

- 1 (a) Expand and simplify $(x+5)(x-9)$

$$\begin{aligned} & x^2 - 9x + 5x - 45 \\ & = x^2 - 4x - 45 \end{aligned}$$

$$\begin{aligned} & x^2 - 4x - 45 \\ & (2) \end{aligned}$$

- (b) Factorise fully $9x^2 + 6x$

$$\begin{aligned} & 3x(3x+2) \\ & (2) \end{aligned}$$

(Total for Question 1 is 4 marks)

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

$$\begin{aligned} &5p + 15 - 2 + 4p \\ &= 9p + 13 \end{aligned}$$

$$9p + 13$$

(Total for Question 2 is 2 marks)

2 Expand and simplify $(m + 7)(m + 3)$

$$m^2 + 3m + 7m + 21$$

$$= m^2 + 10m + 21$$

.....
(Total for Question 2 is 2 marks)

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

$$3y - 6 + 10y + 5$$
$$= 13y - 1$$

$$\frac{13y - 1}{(2)}$$

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

$$\frac{35u^3w^7}{(2)}$$

(Total for Question 3 is 4 marks)

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

$$2x^2 + 3x - 4x - 6$$

$$= 2x^2 - x - 6$$

$$(2x^2 - x - 6)(x + 1)$$

$$= 2x^3 + 2x^2 - x^2 - x - 6x - 6$$

$$= 2x^3 + x^2 - 7x - 6$$

Tip: First multiply out the first two brackets as normal

Tip: Multiply the $2x^2$ by everything in the second bracket, then repeat for the $-x$, and then for the -6

$$\underline{2x^3 + x^2 - 7x - 6}$$

(3)

$$\frac{y^4 \times y^n}{y^2} = y^{-3}$$

- (b) Find the value of n .

$$\begin{array}{r|l} 4 + n - 2 & = -3 \\ 2 + n & = -3 \\ -2 & = -2 \\ n & = -5 \end{array}$$

$$\underline{-5}$$

(2)

- (c) Solve $5x^2 - 4x - 3 = 0$

Give your solutions correct to 3 significant figures.

Tip: Because you have been told to give your answer to 3 significant figures, you will need to use the Quadratic Formula

$$a = 5$$

$$b = -4$$

$$c = -3$$

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

$$\frac{-(-4) \pm \sqrt{(-4)^2 - 4(5)(-3)}}{2(5)}$$

$$\underline{x = 1.27 \text{ or } -0.472}$$

(3)

(Total for Question 9 is 8 marks)



- 10 Show that $(x+1)(x+2)(x+3)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a , b , c and d are positive integers.

$$\begin{aligned} & x^2 + 2x + x + 2 \\ &= (x^2 + 3x + 2)(x + 3) \\ &= x^3 + 3x^2 + 3x^2 + 9x + 2x + 6 \\ &= x^3 + 6x^2 + 11x + 6 \end{aligned}$$

(Total for Question 10 is 3 marks)

12 (a) Express $\frac{x}{x+2} + \frac{2x}{x-4}$ as a single fraction in its simplest form.

Tip: To add fractions the denominators must be the same

$$\frac{x(x-4)}{(x+2)(x-4)} + \frac{2x(x+2)}{(x+2)(x-4)}$$

$$\frac{x(x-4) + 2x(x+2)}{(x+2)(x-4)} = \frac{x^2 - 4x + 2x^2 + 4x}{(x+2)(x-4)}$$

$$= \frac{3x^2}{(x+2)(x-4)}$$

$$\frac{3x^2}{(x+2)(x-4)}$$

(3)

(b) Expand and simplify $(x-3)(2x+3)(4x+5)$

Tip: First multiply out the first two brackets as normal

$$= 2x^2 + 3x - 6x - 9$$

$$= 2x^2 - 3x - 9$$

Tip: Multiply the $2x^2$ by everything in the second bracket, then repeat for the $-3x$, and then for the -9

$$(2x^2 - 3x - 9)(4x + 5)$$

$$= 8x^3 + 10x^2 - 12x^2 - 15x - 36x - 45$$

$$= 8x^3 - 2x^2 - 51x - 45$$

$$8x^3 - 2x^2 - 51x - 45$$

(3)

(Total for Question 12 is 6 marks)

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

$$(x - 2)(3x + 2)$$

$$3x^2 + 2x - 6x - 4$$

$$= (3x^2 - 4x - 4)(2x + 3)$$

$$= 6x^3 + 9x^2 - 8x^2 - 12x - 8x - 12$$

$$= 6x^3 + x^2 - 20x - 12$$

$$6x^3 + x^2 - 20x - 12$$

(Total for Question 12 is 3 marks)

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13 Show that

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

for all values of x .

Tip: Just work out the answer

$$3x^2 + 15x - x - 5$$

$$= 3x^2 + 14x - 5$$

$$(3x^2 + 14x - 5)(4x - 3)$$

$$= 12x^3 - 9x^2 + 56x - 42x - 20x + 15$$

$$= 12x^3 + 47x^2 - 62x + 15$$

(Total of Question 13 is 3 marks)

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

$$6x^2 + 3x + 4x + 2$$

$$= (6x^2 + 7x + 2)(x - 5)$$

$$= 6x^3 - 30x^2 + 7x^2 - 35x + 2x - 10$$

$$= 6x^3 - 23x^2 - 33x - 10$$

$$6x^3 - 23x^2 - 33x - 10$$

(Total for Question 15 is 3 marks)



- 18 (a) Show that $(2x + 1)(x + 3)(3x + 7)$ can be written in the form $ax^3 + bx^2 + cx + d$ where a , b , c and d are integers.

$$\begin{aligned}
 & 2x^2 + 6x + x + 3 \\
 &= (2x^2 + 7x + 3)(3x + 7) \\
 &= 6x^3 + 14x^2 + 21x^2 + 49x + 9x + 21 \\
 &= 6x^3 + 35x^2 + 58x + 21
 \end{aligned}$$

(3)

- (b) Solve

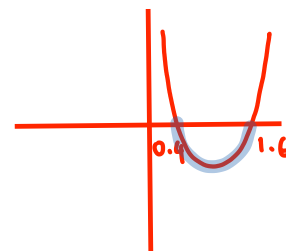
$$(1-x)^2 < \frac{9}{25}$$

$$1-x = \pm \frac{3}{5}$$

Tip: This is a quadratic equation, when you square root you need to consider the positive and negative square root.

$$\begin{array}{lcl}
 1-x & = & \frac{3}{5} \\
 +x & & +x \\
 1 & = & \frac{3}{5} + x \\
 -\frac{3}{5} & & -\frac{3}{5} \\
 0.4 & = & x
 \end{array}
 \quad \text{OR}$$

$$\begin{array}{lcl}
 1-x & = & -\frac{3}{5} \\
 +x & & +x \\
 1 & = & -\frac{3}{5} + x \\
 +\frac{3}{5} & & +\frac{3}{5} \\
 1.6 & = & x
 \end{array}$$



$$0.4 < x < 1.6$$

(3)

(Total for Question 18 is 6 marks)

2 (a) Use your calculator to work out $\frac{29^2 - 4.6}{\sqrt{35 - 1.9^3}}$

Write down all the figures on your calculator display.

157.668255
(2)

(b) Write your answer to part (a) correct to 4 significant figures.

157.7
(1)

(Total for Question 2 is 3 marks)

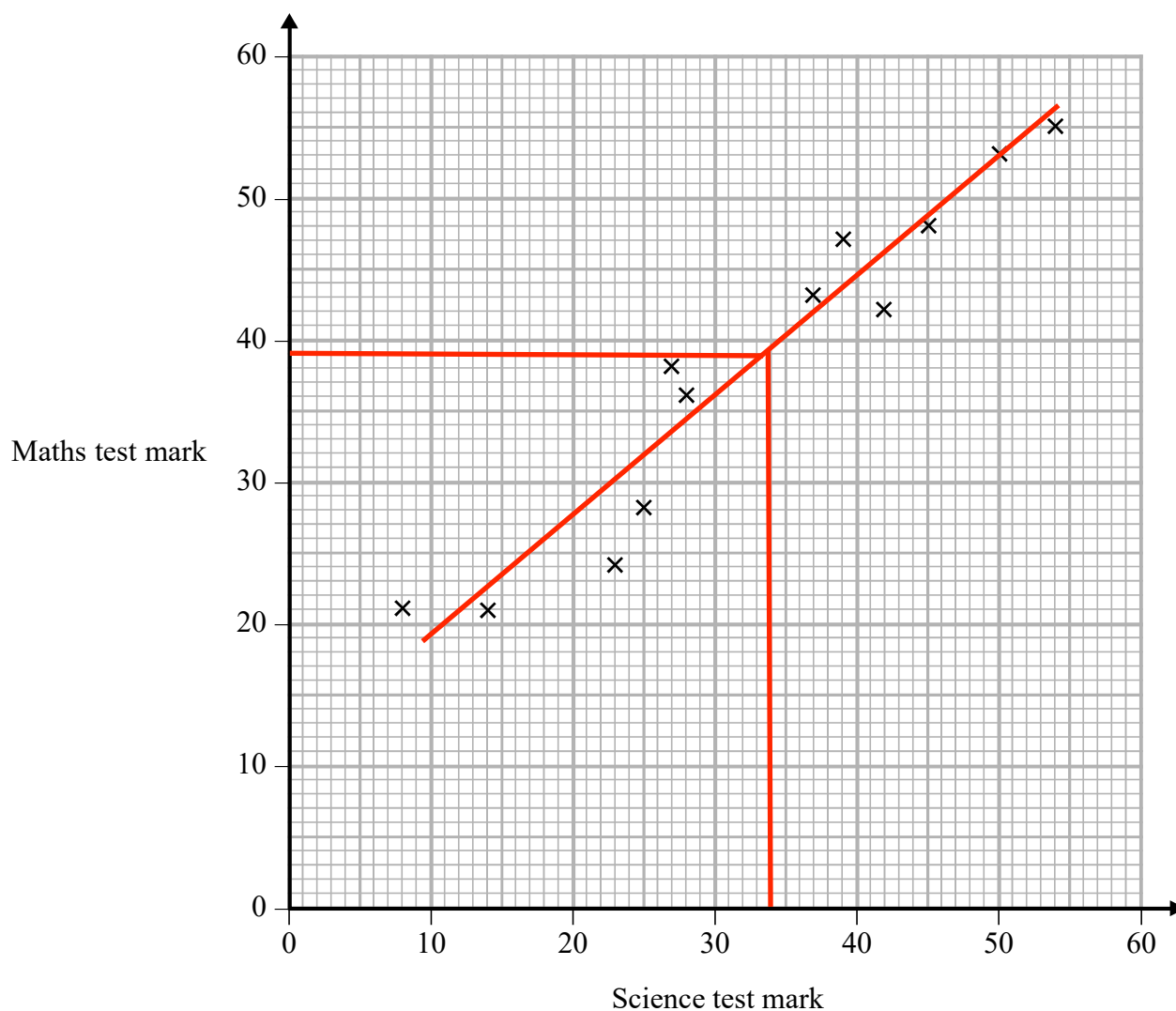
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- 3 The scatter graph shows information about the marks a group of students got in a Science test and in a Maths test.



Jamie got a mark of 34 in the Science test.

Using the scatter graph, find an estimate for Jamie's mark in the Maths test.

39
(35 to 42)

(Total for Question 3 is 2 marks)

- 4 The table gives information about the times taken, in seconds, by 18 students to run a race.

Time (t seconds)	Frequency
$5 < t \leq 10$ 7.5 x	1
$10 < t \leq 15$ 12.5 x	2
$15 < t \leq 20$ 17.5 x	7
$20 < t \leq 25$ 22.5 x	8
18	
335	

Work out an estimate for the mean time.

Give your answer correct to 3 significant figures.

$$335 \div 18 = 18.6\bar{1}$$

18.6 seconds

(Total for Question 4 is 3 marks)

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5 Write 37 cm^3 in mm^3

$$37 \times 10^3$$

$$37,000 \text{ mm}^3$$

(Total for Question 5 is 1 mark)

- 6 Nimer was driving to a hotel.
He looked at his Sat Nav at 13 30

Time	13 30
Distance to destination	65 miles



Nimer arrived at the hotel at 14 48

Work out the average speed of the car from 13 30 to 14 48

You must show all your working.

$$\text{Time} = 1 \text{ hr } 18 \text{ min}$$

$$S = D \div T$$

$$= 65 \div 1 \text{ hr } 18 \text{ min} = 50 \text{ mph}$$

..... 50 mph

(Total for Question 6 is 4 marks)

7 (a) Write 32 460 000 in standard form.

$$3.246 \times 10^7$$

(1)

(b) Write 4.96×10^{-3} as an ordinary number.

$$0.00496$$

(1)

Asma was asked to compare the following two numbers.

$$A = 6.212 \times 10^8 \quad \text{and} \quad B = 4.73 \times 10^9$$

She says,

“6.212 is bigger than 4.73 so A is bigger than B .”

(c) Is Asma correct?

You must give a reason for your answer.

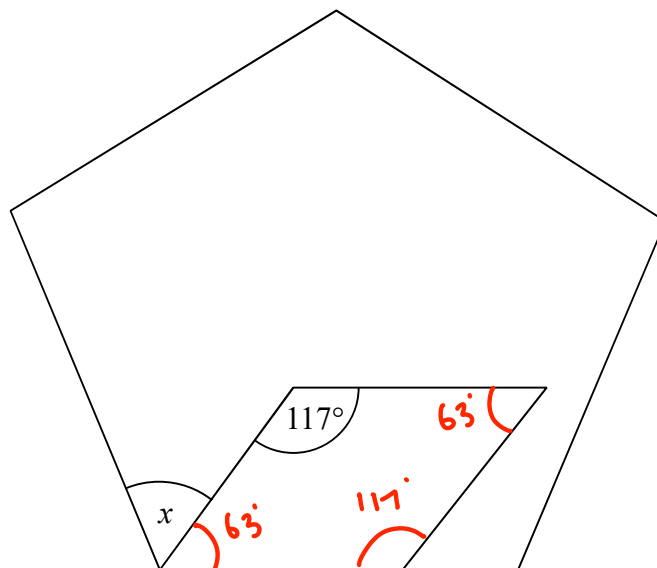
$$\text{no, } 621200000 < 4730000000$$

(1)

(Total for Question 7 is 3 marks)



- 8 The diagram shows a regular pentagon and a parallelogram.



Work out the size of the angle marked x .
You must show all your working.

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

$$540 \div 5 = 108$$

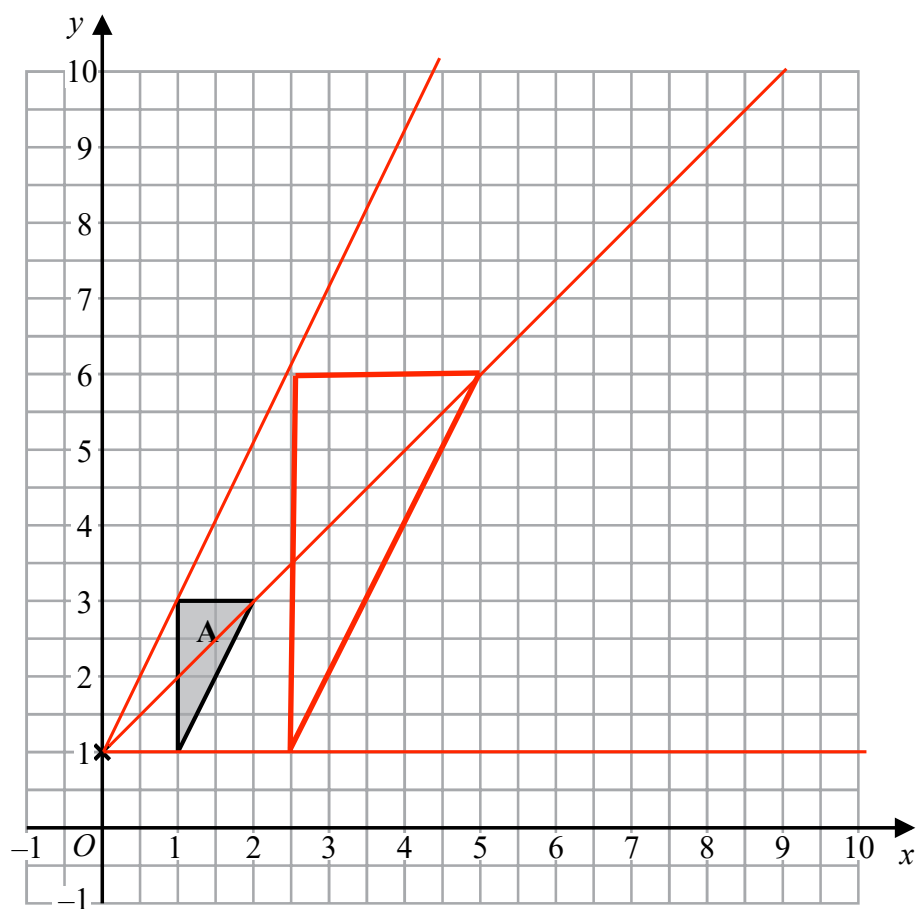
$$108 - 63 = 45$$

45

(Total for Question 8 is 4 marks)



9



Enlarge triangle A by scale factor 2.5 with centre $(0, 1)$

(Total for Question 9 is 2 marks)

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10 (a) Solve $\frac{9+x}{7} = 11-x$

$$\begin{array}{rcl}
 & \times 7 & \times 7 \\
 9+x & = & 11-7x \\
 +7x & & +7x \\
 \hline
 9+8x & = & 11 \\
 -9 & & -9 \\
 \hline
 8x & = & 2 \\
 \div 8 & & \div 8 \\
 \hline
 x & = & 0.25
 \end{array}$$

$$x = \underline{8.5} \quad (3)$$

(b) Simplify $\frac{4(y+3)^3}{(y+3)^2}$

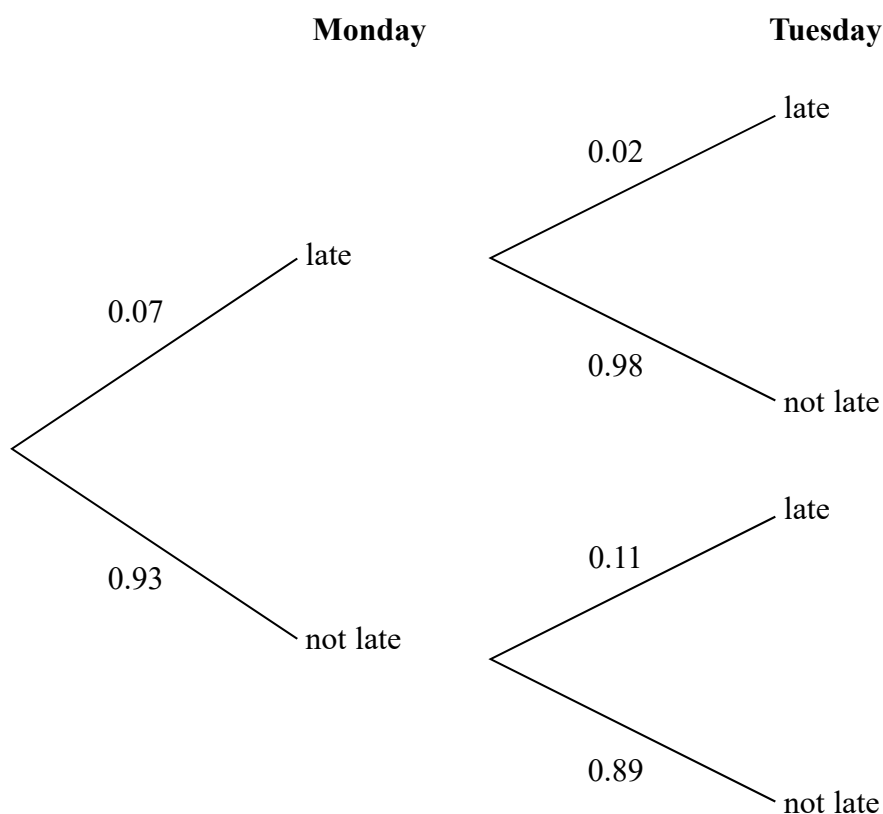
$$\frac{4(y+3)(y+3)(y+3)}{(y+3)(y+3)}$$

$$\underline{4(y+3)} \quad (1)$$

(Total for Question 10 is 4 marks)



- 11 The probability tree diagram shows the probabilities that Bismah will be late for work on two days next week.



Calculate the probability that Bismah will be late on exactly one of the two days.

$$\begin{aligned}
 P(L, L') &= 0.07 \times 0.98 = 0.0686 \\
 P(L', L) &= 0.93 \times 0.11 = 0.1023 \quad + \\
 &\quad \underline{\hspace{1.5cm}} \\
 &\quad \quad \quad 0.1709
 \end{aligned}$$

0.1709

(Total for Question 11 is 3 marks)

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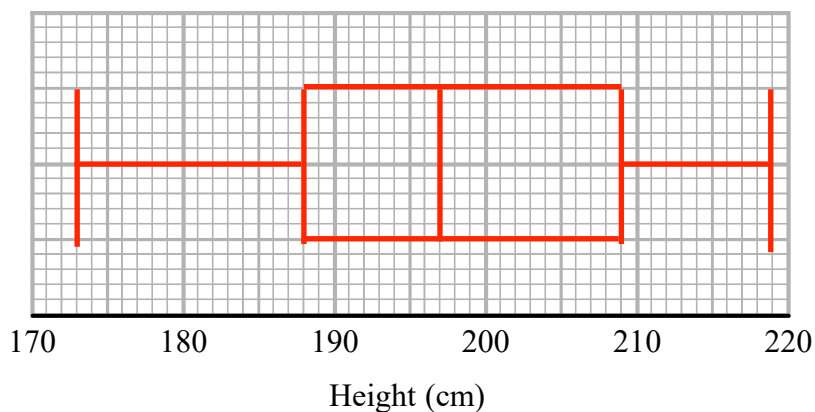
12 The stem and leaf diagram shows information about the heights, in cm, of 23 sunflowers.

17	3	4	9				
18	6	8	8				
19	0	0	1	4	6	7	8
20	1	4	7	7	9	9	
21	4	8	8	9			

Key: 17|3 represents 173 cm

On the grid, draw a box plot for this information.

Lowest = 173
 Highest = 219
 median = 197
 LQ = 188 UQ = 209



(Total for Question 12 is 3 marks)



13 Liquid A and liquid B are mixed together in the ratio 2 : 13 by volume to make liquid C.

Liquid A has density 1.21 g/cm^3

Liquid B has density 1.02 g/cm^3

A cylindrical container is filled completely with liquid C.
The cylinder has radius 3 cm and height 25 cm.

Work out the mass of the liquid in the container.
Give your answer correct to 3 significant figures.
You must show all your working.

$$M = D \times V$$

A $D = 1.21$ $M = 36.3\pi$ $V = 30\pi$	B $D = 1.02$ $M = 198.9\pi$ $V = 195\pi$	C $D =$ $M = 235.2\pi$ $V = 225\pi$
---	---	--



$$\begin{aligned} \text{Mass of C} &= 235.2\pi \\ &= 138.9025.. \end{aligned}$$

$$\begin{aligned} \pi r^2 h &= \pi (3)^2 \times 25 \\ &= 225\pi \text{ (volume C)} \end{aligned}$$

$$\begin{aligned} 225\pi \div 15 &= 15\pi \\ 15\pi \times 2 &= 30\pi \\ 15\pi \times 13 &= 195\pi \end{aligned}$$

739

g

(Total for Question 13 is 4 marks)

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- 14 A group of people went to a restaurant.
Each person chose one starter and one main course.

starter	main course
soup	lasagne
prawns	curry

the number of people who chose soup : the number of people who chose prawns = 2 : 3

Of those who chose soup,

the number of people who chose lasagne : the number of people who chose curry = 5 : 3

Of those who chose prawns,

the number of people who chose lasagne : the number of people who chose curry = 1 : 5

What fraction of the people chose curry?

You must show how you get your answer.

$$\text{Soup} = \frac{2}{5} \quad \text{Prawns} = \frac{3}{5}$$

Soup

$$\text{Lasagne} = \frac{5}{8} \text{ of } \frac{2}{5} = \frac{5}{8} \times \frac{2}{5} = \frac{10}{40}$$

$$\text{Curry} = \frac{3}{8} \times \frac{2}{5} = \frac{6}{40}$$

Prawns

$$\text{Lasagne} = \frac{1}{6} \times \frac{3}{5} = \frac{3}{30}$$

$$\text{Curry} = \frac{5}{6} \times \frac{3}{5} = \frac{15}{30}$$

$$\text{Total Curry} =$$

$$\frac{6}{40} + \frac{15}{30} = \frac{13}{20}$$

$$\frac{13}{20}$$

(Total for Question 14 is 4 marks)

- 15 Prove algebraically that the sum of the squares of any two consecutive even numbers is always a multiple of 4

$$2n \quad \text{and} \quad 2n+2$$

$$(2n)^2 = 4n^2$$

$$\begin{aligned}(2n+2)^2 &= (2n+2)(2n+2) \\ &= 4n^2 + 4n + 4n + 4 \\ &= 4n^2 + 8n + 4\end{aligned}$$

$$\begin{aligned}4n^2 + 4n^2 + 8n + 4 \\ &= 8n^2 + 8n + 4 \\ &= 4(2n^2 + 2n + 1) \\ \therefore \text{Always a multiple of 4}\end{aligned}$$

(Total for Question 15 is 3 marks)

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16 y is inversely proportional to the square of x .

$$y = 8 \text{ when } x = 2.5$$

Find the negative value of x when $y = \frac{8}{9}$

$$y \propto \frac{1}{x^2}$$

$$y = \frac{k}{x^2}$$

$$\begin{array}{l|l} 8 & = \frac{k}{(2.5)^2} \\ \times 2.5^2 & \\ \hline 50 & = k \end{array}$$

$$y = \frac{50}{x^2}$$

$$\begin{array}{l|l} \frac{8}{9} & = \frac{50}{x^2} \\ \times x^2 & \\ \hline \frac{8}{9} x^2 & = 50 \\ \div \frac{8}{9} & \\ \hline x^2 & = \frac{225}{4} \\ \sqrt{} & \\ \hline x & = \pm 1.5 \end{array}$$

-7.5

(Total for Question 16 is 3 marks)

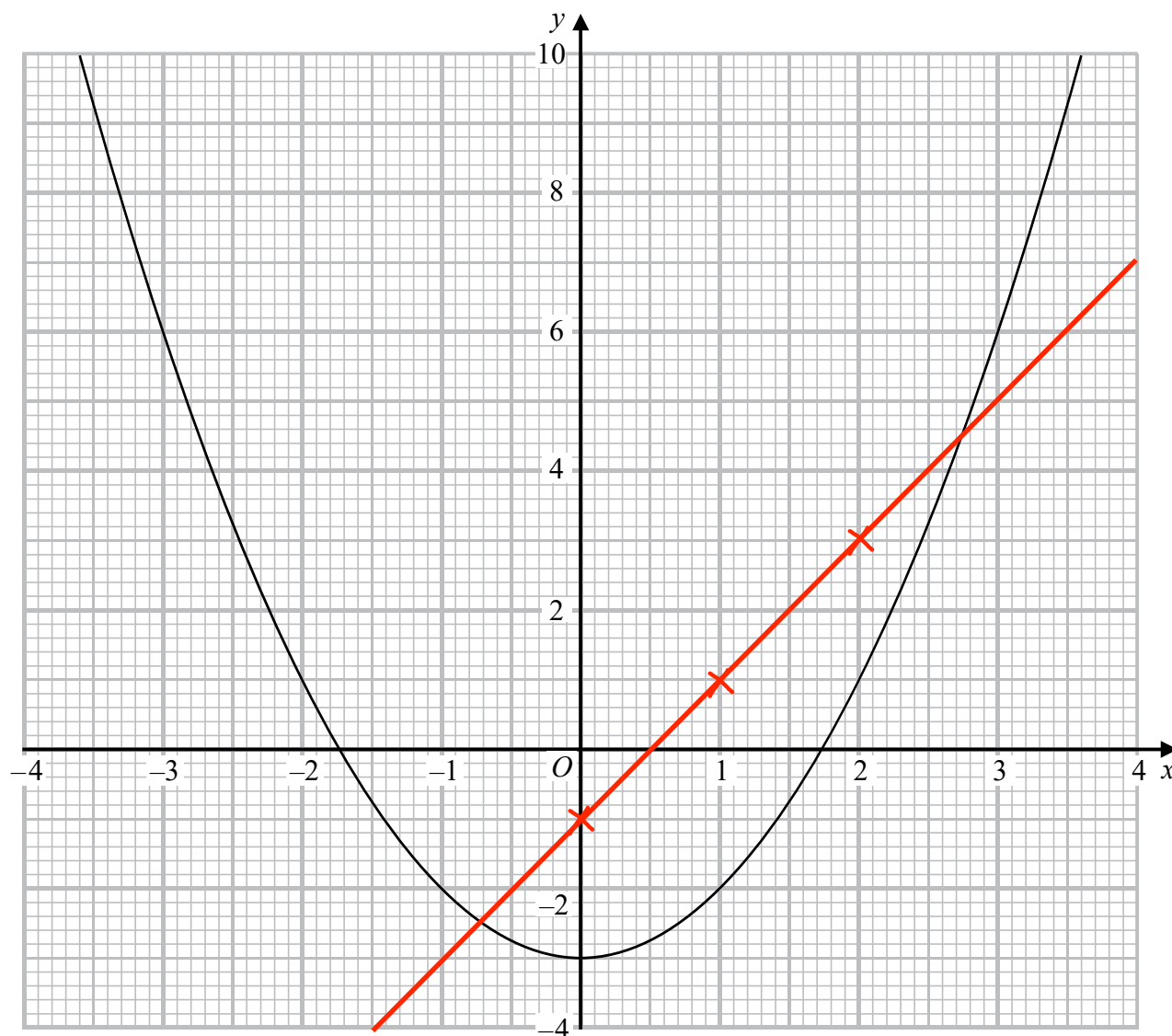
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17 Here is the graph of $y = x^2 - 3$



Use the graph to find estimates for the solutions to the equation $x^2 - 2x - 2 = 0$
You must show how you get your solutions.

$$y = 2x - 1$$

x	0	1	2
y	-1	1	3

$$\begin{array}{r|l} +2x & +2x \\ x^2 - 2 & = 2x \\ -1 & -1 \\ x^2 - 3 & = 2x - 1 \end{array}$$

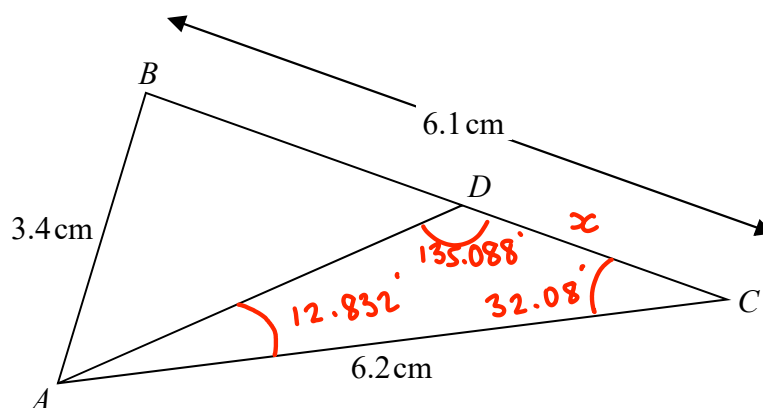
$$x = -0.7 \text{ or } x = 2.7$$

$$(-0.6 \text{ to } -0.8 \text{ or } 2.6 \text{ to } 2.8)$$

(Total for Question 17 is 4 marks)



18 The diagram shows triangle ABC .



$$AB = 3.4 \text{ cm} \quad AC = 6.2 \text{ cm} \quad BC = 6.1 \text{ cm}$$

D is the point on BC such that

$$\text{size of angle } DAC = \frac{2}{5} \times \text{size of angle } BCA$$

Calculate the length DC .

Give your answer correct to 3 significant figures.

You must show all your working.

$$\begin{aligned} \angle BCA &= \cos A = \frac{b^2 + c^2 - a^2}{2bc} \\ \cos A &= \frac{(6.1)^2 + (6.2)^2 - (3.4)^2}{2(6.1)(6.2)} \\ &= 0.8413.. \\ A &= \cos^{-1}(0.8413..) = 32.08^\circ \end{aligned}$$

$$\angle DAC = \frac{2}{5} \times 32.08 = 12.832^\circ$$

$$DC = \frac{x}{\sin(12.832)} = \frac{6.2}{\sin(135.088)}$$

$$\begin{aligned} x &= \frac{6.2}{\sin(135.088)} \times \sin(12.832) \\ &= 1.95033.. \end{aligned}$$

1.95 cm

(Total for Question 18 is 5 marks)

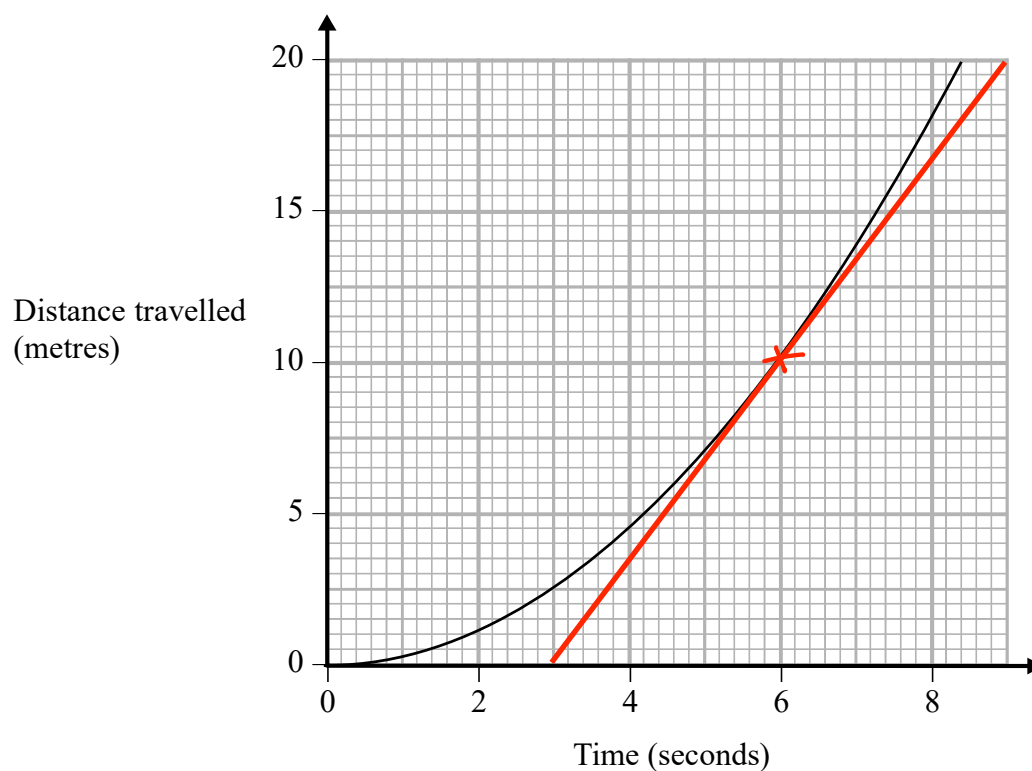
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19 The graph shows information about part of a cyclist's journey.



Work out an estimate of the speed, in m/s, of the cyclist at time 6 seconds.

$$\text{Gradient} = \frac{20}{6} = 3.\dot{3}$$

$3.\dot{3}$
 (3.05 to 3.7) m/s
 (Total for Question 19 is 3 marks)



20 Here are the first five terms of a sequence.

-1 0 3 8 15

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

$+1$ $+3$ $+5$
 $+2$ $+2$

$$\underline{\underline{n^2}}$$

terms	-1	0	3	8
$-n^2$	1	4	9	16

-2 -4 -6 -8
 -2 -2

$$\underline{\underline{-2n}}$$

$$\underline{\underline{n^2 - 2n}}$$

(Total for Question 20 is 2 marks)

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- 21 When a biased coin is thrown 4 times, the probability of getting 4 heads is $\frac{16}{81}$

Work out the probability of getting 4 tails when the coin is thrown 4 times.

$$H \times H \times H \times H = H^4 = \frac{16}{81}$$

$\sqrt[4]{\quad} \quad \sqrt[4]{\quad}$

$$H = \frac{2}{3} \quad \therefore T = \frac{1}{3}$$

$$T^4 = \left(\frac{1}{3}\right)^4 = \frac{1}{81}$$

$$\frac{1}{81}$$

(Total for Question 21 is 2 marks)

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22 Show that $\frac{7x-14}{x^2+4x-12} \div \frac{x-6}{x^3-36x}$ simplifies to ax where a is an integer.

$$x^3 - 36x = x(x^2 - 36) \\ = x(x-6)(x+6)$$

$$\frac{7(\cancel{x-2})}{(x+6)(\cancel{x-2})} \div \frac{\cancel{x-6}}{x(\cancel{x-6})(x+6)}$$

$$\frac{7}{x+6} \times \frac{x(x+6)}{1} = \frac{7x(\cancel{x+6})}{\cancel{x+6}}$$

$$= 7x$$

(Total for Question 22 is 4 marks)

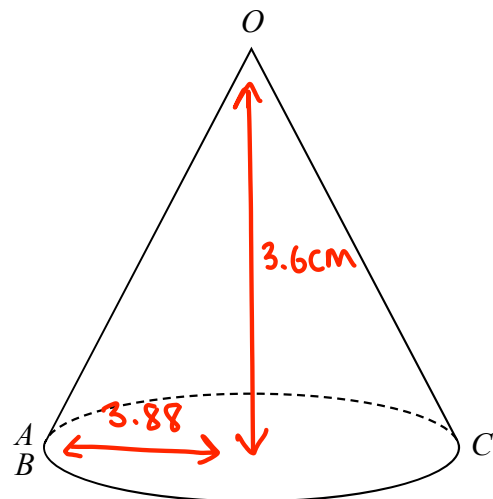
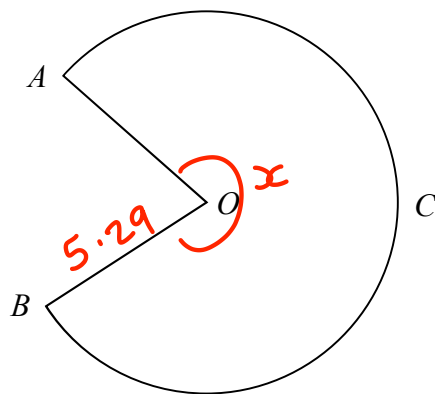
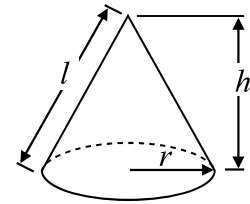


- 23 The diagram shows a sector $OACB$ of a circle with centre O .
The point C is the midpoint of the arc AB .

The diagram also shows a hollow cone with vertex O .
The cone is formed by joining OA and OB .

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

$$\text{Curved surface area of cone} = \pi r l$$



The cone has volume 56.8 cm^3 and height 3.6 cm .

Calculate the size of angle AOB of sector $OACB$.
Give your answer correct to 3 significant figures.
You must show all your working.

$$AC^2 = 3.6^2 + 3.88^2$$

$$= 28.0144$$

$$AC = 5.29$$

$$\begin{aligned} \text{Curved SA} &= \pi r l \\ &= \pi (3.88)(5.29) \\ &= 64.55 \end{aligned}$$

$$\begin{aligned} \text{Sector Area: } \frac{x}{360} \times \pi \times (5.29)^2 &= 64.55 \\ \div (5.29)^2 \pi & \quad \div (5.29)^2 \pi \\ \hline x &= 64.55 \times \frac{360}{\pi \times (5.29)^2} \end{aligned}$$

$$\begin{aligned} \frac{1}{3} \pi \times r^2 \times 3.6 &= 56.8 \\ \frac{6}{5} \pi \times r^2 &= 56.8 \\ \div \frac{6}{5} \pi & \quad \div \frac{6}{5} \pi \\ r^2 &= 15.066.. \\ \sqrt{} & \quad \sqrt{} \\ r &= 3.88 \end{aligned}$$



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$$\begin{array}{r|l} x & \\ \hline 360 & \\ \times 360 & \\ \hline x & \end{array} = \begin{array}{l} 0.734.. \\ \times 360 \\ 264.32.. \end{array}$$

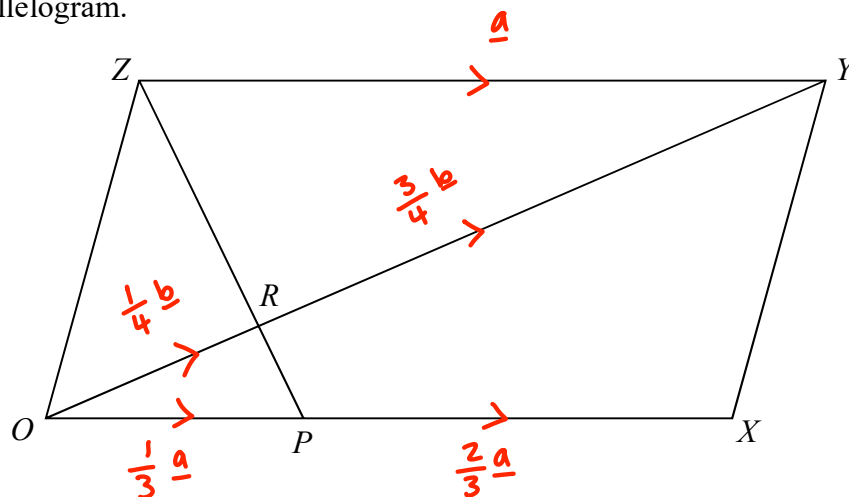
264

°

(Total for Question 23 is 5 marks)



24 $OXYZ$ is a parallelogram.



$$\vec{OX} = \mathbf{a}$$

$$\vec{OY} = \mathbf{b}$$

P is the point on OX such that $OP:PX = 1:2$

R is the point on OY such that $OR:RY = 1:3$

Work out, in its simplest form, the ratio $ZP:ZR$

You must show all your working.

$$\vec{ZP} = \underline{\mathbf{a}} - \underline{\mathbf{b}} + \frac{1}{3}\underline{\mathbf{a}} = \frac{4}{3}\underline{\mathbf{a}} - \underline{\mathbf{b}}$$

$$\vec{ZR} = \underline{\mathbf{a}} - \frac{3}{4}\underline{\mathbf{b}}$$

$$\vec{ZP} = \frac{4}{3}\vec{ZR}$$

$$\begin{array}{c} ZP : ZR \\ \frac{4}{3} : 1 \\ \times 3 \quad \left(\begin{array}{c} \frac{4}{3} : 1 \\ 4 : 3 \end{array} \right) \times 3 \end{array}$$

4 : 3

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

DO NOT WRITE IN THIS AREA

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