Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | | | | | |

Candidate Number | | | | |

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

Monday 10 June 2024

Morning (Time: 1 hour 30 minutes)

Paper reference **1MA1/3H**

Mathematics

PAPER 3 (Calculator)
Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB or B pencil, eraser, calculator, Formulae Sheet (enclosed). Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Find the highest common factor (HCF) of 63 and 105

$63 = 3^2 \times 7$ ← Expressing 63 as a product of prime factors using the calculator

$105 = 3 \times 5 \times 7$ ← Expressing 105 as a product of prime factors using the calculator

3×7 ← The highest common factor is the lowest power of each prime number in both lists multiplied together

Newer Casio calculators can calculate the highest common factor of two numbers without having to do this method

21

(Total for Question 1 is 2 marks)

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2 (a) (i) Write 5.3×10^4 as an ordinary number.

Typing it into the calculator should convert it into an ordinary number

53000

(1)

(ii) Write 7.4×10^{-5} as an ordinary number.

7.4 ← Dividing 7.4 by 10 5 times

Newer Casio calculators can be used to format the standard form as a decimal

0.000074

(1)

(b) Calculate the value of $9.7 \times 10^6 + 2.45 \times 10^7$

Give your answer in standard form.

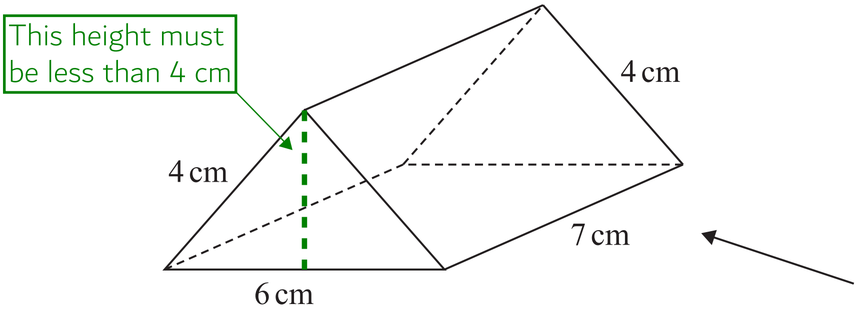
34200000 ← Typing it into the calculator gives this

Dividing by 10 7 times gives 3.42 (which is at least 1 and less than 10). So 3.42 needs to be multiplied by 10^7 → 3.42×10^7

(2)

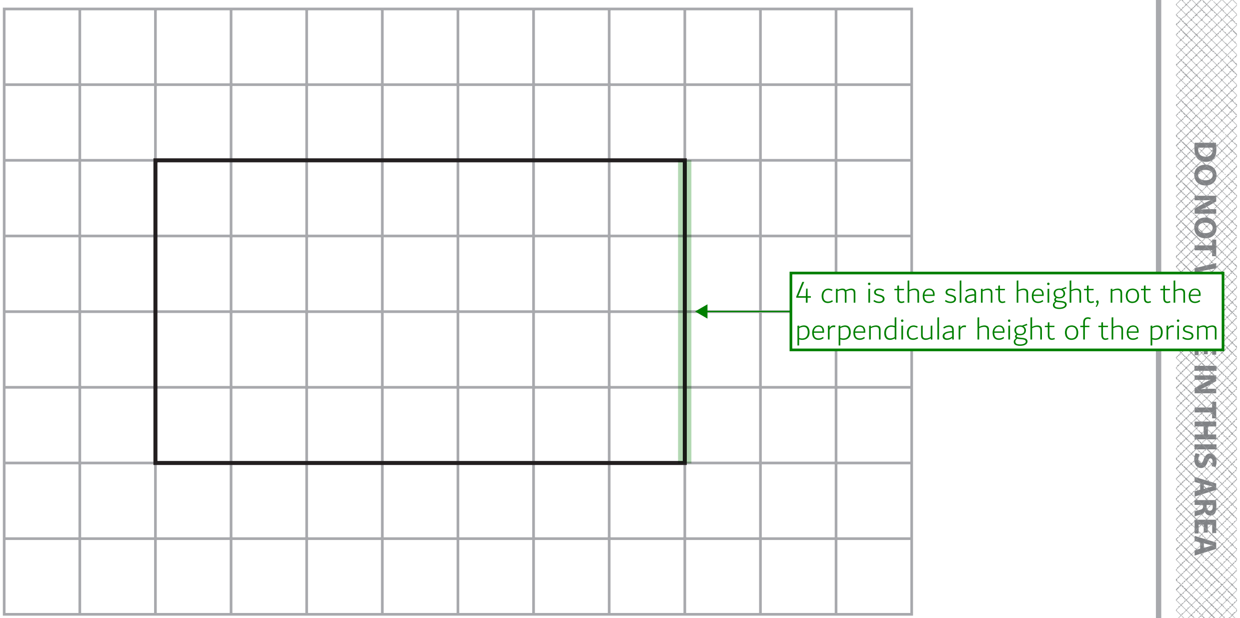
(Total for Question 2 is 4 marks)

3 The diagram shows a solid triangular prism.



Rana is trying to draw the side elevation of the solid prism from the direction of the arrow.

Here is her answer on a centimetre grid.



(a) Explain why Rana's side elevation is not correct.

The height is wrong

....

....

(1)

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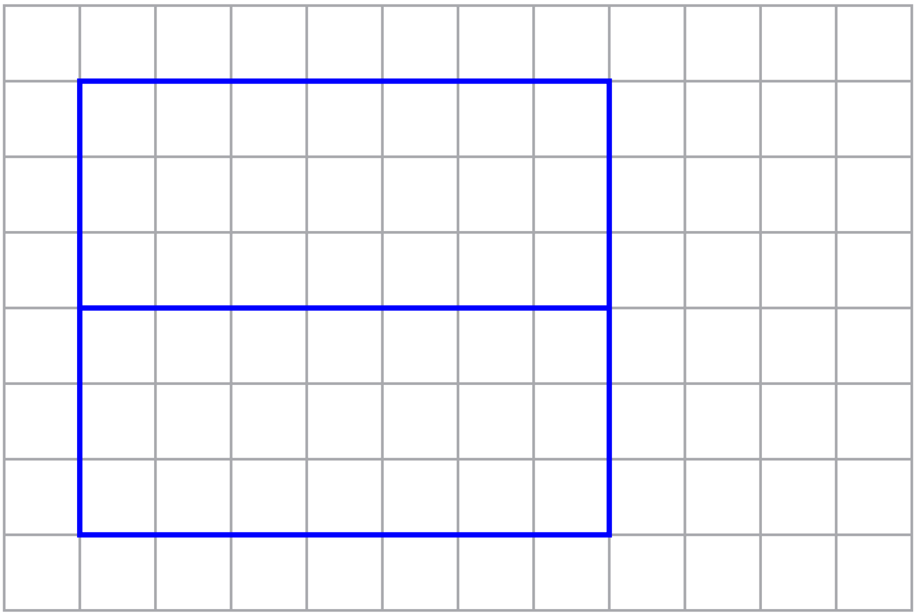
(b) On the centimetre grid below, draw a plan of the solid prism. ← View from above



(2)

(Total for Question 3 is 3 marks)

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4 A company has 25 000 workers.
The number of workers increases at a rate of 6% per year for 3 years.

Calculate the total number of workers at the end of the 3 years.

25000×1.06^3 ← 100% + 6% = 106%. This is the percentage it increases to each year. Dividing the 106% by 100 converts it to the decimal 1.06, which increases the 25000 by 6% when multiplied. Raising the 1.06 to the power of 3 increases the 25000 by 6% 3 times

Rounding 29775.4 to the nearest whole number → 29775

(Total for Question 4 is 4 marks)

5 Habib has two identical tins.

He puts 600 grams of flour into one of the tins.
The flour fills the tin completely.
The density of the flour is 0.6 g/cm^3

Habib puts 600 grams of salt into the other tin.
The salt does **not** fill the tin completely.
The volume of the space in the tin that is **not** filled with salt is 700 cm^3

Work out the density of the salt.
You must show all your working.

$d\,^{m}\,v$ ← Writing the formula triangle for density, mass, volume

$600 \div 0.6$ ← Covering v in the formula triangle finds that volume = mass ÷ density. Dividing the mass of the flour by the density of the flour works out that the volume of the flour is 1000 cm^3. The flour fills the tin completely so the volume of the tins must also be 1000 cm^3

$1000 - 700$ ← Subtracting the volume which is not filled with salt from the volume of the other tin works out that the volume of the salt is 300 cm^3

$600 \div 300$ ← Covering d in the formula triangle finds that density = mass ÷ volume. Dividing the mass of the salt by the volume of the salt works out that the density of the salt is 2 g/cm^3

2 g/cm^3

(Total for Question 5 is 4 marks)

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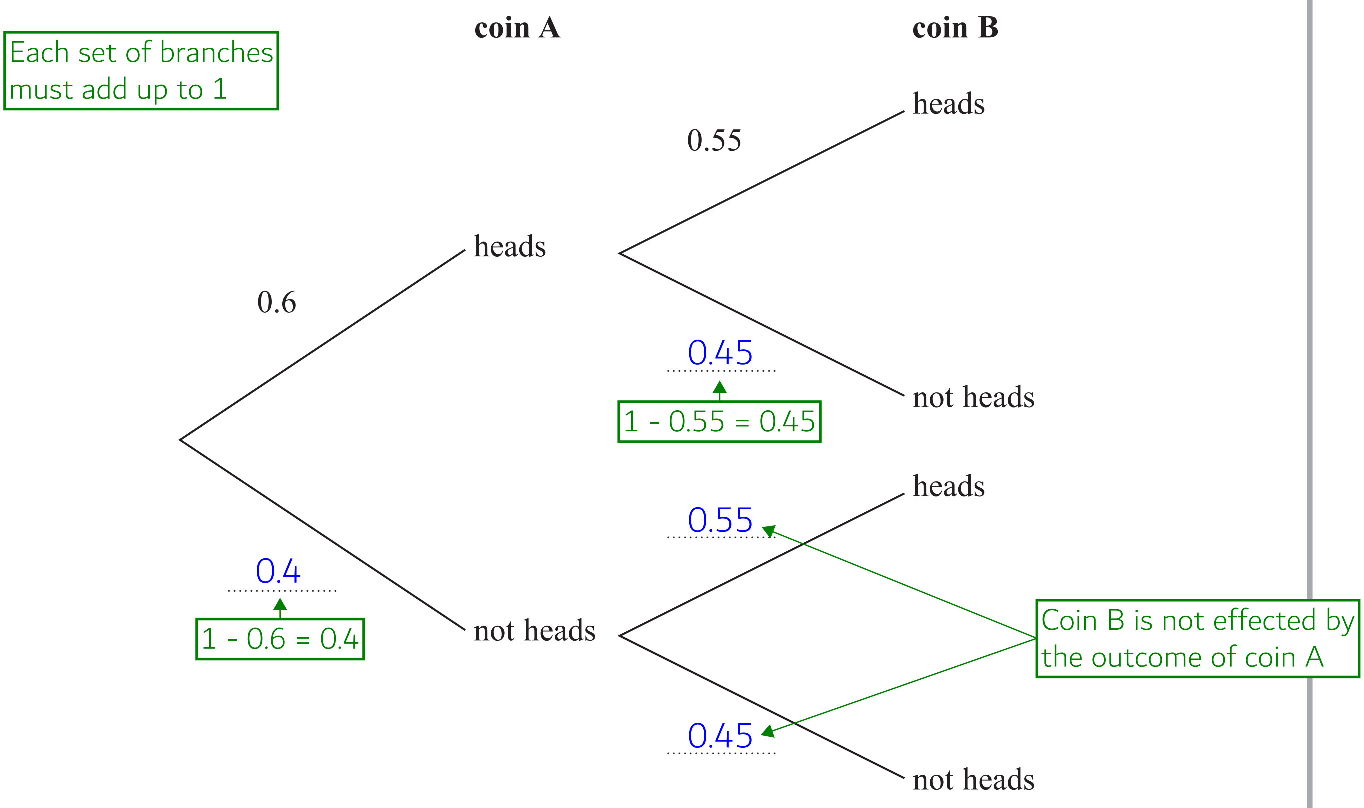
6 Tim has two biased coins, coin **A** and coin **B**.
He is going to throw both coins.

The probability that coin **A** will land on heads is 0.6
The probability that coin **B** will land on heads is 0.55

(a) Complete the probability tree diagram.



(2)

Tim throws coin **A** once and he throws coin **B** once.

(b) Work out the probability that both coins land on heads.

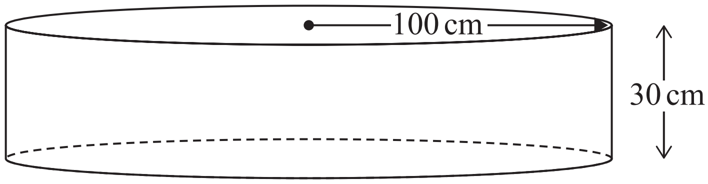
0.6×0.55 ← Heads AND heads. AND means to multiply the probabilities

0.33

(2)

(Total for Question 6 is 4 marks)

7 A paddling pool is in the shape of a cylinder.



The pool has radius 100 cm.
The pool has depth 30 cm.

The pool is empty.
It is then filled with water at a rate of 250 cm^3 per second.

Work out the number of minutes it takes to fill the pool completely.
Give your answer correct to the nearest minute.
You must show all your working.

$\pi \times 100^2 \times 30$ ← Volume of cylinder = area of cross section × length. The length is 30 cm and the cross section is a circle. Area of circle = π × $radius^2$

$300000\pi \div 250$ ← Dividing the volume of the cylinder by the rate it is filled works out that it takes 1200π seconds to fill the pool

$1200\pi \div 60$ ← There are 60 seconds in a minute so dividing the number of seconds it takes to fill the pool by 60 works out that it takes 20π minutes to fill the pool

Formatting 20π as a decimal gives 62.8... which should be rounded to 63 → 63 minutes

(Total for Question 7 is 4 marks)

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8 $\mathbf{a} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$

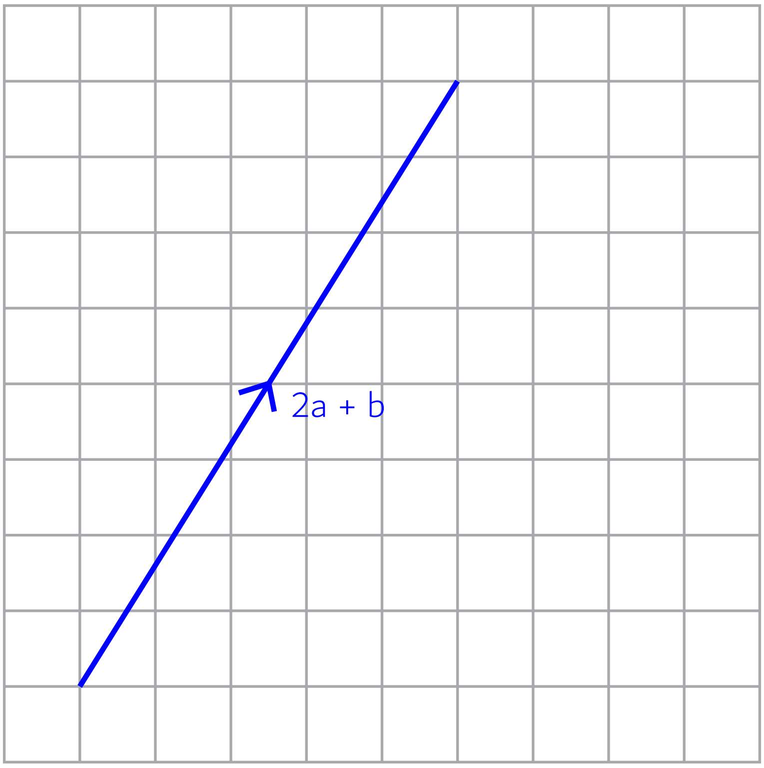
x-component of b

y-component of b

On the grid below, draw and label the vector $2\mathbf{a} + \mathbf{b}$

$2 \times 3 - 1 = 5$ ← Doing 2 times the x-component of a plus the x-component of b works out that the x-component of 2a + b is 5

$2 \times 2 + 4 = 8$ ← Doing 2 times the y-component of a plus the y-component of b works out that the y-component of 2a + b is 8



5 in the x-direction and 8 in the y-direction so 5 to the right and 8 up

(Total for Question 8 is 3 marks)

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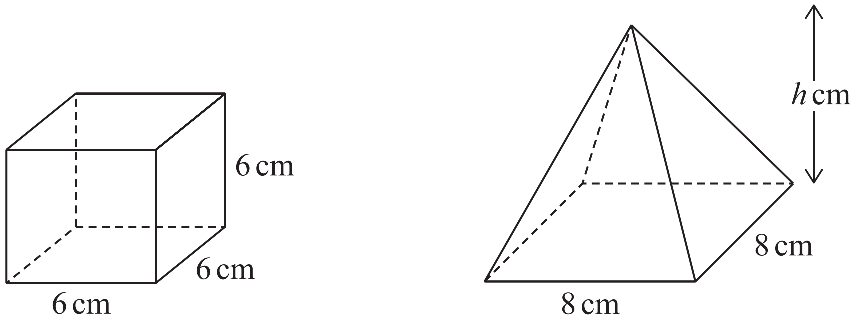
9 The diagram shows a cube and a square-based pyramid.



The volume of the cube is equal to the volume of the pyramid.

Work out the perpendicular height, h cm, of the pyramid.

6^3 ← Volume of cube = length^3. So the volume of the cube is 216 cm^3

$\frac{1}{3} \times 8^2 \times h$ ← Volume of pyramid = 1/3 × area of base × height. The area of the square base is length^2 and the height is h

$\frac{64}{3}h = 216$ ← Simplifying the expression for the volume of the pyramid and setting it equal to the volume of the cube

$h = 216 \div \frac{64}{3}$ ← Dividing both sides by 64/3 gets h on its own

10.125 cm

(Total for Question 9 is 3 marks)

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10 There are only red counters and yellow counters in bag **A**.

number of red counters : number of yellow counters = 3 : 5

There are only green counters and blue counters in bag **B**.
The number of counters in bag **B** is half the number of counters in bag **A**.

Given that there are x red counters in bag **A**,

use algebra to show that the total number of counters in bag **A** and bag **B** is $4x$

$\frac{x}{3} \times 8$ ← Dividing the x red counters by the 3 parts which represent red in the ratio expresses 1 part of the ratio. 3 + 5 = 8 parts in total in the ratio so multiplying the expression of 1 part of the ratio by 8 expresses the total number of counters in bag A. This simplifies to $8x/3$

$\frac{8x}{3} + \frac{8x}{3} \div 2 = 4x$ ← Adding the expressions for the number of counters in bag A and in bag B gives $4x$. Dividing the expression for the number of counters in bag A by 2 expresses the number of counters in bag B

(Total for Question 10 is 3 marks)

Turn over ▶

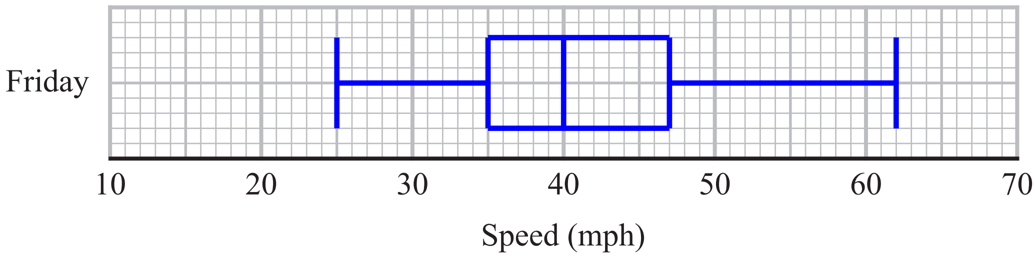
11 Mina records the speeds, in mph, of some cars on a road on Friday.
She uses her results to work out the information in this table.

	Speed (mph)
Lowest speed	25
Lower quartile	35
Median	40
Interquartile range	12
Range	37

Adding the interquartile range to the lower quartile works out that the upper quartile is 47

Adding the range to the lowest speed works out that the highest speed is 62

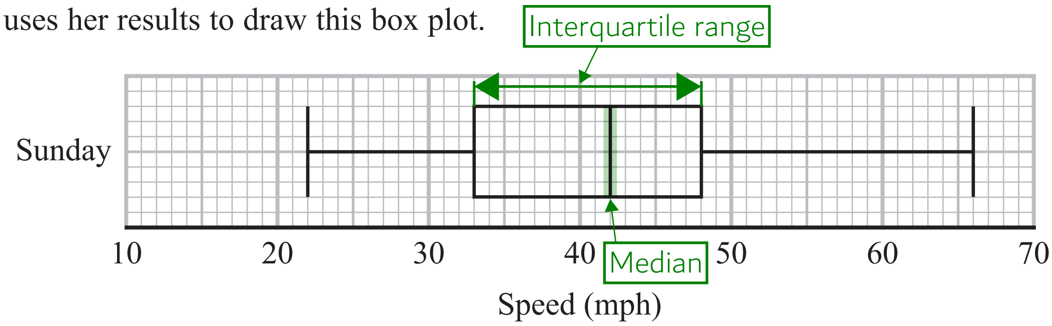
(a) On the grid, draw a box plot to show the information in the table.



