **Z** in the direction shown by the arrow.

The whole train travels at a constant speed as shown in Figure 12.

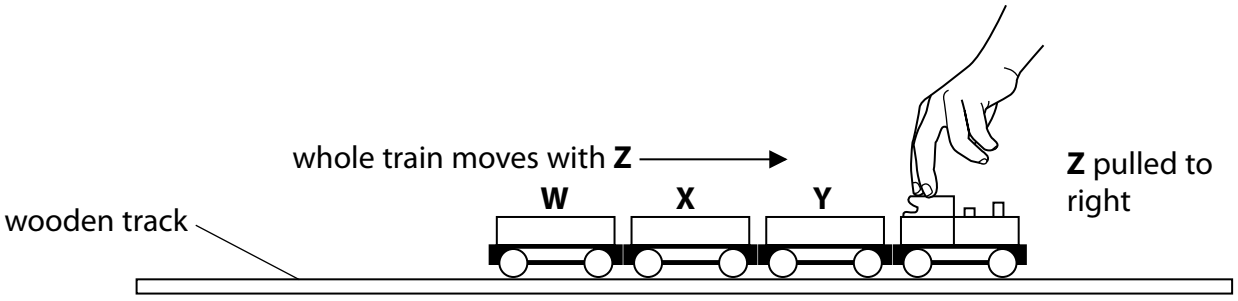

Figure 12

The student repeats this method of adding trucks and pulling the train each time.

When there are seven trucks in total, the train comes apart between **Y** and **Z** when tested as shown in Figure 13.

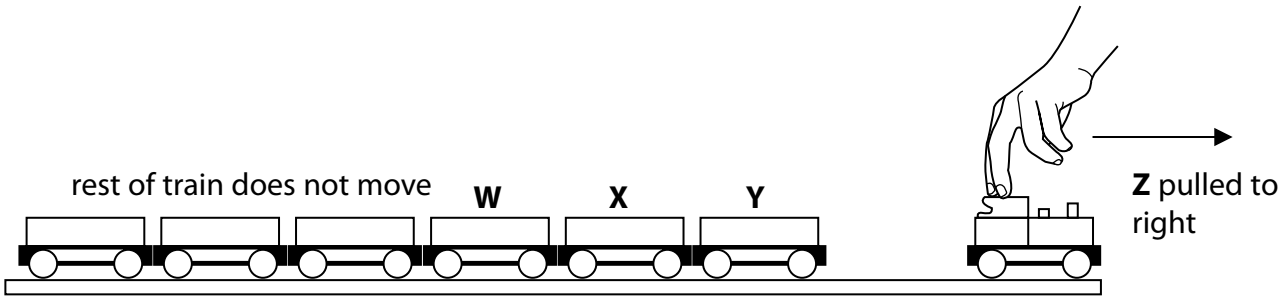

Figure 13

(i) Explain why the train acts in this way by considering the forces involved.

(2)

.....

.....

.....

.....

(ii) Devise an experiment to investigate the horizontal force needed to separate the trucks from the engine.

(3)

(iii) Explain why a larger force is needed to separate the trucks from the engine if the force is applied at an angle to the horizontal.

(2)

(Total for Question 4 = 9 marks)

5 Figure 14 shows an electric car connected to a battery charger.

(Source: © Danil Roudenko/123RF)

Figure 14

The car has a rechargeable battery to drive its motor.

The rechargeable battery provides a potential difference of 330 V and can store up to 64 MJ.

It takes 8 hours for the battery to receive a full charge.

(a) Calculate the total charge that flows while the battery is being charged.

(3)

total charge = ... C

(b) Calculate the average charging current.

(3)

current = ... A

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

*(c) The battery charger shown in Figure 14 is connected to the 230 V a.c. domestic mains supply.

The output voltage of the charger is 335 V and it provides a d.c. charging current. Charging stops if the charging current exceeds 15 A.

Explain how electrical components in the charger can be connected together to give this type of output.

(6)

(Total for Question 5 = 12 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

6 The espresso machine shown in Figure 15 is an electrical appliance.

(Source: © tanawaty/123RF)

Figure 15

(a) The espresso machine has an electrical heater connected to a 440 V mains supply.

The power of the electrical heater is 3.5 kW.

(i) The rating of a fuse is the current above which it melts.

Which of these is the most suitable fuse for the espresso machine circuit?

(1)

- ☒ **A** 1 A
- ☒ **B** 5 A
- ☒ **C** 10 A
- ☒ **D** 13 A

(ii) Before the espresso machine can be used, its heater must raise the temperature of some cold water.

The specific heat capacity of water is 4200 J/kg K.

Show that it takes the heater about 90 s to raise the temperature of 1 kg of water from 18 °C to 95 °C.

Use an equation from the formula sheet.

(3)

(b) The espresso machine has a steam pipe that can be used to heat milk in a jug, as shown in Figure 16.

(Source: © Wavebreak Media Ltd/123RF)

Figure 16

Steam from the pipe enters the milk, where steam condenses to water.

The steam and hot water heat the milk.

(i) Describe, in terms of energy, how the arrangement and movement of particles in the steam changes as the steam enters the milk, condenses and cools.

(2)

.....

.....

.....

.....

(ii) The specific heat capacity of milk is 3840 J/kg K.

The specific heat capacity of water is 4200 J/kg K.

The specific latent heat of condensation of steam is 2260 kJ/kg.

The temperature of the steam is 100 °C.

The mass of steam that condenses is 25 g.

The temperature of the milk rises from 5 °C to 65 °C.

By considering the transfer of energy from the steam to the milk, calculate the mass of milk that is heated by the steam and hot water.

Use equations from the formula sheet.

(4)

mass of milk = ... kg

(iii) Give **two** reasons why the actual mass of steam needed to heat the milk from 5 °C to 65 °C is greater than 25 g.

(2)

1 .....

.....

2 .....

.....

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

Equations

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
force = change in momentum ÷ time $F = \frac{(mv - mu)}{t}$
energy transferred = current × potential difference × time $E = I \times V \times t$
force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length $F = B \times I \times l$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = ½ \times k \times x^2$

Paper 6 P2H Mark scheme

Question number	Answer	Mark
1(a)	C	**(1)**

Question number	Answer	Mark
1(b)(i)	change in GPE = mass × gravitational field strength × change in vertical height	**(1)**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	Transformation (1) $h = \Delta E \div mg$ Substitution (1) h = 39 000 ÷ (580 × 10) Evaluation (1) 6.7 (m)	accept use of g = 9.81 accept 6.72 accept 6.85 (from g = 9.81)	**(3)**

Question number	Answer	Additional guidance	Mark
1(c)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • work is done against friction (1) • energy is stored in another specified way (1)	ignore references to friction as energy store acceptable stores are: • KE of water • thermal energy of water • thermal energy of air • (G)PE of water	**(2)**

Question number	Answer	Additional guidance	Mark
2(a)	• Connect ammeter in series (with thermistor) (1) • Connect voltmeter in parallel (with thermistor) (1) • Reverse (connections for) one of the cells (1)	allow idea that meters should be swapped for two marks (equivalent to first two points)	**(3)**

Question number	Answer	Additional guidance	Mark
2(b)(i)	Any one of the following reasons: • the thermistor and the water are at the same temperature (1) • large volume of water gives a steady temperature rise (1)	accept idea that only small part of thermometer would be in contact with a thermistor in air accept difficult to control change in temperature of thermistor when heated in air	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	Any one of the following developments to the procedure: • add ice to increase lower limit of temperature range (1) • use liquid with higher boiling point to increase upper limit of temperature range (1)	accept named liquid with higher boiling point, e.g. oil	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	A comparison and contrast that must include at least **one** similarity and **one** difference from the following points to a maximum of three marks: Similarities • resistance of both changes with temperature (1) • both graphs show a non-linear relationship (1) • data comparison, e.g. both have the same resistance at 80 °C (1) Differences • resistance of **A** decreases with temperature but resistance of **B** increases with temperature (1) • for **A**, (largest slope/rate of change) is at lower temperature but for **B**, (largest slope/rate of change) is at higher temperature(s) (1) • for **B**, resistance is constant below 50 °C but for **A** resistance is roughly constant above 60°C (1)	accept (smallest slope/rate of change) for A is at higher temperature but (smallest slope/rate of change) for B is at lower temperature	**(3)**

Question number	Answer	Mark
2(c)(ii)	B	**(1)**

Question number	Answer	Additional guidance	Mark
3(a)	Evidence that anomalous reading excluded (1) Evaluation (1) average length = 20.31 (mm)	accept 101.57 (÷5) for first mark accept 20.314 (mm)	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	• Axes with linear scales that use more than half of each edge of the grid and labelled with units from table (1) • All points correctly plotted to ± half a square (1) • Single straight line passing through all points and the origin (1)	allow 1 mark if only one plotting error and correct line drawn for points plotted	**(3)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	A comment that makes reference to the following points: (using table) • idea that equal increments of force/weight/mass cause equal increments of extension (1) • correct reference to figures in the table (1) OR (using graph) • the graph line is straight (1) • the graph line passes through the origin (1) AND therefore the student's conclusion is correct (1)	last marking point can only be achieved if at least one of the other two marks is awarded	**(3)**

Question number	Answer	Additional guidance	Mark
3(c)	An answer that combines points of interpretation/evaluation to provide a logical description: • above 37.5 N/4 mm there are large increases of extension for small increases in load (1) • the maximum extension of the wire is about 16.5 mm before it breaks (1) • above 12 mm the wire keeps on extending when the load is reduced below 46 N (1)	accept extension is (much) greater for each 1 N increase in load above 37.5 N	**(3)**

Question number	Answer	Mark
4(a)	D	**(1)**

Question number	Answer	Mark
4(b)	C	**(1)**

Question number	Answer	Additional guidance	Mark
4(c)(i)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • frictional forces as more trucks are added (1) Plus **one** from: • hence, in order to keep constant speed, the student must increase the force she applies to **Z** (1) • when **Y** and **Z** separate, the frictional forces (to the left) are more than magnetic attraction between **Y** and **Z** (1)		**(2)**

Question number	Answer	Mark
4(c)(ii)	An answer that combines the following points to provide a plan: • use of a Newton meter used horizontally (1) • record largest force observed (1) • repeat readings several times under same conditions (1)	**(3)**

Question number	Answer	Mark
4(c)(iii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • the applied force must be resolved horizontally to determine the force that separates the engine from the trucks • and since the (size of) the resolved force is always less than the (size of) the actual force then a larger force (applied at an angle) is needed to separate the trucks from the engine	**(2)**

Question number	Answer	Additional guidance	Mark
5(a)	Rearrangement of equation (1) $Q = \frac{E}{V}$ Substitution including change of unit (1) 64 MJ = 64 000 000 J $Q = \frac{64000000}{330}$ Answer and unit (1) Q = 190 000 C	allow answers that round to 190 000, e.g. 193 939 if the calculation is worked throughout without changing MJ to J, then maximum of 2 marks unless unit matches quantity	**(3)**

Question number	Answer	Additional guidance	Mark
5(b)	Rearrangement (1) $I = \frac{Q}{t}$ Conversions and substitution (1) 190 (kC) = 190 000 (C) 8 hours = 8 × 3600 (s) = 28 800 (s) $I = \frac{190000}{28800}$ Evaluation (1) = 6.6 (A)	ecf from (a) (6.5972) if 193 939 used then accept 6.7	**(3)**

Question number	Indicative content	Mark
***5(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • the sequence of events is voltage change, conversion to direct current, followed by current limiting • the battery is the load in the secondary circuit not a store of energy for the primary circuit • a transformer is needed to increase (or step up) the voltage • so a diode is needed to change a.c. to d.c. • the charging current can be limited to 15 A using a fuse (or circuit breaker) • a circuit breaker may be preferable to a fuse, since a fuse would need to be replaced after use • the transformer primary coil is connected between the live and neutral in the primary circuit • the diode is connected in the secondary circuit of the transformer • the battery(which is to be charged), diode, fuse and secondary coil should be connected in series in the secondary circuit accept any of these points made using circuit diagrams with standard circuit symbols or labels	**(6)**

Level	Mark	Descriptor
	0	No awardable content.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Mark
6(a)(i)	C	(1)

Question number	Answer	Additional guidance	Mark
6(a)(ii)	Equating the same variable in both equations (1) $\Delta Q = m \times c \times \Delta\theta = P \times t$ Rearrangement (1) $t = \frac{(m \times c \times \Delta\theta)}{P}$ Substitution and evaluation (1) $t = \frac{(1 \times 4200 \times 77)}{3500}$ $= 92\,\text{s}$	allow $\Delta\theta$ seen as $95 - 18$ 92.4 evaluation must be seen to at least 2 s.f. at some point in the working	(3)

Question number	Answer	Additional guidance	Mark
6(b)(i)	An answer that combines the following points of understanding to provide a logical description: • when steam condenses, its molecules move closer together, so the internal energy decreases (1) • when the water from the condensed steam cools, its molecules move more slowly, therefore storing less kinetic energy (1)	allow as water cools, the distance between the particles decreases which increases the intermolecular forces	(2)

Question number	Answer	Additional guidance	Mark
6(b)(ii)	equating the variables in the three equations/principle of conservation of energy (1) $(m_w \times l_w) + (m_w \times c_w \times \Delta\theta_w) = (m_m \times c_m \times \Delta\theta_m)$ rearrangement (1) $m_m = \frac{(m_w \times l_w) + (m_w \times c_w \times \Delta\theta_w)}{(c_m \times \Delta\theta_m)}$ substitution of correctly calculated quantities (1) $= \left(\frac{\left(\left(\frac{25}{1000}\right) \times 2260000\right) + \left(\left(\frac{25}{1000}\right) \times 4200 \times 35\right)}{3840 \times 60} \right)$ evaluation (1) 0.26 (kg)	allow in words or with suitable alternative subscripts temperature changes and l_w must be correct allow maximum of 3 marks for calculations that omit the energy from cooling of water	**(4)**

Question number	Answer	Mark
6(b)(iii)	Any two of the following reasons: • more steam must condense and transfer the energy that is dissipated to the jug during the process (1) • more steam must condense and transfer the energy that is dissipated to the surroundings during the process (1) • more steam must condense and transfer the energy needed to cause the milk to froth (1) • more steam must condense to replace any steam that might leave the milk without condensing (1)	**(2)**

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