

Write your name here

Surname

Other names

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

Centre Number

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Candidate Number

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# 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  $\pi$  button, take the value of  $\pi$  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/

**.CG Maths.**  
Worked Solutions



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 indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

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

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to [curtis@cgmaths.co.uk](mailto:curtis@cgmaths.co.uk)

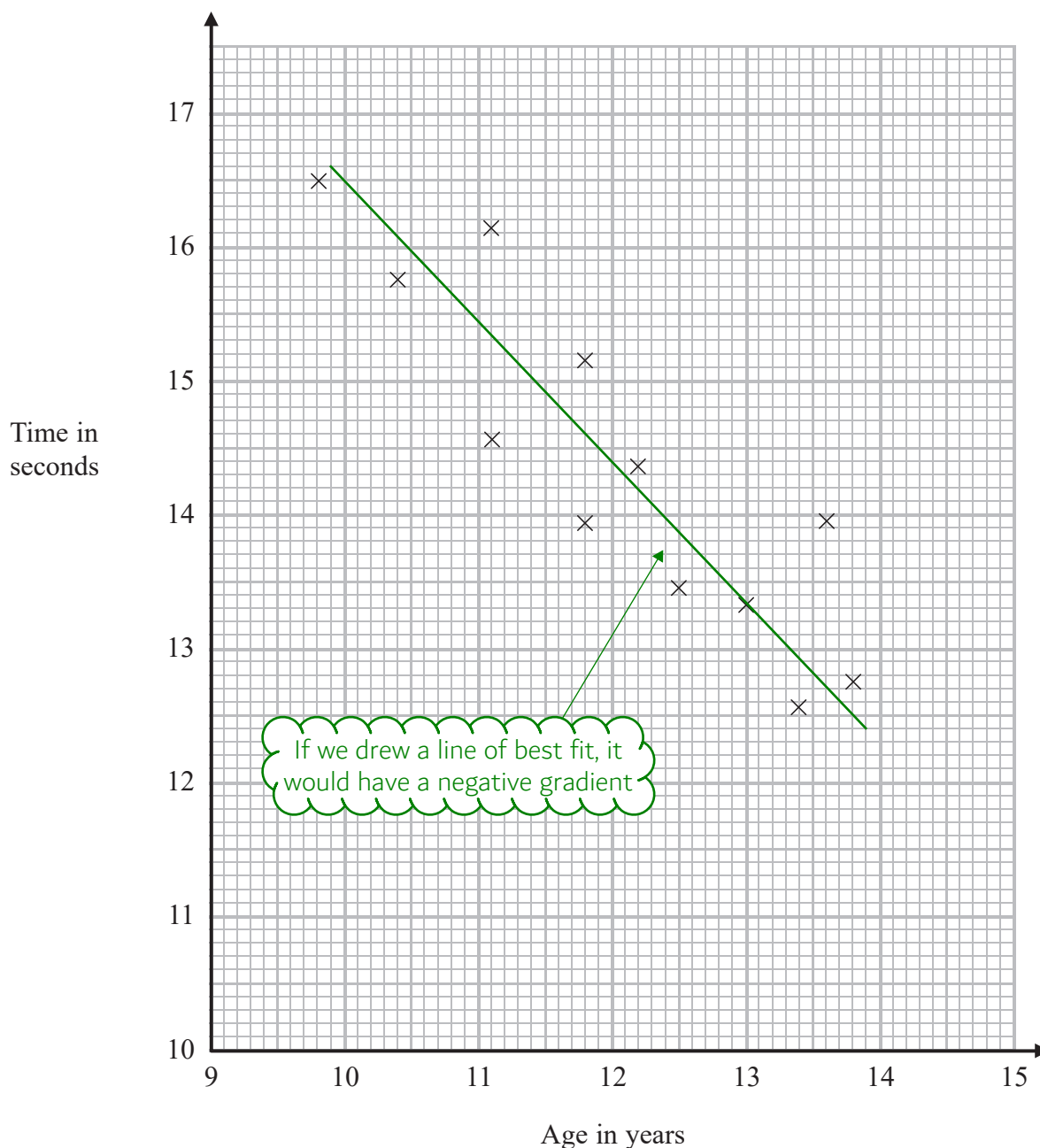
Answer ALL questions.

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.

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 necessarily 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)

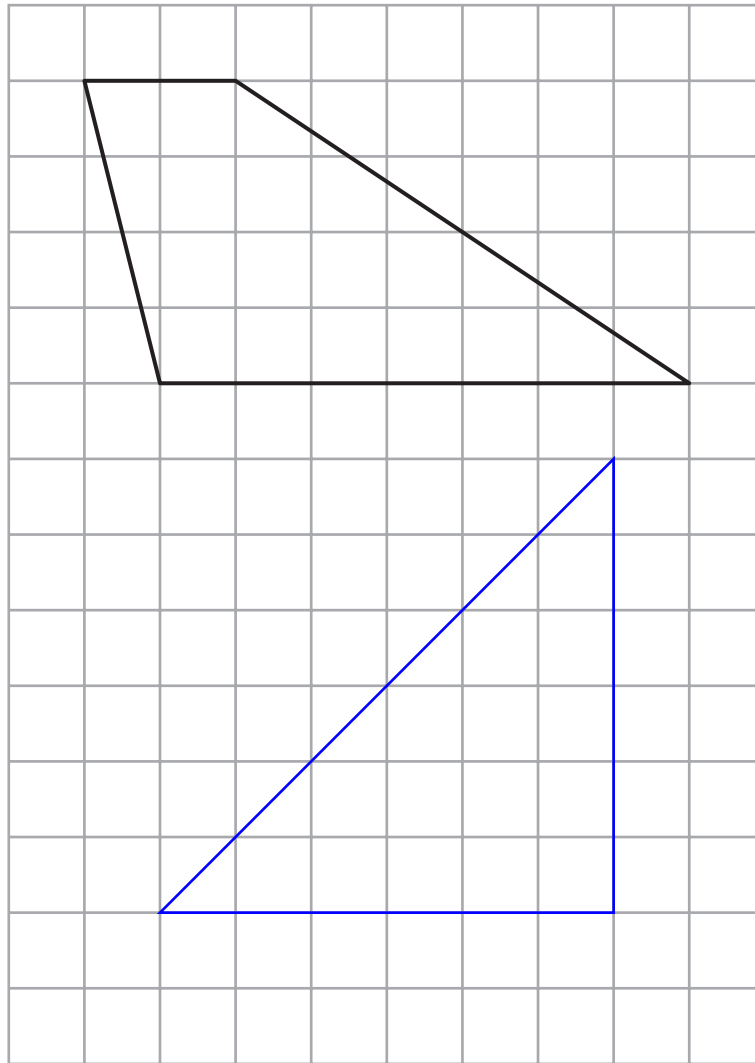
2 Expand and simplify  $5(p + 3) - 2(1 - 2p)$

$$5p + 15 - 2 + 4p$$

$$9p + 13$$

(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 =  $\frac{1}{2} \times (a + b) \times h$ , where a and b are the parallel sides and h is the distance between a and b

$$\frac{1}{2}bh = 18$$

Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$

$$bh = 36$$

Rearranged to find base x height

$6 \times 6 = 36$  so a triangle with height of 6 and base of 6 can be drawn

(Total for Question 3 is 2 marks)

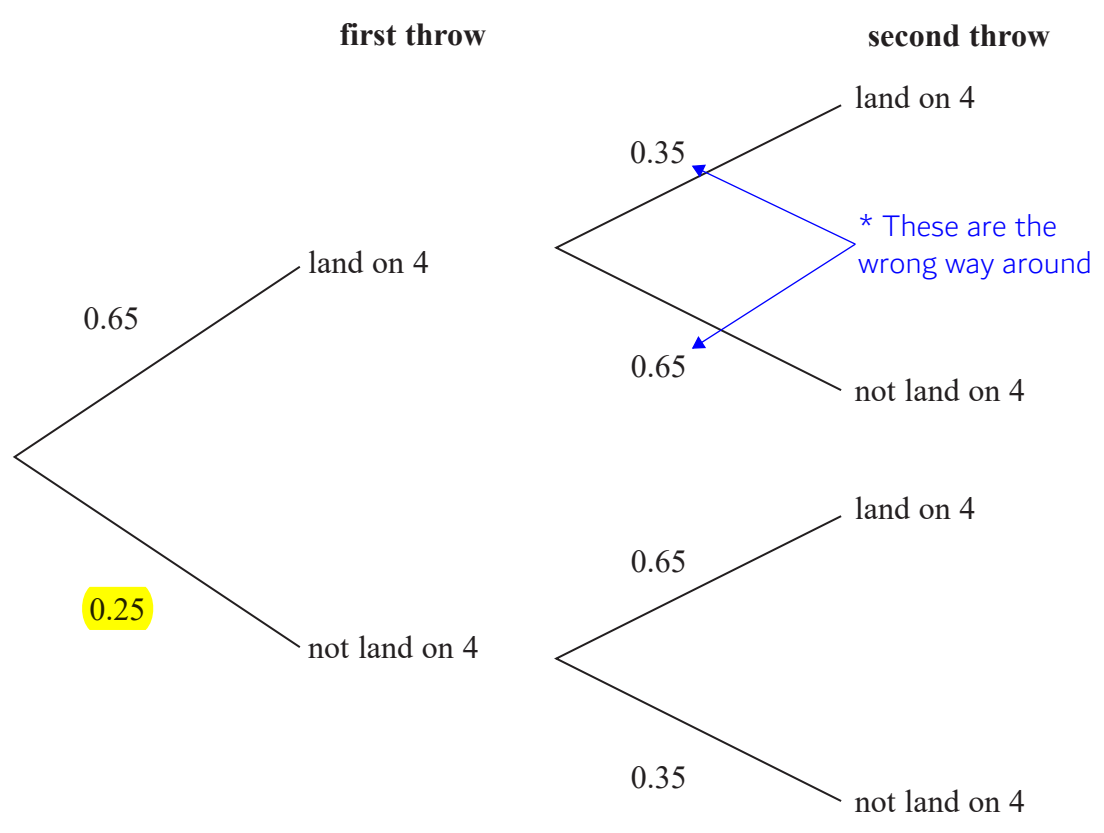
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4 When a biased 6-sided dice is thrown once, the probability that it will land on 4 is 0.65  
The biased dice is thrown twice.

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

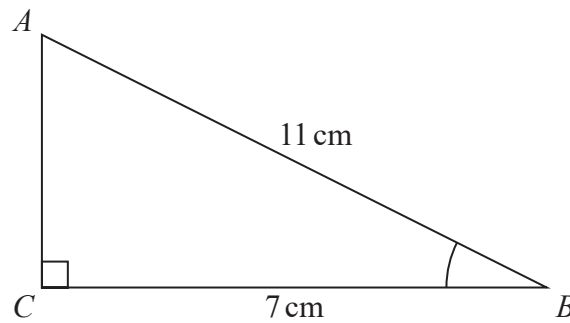
As it is certain to either land on a 4 or not to land on a 4, both probabilities must add to 1

2 See \*

The probability that it will land on 4 is 0.65

(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.

SOH CÁH TOÁ

$\frac{A}{C/H}$

11cm is the hypotenuse and 7cm is the adjacent. CAH can be used

$$\cos^{-1}\left(\frac{7}{11}\right)$$

From the formula triangle:  
cos of the angle = adjacent/hypotenuse  
Rearranging this gives:  
Angle =  $\cos^{-1}(\text{adjacent/hypotenuse})$

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  $90^\circ$

- (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  $7/11$

$\cos ABC = \text{adjacent/hypotenuse}$

(1)

(Total for Question 5 is 3 marks)

- 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.

2:1

This is the ratio of red to white

$$1 - 0.45 - 0.25 = 0.3$$

It is certain to get one of the colours so all the probabilities must add to 1. Therefore subtracting the probabilities of blue and yellow away from 1 leaves the probability of red or white

$$3p = 0.3$$

There are 3 parts in total in the ratio. These represent red or white and the total probability of these is 0.3

$$p = 0.1$$

$$2p = 0.2$$

Dividing both sides by 3 finds the value of 1 part. Multiplying by 2 finds 2 parts, which represent the probability of getting red

$$x \times 0.45 = 18$$

x is the total number of counters. The probability is equal to the relative frequency so therefore 0.45 of the total is 18

$$x = \frac{18}{0.45} = 40$$

Rearranged to find x, the total number of counters

$$40 \times 0.2$$

0.2 of the counters must be red

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

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 and this isn't possible

(1)

(Total for Question 6 is 5 marks)



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

$$5-x = 4x-14$$

First eliminate the fraction by multiplying both sides by 2

$$19 = 5x$$

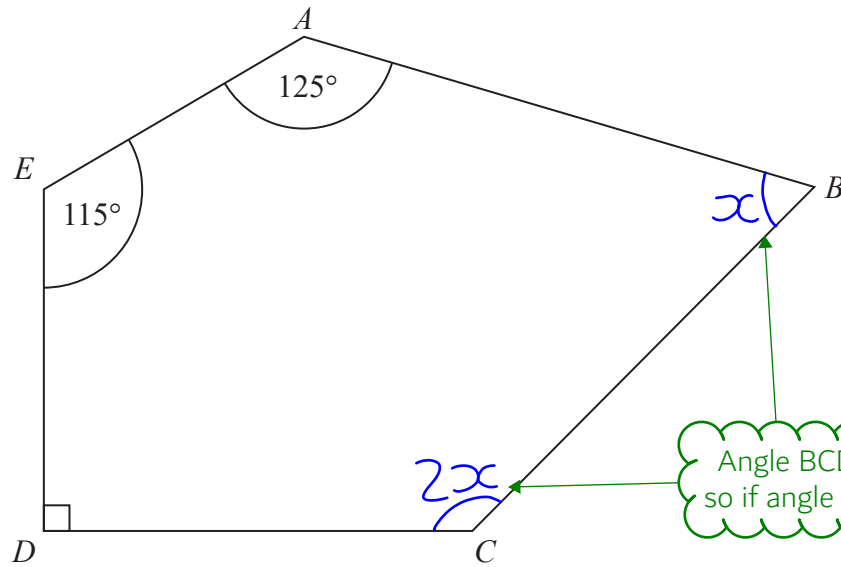
Add x to both sides to bring all the x terms to the same side. Then add 14 to both sides to get the x term on its own

Divide both sides by 5 to get x on its own

$$x = \frac{19}{5}$$

(Total for Question 7 is 3 marks)

8  $ABCDE$  is a pentagon.



Angle  $BCD = 2 \times$  angle  $ABC$

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

$$(5 - 2) \times 180 = 540$$

$(n - 2) \times 180$  is the formula for the total number of degrees in a polygon, where  $n$  is the number of sides

$$90 + 115 + 125 + x + 2x = 540$$

Adding all the angles in the shape gives the total number of degrees

$$330 + 3x = 540$$

Collecting like terms and simplifying on the left side

$$x = \frac{540 - 330}{3} = 70$$

Rearranged to make  $x$  the subject by subtracting 330 then dividing by 3

Angle  $BCD$  was labelled as  $2x$  so it is 2 times  $x$ , which is 70

140

(Total for Question 8 is 5 marks)

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

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

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

(a) Work out the value of  $T$ .

Give your answer in standard form correct to 3 significant figures.

4520

Substituting  $w$  and  $d$  for their values and typing it into the calculator gives 4517.539515. This is written in ordinary form to 3 significant figures

4520 needs to be divided by 10 3 times to get a number between 1 and 10 so we need to multiply by  $10^3$  to put it into standard form

$$T = 4.52 \times 10^3 \quad (2)$$

$w$  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.

$$\sqrt{\frac{5.6 \times 10^{-5} \times 1.1}{(1.4 \times 10^{-4} \times 1.05)^3}} = 4403.6...$$

$$4403.6... < 4520$$

100% + 10% = 110%, which as a decimal is 1.1.  
100% + 5% = 105%, which as a decimal is 1.05.  
Multiplying by these decimals increases the values of  $w$  and  $d$  by the percentages

(2)

(Total for Question 9 is 4 marks)

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10 Here are three lamps.

lamp A



lamp B



lamp C



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?

$$20 = 2^2 \times 5$$

$$45 = 3^2 \times 5$$

$$120 = 2^3 \times 3 \times 5$$

$$2^3 \times 3^2 \times 5 = 360$$

$$\frac{1 \times 60 \times 60}{360}$$

Listing out the prime factors of 20, 45 and 120 (the calculator can do this for you by typing in the number, pressing equals, pressing shift then FACT)

Multiplying the highest power of each prime finds the lowest common multiple of all three numbers

Converting an hour into seconds then dividing by 360 (this is the number of seconds it takes for them all to flash at the same time) to see how many times in one hour they all flash at the same time

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

$$x \times 1.2 \times 0.9 = 162000$$

x is the original price in 2003. Multiplying this by 1.2 increases it by 20% to express the cost in 2007. Then multiplying by 0.9 decreases it by 10% to express the cost in 2012

$$x = \frac{162000}{1.2 \times 0.9}$$

Rearranged to find x

£..... 150000 .....

(Total for Question 11 is 3 marks)

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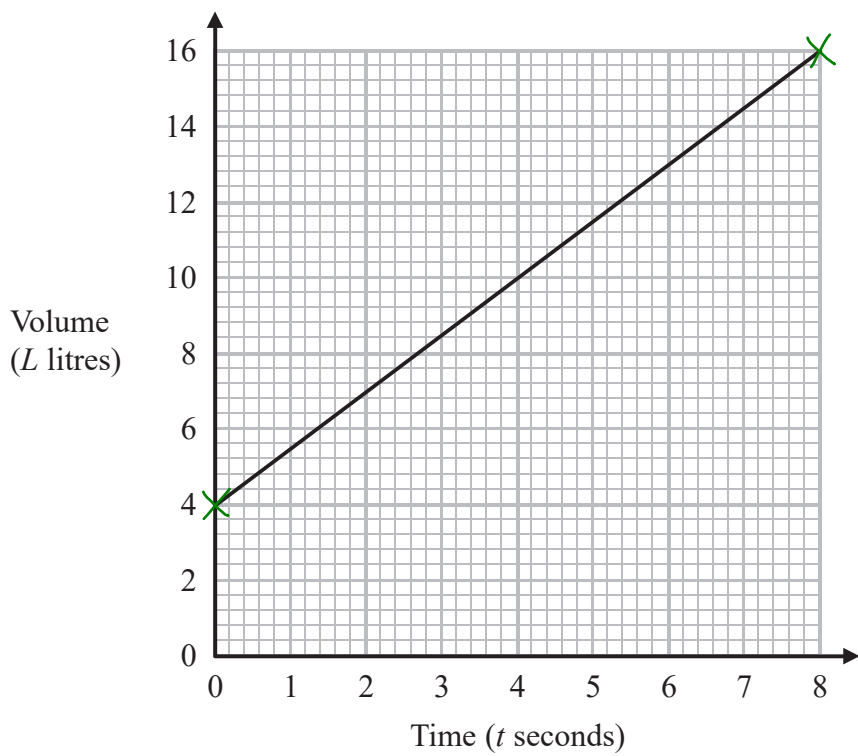
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12 The graph shows the volume of liquid ( $L$  litres) in a container at time  $t$  seconds.



(a) Find the gradient of the graph.

Gradient = change in  $y$  / change in  $x$   
 From 4 to 16  $y$  has changed 12  
 and from 0 to 8  $x$  has changed 8

$$\frac{12}{8}$$

(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  $10 \text{ cm}^3$

Work out the volume of shape **A**.

Give your answer correct to 3 significant figures.

$$(\sqrt{3})^3 : 8$$

Square rooting both sides of the ratio gives the ratio of the lengths. Cubing both sides gives the ratio of the volumes

$$\frac{10}{8} \times (\sqrt{3})^3$$

8 parts of the ratio represents  $10 \text{ cm}^3$ . Dividing by 8 calculates 1 part then multiplying by root 3 cubed calculates the volume of A

The answer of 6.495190528 is rounded to 3 significant figures

..... **6.50** .....  $\text{cm}^3$

(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.

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

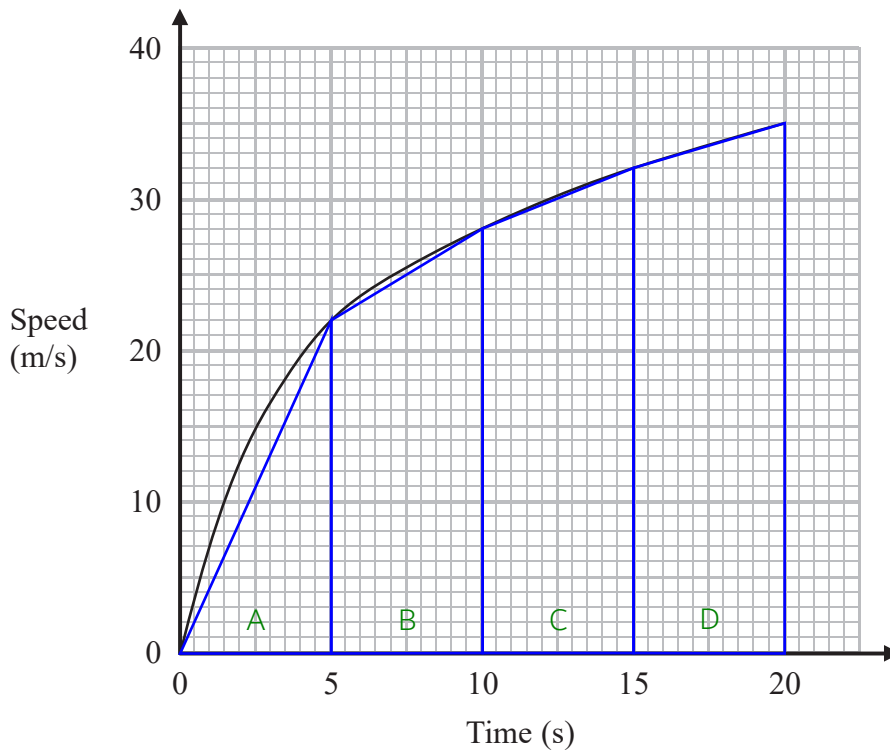
Using the product rule of counting, 16 x 15 gives the total number of matches played if each team plays each other once but it needs to be halved as each match is counted twice (1 match is counted as 2 games as it is a match for 2 of the teams). Multiplying by 2 because each team needs to play 2 games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



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

$$\frac{1}{2} \times 5 \times 22 + \frac{1}{2}(22+28) \times 5 + \frac{1}{2}(28+32) \times 5 + \frac{1}{2}(32+35) \times 5$$

Area of triangle A

Area of trapezium B

Area of trapezium C

Area of trapezium D

Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$   
 Area of trapezium =  $\frac{1}{2} \times (a + b) \times h$ , where a and b are the parallel sides and h is the distance between them

497.5 metres  
(3)

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(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 weren't included

(1)

(Total for Question 15 is 4 marks)

16 The  $n$ th 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.

$$a(2)^2 + b(2) = -2$$

$$4a + 2b = -2$$

$$a(4)^2 + b(4) = 12$$

$$16a + 4b = 12$$

$$8a + 4b = -4$$

$$8a = 16$$

$$a = 2$$

$$4(2) + 2b = -2$$

$$2b = -10$$

$$b = -5$$

$$2(6)^2 - 5(6)$$

On the 2nd term  $n = 2$ . Making an equation by substituting  $n$  for 2 and setting it equal to  $-2$  then simplifying

On the 4th term  $n = 4$ . Making an equation by substituting  $n$  for 4 and setting it equal to 12 then simplifying

Multiplying the equation  $4a + 2b = -2$  by 2 to get the same number of  $b$  as the second equation. Then subtracting it from the second equation to eliminate the  $b$  terms

Substituting  $a$  for 2 in the first equation

Rearranging to make  $b$  the subject to find  $b$

On the 6th term  $n = 6$ . Expressing the 6th term by substituting  $n$  for 6 and  $a$  and  $b$  for the values we have found into  $an^2 + bn$

$$42$$

(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  $n$ th term of this sequence.

$$2 \quad 4$$

Working out the differences between the first 3 terms of the sequence

$$n^2: \quad 1 \quad 4$$

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

$$-1 \quad -2$$

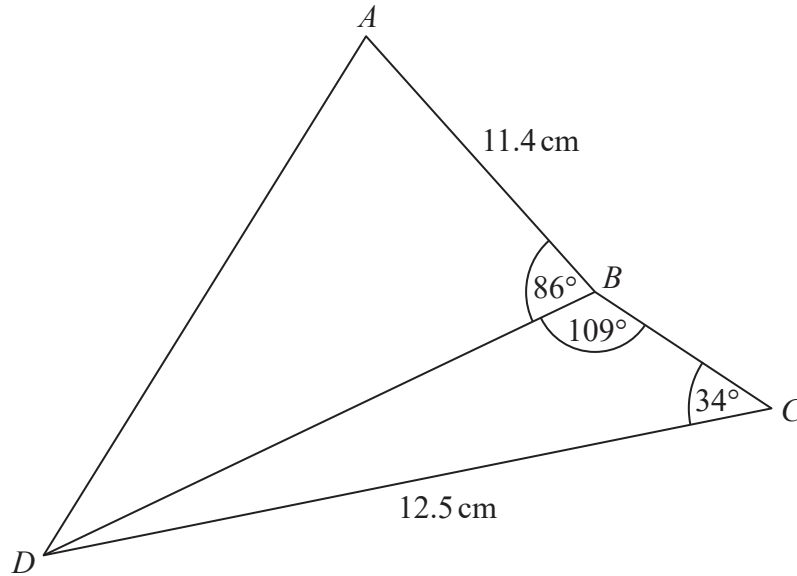
Listing what needs to be added to the  $n^2$  sequence to get the quadratic sequence. This is the sequence of  $-n$

Adding together the two sequences gives this

$$n^2 - n$$

(2)

(Total for Question 16 is 6 marks)



Work out the length of  $AD$ .

Give your answer correct to 3 significant figures.

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

There are opposite pairs of sides and angles in triangle  $DBC$  so we can use the sine rule to work out  $DB$

$$DB = \frac{12.5}{\sin 109} \times \sin 34 = 7.392674744$$

Rearranging the sine rule to make  $a$  the subject and substituting in the values. Angle  $A$  is opposite side  $a$  and angle  $B$  is opposite side  $b$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

There are two sides and the angle between them in triangle  $DAB$  so the cosine rule can be used to find  $AD$

$$AD = \sqrt{11.4^2 + DB^2 - 2 \times 11.4 \times DB \times \cos 86}$$

Rearranging the cosine rule to make  $a$  the subject and substituting in the values

The answer of 13.14739434 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 below and one is above 7

(2)

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

$$x^3 = 7 - x$$

$$x = \sqrt[3]{7 - x}$$

(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  $x^3 + x = 7$

$$x_1 = \sqrt[3]{7 - x_0} = 1.709975947$$

$$x_2 = \sqrt[3]{7 - x_1} = 1.742418802$$

$$x_3 = \sqrt[3]{7 - x_2} = 1.738849506$$

In the calculator, press 2 then equals. Then type in the cube root of 7 - ANS and press equals 3 times

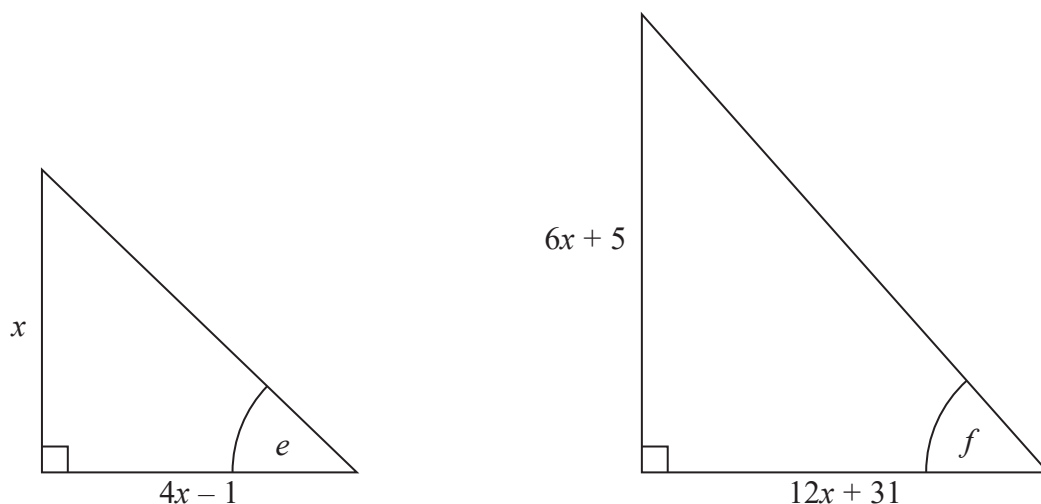
It is only an estimate so there is no need to be very precise

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.

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

From the formula triangle,  $\tan$  of the angle = opposite/adjacent

As the  $\tan$  of the angles are equal, the opposite/adjacent are equal

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

Eliminating the denominators by multiplying both sides by them

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

Expanding the brackets

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

Setting the equation equal to 0 so it can be solved by factorisation

$$= 12x^2 + 3x - 20x - 5$$

$$= 3x(4x+1) - 5(4x+1)$$

$12 \times -5 = -60$ . 3 and -20 multiply to -60 and add to -17. Splitting the middle  $x$  term then factorising both the left half and right half

$$= (3x-5)(4x+1)$$

Either  $3x - 5 = 0$  or  $4x + 1 = 0$ . Rearranging both of these equations to get the solutions

$$x = \frac{5}{3} \text{ or } x = -\frac{1}{4}$$

Length can't be negative so the  $-1/4$  is ignored

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

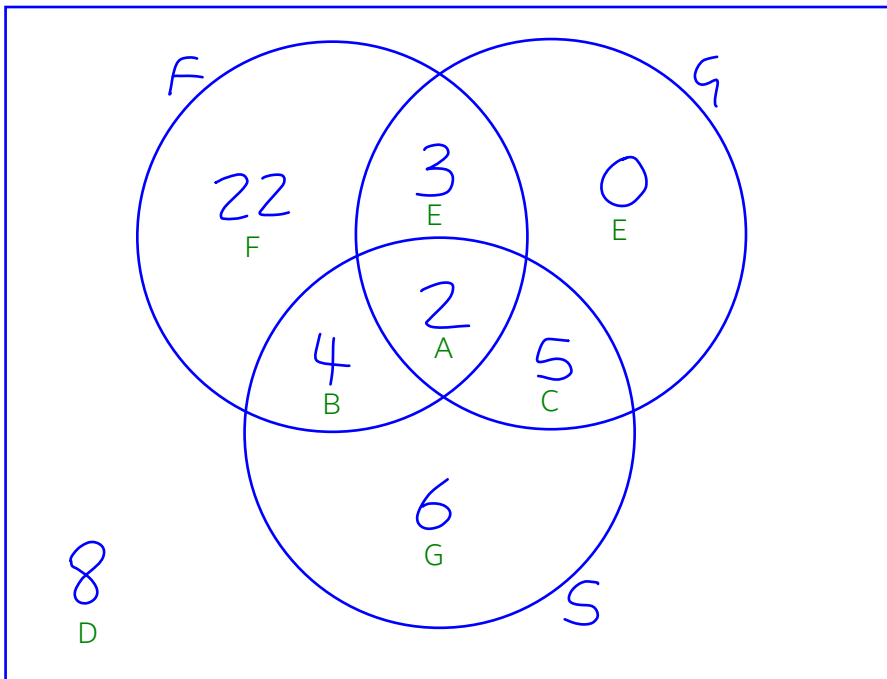
7 speak German and Spanish

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.



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

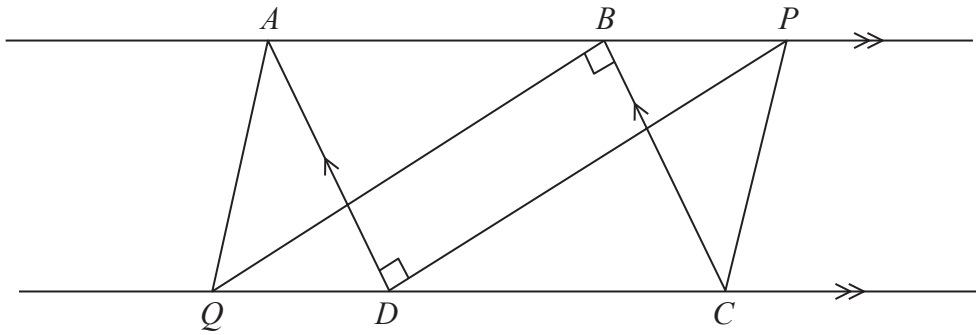
$$\frac{6}{50} \times \frac{5}{49}$$

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  $ADP = \text{angle } CBQ = 90^\circ$

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

Angle  $ADP = \text{angle } CBQ$

Angle  $DAP = \text{angle } BCQ$  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