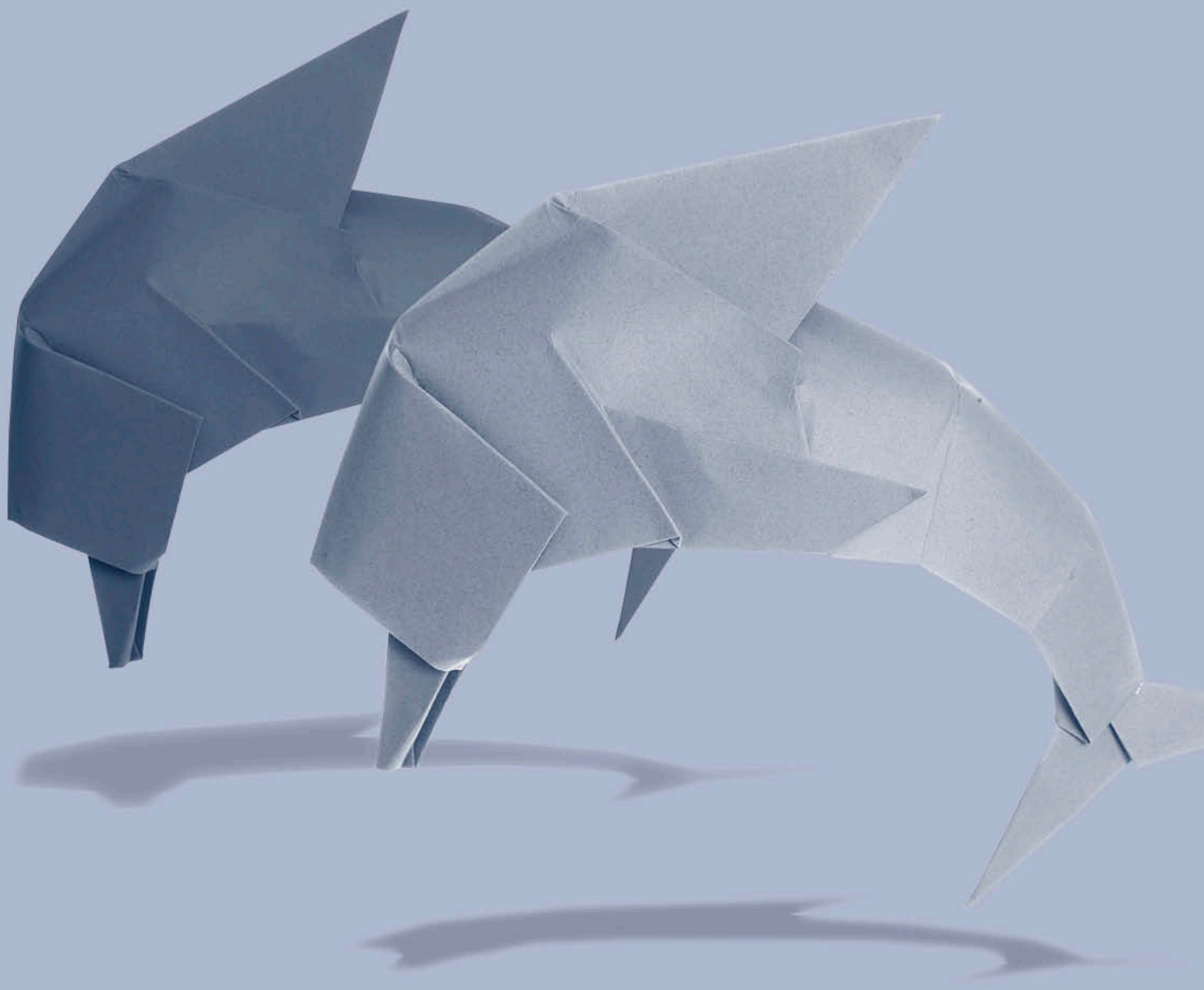
edexcel

Pearson Edexcel Level 1/ Level 2 GCSE (9-1) in Mathematics (1MA1)



EXEMPLIFICATION OF THE SPECIMEN PAPERS SET 2

First certification 2017

ALWAYS LEARNING

PEARSON

Contents

About this booklet

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

The booklet provides additional information on all the questions in the Specimen Papers Set 2. It details the content references and Assessment Objectives being assessed in each question or question part, along with indicating if a question or question part is new to the Foundation tier, new to this specification, or a common question appearing in the respective paper for both tiers.

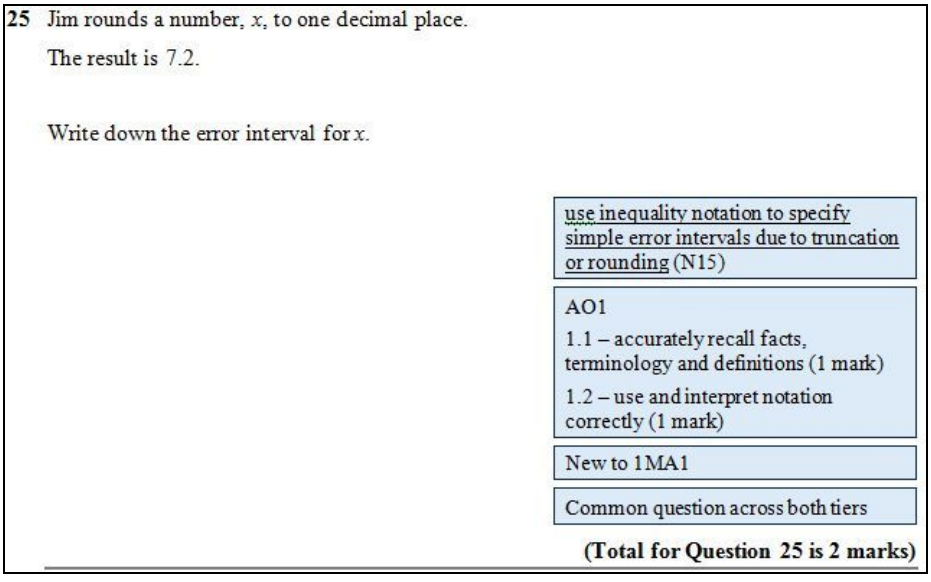
How to use this booklet

Callouts have been added to each question in the Specimen Papers Set 2. In the callouts, the following information has been presented, as relevant to the question:

- **specification references** (in standard, underlined or bold type);
- **Assessment Objectives**, including elements and marks awarded for each element;
- **new to Foundation tier**, for any content previously assessed at Higher tier in 1MA0 or 2MB01;
- **new to 1MA1**, for any content not previously assessed in 1MA0 or 2MB01;
- **common question across both tiers**, for any question that appears in both tiers and is assessing performance at grades 4–5;
- **formula(e) given with the question**: formulae will be provided for students with the relevant examination questions, rather than in a formulae sheet at the front of the examination paper (see Issue 2 of the specification).

Where content references or Assessment Objectives are being assessed across all the parts of a question, these are referred to by a single callout at the end of the question rather than by a callout for each question part.

The New Sample Assessment Materials, along with the two sets of specimen papers, are also available in the new GCSE (9–1) level on **Exam Wizard**, where you can search by topic or assessment objective and build your own practice papers.



25 Jim rounds a number, x, to one decimal place.

The result is 7.2.

Write down the error interval for x.

use inequality notation to specify simple error intervals due to truncation or rounding (N15)

AO1
1.1 – accurately recall facts, terminology and definitions (1 mark)
1.2 – use and interpret notation correctly (1 mark)

New to 1MA1

Common question across both tiers

(Total for Question 25 is 2 marks)

Set 2 Paper 1F

1 Find 10% of £320.

interpret fractions and percentages as operators (N12)
AO1 1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 1 is 1 mark)

2 Write 0.8 as a percentage.

interpret percentages and percentage changes as a fraction or a decimal (R9)
AO1 1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 2 is 1 mark)

3 (*a*) Work out 84 ÷ 3

(1)

(*b*) Work out 0.17 × 6000

(1)

(*c*) Work out $(-2)^3$

(1)

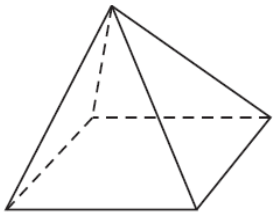
apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers – all both positive and negative; understand and use place value (N2)

AO1

1.3a – accurately carry out routine procedures (3 marks)

(Total for Question 3 is 3 marks)

4 Here is a square-based pyramid.



(i) How many faces does the pyramid have?

(ii) How many edges does the pyramid have?

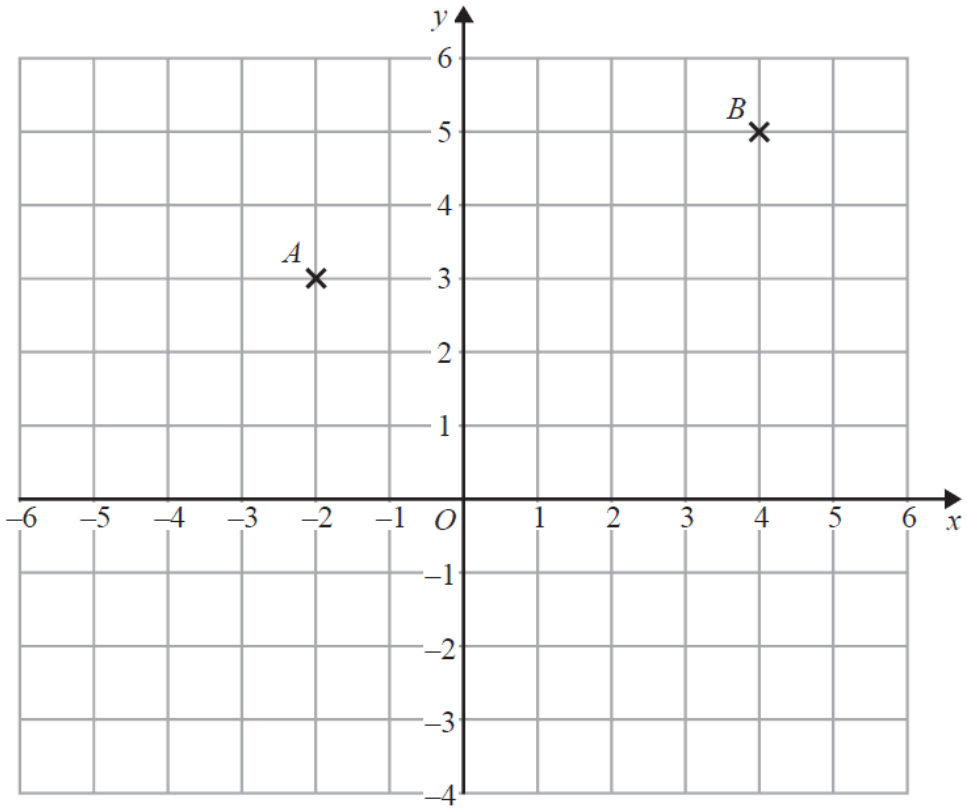
identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres (G12)

AO1

1.1 – accurately recall facts, terminology and definitions (2 marks)

(Total for Question 4 is 2 marks)

5



(*a*) Write down the coordinates of point *B*.

work with coordinates in all four quadrants (A8)
AO1 1.2 – use and interpret notation correctly (1 mark)

(1)

(*b*) Find the coordinates of the midpoint of *AB*.

work with coordinates in all four quadrants (A8)
AO1 1.3a – accurately carry out routine procedures (1 mark)

(1)

(*c*) On the grid, draw the line with equation $y = -3$

plot graphs of equations that correspond to straight-line graphs in the coordinate plane (A9)

AO2

2.3b – communicate information accurately (1 mark)

(1)

(Total for Question 5 is 3 marks)

---

6 Here are the instructions for making a drink.

Add 100 m*l* of juice

to 2 litres of water

Dev uses 5 litres of water to make the drink.

How much drink has he made?

apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing, concentrations) (R5)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 6 is 3 marks)

---

7 In a box there are three types of chocolates.

There are 6 plain chocolates,
8 milk chocolates
and 10 white chocolates.

Ben takes at random a chocolate from the box.

(*a*) Write down the probability that Ben takes a plain chocolate.

apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments (P2)
express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1 (R3)

AO1
1.3a – accurately carry out routine procedures (2 marks)

(2)

Deon takes 2 chocolates from the box.

(*b*) Write down all the possible combinations of types of chocolates that Deon can take.

apply systematic listing strategies (N5)

AO2
2.3b – communicate information accurately (2 marks)

(2)

(Total for Question 7 is 4 marks)

8 8 identical pens cost £12

Work out the cost of 10 of these pens.

solve problems involving direct and inverse proportion, including graphical and algebraic representations (R10)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 8 is 2 marks)

---

9 Here are five fractions.

$\frac{2}{8}$ $\frac{10}{40}$ $\frac{12}{48}$ $\frac{5}{24}$ $\frac{20}{80}$

One of these fractions is **not** equivalent to $\frac{1}{4}$.

(*a*) Write down this fraction.

order positive and negative integers, decimals and fractions (N1)

AO1

1.1 – accurately recall facts, terminology and definitions (1 mark)

(1)

(*b*) Work out $\frac{2}{7}+\frac{1}{14}$

apply the four operations, including formal written methods, to integers, decimals and simple fractions (N2)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(2)

(*c*) Work out $\frac{4}{5}+\frac{3}{10}$

Give your answer in its simplest form.

apply the four operations, including formal written methods, to integers, decimals and simple fractions (N2)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(2)

(Total for Question 9 is 5 marks)

---

10 (*a*) Solve $3x + 7 = 1$

solve linear equations in one unknown algebraically (A17)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(2)

(*b*) $f = 6$

$g = 5$

Work out the value of $3f - 2g$

substitute numerical values into formulae and expressions, including scientific formulae (A2)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(2)

(Total for Question 10 is 4 marks)

---

11 Write down three different multiples of 4 that add up to 40.

use the concepts and vocabulary of multiples (N4)

AO3

3.1a – translate problems in mathematical contexts into a process (2 marks)

(Total for Question 11 is 2 marks)

12 Helen has 80 books to sell.

Each book is Fiction or Non-fiction.

The ratio of the number of Fiction books to the number of Non-fiction books is 3 : 1

Each book has a normal price of £10.

Helen reduces the price of all the Non-fiction books.

Non-fiction

All books

½ price

Helen sells all 80 books.

Work out the total amount of money Helen will receive.

divide a given quantity into two parts in a given part:part or part:whole ratio; apply ratio to real contexts and problems (R5)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 12 is 4 marks)

13 Ryan and Carl each get paid a basic pay of £60 per day.

One day, Ryan also gets a bonus of 25% of his basic pay.

Carl also gets £20 in tips from customers.

Work out the difference between the total amounts of money that Ryan and Carl each get.

interpret fractions and percentages as operators (N12) compare two quantities using percentages (R9)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks) AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (1 mark)

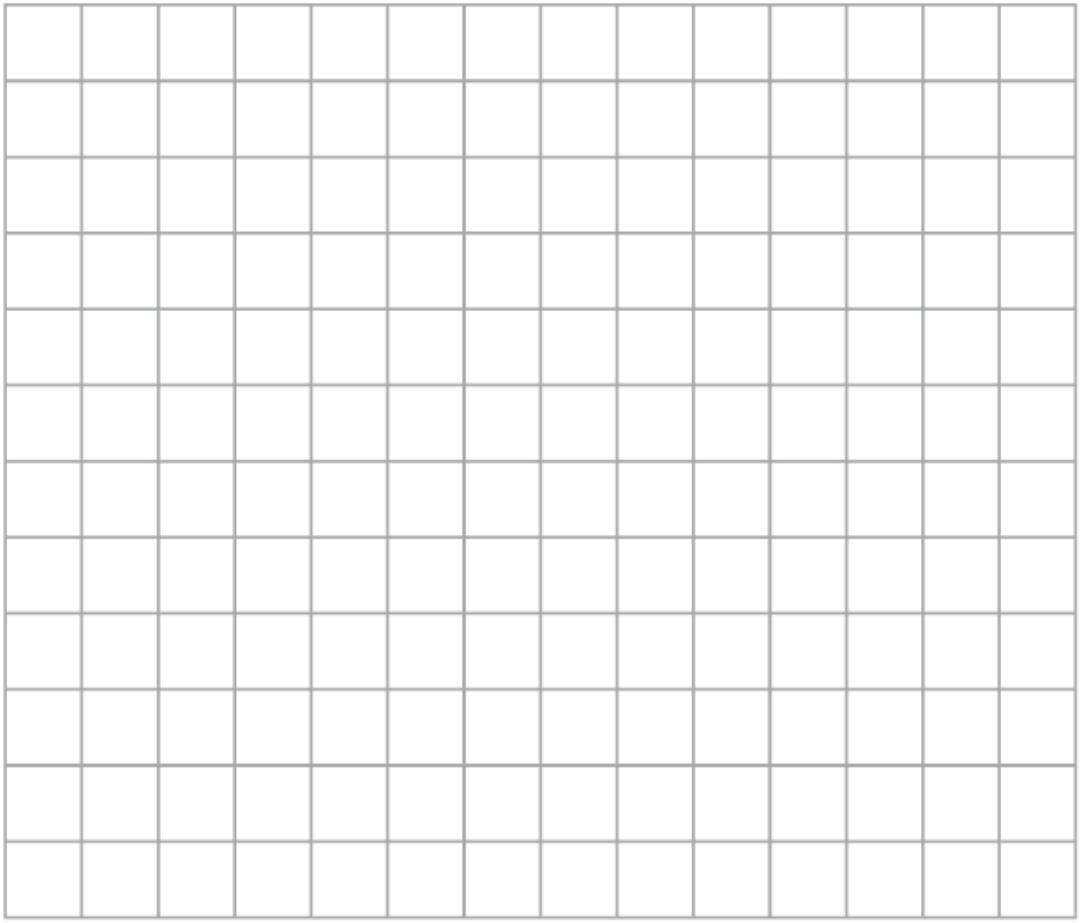
(Total for Question 13 is 3 marks)

14 Some people were asked if they liked swimming or cycling or running.

The table shows the results for the males and the results for the females.

	Swimming	**Cycling**	**Running**
Male	2	6	4
Female	8	5	5

(*a*) On the grid, draw a bar chart to show this information.



interpret and construct tables, charts and diagrams, including frequency tables and bar charts and know their appropriate use (S2)

AO2

2.3a – interpret information accurately (2 marks)

2.3b – communicate information accurately (2 marks)

(4)

(*b*) Work out the percentage of the 30 people that are female.

express one quantity as a percentage of another (R9)
AO1 1.3a – accurately carry out routine procedures (2 marks)

(2)

(Total for Question 14 is 6 marks)

15 The table shows information about the ages of all the people at a party.

Age (years)	**Frequency**
11 – 20	6
21 – 30	16
31 – 40	10
41 – 50	8

(*a*) Work out the total number of these people who were aged 40 or less.

interpret and construct tables (S2)

AO1
1.3a – accurately carry out routine procedures (1 mark)

(1)

Andy says that the range of ages is 39 years because 50 – 11 = 39

(*b*) The range may not be 39 years.
Explain why.

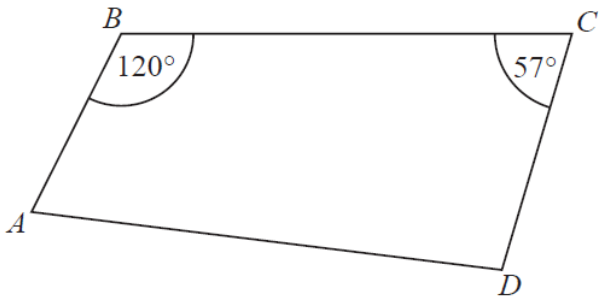
interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency and spread (S4)

AO3
3.4b – evaluate results obtained
(1 mark)

(1)

(Total for Question 15 is 2 marks)

16 The diagram shows a quadrilateral *ABCD*.



Is *AB* parallel to *DC*?

You must give your reasoning.

understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons) (G3)
AO2 2.4a – present arguments (3 marks)

(Total for Question 16 is 3 marks)

17 Irena sells ice creams.

One day she sells 80 ice creams.

The next day she sells 108 ice creams.

Work out the percentage increase in the number of ice creams she sells.

solve problems involving percentage change, including percentage increase/decrease and original value problems (R9)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

(Total for Question 17 is 3 marks)

18 Dimitar has 20 sweets.

Pip also has 20 sweets.

Dimitar gives Pip x sweets.

Dimitar then eats 5 of his sweets.

Pip then eats half of her sweets.

Write expressions for the number of sweets Dimitar and Pip now have.

translate simple situations or procedures into algebraic expressions or formulae (A21)
AO2 2.3a – interpret information accurately (3 marks)

(Total for Question 18 is 3 marks)

---

19 (*a*) Factorise $y^2 + 27y$

(1)

(*b*) Simplify $(t^3)^2$

(1)

(*c*) Simplify $\frac{w^9}{w^4}$

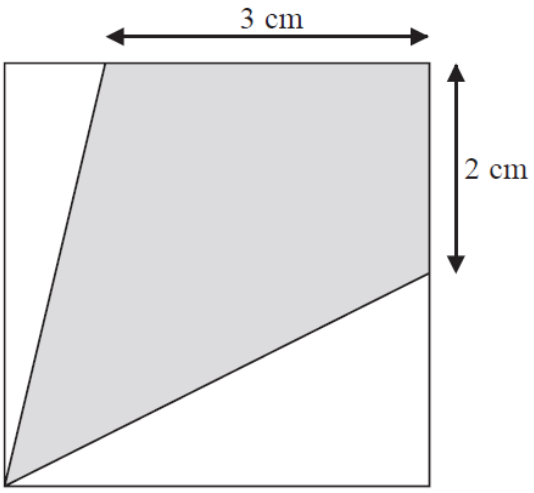
(1)

simplify and manipulate algebraic expressions by taking out common factors and simplifying expressions involving sums, products and powers, including the laws of indices (A4)
AO1 1.3a – accurately carry out routine procedures (3 marks)
Common question across both tiers

(Total for Question 19 is 3 marks)

---

20 The diagram shows a square with perimeter 16 cm.



Work out the proportion of the area inside the square that is shaded.

know and apply formulae to calculate: area of triangles and parallelograms (G16) express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1 (R3)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (3 marks) 3.2 – make and use connections between different parts of mathematics (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 20 is 5 marks)

21 David has designed a game.

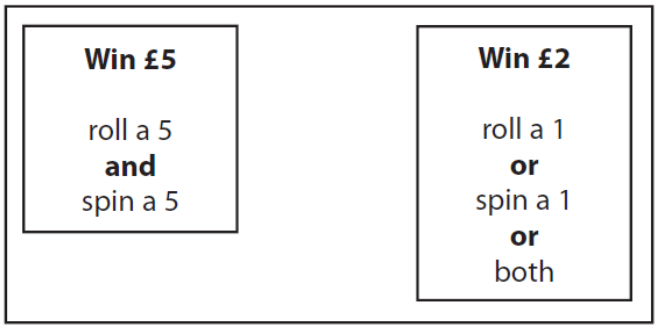
He uses a fair 6-sided dice and a fair 5-sided spinner.

The dice is numbered 1 to 6.

The spinner is numbered 1 to 5.

Each player rolls the dice once and spins the spinner once.

A player can win £5 or win £2.



David expects 30 people will play his game.

Each person will pay David £1 to play the game.

(*a*) Work out how much profit David can expect to make.

apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments (P2)

calculate the probability of independent and dependent combined events (P8)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

New to Foundation

Common question across both tiers

(4)

(*b*) Give a reason why David's actual profit may be different to the profit he expects to make.

understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size (P5)
AO3 3.4b – evaluate results obtained (1 mark)
New to Foundation
Common question across both tiers

(1)

(Total for Question 21 is 5 marks)

---

22 Triangle *ABC* has perimeter 20 cm.

AB = 7 cm.

BC = 4 cm.

By calculation, deduce whether triangle *ABC* is a right-angled triangle.

know the formulae for: Pythagoras' theorem; apply to find angles and lengths in right-angled triangles in two-dimensional figures (G20) use known results to obtain simple proofs (G6)
AO2 2.2 – Construct chains of reasoning to achieve a given result (2 marks) 2.3a – interpret information accurately (1 mark) 2.3b – communicate information accurately (1 mark)
Common question across both tiers

(Total for Question 22 is 4 marks)

---

23 One sheet of A3 card has area $\frac{1}{8}$ m^2.

The card has a mass of 160 g per m^2.

Work out the total mass of 25 sheets of A3 card.

use compound units (R11) use standard units of measure and related concepts (G14)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.2 – use and interpret notation correctly (1 mark) 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 23 is 4 marks)

24 Here are the first five terms of a sequence.

2 8 18 32 50

(*a*) Find the next term of this sequence.

generate terms of a sequence from either a term-to-term or a position-to-term rule (A23)

AO1

1.3a – accurately carry out routine procedures (1 mark)

New to Foundation

(1)

The *n*th term of a different sequence is $3n^2 - 10$

(*b*) Work out the 5th term of this sequence.

generate terms of a sequence from either a term-to-term or a position-to term rule (A23)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

(Total for Question 24 is 2 marks)

25 Write 504 as a product of powers of its prime factors.

use the concepts and vocabulary of prime factorisation, including using product notation and the unique factorisation theorem (N4)
AO1 1.3a – accurately carry out routine procedures (3 marks)

(Total for Question 25 is 3 marks)

TOTAL FOR PAPER IS 80 MARKS

Set 2 Paper 2F

1 Write 6819 to the nearest 1000.

round numbers and measures to an appropriate degree of accuracy (N15)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 1 is 1 mark)

2 Write these temperatures in order.

Start with the lowest temperature.

7°C –2°C 10°C –5°C 3°C

order positive and negative integers (N1)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 2 is 1 mark)

3 Write 0.075 as a fraction.

Give your fraction in its simplest form.

work interchangeably with terminating decimals and their corresponding fractions (N10)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 3 is 2 marks)

4 Find the value of 5^4

use positive integer powers and associated real roots, recognise powers of 2, 3, 4, 5 (N6)
AO1 1.1 – accurately recall facts, terminology and definitions (1 mark)

(1)

(Total for Question 4 is 3 marks)

5

Living to 100 years old
1 in 3 babies born last year are expected to live to 100 years old

720 000 babies were born last year.

How many of these babies are expected to live to 100 years old?

identify and work with fractions in ratio problems (N11)
AO3 3.1c – translate problems in non-mathematical contexts into a mathematical process (1 mark) AO1 1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 5 is 2 marks)

---

6 Here is part of a train timetable from Swindon to London.

Swindon to London							
Swindon	06 10	06 27	06 41	06 58	07 01	07 17	07 28
Didcot	06 27	06 45	06 58	–	7 18	–	07 45
Reading	06 41	06 59	07 13	07 28	07 33	07 43	08 00
London	07 16	07 32	07 44	08 02	08 07	08 14	08 33

(*a*) How long should the 06 58 train from Swindon take to get to London?

use standard units of measure and related concepts (G14)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

Clare says,

"All these trains take more than one hour to get from Swindon to London."

(*b*) Is Clare correct?

You must give a reason for your answer.

use standard units of mass, length, time, money and other measures (N13)

AO2

2.4a – present arguments (1 mark)

(1)

(Total for Question 6 is 2 marks)

7 Tracy buys

2 coffees at £1.10 each
3 teas at 95p each
5 sandwiches at £2.15 each

Tracy shares the total cost equally between 5 people.

How much does each person pay?

use standard units of mass, length, time, money and other measures (N13)

apply the four operations, including formal written methods, to integers and decimals; understand and use place value (N2)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 7 is 4 marks)

8 Rachel carried out a survey of 10 people to find out the type of fruit they like best.

The table gives information about her results.

Type of fruit	**Number of people**
apple	2
banana	5
orange	3

(*a*) Which type of fruit is the mode?

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (S4)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

In Rachel's survey, 2 out of 10 people like apples best.

(*b*) Write 2 out of 10 as a percentage.

interpret percentages as a fraction or a decimal (R9)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

Pete also carried out a survey to find out the type of fruit people like best.

He asked 30 people which type of fruit they like best.

He drew this pie chart for his results.

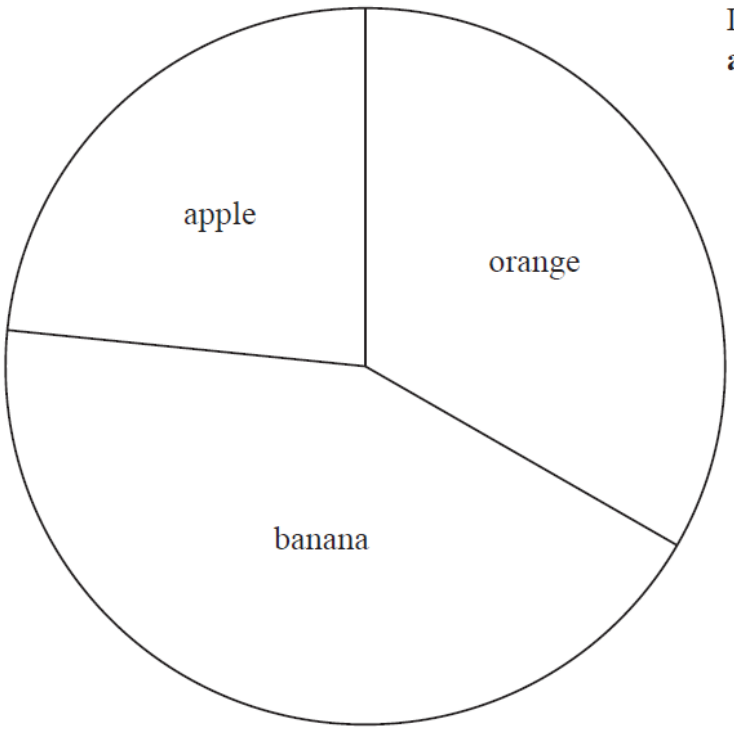


Diagram **accurately** drawn

A smaller proportion of people like bananas best in Pete's survey than in Rachel's survey.

(*c*) Explain how Pete's pie chart and Rachel's table show this.

interpret and construct tables, charts and diagrams and know their appropriate use (S2)
AO2 2.3a – interpret information accurately (1 mark) 2.4a – present arguments (1 mark)

(2)

(Total for Question 8 is 4 marks)

9 The smallest angle of a triangle is 25°.

The triangle is enlarged by scale factor 3.

Ben says,

"The smallest angle of the enlarged triangle is 75° because 25 × 3 = 75"

Is Ben right?

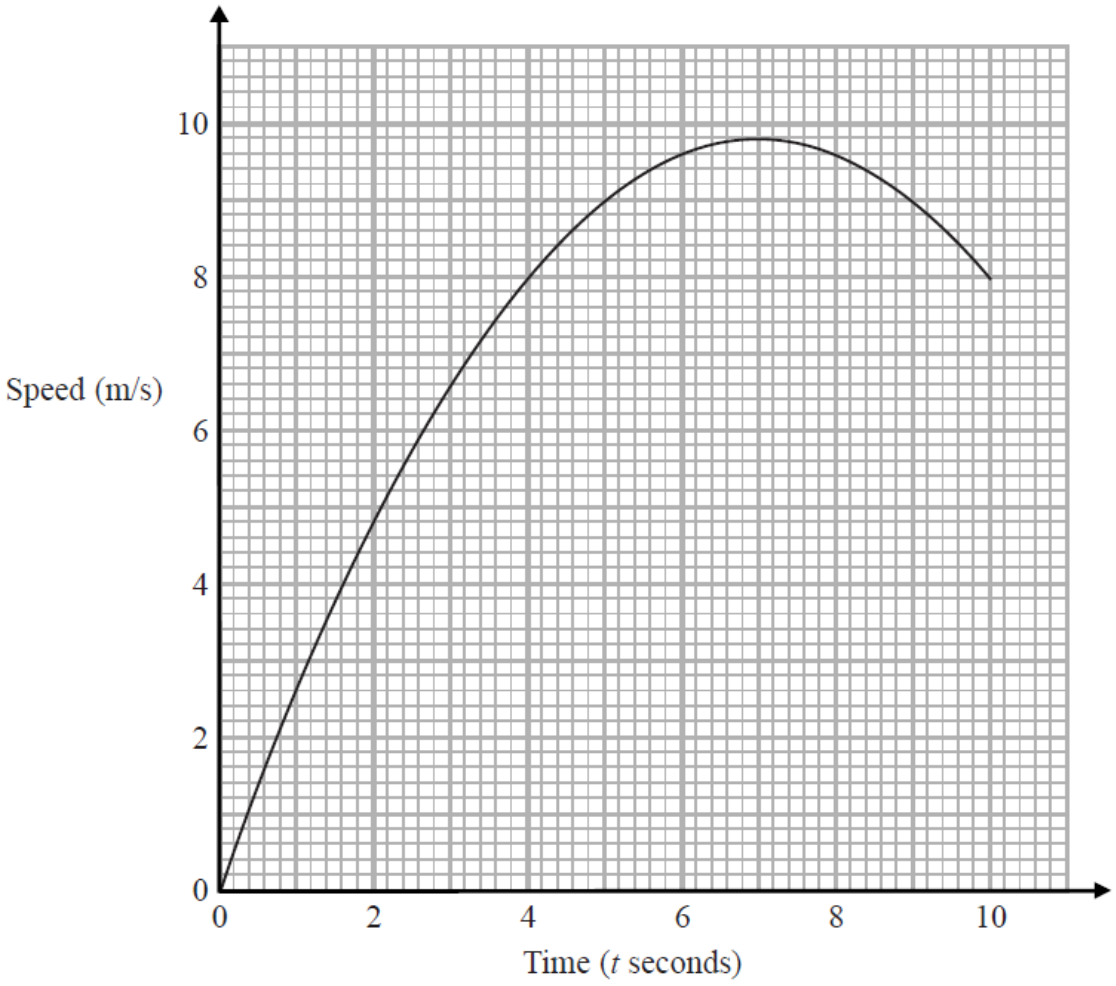
Explain your answer.

apply the concepts of congruence and similarity, including the relationships between lengths, in similar figures (G19)
AO2 2.5a – assess the validity of an argument (1 mark)

(Total for Question 9 is 1 mark)

10 Karol ran in a race.

The graph shows her speed, in metres per second, t seconds after the start of the race.



(a) Write down Karol's speed 3 seconds after the start of the race.

(1)

(b) Write down Karol's greatest speed.

(1)

There were two times when Karol's speed was 9 m/s.

(*c*) Write down these two times.

(1)

plot and interpret graphs of non-standard functions in real contexts to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration (A14)

AO2

2.3a – interpret information accurately (3 marks)

(Total for Question 10 is 3 marks)

11 The first three terms of a number pattern are 1 2 4

Hester says the first five terms of this number pattern are 1 2 4 8 16

(*a*) Write down the rule Hester could have used to get the 4th and 5th terms.

generate terms of a sequence from either a term-to-term or a position-to-term rule (A23)

AO2

2.1b – make inferences to draw conclusions from mathematical information (1 mark)

(1)

(*b*) Write down the 6th term of Hester's number pattern.

generate terms of a sequence from either a term-to-term or a position-to-term rule (A23)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

Jack uses a different rule.

He says the first six terms of the number pattern are 1 2 4 7 11 16

(*c*) Write down the 7th and 8th terms of Jack's number pattern.

generate terms of a sequence from either a term-to-term or a position-to-term rule (A23)

AO2

2.1b – make inferences to draw conclusions from mathematical information (1 mark)

(1)

(Total for Question 11 is 3 marks)

12 Martin has 8 pints of soup in a pan.

He also has 24 soup bowls.

He puts 0.3 pints of soup into each bowl.

How much soup has Martin left over?

apply the four operations, including formal written methods, to integers and decimals; understand and use place value (N2)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 12 is 3 marks)

13 Abi invests £500 for 4 years in a bank account.

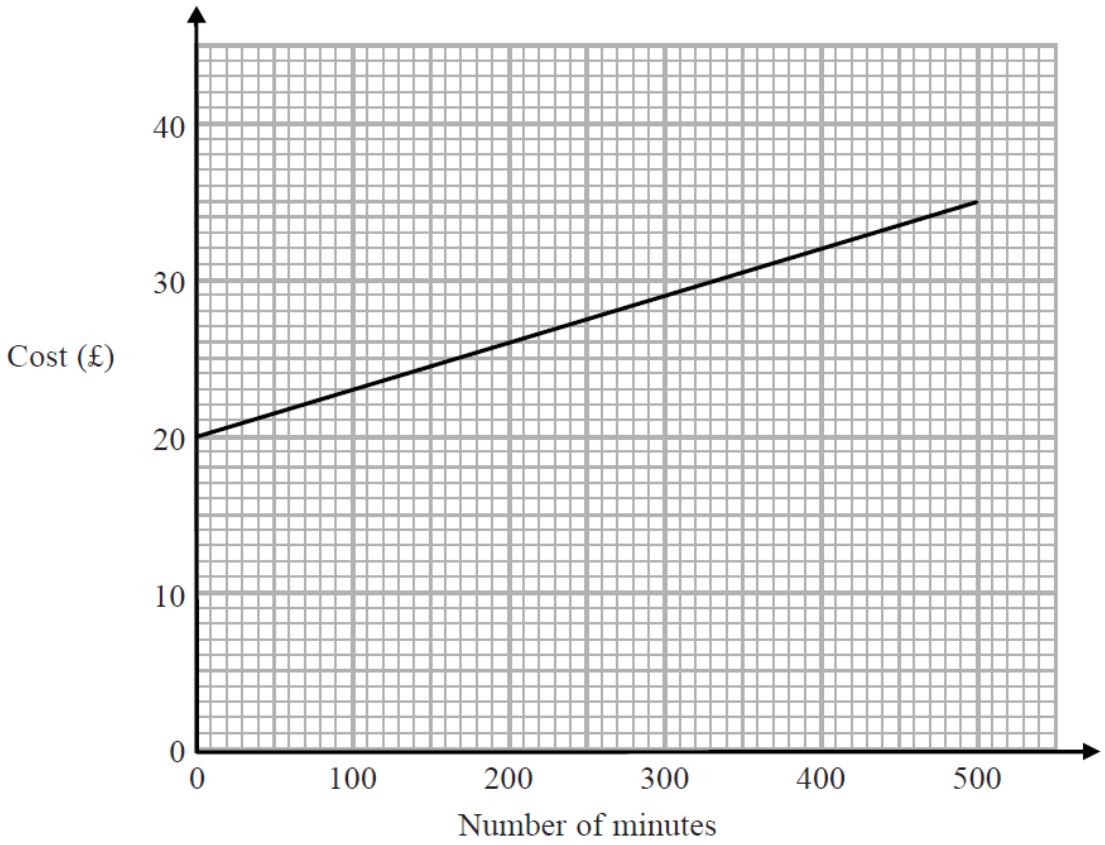
The account pays simple interest at a rate of 2.3% per year.

Work out the total amount of interest Abi has got at the end of 4 years.

solve problems involving percentage change, including percentage increase/decrease and original value problems, and simple interest including in financial mathematics (R9)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

(Total for Question 13 is 3 marks)

14 The graph shows the cost of using a mobile phone for one month for different numbers of minutes of calls made.



The cost includes a fixed rental charge of £20 and a charge for each minute of calls made.

Work out the charge for each minute of calls made.

interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion (R14)
AO2 2.3a – interpret information accurately (2 marks)

(Total for Question 14 is 2 marks)

15 Here is a list of ingredients for making chocolate mousse for 2 people.

Chocolate mousse
for 2 people

40 grams sugar
110 grams dark chocolate
2 eggs
$\frac{1}{4}$ teaspoon lemon juice

Ellie has 250 grams of sugar and 550 grams of dark chocolate.
She assumes that she has plenty of lemon juice and plenty of eggs.

(*a*) What is the greatest number of people Ellie can make chocolate mousse for?
You must justify your answer.

(3)

Ellie only has 6 eggs.

(*b*) What effect would this have on the greatest number of people Ellie can make chocolate mousse for?

apply ratio to real contexts and problems (R5)
solve problems involving direct and inverse proportion (R10)

AO3
3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks)
3.3 – Interpret results in the context of the given problem (1 mark)
3.5 – Evaluate solutions to identify how they may have been affected by assumptions made (1 mark)

(1)

(Total for Question 15 is 4 marks)

16 A sprinter runs a distance of 200 metres in 25 seconds.

Work out the average speed of the sprinter.

use compound units such as speed (R11)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 16 is 1 mark)

---

17 (*a*) Simplify $7x + 2y – 3x + 4y$

simplify and manipulate algebraic expressions by collecting like terms (A4)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(2)

(*b*) Factorise $10x – 15$

simplify and manipulate algebraic expressions by taking out common factors (A4)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

(*c*) Solve $5p = 3p + 8$

solve linear equations in one unknown algebraically (including those with the unknown on both sides of the equation) (A17)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(2)

(Total for Question 17 is 5 marks)

---

18 There are 64 cards in a pack.

Each card is either red or black.

The ratio of the number of red cards to the number of black cards is 1 : 1

8 red cards are removed from the pack.

Find the ratio of the number of red cards now in the pack to the number of black cards now in the pack.

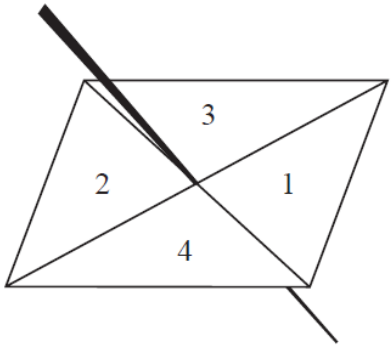
Give your answer in its simplest form.

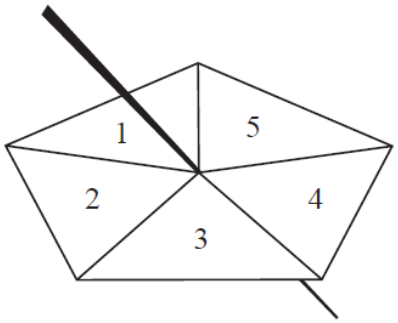
use ratio notation, including reduction to simplest form (R4) apply ratio to real contexts and problems (R5)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 18 is 3 marks)

19 Here are a 4-sided spinner and a 5-sided spinner.

The spinners are fair.





Jeff is going to spin each spinner once.

Each spinner will land on a number.

Jeff will get his score by adding these two numbers together.

(*a*) Complete the possibility space diagram for each possible score.

5-sided spinner

4-sided spinner

	1	**2**	**3**	**4**	**5**
1	2	3	4	5	6
2	3				
3	4				
4	5				

(1)

Jeff spins each spinner once.

(*b*) Find the probability that Jeff gets

(i) a score of 3

(ii) a score of 5 or more.

(2)

construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities (P7)

AO1

1.3a – accurately carry out routine procedures (2 marks)

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 19 is 3 marks)

---

20 Water flows through a pipe at a rate of 20 gallons per minute.

1 gallon = 4.55 litres.

Change 20 gallons per minute to litres per second.

Give your answer correct to 3 significant figures.

change freely between related standard units and compound units in numerical contexts (R1)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 20 is 2 marks)

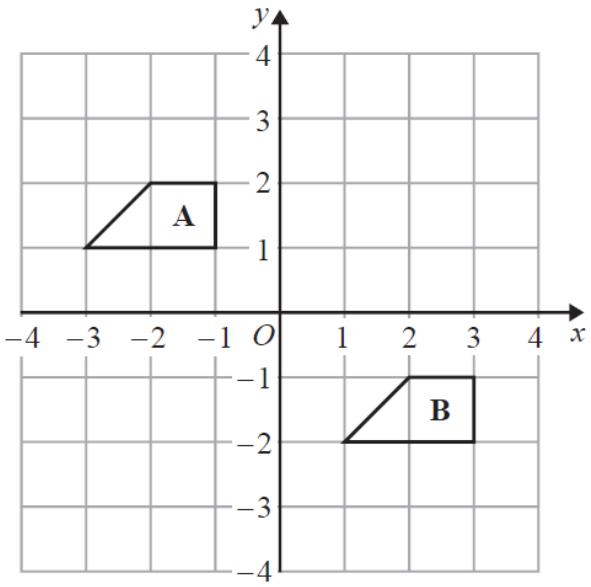
---

21 Find the highest common factor (HCF) of 32, 48 and 72.

use the concepts and vocabulary of highest common factor (N4)
AO1 1.1 – accurately recall facts, terminology and definitions (1 mark) 1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 21 is 2 marks)

22

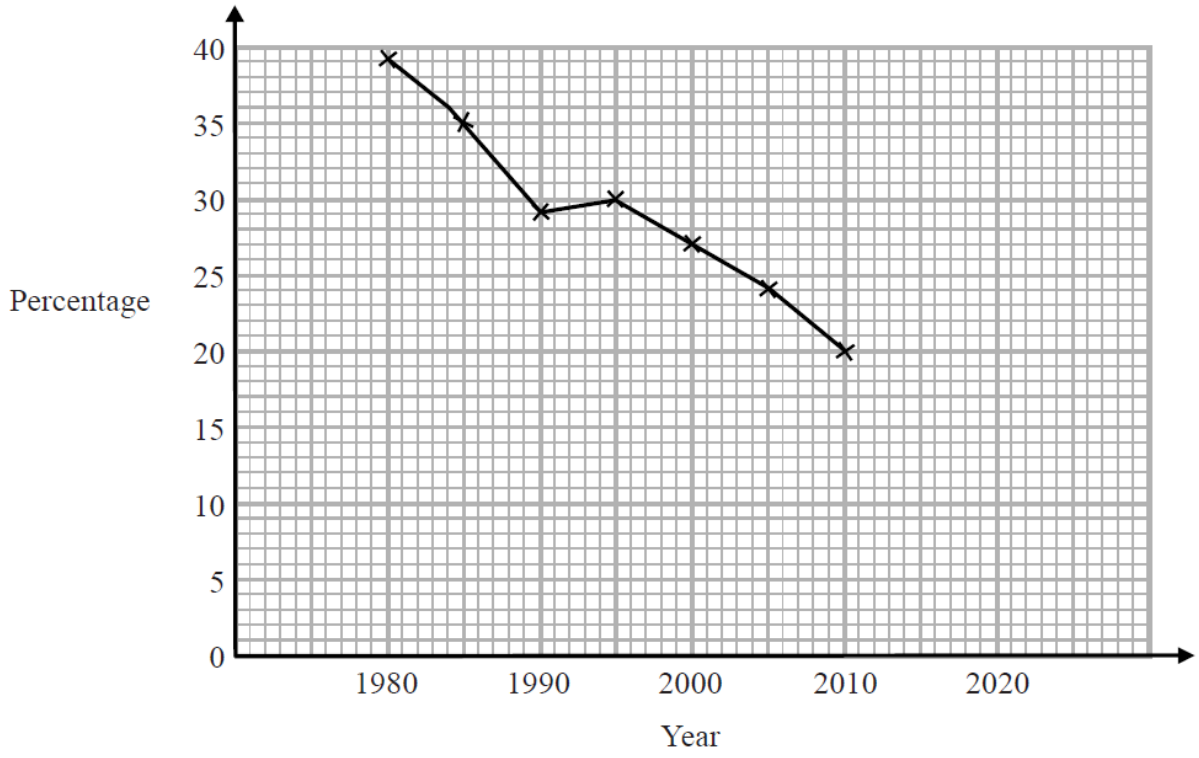


Describe the single transformation that maps shape **A** onto shape **B**.

identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional scale factors) (G7) describe translations as 2D vectors (G24)
AO2 2.3b – communicate information accurately (2 marks)
Common question across both tiers

(Total for Question 22 is 2 marks)

23 The time series graph shows information about the percentages of the people in a village that used the village shop for the years between 1980 and 2010.



(*a*) Describe the trend in the percentage of the people in the village who used the shop for this period.

interpret line graphs for time series data and know their appropriate use (S2)
AO2 2.1a – make deductions to draw conclusions from mathematical information (1 mark)
Common question across both tiers

(1)

(*b*) (i) Use the graph to predict the percentage of the people in the village likely to use

the shop in the year 2020.

(ii) Is your prediction reliable?

Explain your answer.

recognise correlation and know that it does not indicate causation; make predictions; interpolate and extrapolate apparent trends while knowing the dangers of so doing (S6)

AO2

2.3a – interpret information accurately (1 mark)

AO1

1.3a – accurately carry out routine procedures (1 mark)

AO3

3.4b – evaluate results obtained (1 mark)

Common question across both tiers

(3)

(Total for Question 23 is 4 marks)

24 (*a*) Expand and simplify $3(y - 2) + 5(2y + 1)$

simplify and manipulate algebraic expressions by collecting like terms and multiplying a single term over a bracket (A4)

AO1

1.3a – accurately carry out routine procedures (2 marks)

Common question across both tiers

(2)

(*b*) Simplify $5u^2w^4 \times 7uw^3$

simplify and manipulate algebraic expressions by simplifying expressions involving sums, products and powers, including the laws of indices (A4)

AO1

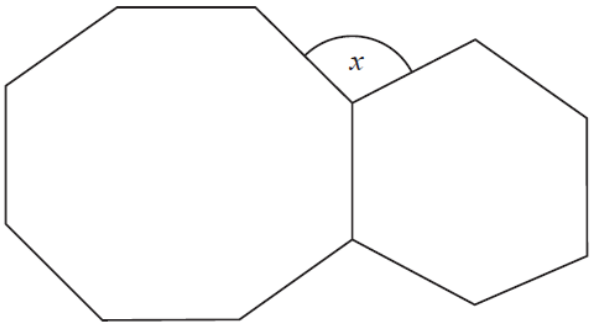
1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

Common question across both tiers

(2)

(Total for Question 24 is 4 marks)

25



The diagram shows a regular octagon and a regular hexagon.

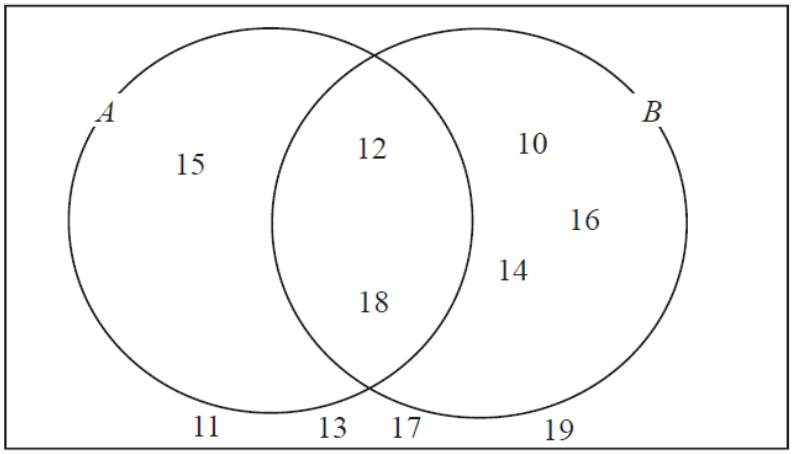
Find the size of the angle marked x

You must show all your working.

apply the properties of angles at a point; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons) (G3)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 25 is 3 marks)

26 Here is a Venn diagram.



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

(i) $A \cup B$

(ii) $A \cap B$

enumerate sets and combinations of sets systematically, using Venn diagrams (P6)
AO2 2.3a – interpret information accurately (2 marks)
New to 1MA1
Common question across both tiers

(2)

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

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

apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one (P4)
AO2 2.3a – interpret information accurately (1 mark) AO1 1.3a – accurately carry out routine procedures (1 mark)
Common question across both tiers

(2)

(Total for Question 26 is 4 marks)

---

27 On a farm

the number of cows and the number of sheep are in the ratio 6 : 5

the number of sheep and the number of pigs are in the ratio 2 : 1

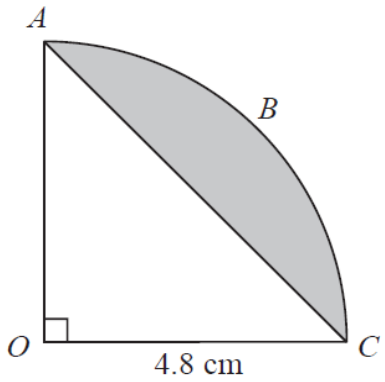
The total number of cows, sheep and pigs on the farm is 189.

How many sheep are there on the farm?

divide a given quantity into two parts in a given part:part or part:whole ratio; apply ratioto real contexts and problems (R5)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 27 is 3 marks)

28



The arc *ABC* is a quarter of a circle with centre *O* and radius 4.8 cm.

AC is a chord of the circle.

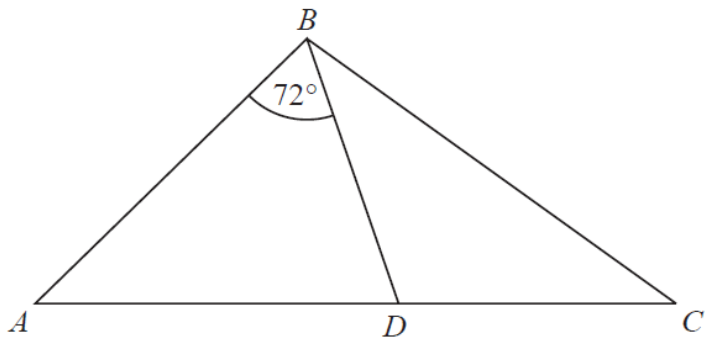
Work out the area of the shaded segment.

Give your answer correct to 3 significant figures.

know the formulae: area of a circle; calculate: areas of circles and composite shapes (G17) know and apply formulae to calculate: area of triangles (G16)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (2 marks) AO1 1.1 – accurately recall facts, terminology and definitions (1 mark)
New to Foundation
Common question across both tiers

(Total for Question 28 is 3 marks)

29



ABC is an isosceles triangle with *BA* = *BC*.

D lies on *AC*.

ABD is an isosceles triangle with *AB* = *AD*.

Angle *ABD* = 72°

Show that the triangle *BCD* is isosceles.

You must give a reason for each stage of your working.

apply the properties of angles at a point on a straight line; derive and use the sum of angles in a triangle (G3)
AO2 2.2 – Construct chains of reasoning to achieve a given result (3 marks) 2.4a – present arguments (2 marks)

(Total for Question 29 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

Set 2 Paper 3F

1 Change 4500 g to kg.

change freely between related standard units in numerical contexts (R1)
AO1 1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 1 is 1 mark)

2 Write 0.19 as a fraction.

work interchangeably with terminating decimals and their corresponding fractions (N10)
AO1 1.3a – accurately carry out routine procedures (1 mark)

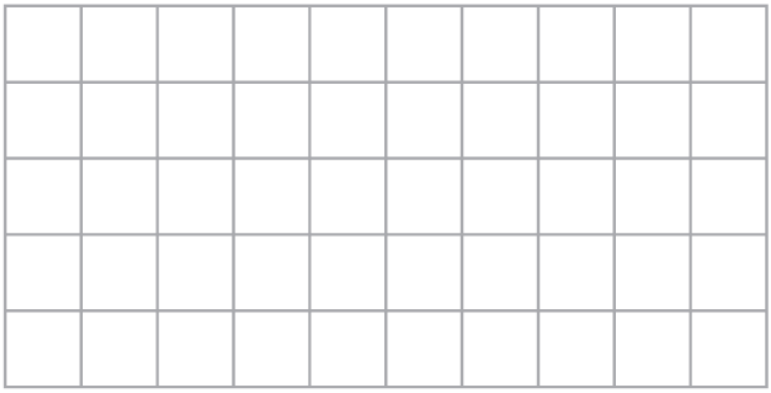
(Total for Question 2 is 1 mark)

3 Write down an even number that is a multiple of 7.

use the concepts and vocabulary of multiples (N4)
AO1 1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 3 is 1 mark)

4 On the grid, draw a parallelogram.



derive and apply the properties and definitions of special types of quadrilaterals (G4)

AO1

1.1 – accurately recall facts, terminology and definitions (1 mark)

(Total for Question 4 is 1 mark)

5 Write $\frac{3}{5}$ as a percentage

interpret percentages and percentage changes as a fraction or a decimal (R9)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 5 is 1 mark)

6 Coffee is sold in jars.

There are 200 g of coffee in each jar.

Ben makes 8 cups of coffee each day.

He thinks he uses 2 g of coffee to make each cup of coffee.

Ben wants to buy enough coffee for 28 days.

(*a*) How many jars of coffee does Ben need to buy?

use standard units of mass, length, time, money and other measures using decimal quantities where appropriate (N13)
apply the four operations, including formal written methods, to integers and decimals; understand and use place value (N2)

AO3
3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks)
3.3 – Interpret results in the context of the given problem (1 mark)

(3)

Ben finds that he uses 2.5 g of coffee to make each cup of coffee.

(*b*) How does this affect the number of jars of coffee he needs to buy?

You must give a reason for your answer.

apply the four operations, including formal written methods, to integers and decimals; understand and use place value (N2)

AO3
3.5 – Evaluate solutions to identify how they may have been affected by assumptions made (2 marks)

(2)

(Total for Question 6 is 5 marks)

7 Write down three different factors of 18 that add together to give a prime number.

use the concepts and vocabulary of prime numbers and factors (N4)

AO1

1.1 – accurately recall facts, terminology and definitions (1 mark)

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 7 is 2 marks)

8 A model plane has a length of 17 cm.

The scale of the model is 1 : 200

Work out the length of the real plane.

Give your answer in metres.

use scale factors, scale diagrams and maps (R2)

change freely between related standard units in numerical contexts (R1)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(Total for Question 8 is 2 marks)

9 (*a*) Find the value of $\sqrt[3]{97.336}$

(1)

(*b*) Find the value of $\sqrt{7.29} + (2.3 - 0.85)^2$

(2)

use positive integer powers and associated real roots, recognise powers of 2, 3, 4, 5 (N6)

AO1

1.3a – accurately carry out routine procedures (3 marks)

(Total for Question 9 is 3 marks)

10 The stem and leaf diagram gives information about the speeds of 27 cars.

3	8
4	1 3 4 6 7 8 8 9 9
5	2 2 4 6 7 7 8 8 9
6	1 1 2 2 2 2 3
7	0

Key:

3 | 8 means 38 miles per hour

(*a*) Find the median speed.

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (S4)

interpret and construct tables, charts and diagrams (S2)

AO2

2.3a – interpret information accurately (1 mark)

(1)

(*b*) Work out the range.

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of spread (S4)

interpret and construct tables, charts and diagrams (S2)

AO2

2.3a – interpret information accurately (1 mark)

(1)

One of the cars is chosen at random.

Jack says,

"The probability that the speed of this car is more than 60 miles per hour is $\frac{1}{3}$"

(*c*) Jack is wrong.

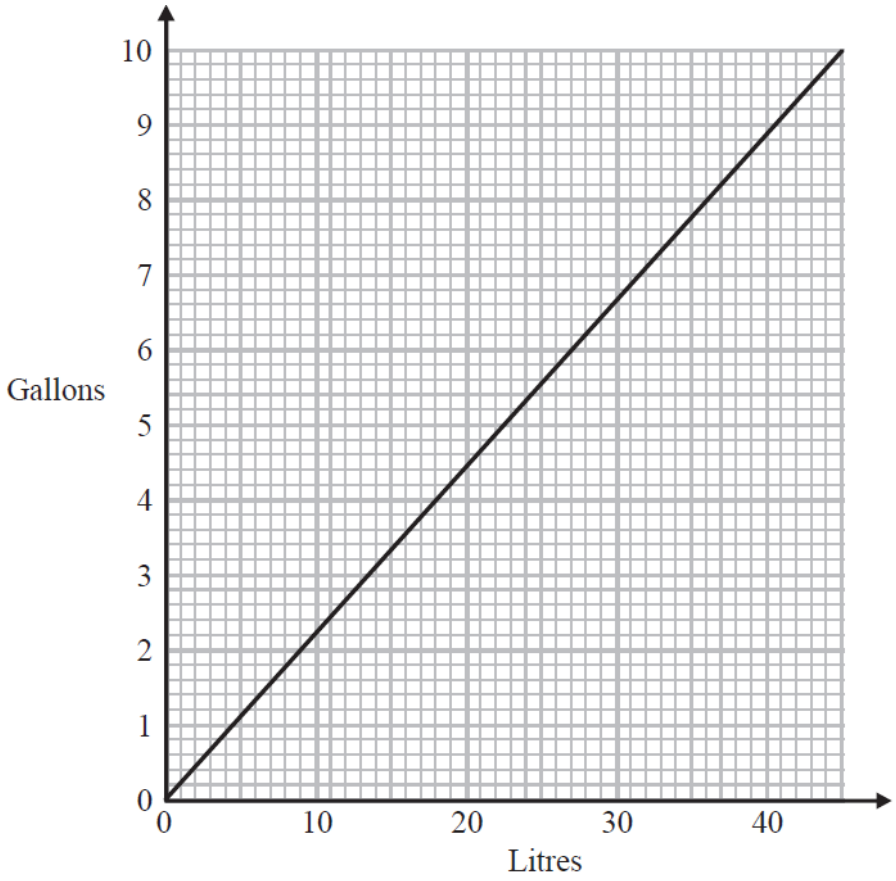
Explain why.

relate relative expected frequencies to theoretical probability, using appropriate language and the 0-1 probability scale (P3) interpret and construct tables, charts and diagrams (S2)
AO2 2.4a – present arguments (2 marks)

(2)

(Total for Question 10 is 4 marks)

11 You can use this graph to change between litres and gallons.



Which is the greater, 60 litres or 12 gallons?

You must show how you get your answer.

plot and interpret graphs in real contexts to find approximate solutions to problems (A14) change freely between related standard units in numerical contexts (R1)

AO2 2.1a – make deductions to draw conclusions from mathematical information (1 mark) 2.3a – interpret information accurately (1 mark)

(Total for Question 11 is 2 marks)

12 Ibrar buys 3 kg of apples.

He also buys 0.4 kg of mushrooms.

The total cost is £6.93.

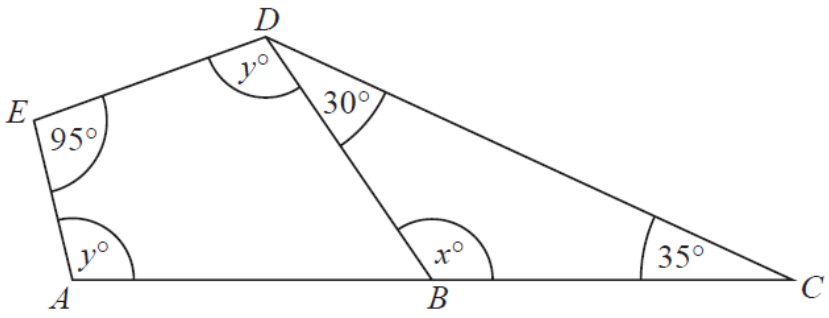
1 kg of apples cost £1.95.

Work out the cost of 1 kg of mushrooms.

use standard units of mass, length, time, money and other measures using decimal quantities where appropriate (N13) apply the four operations, including formal written methods, to integers and decimals; understand and use place value (N2)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 12 is 3 marks)

13



ABC is a straight line.

BCD is a triangle.

ABDE is a quadrilateral.

(*a*) (i) Work out the value of *x*.

(ii) Give a reason for your answer.

derive and use the sum of angles in a triangle (G3)
AO1 1.1 – accurately recall facts, terminology and definitions (1 mark) 1.3a – accurately carry out routine procedures (1 mark)

(2)

(*b*) Work out the value of *y*.

apply the properties of angles at a point on a straight line; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons) (G3)
AO3 3.1a – translate problems in mathematical contexts into a process (1 mark) AO1 1.3a – accurately carry out routine procedures (1 mark)

(2)

(Total for Question 13 is 4 marks)

14 You can use this rule to work out the total cost, in pounds, of hiring a carpet cleaner.

Multiply the number of days by 7.8 and then add 12

Andy hires a carpet cleaner.

The total cost is £82.20.

(*a*) Work out the number of days Andy hires the carpet cleaner for.

substitute numerical values into formulae and expressions, including scientific formulae (A2)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(2)

Chloe hires a carpet cleaner for y days.

The total cost is £T.

(*b*) Write down a formula for T in terms of y.

translate simple situations or procedures into algebraic expressions or formulae (A21)

AO2

2.3b – communicate information accurately (2 marks)

(2)

(Total for Question 14 is 4 marks)

15 There are 35 pens in a box.

15 of the pens are green.

The rest of the pens are red.

(*a*) What fraction of the pens in the box are red?

express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1 (R3)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(1)

(*b*) Write down the ratio of the number of green pens to the number of red pens.

Give your ratio in its simplest form.

use ratio notation, including reduction to simplest form (R4)

divide a given quantity into two parts in a given part:part or part:whole ratio (R5)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(2)

(Total for Question 15 is 3 marks)

16 Ross rolled an ordinary dice 30 times.

The frequency table gives information about his results.

Score	**Frequency**
1	7
2	5
3	4
4	4
5	6
6	4

Ross worked out the mean score as 8.

(*a*) Explain why it is impossible for the mean score to be 8.

(1)

Graham also worked out the mean score.

Here is his working.

$1 \times 7 + 2 \times 5 + 3 \times 4 + 4 \times 4 + 5 \times 6 + 6 \times 4 = 99$

$99 \div 6 = 16.5$

The mean score is 16.5

(*b*) Describe the mistake Graham made in his method to work out the mean score.

(1)

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (S4)

AO3

3.4a – evaluate methods used (1 mark)

3.4b – evaluate results obtained (1 mark)

(Total for Question 16 is 2 marks)

---

17 Amelia, Hayden and Sophie did a test.

The total for the test was 75 marks.

Amelia got 56% of the 75 marks.

Hayden got $\frac{8}{15}$ of the 75 marks.

Sophie got 43 out of 75.

Who got the highest mark?

You must show all your working.

define percentage as 'number of parts per hundred'; interpret percentages and percentage changes as a fraction or a decimal; compare two quantities using percentages (R9)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks)

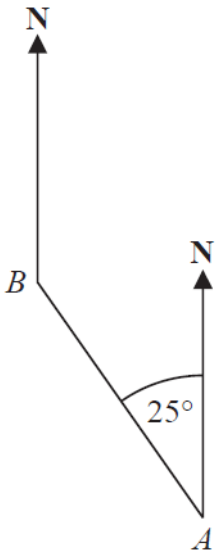
AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 17 is 3 marks)

---

18 The diagram shows the positions of two churches, *A* and *B*.



Amber says,

"The bearing of church *B* from church *A* is 025°"

Amber is wrong.

Explain why.

measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings (G15)
AO2 2.4a – present arguments (1 mark)

(Total for Question 18 is 1 mark)

19 There are only blue counters, green counters, red counters and yellow counters in a bag.
George is going to take at random a counter from the bag.

The table shows each of the probabilities that George will take a blue counter or a green counter or a yellow counter.

Colour	blue	green	red	yellow
Probability	0.5	0.2		0.25

(*a*) Work out the probability that George will take a red counter.

apply the property that the probabilities of an exhaustive set of outcomes sum to one (P4)

AO1
1.3a – accurately carry out routine procedures (1 mark)

(1)

There are 120 counters in the bag.

(*b*) Work out the number of green counters in the bag.

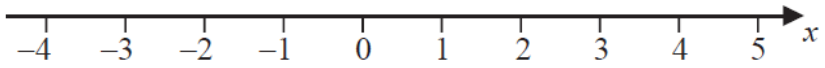
relate relative expected frequencies to theoretical probability, using appropriate language and the 0-1 probability scale (P3)

AO1
1.3a – accurately carry out routine procedures (2 marks)

(2)

(Total for Question 19 is 3 marks)

20 (*a*) Show the inequality $-2 \leq x < 3$ on the number line below.



solve linear inequalities in one variable; represent the solution set on a number line (A22)

AO2

2.3b – communicate information accurately (2 marks)

(2)

(*b*) Solve the inequality $4y + 7 < 16$

solve linear inequalities in one variable (A22)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(2)

(Total for Question 20 is 4 marks)

---

21 Here are the first five terms of an arithmetic sequence.

– 3 1 5 9 13

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

deduce expressions to calculate the *n*th term of linear sequences (A25)

AO2

2.1a – make deductions to draw conclusions from mathematical information (1 mark)

AO1

1.3a – accurately carry out routine procedures (1 mark)

(Total for Question 21 is 2 marks)

---

22 The ratio of the number of boys to the number of girls in a school is 4 : 5

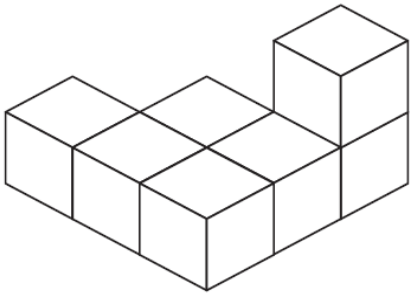
There are 95 girls in the school.

Work out the total number of students in the school.

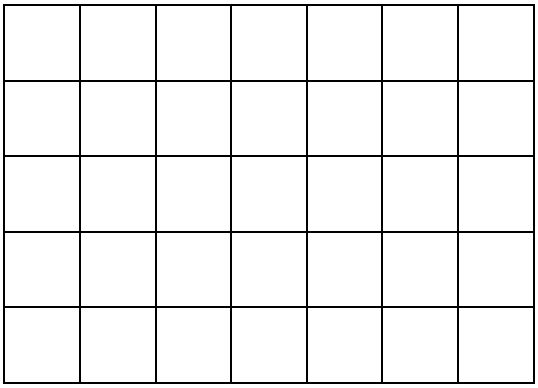
divide a given quantity into two parts in a given part:part or part:whole ratio; apply ratio to real contexts and problems (R5) use ratio notation, including reduction to simplest form (R4)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 22 is 3 marks)

23 The diagram represents a solid made from seven centimetre cubes.



On the centimetre grid below, draw a plan of the solid.



construct and interpret plans and elevations of 3D shapes (G13)

AO2

2.3a – interpret information accurately (1 mark)

2.3b – communicate information accurately (1 mark)

Common question across both tiers

(Total for Question 23 is 2 marks)

24 Make t the subject of the formula $y = \frac{t}{3} - 2a$

understand and use standard mathematical formulae; rearrange formulae to change the subject (A5)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

Common question across both tiers

(Total for Question 24 is 2 marks)

---

25 Jim rounds a number, x, to one decimal place.

The result is 7.2.

Write down the error interval for x.

use inequality notation to specify simple error intervals due to truncation or rounding (N15)

AO1

1.1 – accurately recall facts, terminology and definitions (1 mark)

1.2 – use and interpret notation correctly (1 mark)

New to 1MA1

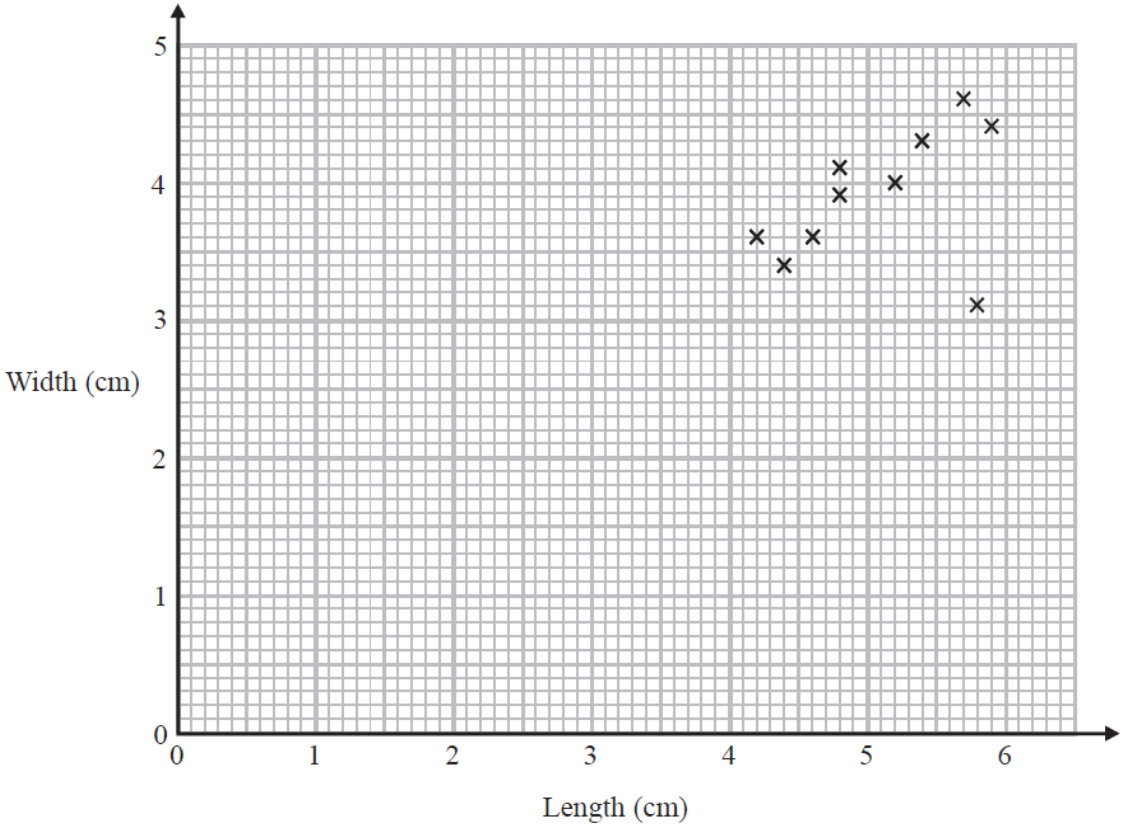
Common question across both tiers

(Total for Question 25 is 2 marks)

---

26 Katie measured the length and the width of each of 10 pine cones from the same tree.

She used her results to draw this scatter graph.



(*a*) Describe one improvement Katie can make to her scatter graph.

use and interpret scatter graphs of bivariate data (S6)

AO2

2.5b – critically evaluate a given way of presenting information (1 mark)

Common question across both tiers

(1)

The point representing the results for one of the pine cones is an outlier.

(*b*) Explain how the results for this pine cone differ from the results for the other pine cones.

use and interpret scatter graphs of bivariate data (S6) interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of spread (range, including consideration of outliers) (S4)
AO2 2.3a – interpret information accurately (1 mark)
Common question across both tiers

(1)

(Total for Question 26 is 2 marks)

27 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.

understand that X is inversely proportional to Y is equivalent to X is proportional to $1/Y$; interpret equations that describe direct and inverse proportion (R13)

AO1

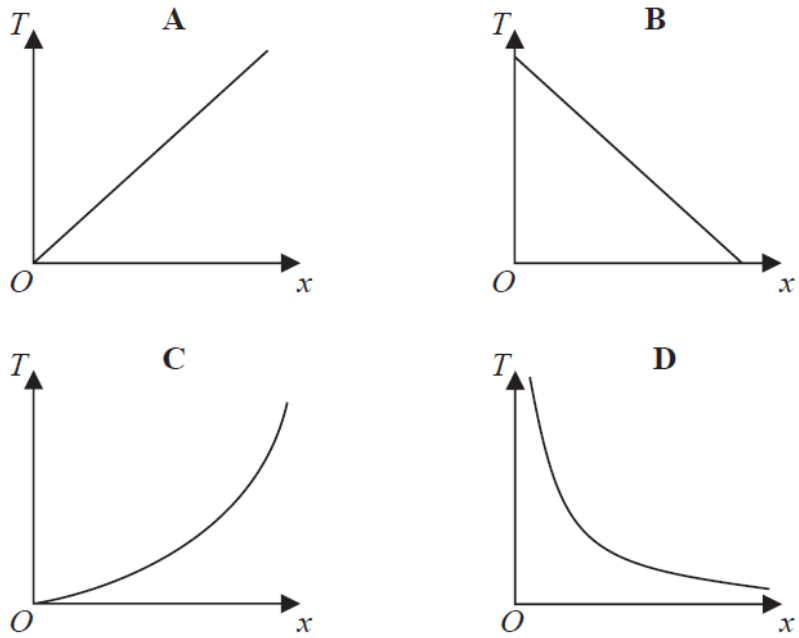
1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

New to 1MA1

Common question across both tiers

(3)

Here are four graphs.



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

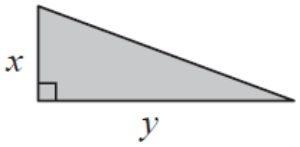
(*b*) Write down the letter of this graph.

solve problems involving direct and inverse proportion, including graphical representations (R10)
AO2 2.3a – interpret information accurately (1 mark)
Common question across both tiers

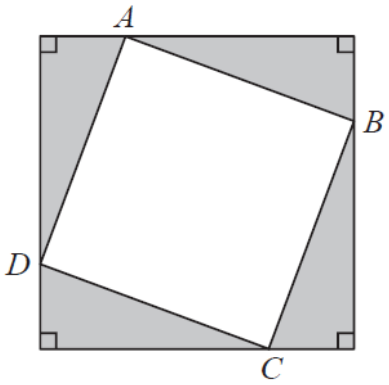
(1)

(Total for Question 27 is 4 marks)

28 Here is a right-angled triangle.



Four of these triangles are joined to enclose the square *ABCD* as shown below.



Show that the area of the square *ABCD* is $x^2 + y^2$

know the formulae for Pythagoras' theorem; apply to find angles and lengths in right-angled triangles in two-dimensional figures (G20)
know and apply formulae to calculate area of parallelograms (G16)
simplify and manipulate algebraic expressions by simplifying expressions involving sums, products and powers, including the laws of indices (A4)

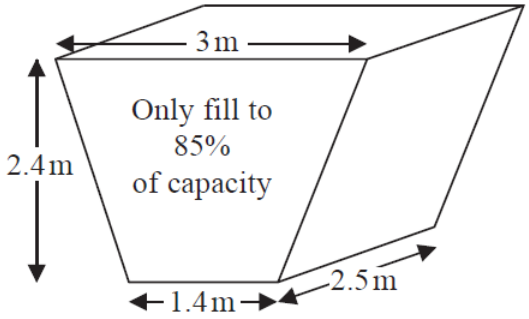
AO2
2.4a – present arguments (3 marks)

Common question across both tiers

(Total for Question 28 is 3 marks)

29 The diagram shows an oil tank in the shape of a prism.

The cross section of the prism is a trapezium.



The tank is empty.

Oil flows into the tank.

After one minute there are 300 litres of oil in the tank.

Assume that oil continues to flow into the tank at this rate.

(*a*) Work out how many **more** minutes it takes for the tank to be 85% full of oil.

($1\ m^3 = 1000$ litres)

know and apply formulae to calculate: area of trapezia; volume of cuboids and other right prisms (G16)

use compound units such as speed, rates of pay, unit pricing, density and pressure (R11)

interpret fractions and percentages as operators (N12)

change freely between related standard units and compound units in numerical contexts (R1)

solve problems involving percentage change (R9)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

3.2 – Make and use connections between different parts of mathematics (1 mark)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

Common question across both tiers

(5)

The assumption about the rate of flow of the oil could be wrong.

(*b*) Explain how this could affect your answer to part (*a*).

use compound units such as speed, rates of pay, unit pricing, density and pressure (R11)

AO3

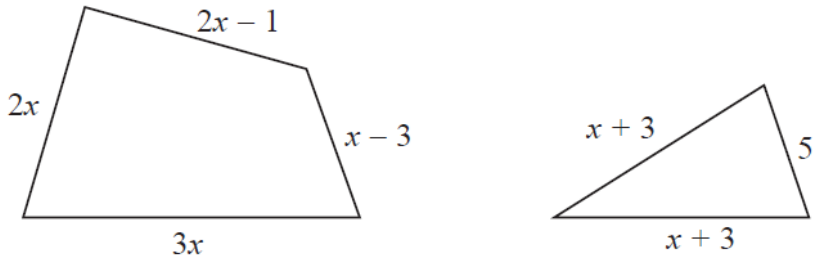
3.5 – Evaluate solutions to identify how they may have been affected by assumptions made (1 mark)

Common question across both tiers

(1)

(Total for Question 29 is 6 marks)

30



In the diagram all measurements are in centimetres.

The perimeter of the quadrilateral is twice the perimeter of the triangle.

Work out the perimeter of the quadrilateral.

translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or two simultaneous equations), solve the equation(s) and interpret the solution (A21) calculate perimeters of 2D shapes (G17)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (1 mark) 3.2 – make and use connections between different parts of mathematics (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(Total for Question 30 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS

Set 2 Paper 1H

1 (*a*) Factorise $y^2 + 27y$

(1)

(*b*) Simplify $(t^3)^2$

(1)

(*c*) Simplify $\frac{w^9}{w^4}$

(1)

simplify and manipulate algebraic expressions by taking out common factors and simplifying expressions involving sums, products and powers, including the laws of indices (A4)

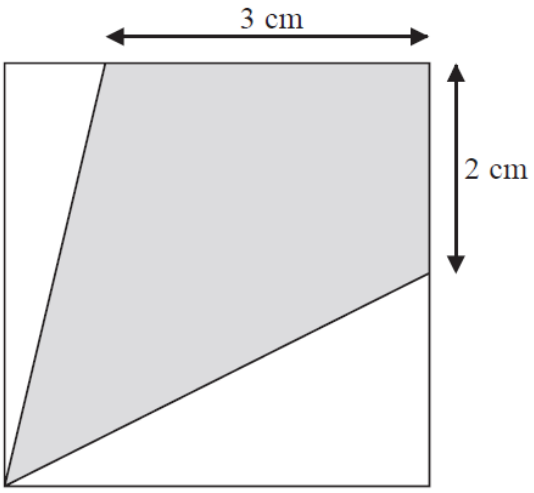
AO1

1.3a – accurately carry out routine procedures (3 marks)

Common question across both tiers

(Total for Question 1 is 3 marks)

2 The diagram shows a square with perimeter 16 cm.



Work out the proportion of the area inside the square that is shaded.

know and apply formulae to calculate: area of triangles and parallelograms (G16) express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1 (R3)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (3 marks) 3.2 – make and use connections between different parts of mathematics (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 2 is 5 marks)

3 David has designed a game.

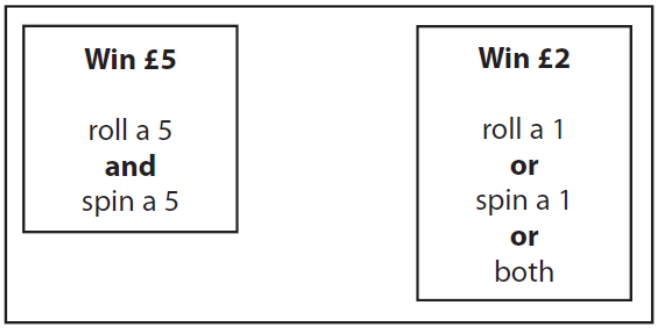
He uses a fair 6-sided dice and a fair 5-sided spinner.

The dice is numbered 1 to 6.

The spinner is numbered 1 to 5.

Each player rolls the dice once and spins the spinner once.

A player can win £5 or win £2.



David expects 30 people will play his game.

Each person will pay David £1 to play the game.

(*a*) Work out how much profit David can expect to make.

apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments (P2)

calculate the probability of independent and dependent combined events (P8)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

Common question across both tiers

(4)

(*b*) Give a reason why David's actual profit may be different to the profit he expects to make.

understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size (P5)
AO3 3.4b – evaluate results obtained (1 mark)
Common question across both tiers

(1)

(Total for Question 3 is 5 marks)

---

4 Triangle *ABC* has perimeter 20 cm.

AB = 7 cm.

BC = 4 cm.

By calculation, deduce whether triangle *ABC* is a right-angled triangle.

know the formulae for: Pythagoras' theorem; apply to find angles and lengths in right-angled triangles in two-dimensional figures (G20) use known results to obtain simple proofs (G6)
AO2 2.2 – construct chains of reasoning to achieve a given result (2 marks) 2.3a – interpret information accurately (1 mark) 2.3b – communicate information accurately (1 mark)
Common question across both tiers

(Total for Question 4 is 4 marks)

---

5 One sheet of A3 card has area $\frac{1}{8}$ m^2.

The card has a mass of 160 g per m^2.

Work out the total mass of 25 sheets of A3 card.

use compound units such as speed, rates of pay, unit pricing, density and pressure (R11) use standard units of measure and related concepts (G14)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.2 – use and interpret notation correctly (1 mark) 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 5 is 4 marks)

6 (*a*) Work out $2\frac{1}{4} \times 3\frac{1}{3}$

Give your answer as a mixed number in its simplest form.

(3)

(*b*) Write the numbers 3, 4, 5 and 6 in the boxes to give the greatest possible total.

You may write each number only once.

$$\square\frac{1}{\square} + \square\frac{2}{\square}$$

(1)

apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers (N2)
AO1 1.3a – accurately carry out routine procedures (3 marks) AO2 2.2 – Construct chains of reasoning to achieve a given result (1 mark)

(Total for Question 6 is 4 marks)

7 A shop has a sale.

Microwave ovens	Combination ovens
$\frac{1}{3}$ off normal price	40% off normal price

A microwave oven has a sale price of £90.

A combination oven has a sale price of £84.

Which of these ovens has the greater normal price?

You must show all your working.

interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively; compare two quantities using percentages (R9)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

AO3

3.3 – Interpret results in the context of the given problem (1 mark)

(Total for Question 7 is 4 marks)

8 Work out an estimate for $\sqrt{4.98 + 2.16 \times 7.35}$

estimate answers (N14)

use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5 (N6)

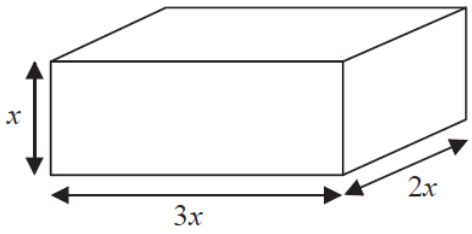
calculate with roots, and with integer indices (N7)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

(Total for Question 8 is 3 marks)

9 Here is a cuboid.



All measurements are in centimetres.

x is an integer.

The total volume of the cuboid is less than 900 cm^3.

Show that $x \leq 5$.

translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or two simultaneous equations), solve the equation(s) and interpret the solution (A21)

know and apply formulae to calculate volume of cuboids (G16)

AO2

2.2 – Construct chains of reasoning to achieve a given result (3 marks)

(Total for Question 9 is 3 marks)

10 y is inversely proportional to x

When $x = 1.5$, $y = 36$

Find the value of y when $x = 6$

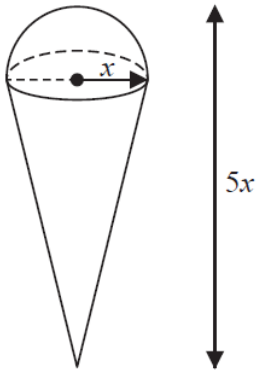
understand that X is inversely proportional to Y is equivalent to X is proportional to $1/Y$ (R13)

AO1

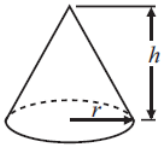
1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

(Total for Question 10 is 3 marks)

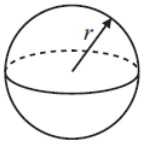
11 A solid is made by putting a hemisphere on top of a cone.



Volume of cone $= \frac{1}{3}\pi r^2 h$



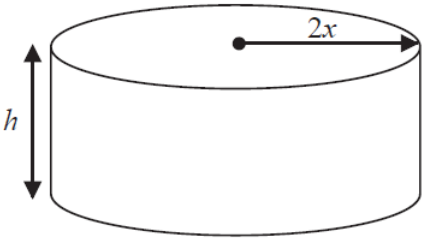
Volume of sphere $= \frac{4}{3}\pi r^3$



The total height of the solid is $5x$

The radius of the base of the cone is x

The radius of the hemisphere is x



A cylinder has the same volume as the solid.

The cylinder has radius $2x$ and height h

All measurements are in centimetres.

Find a formula for h in terms of x

Give your answer in its simplest form.

calculate: areas of circles and composite shapes; surface area and volume of spheres, pyramids, cones and composite solids (G17)

translate simple situations or procedures into algebraic expressions or formulae (A21)

AO3

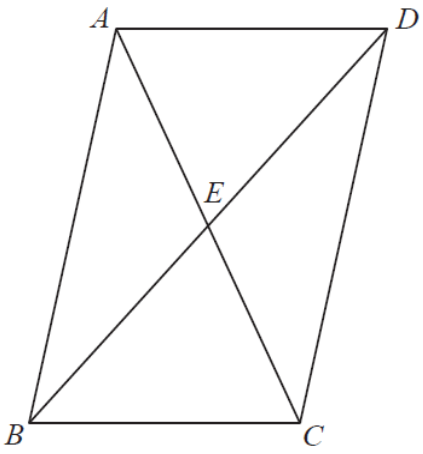
3.1b – translate problems in mathematical contexts into a series of processes (4 marks)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 11 is 5 marks)

12 *ABCD* is a parallelogram.



E is the point where the diagonals *AC* and *BD* meet.

Prove that triangle *ABE* is congruent to triangle *CDE*.

use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS) (G5)
AO2 2.4b – present proofs (3 marks)

(Total for Question 12 is 3 marks)

13 Mr Brown gives his class a test.

The 10 girls in the class get a mean mark of 70%.

The 15 boys in the class get a mean mark of 80%.

Nick says that because the mean of 70 and 80 is 75 then the mean mark for the whole class in the test is 75%.

Nick is not correct.

Is the correct mean mark less than or greater than 75%?

You must justify your answer.

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (S4)
AO2 2.5a – assess the validity of an argument (2 marks)

(Total for Question 13 is 2 marks)

---

14 Show that $\frac{\left(4-\sqrt{3}\right)\left(4+\sqrt{3}\right)}{\sqrt{13}}$ simplifies to $\sqrt{13}$

simplify surd expressions involving squares and rationalise denominators (N8)
AO2 2.2 – Construct chains of reasoning to achieve a given result (2 marks)

(Total for Question 14 is 2 marks)

---

15 (*a*) Find the value of $\sqrt[3]{8\times10^6}$

(1)

(*b*) Find the value of $144^{\frac{1}{2}} \times 64^{-\frac{1}{3}}$

(2)

calculate with roots, and with integer **and fractional** indices (N7)

AO1

1.2 – use and interpret notation correctly (1 mark)

1.3a – accurately carry out routine procedures (2 marks)

(*c*) Solve $3^{2x} = \frac{1}{81}$

simplify and manipulate algebraic expressions by simplifying expressions involving sums, products and powers, including the laws of indices (A4)

solve linear equations in one unknown algebraically (A17)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

(2)

(Total for Question 15 is 5 marks)

16 The probability that Sanay is late for school tomorrow is 0.05.

The probability that Jaden is late for school tomorrow is 0.15.

Alfie says that the probability that Sanay and Jaden will both be late for school tomorrow is 0.0075 because $0.05 \times 0.15 = 0.0075$

What assumption has Alfie made?

calculate the probability of independent and dependent combined events and know the underlying assumptions (P8)
AO3 3.5 – Evaluate solutions to identify how they may have been affected by assumptions made (1 mark)

(Total for Question 16 is 1 mark)

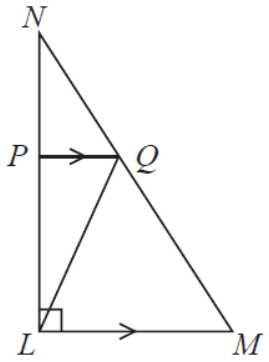
17 Solve $x^2 - 6x - 8 = 0$

Write your answer in the form $a \pm \sqrt{b}$ where a and b are integers.

solve quadratic equations algebraically by factorising, by **completing the square and by using the quadratic formula** (A18)
AO2 2.2 – Construct chains of reasoning to achieve a given result (3 marks)

(Total for Question 17 is 3 marks)

18 LMN is a right-angled triangle.



Angle *NLM* = 90°.

PQ is parallel to *LM*.

The area of triangle *PNQ* is 8 cm^2.

The area of triangle *LPQ* is 16 cm^2.

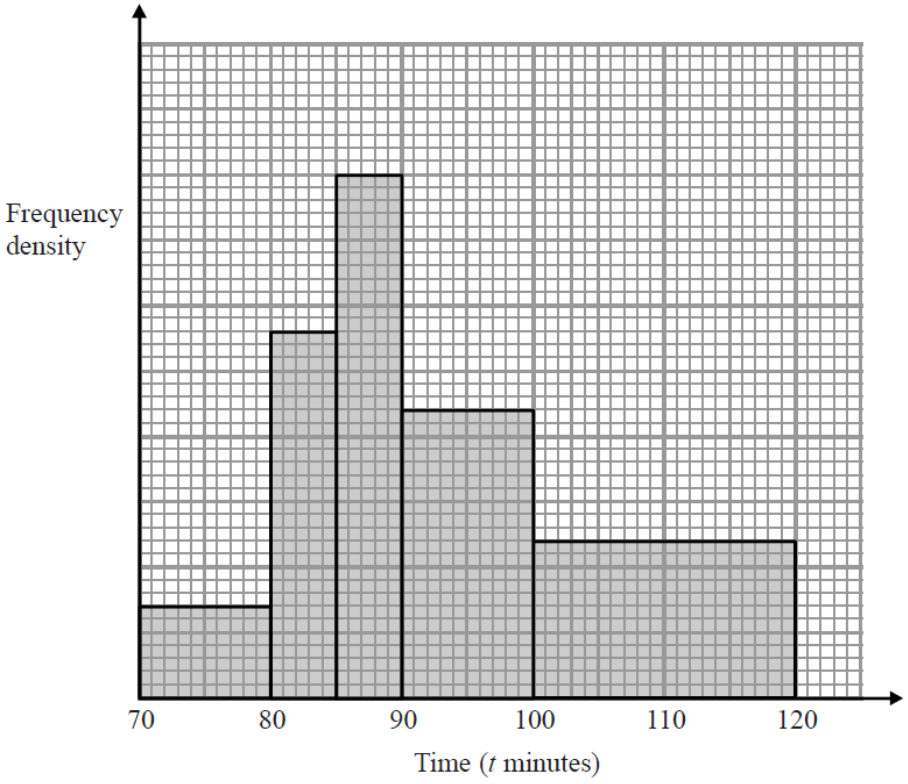
Work out the area of triangle *LQM*.

apply the concepts of congruence and similarity, including the relationships between lengths and **areas** in similar figures (G19)

AO3 3.1b – translate problems in mathematical contexts into a series of processes (2 marks) 3.2 – Make and use connections between different parts of mathematics (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 18 is 4 marks)

19 The histogram shows information about the time taken by cyclists to finish a cycle race.



7 cyclists took 80 minutes or less to finish the race.

(i) Work out an estimate for the number of cyclists who took more than 105 minutes to finish the race.

(ii) Explain why your answer to part (i) is only an estimate.

construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use (S3)

AO2 2.3a – interpret information accurately (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark) AO3 3.4b – evaluate results obtained (1 mark)

(Total for Question 19 is 4 marks)

20 Show that $\frac{3x+6}{x^2-3x-10} \div \frac{x+5}{x^3-25x}$ simplifies to ax where a is an integer.

simplify and manipulate algebraic expressions (including those involving **algebraic fractions**) by taking out common factors and simplifying expressions involving sums, products and powers, including the laws of indices (A4)

AO2

2.2 – Construct chains of reasoning to achieve a given result (4 marks)

(Total for Question 20 is 4 marks)

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

solve quadratic inequalities in one variable (A22)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (4 marks)

New to 1MA1

(Total for Question 21 is 4 marks)

22 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.

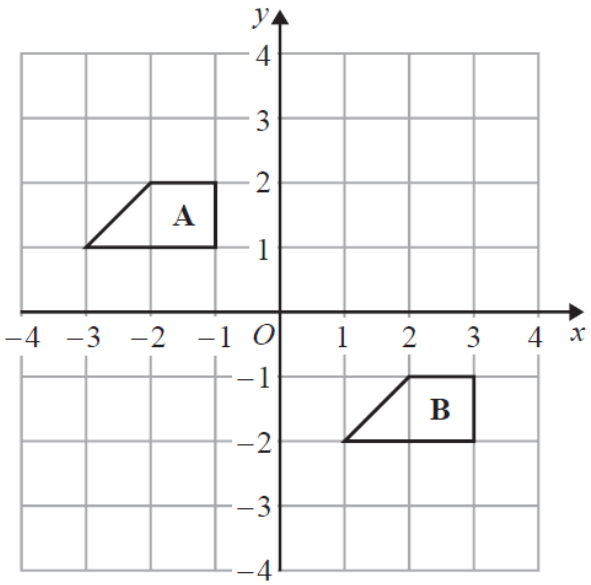
recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point (A16) know and apply formulae to calculate area of triangles (G16) find the equation of the line through two given points or through one point with a given gradient (A9)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (3 marks) 3.2 – make and use connections between different parts of mathematics (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
New to 1MA1

(Total for Question 22 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

Set 2 Paper 2H

1



Describe the single transformation that maps shape **A** onto shape **B**.

identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional scale factors) (G7)

describe translations as 2D vectors (G24)

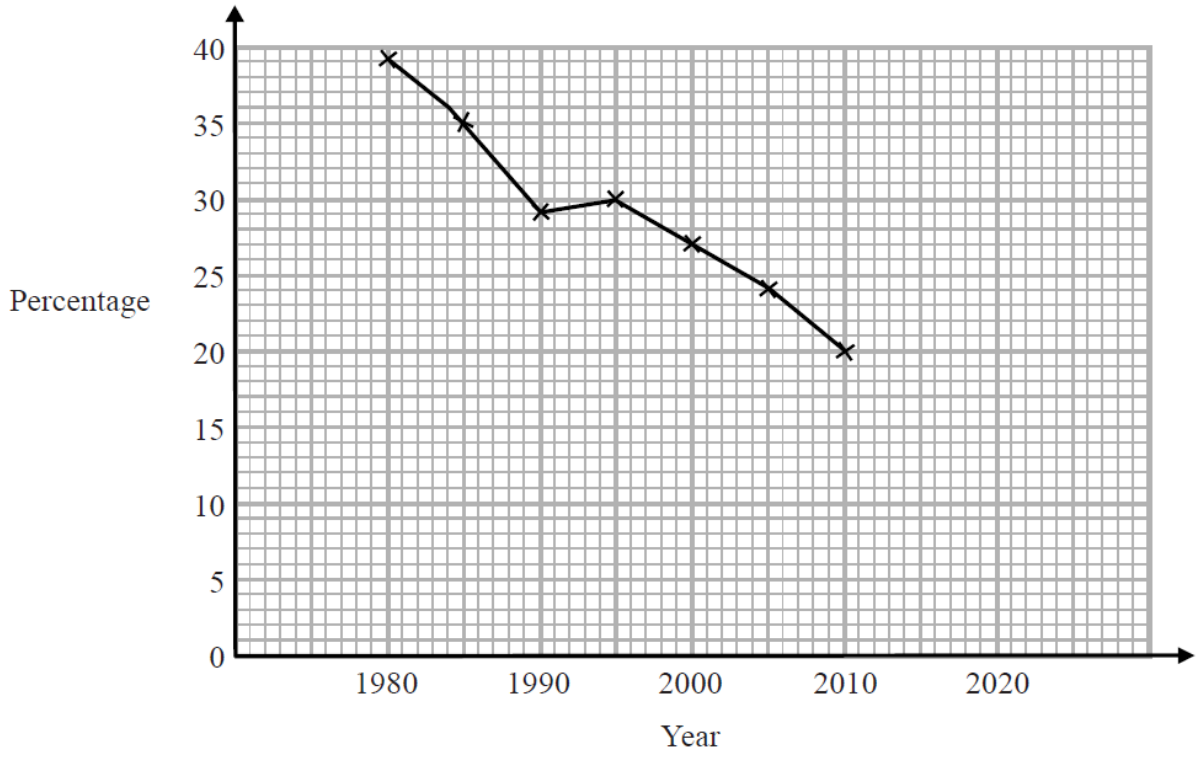
AO2

2.3b – communicate information accurately (2 marks)

Common question across both tiers

(Total for Question 1 is 2 marks)

2 The time series graph shows information about the percentages of the people in a village that used the village shop for the years between 1980 and 2010.



(*a*) Describe the trend in the percentage of the people in the village who used the shop for this period.

interpret line graphs for time series data and know their appropriate use (S2)
AO2 2.1a – make deductions to draw conclusions from mathematical information (1 mark)
Common question across both tiers

(1)

(*b*) (i) Use the graph to predict the percentage of the people in the village likely to use

the shop in the year 2020.

(ii) Is your prediction reliable?

Explain your answer.

recognise correlation and know that it does not indicate causation; make predictions; interpolate and extrapolate apparent trends while knowing the dangers of so doing (S6)

AO2

2.3a – interpret information accurately (1 mark)

AO1

1.3a – accurately carry out routine procedures (1 mark)

AO3

3.4b – evaluate results obtained (1 mark)

Common question across both tiers

(3)

(Total for Question 2 is 4 marks)

3 (*a*) Expand and simplify $3(y - 2) + 5(2y + 1)$

simplify and manipulate algebraic expressions by collecting like terms and multiplying a single term over a bracket (A4)

AO1

1.3a – accurately carry out routine procedures (2 marks)

Common question across both tiers

(2)

(*b*) Simplify $5u^2w^4 \times 7uw^3$

simplify and manipulate algebraic expressions by simplifying expressions involving sums, products and powers, including the laws of indices (A4)

AO1

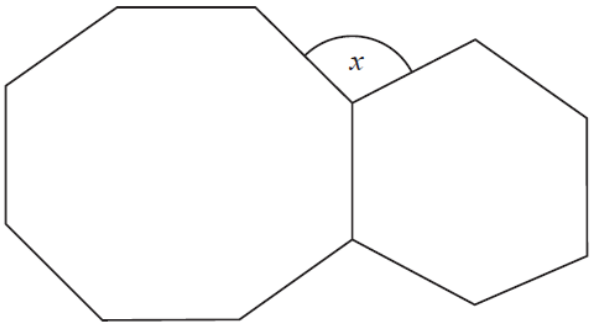
1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

Common question across both tiers

(2)

(Total for Question 3 is 4 marks)

4



The diagram shows a regular octagon and a regular hexagon.

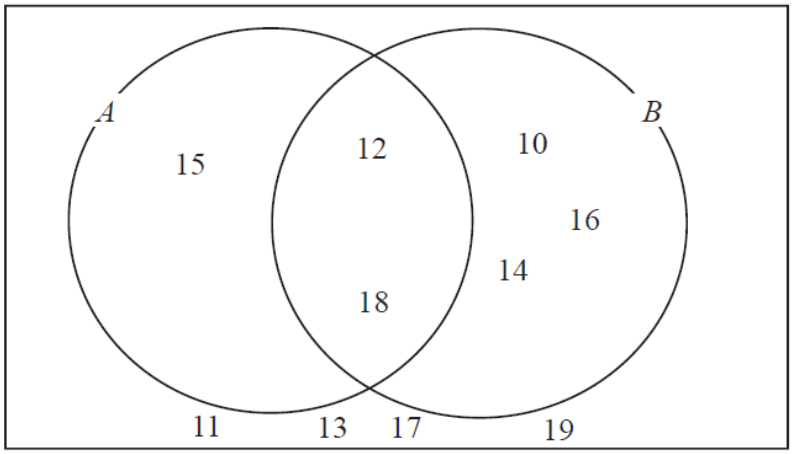
Find the size of the angle marked x

You must show all your working.

apply the properties of angles at a point; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons) (G3)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 4 is 3 marks)

5 Here is a Venn diagram.



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

(i) $A \cup B$

(ii) $A \cap B$

enumerate sets and combinations of sets systematically, using Venn diagrams (P6)
AO2 2.3a – interpret information accurately (2 marks)
New to 1MA1
Common question across both tiers

(2)

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

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

apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one (P4)

AO2

2.3a – interpret information accurately (1 mark)

AO1

1.3a – accurately carry out routine procedures (1 mark)

New to 1MA1

Common question across both tiers

(2)

(Total for Question 5 is 4 marks)

---

6 On a farm

the number of cows and the number of sheep are in the ratio 6 : 5

the number of sheep and the number of pigs are in the ratio 2 : 1

The total number of cows, sheep and pigs on the farm is 189.

How many sheep are there on the farm?

divide a given quantity into two parts in a given part:part or part:whole ratio; apply ratioto real contexts and problems (R5)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks)

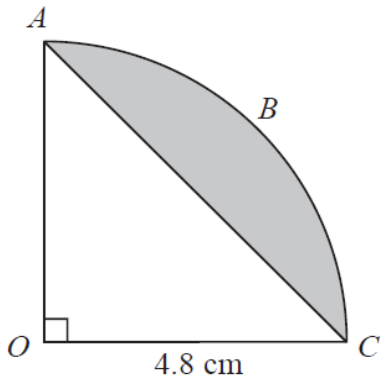
AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

Common question across both tiers

(Total for Question 6 is 3 marks)

7



The arc *ABC* is a quarter of a circle with centre *O* and radius 4.8 cm.

AC is a chord of the circle.

Work out the area of the shaded segment.

Give your answer correct to 3 significant figures.

know the formulae: area of a circle; calculate: areas of circles and composite shapes (G17) know and apply formulae to calculate: area of triangles (G16)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (2 marks) AO1 1.1 – accurately recall facts, terminology and definitions (1 mark)
Common question across both tiers

(Total for Question 7 is 3 marks)

8 Steve is asked to solve the equation $5(x + 2) = 47$

Here is his working.

$$\begin{aligned} 5(x + 2) &= 47 \\ 5x + 2 &= 47 \\ 5x &= 45 \\ x &= 9 \end{aligned}$$

Steve's answer is wrong.

(*a*) What mistake did he make?

solve linear equations in one unknown algebraically (A17)
AO2 2.5a – assess the validity of an argument (1 mark)

(1)

Liz is asked to solve the equation $3x^2 + 8 = 83$

Here is her working.

$$\begin{aligned} 3x^2 + 8 &= 83 \\ 3x^2 &= 75 \\ x^2 &= 25 \\ x &= 5 \end{aligned}$$

(*b*) Explain what is wrong with Liz's answer.

solve quadratic equations algebraically by factorising (A18)
AO3 3.4b – evaluate results obtained (1 mark)

(1)

(Total for Question 8 is 2 marks)

9 The functions f and g are such that

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

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

(1)

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

(2)

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

(2)

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)** (A7)
AO1 1.2 – use and interpret notation correctly (1 mark) 1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks) AO2 2.2 – Construct chains of reasoning to achieve a given result (2 marks)
New to 1MA1

(Total for Question 9 is 5 marks)

10 The population of a city increased by 5.2% for the year 2014.

At the beginning of 2015 the population of the city was 1 560 000.

Lin assumes that the population will continue to increase at a constant rate of 5.2% each year.

(*a*) Use Lin's assumption to estimate the population of the city at the beginning of 2017.
Give your answer correct to 3 significant figures.

set up, solve and interpret the answers in growth and decay problems (R16) work with percentages greater than 100%; solve problems involving percentage change (R9)
AO3 3.1c – translate problems in non-mathematical contexts into a mathematical process (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(3)

(*b*) (i) Use Lin's assumption to work out the year in which the population of the city will reach 2 000 000.

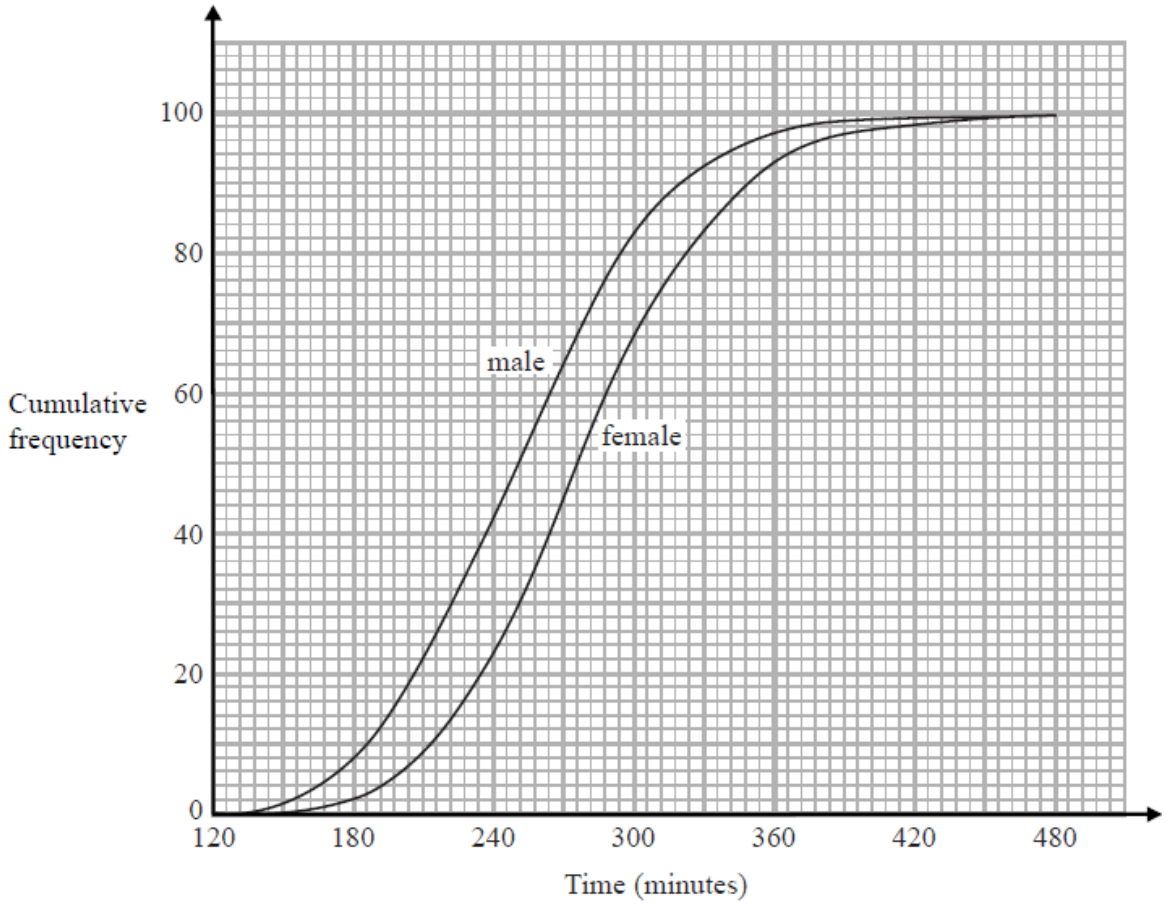
(ii) If Lin's assumption about the rate of increase of the population is too low, how might this affect your answer to (*b*)(i)?

set up, solve and interpret the answers in growth and decay problems (R16)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (1 mark) 3.5 – Evaluate solutions to identify how they may have been affected by assumptions made (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(3)

(Total for Question 10 is 6 marks)

11 The cumulative frequency graphs show information about the times taken by 100 male runners and by 100 female runners to finish the London marathon.



A male runner is chosen at random.

(*a*) Find an estimate for the probability that this runner took less than 4 hours to finish the London marathon.

relate relative expected frequencies to theoretical probability, using appropriate language and the 0-1 probability scale (P3) **construct and interpret diagrams for grouped discrete data and continuous data, i.e. cumulative frequency graphs, and know their appropriate use** (S3)
AO2 2.3a – interpret information accurately (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(2)

(*b*) Use medians and interquartile ranges to compare the distribution of the times taken by the male runners with the distribution of the times taken by the female runners.

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of central tendency (median, mean, mode and modal class) and spread (range, including consideration of outliers, **quartiles and inter-quartile range**) (S4)

AO2

2.1b – make inferences to draw conclusions from mathematical information (2 marks)

AO1

1.3a – accurately carry out routine procedures (1 mark)

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(4)

(Total for Question 11 is 6 marks)

12 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?

apply systematic listing strategies, **including use of the product rule for counting** (N5)
AO1 1.3a – accurately carry out routine procedures (2 marks)
New to 1MA1

(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

or

boy girl boy

girl boy girl

(*b*) How many different lists can David write?

apply systematic listing strategies, **including use of the product rule for counting** (N5)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
New to 1MA1

(3)

(Total for Question 12 is 5 marks)

13 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.

set up, solve and interpret the answers in growth and decay problems, including compound interest **and work with general iterative processes** (R16)
AO1 1.2 – use and interpret notation correctly (2 marks) AO3 3.3 – Interpret results in the context of the given problem (1 mark)
New to 1MA1

(Total for Question 13 is 3 marks)

14 D is directly proportional to the cube of n.

Mary says that when n is doubled, the value of D is multiplied by 6.

Mary is wrong.
Explain why.

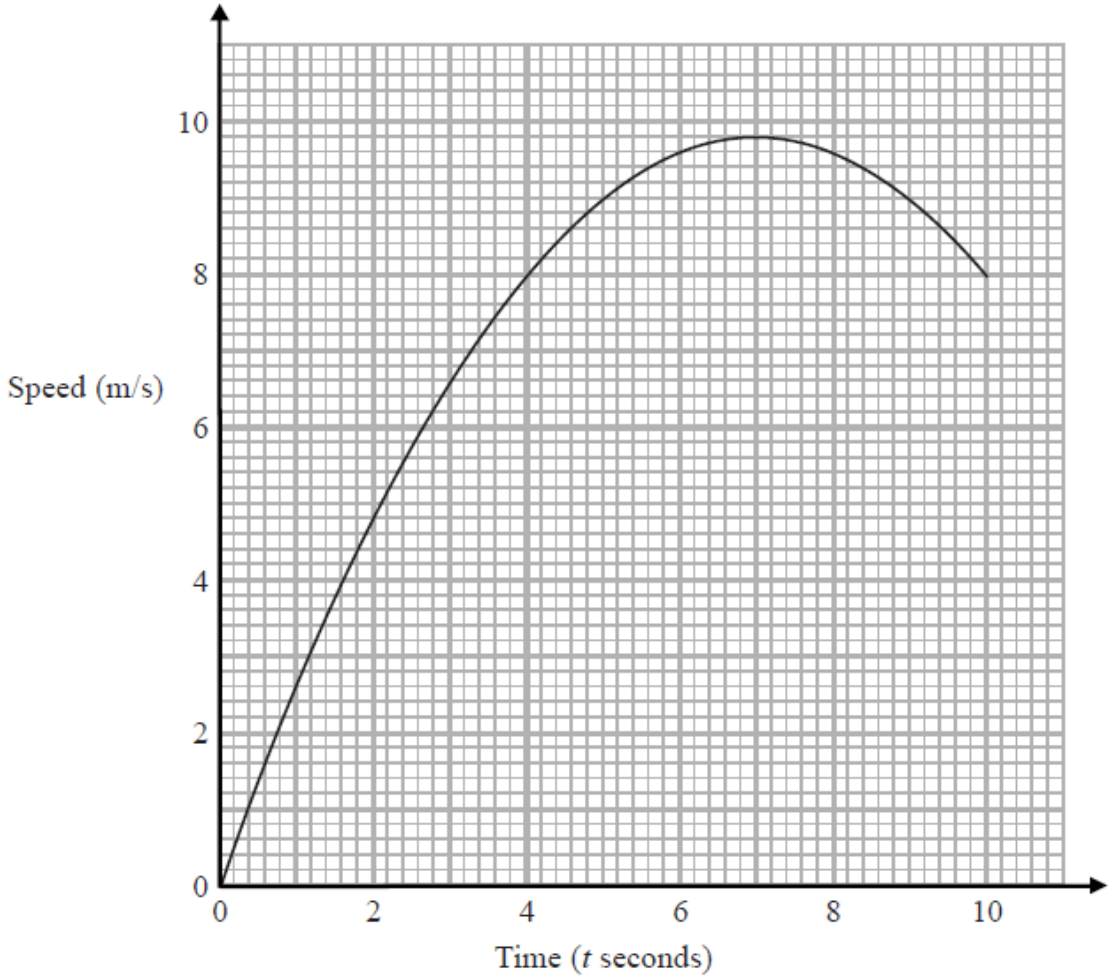
solve problems involving direct and inverse proportion, including graphical and algebraic representations (R10)
AO3 3.4a – evaluate methods used (1 mark)

(1)

(Total for Question 14 is 1 mark)

15 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.

calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as velocity-time graphs (A15)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks) AO2 2.3a – interpret information accurately (1 mark)
New to 1MA1

(3)

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

calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as velocity-time graphs (A15)
AO2 2.3a – interpret information accurately (2 marks)
New to 1MA1

(2)

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

calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as velocity-time graphs (A15)
AO3 3.4a – evaluate methods used (1 mark)
New to 1MA1

(1)

(Total for Question 15 is 6 marks)

---

16 (i) Find the value of $\sqrt[5]{3.2 \times 10^{11}}$

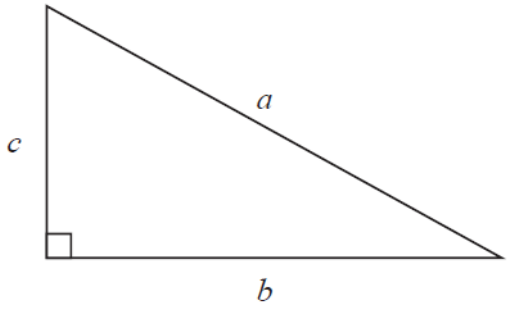
(ii) Find the value of $10^{\frac{3}{4}}$

Give your answer correct to 1 decimal place.

calculate with roots, and with integer **and fractional** indices (N7) calculate with and interpret standard form (N9)
AO1 1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 16 is 2 marks)

17



a is 8.3 cm correct to the nearest mm

b is 6.1 cm correct to the nearest mm

Calculate the upper bound for *c*.

You must show your working.

apply and interpret limits of accuracy, **including upper and lower bounds** (N16)

know the formulae for: Pythagoras' theorem; apply to find angles and lengths in right-angled triangles (G20)

AO3

3.2 – make and use connections between different parts of mathematics (2 marks)

AO1

1.1 – accurately recall facts, terminology and definitions (1 mark)

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 17 is 4 marks)

18 Simplify fully $\left(\sqrt{a}+\sqrt{4b}\right)\left(\sqrt{a}-2\sqrt{b}\right)$

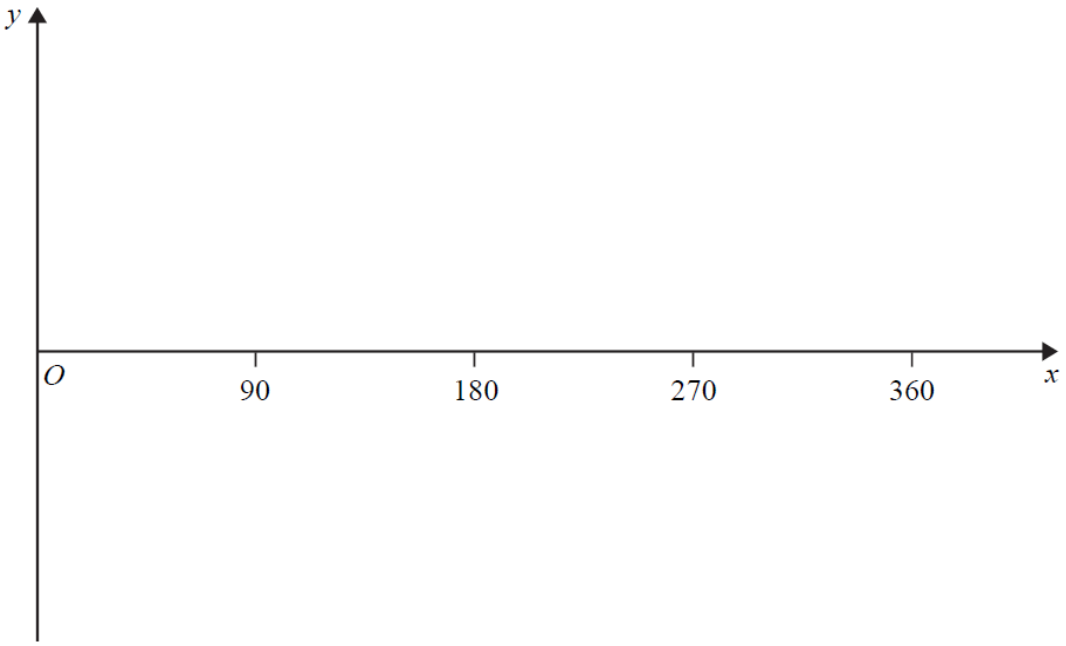
simplify and manipulate algebraic expressions (including those involving surds) by expanding products of two binomials and simplifying expressions involving sums, products and powers, including the laws of indices (A4)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)

(Total for Question 18 is 3 marks)

19 (*a*) Sketch the graph of $y = \cos x°$ for $0 \leq x \leq 360$

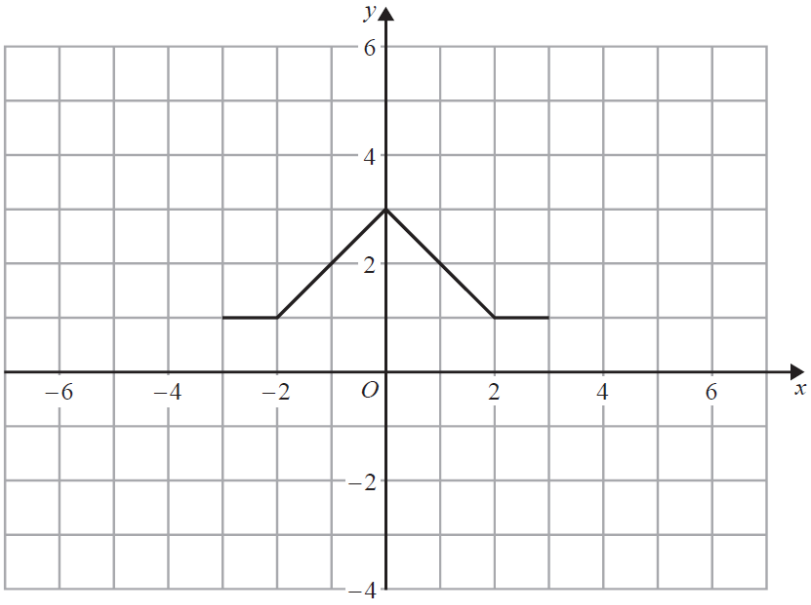


recognise, sketch and interpret graphs **of the trigonometric functions (with arguments in degrees) for angles of any size** (A12)
AO2 2.3b – communicate information accurately (2 marks)
New to 1MA1

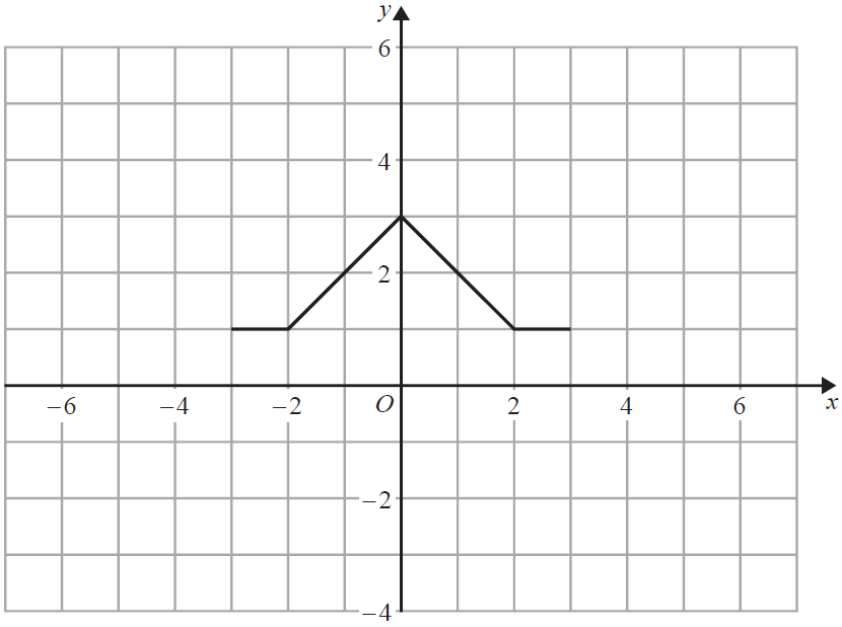
(2)

(*b*) The graph of $y = f(x)$ is shown on both grids below.

(i) On this grid, draw the graph of $y = 2f(x)$



(ii) On the grid below, draw the graph of $y = f(x - 3)$



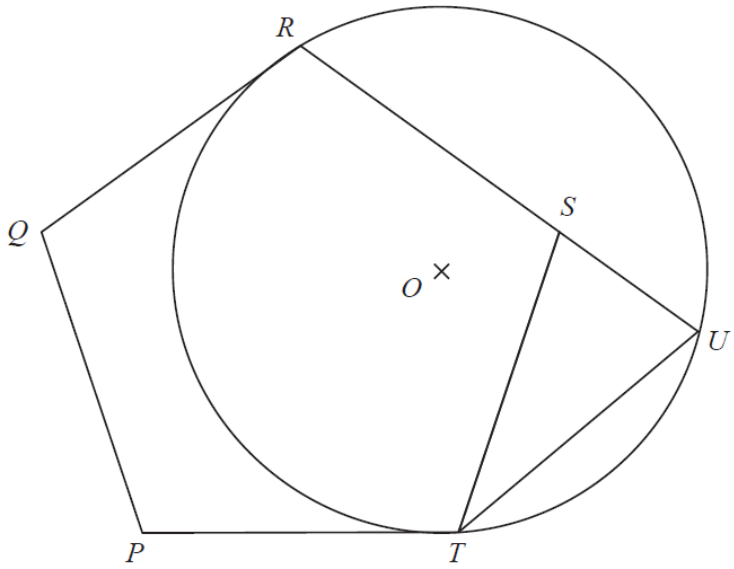
sketch translations and reflections of a given function (A13)

AO2 2.3b – communicate information accurately (2 marks)

(2)

(Total for Question 19 is 4 marks)

20



PQRST is a regular pentagon.

R, *U* and *T* are points on a circle, centre *O*.

QR and *PT* are tangents to the circle.

RSU is a straight line.

Prove that $ST = UT$.

derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons) (G3)
apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs (G6)
apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results (G10)

AO2
2.4b – present proofs (4 marks)
AO3
3.1b – translate problems in mathematical contexts into a series of processes (1 mark)

(Total for Question 20 is 5 marks)

21 Given that

$2x - 1 : x - 4 = 16x + 1 : 2x - 1$

find the possible values of x.

solve quadratic equations (**including those that require rearrangement**) algebraically by factorising (A18) relate ratios to fractions and to linear functions (R8)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (3 marks) 3.2 – Make and use connections between different parts of mathematics (1 mark) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

Set 2 Paper 3H

1 The ratio of the number of boys to the number of girls in a school is 4 : 5

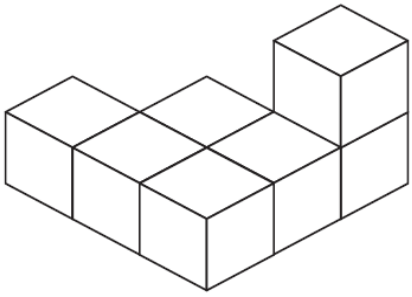
There are 95 girls in the school.

Work out the total number of students in the school.

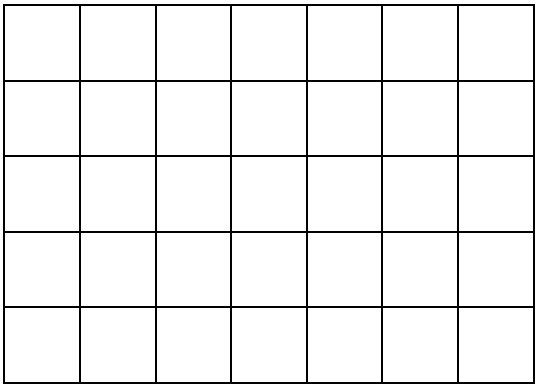
divide a given quantity into two parts in a given part:part or part:whole ratio; apply ratio to real contexts and problems (R5) use ratio notation, including reduction to simplest form (R4)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)
Common question across both tiers

(Total for Question 1 is 3 marks)

2 The diagram represents a solid made from seven centimetre cubes.



On the centimetre grid below, draw a plan of the solid.



construct and interpret plans and elevations of 3D shapes (G13)
AO2 2.3a – interpret information accurately (1 mark) 2.3b – communicate information accurately (1 mark)
Common question across both tiers

(Total for Question 2 is 2 marks)

3 Make t the subject of the formula $y = \frac{t}{3} - 2a$

understand and use standard mathematical formulae; rearrange formulae to change the subject (A5)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks)

Common question across both tiers

(Total for Question 3 is 2 marks)

---

4 Jim rounds a number, x, to one decimal place.

The result is 7.2.

Write down the error interval for x.

use inequality notation to specify simple error intervals due to truncation or rounding (N15)

AO1

1.1 – accurately recall facts, terminology and definitions (1 mark)

1.2 – use and interpret notation correctly (1 mark)

New to 1MA1

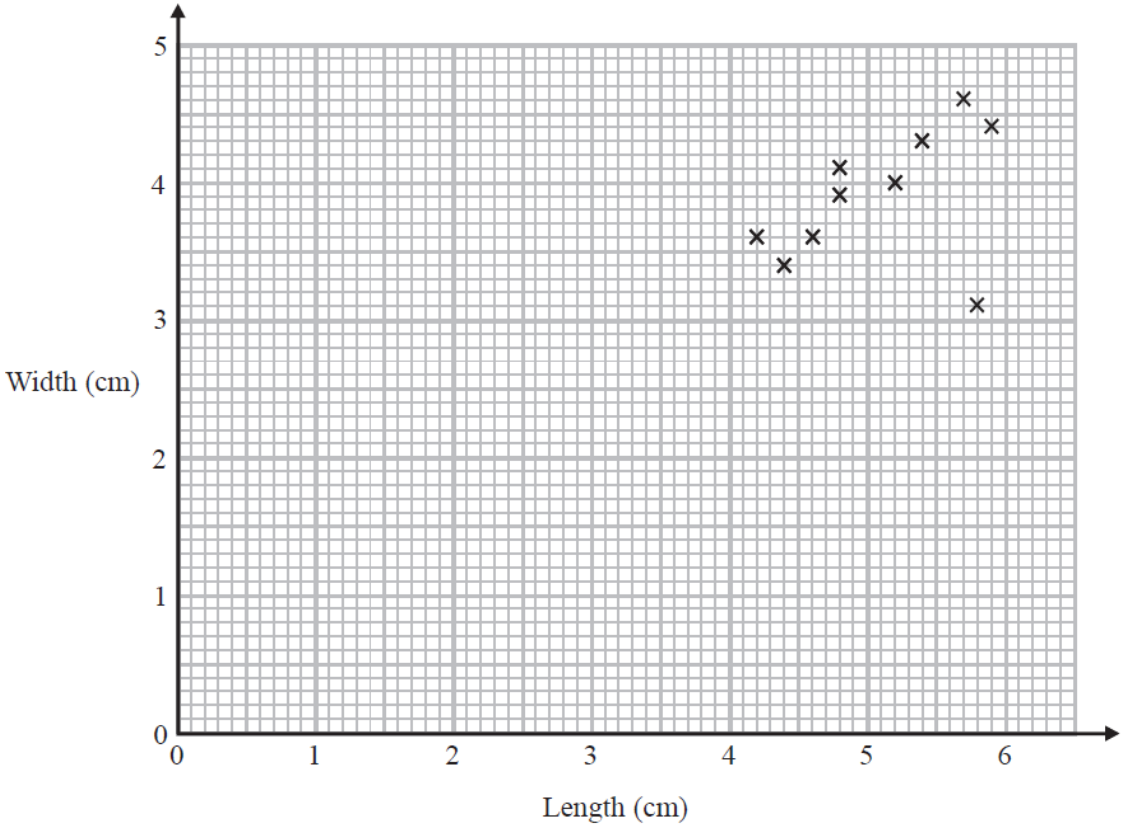
Common question across both tiers

(Total for Question 4 is 2 marks)

---

5 Katie measured the length and the width of each of 10 pine cones from the same tree.

She used her results to draw this scatter graph.



(*a*) Describe one improvement Katie can make to her scatter graph.

use and interpret scatter graphs of bivariate data (S6)
AO2 2.5b – critically evaluate a given way of presenting information (1 mark)
Common question across both tiers

(1)

The point representing the results for one of the pine cones is an outlier.

(*b*) Explain how the results for this pine cone differ from the results for the other pine cones.

use and interpret scatter graphs of bivariate data (S6)

interpret, analyse and compare the distributions of data sets from univariate empirical distributions through appropriate measures of spread (range, including consideration of outliers) (S4)

AO2

2.3a – interpret information accurately (1 mark)

Common question across both tiers

(1)

(Total for Question 5 is 2 marks)

6 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

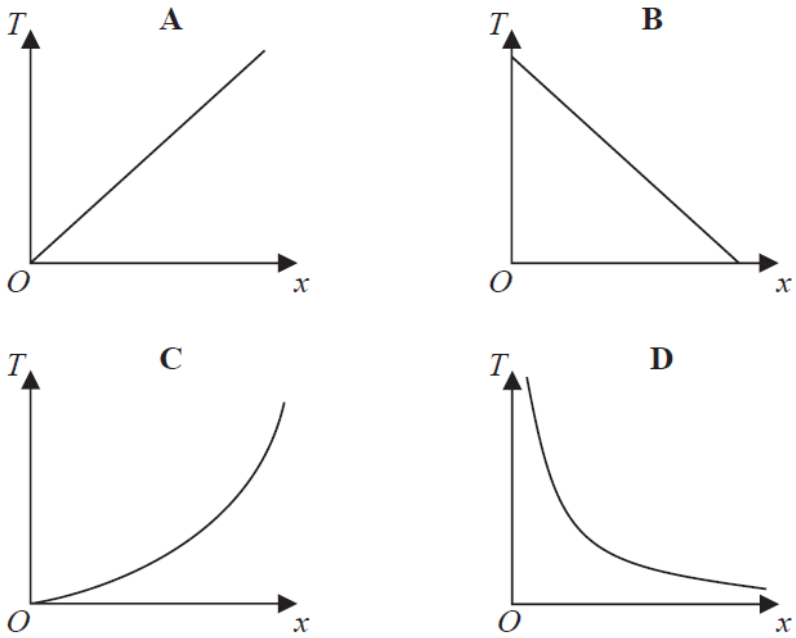
$$T = \frac{4500}{x}$$

(*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.

understand that X is inversely proportional to Y is equivalent to X is proportional to $1/Y$; interpret equations that describe direct and inverse proportion (R13)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks)
New to 1MA1
Common question across both tiers

(3)

Here are four graphs.



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

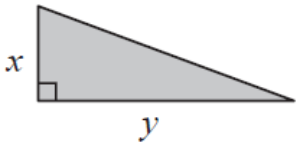
(*b*) Write down the letter of this graph.

solve problems involving direct and inverse proportion, including graphical representations (R10)
AO2 2.3a – interpret information accurately (1 mark)
New to 1MA1
Common question across both tiers

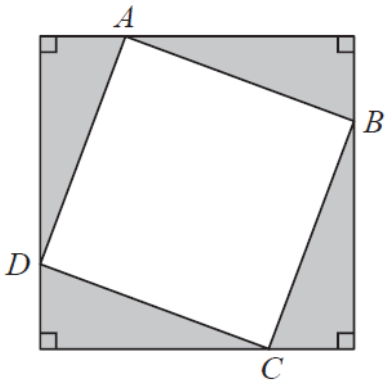
(1)

(Total for Question 6 is 4 marks)

7 Here is a right-angled triangle.



Four of these triangles are joined to enclose the square *ABCD* as shown below.



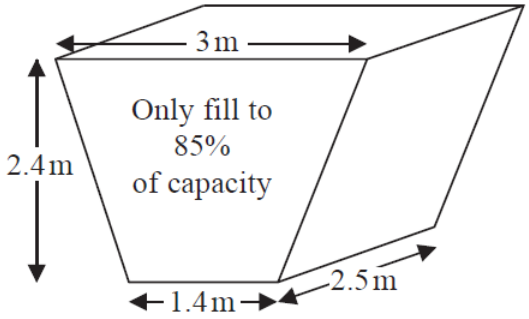
Show that the area of the square *ABCD* is $x^2 + y^2$

know the formulae for Pythagoras' theorem; apply to find angles and lengths in right-angled triangles in two-dimensional figures (G20) know and apply formulae to calculate area of parallelograms (G16) simplify and manipulate algebraic expressions by simplifying expressions involving sums, products and powers, including the laws of indices (A4)
AO2 2.4a – present arguments (3 marks)
Common question across both tiers

(Total for Question 7 is 3 marks)

8 The diagram shows an oil tank in the shape of a prism.

The cross section of the prism is a trapezium.



The tank is empty.

Oil flows into the tank.

After one minute there are 300 litres of oil in the tank.

Assume that oil continues to flow into the tank at this rate.

(*a*) Work out how many **more** minutes it takes for the tank to be 85% full of oil.

($1\ m^3 = 1000$ litres)

know and apply formulae to calculate: area of trapezia; volume of cuboids and other right prisms (G16)

use compound units such as speed, rates of pay, unit pricing, density and pressure (R11)

interpret fractions and percentages as operators (N12)

change freely between related standard units and compound units in numerical contexts (R1)

solve problems involving percentage change (R9)

AO3

3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

3.2 – Make and use connections between different parts of mathematics (1 mark)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

Common question across both tiers

(5)

The assumption about the rate of flow of the oil could be wrong.

(*b*) Explain how this could affect your answer to part (*a*).

use compound units such as speed, rates of pay, unit pricing, density and pressure (R11)

AO3

3.5 – Evaluate solutions to identify how they may have been affected by assumptions made (1 mark)

Common question across both tiers

(1)

(Total for Question 8 is 6 marks)

9 Ibrar bought a house for £145 000.

The value of the house depreciated by 4% in the first year.
The value of the house depreciated by 2.5% in the second year.

Ibrar says,

"4 + 2.5 = 6.5 so in two years the value of my house depreciated by 6.5%"

(*a*) Is Ibrar right?
You must give a reason for your answer.

solve problems involving percentage change, including percentage increase/decrease and original value problems, and simple interest including in financial mathematics (R9)
AO2 2.5a – assess the validity of an argument (2 marks)

(2)

The value of Ibrar's house increases by x% in the third year.
At the end of the third year the value of Ibrar's house is £140 000.

(*b*) Work out the value of x.
Give your answer correct to 3 significant figures.

set up, solve and interpret the answers in growth and decay problems (R16)
AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (2 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(3)

(Total for Question 9 is 5 marks)

10 The surface gravity of a planet can be worked out using the formula

$$g = \frac{6.67 \times 10^{-11} m}{r^2}$$

where

m kilograms is the mass of the planet

r metres is the radius of the planet

For the Earth and Jupiter here are the values of m and r.

Earth	Jupiter
$m = 5.98 \times 10^{24}$ $r = 6.378 \times 10^{6}$	$m = 1.90 \times 10^{27}$ $r = 7.149 \times 10^{7}$

Work out the ratio of the surface gravity of Earth to the surface gravity of Jupiter.

Write your answer in the form 1 : n.

calculate with and interpret standard form (N9) divide a given quantity into two parts in a given part:part or part:whole ratio (R5)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (2 marks) AO3 3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (1 mark)

(Total for Question 10 is 3 marks)

11 Solve the simultaneous equations

$2x - 4y = 19$

$3x + 5y = 1$

solve two simultaneous equations in two variables algebraically (A19)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (4 marks)

(Total for Question 11 is 4 marks)

12 Zahra mixes 150 g of metal A and 150g of metal B to make 300 g of an alloy.

Metal A has a density of 19.3 g/cm^3.

Metal B has a density of 8.9 g/cm^3.

Work out the density of the alloy.

use compound units such as speed, rates of pay, unit pricing, density and pressure (R11)

change freely between related standard units and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical contexts (R1)

AO3

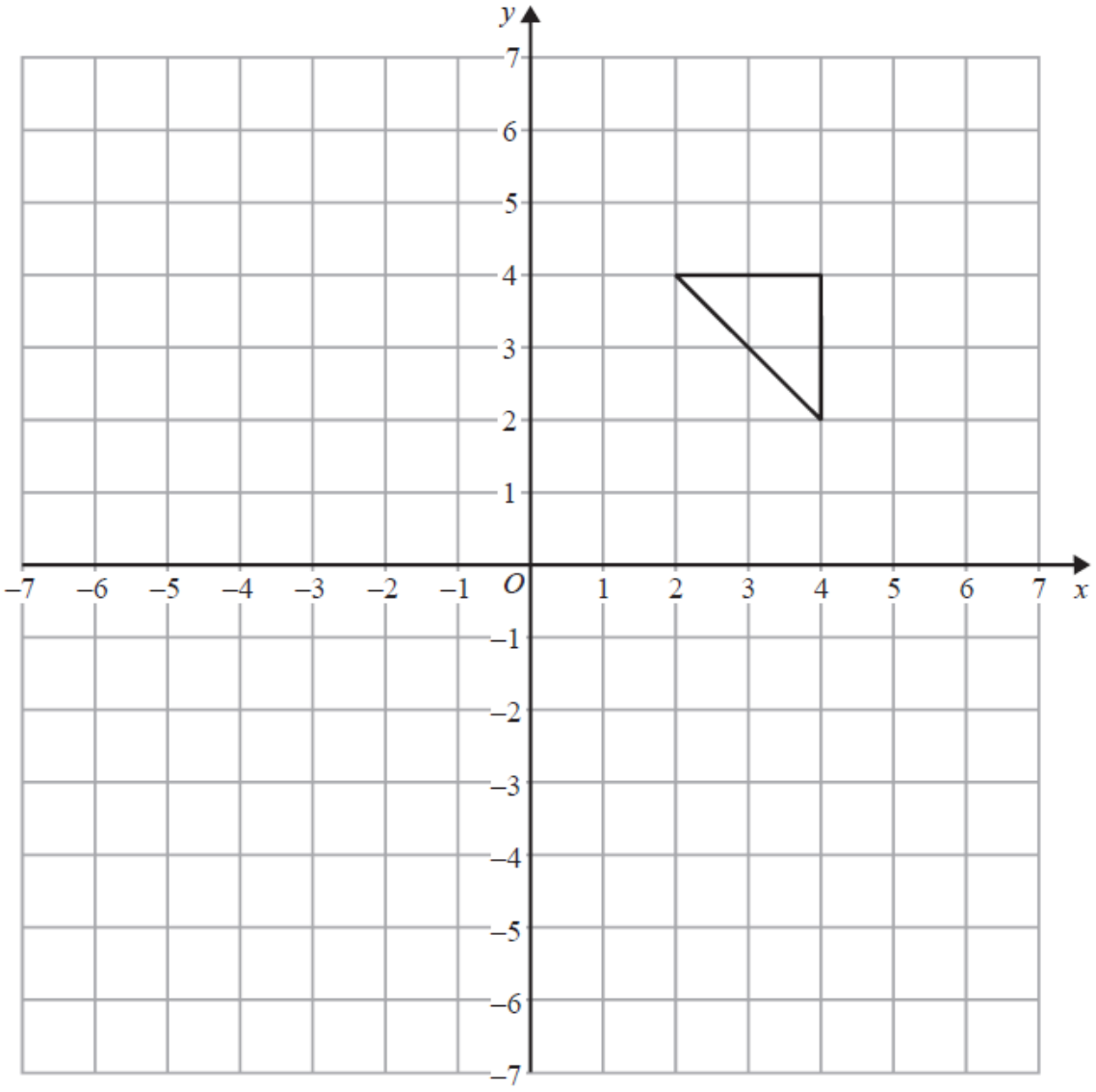
3.1d – translate problems in non-mathematical contexts into a series of mathematical processes (3 marks)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 12 is 4 marks)

13



On the grid, enlarge the triangle by scale factor $-1\frac{1}{2}$, centre (0, 2).

identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional **and negative** scale factors) (G7)

AO1

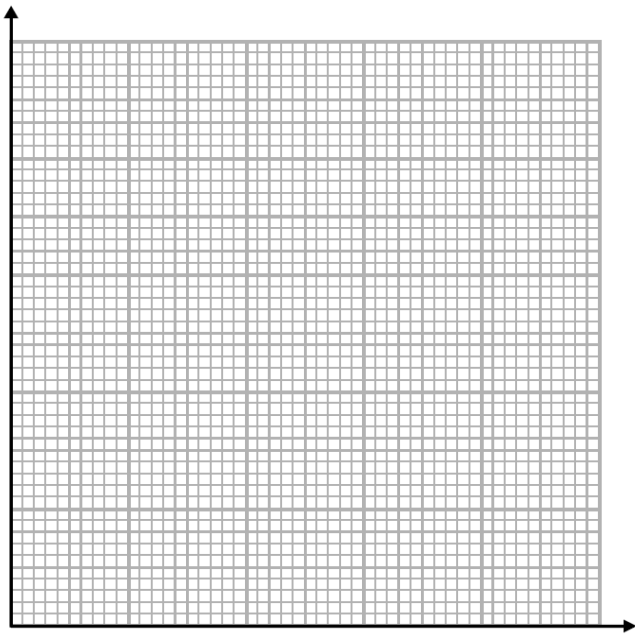
1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 13 is 2 marks)

14 The table gives information about the speeds, in km/h, of 81 cars.

Speed (s km/h)	**Frequency**
$90 < s \leq 100$	13
$100 < s \leq 105$	16
$105 < s \leq 110$	18
$110 < s \leq 120$	22
$120 < s \leq 140$	12

(*a*) On the grid, draw a histogram for the information in the table.



(3)

(*b*) Find an estimate for the median.

(2)

construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and know their appropriate use (S3)

AO2

2.3b – communicate information accurately (3 marks)

2.3a – interpret information accurately (2 marks)

(Total for Question 14 is 5 marks)

15 Show that $\frac{a}{b+1}-\frac{a}{(b+1)^2}$ can be written as $\frac{ab}{(b+1)^2}$

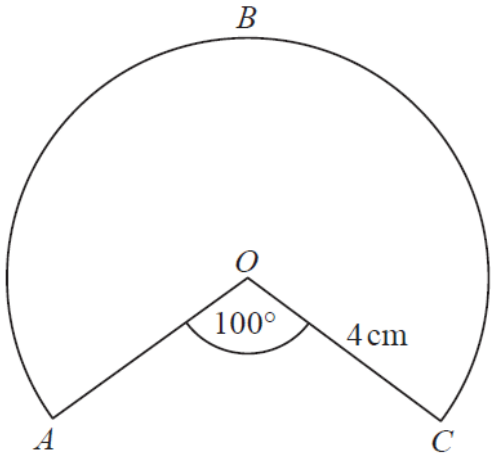
simplify and manipulate algebraic expressions (including those involving **algebraic fractions**) by collecting like terms, multiplying a single term over a bracket and simplifying expressions involving sums, products and powers, including the laws of indices (A4)

AO2

2.2 – Construct chains of reasoning to achieve a given result (2 marks)

(Total for Question 15 is 2 marks)

16 The diagram shows a sector of a circle of radius 4 cm.



Work out the length of the arc *ABC*.

Give your answer correct to 3 significant figures.

calculate arc lengths, angles and areas of sectors of circles (G18)

AO1

1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 16 is 2 marks)

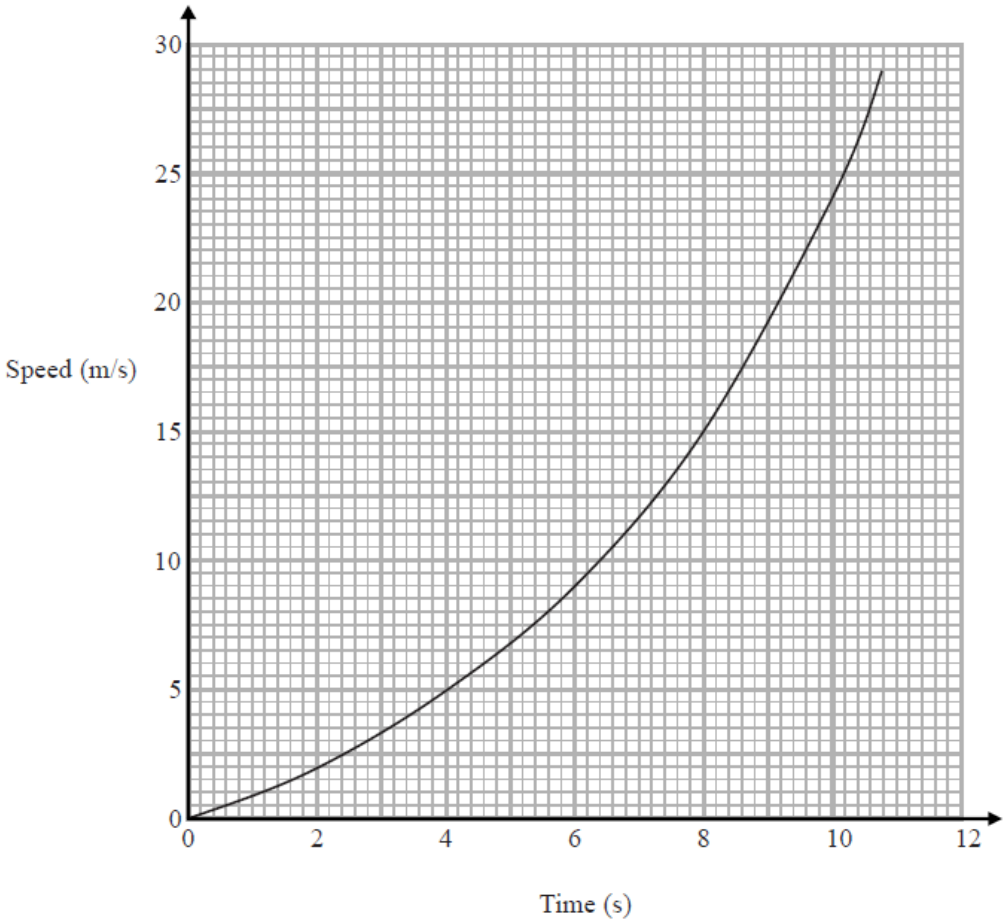
17 The product of two consecutive positive integers is added to the larger of the two integers.

Prove that the result is always a square number.

argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments **and proofs** (A6)
AO2 2.4b – present proofs (3 marks)

(Total for Question 17 is 3 marks)

18 Here is a speed-time graph for a car.



(*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)

calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as velocity-time graphs (A15)
AO1 1.3a – accurately carry out routine procedures (3 marks) AO3 3.4a – evaluate methods used (1 mark)
New to 1MA1

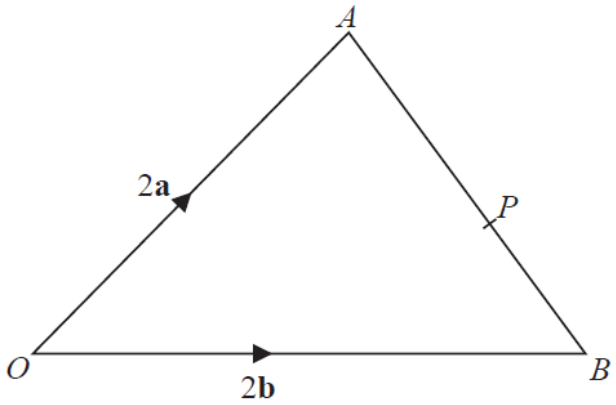
(Total for Question 18 is 4 marks)

19 Prove algebraically that the recurring decimal $0.3\dot{1}\dot{8}$ can be written as $\frac{7}{22}$

change recurring decimals into their corresponding fractions and vice versa (N10)
AO1 1.3a – accurately carry out routine procedures (2 marks)

(Total for Question 19 is 2 marks)

20



OAB is a triangle.

P is the point on *AB* such that *AP* : *PB* = 5 : 3

$\overrightarrow{OA}$ = 2**a**

$\overrightarrow{OB}$ = 2**b**

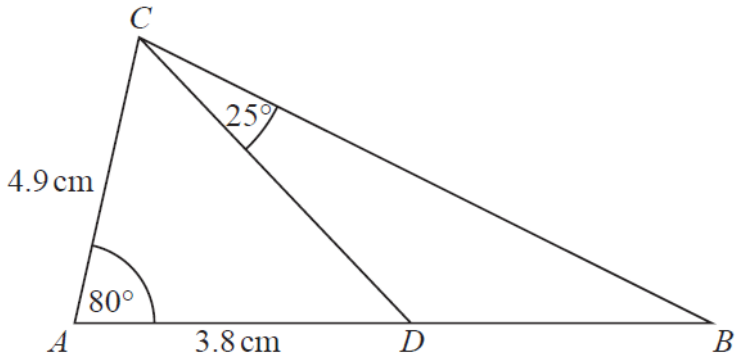
$\overrightarrow{OP}$ = *k*(3**a** + 5**b**) where *k* is a scalar quantity.

Find the value of *k*.

apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors (G25)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (3 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 20 is 4 marks)

21



ABC is a triangle.

D is a point on *AB*.

Work out the area of triangle *BCD*.

Give your answer correct to 3 significant figures.

know and apply Area = ½ *ab* sin *C* to calculate the area, sides or angles of any triangle (G23) **know and apply the sine rule and cosine rule to find unknown lengths and angles** (G22)
AO3 3.1b – translate problems in mathematical contexts into a series of processes (4 marks) AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(Total for Question 21 is 5 marks)

22 There are y black socks and 5 white socks in a drawer.

Joshua takes at random two socks from the drawer.

The probability that Joshua takes one white sock and one black sock is $\frac{6}{11}$

(*a*) Show that $3y^2 - 28y + 60 = 0$

translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or two simultaneous equations), solve the equation(s) and interpret the solution (A21)

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

AO2

2.2 – Construct chains of reasoning to achieve a given result (4 marks)

(4)

(*b*) Find the probability that Joshua takes two black socks.

solve quadratic equations algebraically by factorising (A18)

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

AO3

3.2 – make and use connections between different parts of mathematics (1 mark)

3.3 – Interpret results in the context of the given problem (1 mark)

AO1

1.3b – accurately carry out set tasks requiring multi-step solutions (1 mark)

(3)

(Total for Question 22 is 7 marks)

23 (*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)

deduce roots algebraically **and turning points by completing the square** (A11)
AO1 1.3b – accurately carry out set tasks requiring multi-step solutions (3 marks) 1.3a – accurately carry out routine procedures (1 mark)
New to 1MA1

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS