

Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Show that $3\frac{5}{7} \div 1\frac{5}{8} = 2\frac{2}{7}$

$$3\frac{5}{7} = \frac{26}{7}$$

$$1\frac{5}{8} = \frac{13}{8}$$

$$\frac{26}{7} \div \frac{13}{8} = \frac{26}{7} \times \frac{8}{13}$$

$$= \frac{18}{7}$$

$$\frac{18}{7} = 2\frac{2}{7} \text{ as required}$$

(Total for Question 1 is 3 marks)

2 Change a speed of 90 kilometres per hour to a speed in metres per second. Show your working clearly.

$$90 \text{ km} = 1 \text{ hour} = 3600 \text{ seconds}$$

$$\div 3600 \left(\begin{array}{l} 90000 \text{ m} = 3600 \text{ s} \\ 25 \text{ m} = 1 \text{ second} \end{array} \right) \div 3600$$

..... 25 m/s

(Total for Question 2 is 3 marks)

3 $\mathcal{E} = \{11, 12, 13, 14, 15, 16, 17, 18, 19, 20\}$

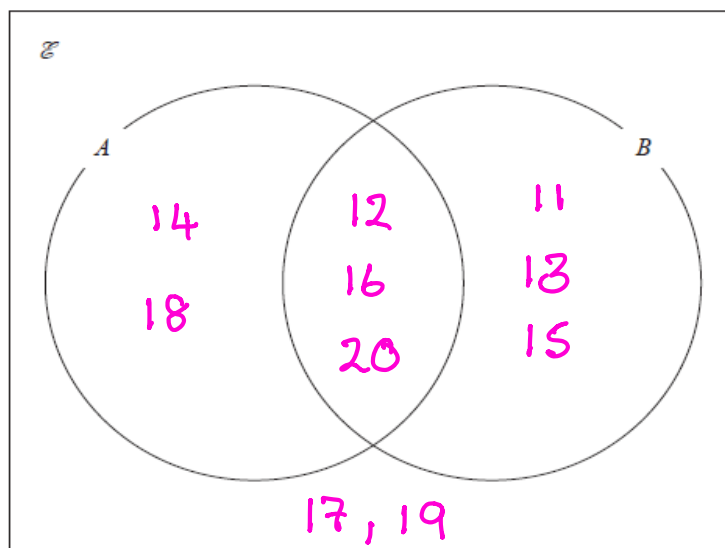
$A = \{\text{even numbers}\}$

$A \cap B = \{12, 16, 20\}$

$(A \cup B)' = \{17, 19\}$

12 14 16 18 20 ✓

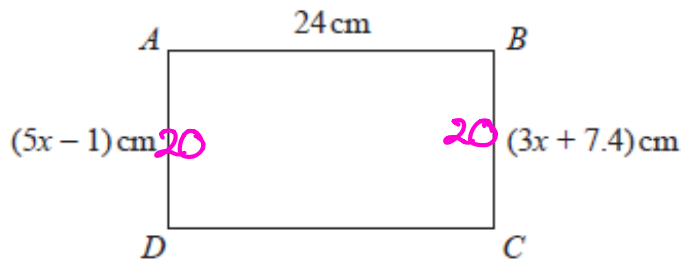
Complete the Venn diagram for the sets \mathcal{E} , A and B



(Total for Question 3 is 3 marks)

4 The diagram shows rectangle $ABCD$

Work out the perimeter of the rectangle.
Show your working clearly.



$$5x - 1 = 3x + 7.4$$

$$2x = 8.4$$

$$x = 4.2$$

AD $5 \times 4.2 - 1 = 20$

$$\begin{aligned} \text{Perimeter} &= 24 + 24 + 20 + 20 \\ &= 88 \end{aligned}$$

88

..... cm

(Total for Question 4 is 4 marks)

5 The weight of a cake is 2.75 kg, correct to 2 decimal places.

2.74 ↑ 2.75 ↑ 2.76

(a) Write down the lower bound of the weight of the cake.

2.745

..... kg (1)

(b) Write down the upper bound of the weight of the cake.

2.755

..... kg (1)

Penny has worked out $\frac{81.3 \times 59.2}{1.9^2}$.

Her answer is 13 332.299 17

Penny's answer is not sensible.

(c) By rounding each number to one significant figure, work out a suitable estimate to show that her answer is not sensible. Show your working clearly.

$$\frac{80 \times 60}{2^2} = \frac{4800}{4} = 1200$$

(2)

(Total for Question 5 is 4 marks)

6 The points A and B are on a coordinate grid.

The coordinates of A are $(6, 4)$

The coordinates of B are $(17, j)$ where j is a constant.

The midpoint of AB has coordinates $(k, 15)$ where k is a constant.

Find the value of j and the value of k

$A(6, 4)$ $B(17, j)$ midpoint $(k, 15)$

$$x \quad \frac{6+17}{2} = 11.5$$

$$y \quad 15 = \frac{4+j}{2}$$

$$30 - 4 = j = 26$$

$$j = \dots 11.5 \dots$$

$$k = \dots 26 \dots$$

(Total for Question 6 is 3 marks)

7 Solve the simultaneous equations

$$\begin{aligned} 5x + 4y &= -2 \\ 2x - y &= 4.4 \end{aligned}$$

Show clear algebraic working.

$$\begin{aligned} & \textcircled{1} \quad 5x + 4y = -2 \\ & \quad \quad \quad \times 4 \\ & \quad \quad \quad 8x - 4y = 17.6 \quad \textcircled{3} \\ & \quad \quad \quad \underline{5x + 4y = -2} \quad \textcircled{1} \\ & \quad \quad \quad 13x = 15.6 \\ & \quad \quad \quad x = \frac{15.6}{13} = 1.2 \end{aligned}$$

sub in $\textcircled{1}$

$$\begin{aligned} 5 \times 1.2 + 4y &= -2 \\ 4y &= -2 - 6 = -8 \\ y &= -2 \end{aligned}$$

$$x = \dots 1.2 \dots$$

$$y = \dots -2 \dots$$

(Total for Question 7 is 3 marks)

8 Matteo is going to invest 5000 Swiss francs for two years. He can invest his money in Bank G or in Bank H.

<p style="text-align: center;">Bank G</p> <p style="text-align: center;">1.6% per year compound interest</p>

<p style="text-align: center;">Bank H</p> <p style="text-align: center;">2.9% interest added after two years</p>

The total amount of interest Matteo would receive at the end of two years from

Bank G is more than the amount of interest Matteo would receive at the end of two years from Bank H.

How much more?

$$5000 \times 1.016 \times 1.016$$

$$= 5161.28$$

$$5000 \times 1.029$$

$$= 5145$$

$$\text{Difference} = 5145 - 5161.28$$

$$= 16.28$$

..... 16.28 Swiss francs

(Total for Question 8 is 4 marks)

9 (a) Write down the value of $(m + 2)^0$ where m is a positive integer.

..... 1 (1)

(b) Simplify $(3a^2b^4)^3$

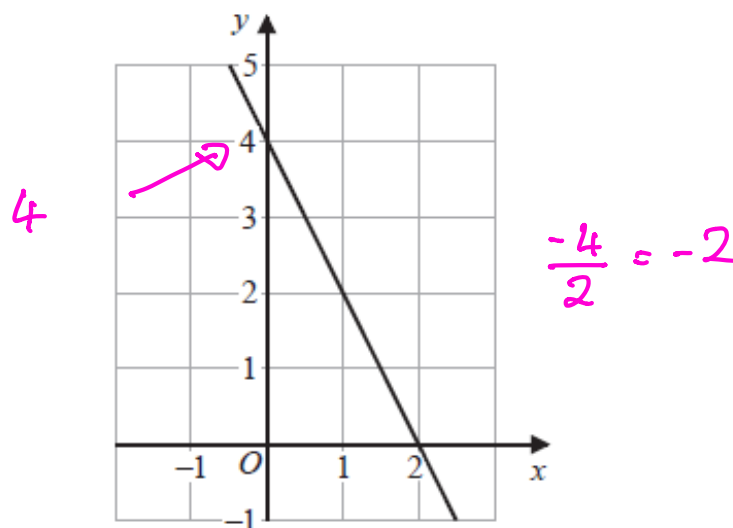
$$3^3 a^{2 \times 3} b^{4 \times 3}$$

..... $27a^6b^{12}$ (2)

(c) Factorise fully $14x^2y^4 + 21x^3y^2$

..... $7x^2y^2(2y^2 + 3x)$ (2)

The diagram shows a straight line drawn on a grid.



(d) Write down an equation of the line.

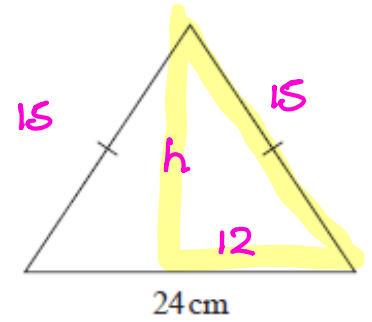
..... $y = -2x + 4$ (2)

(Total for Question 9 is 7 marks)

10 The diagram shows an isosceles triangle, with base length 24 cm.

The perimeter of the triangle is 54 cm.

Work out the area of the triangle.



$$54 - 24 = 30 \quad 30 \div 2 = 15$$

$$h^2 = 15^2 - 12^2$$

$$= 225 - 144 = 81$$

$$h = \sqrt{81} = 9$$

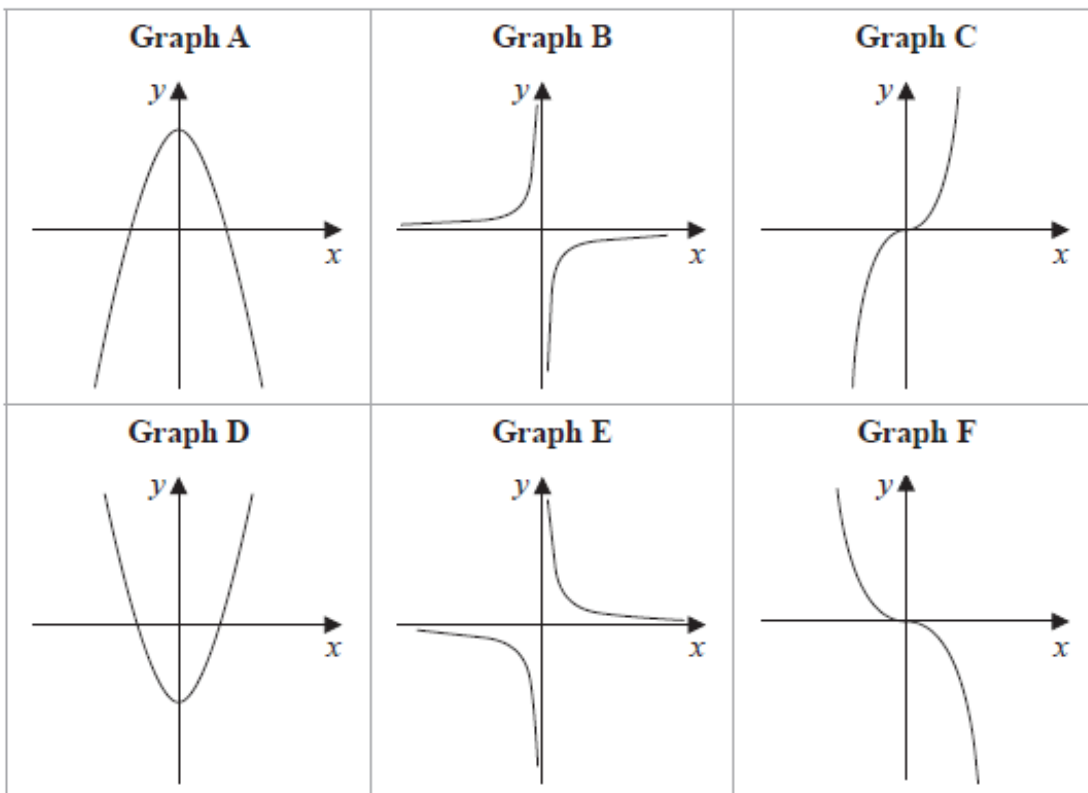
$$\text{Area} = \frac{1}{2} \times 24 \times 9$$

$$= 108$$

..... 108 cm²

(Total for Question 10 is 5 marks)

11 Here are six graphs.

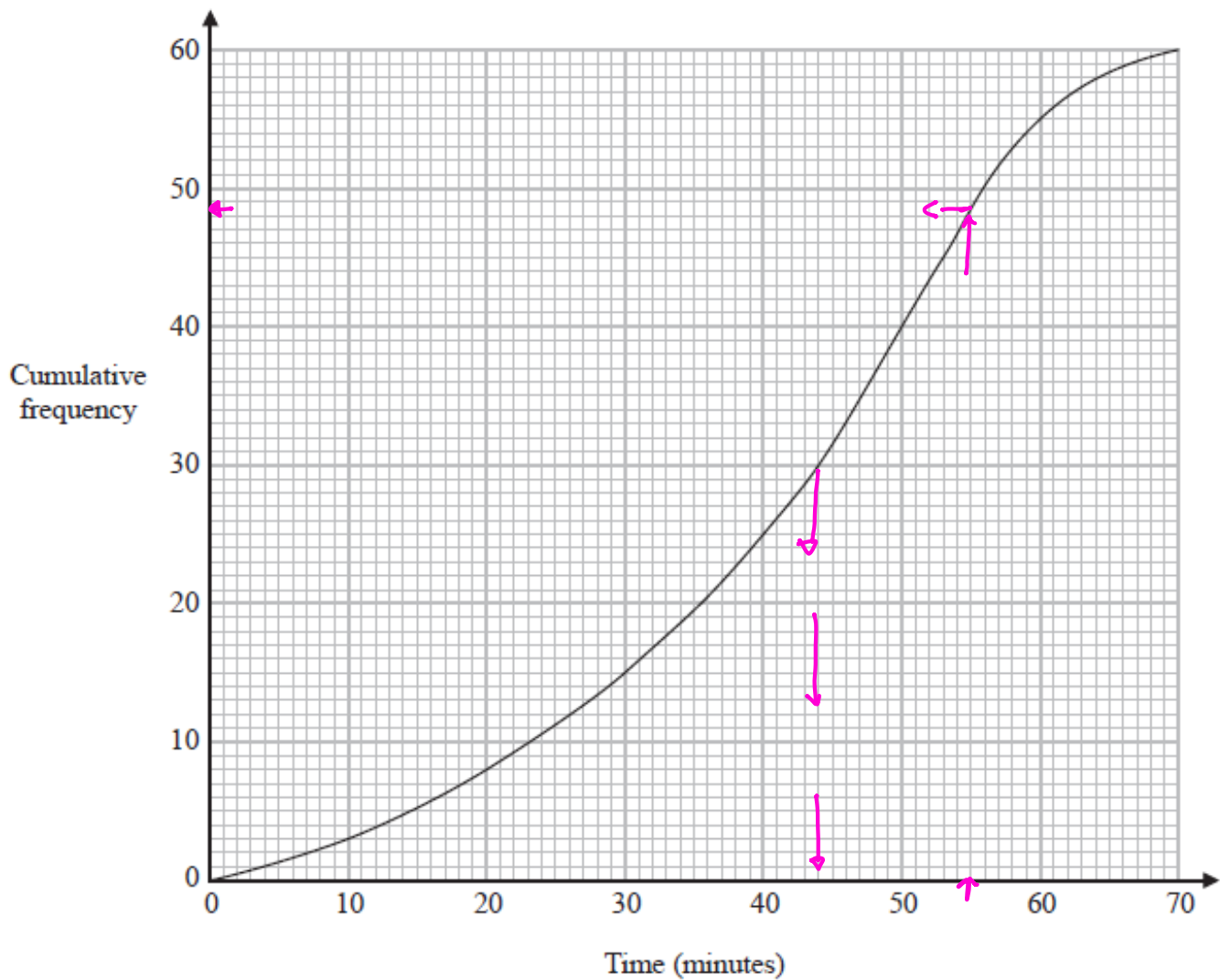


Complete the table below with the letter of the graph that could represent each given equation. Write your answers on the dotted lines.

Equation	Graph
$y = -\frac{2}{x}$	B
$y = 5 - x^2$	A
$y = -2x^3$	F

(Total for Question 11 is 3 marks)

- 12 The cumulative frequency graph gives information about the time, in minutes, each of 60 people took to shop in a market.



- (a) Use the graph to find an estimate for the median time people took to shop in the market.

..... 44.5 minutes (1)

- (b) Use the graph to find an estimate for the number of people who took longer than 55 minutes to shop in the market.

..... 11 (2)

- (c) Use the graph to complete the frequency table to give information about the time, in minutes, each of the 60 people took to shop in the market.

Time taken to shop in the market (m minutes)	Frequency
$0 < m \leq 10$	3
$10 < m \leq 20$	5
$20 < m \leq 30$	7
$30 < m \leq 40$	10
$40 < m \leq 50$	15
$50 < m \leq 60$	15
$60 < m \leq 70$	5

(2)

(Total for Question 12 is 5 marks)

13 Solve $\frac{x+3}{4} - \frac{7-x}{5} = 4.3$

Show clear algebraic working.

$$5(x+3) - 4(7-x) = 20 \times 4.3$$

$$5x + 15 - 28 + 4x = 86$$

$$9x = 86 - 15 + 28$$

$$9x = 99$$

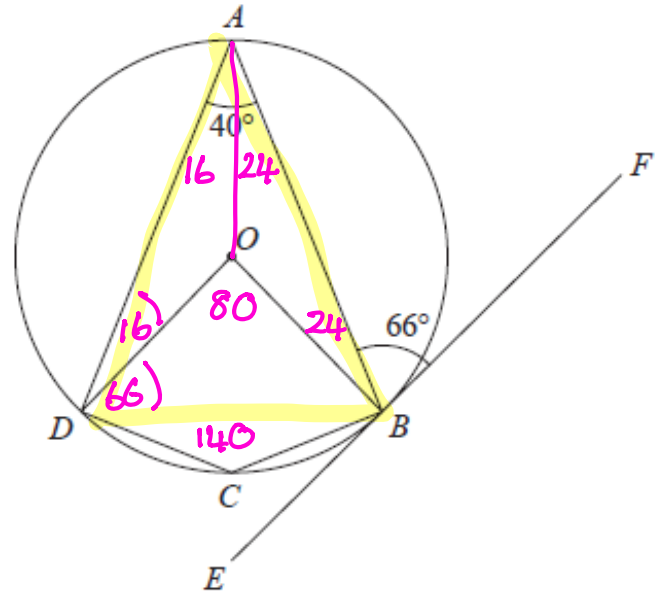
$$x = 11$$

$x =$ 11

(Total for Question 13 is 3 marks)

14 A, B, C and D are points on a circle, centre O

EBF is the tangent to the circle at B



(a) (i) Work out the size of angle DCB

$$180 - 40$$

$$\dots\dots\dots 140 \dots\dots\dots^\circ \quad (1)$$

(ii) Give a reason for your answer to (a)(i)

opposite angles in a cyclic quadrilateral add up to 180°
 (1)

(b) Work out the size of angle ADO

$$\dots\dots\dots 16 \dots\dots\dots^\circ \quad (3)$$

(Total for Question 14 is 5 marks)

15 Here is a list giving the numbers of runs scored last week by the eleven members of cricket team A.

- 2 3 4 6 21 26 27 32 34 61 72

The interquartile range of the numbers of runs scored last week by the eleven members of cricket team B was 42

Using a suitable calculation, write down one comparison between the numbers of runs scored by the members of cricket team A and the members of cricket team B.

Show your working clearly.

$$\text{IQR for A} = 34 - 4 = 30 \qquad \text{B IQR} = 42$$

The runs scored by team A were more consistent than team B

(Total for Question 15 is 3 marks)

16 Use algebra to show that $0.4\dot{3}\dot{8} = \frac{217}{495}$

$$\begin{array}{r} 100x = 43.838\dots \\ x = 0.43838\dots \\ \hline \end{array}$$

$$99x = 43.4$$

$$x = \frac{43.4}{99} = \frac{434}{990}$$

$$\frac{434}{990} = \frac{217}{495} \quad \text{as required.}$$

(Total for Question 16 is 2 marks)

17 Given that $8\sqrt{m} + \sqrt{49m} - \sqrt{9m} = k\sqrt{m}$ where k is an integer and m is a prime number,
(a) work out the value of k

$$\sqrt{49m} = 7\sqrt{m}$$

$$\sqrt{9m} = 3\sqrt{m}$$

$$\begin{aligned} 8\sqrt{m} + 7\sqrt{m} - 3\sqrt{m} \\ = 12\sqrt{m} \end{aligned}$$

$$k = \underline{12} \dots \dots \dots (1)$$

(b) Show that $\frac{5 - \sqrt{18}}{1 - \sqrt{2}}$ can be written in the form $a + b\sqrt{2}$

where a and b are integers. Show each stage of your working clearly.

$$\frac{5 - \sqrt{18}}{1 - \sqrt{2}} \times \frac{1 + \sqrt{2}}{1 + \sqrt{2}} = \frac{5 + 5\sqrt{2} - \sqrt{18} - \sqrt{36}}{-1} = \frac{5 - 6 + 5\sqrt{2} - \sqrt{18}}{-1}$$

$$\begin{aligned} \sqrt{18} &= \sqrt{2\sqrt{9}} \\ &= 3\sqrt{2} \end{aligned}$$

$$= \frac{-1 - 3\sqrt{2} + 5\sqrt{2}}{-1}$$

$$= 1 + 3\sqrt{2} - 5\sqrt{2}$$

$$= 1 - 2\sqrt{2}$$

$$a = 1 \quad b = -2$$

(3)

(Total for Question 17 is 4 marks)

18 The table gives information about the weights, in kg, of the parcels that Pedro delivers on Monday.

Weight (w kg)	Frequency
$0 < w \leq 2$	12
$2 < w \leq 3$	7
$3 < w \leq 6$	15
$6 < w \leq 9$	12
$9 < w \leq 14$	9

width Frequency density

2 $12 \div 2 = 6$

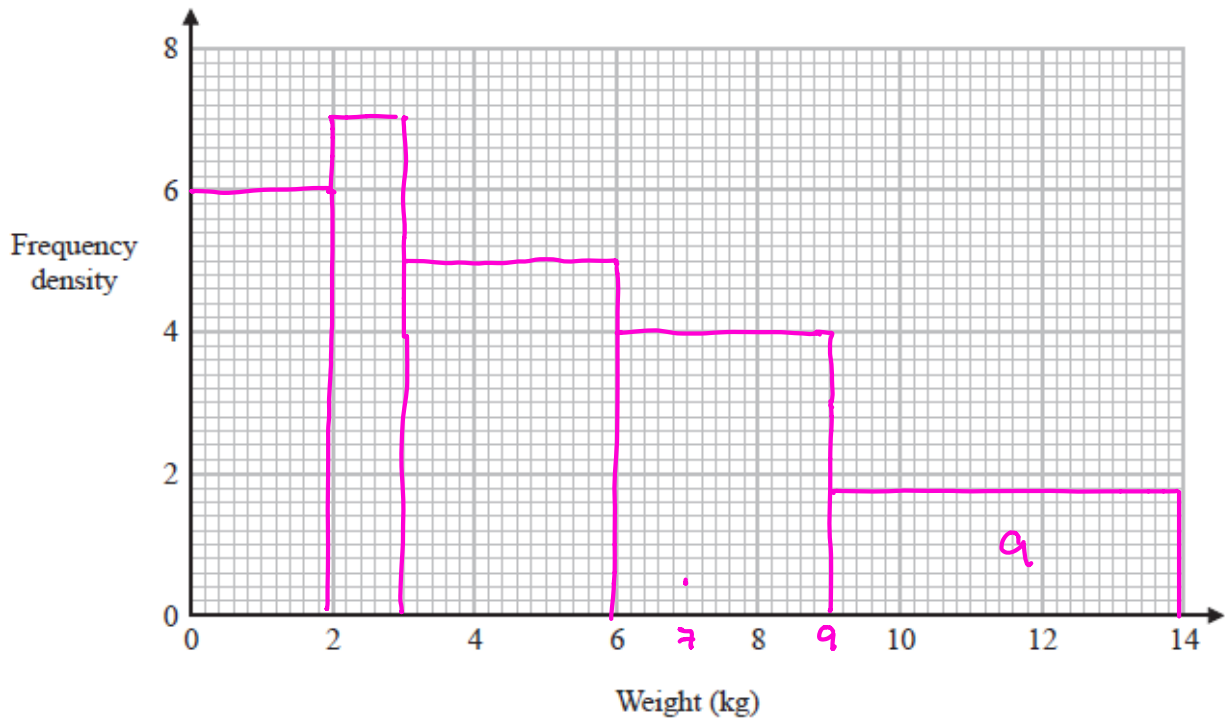
1 $7 \div 1 = 7$

3 $15 \div 3 = 5$

3 $12 \div 3 = 4$

5 $9 \div 5 = 1.8$

(a) On the grid, draw a histogram for this information.



(3)

One of the parcels that Pedro delivered on Monday is chosen at random.

(b) Using the information in the table, find an estimate for the probability that this parcel weighs more than 7 kg.

$$12 + 7 + 15 + 12 + 9 = 55$$

$$6 \rightarrow 9 = 12 \quad \frac{2}{3} \text{ of } 12 = 8 \quad 8 + 9 = 17$$

$$\frac{17}{55}$$

..... (2)
(Total for Question 18 is 5 marks)

19 A and B are two similar vases.

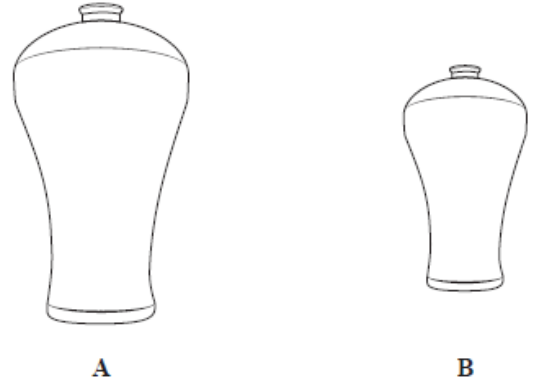
The vases are such that

surface area of vase B = $\frac{25}{64}$ surface area of vase A

and that

volume of vase A – volume of vase B = 541.8 cm³

Calculate the volume of vase B



Area SF = $\frac{64}{25}$ Length SF = $\frac{8}{5}$ so Vol SF = $\frac{512}{125}$

Vol. $\frac{512}{125} \times B - B = 541.8$

$B \left(\frac{512}{125} - 1 \right) = 541.8$

$B = 541.8 \div \frac{387}{125} = 175$

..... 175 cm³

(Total for Question 19 is 4 marks)

20 Solve the simultaneous equations

$$\begin{aligned} y &= 7 - 2x \\ x^2 + y^2 &= 34 \end{aligned}$$

Show clear algebraic working.

$$y^2 = 49 - 28x + 4x^2$$

$$x^2 + 49 - 28x + 4x^2 = 34$$

$$5x^2 - 28x + 15 = 0$$

$$5x^2 - 25x - 3x + 15 = 0$$

$$5x(x - 5) - 3(x - 5) = 0$$

$$(5x - 3)(x - 5) = 0$$

$$x = \frac{3}{5} = 0.6 \quad x = 5$$

$$y = 5.8 \quad y = -3$$

..... $x = 0.6, y = 5.8$ $x = 5, y = -3$

(Total for Question 20 is 5 marks)

21 Given that the surface area of a sphere is $49\pi \text{ cm}^2$ find the volume of the sphere.

Give your answer correct to the nearest integer.

$$S.A = 4\pi r^2 = 49\pi$$

$$r^2 = \frac{49\pi}{4\pi}$$

$$r^2 = \frac{49\pi}{4\pi} \text{ so } r = \frac{7}{2} = 3.5$$

$$Vol = \frac{4}{3} \times \pi \times 3.5^3$$

$$= 179.59438$$

..... 180 cm^3

(Total for Question 21 is 3 marks)

22 Solve the inequality $6x^2 + 37x \leq 35$

Show clear algebraic working.

$$6x^2 + 37x - 35 \leq 0$$

$$210 \leftarrow 42 \times 5 \quad 42 - 5 = 37$$

$$6x^2 + 42x - 5x - 35 \leq 0$$

$$6x(x+7) - 5(x+7)$$

$$6x(x+7) - 5(x+7) \leq 0$$

$$6x^2 + 42x - 5x$$

$$(6x-5)(x+7) \leq 0$$

$$\frac{5}{6} \quad -7$$

$$-7 \leq x \leq \frac{5}{6}$$

.....
(Total for Question 22 is 3 marks)

23 The diagram shows a solid prism $ABCDEFGHJI$

The prism is such that each cross section is a pentagon where

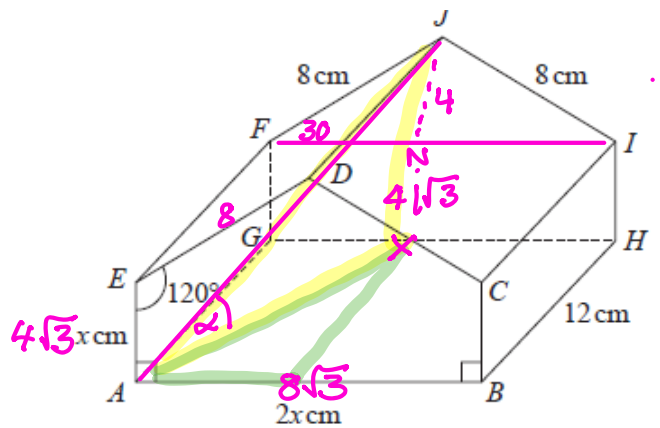
$$AE = BC = x \text{ cm} \quad AB = 2x \text{ cm} \quad ED = CD = 8 \text{ cm}$$

$$\text{angle } EAB = \text{angle } CBA = 90^\circ$$

$$\text{angle } AED = \text{angle } BCD = 120^\circ$$

$$\text{Given that } AG = BH = EF = DJ = CI = 12 \text{ cm}$$

calculate the angle that AJ makes with the base $ABHG$ of the prism. Give your answer correct to 3 significant figures.



$$\underline{FN} \text{ (ie } x) \cos 30 = \frac{x}{8} \quad x = 8 \cos 30 = 4\sqrt{3} \quad \text{so } 2x = 8\sqrt{3}$$

$$\underline{JN} \sin 30 = \frac{JN}{8} \quad JN = 4$$

$$\underline{AX} \sqrt{(4\sqrt{3})^2 + 12^2} = 8\sqrt{3}$$

$$\tan \alpha = \frac{4 + 4\sqrt{3}}{8\sqrt{3}} \quad \alpha = 38.261..$$

38.3

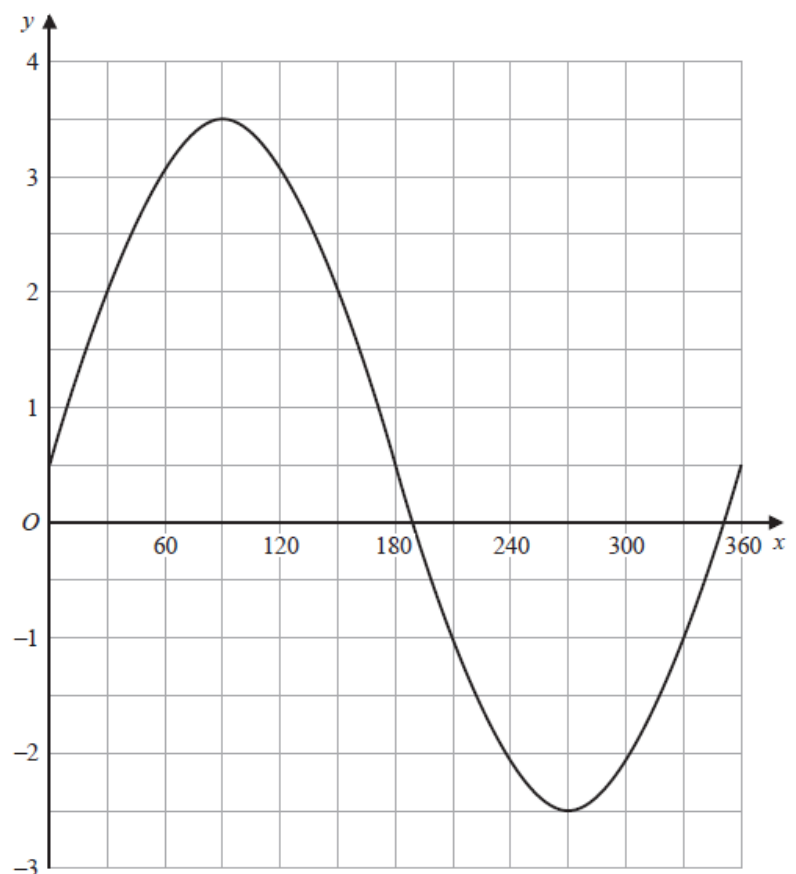
(Total for Question 23 is 5 marks)

24 The graph of $y = a \sin x^\circ + b$ is drawn on the grid.

Find the value of a and the value of b

$$a = \dots\dots\dots 3$$

$$b = \dots\dots\dots 0.5$$



(Total for Question 24 is 2 marks)

25 The function f is such that $f(x) = 3x^2 - 12x + 7$ where $x \leq 2$

Express the inverse function f^{-1} in the form $f^{-1}(x) = \dots$

$$y = 3x^2 - 12x + 7 = 3(x^2 - 4x) + 7$$

$$= 3[(x-2)^2 - 4] + 7 = 3(x-2)^2 - 12 + 7$$

$$y = 3(x-2)^2 - 5$$

$$\pm \sqrt{\frac{y+5}{3}} = x-2$$

$$x = 2 \pm \sqrt{\frac{y+5}{3}}$$

$$\text{so } f^{-1}(x) = 2 \pm \sqrt{\frac{x+5}{3}}$$

given $x \leq 2$

$$f^{-1}(x) = 2 - \sqrt{\frac{x+5}{3}}$$

(Total for Question 25 is 4 marks)

26 Find the values of n such that

$$\frac{(2 \times 5)^{4n} \times 2^{3(n^2-5n)} \times 5^{2(1-2n)}}{20^2} = 1$$

$(2 \times 5)^{4n} = 2^{4n} \times 5^{4n}$ 2^{3n^2-15n} 5^{2-4n}
 $(2 \times 5 \times 2)^2 = 2^4 \times 5^2$

Show clear algebraic working.

$$\frac{2^{4n} \times 5^{4n} \times 2^{3n^2-15n} \times 5^{2-4n}}{2^4 \times 5^2} = 1$$

$$2^{4n+3n^2-15n-4} \times 5^{4n+2-4n-2} = 1$$

$$2^{3n^2-11n-4} = 1 = 2^0$$

$$\text{so } 3n^2 - 11n - 4 = 0 \quad 3 \times 4 = 12$$

$$3n^2 - 12n + n - 4 = 0$$

$$3(n-4) + 1(n-4) = 0 \quad (3n+1)(n-4) = 0$$

$$n = -\frac{1}{3} \quad n = 4$$

(Total for Question 26 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS