

- 1 (a) Write 7357 correct to 3 significant figures.

7360

(1)

- (b) Work out $\frac{\sqrt{17 + 4^2}}{7.3^2}$

Write down all the figures on your calculator display.

0.1017981356

(2)

(Total for Question 1 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- 2 Last year Jo paid £245 for her car insurance.
This year she has to pay £883 for her car insurance.

$$\frac{\text{change}}{\text{original}} \times 100$$

Work out the percentage increase in the cost of her car insurance.

$$\frac{883 - 245}{245} \times 100 = 260.408\ldots$$

$$\begin{array}{c} 260 \\ (260 \text{ to } 260.5) \end{array} \%$$

(Total for Question 2 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

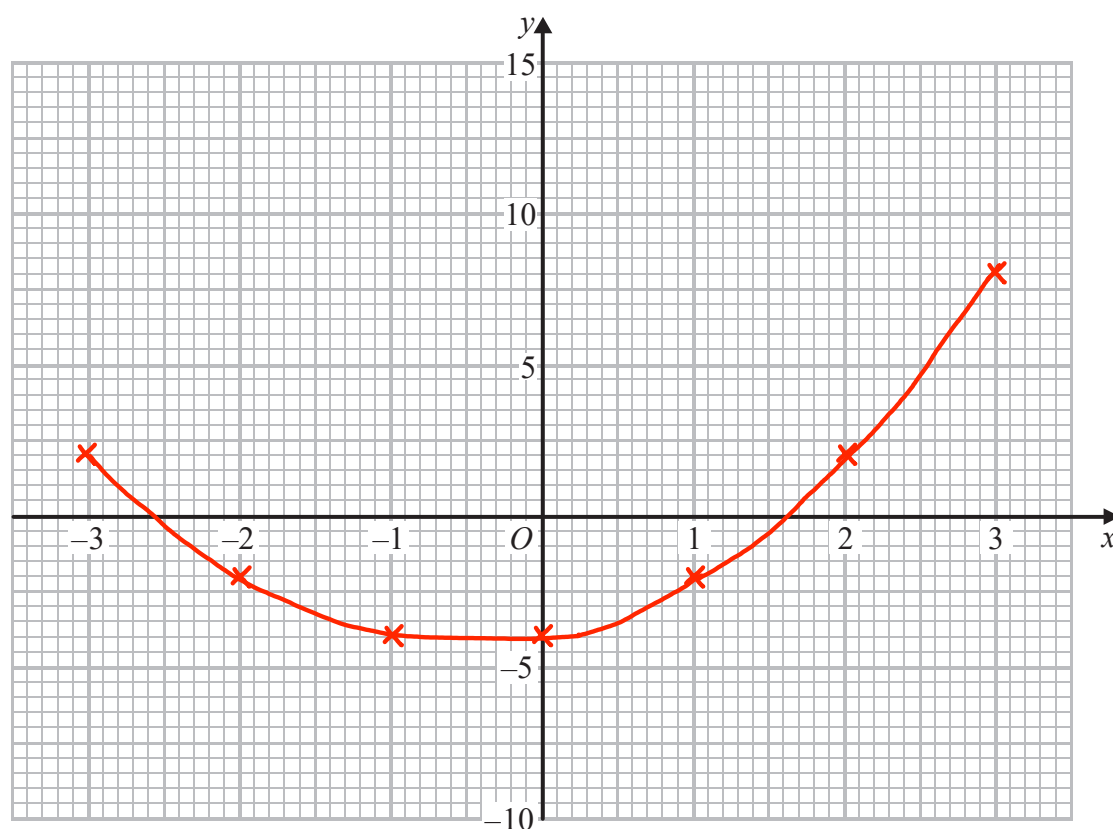
DO NOT WRITE IN THIS AREA

- 3 (a) Complete this table of values for $y = x^2 + x - 4$

x	-3	-2	-1	0	1	2	3
y	2	-2	-4	-4	-2	2	8

(2)

- (b) On the grid, draw the graph of $y = x^2 + x - 4$ for values of x from -3 to 3



(2)

- (c) Use the graph to estimate a solution to $x^2 + x - 4 = 0$

$$x = -2.6, 1.6$$

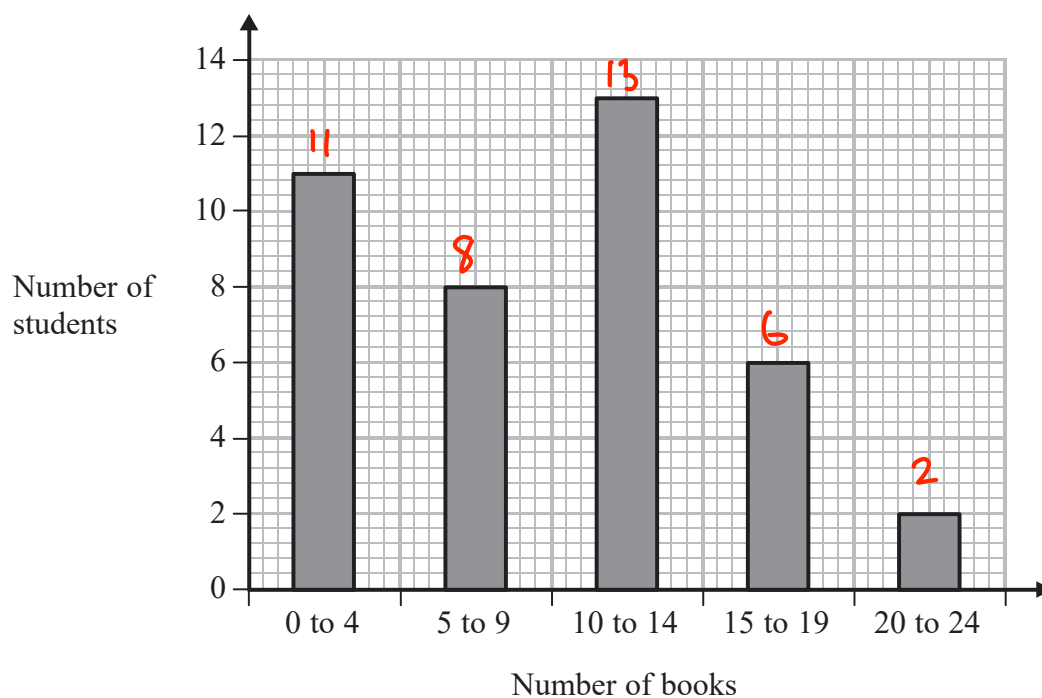
(1)

(Total for Question 3 is 5 marks)



- 4 Fran asks each of 40 students how many books they bought last year.

The chart below shows information about the number of books bought by each of the 40 students.



- (a) Work out the percentage of these students who bought 20 or more books.

$$\frac{2}{40} \times 100 = 5$$

.....5%
(2)

- (b) Show that an estimate for the mean number of books bought is 9.5
You must show all your working.

No. of Students	Frequency
0-4 2	$\times$ 11 22
5-9 7	$\times$ 8 56
10-14 12	$\times$ 13 156
15-19 11	$\times$ 6 102
20-24 22	$\times$ 2 44
	40 380

$$380 \div 40 = 9.5$$

(4)

(Total for Question 4 is 6 marks)



5 Lara is a skier.

She completed a ski race in 1 minute 54 seconds.

The race was 475 m in length.

Lara assumes that her average speed is the same for each race.

- (a) Using this assumption, work out how long Lara should take to complete a 700 m race.
Give your answer in minutes and seconds.



$$S = \frac{D}{T} = \frac{475}{114} = 4.16 \text{ m/s}$$

$$T = \frac{D}{S} = \frac{700}{4.16} = 168 \text{ seconds}$$

2 minutes 48 seconds
(3)

Lara's average speed actually increases the further she goes.

- (b) How does this affect your answer to part (a)?

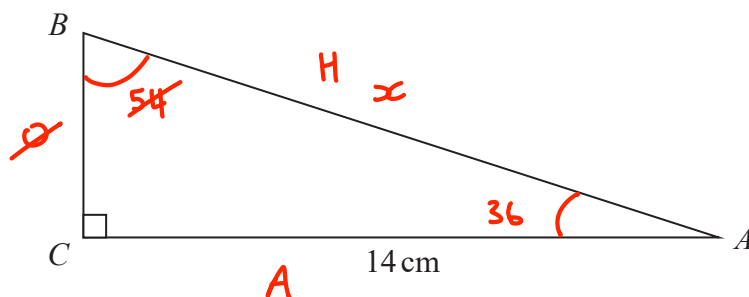
It will take her less time

(1)

(Total for Question 5 is 4 marks)



6 ABC is a right-angled triangle.



$AC = 14$ cm.

Angle $C = 90^\circ$

size of angle B : size of angle $A = 3 : 2$

Work out the length of AB .

Give your answer correct to 3 significant figures.

$$90 \div 5 = 18 \text{ (1 part)}$$

$$B : A$$

$$54 : 36$$

$$S^{\circ} H \quad C^A \quad T^{\circ} A$$

$$\frac{14}{\cos(36)}$$



$$= 17.304 \dots$$

..... 17.3 cm

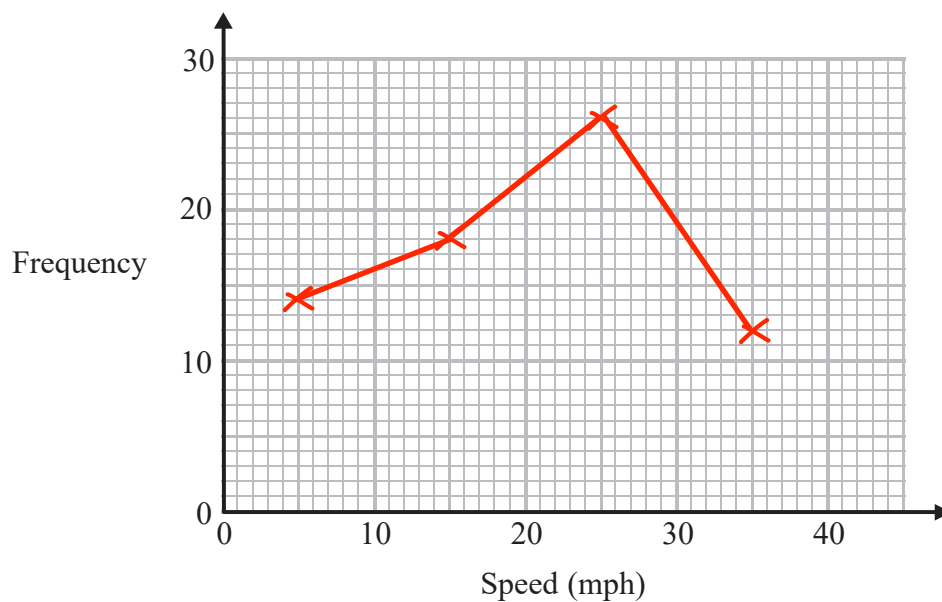
(Total for Question 6 is 4 marks)



- 7 The table gives information about the speeds of 70 cars.

Speed (s mph)	Frequency
$0 < s \leq 10$	14
$10 < s \leq 20$	18
$20 < s \leq 30$	26
$30 < s \leq 40$	12

Draw a frequency polygon for this information.



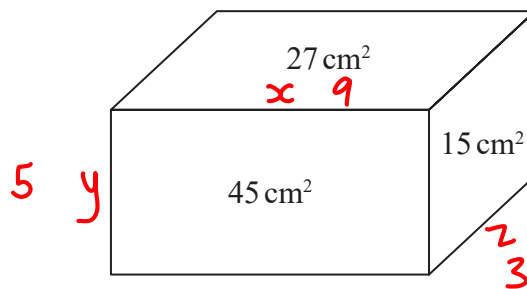
(Total for Question 7 is 2 marks)



- 8 The diagram shows a solid metal cuboid.

The areas of three of the faces are marked on the diagram.

The lengths, in cm, of the edges of the cuboid are whole numbers.



The metal cuboid is melted and made into cubes.

Each of the cubes has sides of length 2.5 cm.

Work out the greatest number of these cubes that can be made.

$$\begin{aligned} xy &= 45 & (9 \times 5) & & x &= 9 & y &= 5 \\ xz &= 27 & (3 \times 9) & & & & & \\ yz &= 15 & (3 \times 5) & & z &= 3 & & \end{aligned}$$

$$\begin{aligned} 9 \div 2.5 &= 3.6 & (3 \text{ across}) & \\ 5 \div 2.5 &= 2 & (2 \text{ up}) & \\ 3 \div 2.5 &= 1.2 & (1 \text{ back}) & \end{aligned}$$

$$3.6 \times 2 \times 1.2 = 8.64$$

8

(Total for Question 8 is 5 marks)



- 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 $f(x) = 4\sin x^\circ$

(a) Find $f(23)$

Give your answer correct to 3 significant figures.

$$\begin{aligned} f(23) &= 4\sin(23) \\ &= 1.562924514 \end{aligned}$$

$$\underline{1.56}$$

(1)

$g(x) = 2x - 3$

(b) Find $fg(34)$

Give your answer correct to 3 significant figures.

$$\begin{aligned} g(34) &= 2(34) - 3 \\ &= 65 \end{aligned}$$

Tip: Find $g(34)$ first and then substitute the answer into $f(x)$

$$\begin{aligned} f(65) &= 4\sin(65) \\ &= 3.625231148 \end{aligned}$$

$$\underline{3.63}$$

(2)

$h(x) = (x + 4)^2$

Ivan needs to solve the following equation $h(x) = 25$

He writes

$$(x + 4)^2 = 25$$

$$x + 4 = 5$$

$$x = 1$$

This is not fully correct.

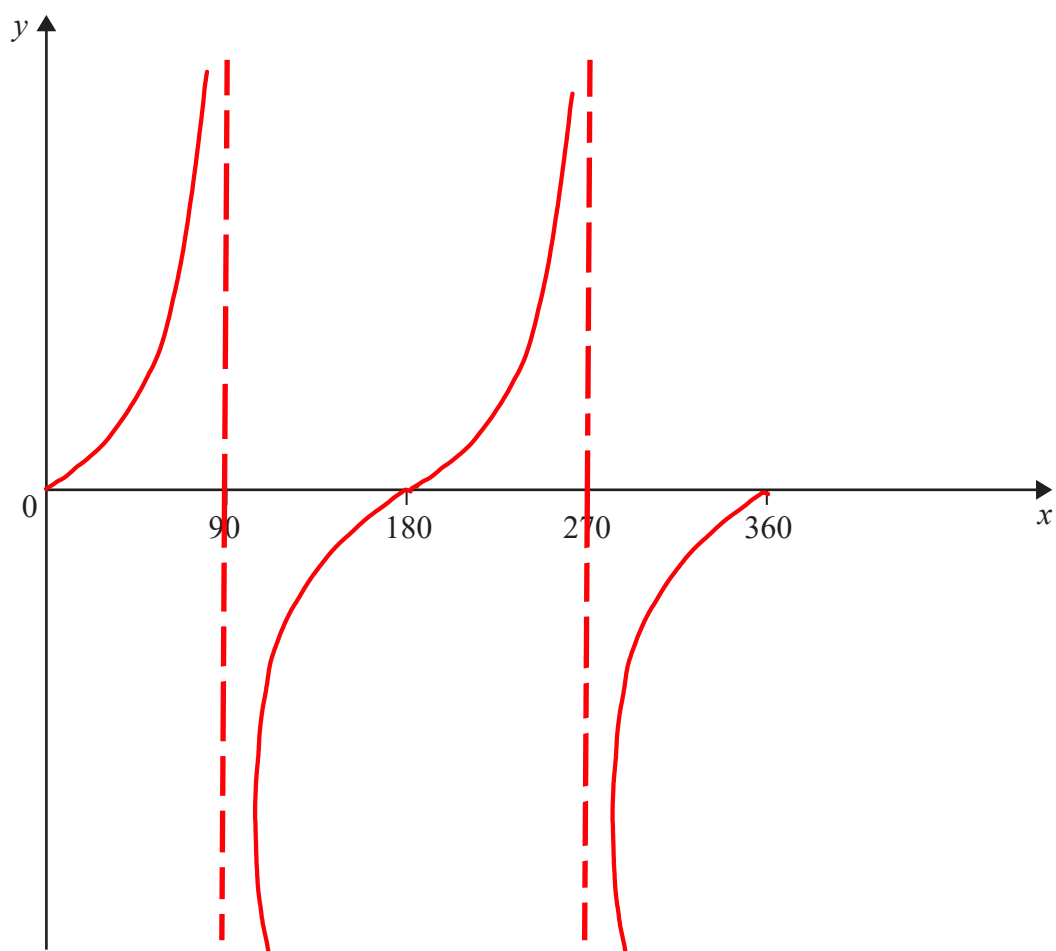
(c) Explain why.

The square root of 25 is both 5 and -5

(1)

(Total for Question 10 is 4 marks)

11 Sketch the graph of $y = \tan x^\circ$ for $0 \leq x \leq 360$



(Total for Question 11 is 2 marks)

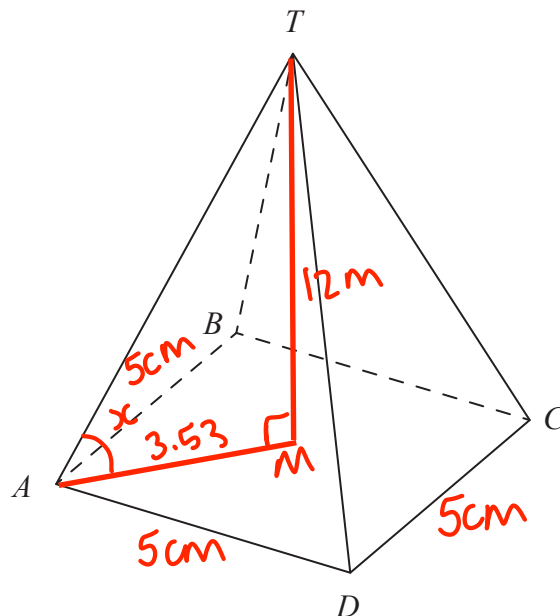
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



12 Here is a pyramid with a square base $ABCD$.



$$AB = 5 \text{ m}$$

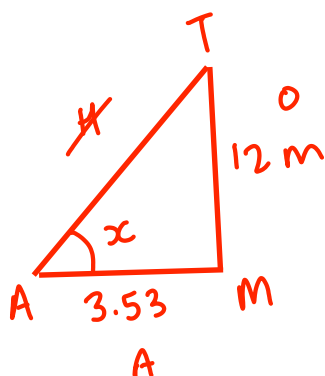
The vertex T is 12 m vertically above the midpoint of AC .

Calculate the size of angle TAC .

$$AC = 5^2 + 5^2 = 50$$

$$\sqrt{50} = 7.0710 \dots$$

$$AM = \frac{1}{2} AC = 3.535 \dots$$



$$\sin^{-1} \left(\frac{12}{7.071} \right) = 90^\circ$$

$$\tan^{-1} \left(\frac{12}{3.53} \right) = 73.58 \dots$$

73.6

(Total for Question 12 is 4 marks)

- 13 The number of animals in a population at the start of year t is P_t
The number of animals at the start of year 1 is 400

Given that

$$P_{t+1} = 1.01P_t$$

work out the number of animals at the start of year 3

$$P_1 = 1.01(400) = 404 \quad (\text{Start yr 2})$$

$$P_2 = 1.01(404) = 408.04 \quad (\text{Start yr 3})$$

408

(Total for Question 13 is 2 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



14 y is inversely proportional to x^3

$$y = 44 \text{ when } x = a$$

Show that $y = 5.5$ when $x = 2a$

$$y \propto \frac{1}{x^3}$$

$$y = \frac{k}{x^3}$$

$$\begin{array}{l|l} 44 & = & \frac{k}{a^3} \\ \hline x a^3 & & x a^3 \\ \hline 44 a^3 & = & k \end{array}$$

$$y = \frac{44a^3}{x^3}$$

$$\text{When } x = 2a$$

$$y = \frac{44a^3}{(2a)^3}$$

$$= \frac{44a^3}{8a^3}$$

$$= \frac{44}{8} = 5.5$$

(Total for Question 14 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- 15 Prove algebraically that the difference between the squares of any two consecutive odd numbers is always a multiple of 8

Tip: Two consecutive odd numbers can be given as ' $2n+1$ ' and ' $2n+3$ '

$$(2n+1)(2n+1) = 4n^2 + 4n + 1$$

$$(2n+3)(2n+3) = 4n^2 + 12n + 9$$

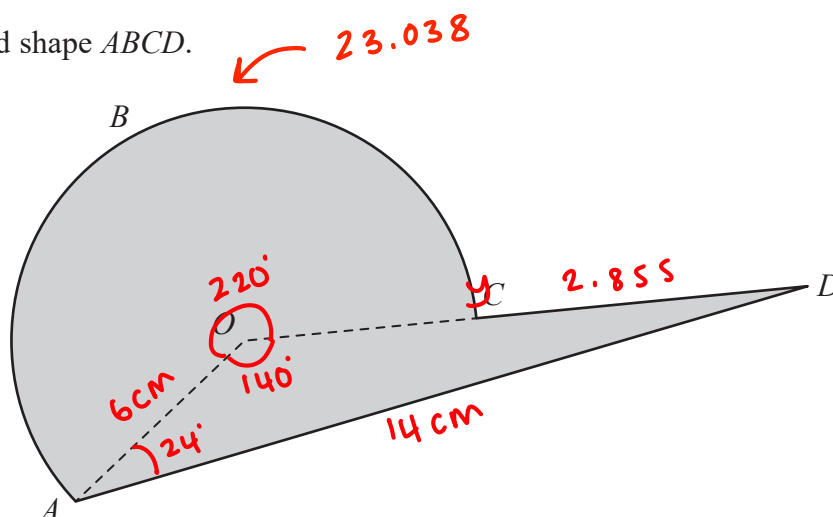
$$\begin{aligned} 4n^2 + 12n + 9 - (4n^2 + 4n + 1) &= 8n + 8 \\ &= 8(n+1) \end{aligned}$$

$\therefore$ always a multiple of 8

(Total for Question 15 is 3 marks)



16 Here is a shaded shape $ABCD$.



The shape is made from a triangle and a sector of a circle, centre O and radius 6 cm.
 OCD is a straight line.

$$AD = 14 \text{ cm}$$

$$\text{Angle } AOD = 140^\circ$$

$$\text{Angle } OAD = 24^\circ$$

Calculate the perimeter of the shape.

Give your answer correct to 3 significant figures.

$$360 - 140 = 220^\circ$$

$$AC = \frac{220}{360} \times \pi \times 12 = 23.038$$

$$OD = \frac{y}{\sin 24} = \frac{14}{\sin 140}$$

$$y = \frac{14}{\sin 140} \times \sin 24 = 8.859$$

$$CD = 8.859 - 6 = 2.859$$

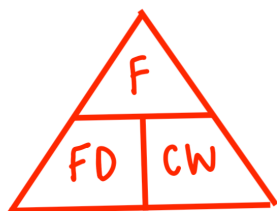
$$23.038 + 14 + 2.859 = 39.897$$

39.9 cm

(Total for Question 16 is 5 marks)



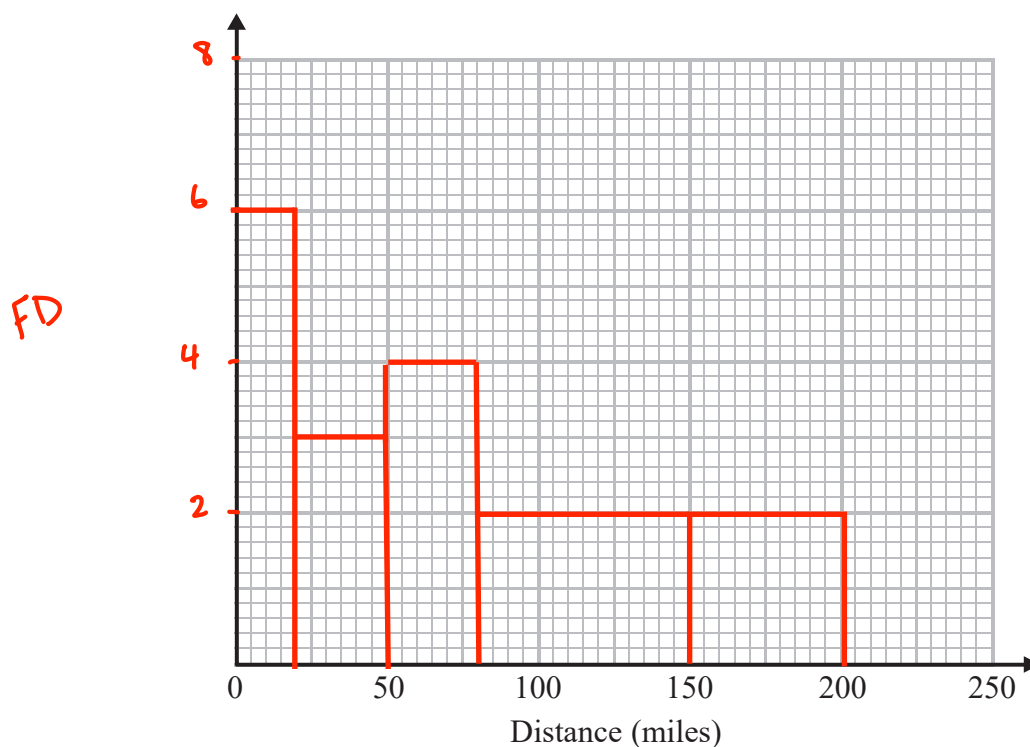
- 17 The table shows information about the distances 570 students travelled to a university open day.



Distance (d miles)	Frequency
$0 < d \leq 20$	120
$20 < d \leq 50$	90
$50 < d \leq 80$	120
$80 < d \leq 150$	140
$150 < d \leq 200$	100

FD
 $120 \div 20 = 6$
 3
 4
 2
 2

- (a) Draw a histogram for the information in the table.



(3)

- (b) Estimate the median distance.

$$\frac{570}{2} = 285^{\text{th}}$$

$$50 + \frac{75}{120} \times 30 = 68.75$$

68.75 miles
 (66 to 71) (2)

(Total for Question 17 is 5 marks)

$$LB = 486.5 \quad UB = 487.5$$

- 18 A high speed train travels a distance of 487 km in 3 hours. = 180 mins

The distance is measured correct to the nearest kilometre.

The time is measured correct to the nearest minute.

$$LB = 179.5$$

$$UB = 180.5$$

By considering bounds, work out the average speed, in km/minute, of the train to a suitable degree of accuracy.

You must show all your working and give a reason for your answer.

$$S_L = \frac{D_L}{T_u} = \frac{486.5}{180.5} = 2.69529...$$



$$S_u = \frac{D_u}{T_L} = \frac{487.5}{179.5} = 2.71587...$$

$$S = 2.7 \text{ km/min}$$

Both UB and LB is 2.7 to 1.d.p

.....km/minute

(Total for Question 18 is 5 marks)



19 Solve algebraically the simultaneous equations

$$2x^2 - y^2 = 17$$

$$x + 2y = 1$$

$$\rightarrow x = 1 - 2y$$

$$\begin{aligned} x^2 &= (1 - 2y)(1 - 2y) \\ &= 1 - 2y - 2y + 4y^2 \\ &= 1 - 4y + 4y^2 \end{aligned}$$

$$2(1 - 4y + 4y^2) - y^2 = 17$$

$$2 - 8y + 8y^2 - y^2 = 17$$

$$7y^2 - 8y + 2 \quad | \quad = \quad 17$$

$$-17 \quad | \quad -17$$

$$7y^2 - 8y - 15 \quad | \quad = \quad 0$$

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

$$a = 7$$

$$b = -8$$

$$c = -15$$

$$\frac{-(-8) \pm \sqrt{(-8)^2 - 4(7)(-15)}}{2(7)}$$

$$y = \frac{15}{7} \text{ or } y = -1$$

$$x = 1 - 2y$$

$$= 1 - 2\left(\frac{15}{7}\right) = -\frac{23}{7}$$

$$\text{OR } = 1 - 2(-1) = 3$$

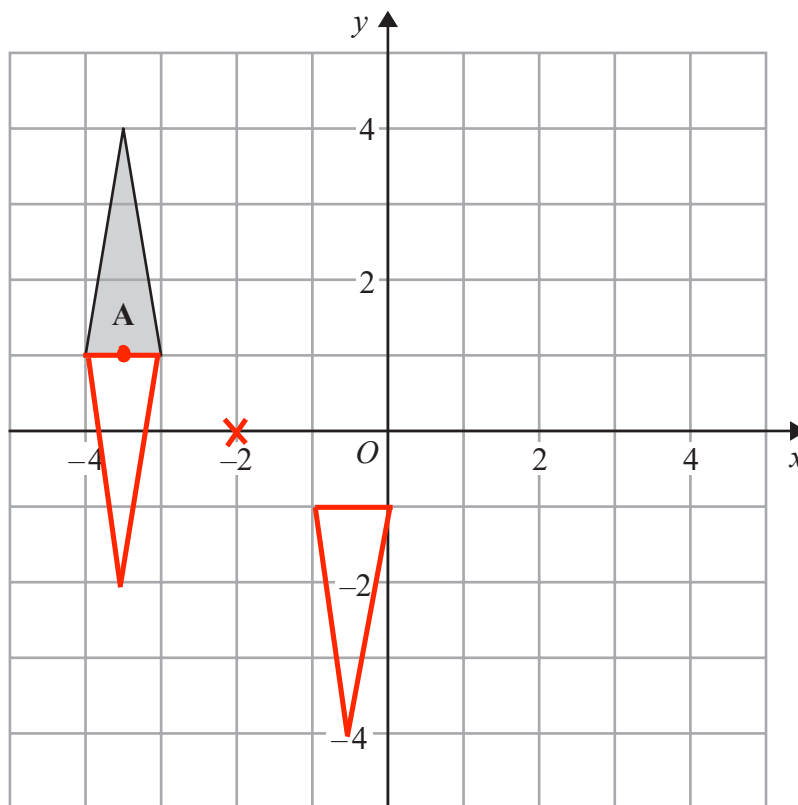
$$x = -\frac{23}{7}, y = \frac{15}{7}$$

$$x = 3, y = -1$$

(Total for Question 19 is 5 marks)



20



Triangle **A** is transformed by the combined transformation of a rotation of 180° about the point $(-2, 0)$ followed by a translation with vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

One point on triangle **A** is invariant under the combined transformation.

Find the coordinates of this point.

(-3.5, 1)

(Total for Question 20 is 2 marks)

TOTAL FOR PAPER IS 80 MARKS