GCSE (9–1)
Mathematics

New topics – sample questions

Contents

About this booklet

This new topics sample questions booklet has been produced to support mathematics teachers delivering the new GCSE (9–1) in Mathematics (1MA1) specification (first assessment summer 2017).

How to use this booklet

This booklet provides a list of questions assessing new topics from the New Sample Assessment Materials and two sets of specimen papers (plus one question from the Original Sample Assessment Materials). Also included are a few sample questions for new assessment objectives. The questions are ordered by specification point.

Issue 2 includes questions from the three sets of mock papers issued in 2016 and 2017.

Free support

Our free support for the GCSE (9–1) Mathematics specification (1MA1) can be found on the Edexcel mathematics website (http://qualifications.pearson.com/en/home.html) and on the Emporium (www.edexcel.com).

1. Number

Structure and calculation

N5	apply systematic listing strategies, including use of the product rule for counting (**i.e. if there are *m* ways of doing one task and for each of these, there are *n* ways of doing another task, then the total number of ways the two tasks can be done is *m* × *n* ways**)

New to GCSE (9–1) Maths

Use of the product rule for counting.

Sample questions

Sally has three tiles.
Each tile has a different number on it.
Sally puts the three tiles down to make a number.
Each number is made with all three tiles.

How many different numbers can Sally make?

(Total 2 marks)
New SAMs Paper 1F qu.11 (N5 – AO1)

_____

There are 24 girls and 12 boys in a club.

One girl and one boy are going to be chosen to go to a meeting.

Work out the total number of ways of choosing a girl and a boy.

(Total 2 marks)
Mock Papers Set 2, Paper 3H qu.12 (N5 – AO1)

_____

There are 14 boys and 12 girls in a class.

Work out the total number of ways that 1 boy and 1 girl can be chosen from the class.

(Total 2 marks)
Specimen Papers Set 1, Paper 3H qu.13 (N5 – AO1)

_____

A cafe owner sells 10 different types of sandwich.

Rayheem buys a different type of sandwich on Monday, on Tuesday and on Wednesday.

In how many ways can he do this?

(Total for Question 14 is 2 marks)
Mock Papers Set 3, Paper 2H qu.14 (N5 – AO1)

_____

Marie has 25 cards.
Each card has a different symbol on it.

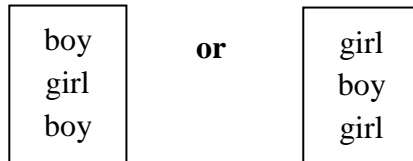Marie gives one card to Shelley and one card to Pauline.

(a) In how many different ways can Marie do this?

(2)

There are 12 boys and 10 girls in David's class.
David is going to pick three different students from his class and write their names in a
list in order.

The order will be

boy		girl
girl	**or**	boy
boy		girl

(b) How many different lists can David write?

(3)

(Total 5 marks)
Specimen Papers Set 2, Paper 2H qu.12 (N5 – AO1/AO3)

_____

There are 17 men and 26 women in a choir.
The choir is going to sing at a concert.
One of the men and one of the women are going to be chosen to make a pair to sing the first song.

(a) Work out the number of different pairs that can be chosen.

(2)

Two of the men are going to be chosen to make a pair to sing the second song.
Ben thinks the number of different pairs that can be chosen is 136
Mark thinks the number of different pairs that can be chosen is 272

(b) Who is correct, Ben or Mark?
     Give a reason for your answer.

(1)

(Total 3 marks)
New SAMs Paper 3H qu.15 (N5 – AO1/AO2)

_____

There are 95 girls and 87 boys in Year 13 at a school.

One girl is going to be chosen for the role of Head Girl.
A different girl is going to be chosen for the role of Deputy Head Girl.
One boy is going to be chosen for the role of Head Boy.
A different boy is going to be chosen for the role of Deputy Head Boy.

Work out how many different ways this can be done.

(Total 3 marks)
Mock Papers Set 1, Paper 2H qu.18 (N5 – AO1)

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Measures and accuracy

N15	round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures); use inequality notation to specify simple error intervals due to truncation or rounding

New to GCSE (9–1) Maths

Using inequality notation to specify simple error intervals due to truncation or rounding.

Sample questions

The length, *L* cm, of a line is measured as 13 cm correct to the nearest centimetre.

Complete the following statement to show the range of possible values of *L*.

.... $\leq L <$ ....

(Total 2 marks)
Specimen Papers Set 1, Paper 3F qu.22 / 3H qu.2 (N15 – AO1)

_____

Jim rounds a number, *x*, to one decimal place.
The result is 7.2.

Write down the error interval for *x*.

(Total 2 marks)
Specimen Papers Set 2, Paper 3F qu.25 / 3H qu.4 (N15 – AO1)

_____

Lyn measures the length, *x* cm, of a piece of string as 3.5 cm correct to the nearest millimetre.

Write down the error interval for *x*.

(Total 2 marks)
Mock Papers Set 2, Paper 2F qu.20 (N15 – AO1)

_____

A number, *y*, is rounded to 2 significant figures.

The result is 0.46.

Write down the error interval for *y*.

(Total 2 marks)
Mock Papers Set 1, Paper 1F qu.23 (N15 – AO1)

_____

Kiera used her calculator to work out the value of a number *x*.
She wrote down the first two digits of the answer on her calculator.

She wrote down 7.3

Write down the error interval for *x*.

(Total 2 marks)
Mock Papers Set 3, Paper 3H qu.8 (N15 – AO1)

_____

2. Algebra

Notation, vocabulary and manipulation

A4	simplify and manipulate algebraic expressions (including those involving surds **and algebraic fractions**) by:

  - collecting like terms
  - multiplying a single term over a bracket
  - taking out common factors
  - expanding products of two **or more** binomials
  - factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares; **factorising quadratic expressions of the form $ax^2 + bx + c$**
  - simplifying expressions involving sums, products and powers, including the laws of indices

New to GCSE (9–1) Maths

Expanding the products of more than two binomials.

Sample questions

Show that

$$(3x - 1)(x + 5)(4x - 3) = 12x^3 + 47x^2 - 62x + 15$$

for all values of x.

(Total 3 marks)
Specimen Papers Set 1, Paper 2H qu.13 (A4, A6 – AO2)

_____

Expand and simplify $(x + 2)(x + 8)(x - 4)$

(Total 3 marks)
Mock Papers Set 3, Paper 3H qu.11 (A4 – AO1)

_____

Expand and simplify $(x + 2)(2x - 3)(3x + 1)$

(Total 3 marks)
Mock Papers Set 2, Paper 3H qu.13a (A4 – AO1)

_____

Martin expands $(2x + 1)(2x - 3)(3x + 2)$

He gets $12x^3 - 4x^2 - 17x + 6$

Explain why Martin's solution cannot be correct.

(Total 1 mark)
Mock Papers Set 1, Paper 1H qu.16b (A4 – AO3)

_____

A7   where appropriate, interpret simple expressions as functions with inputs and outputs;
interpret the reverse process as the 'inverse function';
**interpret the succession of two functions as a 'composite function' (the use of formal
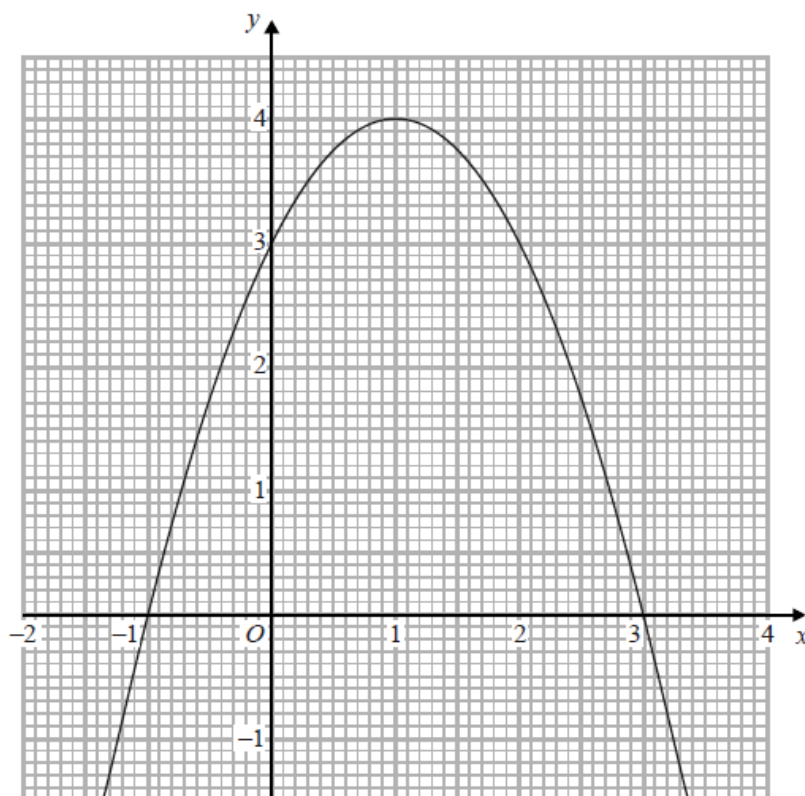function notation is expected)**

New to GCSE (9–1) Maths

Interpreting the reverse process as the 'inverse function'.

Interpreting the succession of two functions as a 'composite function'.

Sample questions

The graph of $y = f(x)$ is drawn on the grid.

(*a*) Write down the coordinates of the turning point of the graph.

(1)

(*b*) Write down the roots of f(*x*) = 2

(1)

(*c*) Write down the value of f(0.5)

(1)

(Total 3 marks)
New SAMs Paper 2H qu.7 (A7, A11 – AO2)

_____

2. Algebra

The functions f and g are such that

$$f(x) = 3(x - 4) \quad \text{and} \quad g(x) = \frac{x}{5} + 1$$

(*a*) Find the value of   f(10)

(1)

(*b*) Find $g^{-1}(x)$

(2)

(*c*) Show that $ff(x) = 9x - 48$

(2)

(Total 5 marks)
Specimen Papers Set 2, Paper 2H qu.9 (A7 – AO1/AO2)

_____

The function f is such that

$$f(x) = 4x - 1$$

(*a*) Find $f^{-1}(x)$

(2)

The function g is such that

$$g(x) = kx^2 \text{ where } k \text{ is a constant.}$$

Given that fg(2) = 12

(*b*) work out the value of *k*

(2)

(Total 4 marks)
New SAMs Paper 3H qu.10 (A7 – AO1/AO3)

_____

$$f(x) = 3x^2 - 2x - 8$$

Express f(*x* + 2) in the form $ax^2 + bx$

(Total 3 marks)
Specimen Papers Set 1, Paper 2H qu.18 (A7 – AO1/AO2)

_____

For all values of x

$$f(x) = 2x - 3 \quad \text{and} \quad g(x) = x^2 + 2$$

(*a*) Find   g(−4)

(1)

(*b*) Show that   gf(x) = $4x^2 - 12x + 11$

(2)

(*c*) Solve   fg(x) = gf(x)

(4)

(Total 7 marks)
Mock Papers Set 1, Paper 3H qu.20 (A7, A4, A18 – AO1/AO2/AO3)

_____

f and g are functions such that

$$f(x) = 3x^2 \text{ and } g(x) = \frac{1}{x-2}$$

Find gf(4).
Give your answer as a fraction.

(Total 2 marks)
Mock Papers Set 2, Paper 2H qu.21 (A7 – AO1)

_____

$f(x) = x^3$
$g(x) = 4x - 1$

(*a*) Find   fg(2)

(2)

h(x) = fg(x)

(*b*) Find an expression for h^{-1}(x)

h^{-1}(x) = ...

(3)

(Total 5 marks)
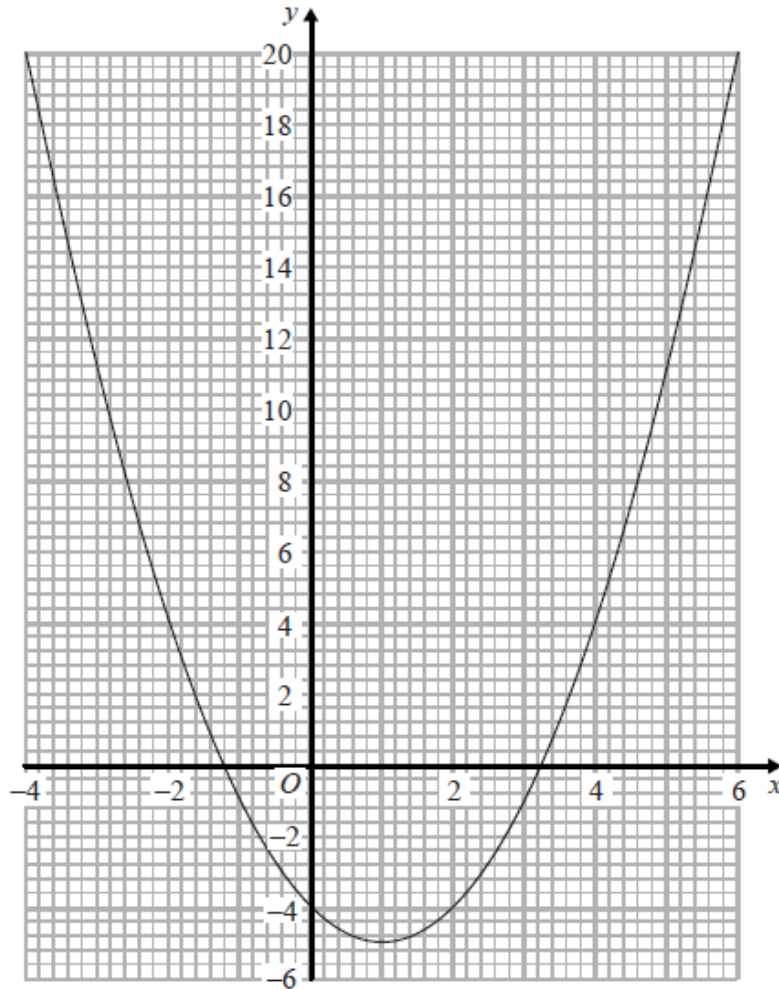*Mock Papers Set 3, Paper 3H qu.21 (A7 – AO1)*

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Graphs

A11	identify and interpret roots, intercepts, turning points of quadratic functions graphically; deduce roots algebraically **and turning points by completing the square**

New to GCSE (9–1) Maths

The content in A11 is new to GCSE (9–1) Maths.

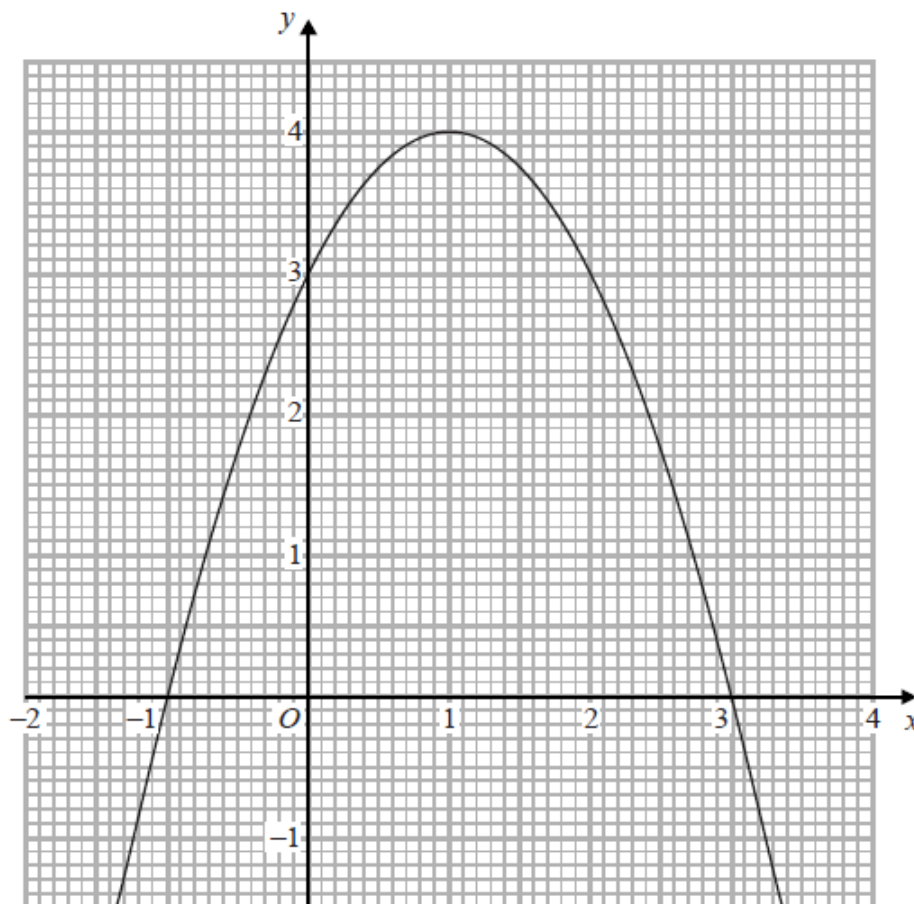### Sample questions

Here is the graph of $y = x^2 - 2x - 4$

(a) Write down estimates for the roots of $x^2 - 2x - 4 = 0$

(2)

(b) Write down the coordinates of the turning point of $y = x^2 - 2x - 4$

(.......................... , ...)

(1)

(Total 3 marks)

Mock Papers Set 2, Paper 2F qu.25 / 2H qu.4 (A11 – AO2)

_____

The graph of $y = f(x)$ is drawn on the grid.

(a) Write down the coordinates of the turning point of the graph.

(1)

(b) Write down the roots of $f(x) = 2$

(1)

(c) Write down the value of $f(0.5)$

(1)

(Total 3 marks)

New SAMs Paper 2H qu.7 (A11, A7 – AO2)

_____

(a) Write $2x^2 + 16x + 35$ in the form $a(x + b)^2 + c$ where a, b, and c are integers.

(3)

(b) Hence, or otherwise, write down the coordinates of the turning point of the graph of $y = 2x^2 + 16x + 35$

(1)

(Total 4 marks)

Specimen Papers Set 2, Paper 3H qu.23 (A11 – AO1)

_____

> **A12** recognise, sketch and interpret graphs of linear functions, quadratic functions, <u>simple cubic functions, the reciprocal function</u> $y = \dfrac{1}{x}$ with $x \neq 0$, **exponential functions** $y = k^x$
>
> **for positive values of k, and the trigonometric functions (with arguments in degrees)** $y = \sin x$, $y = \cos x$ **and** $y = \tan x$ **for angles of any size**

New to GCSE (9–1) Maths

The content in A12 is not new to GCSE (9–1) Maths, but below are two A12 questions assessing new Assessment Objectives.

Sample questions

In triangle *RPQ*,

RP = 8.7 cm
PQ = 5.2 cm
Angle *PRQ* = 32°

(*a*) Assuming that angle *PQR* is an acute angle,
calculate the area of triangle *RPQ*.
Give your answer correct to 3 significant figures.

(4)

(*b*) If you did not know that angle *PQR* is an acute angle, what effect would this have on your calculation of the area of triangle *RPQ*?

(1)

(Total 5 marks)
New SAMs Paper 2H qu.21 (A12, G23 – AO1/AO3)

_____

Louis and Robert are investigating the growth in the population of a type of bacteria.
They have two flasks A and B.

At the start of day 1, there are 1000 bacteria in flask A.
The population of bacteria grows exponentially at the rate of 50% per day.

(*a*) Show that the population of bacteria in flask A at the start of each day forms a geometric progression.

(2)

The population of bacteria in flask A at the start of the 10th day is *k* times the population of bacteria in flask A at the start of the 6th day.

(*b*) Find the value of *k*.

(2)

At the start of day 1 there are 1000 bacteria in flask B.
The population of bacteria in flask B grows exponentially at the rate of 30% per day.

(*c*) Sketch a graph to compare the size of the population of bacteria in flask A and in flask B.

(1)

(Total 5 marks)
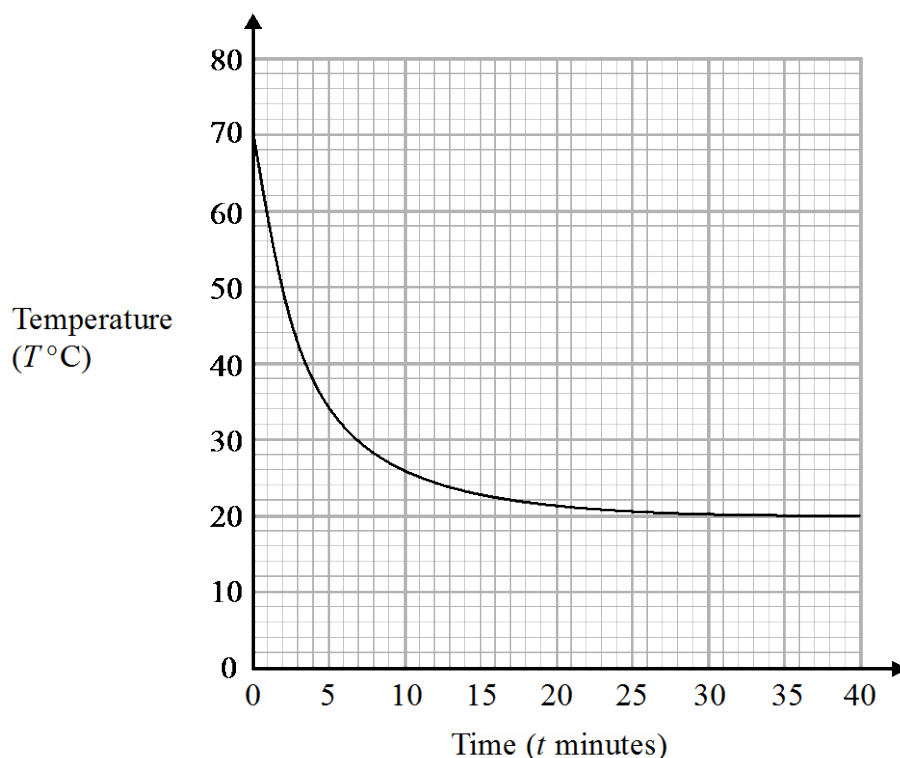*New SAMs Paper 3H qu.17 (A12, R16 – AO1/AO2/AO3)*

_____

> **A15** calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as distance–time graphs, velocity–time graphs and graphs in financial contexts (this does not include calculus)

New to GCSE (9–1) Maths

The content in A15 is new to GCSE (9–1) Maths.

Sample questions

The graph shows the temperature, $T\,°C$, of the coffee in a cup at a time t minutes.

(a) Find an estimate for the gradient of the graph at time 5 minutes.

(2)

(b) Explain what this gradient represents.

(1)

(Total 3 marks)
Mock Papers Set 3, Paper 1H qu.13 (A15, R15 – AO1/AO2)

_____

Karol runs in a race.

The graph shows her speed, in metres per second, t seconds after the start of the race.
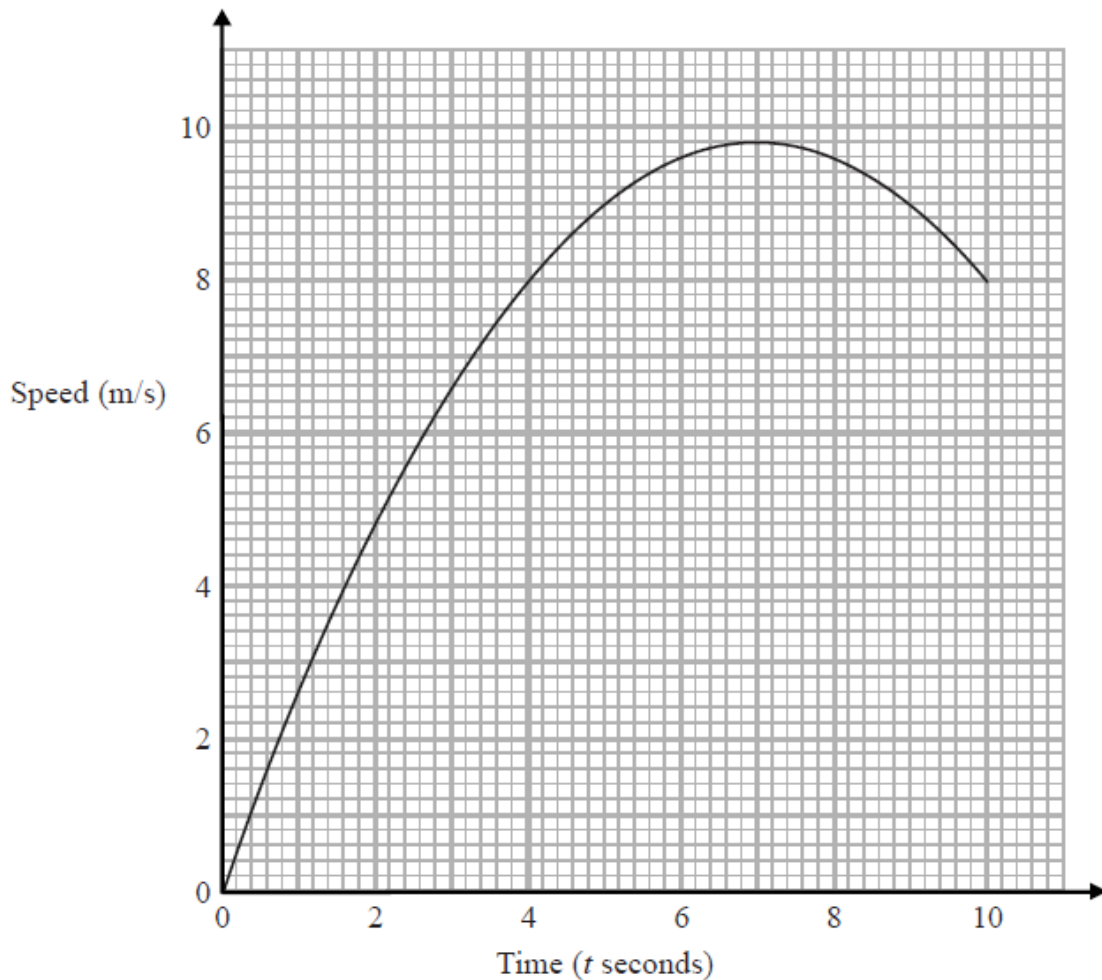
(a) Calculate an estimate for the gradient of the graph when $t = 4$
You must show how you get your answer.

(3)

(b) Describe fully what your answer to part (a) represents.

(2)

(c) Explain why your answer to part (a) is only an estimate.

(1)

(Total 6 marks)
Specimen Papers Set 2, Paper 2H qu.15 (A15 –AO1/AO2/AO3)

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Here is a speed-time graph showing the speed, in metres per second, of an object *t* seconds after it started to move.
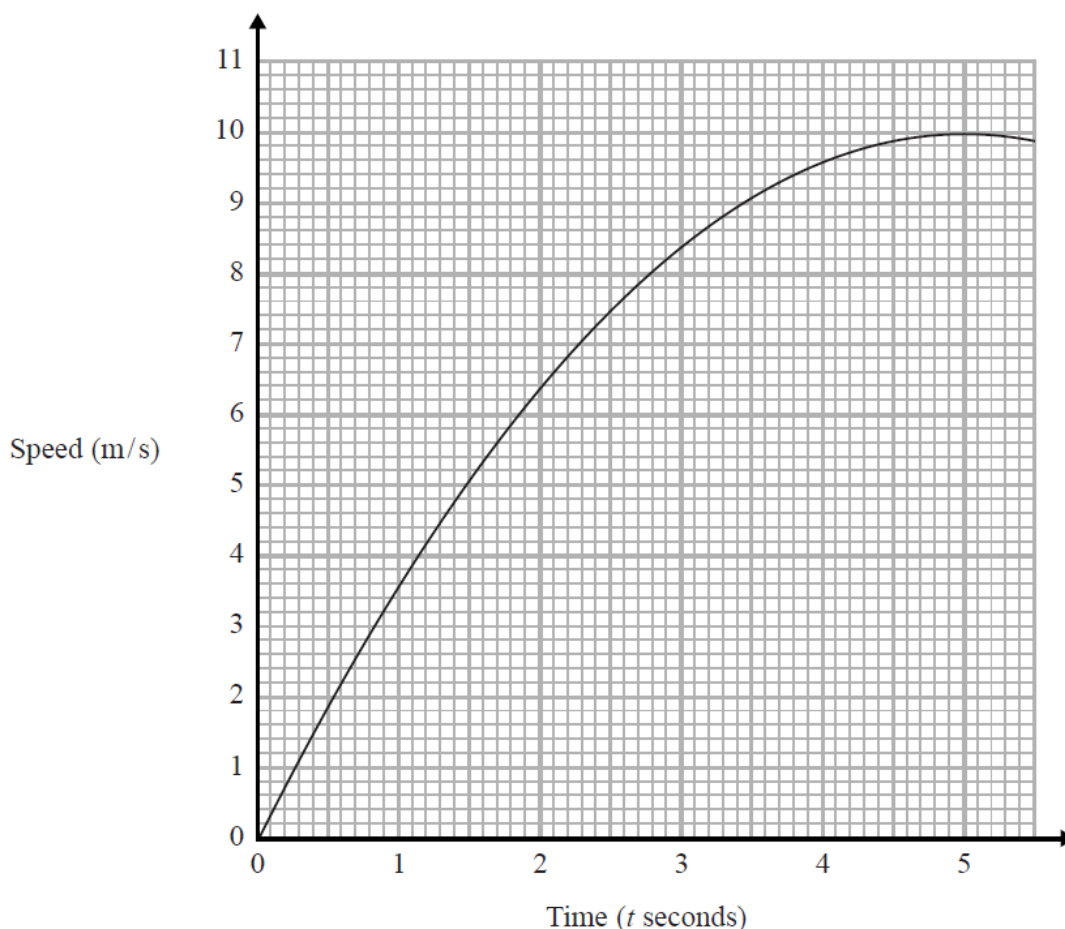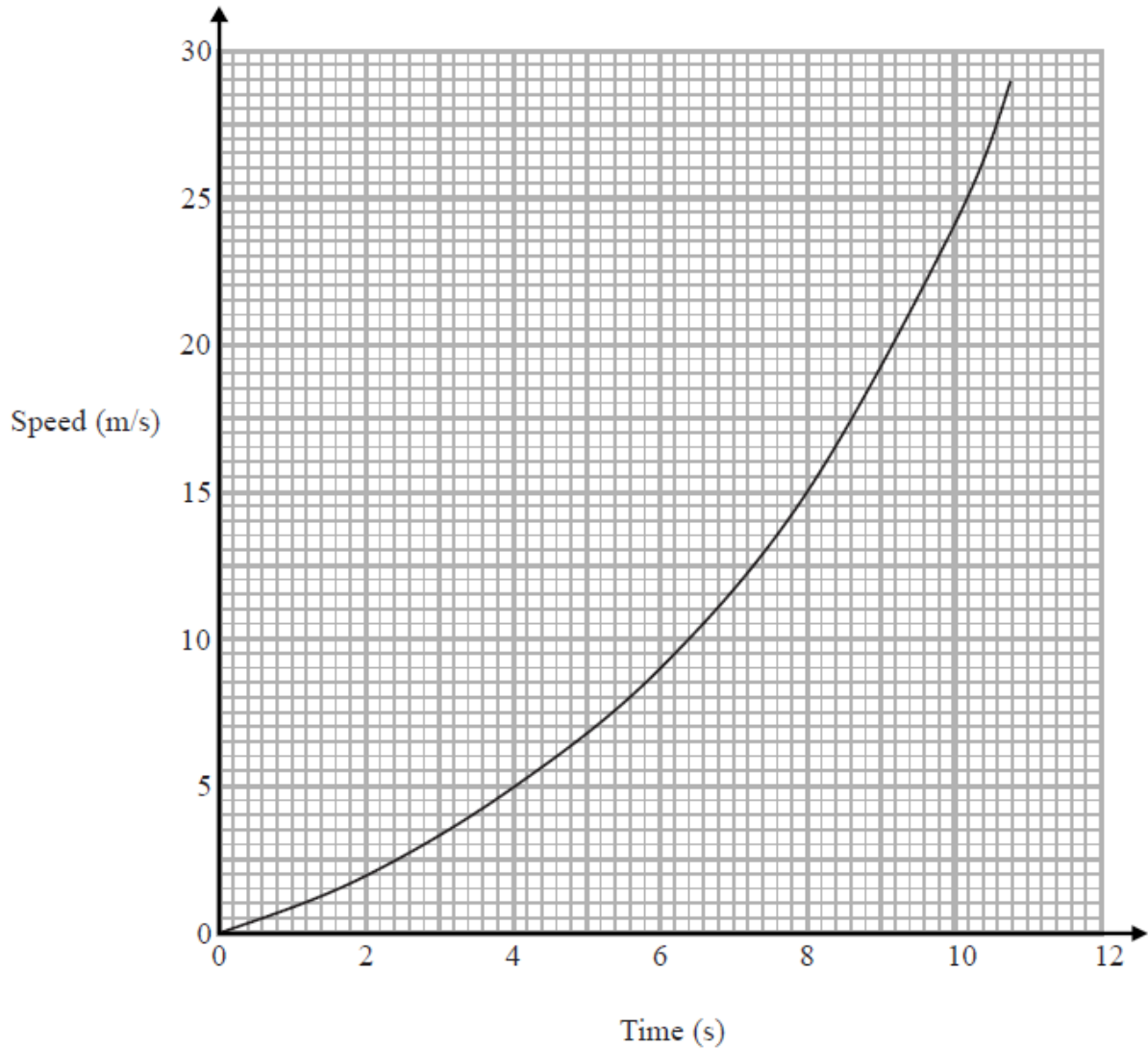

(*a*) Use 3 strips of equal width to find an estimate for the area under the graph between *t* = 1 and *t* = 4

(3)

(*b*) Describe fully what your answer to part (a) represents.

(2)

(*c*) Explain whether your answer in part (a) gives an underestimate or an overestimate for the area under the graph.

(1)

(Total 6 marks)
Mock Papers Set 1, Paper 2H qu.17 (A15 – AO1/AO2/AO3)

_____

2. Algebra

Here is a speed-time graph for a car.

Speed (m/s)

Time (s)

(*a*) Work out an estimate for the distance the car travelled in the first 10 seconds.
Use 5 strips of equal width.

(3)

(*b*) Is your answer to (*a*) an underestimate or an overestimate of the actual distance?
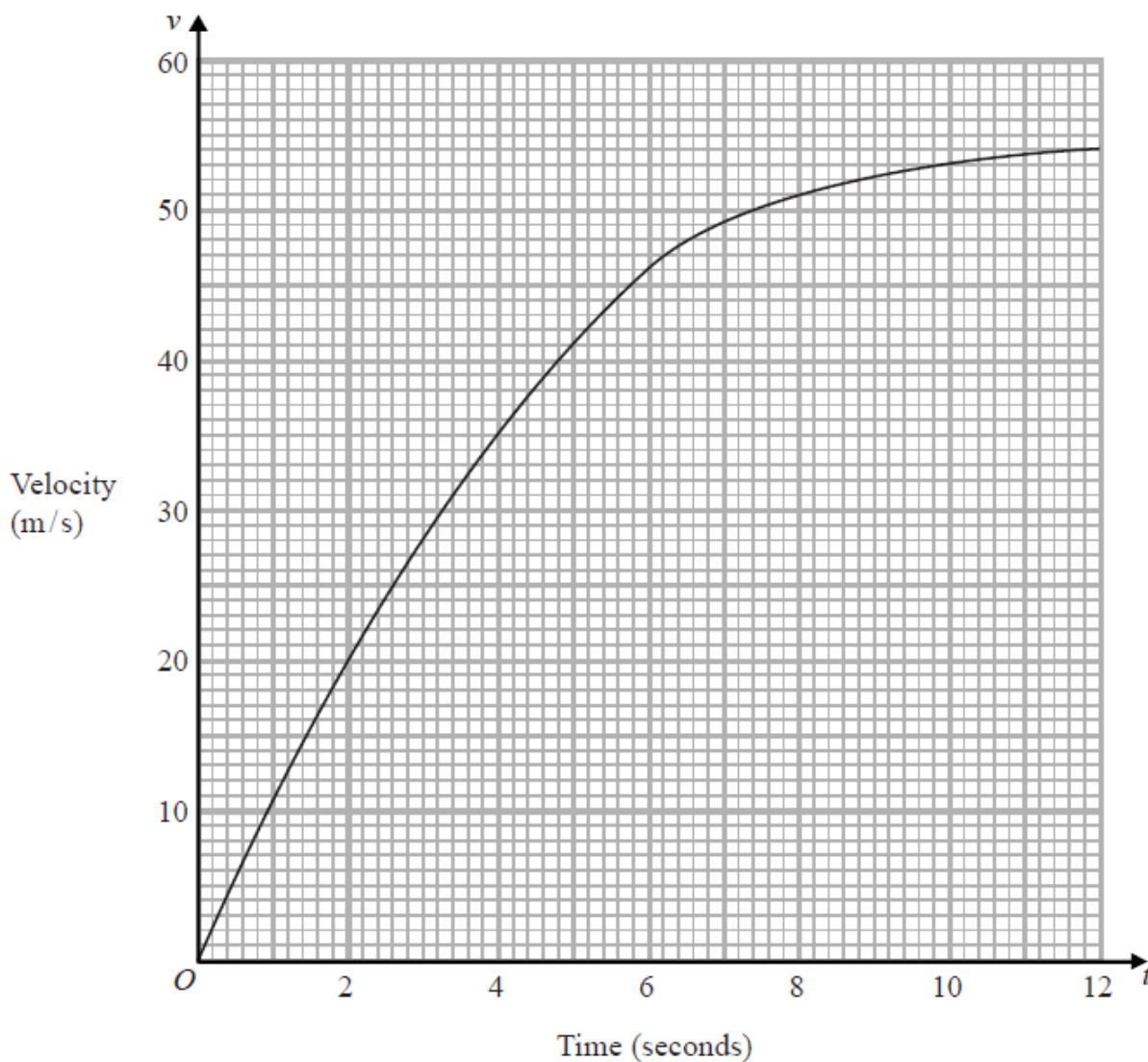Give a reason for your answer.

(1)

(Total 4 marks)
Specimen Papers Set 2, Paper 3H qu.18 (A15 –AO1/AO3)

The graph shows information about the velocity, v m/s, of a parachutist t seconds after leaving a plane.

(a) Work out an estimate for the acceleration of the parachutist at $t = 6$

(2)

(b) Work out an estimate for the distance fallen by the parachutist in the first 12 seconds after leaving the plane.
Use 3 strips of equal width.

(3)

(Total 5 marks)

Specimen Papers Set 1, Paper 2H qu.20 (A15 –AO1/AO2)

Here is a speed-time graph for a car journey.
The journey took 100 seconds.
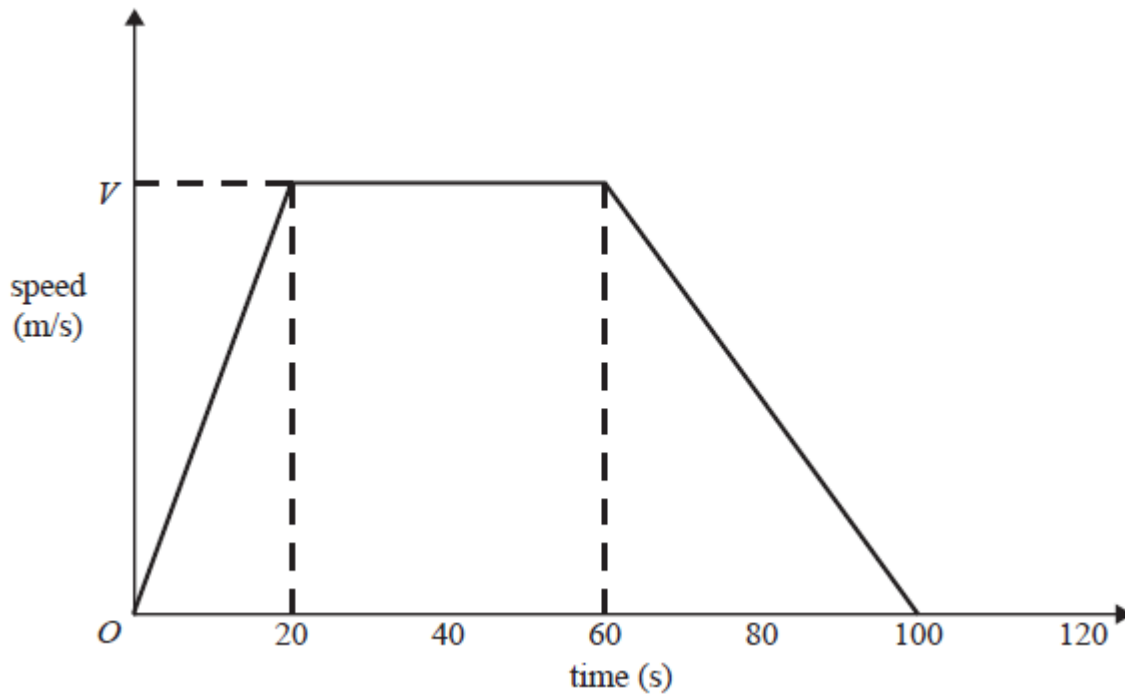
The car travelled 1.75 km in the 100 seconds.

(a) Work out the value of V.

(3)

(b) Describe the acceleration of the car for each part of this journey.

(2)

(Total 5 marks)
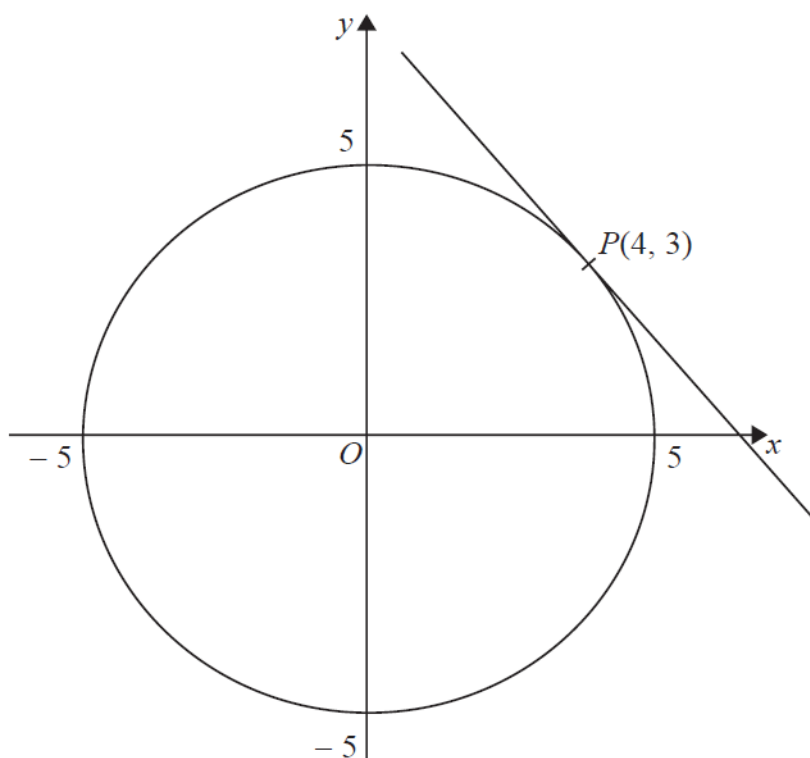*New SAMs Paper 1H qu.21 (A15 – AO1/AO2/AO3)*

_____

A16 recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point

New to GCSE (9–1) Maths

Finding the equation of a tangent to a circle at a given point.

Sample questions

Here is a circle, centre O, and the tangent to the circle at the point $P(4, 3)$ on the circle.
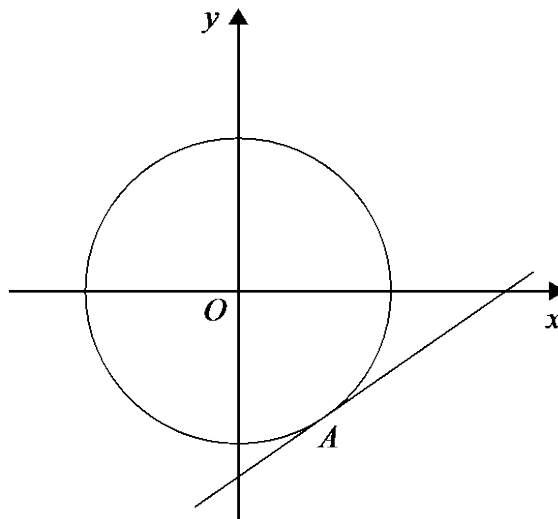

Find an equation of the tangent at the point P.

(Total 3 marks)
Specimen Papers Set 1, Paper 2H qu.23 (A16 –AO1)

2. Algebra

The diagram shows the circle with equation $x^2 + y^2 = 261$

A tangent to the circle is drawn at point A with coordinates $(p, -15)$, where $p > 0$

Find an equation of the tangent at A.

(Total 5 marks)
Mock Papers Set 3, Paper 3H qu.22 (A16, A9, A10 – AO1/AO3)

_____

The line l is a tangent to the circle $x^2 + y^2 = 40$ at the point A.
A is the point (2, 6).

The line l crosses the x-axis at the point P.

Work out the area of triangle OAP.

(Total 5 marks)
Specimen Papers Set 2, Paper 1H qu.22 (A16, A9, G16 –AO1/AO3)

_____

Solving equations and inequalities

A20	**find approximate solutions to equations numerically using iteration**

New to GCSE (9–1) Maths

The content in A20 is new to GCSE (9–1) Maths.

Sample questions

(a) Show that the equation $x^3 + 5x - 4 = 0$ has a solution between $x = 0$ and $x = 1$

(2)

(b) Show that the equation $x^3 + 5x - 4 = 0$ can be arranged to give $x = \dfrac{4}{x^2 + 5}$

(2)

(c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \dfrac{4}{x_n^2 + 5}$ twice,

to find an estimate for the solution of $x^3 + 5x - 4 = 0$

(3)

(Total 7 marks)

Mock Papers Set 1, Paper 3H qu.13 (A20, A2, A4 – AO1/AO2)

_____

(a) Show that the equation $x^3 + 4x = 1$ has a solution between $x = 0$ and $x = 1$

(2)

(b) Show that the equation $x^3 + 4x = 1$ can be arranged to give $x = \dfrac{1}{4} - \dfrac{x^3}{4}$

(1)

(c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \dfrac{1}{4} - \dfrac{x_n^3}{4}$ twice,

to find an estimate for the solution of $x^3 + 4x = 1$

(3)

(Total 6 marks)

New SAMs Paper 3H qu.14 (A20, A4 – AO1/AO2)

_____

(a) Show that the equation $x^3 - 3x^2 + 3 = 0$ has a solution between $x = 2$ and $x = 3$

(2)

(b) Show that the equation $x^3 - 3x^2 + 3 = 0$ can be rearranged to give $x = \sqrt[3]{3x^2 - 3}$

(1)

(c) Starting with $x_0 = 2$, use the iteration formula $x_{n+1} = \sqrt[3]{3x^2 - 3}$ to find the value of x_2.
Give your answer correct to 3 decimal places.

(3)

(Total 6 marks)
Mock Papers Set 3, Paper 2H qu.16 (A20, A4 – AO1/AO2)

_____

(a) Show that the equation $3x^2 - x^3 + 3 = 0$ can be rearranged to give

$$x = 3 + \frac{3}{x^2}$$

(2)

(b) Using

$$x_{n+1} = 3 + \frac{3}{x_n^2} \qquad \text{with } x_0 = 3.2,$$

find the values of x_1, x_2 and x_3

(3)

(c) Explain what the values of x_1, x_2 and x_3 represent.

(1)

(Total 6 marks)
Specimen Papers Set 1, Paper 3H qu.21 (A20, A5 –AO1/AO2/AO3)

_____

(a) Show that the equation $2x^3 + 4x = 3$ has a solution between 0 and 1.

(2)

(b) Show that $2x^3 + 4x = 3$ can be arranged to give $x = \frac{3}{4} - \frac{x^3}{2}$

(1)

(c) Starting with $x_0 = 0$, use the iteration formula $x_{n+1} = \frac{3}{4} - \frac{x_n^3}{2}$ three times to find an estimate for
the solution to $2x^3 + 4x = 3$

(3)

(Total 6 marks)
Mock Papers Set 2, Paper 2H qu.23 (A20, A4 – AO1/AO2)

_____

> **A22** solve linear inequalities in one **or two** variable**(s), and quadratic inequalities in one variable**;
> represent the solution set on a number line**, using set notation and on a graph**

New to GCSE (9–1) Maths

Solving quadratic inequalities in one variable and representing the solution set using set notation.

Sample questions

Solve $x^2 > 3x + 4$

(Total 3 marks)

New SAMs Paper 1H qu.19 (A22 – AO1)

_____

Solve $2x^2 - 5x - 12 > 0$

(Total 3 marks)

Mock Papers Set 2, Paper 3H qu.19 (A22 – AO1)

_____

Solve the inequality $x^2 > 3(x + 6)$

(Total 4 marks)

Specimen Papers Set 2, Paper 1H qu.21 (A22 –AO1)

_____

Sequences

A24	recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, <u>Fibonacci-type sequences, quadratic sequences, and simple geometric progressions</u> (r^n where n is an integer, and r is a rational number > 0 **or a surd**) **and other sequences**

New to GCSE (9–1) Maths

Recognising and using Fibonacci-type sequences, quadratic sequences and simple geometric progressions (including surds) and other sequences.

Sample questions

Here are the first six terms of a Fibonacci sequence.

$$1 \quad 1 \quad 2 \quad 3 \quad 5 \quad 8$$

The rule to continue a Fibonacci sequence is,

the next term in the sequence is the sum of the two previous terms.

(*a*) Find the 9th term of this sequence.

(1)

The first three terms of a different Fibonacci sequence are

$$a \quad b \quad a + b$$

(*b*) Show that the 6th term of this sequence is $3a + 5b$

(2)

Given that the 3rd term is 7 and the 6th term is 29,

(*c*) find the value of *a* and the value of *b*.

(3)

(Total 6 marks)
New SAMs Paper 3F qu.20 / 3H qu.3 (A24, A19, A21 – AO1/AO2/AO3)

_____

Here are the first four terms of a quadratic sequence.

$$3 \quad 8 \quad 15 \quad 24$$

(*a*) Find an expression, in terms of *n*, for the *n*th term of this sequence.

(3)

The *n*th term of a different sequence is $2^n + 5$

(*b*) Show that 36 is **not** a term of this sequence.

(1)

(Total 4 marks)
Mock Papers Set 1, Paper 2H qu.12 (A24, A25 – AO1/AO2)

_____

A25   deduce expressions to calculate the *n*th term of linear **and quadratic** sequences

New to GCSE (9–1) Maths

Deducing expressions to calculate the *n*th term of quadratic sequences.

Sample questions

Here are the first 5 terms of a quadratic sequence.

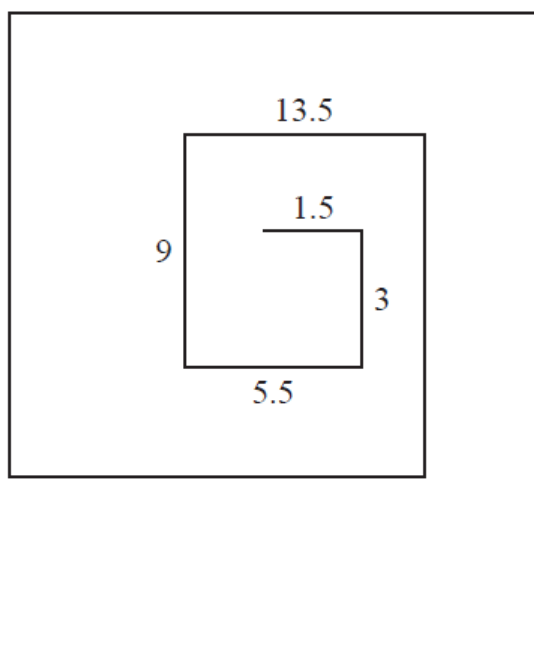<div align="center">

1   3   7   13   21

</div>

Find an expression, in terms of *n*, for the *n*th term of this quadratic sequence.

(Total 3 marks)
Specimen Papers Set 1, Paper 2H qu.17 (A25 –AO1/AO2)

_____

The diagram shows the first 10 sides of a spiral pattern.
It also gives the lengths, in cm, of the first 5 sides.

The lengths, in cm, of the sides of the spiral form a sequence.

Find an expression in terms of *n* for the length, in cm, of the *n*th side.

(Total 3 marks)
Mock Papers Set 1, Paper 1H qu.18 (A25 – AO2/AO3)

_____

3. Ratio, proportion and rates of change

R1	change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, <u>density, pressure</u>) in numerical and <u>algebraic</u> contexts

New to GCSE (9–1) Maths

Changing between related standard units and compound units in algebraic contexts.

Sample questions

A box exerts a force of 140 newtons on a table.
The pressure on the table is 35 newtons/m^2.

Calculate the area of the box that is in contact with the table.

$$P = \frac{F}{A}$$

p = pressure

F = force

A = area

(Total 3 marks)
Specimen Papers Set 1, Paper 1F qu.21 / 1H qu.2 (R1, R11, A2 – AO1)

_____

| R6 | express a multiplicative relationship between two quantities as a ratio or a fraction |

New to GCSE (9–1) Maths

The content in R6 is new to GCSE (9–1) Maths.

Sample questions

Mark asked each student in a different class to name their favourite colour.

For this class,
the number of students who said blue is three times the number of students who said green.

Write down the ratio of
the number of students who said blue to the number of students who said green.

(Total 1 mark)
Mock Papers Set 3, Paper 2F qu.5c (R6 – AO1)

_____

In a box of pens, there are

     three times as many red pens as green pens
and two times as many green pens as blue pens.

For the pens in the box, write down
the ratio of the number of red pens to the number of green pens to the number of blue pens.

(Total 2 marks)
New SAMs Paper 2H qu.8 (R6 – AO2)

_____

Anna and Bill share some money in the ratio 2 : 5

Anna gets £A
Bill gets £B

Carl and Donna share twice as much money as Anna and Bill share.
They share the money in the ratio 3 : 1

Carl gets £C
Donna gets £D

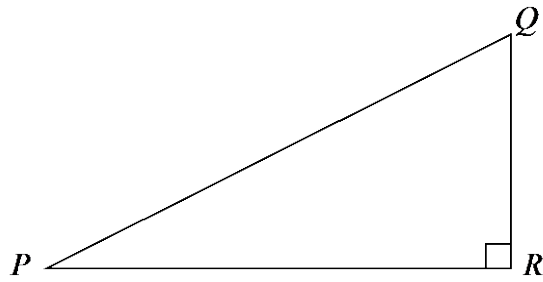Find $A : B : C : D$
Give your answer in its simplest form.

(Total 3 marks)
Mock Papers Set 3, Paper 2H qu.11 (R6, R4 – AO1/AO3)

_____

3. Ratio, proportion and rates of change

Here is triangle *PQR*.

The length of *QR* is 60% of the length of *PR*.

Find the value of sin *QPR*.
Give your answer correct to 3 significant figures.

(Total 3 marks)
Mock Papers Set 3, Paper 2H qu.12 (R6, G20 – AO1/AO3)

_____

| **R8** | relate ratios to fractions and to linear functions |

New to GCSE (9–1) Maths

Relating ratios to linear functions.

Sample questions

An indicative example from the FAQs document:

Purple paint is made from using red paint and blue paint in the ratio 1 : 2.

Write an equation for y in terms of x to show the relationship between the amount of red paint (y) and the amount of blue paint (x).

_____

There are only red counters, blue counters and green counters in a bag.

number of red counters : number of blue counters : number of green counters = 1 : 3 : 7

A counter is going to be taken at random from the bag.

Complete the table below to show each of the probabilities that the counter will be red or blue or green.

Colour	red	blue	green
Probability			

(Total 2 marks)
Mock Papers Set 3, Paper 3F qu.22a / 3H qu.4a (R8, P4 – AO2)

_____

3. Ratio, proportion and rates of change

The height (x cm) and the width (y cm) of TVs are in the ratio 9 : 16

(a) Use this information to draw a graph to show the relationship between the height and the width of TVs.
Use values of x from 20 to 80

Width of TV (cm)
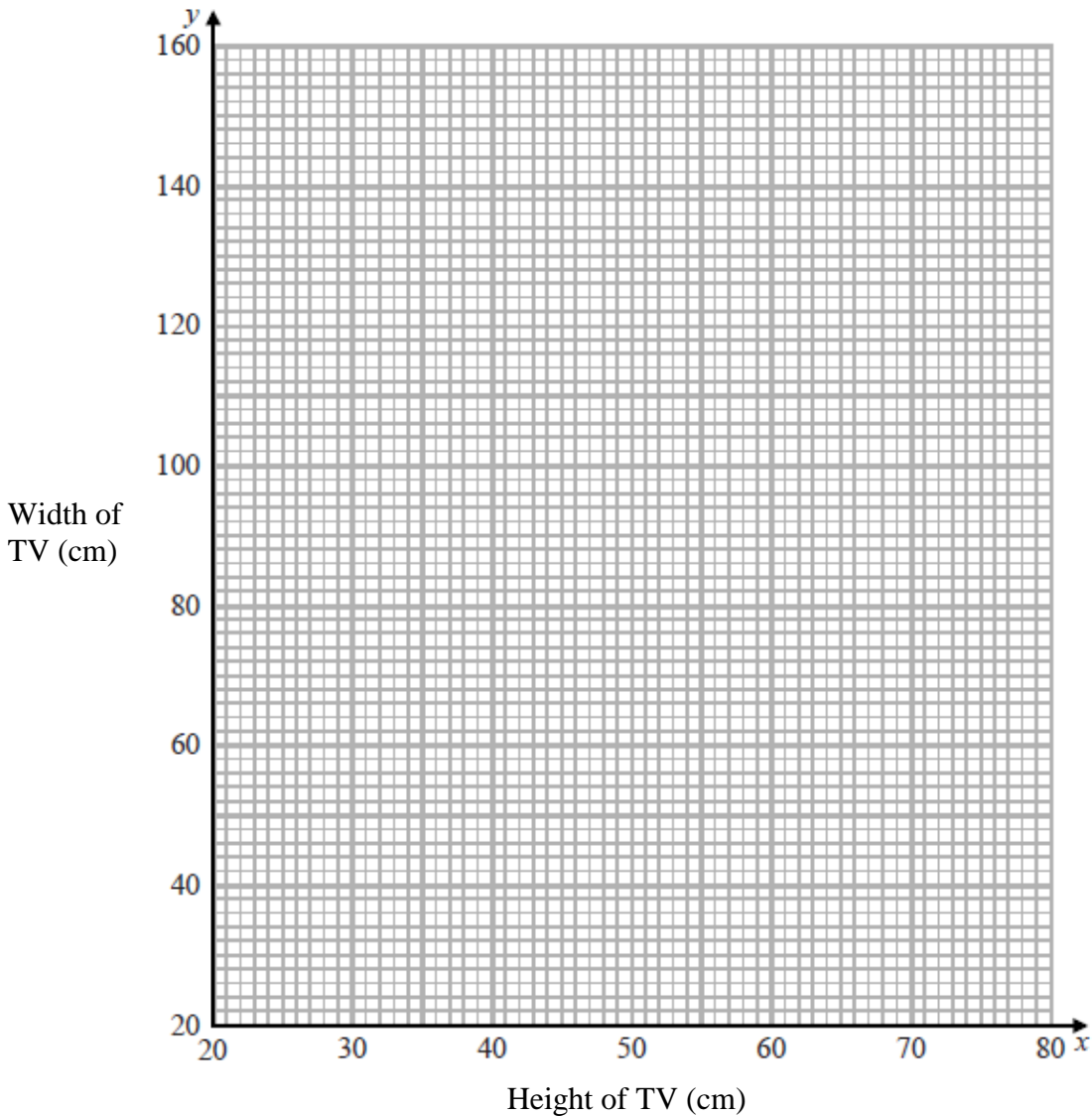
Height of TV (cm)

(2)

A TV has a width of 90 cm.

(b) Use your graph to work out the height of this TV.

(1)

(Total 3 marks)

Mock Papers Set 2, Paper 3F qu.21 / 3H qu.5 (R8, R14 – AO2)

_____

$x^2 - 9y^2 = 0$ where $x > 0$ and $y > 0$

Work out the ratio $x : y$

(Total 3 marks)

Mock Papers Set 3, Paper 1H qu.17a (R8, A4 – AO1)

_____

R13 understand that X is inversely proportional to Y is equivalent to X is proportional to $\dfrac{1}{Y}$;

construct and interpret equations that describe direct and inverse proportion

New to GCSE (9–1) Maths

The content in R13 is not new to GCSE (9–1) Maths, but below is an R13 question assessing new Assessment Objectives.

Sample questions

At a depth of x metres, the temperature of the water in an ocean is $T\,°C$.
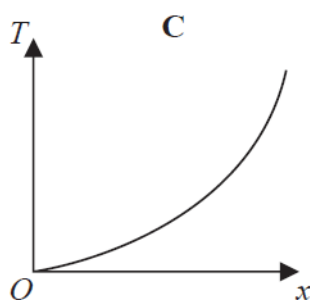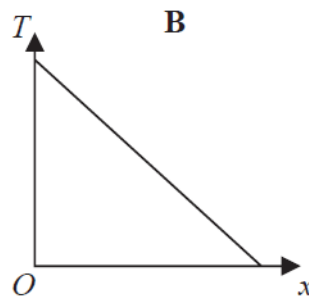At depths below 900 metres, T is inversely proportional to x.

T is given by

$$T = \frac{4500}{x}$$

(a) Work out the difference in the temperature of the water at a depth of 1200 metres and the temperature of the water at a depth of 2500 metres.

(3)

Here are four graphs.
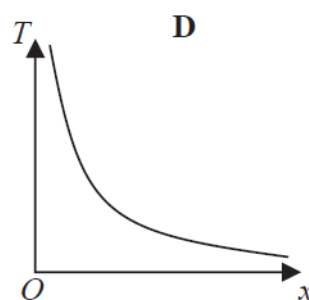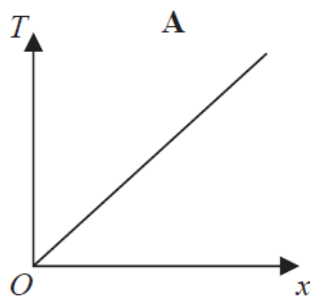
One of the graphs could show that T is inversely proportional to x.

(b) Write down the letter of this graph.

(1)

(Total 4 marks)
Specimen Papers Set 2, Paper 3F qu.27 / 3H qu.6 (R13, R10 – AO1/AO2)
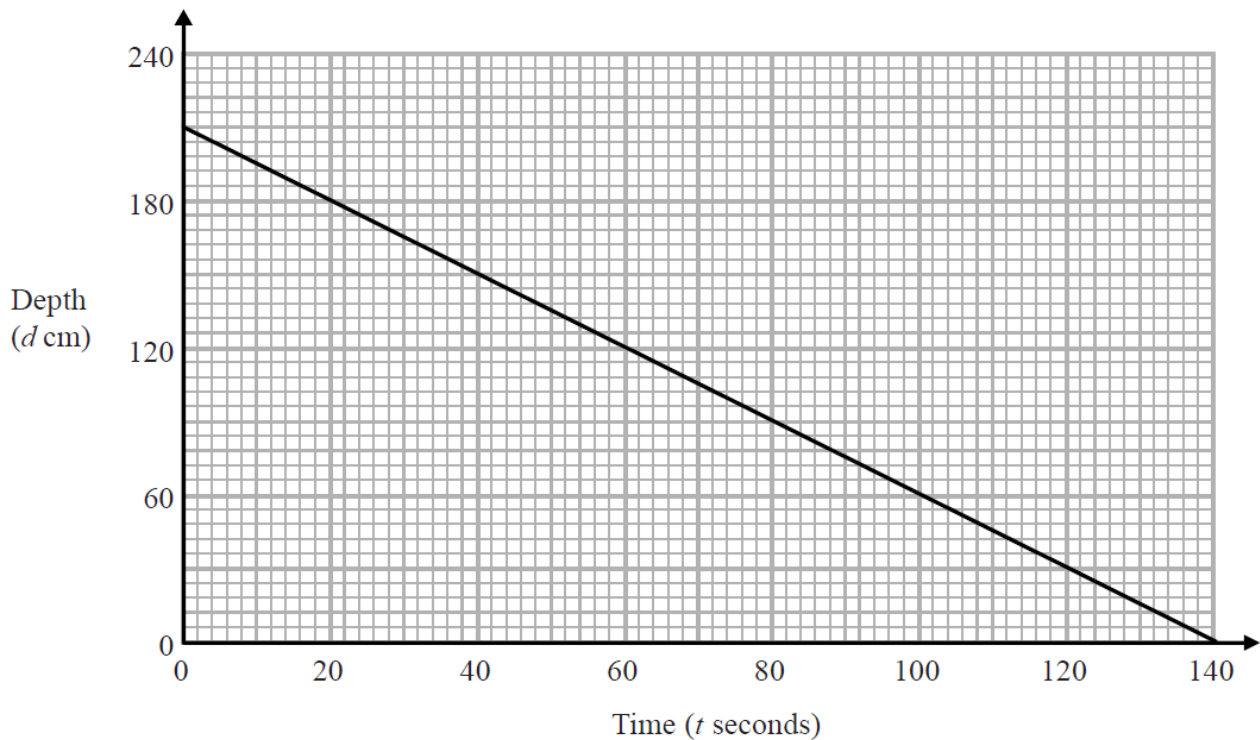
R14	interpret the gradient of a straight-line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion

New to GCSE (9–1) Maths

Interpreting the gradient of a straight line graph as a rate of change.

Sample questions

The graph shows the depth, d cm, of water in a tank after t seconds.

(a) Find the gradient of this graph.
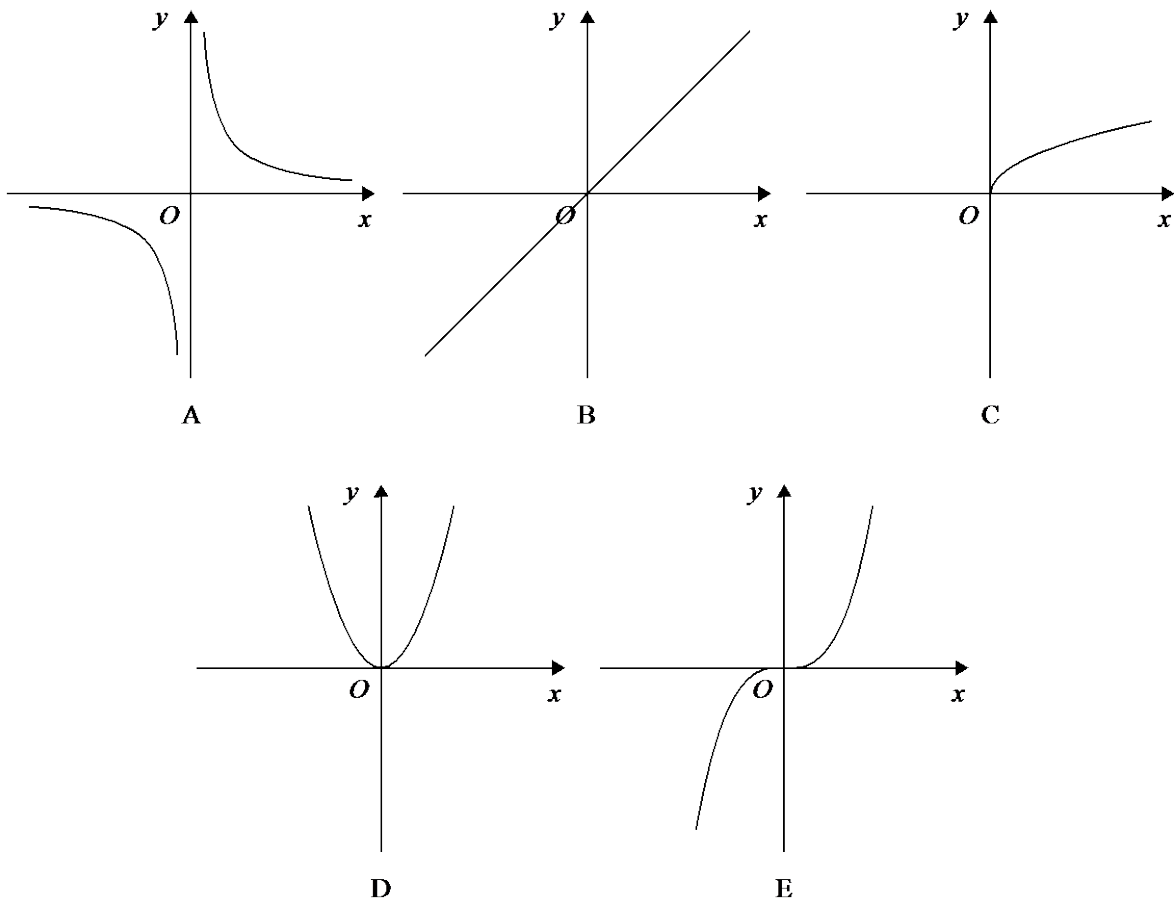
(2)

(b) Explain what this gradient represents.

(1)

(Total 3 marks)
Specimen Papers Set 1, Paper 2H qu.10 (R14 – AO1/AO2)

Here are five graphs.
Each graph shows either direct proportion or inverse proportion.

A

B

C

D

E

The table shows five equations.

Equation	Graph
$y = kx^3$	....
$y = k\sqrt{x}$	....
$y = kx^2$	....
$y = \dfrac{k}{x}$	....
$y = kx$	....

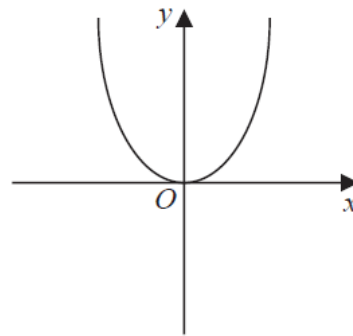Match the letter of each graph to its equation.

(Total 3 marks)

Mock Papers Set 3, Paper 2H qu.13 (R14 – AO2)
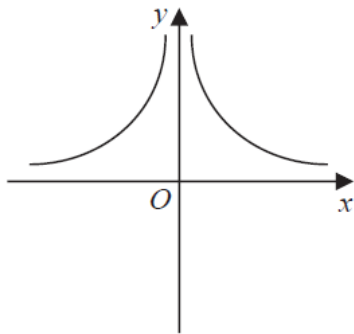
3. Ratio, proportion and rates of change

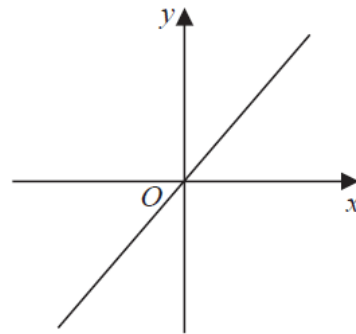These graphs show four different proportionality relationships between y and x.
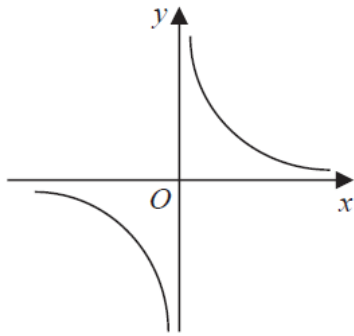
Graph A

Graph B

Graph C

Graph D

Match each graph with a statement in the table below.

Proportionality relationship	Graph letter
y is directly proportional to x	
y is inversely proportional to x	
y is proportional to the square of x	
y is inversely proportional to the square of x	

(Total 2 marks)

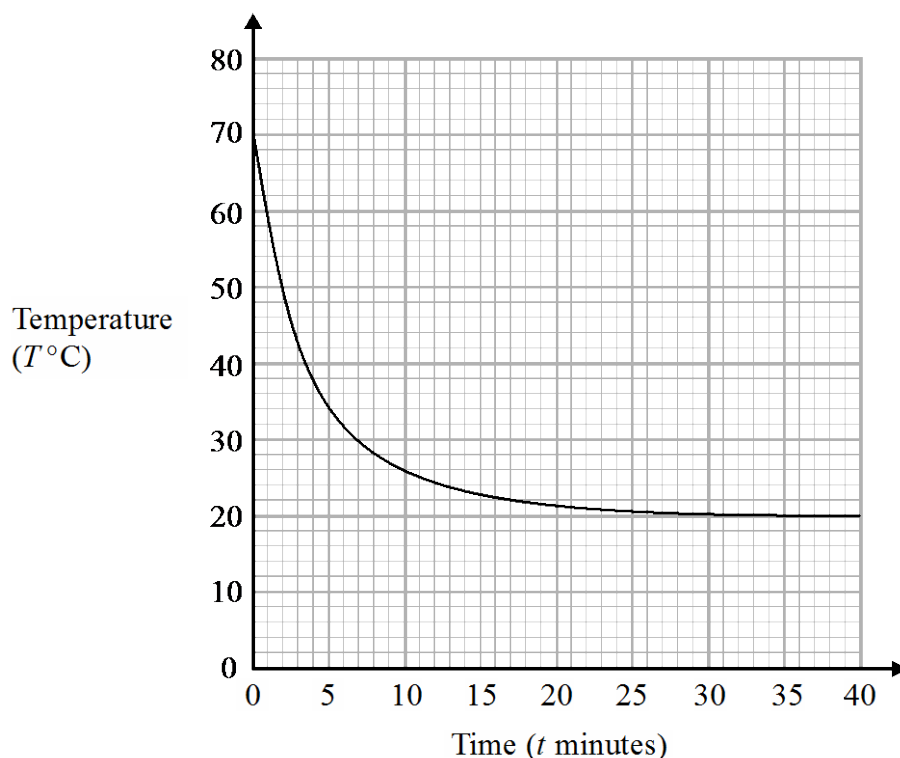*Specimen Papers Set 1, Paper 1H qu.16 (R14 – AO2)*

_____

> **R15**   interpret the gradient at a point on a curve as the instantaneous rate of change;
> apply the concepts of average and instantaneous rate of change (gradients of chords
> and tangents) in numerical, algebraic and graphical contexts (this does not include
> calculus)

New to GCSE (9–1) Maths

The content in R15 is new to GCSE (9–1) Maths.

Sample questions

The graph shows the temperature, $T\,°C$, of the coffee in a cup at a time t minutes.

(*a*) Find an estimate for the gradient of the graph at time 5 minutes.

(2)

(*b*) Explain what this gradient represents.

(1)

(Total 3 marks)
Mock Papers Set 3, Paper 1H qu.13 (R15, A15 – AO1/AO2)

3. Ratio, proportion and rates of change

The quantity of heat, H calories, delivered by an electric current, I amps, acting for t seconds to heat an amount of water is given by the formula
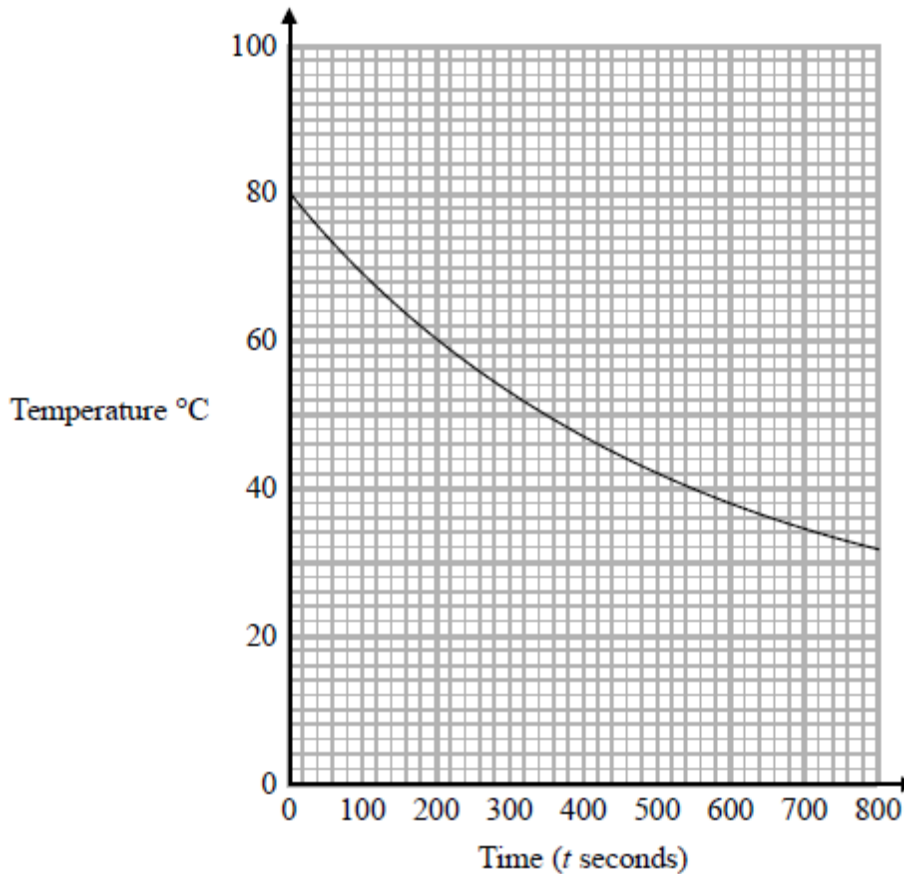
$$H = atI^2 - b$$

where a and b are constants.

(a) Rearrange the formula to make I the subject.

(2)

The graph gives information about the variation in the temperature, in °C, of an amount of water that is allowed to cool from 80 °C.

(b) (i) Work out the average rate of decrease of the temperature of the water between $t = 0$ and $t = 800$.

The instantaneous rate of decrease of the temperature of the water at time T seconds is equal to the average rate of decrease of the temperature of the water between $t = 0$ and $t = 800$.

(ii) Find an estimate for the value of T.
You must show how you got your answer.

(4)

(Total 6 marks)
Original SAMs Paper 3H qu.14 (R15, R14, A5 – AO1/AO2/AO3)

> **R16** <u>set up, solve and interpret the answers in growth and decay problems, including compound interest</u> **and work with general iterative processes**

New to GCSE (9–1) Maths

Working with general iterative processes.

Sample questions

The number of slugs in a garden t days from now is p_t where

$p_0 = 100$

$p_{t+1} = 1.06p_t$

Work out the number of slugs in the garden 3 days from now.

(Total 3 marks)
Specimen Papers Set 2, Paper 2H qu.13 (R16 – AO1/AO3)

_____

At the start of year n, the quantity of a radioactive metal is P_n
At the start of the following year, the quantity of the same metal is given by

$$P_{n+1} = 0.87P_n$$

At the start of 2016 there were 30 grams of the metal.

What will be the quantity of the metal at the start of 2019?
Give your answer to the nearest gram.

(Total 3 marks)
Mock Papers Set 3, Paper 3H qu.17 (R16 – AO1)

_____

Louis and Robert are investigating the growth in the population of a type of bacteria.
They have two flasks A and B.

At the start of day 1, there are 1000 bacteria in flask A.
The population of bacteria grows exponentially at the rate of 50% per day.

(*a*) Show that the population of bacteria in flask A at the start of each day forms a geometric
progression.

(2)

The population of bacteria in flask A at the start of the 10th day is *k* times the population of bacteria
in flask A at the start of the 6th day.

(*b*) Find the value of *k*.

(2)

At the start of day 1 there are 1000 bacteria in flask B.
The population of bacteria in flask B grows exponentially at the rate of 30% per day.

(*c*) Sketch a graph to compare the size of the population of bacteria in flask A and in flask B.

(1)

(Total 5 marks)
New SAMs Paper 3H qu.17 (R16, A12 – AO1/AO2/AO3)

_____

The number of bees in a beehive at the start of year *n* is P_n.
The number of bees in the beehive at the start of the following year is given by

$$P_{n+1} = 1.05(P_n - 250)$$

At the start of 2015 there were 9500 bees in the beehive.

How many bees will there be in the beehive at the start of 2018?

(Total 3 marks)
Specimen Papers Set 1, Paper 2H qu.21 (R16 – AO3)

_____

4. Geometry and measures

Mensuration and calculation

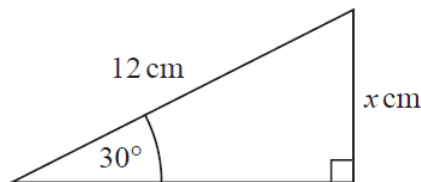| **G21** | know the exact values of sin θ and cos θ for $\theta = 0°$, $30°$, $45°$, $60°$ and $90°$; know the exact value of tan θ for $\theta = 0°$, $30°$, $45°$ and $60°$ |

New to GCSE (9–1) Maths

The content in G21 is new to GCSE (9–1) Maths.

Sample questions
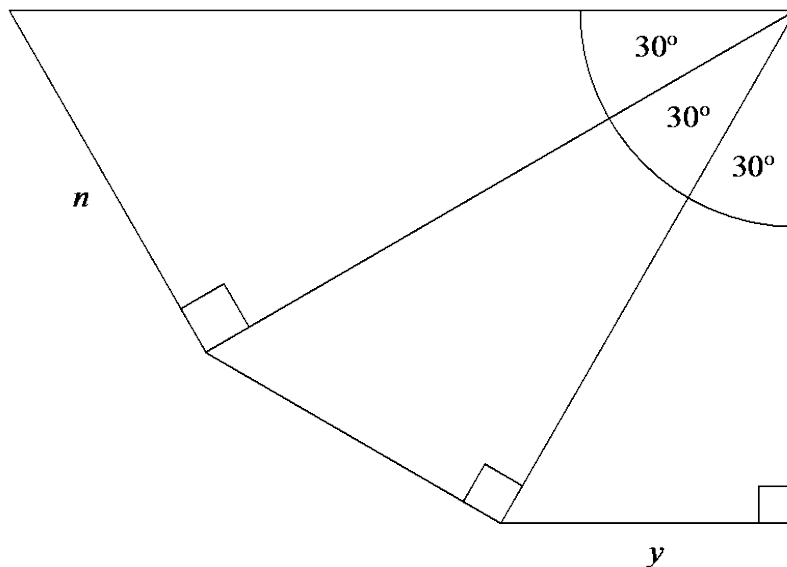
(*a*) Write down the exact value of cos30°

(1)

(*b*)

Given that sin 30° = 0.5, work out the value of *x*.

(2)

(Total 3 marks)
Specimen Papers Set 1, Paper 1F qu.26 / 1H qu.7 (G21, G20 – AO1)

The diagram shows three right-angled triangles.

Prove that $y = \dfrac{3}{4}n$

(Total 4 marks)
Mock Papers Set 3, Paper 1H qu.20 (G21, G21 – AO1/AO2)

> **G23** know and apply area = $\dfrac{1}{2}$ *ab* sin *C* to calculate the area, sides or angles of any triangle

New to GCSE (9–1) Maths

The content in G23 is not new to GCSE (9–1) Maths, but below is a G23 question assessing new Assessment Objectives.

Sample questions

In triangle *RPQ*,

RP = 8.7 cm
PQ = 5.2 cm
Angle *PRQ* = 32°

(*a*) Assuming that angle *PQR* is an acute angle,
calculate the area of triangle *RPQ*.
Give your answer correct to 3 significant figures.

(4)

(*b*) If you did not know that angle *PQR* is an acute angle, what effect would this have on your calculation of the area of triangle *RPQ*?

(1)

(Total 5 marks)
New SAMs Paper 2H qu.21 (G23, A12 – AO1/AO3)

_____

5. Probability

P1	record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees

New to GCSE (9–1) Maths

Use frequency trees to record, describe and analyse the frequency of outcomes of probability experiments.
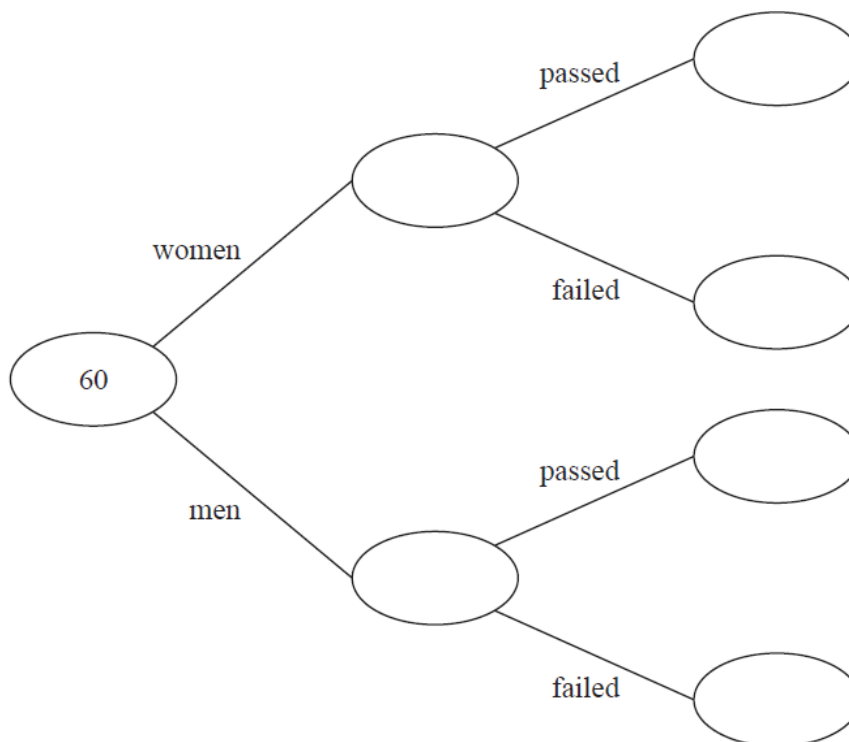
Sample questions

60 people each took a driving test one day.

21 of these people were women.
18 of the 60 people failed their test.
27 of the men passed their test.

(*a*) Use this information to complete the frequency tree.

(3)

One of the men is chosen at random.

(*b*) Work out the probability that this man failed his test.

(2)

(Total 5 marks)
Mock Papers Set 1, Paper 1F qu.12 (P1, P3 – AO2)
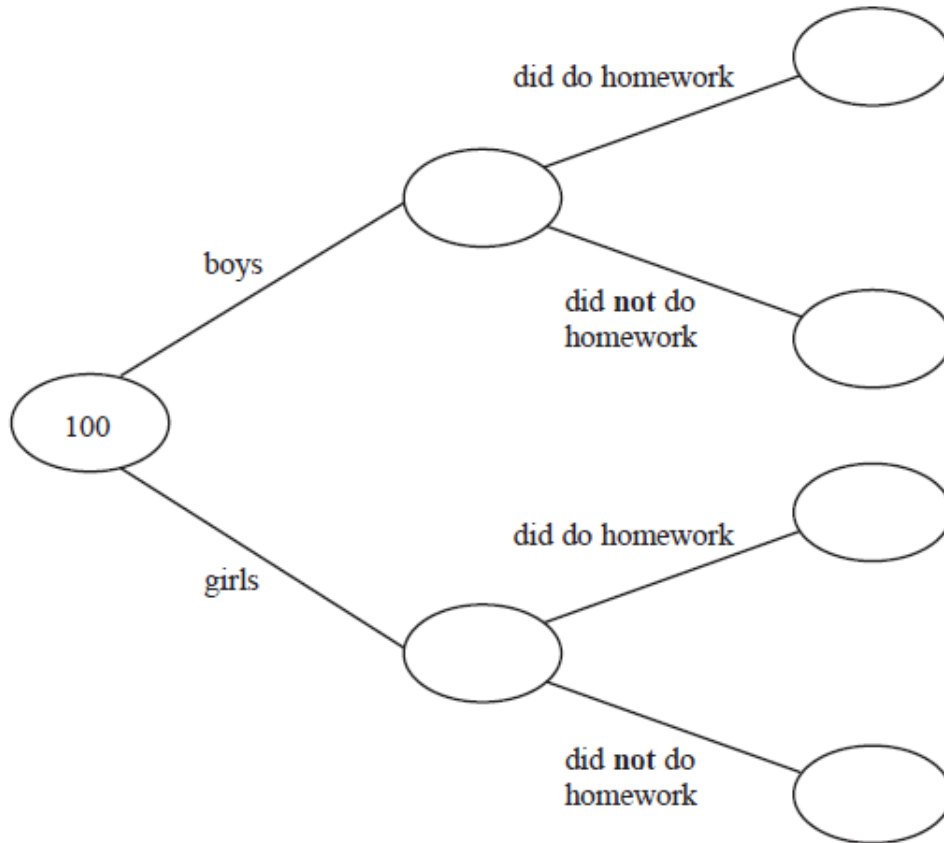
_____

100 students had some homework.

42 of these students are boys.
8 of the 100 students did **not** do their homework.
53 of the girls did do their homework.

(*a*) Use this information to complete the frequency tree.

(3)

One of the girls is chosen at random.

(*b*) Work out the probability that this girl did **not** do her homework.

(2)

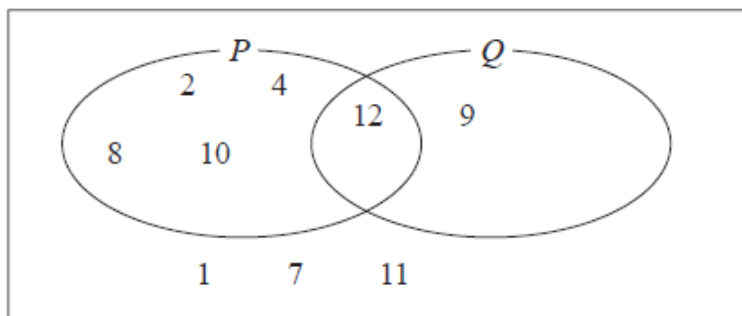**(Total 5 marks)**
New SAMs Paper 1F qu.17 (P1, P3 – AO1/AO2)

_____

P6	enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams <u>and tree diagrams</u>

New to GCSE (9–1) Maths

Use Venn diagrams to enumerate sets and combinations of sets systematically.

Sample questions

The numbers 1, 2, 4, 7, 8, 9, 10, 11 and 12 are put into a Venn diagram.

The number 3 is in set Q but not in set P.
The number 6 is in both set P and set Q.

(*a*) Complete the Venn diagram.

(2)

A student chooses at random a number in the completed Venn diagram.

(*b*) Write down the probability that this number is **not** in Set Q.

(2)

(Total 4 marks)
Mock Papers Set 2, Paper 1F qu.17 (P6, P4 – AO1/AO2)

_____

$\mathscr{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
$A = \{\text{multiples of 2}\}$
$A \cap B = \{2, 6\}$
$A \cup B = \{1, 2, 3, 4, 6, 8, 9, 10\}$

Draw a Venn diagram for this information.

(Total 4 marks)
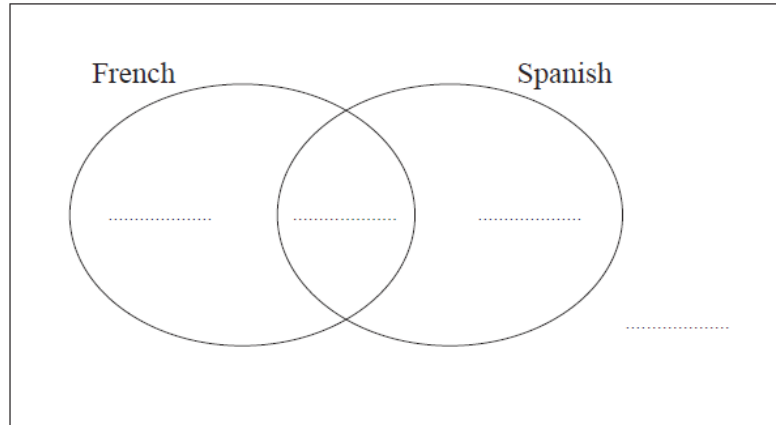*Specimen Papers Set 1, Paper 3F qu.20 (P6, N4 – AO2)*

_____

There are 60 students at a college.

   20 students study both French and Spanish.
   13 students study French but not Spanish.
   A total of 43 students study Spanish.

(*a*) Complete the Venn diagram for this information.

(3)

One of the students at the college is to be selected at random.

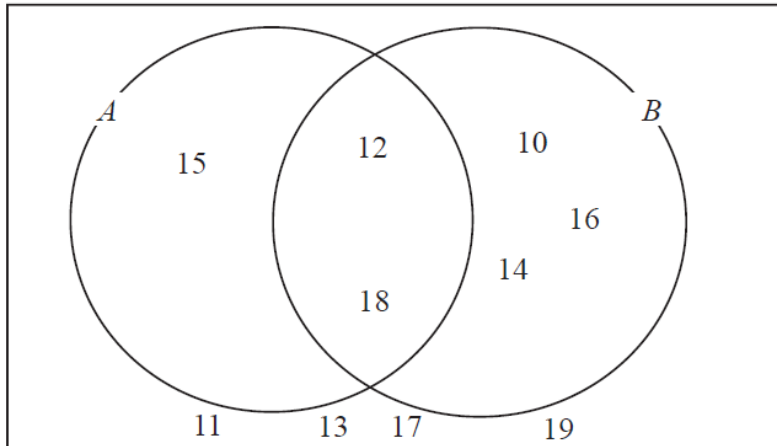(*b*) Write down the probability that this student studies neither French nor Spanish.

(1)

(Total 4 marks)
Mock Papers Set 1, Paper 2F qu.23 / 2H qu.1 (P6, P8 – AO1/AO2)

_____

Here is a Venn diagram.

(*a*) Write down the numbers that are in set

    (i) $A \cup B$

    (ii) $A \cap B$

(2)

One of the numbers in the diagram is chosen at random.

(*b*) Find the probability that the number is in set A'

(2)

(Total 4 marks)
Specimen Papers Set 2, Paper 2F qu.26 / 2H qu.5 (P6, P4 – AO1/AO2)

_____

P9	**calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams**

New to GCSE (9–1) Maths

Use Venn diagrams to calculate and interpret conditional probabilities.

Sample questions

John has an empty box.
He puts some red counters and some blue counters into the box.

The ratio of the number of red counters to the number of blue counters is 1 : 4

Linda takes at random 2 counters from the box.

The probability that she takes 2 red counters is $\dfrac{6}{155}$

How many red counters did John put into the box?

(Total 4 marks)
New SAMs Paper 1H qu.24 (P9, A21, R8 – AO1/AO3)

_____

Sami asked 50 people which drinks they liked from tea, coffee and milk.

All 50 people like at least one of the drinks.
19 people like all three drinks.
16 people like tea and coffee but do **not** like milk.
21 people like coffee and milk.
24 people like tea and milk.
40 people like coffee.
1 person likes only milk.
Sami selects at random one of the 50 people.

(*a*) Work out the probability that this person likes tea.

(4)

(*b*) Given that the person selected at random from the 50 people likes tea,
find the probability that this person also likes exactly one other drink.

(2)

(Total 6 marks)
New SAMs Paper 3H qu.12 (P9, P8 – AO1/AO2/AO3)

_____

6. Statistics

No new topics in Statistics.