Drawing vertical lines for the lowest, lower quartile, median, upper quartile and highest then joining them up in a box plot

(3)

Mina also records the speeds of some cars on the same road on Sunday.
She uses her results to draw this box plot.



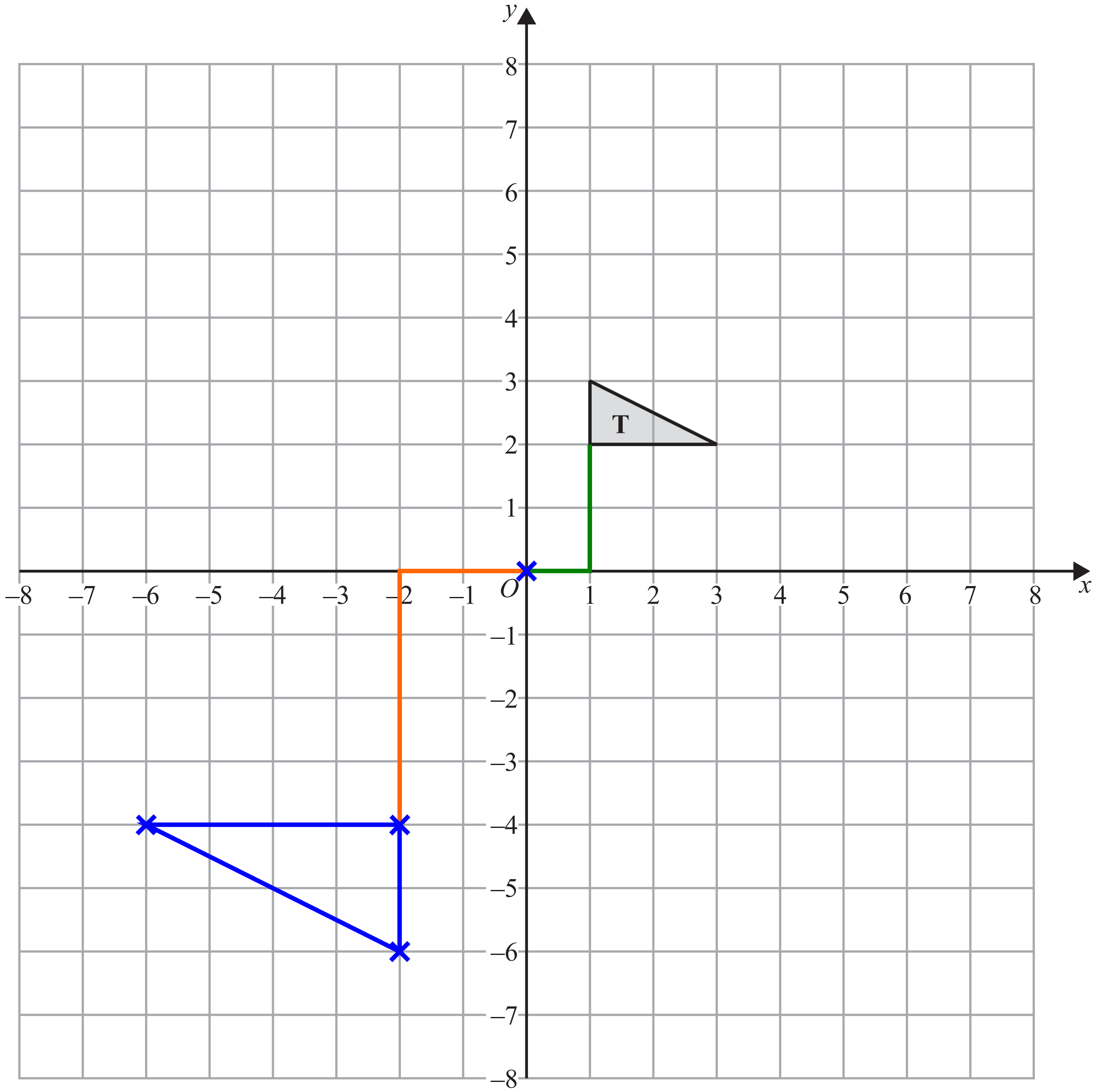
(b) Compare the distribution of the speeds on Friday with the distribution of the speeds on Sunday.

Both the median and interquartile range are less on Friday

(2)

(Total for Question 11 is 5 marks)

12 The diagram shows triangle **T** drawn on a grid.



Enlarge triangle **T** by scale factor –2 with centre of enlargement (0, 0)

(Total for Question 12 is 2 marks)

$\begin{pmatrix}1\\2\end{pmatrix} \times -2 = \begin{pmatrix}-2\\-4\end{pmatrix}$

$\begin{pmatrix}1\\3\end{pmatrix} \times -2 = \begin{pmatrix}-2\\-6\end{pmatrix}$

$\begin{pmatrix}3\\2\end{pmatrix} \times -2 = \begin{pmatrix}-6\\-4\end{pmatrix}$

Multiplying the vectors from the centre of enlargement to each corner of the triangle by the scale factor then doing the resulting vector from the centre of enlargement. Drawing the corners then joining them up with straight lines

13 There are 30 students in a class.
A teacher is going to choose at random 2 of the students.

Work out the number of different pairs of students that the teacher can choose.

$\frac{30 \times 29}{2}$ ← Using the product rule for counting. There are 30 students for the first pick then as there is one fewer student there are 29 students for the second pick. Multiplying the 30 by the 29 but then dividing by 2 as each pair is counted twice (picking student A then student B is the same pair as picking student B then student A)

435

(Total for Question 13 is 2 marks)

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14 At the start of 2022 Kim invested some money in a savings account.
The account paid 3.5% compound interest each year.

At the end of 2022
interest was added to the account then Kim took £750 from the account.

At the end of 2023
interest was added to the account then Kim took £1000 from the account.

There was then £2937.14 in the account.

Work out how much money Kim invested at the start of 2022
You must show all your working.

2937.14 + 1000 ← Adding the £1000 to the £2937.14 works out that there was £3937.14 before Kim took the £1000 from the account at the end of 2023

3937.14 ÷ 103.5 ← Adding the 3.5% to 100% works out that the investment increases to 103.5% each year. Dividing the £3937.14 by 103.5 works out that 1% of the value at the end of 2022 is £38.04

38.04 × 100 ← Multiplying 1% of the value at the end of 2022 by 100 works out that the value is £3804 at the end of 2022

3804 + 750 ← Adding the £750 to the value at the end of 2022 works out that there was £4554 before Kim took the £750 from the account at the end of 2022

4554 ÷ 103.5 ← Adding the 3.5% to 100% works out that the investment increases to 103.5% each year. Dividing the £4554 by 103.5 works out that 1% of the value at the start of 2022 is £44

44 × 100 ← Multiplying 1% of the value at the start of 2022 by 100 works out that the value is £4400 at the start of 2022

£ 4400

(Total for Question 14 is 4 marks)

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15 (a) Simplify fully $\frac{(a-3)^2}{5(a-3)}$

Both the numerator and denominator can be divided by (a - 3). There are no other common factors of the numerator and denominator

$\frac{a-3}{5}$

(1)

(b) Factorise $3k^2 + 11k - 4$ ← It is in the quadratic form: $ak^2 + bk + c$. So a = 3, b = 11, c = -4

$3k^2 + 12k - k - 4$ ← Multiplying a by c gives -12. Two numbers which multiply to -12 and add to b are 12 and - 1. Splitting the middle k term into these numbers of k

$3k(k + 4) - 1(k + 4)$ ← Factorising the left two terms separately to the right two terms. -1 is brought out as a factor for $-k - 4$ as k is negative and a factor must be brought out

Bringing together the $3k$ and -1 then writing the repeated bracket once → $(3k - 1)(k + 4)$

(2)

(c) Simplify fully $\frac{4-x^2}{x^2+3x} \div \frac{x+2}{x+3}$

$\frac{(2 + x)(2 - x)(x + 3)}{x(x + 3)(x + 2)}$ ← Expressing as a single fraction and factorising fully. $4 - x^2$ can be factorised using difference of two squares: $A^2 - B^2 = (A + B)(A - B)$. So $4 - x^2$ becomes $(2 + x)(2 - x)$. Factorising $x^2 + 3x$ gives $x(x + 3)$. To divide by a fraction: multiply by the reciprocal of the fraction (keep the first part, change the sign to a multiply, flip the second fraction). To multiply fractions: multiply the numerators and multiply the denominators. So the numerator is multiplied by $(x + 3)$ and the denominator is multiplied by $(x + 2)$

To simplify a fraction: divide both the numerator and denominator by a common factor. $(x + 3)$ can be cancelled out from both the numerator and denominator and so can the $(2 + x)$ and $(x + 2)$ as they are the same → $\frac{2-x}{x}$

(3)

(Total for Question 15 is 6 marks)

16 The functions f and g are given by

$$f(x) = \frac{12}{x+1} \quad \text{and} \quad g(x) = 5 - 3x$$

(a) Find f(–3)

$\frac{12}{-3 + 1}$ ← Substituting -3 for x in f(x)

-6

(1)

(b) Find fg(1)

$5 - 3(1)$ ← Substituting 1 for x in g(x) finds that g(1) = 2

$\frac{12}{2 + 1}$ ← Substituting the value of g(1) for x in f(x)

4

(2)

(c) Find $g^{-1}(4)$

$4 = 5 - 3y$ ← The inverse function can be found by switching x for y and g(x) for x then rearranging to find y. Substituting 4 for x

$-1 = -3y$ ← Subtracting 5 from both sides to get the y term on its own

Dividing both sides by -3 finds that y = 1/3. So this must be $g^{-1}(4)$ → $\frac{1}{3}$

(2)

(Total for Question 16 is 5 marks)

17 A ball is thrown upwards and reaches a maximum height.
The ball then falls and bounces repeatedly.

After the *n*th bounce, the ball reaches a height of h_n
After the next bounce, the ball reaches a height given by $h_{n+1} = 0.55h_n$

After the 1st bounce, the ball reaches a height of 8 metres. ← $h_1 = 8$

What height does the ball reach after the 4th bounce?

$h_2 = 0.55 \times 8$ ← Substituting h_1 for h_n in the iteration formula works out that $h_2 = 4.4$

$h_3 = 0.55 \times 4.4$ ← Substituting h_2 for h_n in the iteration formula works out that $h_3 = 2.42$

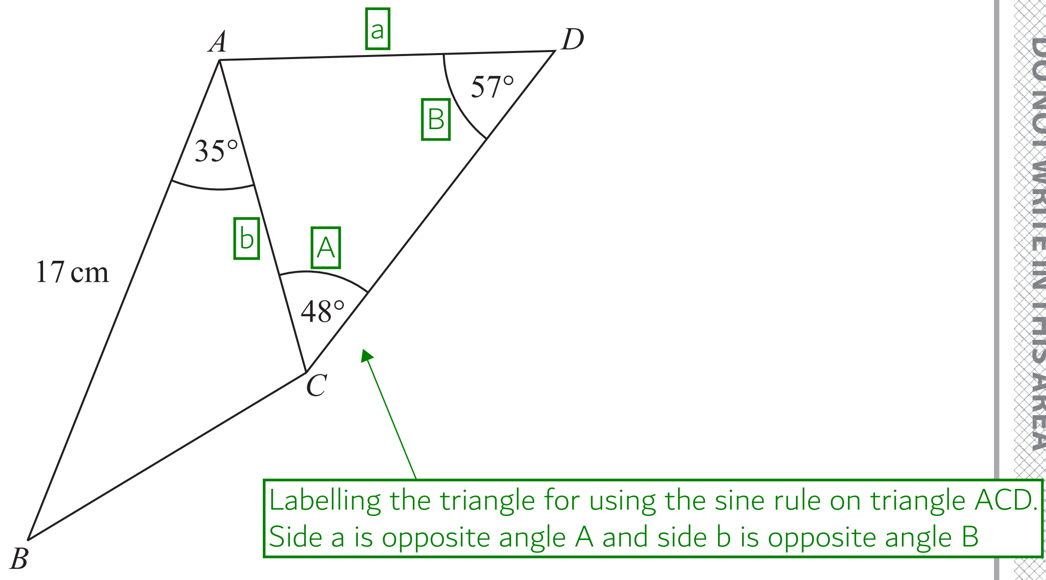
$h_4 = 0.55 \times 2.42$ ← Substituting h_3 for h_n in the iteration formula works out that $h_4 = 1.331$

With iteration, the calculator can be used to quickly get h_4. Enter 8 then press = or exe. Then enter 0.55 × ANS and press = or exe to get h_2. Press it again to get h_3. Press it again to get h_4

1.331 metres

(Total for Question 17 is 3 marks)

18 *ABCD* is a quadrilateral.



The area of triangle *ABC* is 54 cm²

Calculate the area of triangle *ACD*.
Give your answer correct to 3 significant figures.

$\frac{1}{2} \times 17 \times AC \times \sin 35$ ← Expressing the area of triangle ABC in terms of side AC. Area of triangle = 1/2 ***ab***sin***C***. Substituting 17 for ***a***, AC for ***b*** and 35 for ***C***

$4.8...AC = 54$ ← Simplifying the expression of the area of triangle ABC and setting it equal to the value of the area

$AC = 11.0...$ ← Dividing both sides by 4.8... works out that AC is 11.0... cm. Storing the exact value on the calculator

$\frac{AD}{\sin 48} = \frac{11.0...}{\sin 57}$ ← $\frac{a}{\sin A} = \frac{b}{\sin B}$ ← There are two opposite pairs of sides and angles so using the sine rule in triangle ACD. Using the exact value stored on the calculator for 11.0...

$AD = 9.8...$ ← Multiplying both sides by sin48 finds that AD is 9.8... cm. Storing the exact value on the calculator

$180 - 48 - 57$ ← There are 180° in total in a triangle so subtracting the 48° and 57° from 180° works out that angle CAD is 75°

$\frac{1}{2} \times 11.0... \times 9.8... \times \sin 75$ ← Working out the area of triangle ACD. Area of triangle = 1/2 ***ab***sin***C***. Substituting 11.0... for ***a***, 9.8... for ***b*** and 75 for ***C***. Using the exact values stored on the calculator for 11.0... and 9.8...

52.50... is rounded to 3 significant figures → 52.5 cm²

(Total for Question 18 is 5 marks)

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19 $R = \dfrac{P}{Q}$

$P = 5.88 \times 10^8$ correct to 3 significant figures.
$Q = 3.6 \times 10^5$ correct to 2 significant figures.

Work out the lower bound for R.
Give your answer as an ordinary number correct to the nearest integer.
You must show all your working.

$$\frac{\left(5.88 - \frac{0.01}{2}\right) \times 10^8}{\left(3.6 + \frac{0.1}{2}\right) \times 10^5}$$

Lower bound for R = (lower bound for P)/(upper bound for Q), as dividing by more makes the answer lower. Subtracting half of the resolution of the 5.88 (which is 0.01 as this is the place value of the third significant figure) and then multiplying by the 10^8 gives the lower bound for P. Adding half of the resolution of the 3.6 (which is 0.1 as this is the place value of the second significant figure) and then multiplying by the 10^5 gives the upper bound for Q

Rounding 1609.5... to the nearest integer → 1610

(Total for Question 19 is 3 marks)

20 $x-4$, $x+2$ and $3x+1$ are three consecutive terms of an arithmetic sequence. ← Increases by the same amount between each term

(a) Find the value of x.

$x + 2 + 6 = 3x + 1$ ← It increased by 6 from the 1st term to the 2nd term. So adding 6 to the 2nd term must give the 3rd term

$8 = 2x + 1$ ← Subtracting x from both sides gets all the x on the same side. 2 + 6 = 8

$7 = 2x$ ← Subtracting 1 from both sides gets the x term on its own

Dividing both sides by 2 gets x on its own → $x =$ 3.5

(2)

$y-4$, $y+2$ and $3y+1$ are three consecutive terms of a geometric sequence. ← Multiplied by the same amount between each term

(b) Find the possible values of y.

$$\frac{y+2}{y-4} = \frac{3y+1}{y+2}$$

← Dividing the 2nd term by the 1st term expresses the common ratio (what it multiplies by between each term). Dividing the 3rd term by the 2nd term also expresses the common ratio. So these two expressions must be equal to each other

$(y + 2)(y + 2) = (3y + 1)(y - 4)$ ← Multiplying both sides by the denominators eliminates them

$y^2 + 2y + 2y + 4 = 3y^2 - 12y + y - 4$ ← Expanding the brackets

$0 = 2y^2 - 15y - 8$ ← Moving all terms onto the same side and collecting like terms to put it into the quadratic form: $ay^2 + by + c = 0$

$$y = \frac{--15 \pm \sqrt{(-15)^2 - 4 \times 2 \times -8}}{2 \times 2}$$

← $y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ ← Solving using the quadratic formula. a = 2, b = -15, c = -8

8, - 0.5

(5)

(Total for Question 20 is 7 marks)

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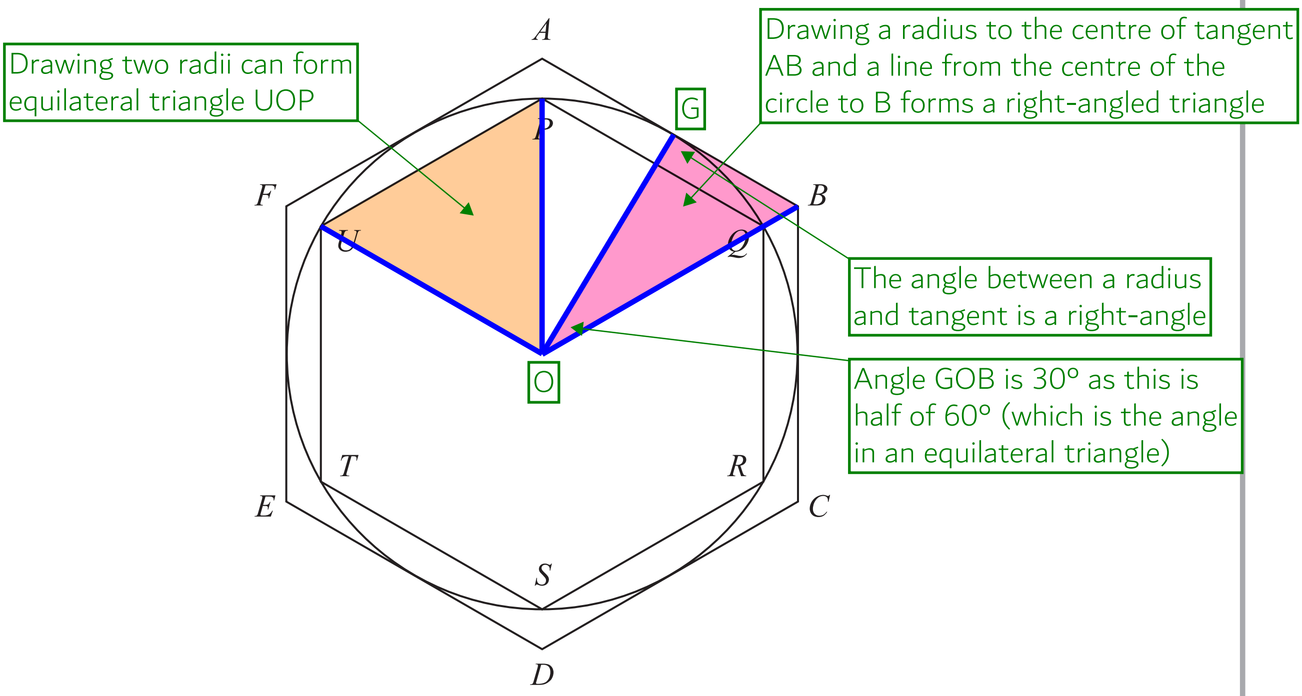
21 The diagram shows a circle, radius *r* cm and two regular hexagons.



Each side of the larger hexagon *ABCDEF* is a tangent to the circle.
Each side of the smaller hexagon *PQRSTU* is a chord of the circle.

By considering perimeters, show that

$$3 < \pi < 2\sqrt{3}$$

S O H C A H T O A (O ✓, A ✓, O ✓, A ✓) ← Using right-angled trigonometry in the pink triangle. The angle is the 30°. OG is the adjacent and is the radius (which is given as r) so ticking A. GB is the opposite and is useful to find as it is part of the perimeter of the larger hexagon so ticking A. There are two ticks on TOA so this formula triangle can be used

$\tan 30 \times r$ ← Covering O in the formula triangle finds that opposite = tan of the angle × adjacent. The angle is 30° and the adjacent is OG, which is r. This expresses GB

$\frac{\sqrt{3}}{3} r \times 2 \times 6$ ← Simplifying the expression of GB and multiplying by 2 to express AB (as GB is half of AB). Multiplying by 6 to express the perimeter of the larger hexagon (as it is regular all the sides are the same)

$6r < 2\pi r < 4\sqrt{3}r$ ← The perimeter of the smaller hexagon is 6r as UO = r = UP in the orange equilateral triangle and multiplying UP by 6 gives the perimeter of the smaller hexagon (as it is regular all the sides are the same). Circumference of the circle = 2πr. The circumference of the circle must be more than the perimeter of the smaller hexagon and less than the perimeter of the larger hexagon (the expression of the perimeter of the larger hexagon is simplified here)

$3 < \pi < 2\sqrt{3}$ ← Dividing all sides of the inequality by 2r

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS