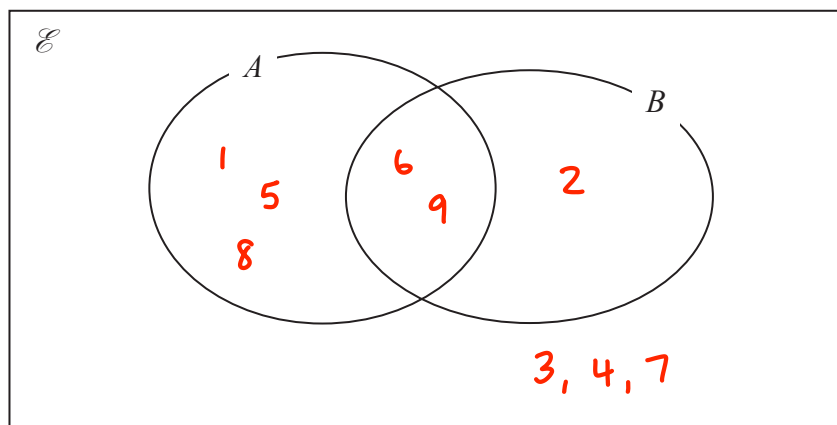




- 1 $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$
 $A = \{1, 5, 6, 8, 9\}$
 $B = \{2, 6, 9\}$



- (a) Complete the Venn diagram to represent this information.

(3)

A number is chosen at random from the universal set $\mathcal{E}$.

- (b) Find the probability that the number is in the set $A \cap B$

$2/9$

(2)

(Total for Question 1 is 5 marks)

- 2 Katy invests £200 000 in a savings account for 4 years.
The account pays compound interest at a rate of 1.5% per annum.

Calculate the total amount of interest Katy will get at the end of 4 years.

$$200000 \times 1.015^4 = 212272.71$$

$$212272.71 - 200000 = 12272.71$$

£ 12,272.71

(Total for Question 2 is 3 marks)

3 The table shows information about the heights of 80 plants.

Height (h cm)	Frequency
$10 < h \leq 20$	7
$20 < h \leq 30$	13
$30 < h \leq 40$	14
$40 < h \leq 50$	12
$50 < h \leq 60$	16
$60 < h \leq 70$	18

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

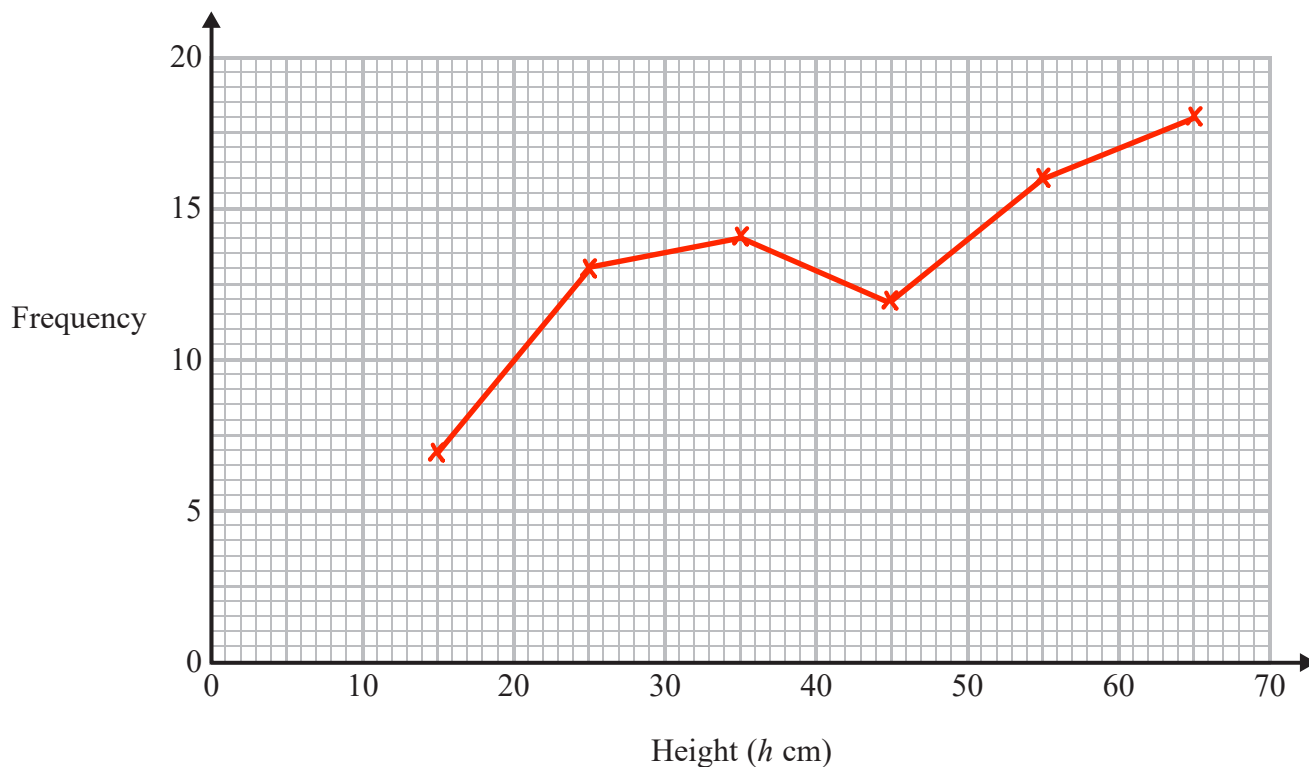
(a) Find the class interval that contains the median.

$$80 \div 2 = 40$$

$$40 < h \leq 50$$

(1)

(b) On the grid, draw a frequency polygon for the information in the table.

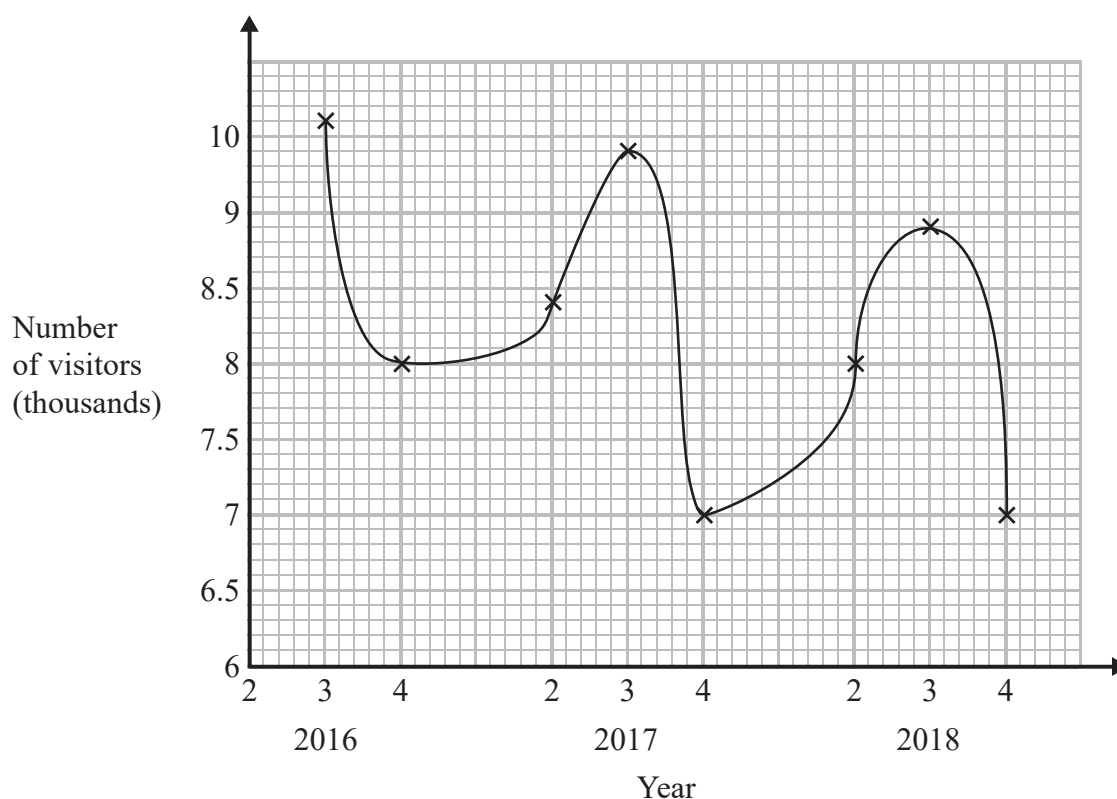


(2)

(Total for Question 3 is 3 marks)



- 4 Sean has drawn a time series graph to show the numbers, in thousands, of visitors to a fun park.



Write down two things that are wrong or could be misleading with this graph.

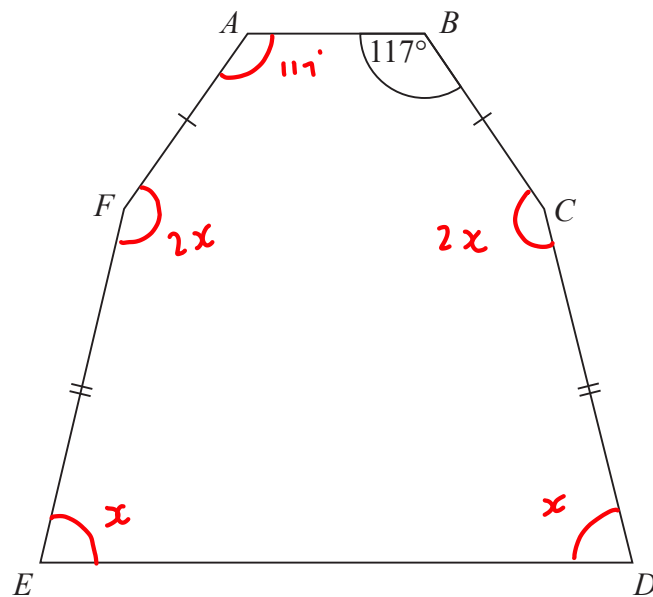
1 9.5 missing from y axis

2 The year axis doesn't make sense

(Total for Question 4 is 2 marks)



- 5 The diagram shows a hexagon.
The hexagon has one line of symmetry.



$$FA = BC$$

$$FE = CD$$

$$\text{Angle } ABC = 117^\circ$$

$$\text{Angle } BCD = 2 \times \text{angle } CDE$$

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

Tip: To find the sum of interior angles in a polygon with n sides, use the formula: $(n - 2) \times 180$

$$(6 - 2) \times 180 = 720^\circ$$

$$\begin{array}{rcl}
 2x + x + x + 2x + 117 + 117 & = & 720 \\
 6x + 234 & = & 720 \\
 - 234 & & - 234 \\
 \hline
 6x & = & 486 \\
 \div 6 & & \div 6 \\
 \hline
 x & = & 81
 \end{array}$$

$$\begin{aligned}
 AFE &= 2x \\
 &= 2 \times 81 \\
 &= 162
 \end{aligned}$$

162

(Total for Question 5 is 4 marks)

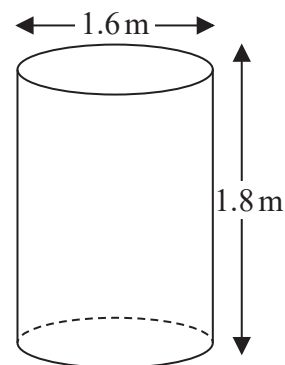


- 6 Jeremy has to cover 3 tanks completely with paint.

Each tank is in the shape of a cylinder with a top and a bottom.
The tank has a diameter of 1.6 m and a height of 1.8 m.

Jeremy has 7 tins of paint.
Each tin of paint covers 5 m^2

Has Jeremy got enough paint to cover completely the 3 tanks?
You must show how you get your answer.



Surface area!

$$\pi \times 0.8^2 = 2.01 \times 2 = 4.021 \text{ m}^2 \text{ (Top + Bottom)}$$

$$\pi \times 1.6 \times 1.8 = 9.048 \text{ (middle)}$$

$$4.021 + 9.048 = 13.069 \text{ m}^2 \text{ (SA of 1 tank)}$$

$$\times 3 = 39.21 \text{ m}^2$$

$$7 \times 5 = 35 \text{ m}^2$$

No, he has enough for 35 m^2 but needs 39.21 m^2

(Total for Question 6 is 5 marks)

7 Work out $\sqrt{\frac{2.5 \times \sin 43^\circ}{8.2^2 - 50.5}}$

Give your answer correct to 3 significant figures.

0.3191419855

0.319

(Total for Question 7 is 2 marks)

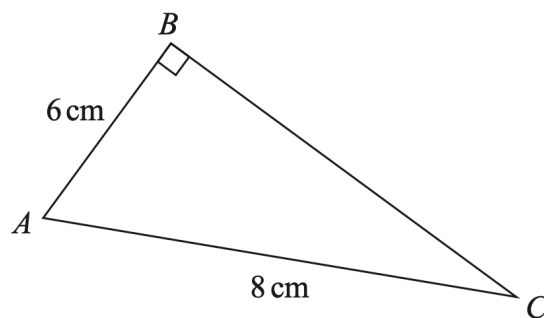
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



8 ABC is a right-angled triangle.



Here is Sarah's method to find the length of BC .

$$\begin{aligned} BC^2 &= AB^2 + AC^2 \\ &= 6^2 + 8^2 \\ &= 100 \\ BC &= 10 \end{aligned}$$

(a) What mistake has Sarah made in her method?

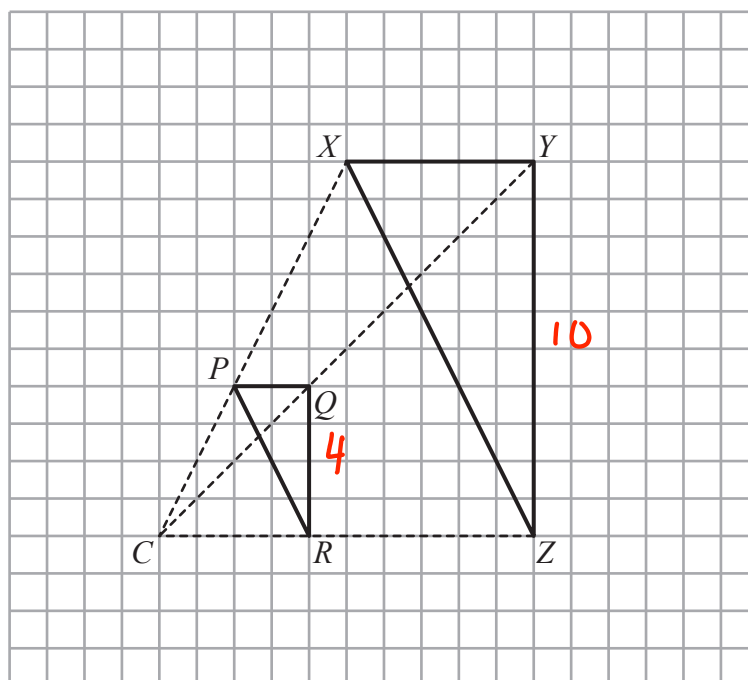
BC is not the longest side
 $BC^2 = AC^2 - AB^2$

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Roy is going to enlarge triangle PQR with centre C and scale factor $1\frac{1}{2}$

He draws triangle XYZ .

(b) Explain why Roy's diagram is **not** correct.

He has used a SF of $2\frac{1}{2}$

(1)

(Total for Question 8 is 2 marks)

- 9 A company has to make a large number of boxes.

The company has 6 machines.

All the machines work at the same rate.

When all the machines are working, they can make all the boxes in 9 days.

The table gives the number of machines working each day.

	day 1	day 2	day 3	all other days
Number of machines working	3	4	5	6

Work out the total number of days taken to make all the boxes.

$$3 + 4 + 5 = 12 \text{ machines (3 days)}$$

$$54 - 12 = 42$$

$$42 \div 6 = 7 \text{ (1 days)}$$

$$3 + 7 = 10 \text{ days}$$

10

(Total for Question 9 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- 10 Marie invests £8000 in an account for one year.
At the end of the year, interest is added to her account.

Marie pays tax on this interest at a rate of 20%
She pays £28.80 tax.

Work out the percentage interest rate for the account.

Interest

$$\begin{array}{lcl} \div 2 & 20\% = 28.80 & \div 2 \\ \downarrow & & \downarrow \\ & 10\% = 14.40 & \\ \times 10 & & \times 10 \\ \downarrow & & \downarrow \\ & 100\% = 144 & \end{array}$$

$$8000 + 144 = 8144$$

$$8000 \times x' = 8144$$

$$\div 8000$$

$$\div 8000$$

$$x' = 1.018$$

1.8 % increase

1.8 %

(Total for Question 10 is 3 marks)

11 In May 2019, the distance between Earth and Mars was 3.9×10^7 km.



In May 2019, a signal was sent from Earth to Mars.

Assuming that the signal sent from Earth to Mars travelled at a speed of 3×10^5 km per second,

(a) how long did the signal take to get to Mars?

$$T = \frac{D}{S} = \frac{3.9 \times 10^7}{3 \times 10^5} = 130$$

.....130..... seconds
(2)

The speed of the signal sent from Earth to Mars in May 2019 was actually less than 3×10^5 km per second.

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

It would take longer

.....
.....
.....
(1)

(Total for Question 11 is 3 marks)

12 Patrick has to work out the exact value of $64^{\frac{1}{4}}$

Patrick says,

“ $\frac{1}{4}$ of 64 is 16 so $64^{\frac{1}{4}} = 16$ ”

Explain what is wrong with what Patrick says.

He should be finding the fourth root of 64

.....

.....

.....

(Total for Question 12 is 1 mark)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- 13 The density of ethanol is 1.09 g/cm^3
The density of propylene is 0.97 g/cm^3

60 litres of ethanol are mixed with 128 litres of propylene to make 188 litres of antifreeze.

Work out the density of the antifreeze.

Give your answer correct to 2 decimal places.

Ethanol

propylene

Antifreeze

$$D = 1.09$$

$$M = 60 \text{ L}$$

$$V = 55.046$$

$$D = 0.97$$

$$M = 128 \text{ L}$$

$$V = 131.959$$

$$D =$$

$$M = 188 \text{ L}$$

$$V = 187.005$$

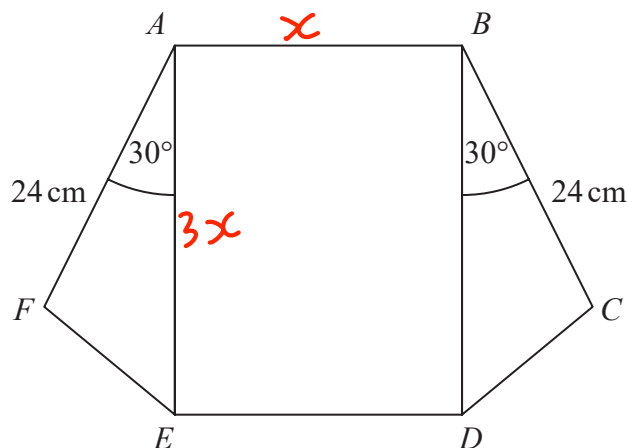
$$D = \frac{M}{V} = \frac{188}{187.005} = 1.0053..$$

1.01

..... g/cm^3

(Total for Question 13 is 4 marks)

- 14 The diagram shows a rectangle, $ABDE$, and two congruent triangles, AFE and BCD .



area of rectangle $ABDE$ = area of triangle AFE + area of triangle BCD

$$AB : AE = 1 : 3$$

Work out the length of AE .

$$x : 3x$$

Tip: Use the formula for the area of a non-right angled triangle:

$$\frac{1}{2} ab \sin C$$

$$\text{area } ABDE = x \times 3x = 3x^2$$

$$\text{area } AFE = \frac{1}{2} \times 24 \times 3x \times \sin(30) = 18x$$

$$\text{area } BCD = \text{area } AFE = 18x$$

$$3x^2 = 18x + 18x$$

$$\begin{array}{r|l} 3x^2 & = & 36x \\ \div x & & \div x \end{array}$$

$$3x = 36$$

36

..... cm

(Total for Question 14 is 4 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- 15 The graph of the curve C with equation $y = f(x)$ is transformed to give the graph of the curve S with equation $y = f(-x) - 3$

The point on C with coordinates $(7, 2)$ is mapped to the point Q on S .

Find the coordinates of Q .

(-7 , -1)

(Total for Question 15 is 2 marks)



16 Here are the first six terms of a quadratic sequence.

-1 5 15 29 47 69

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

$\xrightarrow{+6}$ $\xrightarrow{+10}$ $\xrightarrow{+14}$
 $\xrightarrow{+4}$ $\xrightarrow{+4}$ $\rightarrow 2n^2$

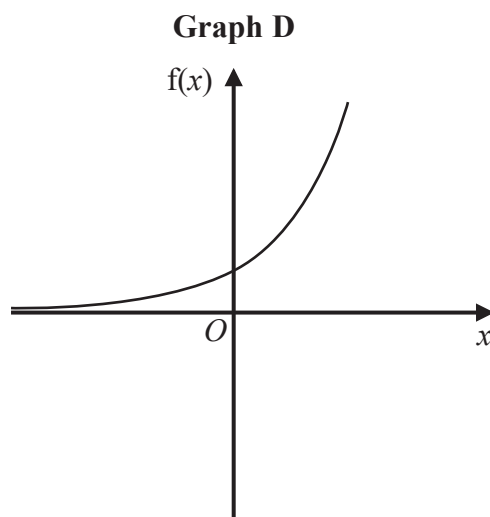
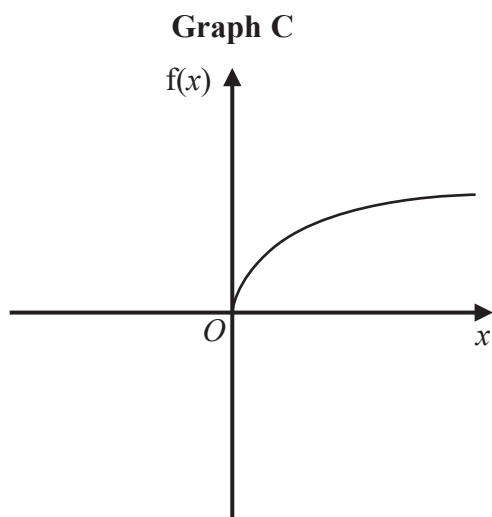
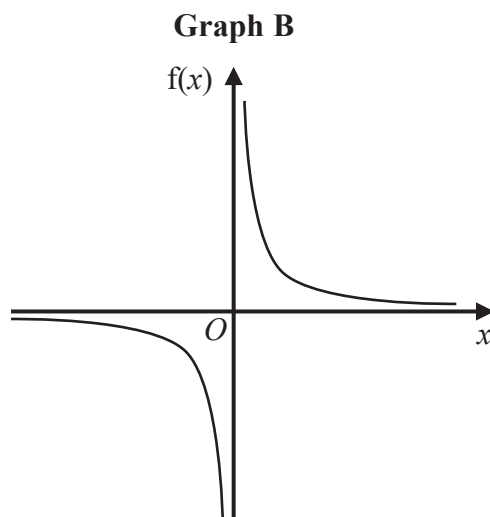
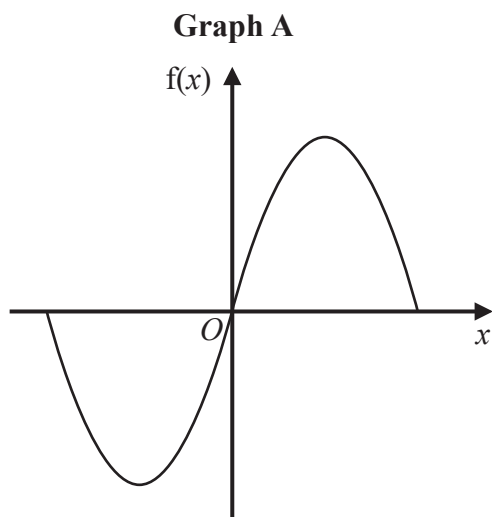
terms	-1	5	15
$- 2n^2$	2	8	18
	-3	-3	-3

n^2	1	4	9
$2n^2$	2	8	18

$2n^2 - 3$

(Total for Question 16 is 3 marks)

17 Here are four graphs.



The graphs represent four different types of function f .

Match each description of the function in the table to the letter of its graph.

Description of function	Graph
$f(x)$ is inversely proportional to x	B
$f(x)$ is a trigonometrical function	A
$f(x)$ is an exponential function	D
$f(x)$ is directly proportional to $\sqrt{x}$	C

(Total for Question 17 is 2 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.

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

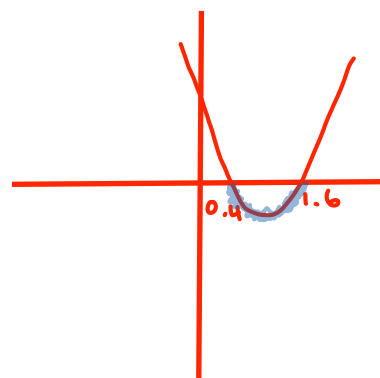
(b) Solve $(1 - x)^2 < \frac{9}{25}$

$$\begin{aligned}
 (1 - x)(1 - x) &< \frac{9}{25} \\
 1 - x - x + x^2 &< \frac{9}{25} \\
 x^2 - 2x + 1 &< \frac{9}{25} \\
 &\quad - \frac{9}{25} \qquad - \frac{9}{25} \\
 x^2 - 2x + \frac{16}{25} &< 0
 \end{aligned}$$

$$\frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(\frac{16}{25})}}{2(1)}$$

$$x = 0.4 \text{ or } 1.6$$

(3)



$$0.4 < x < 1.6$$

(3)

(Total for Question 18 is 6 marks)

19 $D = \frac{u^2}{2a}$

$u = 26.2$ correct to 3 significant figures UB = 26.25

$a = 4.3$ correct to 2 significant figures LB = 4.25

- (a) Calculate the upper bound for the value of D .
Give your answer correct to 6 significant figures.
You must show all your working.

$$D_u = \frac{u_u^2}{2a_l} = \frac{(26.25)^2}{2(4.25)} = 81.0661764...$$

$$\underline{81.0662} \quad (3)$$

The lower bound for the value of D is 78.6003 correct to 6 significant figures.

- (b) By considering bounds, write down the value of D to a suitable degree of accuracy.
You must give a reason for your answer.

$D = 80$. Both UB and LB are 80
to nearest 10.

(2)

(Total for Question 19 is 5 marks)



20 Solve algebraically the simultaneous equations

$$x^2 - 4y^2 = 9$$

$$3x + 4y = 7$$

$$\rightarrow 3x = 7 - 4y$$

$$x = \frac{7-4y}{3}$$

$$\begin{aligned} x^2 &= \left(\frac{7-4y}{3}\right)\left(\frac{7-4y}{3}\right) \\ &= \frac{49 - 28y - 28y + 16y^2}{9} \\ &= \frac{16y^2 - 56y + 49}{9} \end{aligned}$$

$$\frac{16y^2 - 56y + 49}{9} - 4y^2 = 9$$

 $\times 9$
 $\times 9$

$$16y^2 - 56y - 36y^2 = 81$$

$$-20y^2 - 56y + 49 = 81$$

 -81
 -81

$$-20y^2 - 56y - 32 = 0$$

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

$$a = -20$$

$$b = -56$$

$$c = -32$$

$$\frac{-(-56) \pm \sqrt{(-56)^2 - 4(-20)(-32)}}{2(-20)}$$

$$y = -2 \text{ or } y = -\frac{4}{5}$$

$$x = \frac{7-4y}{3}$$

$$= \frac{7-4(-2)}{3} = 5$$

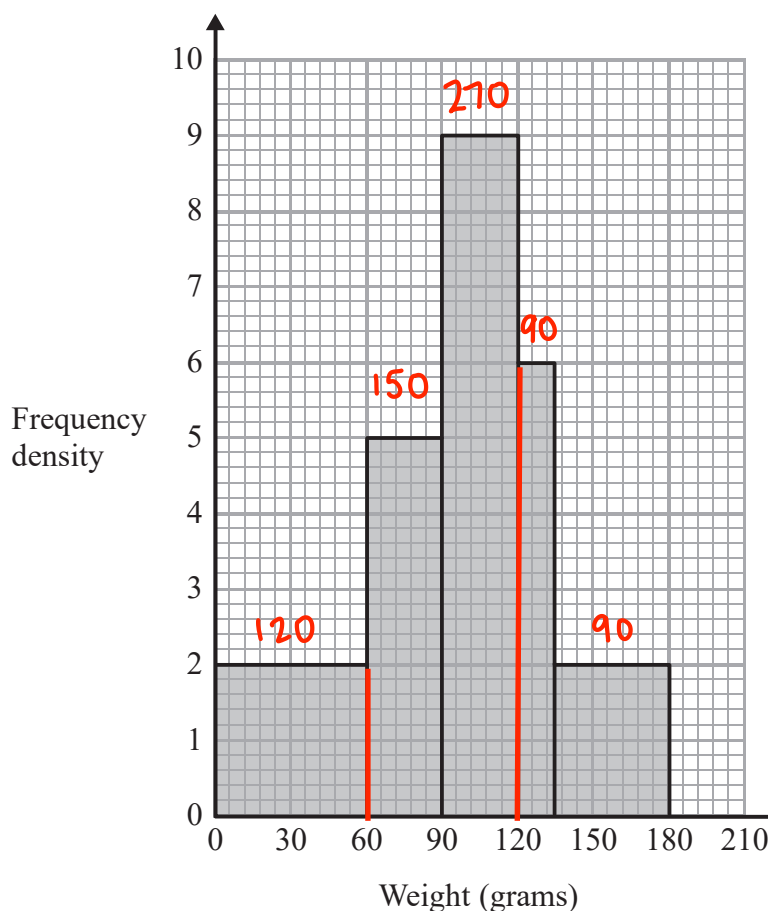
$$\text{OR } = \frac{7-4(-4/5)}{3} = \frac{17}{5}$$

$$x = 5, y = -2$$

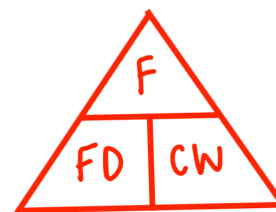
$$x = \frac{17}{5}, y = -\frac{4}{5}$$

(Total for Question 20 is 5 marks)

- 21 The histogram gives information about the distribution of the weights of some onions grown by a farmer.



Onions less than 60 grams in weight are used for pickling.
Onions greater than 120 grams in weight are sold at the market.
The rest of the onions are sent to a food processing factory.



$$F = FD \times CW$$

120 pickling
420 Food processing
180 Market

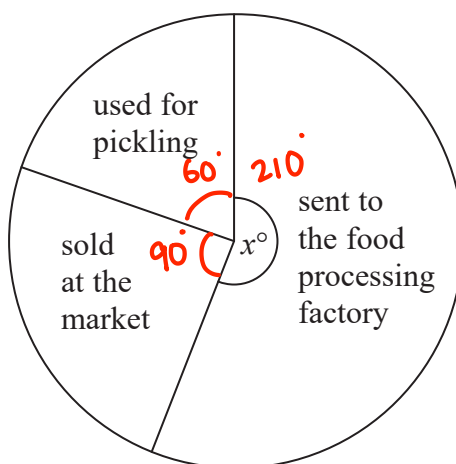
720

$$\begin{array}{l} \div 120 \quad 360^\circ = 720 \text{ onions} \\ \quad \quad \quad \downarrow \quad \quad \quad \downarrow \div 120 \\ \quad \quad \quad 0.5^\circ = 1 \text{ onion} \end{array}$$

$$420 \times 0.5^\circ = 210$$



A pie chart is drawn using the information opposite to show what the farmer does with the onions he grows.



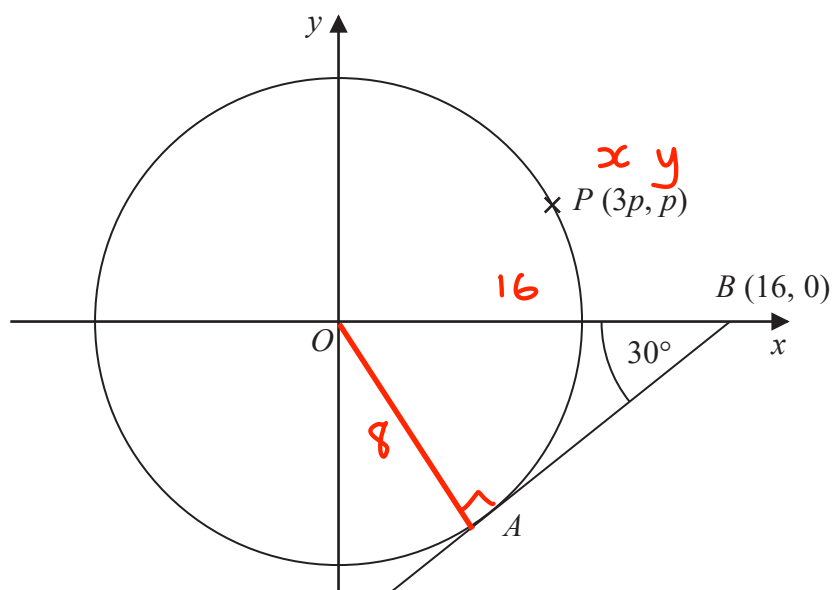
The angle of the sector for the onions sent to the food processing factory is x° .

Work out the value of x .

$$x = 210$$

(Total for Question 21 is 4 marks)

22 The diagram shows a circle, centre O .



AB is the tangent to the circle at the point A .
Angle $OBA = 30^\circ$

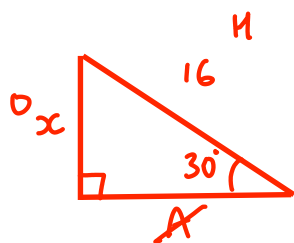
Point B has coordinates $(16, 0)$

Point P has coordinates $(3p, p)$

Find the value of p .

Give your answer correct to 1 decimal place.

You must show all your working.



$$\begin{aligned} \text{S}^{\theta} \text{H} \text{C}^{\text{A}} \text{H} \text{T}^{\text{O}} \text{A} \\ \sin(30) \times 16 = 8 \\ r = 8 \end{aligned}$$

$$\begin{aligned} x^2 + y^2 &= 8^2 \\ (3p)^2 + (p)^2 &= 64 \end{aligned}$$

$$9p^2 + p^2 = 64$$

$$\begin{array}{l|l} 10p^2 & = 64 \\ \div 10 & \div 10 \end{array}$$

$$p^2 = 6.4$$

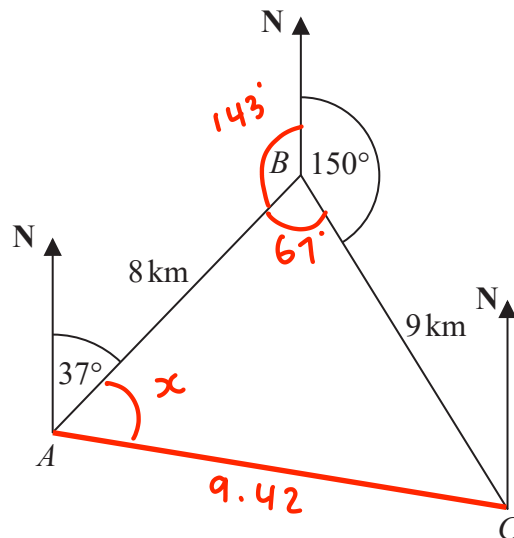
$$p = 2.529..$$

$$p = 2.5$$

(Total for Question 22 is 4 marks)



- 23 The diagram shows the positions of three towns, Acton (A), Barston (B) and Chorlton (C).



Barston is 8 km from Acton on a bearing of 037°
 Chorlton is 9 km from Barston on a bearing of 150°

Find the bearing of Chorlton from Acton.

Give your answer correct to 1 decimal place.

You must show all your working.

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

$$AC^2 = 8^2 + 9^2 - 2(8)(9) \cos(61)$$

$$= 88.734..$$

$$\sqrt{}$$

$$AC = 9.42$$

$$\frac{\sin x}{9} = \frac{\sin(61)}{9.42}$$

$$\sin x = \frac{\sin(61)}{9.42} \times 9 = 0.8794..$$

$$x = \sin^{-1}(0.8794..) = 61.518$$

$$61.518 + 31 = 98.511..$$

98.6

(Total for Question 23 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS