Write your name here

Surname	Other names

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

Centre Number	Candidate Number

Mathematics

Paper 3 (Calculator)

Higher Tier

Tuesday 12 June 2018 – Morning
Time: 1 hour 30 minutes

Paper Reference
1MA1/3H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.

Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

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

Turn over

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6/7/7/7/8/7/1/

Pearson

Please note that these worked solutions have neither been provided nor approved by Pearson Education and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue should be written in the exam.

Anything written in green in a rectangle doesn't have to be written in the exam.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

.CG Maths.

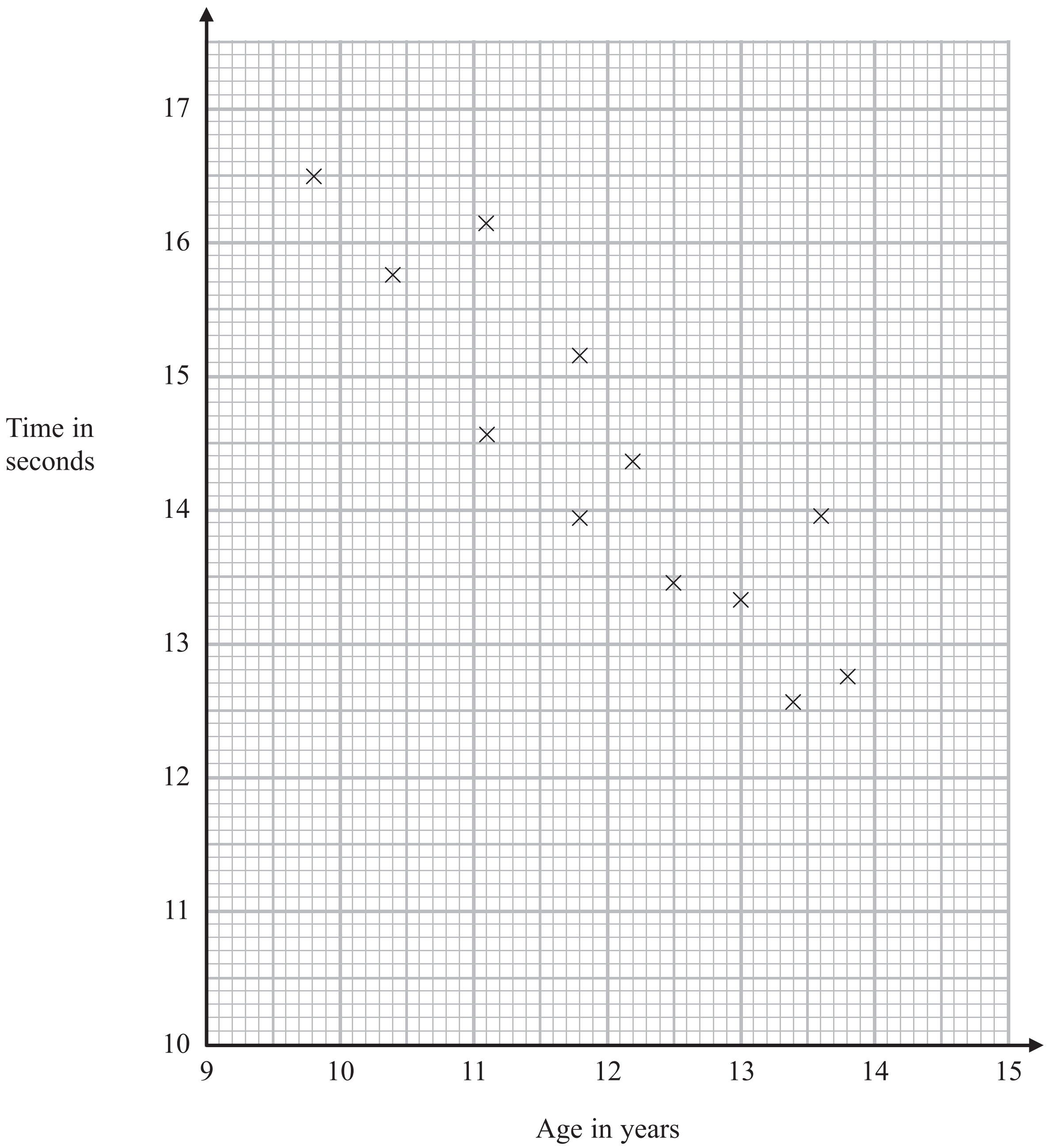
Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The scatter diagram shows information about 12 girls.

It shows the age of each girl and the best time she takes to run 100 metres.



(a) Write down the type of correlation.

As the age in years increases, the time in seconds generally decreases

Negative

(1)

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Kristina is 11 years old.
Her best time to run 100 metres is 12 seconds.

The point representing this information would be an outlier on the scatter diagram.

(b) Explain why.

It is far away from the other points

(1)

Debbie is 15 years old.
Debbie says,
"The scatter diagram shows I should take less than 12 seconds to run 100 metres."

(c) Comment on what Debbie says.

It does not show this as 15 years old is outside the range of the data given

The downward trend might not continue

(1)

(Total for Question 1 is 3 marks)

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2 Expand and simplify $5(p + 3) - 2(1 - 2p)$

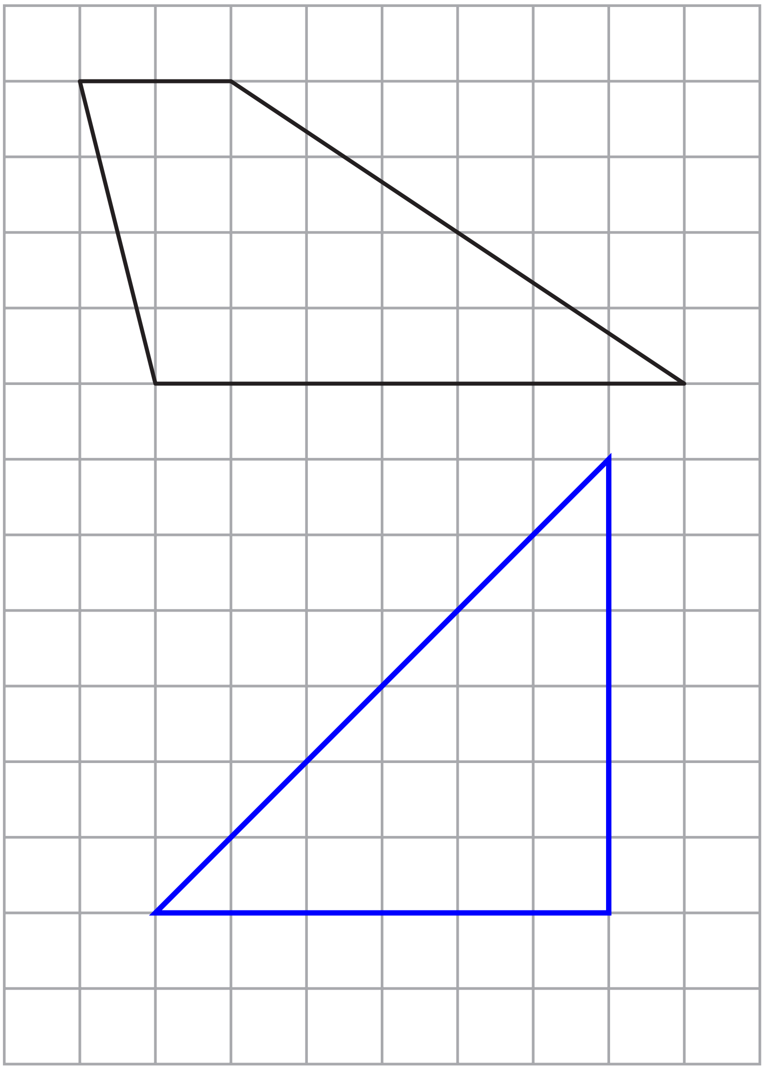
$5p + 15 - 2 + 4p$ ← Expanding the brackets

Simplifying by collecting like terms

$9p + 13$

(Total for Question 2 is 2 marks)

3 Here is a trapezium drawn on a centimetre grid.



On the grid, draw a triangle equal in area to this trapezium.

$\frac{1}{2}(2+7)\times 4 = 18$ ← Area of trapezium = 1/2 × (a + b) × h, where a and b are the parallel sides and h is the distance between a and b. So the area of the trapezium is 18 cm²

$\frac{1}{2}bh = 18$ ← Area of triangle = 1/2 × base × height. The area must also be 18 cm²

$bh = 36$ ← Multiplying both sides by 2 eliminates the 1/2 on the left

6 × 6 = 36 so a triangle with base of 6 cm and height of 6 cm could be drawn

(Total for Question 3 is 2 marks)

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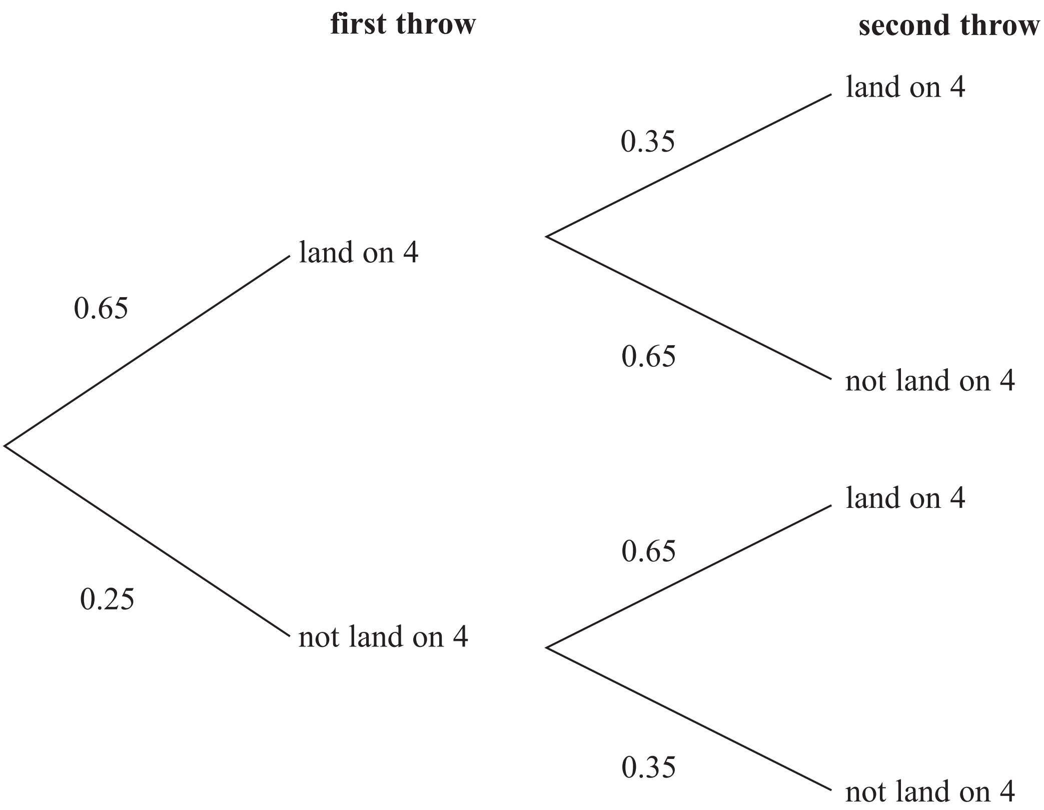
4 When a biased 6-sided dice is thrown once, the probability that it will land on 4 is 0.65
The biased dice is thrown twice.

Amir draws this probability tree diagram.
The diagram is **not** correct.



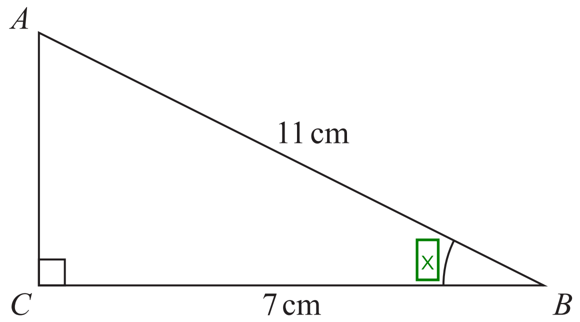
Write down **two** things that are wrong with the probability tree diagram.

1 0.25 should be 0.35 ← As it is certain to either land on a 4 or not to land on a 4, both probabilities must add to 1. 0.65 + 0.25 = 0.9, not 1

2 0.35 and 0.65 are the wrong way round ← The probability that it will land on 4 is 0.65, not 0.35

(Total for Question 4 is 2 marks)

5 *ABC* is a right-angled triangle.



(a) Work out the size of angle *ABC*.
Give your answer correct to 1 decimal place.

S O✓ H C A✓ H T O✓ A

Using right-angled trigonometry. Ticking H as the 11 cm is the hypotenuse and ticking A as the 7 cm is the adjacent. There are two ticks on the CAH formula triangle so this one can be used

$\cos x = \frac{7}{11}$

Covering C in the CAH formula triangle finds that cos of the angle = adjacent/hypotenuse

Doing the inverse cos of both sides gets x on its own. 50.47... is rounded to 1 decimal place

50.5 °

(2)

The length of the side *AB* is reduced by 1 cm.

The length of the side *BC* is still 7 cm.
Angle *ACB* is still 90°

(b) Will the value of cos *ABC* increase or decrease?
You must give a reason for your answer.

Increases as 7/10 is greater than 7/11

CosABC = adjacent/hypotenuse

(1)

(Total for Question 5 is 3 marks)

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6 There are some counters in a bag.
The counters are red or white or blue or yellow.

Bob is going to take at random a counter from the bag.

The table shows each of the probabilities that the counter will be blue or will be yellow.

Colour	red	white	blue	yellow
Probability			0.45	0.25

There are 18 blue counters in the bag.

The probability that the counter Bob takes will be red is twice the probability that the counter will be white.

(a) Work out the number of red counters in the bag.

$18 \div 0.45 = 40$ ← Multiplying the total number of counters by the probability of blue would give the number of blue counters. So dividing the 18 blue counters by the probability of blue works out that there are 40 counters in total

$1 - 0.45 - 0.25$ ← Subtracting the probabilities of blue and yellow from 1 finds that the probability of red or white is 0.3

$0.3 \div 3$ ← The ratio of red to white is 2 : 1 and 2 + 1 = 3 parts in total in the ratio which represents the red and white counters. So dividing the probability of red or white by 3 works out that 1 part of the ratio is worth 0.1

0.1×2 ← Multiplying the value of 1 part of the ratio by the 2 parts which represent red works out that the probability of red is 0.2

40×0.2 ← Multiplying the total number of counters by the probability of red works out that there are 8 red counters

8

(4)

A marble is going to be taken at random from a box of marbles.
The probability that the marble will be silver is 0.5 ← 0.5 is 1/2

There must be an even number of marbles in the box.

(b) Explain why.

If there was an odd number, halving would give a fraction of a marble

If the probability is 1/2 then 1/2 of the marbles must be silver. There must be a whole number of silver marbles

(1)

(Total for Question 6 is 5 marks)

7 Solve $\dfrac{5 - x}{2} = 2x - 7$

$5 - x = 4x - 14$ ← Multiplying both sides by 2 eliminates the 2 as a denominator on the left

$5 = 5x - 14$ ← Adding x to both sides gets all the x on the same side

$19 = 5x$ ← Adding 14 to both sides eliminates the -14 on the right and gets the x term on its own

Dividing both sides by 5 gets x on its own

$x =$ 3.8

(Total for Question 7 is 3 marks)

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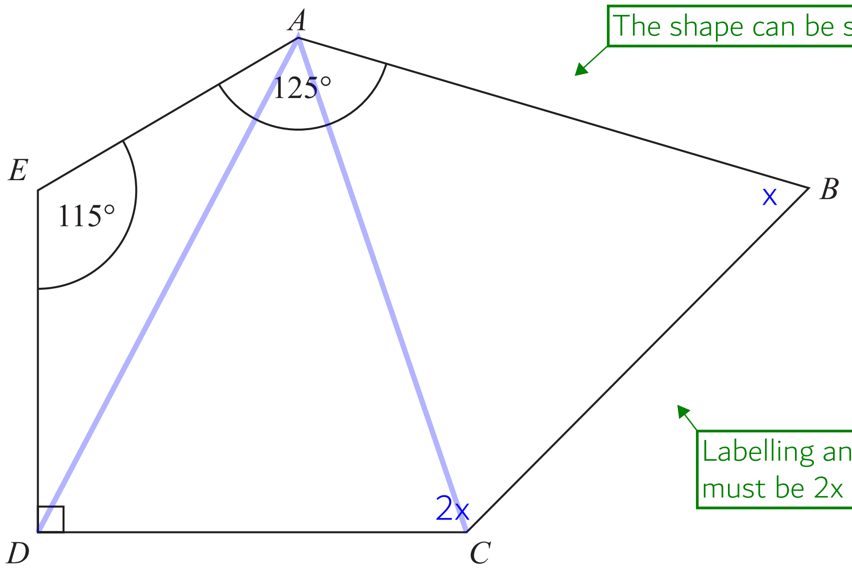
8 *ABCDE* is a pentagon.



The shape can be split into 3 triangles

Labelling angle ABC as x. Angle BCD must be 2x as it is 2 × angle ABC

Angle $BCD = 2 \times$ angle ABC

Work out the size of angle *BCD*.
You must show all your working.

$3 \times 180 = 540$ ← There are 180° in a triangle. Multiplying 180° by the 3 triangles in the pentagon works out that there are 540° in total in a pentagon

$90 + 115 + 125 + x + 2x$ ← Adding all the angles in the pentagon expresses the total of the angles in terms of x

$3x + 330 = 540$ ← Simplifying by collecting like terms. This expression of the total of the angles in the pentagon must be equal to 540°

$3x = 210$ ← Subtracting 330 from both sides gets the x term on its own

$x = 70$ ← Dividing both sides by 3 gets x on its own. So angle ABC is 70°

2×70 ← Angle BCD = 2 × angle ABC

140 °

(Total for Question 8 is 5 marks)

9 $T = \sqrt{\dfrac{w}{d^3}}$

$w = 5.6 \times 10^{-5}$
$d = 1.4 \times 10^{-4}$

(a) Work out the value of T.
Give your answer in standard form correct to 3 significant figures.

$\sqrt{\dfrac{5.6 \times 10^{-5}}{(1.4 \times 10^{-4})^3}}$ ← Substituting in the values of w and d gives T

4520 ← 4517.5... is 4520 to 3 significant figures

Dividing 4520 by ten 3 times gives 4.52, which is at least 1 and less than 10. The 4.52 must be multiplied by 10^3 to keep it equal

$T =$ 4.52×10^3

(2)

w is increased by 10%
d is increased by 5%

Lottie says,

"The value of T will increase because both w and d are increased."

(b) Lottie is wrong.
Explain why.

$\sqrt{\dfrac{5.6 \times 10^{-5} \times 1.1}{(1.4 \times 10^{-4} \times 1.05)^3}} = 4403.6...$ ← Substituting in the new values of w and d gives the new value of T. Multiplying by 1.1 increases by 10% and multiplying by 1.05 increases by 5%

T will decrease ← 4403.6... is less than 4517.5...

(2)

(Total for Question 9 is 4 marks)

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10 Here are three lamps.

Lamp **A** flashes every 20 seconds.
Lamp **B** flashes every 45 seconds.
Lamp **C** flashes every 120 seconds.

The three lamps start flashing at the same time.

How many times in one hour will the three lamps flash at the same time?

$20 = 2^2 \times 5$ ← Expressing 20 as a product of prime factors using the calculator

$45 = 3^2 \times 5$ ← Expressing 45 as a product of prime factors using the calculator

$120 = 2^3 \times 3 \times 5$ ← Expressing 120 as a product of prime factors using the calculator

$2^3 \times 3^2 \times 5 = 360$ ← The lowest common multiple of 20, 45 and 120 is the highest power of each prime in all three product of prime factors multiplied together. So all three lamps flash at the same time every 360 seconds

$1 \times 60 \times 60$ ← 1 hour = 60 minutes and 1 minutes = 60 seconds. So multiplying 1 hour by 60 converts it to minutes then multiplying this by 60 converts it to 3600 seconds

$3600 \div 360$ ← Dividing the 3600 seconds in one hour by the 360 seconds after which they all flash at the same time works out that they all flash at the same time 10 times in one hour

.... 10

(Total for Question 10 is 3 marks)

11 In 2003, Jerry bought a house.

In 2007, Jerry sold the house to Mia.
He made a profit of 20%

In 2012, Mia sold the house for £162 000
She made a loss of 10%

Work out how much Jerry paid for the house in 2003

100 - 10 ← Subtracting the 10% from 100% finds that in 2012 the value had reduced to 90% of the value in 2007

162000 ÷ 90 ← Dividing the value in 2012 by 90 works out that 1% of the value in 2007 is £1800

1800 × 100 = 180000 ← Multiplying the value of 1% of 2007 by 100 works out that 100% of the value in 2007 is £180000

100 + 20 ← Subtracting the 20% from 100% finds that in 2007 the value had increased to 120% of the value in 2003

180000 ÷ 120 ← Dividing the value in 2007 by 120 works out that 1% of the value in 2003 is £1500

1500 × 100 ← Multiplying the value of 1% of 2003 by 100 works out that 100% of the value in 2003 is £150000

£ 150000

(Total for Question 11 is 3 marks)

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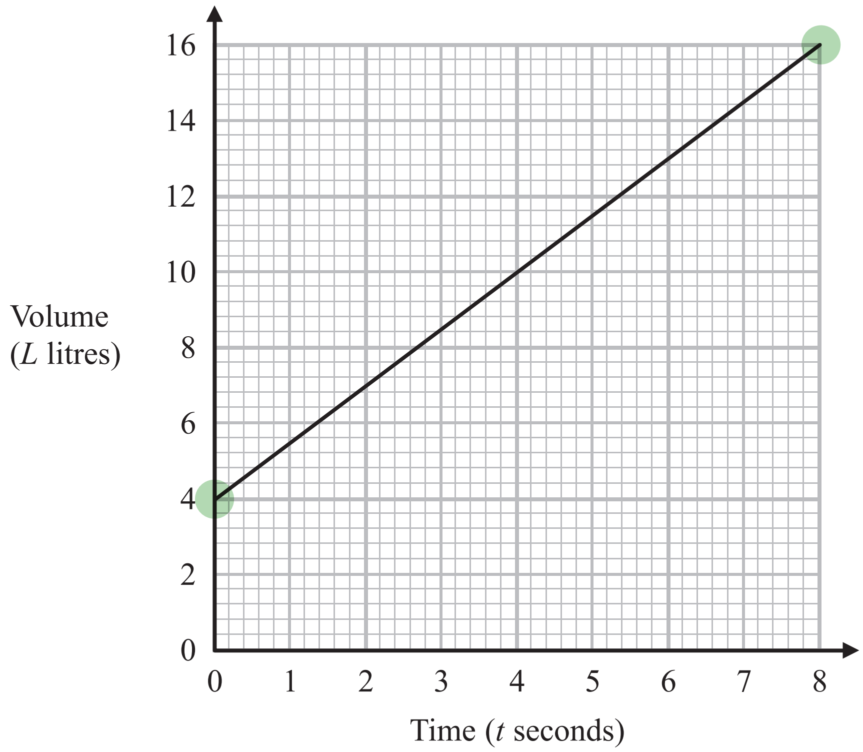
12 The graph shows the volume of liquid (L litres) in a container at time t seconds.



(a) Find the gradient of the graph.

$\frac{16 - 4}{8 - 0}$ ← Gradient = (change in y)/(change in x). Using the two end points of the line as these are easy to read and are far away from each other. y changes from 4 to 16 and x changes from 0 to 8

1.5

(2)

(b) Explain what this gradient represents.

The rate the volume of liquid increases

(1)

The graph intersects the volume axis at $L = 4$

(c) Explain what this intercept represents.

The volume of liquid at the start

(1)

(Total for Question 12 is 4 marks)

13 Here are two similar solid shapes.

surface area of shape **A** : surface area of shape **B** = 3 : 4

The volume of shape **B** is 10 cm^3

Work out the volume of shape **A**.
Give your answer correct to 3 significant figures.

cm = $\sqrt{3}$: 2 ← The unit of surface area is cm^2. So square rooting the ratio for the surface areas gives the ratio of the lengths

cm^3 = $(\sqrt{3})^3$: 8 ← Cubing the ratio of the lengths gives the ratio of the volumes

10 ÷ 8 ← 8 parts of the ratio of the volumes represents the volume of B. So dividing the volume of B by 8 works out that 1 part of the ratio is worth 1.25 cm^3

1.25 × $(\sqrt{3})^3$ ← Multiplying the value of 1 part of the ratio by the $(\sqrt{3})^3$ parts which represent the volume of A works out the volume of A

6.495... is rounded to 3 significant figures

6.50 cm^3

(Total for Question 13 is 3 marks)

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14 There are 16 hockey teams in a league.
Each team played two matches against each of the other teams.

Work out the total number of matches played.

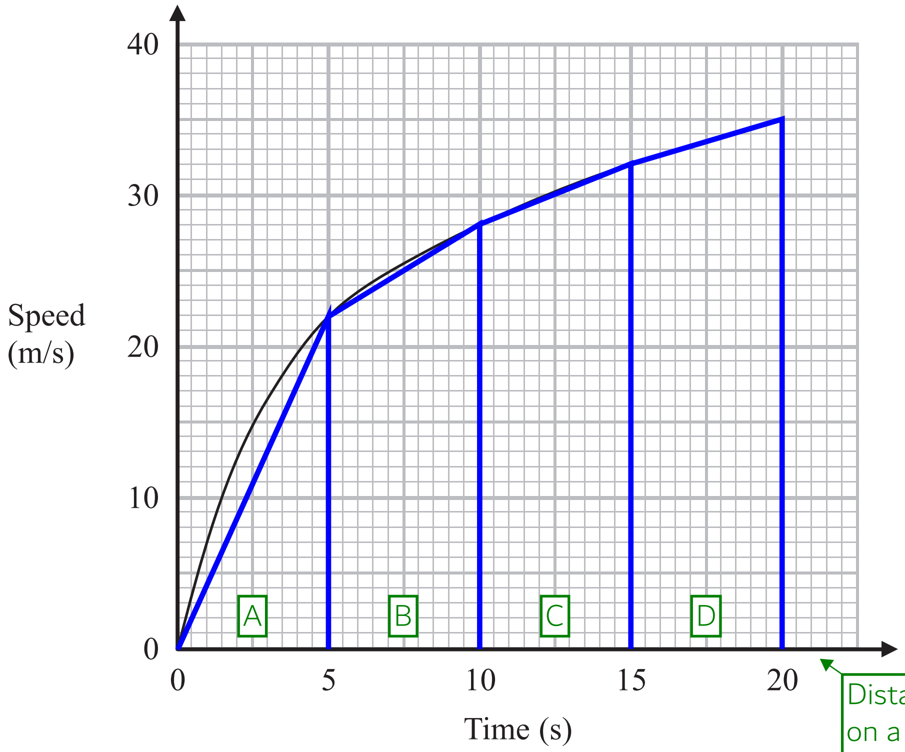
$$\frac{16 \times 15}{2} \times 2$$

Using the product rule of counting, 16 × 15 gives the total number of matches played if each team plays each other once but it needs to be halved as each match is counted twice (1 match is counted twice as it is a match for 2 of the teams). Then multiplying by 2 because each team needs to play 2 games against each of the other teams

240

(Total for Question 14 is 2 marks)

15 The graph shows the speed of a car, in metres per second, during the first 20 seconds of a journey.



Distance is the area under the line on a speed-time graph. Splitting it into 4 strips of equal width

(a) Work out an estimate for the distance the car travelled in the first 20 seconds.
Use 4 strips of equal width.

$\frac{1}{2} \times 5 \times 22 = 55$ ← Area of triangle A. Area of triangle = 1/2 × base × height

$\frac{1}{2}(22 + 28) \times 5 = 125$ ← Area of trapezium B

$\frac{1}{2}(28 + 32) \times 5 = 150$ ← Area of trapezium C

$\frac{1}{2}(32 + 35) \times 5 = 167.5$ ← Area of trapezium D

Area of trapezium = 1/2 (a + b) × h, where a and b are the parallel sides and h is the distance between them

$55 + 125 + 150 + 167.5$ ← Adding the area of each strip works out an estimate of the total area under the line

497.5 metres

(3)

DO NOT WRITE IN THIS AREA

(b) Is your answer to part (a) an underestimate or an overestimate of the actual distance the car travelled in the first 20 seconds?
Give a reason for your answer.

Underestimate as parts of the area under the curve were missed

(1)

(Total for Question 15 is 4 marks)

16 The nth term of a sequence is given by $an^2 + bn$ where a and b are integers.

The 2nd term of the sequence is –2
The 4th term of the sequence is 12

(a) Find the 6th term of the sequence.

$a(2)^2 + b(2)$ ← Substituting 2 for n in the nth term expresses the 2nd term

$4a + 2b = -2$ ← Simplifying and setting equal to the value of the 2nd term forms the 1st equation

$a(4)^2 + b(4)$ ← Substituting 4 for n in the nth term expresses the 4th term

$16a + 4b = 12$ ← Simplifying and setting equal to the value of the 4th term forms the 2nd equation

$8a + 4b = -4$ ← Multiplying the 1st equation by 2 gets the same number of b as the 2nd equation. This forms the 3rd equation

$8a = 16$ ← Subtracting the 3rd equation from the 2nd equation cancels out the b and leaves an equation just in term of a

$a = 2$ ← Dividing both sides by 8 gets a on its own

$4(2) + 2b = -2$ ← Substituting 2 for a in the 1st equation

$2b = -10$ ← Subtracting 4(2) from both sides gets the b term on its own

$b = -5$ ← Dividing both sides by 2 gets b on its own

$2(6)^2 - 5(6)$ ← Substituting 2 for a and -5 for b in the nth term. Substituting 6 for n finds the 6th term

42

(4)

Here are the first five terms of a different quadratic sequence.

0 2 6 12 20

(b) Find an expression, in terms of n, for the nth term of this sequence.

2 4 ← Writing the differences between the first 3 terms of the sequence

n^2: 1 4 ← The second difference is 2 as this is the difference between 2 and 4. Halving this gives 1, which is the number of n^2. Listing out the first 2 terms of the n^2 sequence

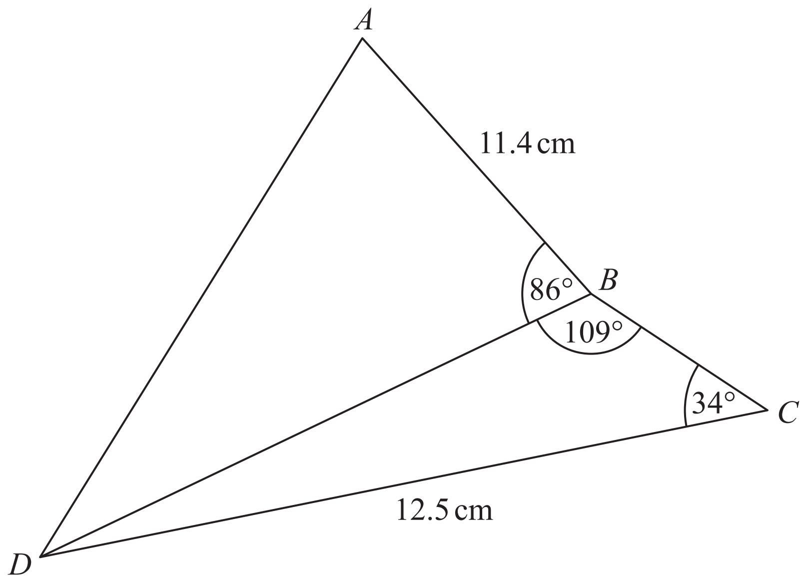
-1 -2 ← Listing what needs to be added to the n^2 sequence to get the quadratic sequence. This is the sequence of -n

Adding together the two sequences gives this → $n^2 - n$

(2)

(Total for Question 16 is 6 marks)

17



Work out the length of *AD*.
Give your answer correct to 3 significant figures.

$\frac{DB}{\sin 34} = \frac{12.5}{\sin 109}$

There are two opposite pairs of sides and angles in triangle DBC so the sine rule can be used. a/sinA = b/sinB, where side a is opposite angle A and side b is opposite angle B

DB = 7.3...

Multiplying both sides by sin34 gets DB on its own

$AD^2 = 7.3...^2 + 11.4^2 - 2 \times 7.3... \times 11.4 \times \cos 86$

There are not two opposite pairs of sides and angles in triangle DBC so the sine rule cannot be used. So the cosine rule could be used instead. $a^2 = b^2 + c^2 - 2bc\cos A$. Side a is opposite angle A

Square rooting both sides gets AD on its own. 13.14... is rounded to 3 significant figures

13.1 cm

(Total for Question 17 is 5 marks)

18 (a) Show that the equation $x^3 + x = 7$ has a solution between 1 and 2

$(1)^3 + (1) = 2$

$(2)^3 + (2) = 10$

Substituting 1 and 2 into the left side of the equation

One is less than 7 and one is greater than 7

As the left side is a cubic function, it is continuous, which means there are no breaks in the line if drawn on a graph. So it must go through 7 at some point between where x is 1 and 2

(2)

(b) Show that the equation $x^3 + x = 7$ can be rearranged to give $x = \sqrt[3]{7 - x}$

$x^3 = 7 - x$ ← Subtracting x from both sides

$x = \sqrt[3]{7 - x}$ ← Cube rooting both sides

(1)

(c) Starting with $x_0 = 2$,
use the iteration formula $x_{n+1} = \sqrt[3]{7 - x_n}$ three times to find an estimate for a solution of $x^3 + x = 7$

$x_1 = \sqrt[3]{7 - 2}$ ← Substituting x_0 into the right side of the formula works out x_1

$x_2 = \sqrt[3]{7 - 1.70...}$ ← Substituting x_1 into the right side of the formula works out x_2

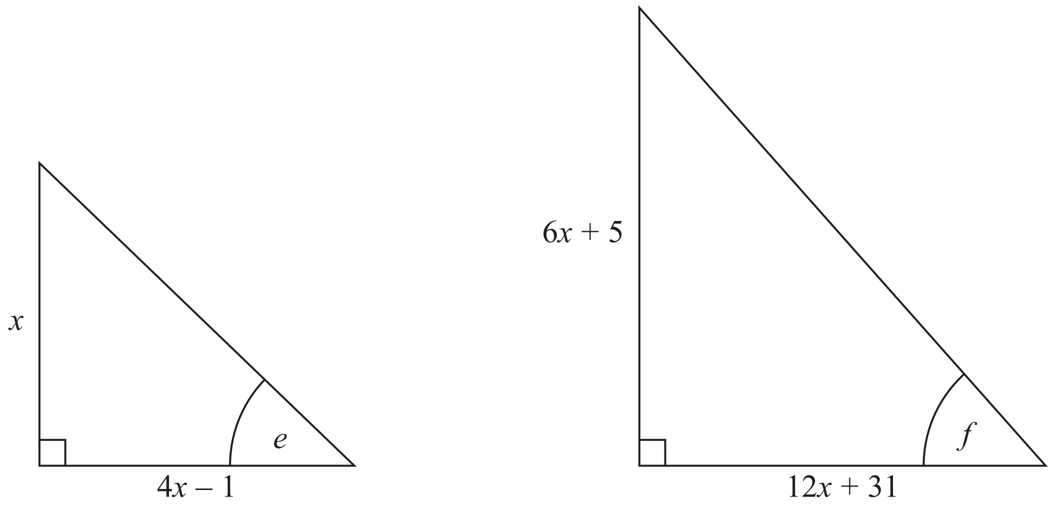
$x_3 = \sqrt[3]{7 - 1.74...}$ ← Substituting x_2 into the right side of the formula works out x_3

1.74

(3)

(Total for Question 18 is 6 marks)

19 Here are two right-angled triangles.



Given that

$$\tan e = \tan f$$

find the value of x.

You must show all your working.

$$\frac{x}{4x - 1} = \frac{6x + 5}{12x + 31}$$

Tan of the angle = opposite/adjacent. So tane = x/(4x - 1) and tanf = (6x + 5)/(12x + 31). These are equal to each other

$$x(12x + 31) = (6x + 5)(4x - 1)$$

Multiplying both sides by the denominators eliminates them

$$12x^2 + 31x = 24x^2 - 6x + 20x - 5$$

Expanding the brackets

$$0 = 12x^2 - 17x - 5$$

Subtracting $12x^2$ and 31x from both sides and collecting like terms to put into the quadratic form

$$x = \frac{--17 \pm \sqrt{(-17)^2 - 4 \times 12 \times -5}}{2 \times 12}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Solving using the quadratic formula

The solution of -1/4 is ignored as x is a length so must be positive

$\frac{5}{3}$

(Total for Question 19 is 5 marks)

20 50 people were asked if they speak French or German or Spanish.

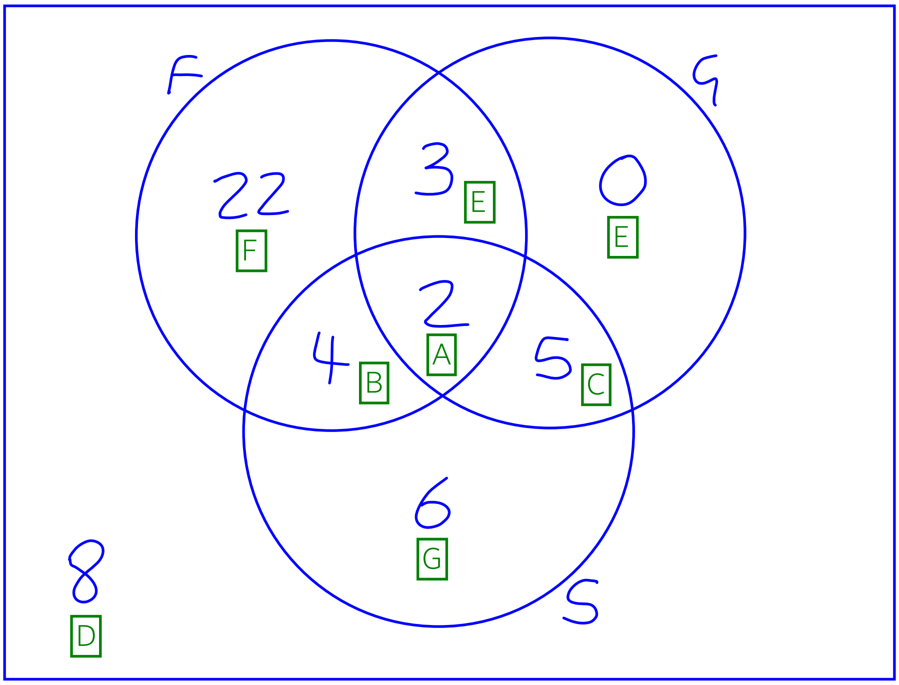
Of these people,

- 31 speak French
- 2 speak French, German and Spanish
- 4 speak French and Spanish but not German
- 7 speak German and Spanish
- 8 do not speak any of the languages
- all 10 people who speak German speak at least one other language

Two of the 50 people are chosen at random.

Work out the probability that they both only speak Spanish.

The languages overlap so the information can be organised into a Venn diagram



A: 2 speak French, German and Spanish
B: 4 speak French and Spanish but not German
C: 7 speak German and Spanish (including 2 speak French, German and Spanish)
D: 8 do not speak any of the languages
E: all 10 people who speak German speak at least one other language
F: 31 speak French
G: there are 50 people in total

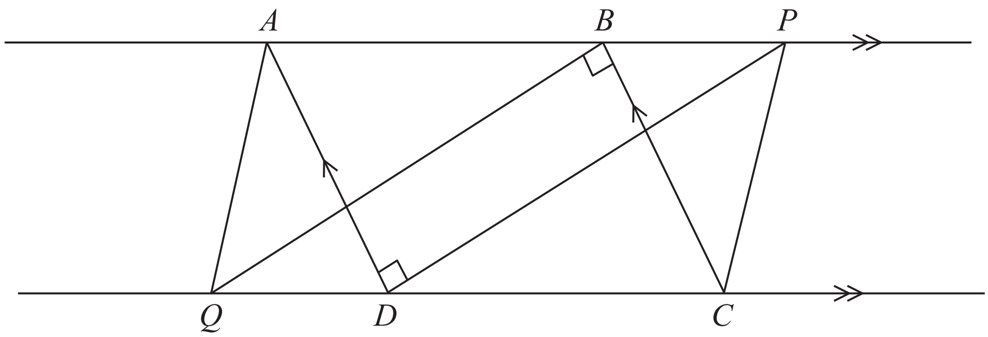
$\frac{6}{50} \times \frac{5}{49}$

6 out of the 50 people speak only Spanish. Once one has been chosen, there is 1 fewer person in total and 1 fewer only Spanish speaker left. There are then 5 out of 49 people who speak only Spanish. Multiplying these fractions works out the probability of the first outcome AND the second outcome

$\frac{3}{245}$

(Total for Question 20 is 5 marks)

21



ABCD is a parallelogram.
ABP and *QDC* are straight lines.
Angle *ADP* = angle *CBQ* = 90°

(a) Prove that triangle *ADP* is congruent to triangle *CBQ*.

Angle ADP = angle CBQ

Angle DAP = angle BCQ as opposite angles in a parallelogram are equal

AD = BC as opposite sides of a parallelogram are equal

Therefore they are congruent as ASA

(3)

(b) Explain why *AQ* is parallel to *PC*.

AP = QC as they are sides on the congruent triangles

As AP and QC are equal and parallel, APCQ is a parallelogram

AQ and PC are parallel as they are opposite sides in a parallelogram

(2)

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS