OCR
Oxford Cambridge and RSA

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Friday 16 June 2017 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE PHYSICS A/ADDITIONAL SCIENCE A

A182/01 Modules P4 P5 P6 (Foundation Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

* A 1 8 2 0 1 *

* 6 7 2 0 0 8 9 4 5 5 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil ( ).
- A list of useful relationships is printed on page **2**.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable Energy

energy transferred = power × time

power = voltage × current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining Motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

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

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric Circuits

power = voltage × current

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive Materials

energy = mass × [speed of light in a vacuum]^2

Answer **all** the questions

1 For each of the following situations say whether there are **no forces** acting on the object, or there is a **resultant force**, or there are forces acting which are **balanced**.

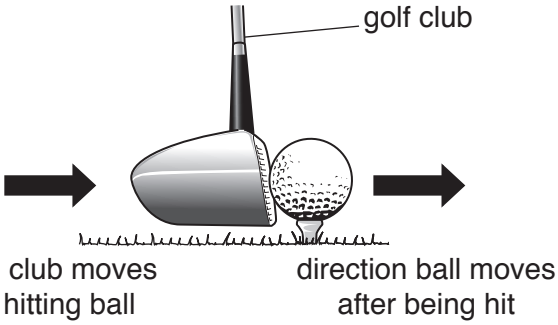
Put a tick (✓) in the one correct box for each situation.

Situation	No forces	Resultant force	Balanced forces
a ball accelerating as it falls vertically			
a person parachuting falling vertically at constant speed			
a book resting on a table			
a car moving along a straight road without accelerating			

[4]

[Total: 4]

2 Grace is playing golf. She swings her golf club so that it hits a stationary ball.



(a) (i) Why is the kinetic energy of the ball zero **before** it is hit?

..... **[1]**

(ii) The ball has mass 0.050 kg and velocity 40 m/s after it has been hit.

Calculate the kinetic energy of the ball **after** it has been hit.

Show your working.

kinetic energy = ... J **[2]**

(iii) Grace hears the club hit the ball.

How does the amount of kinetic energy gained by the ball compare with the kinetic energy of the club just before it hits the ball?

Put a (ring) around the correct answer.

less than **the same** **more than**

Justify your choice.

.....

..... **[2]**

(b) (i) Grace calculates that the momentum of the ball changes by 2.0 kg m/s.

Explain how she got this value.

.....

..... **[2]**

(ii) The force **on the ball** due to the club is 4000 N.

How large is the force **on the club**?

Put a (ring) around the correct answer.

< 4000 N **4000 N** **> 4000 N** **[1]**

(iii) Grace hits the golf ball with a different club.

The force on the ball is the same as before, but the club and ball are in contact for a longer time.

Grace thinks this makes the ball go faster.

Do you agree with Grace?

Use ideas about momentum and time to explain your answer.

.....

.....

.....

..... **[2]**

[Total: 10]

3 A car travels along a straight horizontal road.

The table shows how the speed of the car varies for part of its journey.

Time (s)	0	10	20	30	40	50	60	70	80
Speed (m/s)	20	20	20	20	22	24	26	28	30

Use the data in the table to describe and explain the motion of the car.

You may draw a **sketch** graph with important points clearly labelled to help you answer the question.

The quality of written communication will be assessed in your answer.

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..... **[6]**

[Total: 6]

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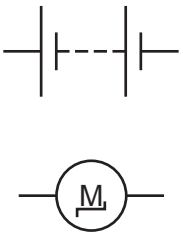
4 **(a)** Jake is buying an electric car.

(i) The car's source of energy is a battery, which is connected to an electric motor by metal wires.

A voltmeter is used to measure the voltage across the battery.

Complete the circuit diagram below by connecting the battery to the motor and showing the voltmeter connected correctly.



motor

[3]

(ii) There is an electric current in the connecting wires when the motor is working.

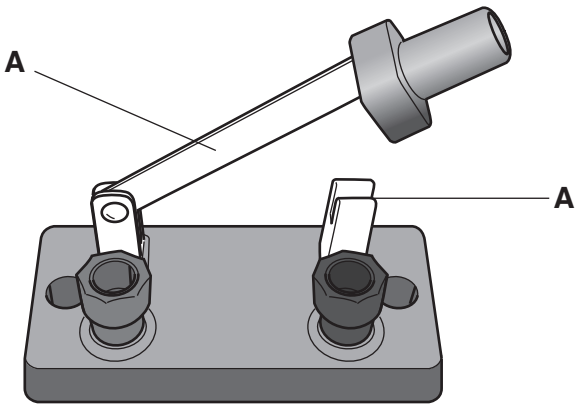
What moves in the wires to cause this electric current?

Put a tick (✓) in the box next to the correct answer.

electrons and protons	☐
electrons only	☐
metal ions	☐
protons only	☐

[1]

(iii) The diagram shows a switch which can be used to turn the motor on and off.



Which of the following materials can be used for the parts labelled **A**?

Put a (ring) around the **two** correct answers.

aluminium **copper** **plastic** **wood** **[1]**

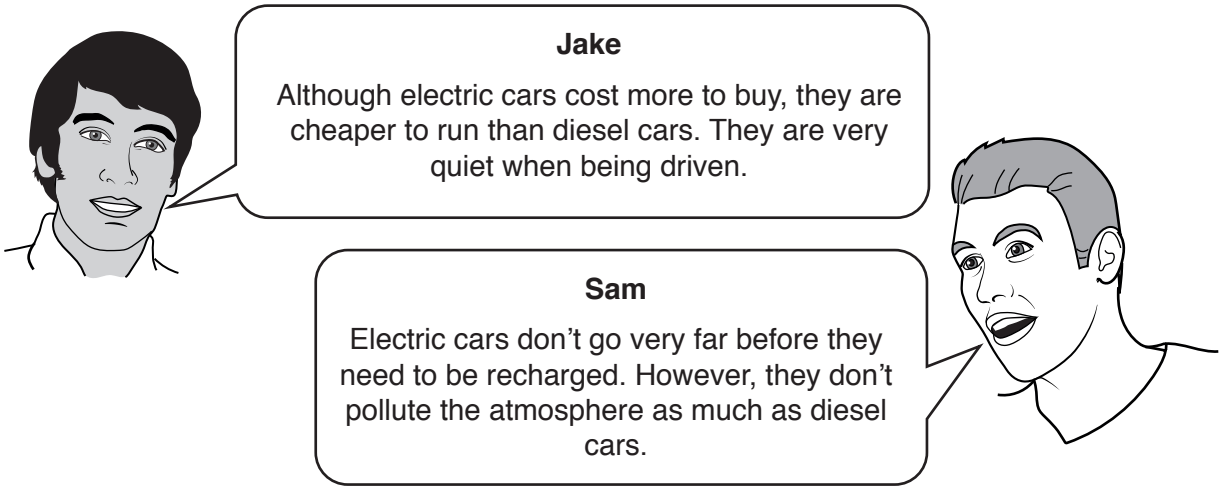
(b) The voltage of the battery is 300 V.

Which is the correct calculation to get the power of the motor when the current is 100 A?

Put a (ring) around the correct answer.

(100 ÷ 300) **(300 ÷ 100)** **(300 + 100)** **(300 × 100)** **[1]**

(c) Jake discusses with Sam the advantages and disadvantages of electric cars compared with diesel powered cars.



(i) Why do diesel cars pollute the atmosphere more than electric cars?

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..... **[1]**

(ii) Electric cars are very quiet.

Suggest why this might be dangerous for pedestrians.

.....

..... **[1]**

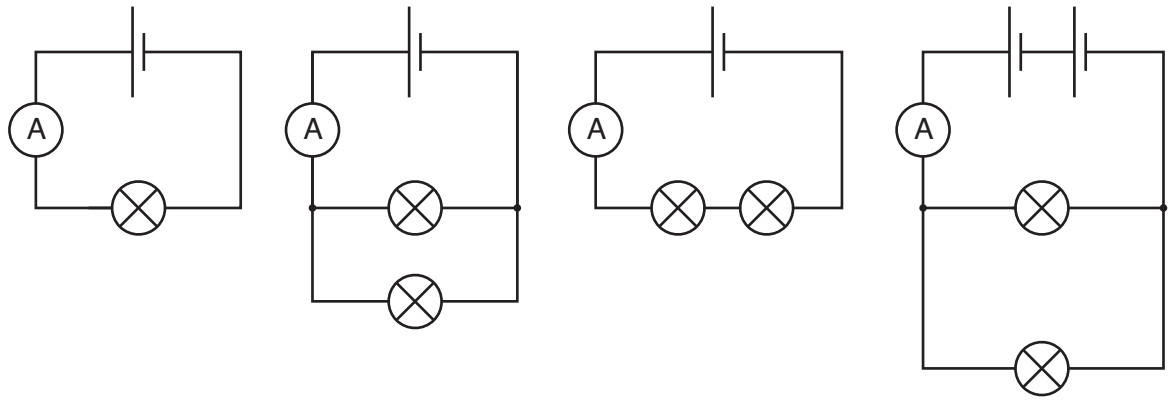
[Total: 8]

5 Alyssia is doing electricity experiments.

(a) She investigates the current in circuits made from cells and lamps.

All the cells are alike and all the lamps are alike.

Here are four circuits she connects up. Each circuit contains an ammeter.



circuit **A** | circuit **B** | circuit **C** | circuit **D**

For each statement choose the correct circuit.

Put a letter **A**, **B**, **C** or **D** in each box to show your choice.

You can use each letter once, twice or not at all.

(i) The ammeter in this circuit has the **smallest** reading. ☐ **[1]**

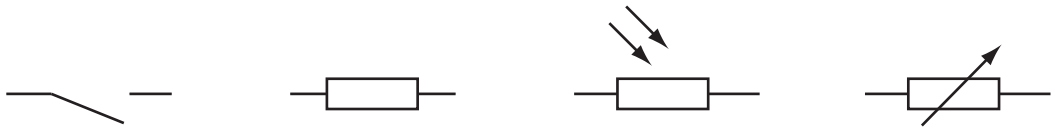
(ii) The ammeter in this circuit has the **greatest** reading. ☐ **[1]**

(iii) In these **TWO** circuits the lamps are connected in **parallel**. ☐ and ☐ **[1]**

(b) Alyssia then uses an LDR.

Which is the symbol for an LDR?

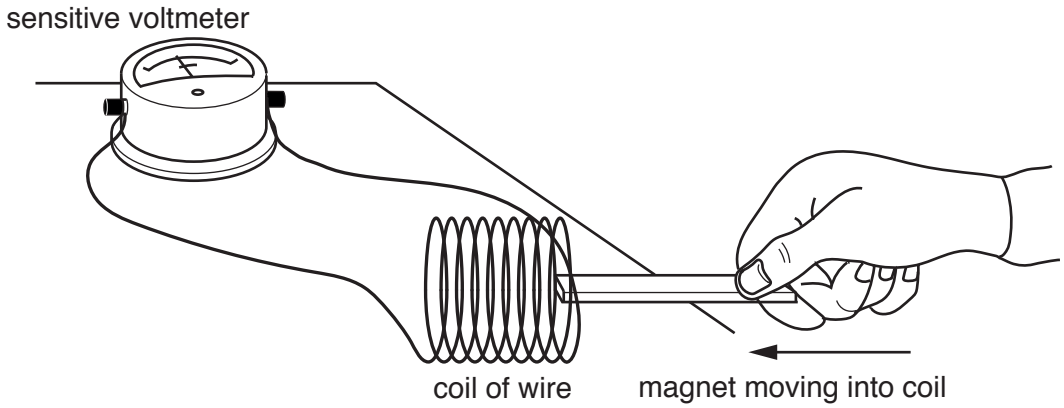
Put a (ring) around the correct symbol.



[1]

(c) Alyssia uses a magnet and a coil of wire to generate electricity.

The coil is connected to a sensitive voltmeter.



When Alyssia pushes the magnet into the coil the voltmeter reads 2 mV.

(i) What is the reading on the voltmeter when the magnet is held stationary in the coil?

..... **[1]**

(ii) What can Alyssia do to generate a voltage of 2 mV in the opposite direction?

.....

..... **[1]**

[Total: 6]

6 Zac and Megan are doing an experiment with a thermistor.

They use a 12 V power supply and an ammeter and voltmeter connected to the thermistor.

They put the thermistor in a beaker of water and gently heat the water.

They record the voltmeter and ammeter readings as well as the temperature of the water.

Here are their results.

Temperature (°C)	10	20	30	40
Voltage (V)	12	12	12	12
Current (mA)	0.60	1.0	1.5	2.4

Zac says: "There is no correlation between **temperature** and **current**."

Megan says: "The **resistance** of the thermistor changes as it gets warmer."

Comment on Zac and Megan's statements.

Use the data to justify your answer.

The quality of written communication will be assessed in your answer.

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..... **[6]**

[Total: 6]

7 Draw one straight line from each **word** to its correct **meaning** in the physics of radioactive materials.

Word	Meaning
	contains protons and electrons
fusion	
	gives out ionising radiation
	contains nuclei which never change
nucleus	
	a nucleus splits
	nuclei join
radioactive	
	small, massive and positive part of an atom

[3]

[Total: 3]

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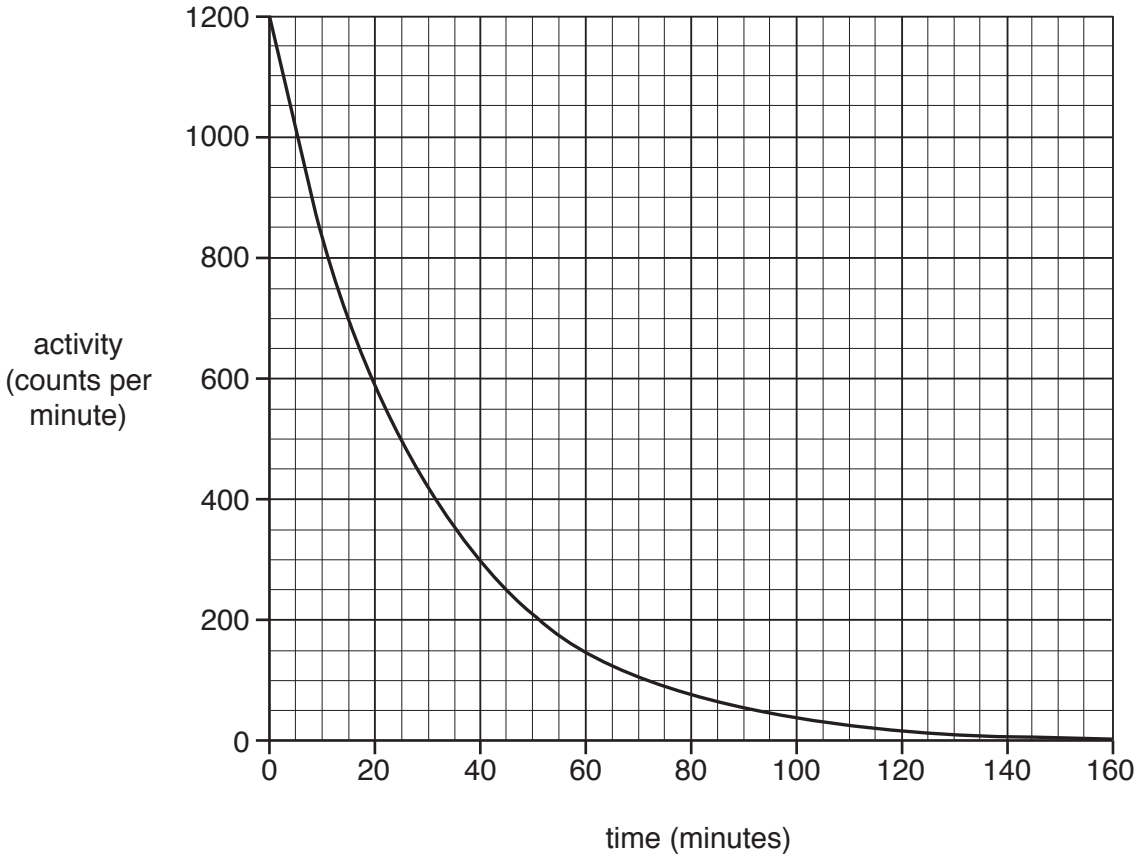
8 The graph shows how the activity of a radioactive source, **X**, decreases with time.



(a) At what time is the activity 200 counts per minute?

Put a (ring) around the correct answer.

40 minutes **52 minutes** **60 minutes** **68 minutes** **[1]**

(b) The half-life of the source is 20 minutes.

Explain how the graph shows this.

Use data from the graph to support your answer.

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..... **[2]**

(c) Another radioactive source, **Y**, has a starting activity of 1200 counts/minute, like **X**.

However, its half-life is **much less than 20 minutes**.

If it is plotted on the same graph, where will the line be?

Put a (ring) around the correct answer.

below the line for X **same place as X** **above the line for X** **[1]**

[Total: 4]

9 Background radiation is slightly higher in areas of the UK where there is granite rock.

Granite is radioactive, emitting gamma rays and radon gas.

Some of the decay products of radon are also radioactive, emitting alpha particles.

These decay products can stick to atmospheric dust. We breathe in this dust and it gets lodged in our lungs.

(a) What is meant by background radiation?

.....

..... **[1]**

(b) Use the information above about granite and radon decay products to explain the difference between **contamination** and **irradiation**.

.....

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.....

.....

..... **[3]**

(c) Radioactive materials may also emit beta particles as well as alpha particles and gamma rays.

These radiations are stopped by different materials.

Complete the table by putting a tick (✓) in the box if the material **stops** the radiation passing through.

You may put more than one tick in each row.

Material	**Type of radiation**		
	Alpha particle	**Beta particle**	**Gamma ray**
very thick lead			
3 mm of aluminium			
0.5 m of air			

[3]

[Total: 7]

10 Ryan has been advised by doctors that he needs to have a full-body CT scan.

The CT scan uses ionising radiation in order to produce an image of his internal organs.

Ryan is concerned as he has heard that ionising radiation can damage the body.

He has found the following information about doses of ionising radiation.

	Dose (millisievert)
Average background dose per year	2.7
Lowest dose per year definitely linked to an increase in cancer later in life	100
Fatal dose	5000
Recommended highest dose per year	50
Chest X-ray	0.10
Dental X-ray	0.01
Eating one banana or 100 g of Brazil nuts	0.01

The doctors have told Ryan that the CT scan will give him a dose of 10 millisievert.

Describe how ionising radiation can damage the body and explain why the doctors say that the benefits of a CT scan outweigh the risks.

Use the data in your answer.

The quality of written communication will be assessed in your answer.

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[Total: 6]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).