

Topic Units 1, 2 & 3	2000		2001		2002		2003		2004	
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Significant Figs Scientific Notation										
% Calculations		<u>4</u>		<u>1</u>		<u>10</u>				<u>1</u>
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Multiplying out Factorising	<u>3</u>	<u>2</u>	<u>17</u>	<u>7</u>	<u>4</u>		<u>1</u>			<u>3a 3b</u> <u>8</u>
Circles: arcs, sectors, symmetry, chords	<u>4</u>	<u>3 8</u>		<u>10</u>		<u>4</u>	<u>7</u>	<u>1 8</u>	<u>3</u>	<u>4</u>
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Linear Relationships	<u>2</u>	<u>3</u>	<u>1 5</u>		<u>2 11</u>		<u>1</u>			
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Circles: arcs, sectors, symmetry, chords		<u>5 9</u>		<u>4 8</u>		<u>2 14</u>	<u>7</u>			
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FORMULAE LIST

The roots of $ax^2 + bx + c = 0$ are $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$ or $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Area of a triangle: $\text{Area} = \frac{1}{2}ab \sin C$

Volume of a sphere: $\text{Volume} = \frac{4}{3}\pi r^3$

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

Volume of a cylinder: $\text{Volume} = \pi r^2 h$

Standard deviation: $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n - 1}}$, where n is the sample size.

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2000 - 2004

2005 - 2009

2008 Paper 1

1. A straight line has equation $y = 4x + 5$.
State the gradient of this line.

1

Gradient, $m = 4$

(the number in front of the x term)

2. Multiply out the brackets and collect like terms.

$$(3x + 2)(x - 5) + 8x$$

3

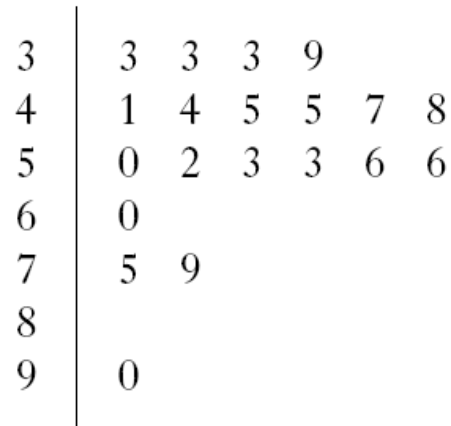
$$= 3x^2 - 15x + 2x - 10 + 8x$$

$$= 3x^2 - 5x - 10$$

Main Grid

Solution

3. The stem and leaf diagram shows the number of points gained by the football teams in the Premiership League in a season.



$n = 20$

4 | 1 represents 41 points

- (a) Arsenal finished 1st in the Premiership with 90 points.

In what position did Southampton finish if they gained 47 points?

1

- (b) What is the probability that a team chosen at random scored less than 44 points?

1

(a) 12th

(b) 5/20 or 1/4

Main Grid

Solution

4. (a) Factorise

$$x^2 - y^2.$$

1

(b) Hence, or otherwise, find the value of

$$9.3^2 - 0.7^2.$$

2

(a) $(x + y)(x - y)$

(b) $(9.3 + 0.7)(9.3 - 0.7)$

$$= (10)(8.6)$$

$$= 86$$

Main Grid

Solution

5. In a survey, the number of books carried by each girl in a group of students was recorded.

The results are shown in the frequency table below.

<i>Number of books</i>	<i>Frequency</i>
0	1
1	2
2	3
3	5
4	5
5	6
6	2
7	1

- (a) Copy this frequency table and add a cumulative frequency column. 1
- (b) For this data, find:
- (i) the median; 1
 - (ii) the lower quartile; 1
 - (iii) the upper quartile. 1
- (c) Calculate the semi-interquartile range. 1

- (d) In the same survey, the number of books carried by each boy was also recorded.

The semi-interquartile range was 0.75.

Make an appropriate comment comparing the distribution of data for the girls and the boys. 1

Main Grid

Solution

5 (a)

<i>Number of books</i>	<i>Frequency</i>	<i>Cum Freq</i>
0	1	1
1	2	3
2	3	6
3	5	11
4	5	16
5	6	22
6	2	24
7	1	25

(b) Median (position 13) = 4 books

Lower Quartile (position 7) = 3 books

Upper Quartile (position 19) = 5 books

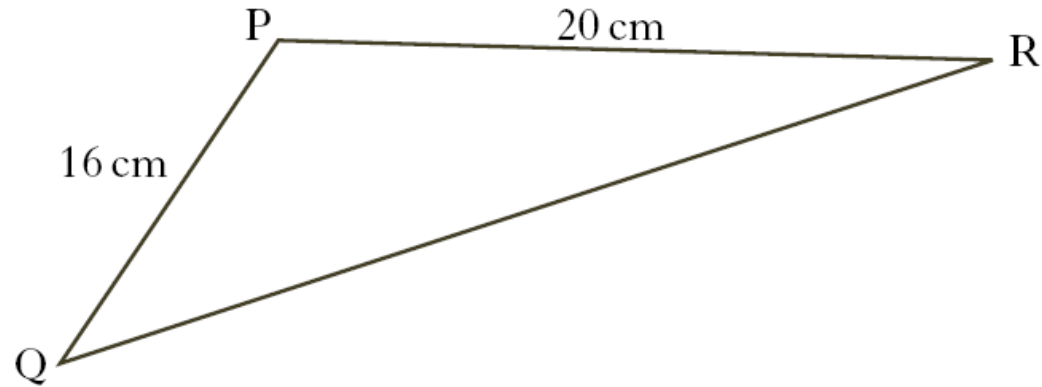
(c) Semi Interquartile range = (Upper Q – Lower Q) \div 2

$$= (5 - 3) \div 2$$

$$= 1$$

(d) The semi interquartile range for boys was 0.75 which is less than the SIQR for girls which was 1, so boys tended to carry less books.

6. Triangle PQR is shown below.



If $\sin P = \frac{1}{4}$, calculate the area of triangle PQR.

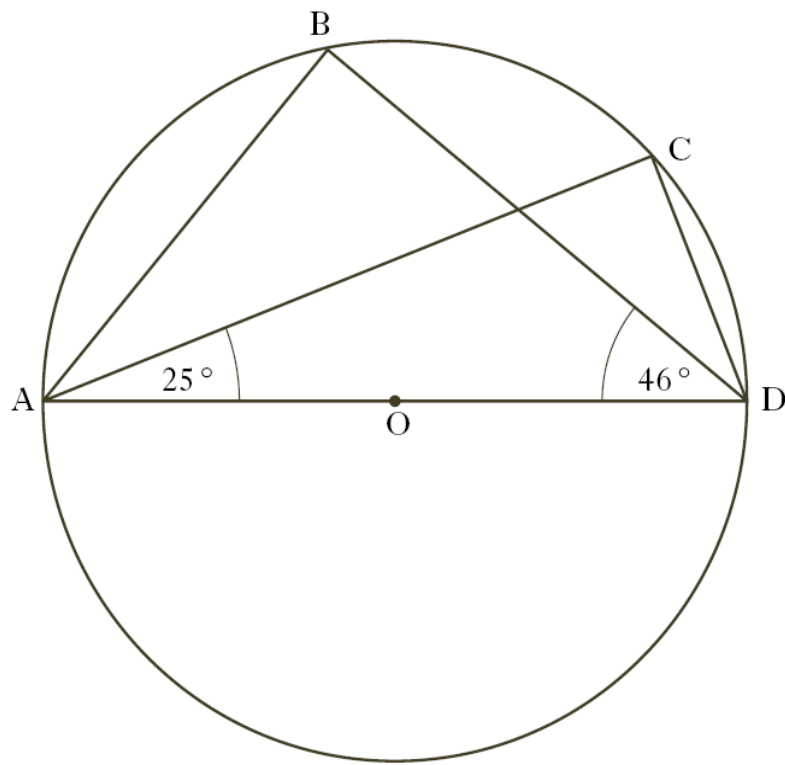
2

$$\begin{aligned}\text{Area} &= \frac{1}{2} qr \sin P \\ &= \frac{1}{2} \times 20 \times 16 \times \frac{1}{4} \\ &= 10 \times 4 \\ &= 40 \text{ cm}^2\end{aligned}$$

Main Grid

Solution

7.



AD is a diameter of a circle, centre O.

B and C are points on the circumference of the circle.

Angle CAD = 25° .

Angle BDA = 46° .

Calculate the size of angle BAC.

3

Main Grid

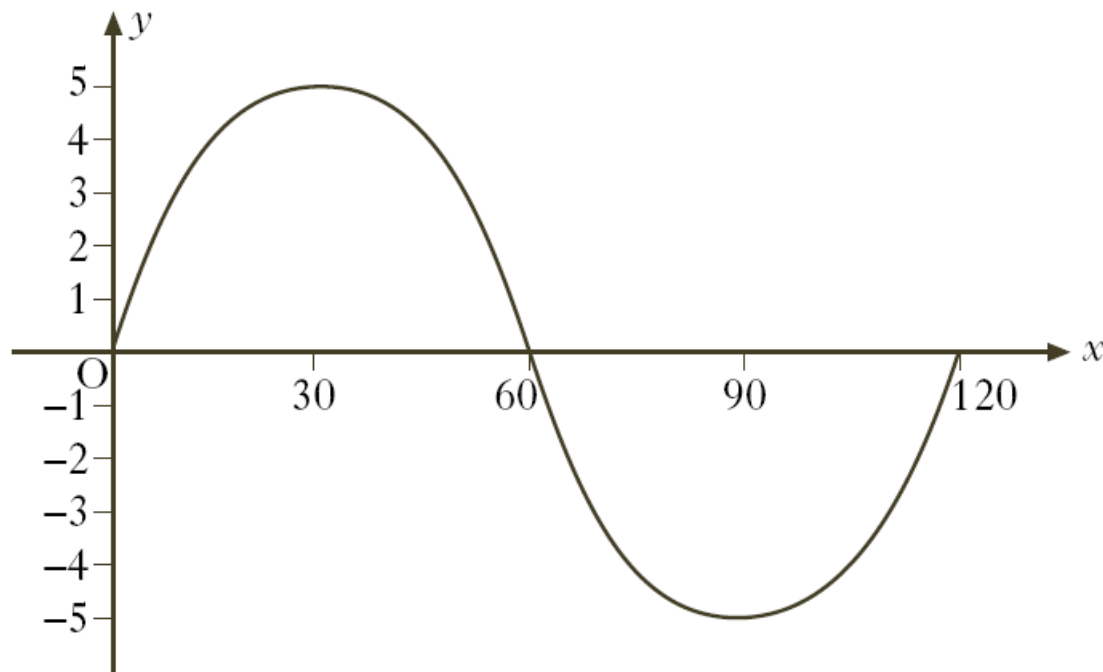
$ABD = 90^\circ$ (right angled triangle in a semi circle)

Angle BAC + 25° + $46^\circ = 180^\circ$ (sum of angles in a triangle = 180°)

So BAC = 109°

Solution

8. Part of the graph of $y = a \sin bx^\circ$ is shown in the diagram.



State the values of a and b .

2

$a = 5$ (Amplitude is 5 units)

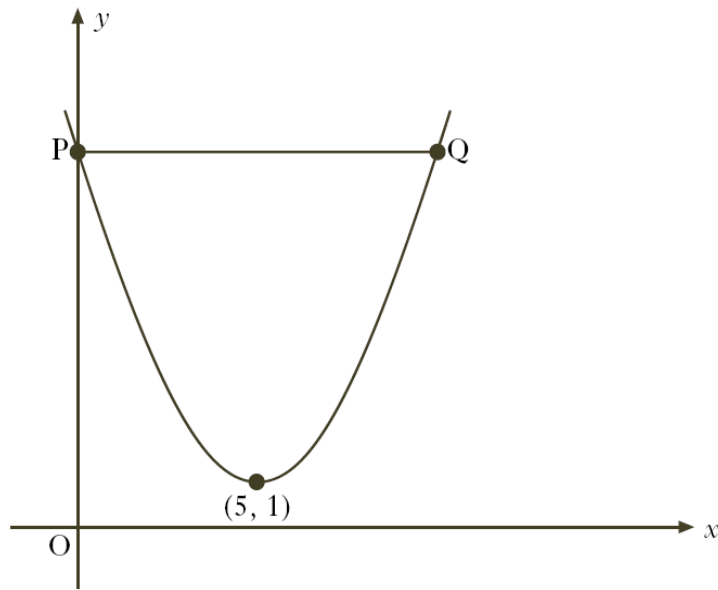
$b = 3$ (Period is 120° i.e. $360^\circ \div 3$)

Main Grid

Solution

9. The graph below shows part of a parabola with equation of the form

$$y = (x + a)^2 + b.$$



- (a) State the values of a and b . 2
- (b) State the equation of the axis of symmetry of the parabola. 1
- (c) The line PQ is parallel to the x -axis.
Find the coordinates of points P and Q. 3

(a) $a = -5$ and $b = 1$ (from min TP of (5,1))

(b) $X = 5$

(c) When $x = 0$, $y = (0 - 5)^2 + 1 = 25 + 1 = 26$

So P (0,26) and Q (9, 26) since Q is 4 units to right of axis of symmetry

Main Grid

Solution

10. If $\sin x^\circ = \frac{4}{5}$ and $\cos x^\circ = \frac{3}{5}$, calculate the value of $\tan x^\circ$.

2

$$\tan x = \frac{\sin x}{\cos x} = \frac{4}{5} \div \frac{3}{5}$$

$$= \frac{4}{5} \times \frac{5}{3}$$

$$= \frac{20}{15}$$

$$= \frac{4}{3}$$

Main Grid

Solution

2008 Paper 2

1. Calculate the **compound interest** earned when £50 000 is invested for 4 years at 4.5% per annum.

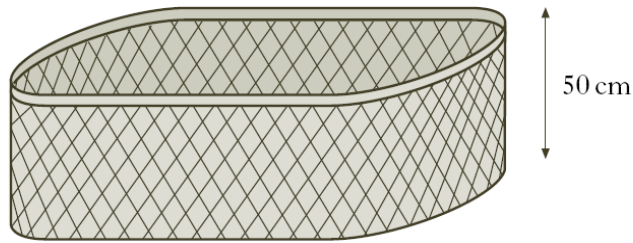
Give your answer to the nearest penny.

4

NOTE: multiplier is 1.045 this adds on 4.5% per year
“to the power 4” is for four years.

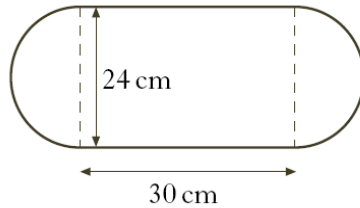
$$\begin{aligned}\text{£}50\,000 \times (1.045)^4 &= \text{£}59\,625.93003 \\ &= \text{£}59\,625.93 \text{ (nearest p)}\end{aligned}$$

2. Jim Reid keeps his washing in a basket. The basket is in the shape of a prism.



The height of the basket is 50 centimetres.

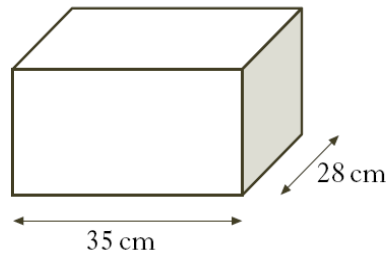
The cross section of the basket consists of a rectangle and two semi-circles with measurements as shown.



- (a) Find the volume of the basket in cubic centimetres.
Give your answer correct to three significant figures.

4

Jim keeps his ironing in a storage box which has a volume **half** that of the basket.



Main Grid

Solution

The storage box is in the shape of a cuboid, 35 centimetres long and 28 centimetres broad.

- (b) Find the height of the storage box.

3

2 (a)

Volume of a prism = area of cross section x length

$$= (\text{area of a circle} + \text{area of rectangle}) \times \text{length}$$

$$= (\pi r^2 + L \times b) \times \text{length}$$

$$= [(\pi \times 12 \times 12) + (24 \times 30)] \times 50$$

$$= [452.389 + 720] \times 50$$

$$= 58\,619.467$$

$$= 58\,600 \text{ cm}^3 \text{ (3 sig figs)}$$

(b) Volume of box = $58\,600 \div 2 = 29\,300 \text{ cm}^3$

$$\text{Volume of cuboid} = lbh$$

$$29\,300 = 35 \times 28 \times h$$

$$29\,300 = 980 \times h$$

$$h = 29\,300 \div 980$$

$$h = 29.897 = 29.9 \text{ cm}$$

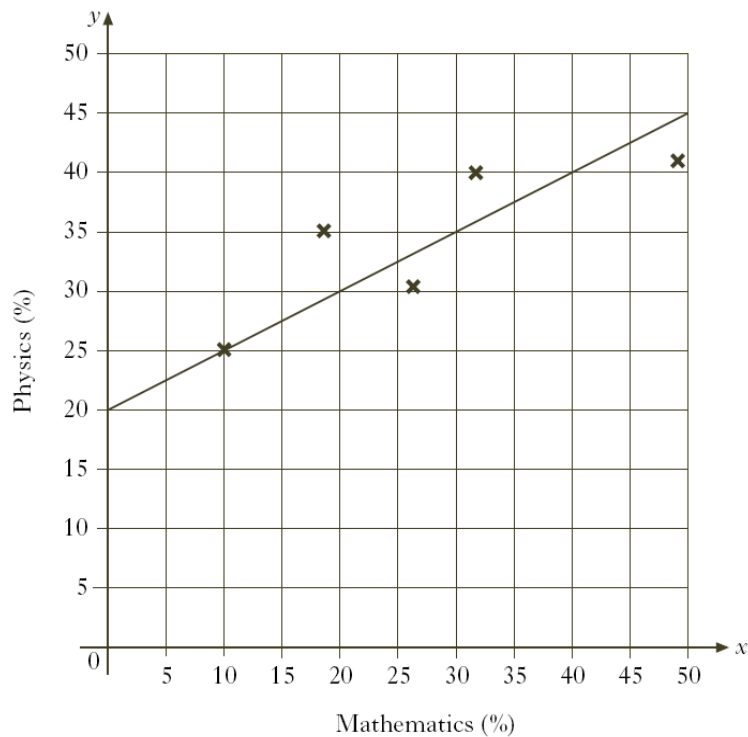
Main Grid

3. The results for a group of students who sat tests in mathematics and physics are shown below.

<i>Mathematics (%)</i>	10	18	26	32	49
<i>Physics (%)</i>	25	35	30	40	41

- (a) Calculate the standard deviation for the mathematics test. 4
- (b) The standard deviation for physics was 6.8.
Make an appropriate comment on the distribution of marks in the two tests. 1

These marks are shown on the scattergraph below.
A line of best fit has been drawn.



- (c) Find the equation of the line of best fit. 3
- (d) Another pupil scored 76% in the mathematics test but was absent from the physics test.
Use your answer to part (c) to predict his physics mark. 1

Main Grid

Solution

$$\sum x = 10 + 18 + 26 + 32 + 49 = 135$$

$$\frac{(\sum x)^2}{n} = \frac{(135)^2}{5} = 3645$$

$$\sum x^2 = 10^2 + 18^2 + 26^2 + 32^2 + 49^2 = 4525$$

Substituting in to 2nd formula given on exam sheet

Standard deviation:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum x^2 - (\sum x)^2 / n}{n-1}}, \text{ where } n \text{ is the sample size.}$$

$$(a) \quad s = \sqrt{\frac{4525 - 3645}{5-1}}$$
$$= \sqrt{\frac{880}{4}} = \sqrt{220} = 14.8$$

(b) The standard deviation was higher for maths marks so these marks are more widely spread compared to the physics marks.

(c) Gradient from graph = up/along = $\frac{1}{2}$ so $m = \frac{1}{2}$

Intercept = 20

Equation $y = \frac{1}{2}x + 20$

(d) physics, $y = \frac{1}{2} \times 76 + 20 = 58\%$

**Click for
Solutions**

4. Suzie has a new mobile phone. She is charged x pence per minute for calls and y pence for each text she sends. During the first month her calls last a total of 280 minutes and she sends 70 texts. Her bill is £52.50.

(a) Write down an equation in x and y which satisfies the above condition. 1

The next month she reduces her bill. She restricts her calls to 210 minutes and sends 40 texts. Her bill is £38.00.

(b) Write down a second equation in x and y which satisfies this condition. 1

(c) Calculate the price per minute for a call and the price for each text sent. 4

(a) $280x + 70y = 52.50$

(b) $210x + 40y = 38$

Solution

Solve simultaneous equations

$$280x + 70y = 52.50 \quad \times 4 \quad 1120x + 280y = 210$$

$$210x + 40y = 38 \quad \times 7 \quad 1470x + 280y = 266$$

$$\text{subtract} \quad -350x \quad = -56$$

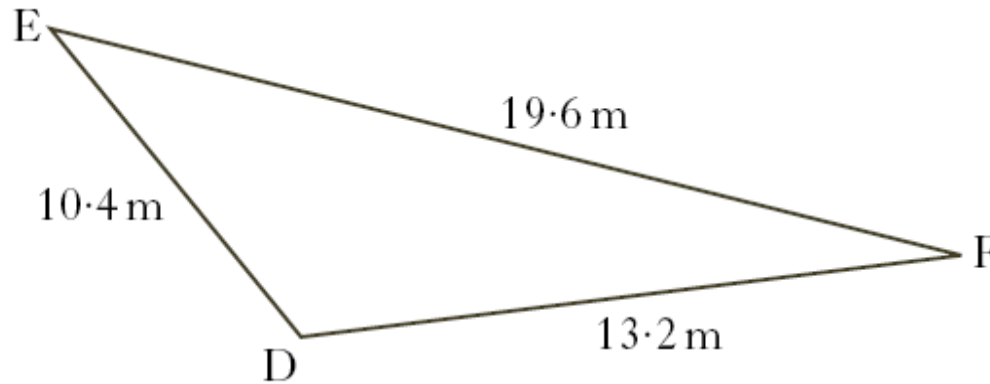
$$x \quad = -56/-350 = 0.16 \text{ (16p a min)}$$

$$\text{substitute} \quad 280 \times 0.16 + 70y = 52.50$$

$$y \quad = (52.50 - 44.80)/70 = 0.11 \text{ (11p per txt)}$$

Main Grid

5. Triangle DEF is shown below.



It has sides of length 10.4 metres, 13.2 metres and 19.6 metres.

Calculate the size of angle EDF.

Do not use a scale drawing.

3

$$\begin{aligned}\cos D &= \frac{e^2 + f^2 - d^2}{2ef} \\ &= \frac{13.2^2 + 10.4^2 - 19.6^2}{2 \times 13.2 \times 10.4}\end{aligned}$$

$$\cos D = -101.76 / 274.56 = -0.3706$$

$$D = \cos^{-1}(-0.3706) = 111.8^\circ$$

Main Grid

Solution

6. Solve the equation

$$5x^2 + 4x - 2 = 0,$$

giving the roots correct to 2 decimal places.

4

Rounding asked for so must be using Quadratic Formula

See FORMULA LIST

$$a = 5 \quad b = 4 \quad c = -2$$

$$x = \frac{-4 \pm \sqrt{4^2 - 4 \times 5 \times -2}}{2 \times 5}$$

$$= \frac{-4 \pm \sqrt{56}}{10}$$

$$x = 0.348 \quad \text{or} \quad -1.148$$

$$x = 0.35 \quad \text{or} \quad -1.15 \quad (2 \text{ d.p.})$$

Main Grid

Solution

7. (a) Simplify

$$\frac{m^5}{m^3}.$$

1

(b) Express

$$2\sqrt{5} + \sqrt{20} - \sqrt{45}$$

as a surd in its simplest form.

3

(a) $m^{5-3} = m^2$

(b)
$$\begin{aligned} & 2\sqrt{5} + \sqrt{4 \times 5} - \sqrt{9 \times 5} \\ &= 2\sqrt{5} + 2\sqrt{5} - 3\sqrt{5} \\ &= \sqrt{5} \end{aligned}$$

Main Grid

Solution

8. Solve the equation

$$4 \cos x^\circ + 3 = 0, \quad 0 \leq x \leq 360.$$

3

$$4 \cos x^\circ = -3$$

$$\cos x^\circ = -3/4 = 0.75$$

$$x^\circ = \cos^{-1}(0.75)$$

$$= 41.4^\circ$$

S	A	√
T	C	√

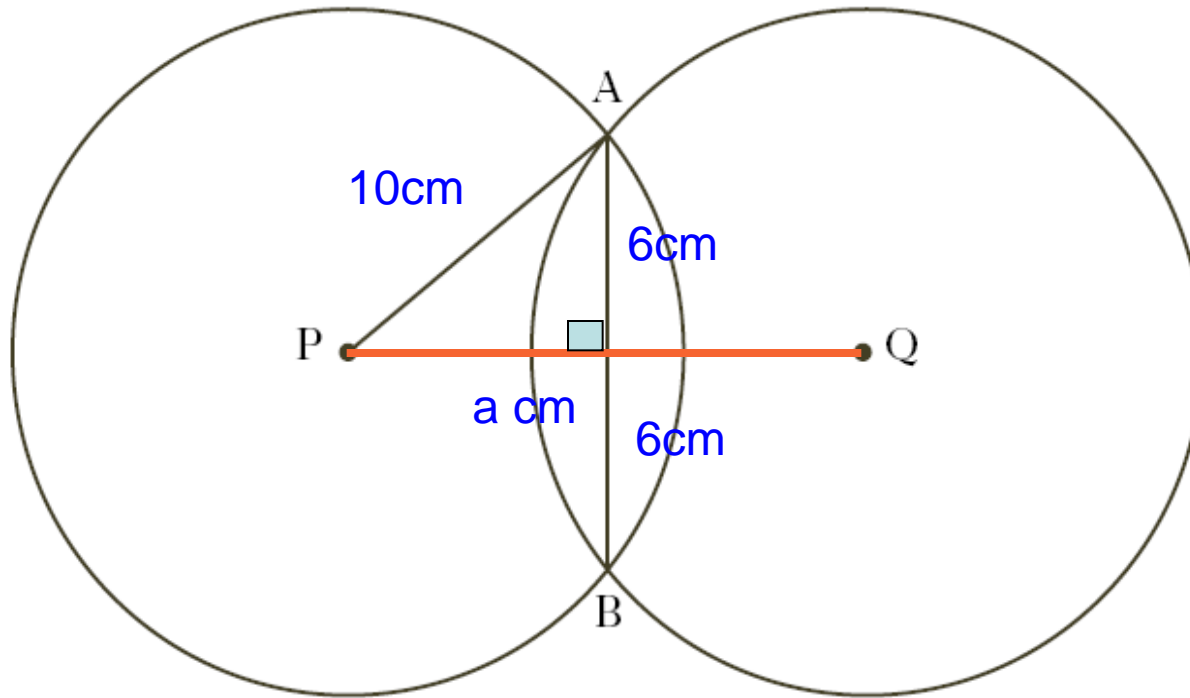
Cos also positive in 4th quadrant

$$\text{So } 360^\circ - 41.4^\circ = 318.6^\circ$$

Main Grid

Solution

9. Two identical circles, with centres P and Q, intersect at A and B as shown in the diagram.



Use Pythagoras

$$a^2 = 10^2 - 6^2$$
$$= 100 - 36 = 64$$

$$a = \sqrt{64} = 8$$

$$PQ = 2 \times 8 = 16 \text{ cm}$$

The radius of each circle is 10 centimetres.

The length of the common chord, AB, is 12 centimetres.

Calculate PQ, the distance between the centres of the two circles.

Solution

5

Main Grid

10. Change the subject of the formula

$$p = q + \sqrt{a}$$

to a .

2

Swap sides

$$q + \sqrt{a} = p$$

$$\sqrt{a} = p - q$$

Square both sides

$$a = (p - q)^2$$

Solution

Main Grid

11. Express

$$\frac{2}{a} - \frac{3}{(a+4)}, \quad a \neq 0, a \neq -4,$$

as a single fraction in its simplest form.

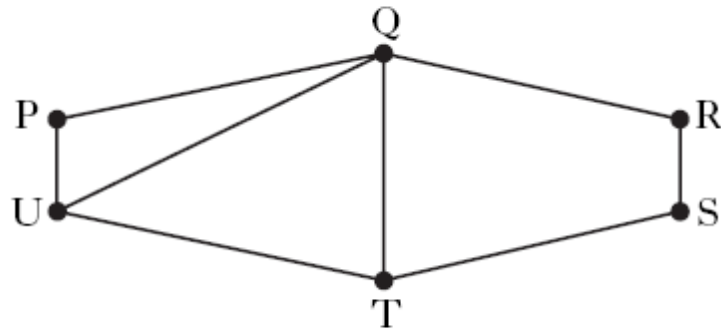
3

$$\begin{aligned} & \frac{2(a+4)}{a(a+4)} - \frac{3a}{a(a+4)} \\ &= \frac{2a+8-3a}{a(a+4)} \\ &= \frac{8-a}{a(a+4)} \end{aligned}$$

Main Grid

Solution

8. A network diagram is shown below.



Write down the letters which represent the **odd** nodes.

1

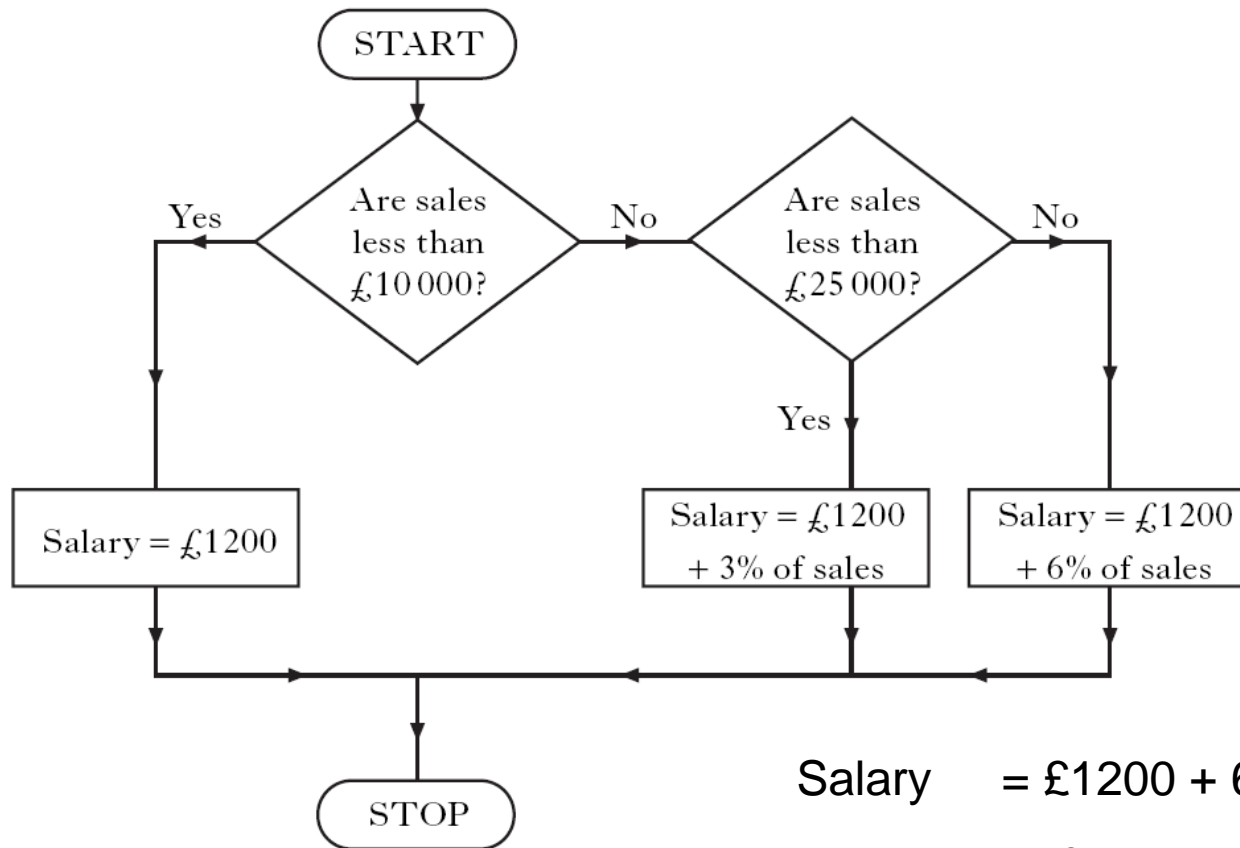
U and T (have nodes of order 3)

Main Grid

Solution

9. Jamie works for a firm which pays its employees a basic salary of £1200 per month plus commission on sales.

The flowchart below shows how the salaries are calculated.



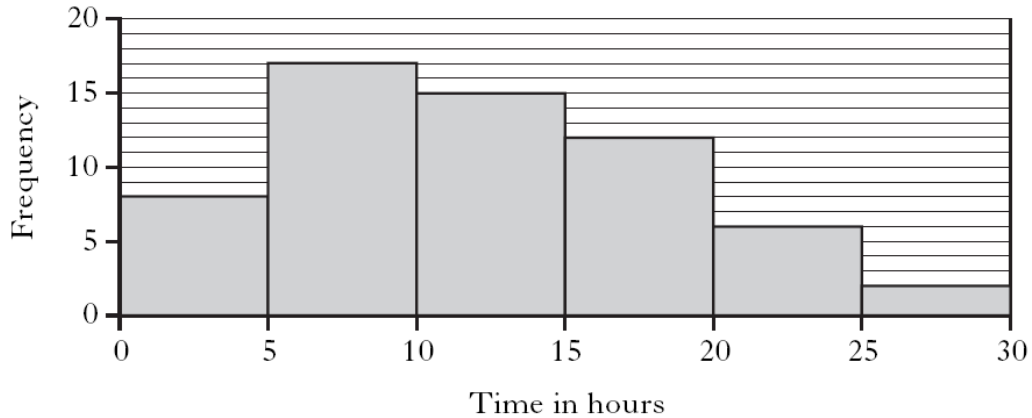
$$\begin{aligned}
 \text{Salary} &= \text{£}1200 + 6\% \text{ of } \text{£}40\,000 \\
 &= \text{£}1200 + \text{£}2400 \\
 &= \text{£}3600
 \end{aligned}$$

One month Jamie's sales are £40 000.
Calculate his salary for that month.

2

Solution**Main Grid**

10. A group of students was asked how many hours they spend studying each week. The histogram below shows the results of the survey.



The **same** group of students was asked how many hours of television they watch each week.

The results of the survey are shown in the table below.

Time (h hours)	Frequency
$0 \leq h < 5$	1
$5 \leq h < 10$	4
$10 \leq h < 15$	9
$15 \leq h < 20$	20
$20 \leq h < 25$	14
$25 \leq h < 30$	12

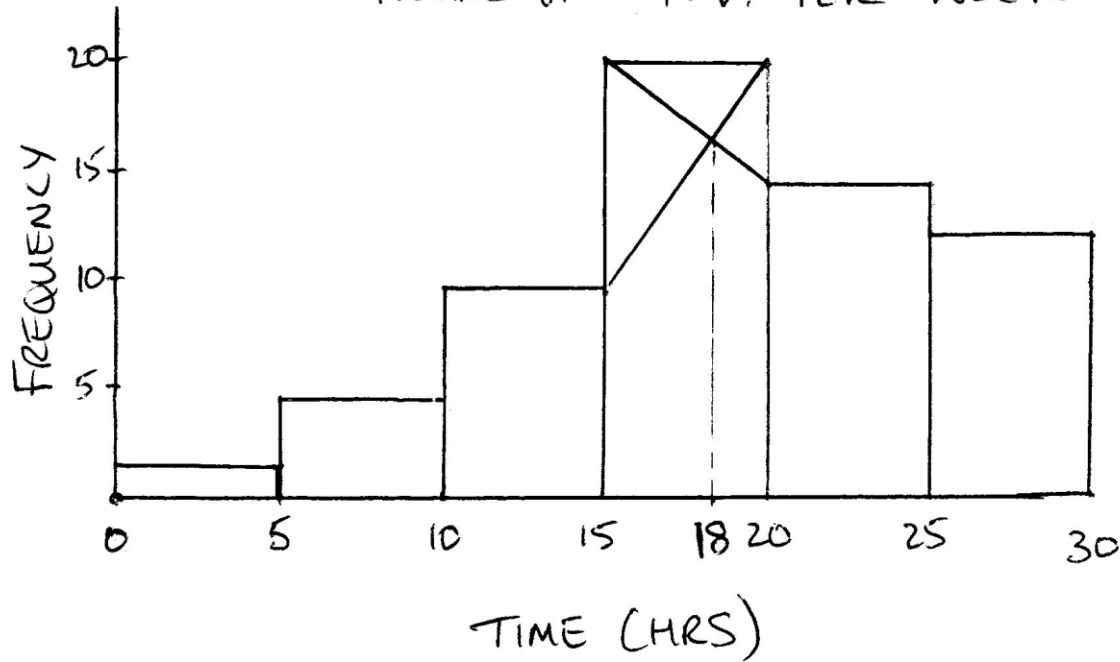
Main Grid

- (a) Using squared paper, draw a histogram to illustrate the results of this survey. 2
- (b) For the histogram you have drawn, estimate the mode to the nearest hour. 1
- (c) Compare the two histograms and comment. 1

Solution

(a)

HOURS OF T.V. PER WEEK



(b) Mode is approx 18 hrs

(c) Mode for studying is about 7 hrs.

This is much less than the time spent watching TV.

Main Grid

11. The sum of the terms of a sequence of numbers is given by the formula

$$S = \frac{a(r^n - 1)}{r - 1}.$$

Calculate S when $a = 3$, $r = 2$ and $n = 4$.

3

$$\begin{aligned} S &= 3(2^4 - 1) / 2 - 1 \\ &= 3(16 - 1) / 1 \\ &= 3 \times 15 \\ &= 45 \end{aligned}$$

Main Grid

Solution

6. Below is a copy of part of David Leblanc's credit card statement.

<i>Southern Star Credit</i>		
Name: David Leblanc		12 May, 2008
Card Number: 4517 6767 2368 9001		Credit Limit £3600
12 April 2008	Balance brought forward	£125.00
2 May 2008	Payment received	<u>-50.00</u>
	Balance	A
	Interest at 1.6%	B
5 May 2008	Bon Cave Wines	62.99
5 May 2008	Jacques Delicatessen	15.88
	Balance owed	C
Minimum payment: 3% of Balance owed or £5, whichever is greater.		

(a) Calculate the amounts which would appear at **A**, **B** and **C**.

(b) David makes the minimum payment.
How much does he pay?

$$A = 125 - 50$$

$$= £75$$

$$B = £75 + 1.6\% \text{ of } £75$$

$$= £75 + £1.20$$

$$= £76.20$$

$$C = £76.20 + £62.99 + £15.88$$

$$= £155.07$$

(b) 3% of £ 155.07

$$= £4.65$$

He needs to pay £5 as
3 this is the greater
value.

2

Main Grid

Solution

7. Steve Bolton has invested £10000 in the Brigadoon Building Society. The building society adds 0.4% interest to his account at the start of each month. In addition, Steve deposits £250 into his account each month. He designs a spreadsheet to calculate the amount of money he has in the bank each month.

Column B = the amount in his account at the start of each month after interest at 0.4% is added.

Column C = the amount in his account each month after his monthly deposit of £250 is paid in.

	A	B	C
1	Brigadoon Building Society		
2			
3	Steve Bolton: Investment Account		
4			
5	Interest rate 0.4% per month		
6			
7	Amount invested £10,000.00		
8	Monthly payment £250.00		
9			
10	Amount	after interest	after deposit
11			
12	January	£10,040.00	£10,290.00
13	February	£10,331.16	£10,581.16
14	March	£10,623.48	£10,873.48
15	April	£10,916.98	£11,166.98
16	May	£11,211.65	£11,461.65
17	June	£11,507.49	£11,757.49
18	July	£11,804.52	£12,054.52
19	August	£12,102.74	£12,352.74
20	September	£12,402.15	£12,652.15
21	October	£12,702.76	£12,952.76
22	November	£13,004.57	£13,254.57
23	December		

$$(a) = C22 * 1.004$$

$$(b) = B23 + 250$$

$$(c) \text{ £13 557.59}$$

Main Grid

Solution

- (a) Write down the **formula** to enter in cell B23 the amount in Steve's account at the start of December after interest has been added.

1

- (b) Write down the **formula** to enter in cell C23 the amount in his account in December after his monthly deposit of £250 is paid in.

1

- (c) What will appear in cell C23?

2

8. Luljeta Dumani sells carpets. Her gross annual salary for the last year was £15 425.

The table below shows the rates of tax applicable for last year.

Taxable Income	Rate
On the first £2230	10%
On the next £32 370	22%
On any income over £34 600	40%

Luljeta's total tax allowance is £5225.

Calculate her annual tax bill for last year.

4

$$\text{Taxable income} = £15\,425 - £5\,225 = £10\,200$$

$$10\% \text{ of } £2230 = £223$$

$$\text{Amount left at } 22\% = £10\,200 - £2\,230 = £7\,970$$

$$22\% \text{ of } £7\,970 = £1753.40$$

$$\text{Total tax} = £223 + £1753.40$$

$$= \underline{£1976.40}$$

Main Grid

Solution

10. Irene works in the local chemist's shop.

One week she works 40 hours at her basic rate of pay and 3 hours overtime at double time.

Her gross pay for that week was £239.20.

Calculate Irene's basic hourly rate of pay.

3

$$\text{Total equivalent hours worked} = 40 + 3 \times 2 = 46$$

$$\begin{aligned} \text{Rate of pay} &= £239.20 \div 46 \\ &= £5.20 \text{ per hour} \end{aligned}$$

Main Grid

Solution

1. The table below shows the results of a survey of First Year pupils.

	<i>Wearing a blazer</i>	<i>Not wearing a blazer</i>
<i>Boys</i>	40	22
<i>Girls</i>	29	9

What is the probability that a pupil, chosen at random from this sample, will be a girl wearing a blazer?

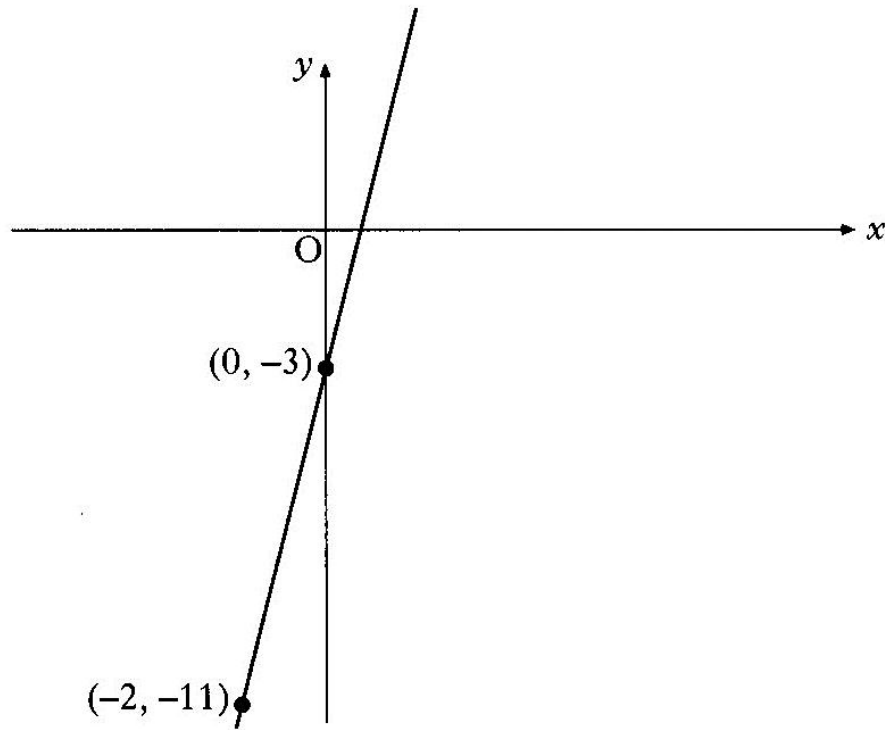
1

$$\text{Prob}(\text{girl} + \text{blazer}) = \frac{29}{100}$$

Main Grid

Solution

2.



Find the equation of the straight line passing through the points $(0, -3)$ and $(-2, -11)$.

3

Main Grid

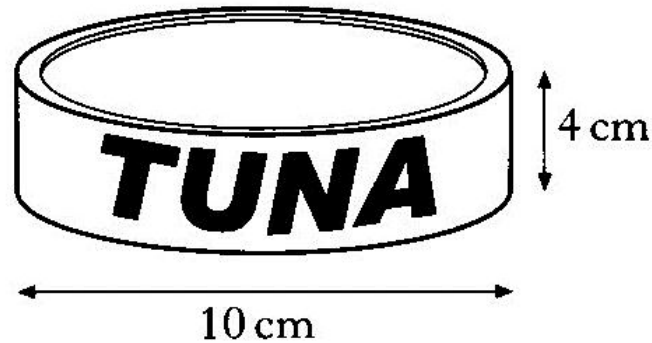
$$m = \frac{-3 - (-11)}{0 - (-2)} = \frac{8}{2} = 4$$

From graph $c = -3$

Equation of line $y = 4x - 3$

Solution

3. A tin of tuna is in the shape of a cylinder.



It has diameter 10 centimetres and height 4 centimetres.

Calculate its volume.

Take $\pi = 3.14$.

2

$$V = \pi r^2 h$$

$$= 3.14 \times 5 \times 5 \times 4$$

$$= 314 \text{ cm}^3$$

Main Grid

Solution

4. Find the point of intersection of the straight lines with equations $x + 2y = -5$ and $3x - y = 13$.

$$\begin{array}{rcl}
 4. & x + 2y = -5 & \text{--- (1)} \\
 & 3x - y = 13 & \text{--- (2)}
 \end{array}
 \Rightarrow x + 2y = -5$$

$$\begin{array}{r}
 \times 2 \Rightarrow 6x - 2y = 26 \\
 \hline
 \text{Add} \quad 7x = 21 \\
 x = 3
 \end{array}$$

$$\begin{array}{l}
 \text{put in eq (1)} \quad 3 + 2y = -5 \\
 \quad \quad \quad 2y = -8 \\
 \quad \quad \quad y = -4
 \end{array}$$

$$\text{Check eq (2)} \quad 3 \times 3 - (-4) = 13 \quad \checkmark$$

pt. of intersection $(3, -4)$.

Main Grid

Solution

5. Multiply out the brackets and collect like terms.

$$(x + 3)(x^2 + 4x - 12)$$

3

$$x^3 + 4x^2 - 12x + 3x^2 + 12x - 36$$

$$x^3 + 7x^2 - 36$$

Main Grid

Solution

6. (a) Show that the standard deviation of 1, 1, 1, 2 and 5 is equal to $\sqrt{3}$. 3

(b) **Write down** the standard deviation of 101, 101, 101, 102 and 105. 1

(a) $\Sigma x = 10$

$$\frac{(\Sigma x)^2}{n} = \frac{10^2}{5} = \frac{100}{5} = 20$$

$$\Sigma x^2 = 1^2 + 1^2 + 1^2 + 2^2 + 5^2 = 32$$

$$s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}} = \sqrt{\frac{32 - 20}{4}} = \sqrt{\frac{12}{4}} = \sqrt{3}$$

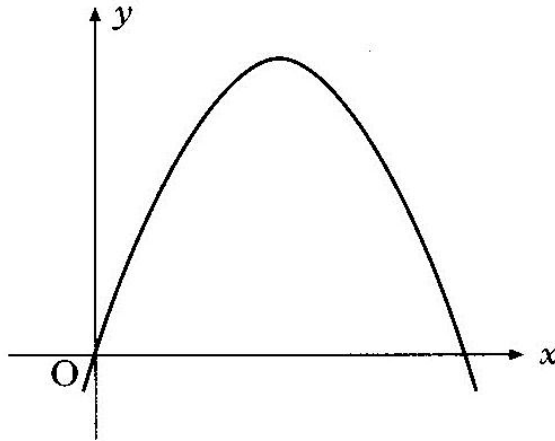
Main Grid

(b) Answer is $\sqrt{103}$

Since Standard Deviation is a measure of spread from the mean.

Solution

7. The graph shown below is part of the parabola with equation $y = 8x - x^2$.



- (a) By factorising $8x - x^2$, find the roots of the equation

$$8x - x^2 = 0.$$

2

- (b) State the equation of the axis of symmetry of the parabola.

1

- (c) Find the coordinates of the turning point.

2

Main Grid

$$(a) 8x - x^2 = 0$$

$$x(8 - x) = 0$$

$$x = 0 \text{ or } x = 8$$

$$(b) x = 4 \text{ (halfway between roots)}$$

$$(c) y = 8x - x^2$$

$$= 8 \times 4 - 4^2$$

$$= 16$$

Coords (4, 16)

Solution

8. Given that

$$\cos 60^\circ = 0.5,$$

what is the value of $\cos 240^\circ$?

1

	S	A
√	T	C

Cos negative in quadrant 3

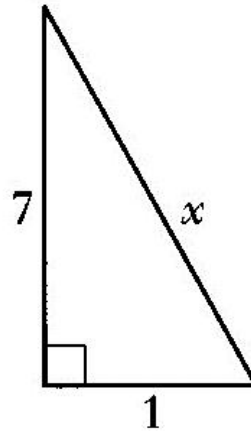
$$240^\circ = 180^\circ + 60^\circ$$

$$\text{So } \cos 240^\circ = -0.5$$

Main Grid

Solution

9. A right-angled triangle is shown below.



Using Pythagoras' Theorem, find x .

Express your answer as a surd in its simplest form.

3

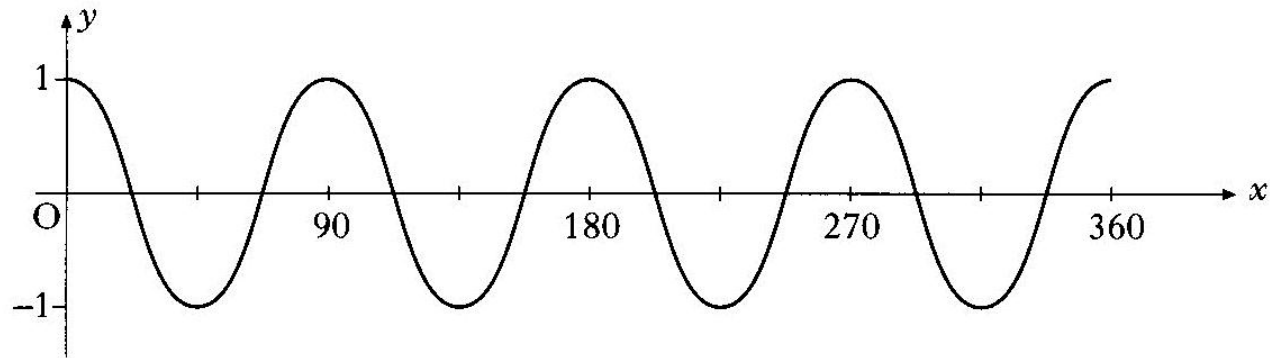
$$\begin{aligned}x^2 &= 7^2 + 1^2 \\ &= 49 + 1\end{aligned}$$

$$\begin{aligned}x &= \sqrt{50} \\ &= \sqrt{25} \times \sqrt{2} \\ &= 5\sqrt{2}\end{aligned}$$

Main Grid

Solution

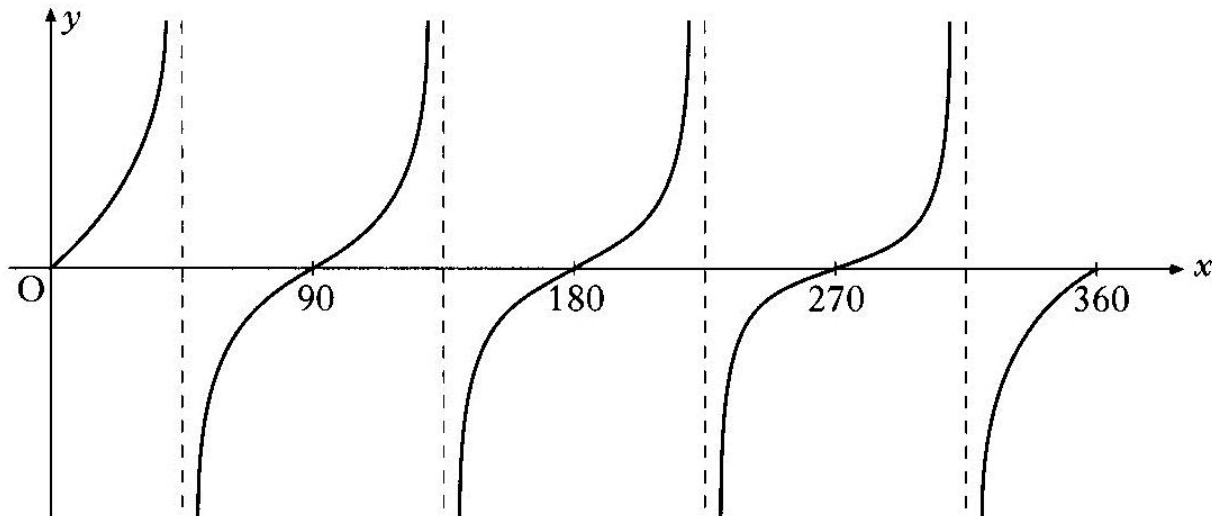
10. (a) Part of the graph of $y = \cos ax^\circ$ is shown below.



State the value of a .

$$a = \text{period} = 360 \div 90 = 4 \quad 1$$

- (b) Part of the graph of $y = \tan bx^\circ$ is shown below.



State the value of b .

$$b = \text{period} = 180 \div 90 = 2 \quad 1$$

Main Grid

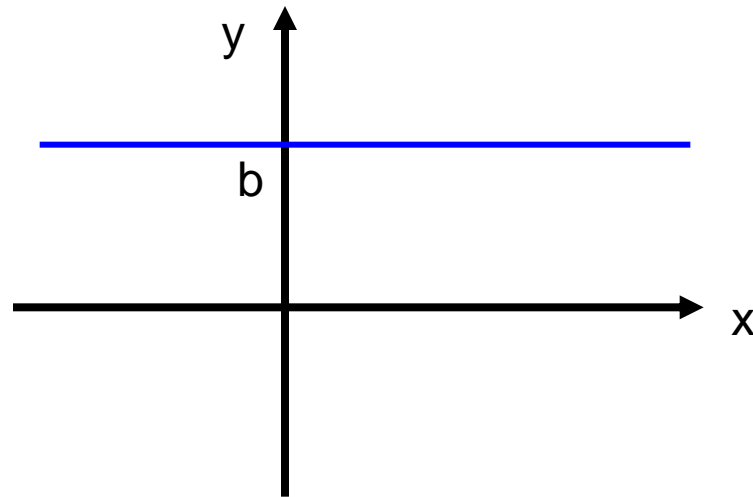
Solution

11. A straight line is represented by the equation $y = ax + b$.

Sketch a possible straight line graph to illustrate this equation when $a = 0$ and $b > 0$.

$a = 0$ means gradient = 0 i.e. a horizontal line

$b > 0$ means line intercepts above x axis



Main Grid

Solution

1. Ian's annual salary is £28 400. His boss tells him that his salary will increase by 2.3% per annum.

What will Ian's annual salary be after 3 years?

Give your answer to the nearest pound.

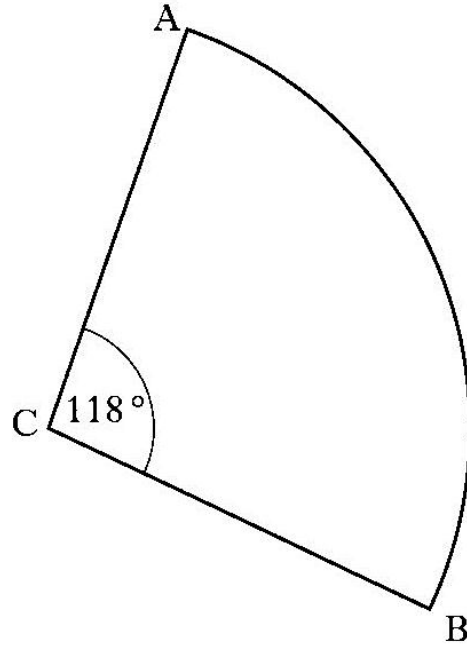
3

$$\begin{aligned}\text{£}28\,400 \times (1.023)^3 &= \text{£}30\,405.02 \\ &= \text{£}30\,405 \text{ (to the nearest £)}\end{aligned}$$

Main Grid

Solution

2. The diagram below shows a sector of a circle, centre C.



The radius of the circle is 10.5 centimetres and angle ACB is 118° .
Calculate the length of arc AB.

$$\begin{aligned}\text{Arc AB} &= \frac{118}{360} \times \pi \times 21 \\ &= 21.6\text{cm}\end{aligned}$$

3

Main Grid

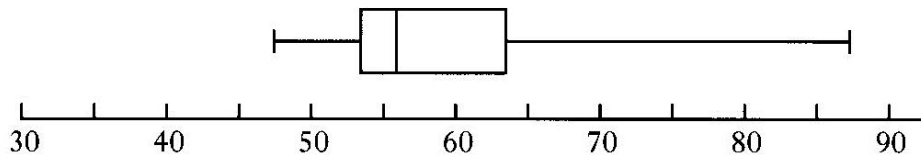
Solution

3. This back-to-back stem and leaf diagram shows the results for a class in a recent mathematics examination.

Girls		Boys
	3	
	4	7 9
8 7 4 3 2 2	5	2 3 4 4 6 6 7 9
9 4	6	3
9 6 3	7	4 8
8 1	8	7
n = 15		n = 14

Key		
3	7	represents 73%
8	7	represents 87%

(a) A boxplot is drawn to represent one set of data.



Does the boxplot above represent the girls' data or the boys' data?

Give a reason for your answer.

1

(b) For the **other** set of data, find:

(i) the median;

1

(ii) the lower quartile;

1

(iii) the upper quartile.

1

(c) Use the answers found in part (b) to construct a second boxplot.

2

(d) Make an appropriate comment about the distribution of data in the two sets.

1

Main Grid

Solution

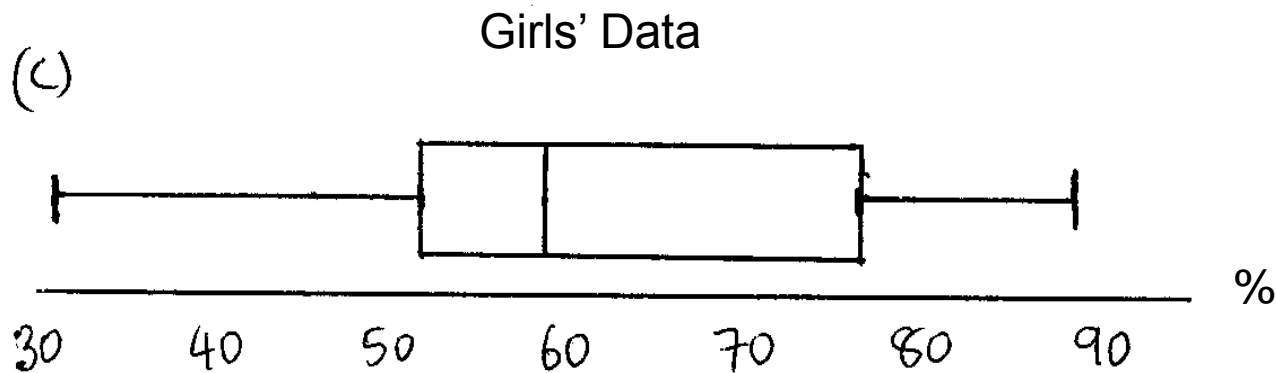
(a) Boys' data

Lowest value is 47

(b) (i) $Q_2 = 58$

(ii) $Q_1 = 52$

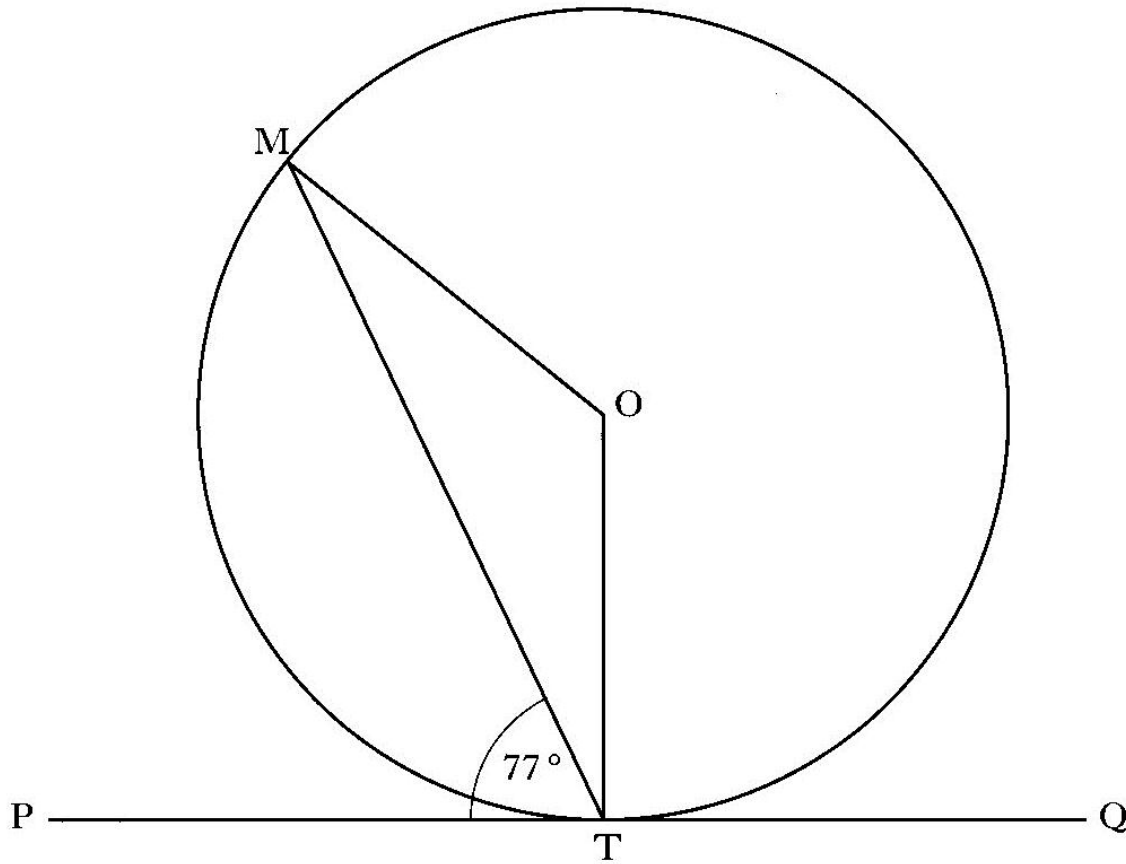
(iii) $Q_3 = 76$



(d) The girls' mean is higher 58 instead of 56.

The girls' score has greater Semi IQR. 24 instead of 10 for the boys.

4.



The tangent PQ touches the circle, centre O , at T .
 Angle MTP is 77° .

(a) Calculate the size of angle MOT .

2

(b) The radius of the circle is 8 centimetres.
 Calculate the length of chord MT .

3

Main Grid

Solution

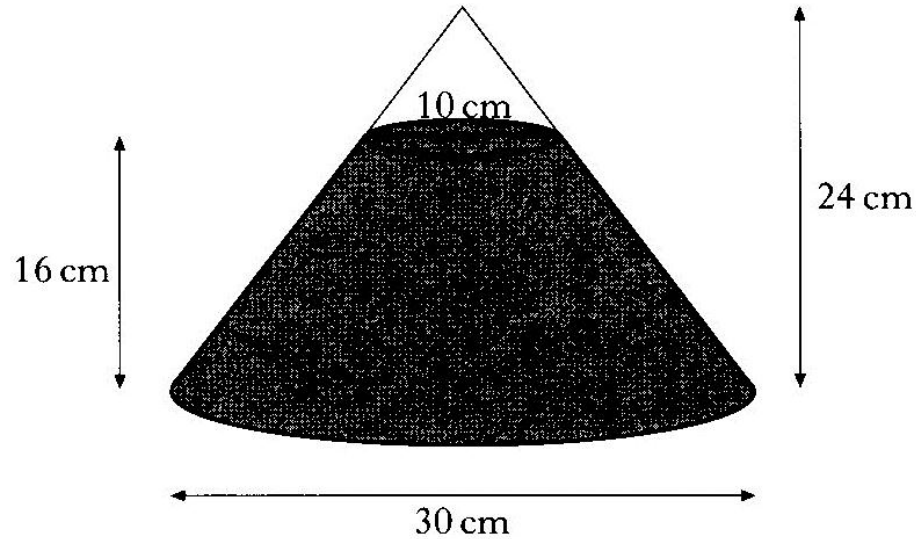
4 (a) $OTM = 90^\circ - 77^\circ = 13^\circ$

Triangle OMT is isosceles so $OMT = 13^\circ$

So $MOT = 180^\circ - (13^\circ + 13^\circ) = 154^\circ$

(b)
$$\begin{aligned} MT^2 &= 8^2 + 8^2 - (2 \times 8 \times 8 \times \cos 154^\circ) \\ &= 255.75 \\ &= \sqrt{255.75} \\ &= 15.99 \text{ cm} \end{aligned}$$

5. A glass ornament in the shape of a cone is partly filled with coloured water.



The cone is 24 centimetres high and has a base of diameter 30 centimetres. The water is 16 centimetres deep and measures 10 centimetres across the top.

What is the volume of the water?

Give your answer correct to 2 significant figures.

5

Main Grid**Solution**

$$\begin{aligned} 5. \quad \text{Volume of large cone} &= \frac{1}{3} \times \pi \times 15^2 \times 24 \\ &= 5654.862 \end{aligned}$$

$$\begin{aligned} \text{Volume of small cone} &= \frac{1}{3} \times \pi \times 5^2 \times 8 \\ \text{(at top)} & \\ &= 209.44 \end{aligned}$$

$$\begin{aligned} \text{Volume of water} &= \text{large cone} - \text{small cone} \\ &= 5654.862 - 209.44 \\ &= 5445.4 \\ &= \underline{\underline{5400 \text{ cm}^3}} \text{ (2 sig figs)} \end{aligned}$$

6. Tasnim rolls a standard dice with faces numbered 1 to 6.
The probability that she gets a number less than 7 is

- A 0
- B $\frac{1}{7}$
- C $\frac{1}{6}$
- D 1.

Write down the letter that corresponds to the correct probability.

1

$$\text{Prob}(7) = \frac{\textit{favourable}}{\textit{possible}} = \frac{6}{6} = 1$$

So choice 'D'

Main Grid

Solution

7. (a) Factorise **fully**

$$2x^2 - 18.$$

2

(b) Simplify

$$\frac{(2x+5)^2}{(2x-1)(2x+5)}.$$

1

(a) $2x^2 - 18$

$= 2(x^2 - 9)$ common factor

$= 2(x-3)(x+3)$ difference of two squares

(b) $\frac{(2x+5)^{\cancel{2}}}{(2x-1)\cancel{(2x+5)}}$ cancel by $(2x+5)$

$$= \frac{2x+5}{2x-1}$$

Main Grid

Solution

8. Solve the equation

$$2x^2 - 6x - 5 = 0,$$

giving the roots correct to one decimal place.

4

$$2x^2 - 6x - 5 = 0$$

$$a = 2 \quad b = -6 \quad c = -5$$

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - (4 \times 2 \times -5)}}{2 \times 2}$$

$$= \frac{6 \pm \sqrt{36 - (-40)}}{4}$$

$$= \frac{6 + \sqrt{76}}{4} \text{ or } \frac{6 - \sqrt{76}}{4}$$

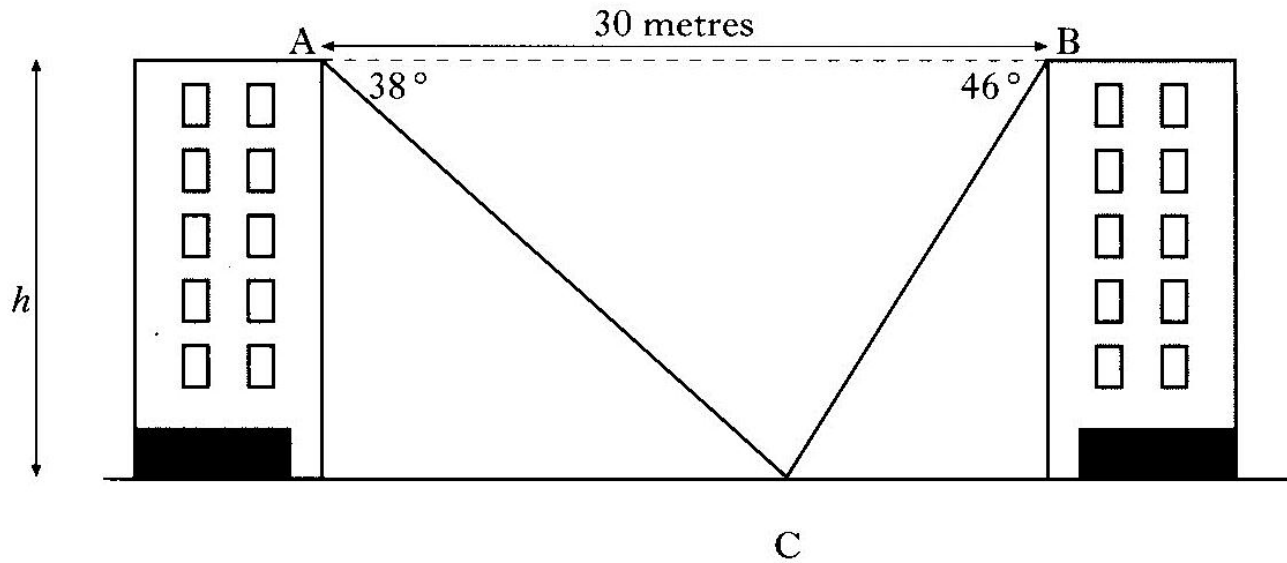
$$= 3.68 \quad \text{or} \quad -0.679$$

$$= 3.7 \quad \text{or} \quad -0.7 \quad \text{to 1d.p.}$$

Main Grid

Solution

9. The diagram shows two blocks of flats of equal height.



A and B represent points on the top of the flats and C represents a point on the ground between them.

To calculate the height, h , of each block of flats, a surveyor measures the angles of depression from A and B to C.

From A, the angle of depression is 38° .

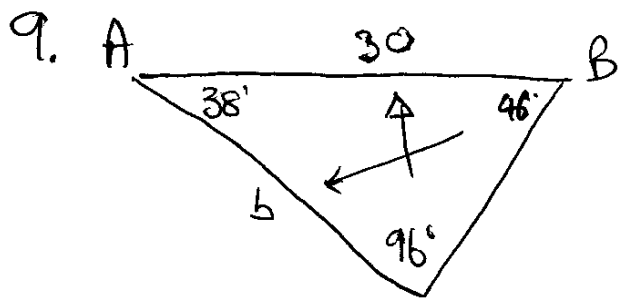
From B, the angle of depression is 46° .

The distance AB is 30 metres.

Calculate the height, h , in metres.

Main Grid

Solution



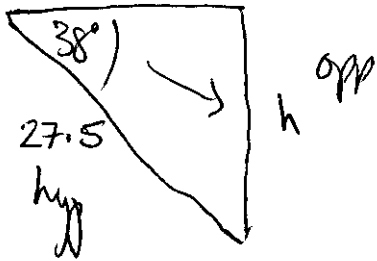
$$180 - (38 + 46) = 96$$

$$\frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{b}{\sin 46} = \frac{30}{\sin 96} \quad (\text{cross multiply})$$

$$b \sin 96 = 30 \sin 46$$

$$b = \frac{30 \sin 46}{\sin 96} = 21.7 \text{ m}$$



(S^oH) C^AH T^oA

$$\sin 38^\circ = \frac{h}{21.7}$$

$$h = 21.7 \times \sin 38^\circ$$

$$= \underline{\underline{13.4 \text{ m}}}$$

Main Grid

10. Express $\frac{5p^2}{8} \div \frac{p}{2}$ as a fraction in its simplest form.

$$\frac{5p^2}{8} \div \frac{p}{2}$$

$$= \frac{5p^2}{8} \times \frac{2}{p}$$

$$= \frac{10p^2}{8p}$$

Cancelling by p and 2

$$= \frac{5p}{4}$$

Main Grid

Solution

11. Change the subject of the formula

$$K = \frac{m^2 n}{p}$$

to m .

3

$$\frac{m^2 n}{p} = K$$

$$m^2 n = Kp$$

$$m^2 = \frac{Kp}{n}$$

$$m = \sqrt{\frac{Kp}{n}}$$

Main Grid

Solution

12. Simplify the expression below, giving your answer with a positive power.

$$m^5 \times m^{-8}$$

2

$$= m^{5+(-8)} = m^{5-8} = m^{-3}$$

$$= \frac{1}{m^3}$$

Main Grid

Solution

13. Solve the equation

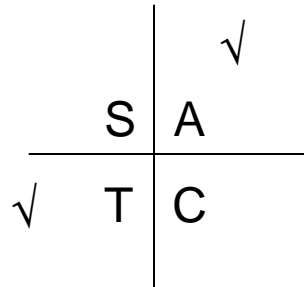
$$5 \tan x^\circ - 6 = 2, \quad 0 \leq x < 360.$$

3

$$5 \tan x = 2 + 6$$

$$\tan x = \frac{8}{5}$$

$$\begin{aligned} x &= \tan^{-1}\left(\frac{8}{5}\right) \\ &= 58^\circ \end{aligned}$$



Tan positive in quadrant 1 and 3

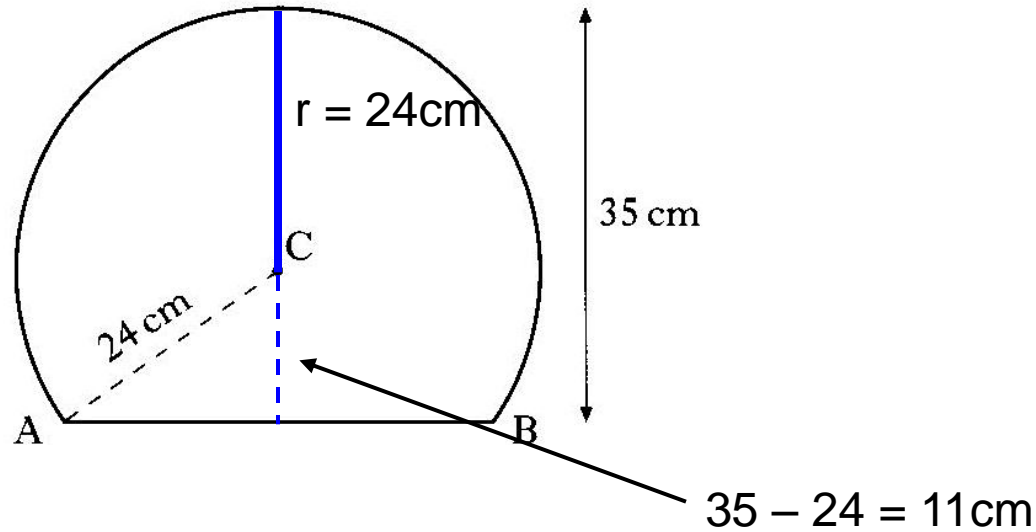
$$180^\circ + 58^\circ = 238^\circ$$

$$x = 58^\circ \text{ or } 238^\circ$$

Main Grid

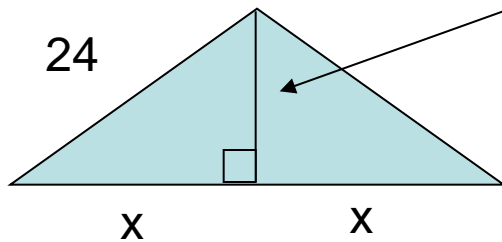
Solution

14. A mirror is shaped like part of a circle.



The radius of the circle, centre C, is 24 centimetres.
The height of the mirror is 35 centimetres.

Calculate the length of the base of the mirror, represented in the diagram by AB.



Pythagoras shorter side

$$x^2 = 24^2 - 11^2 = 576 - 121 = 455$$

$$x = \sqrt{455} = 21.3$$

$$\text{mirror base} = 2x = 2 \times 21.3 = 42.6\text{ cm}$$

3

Main Grid

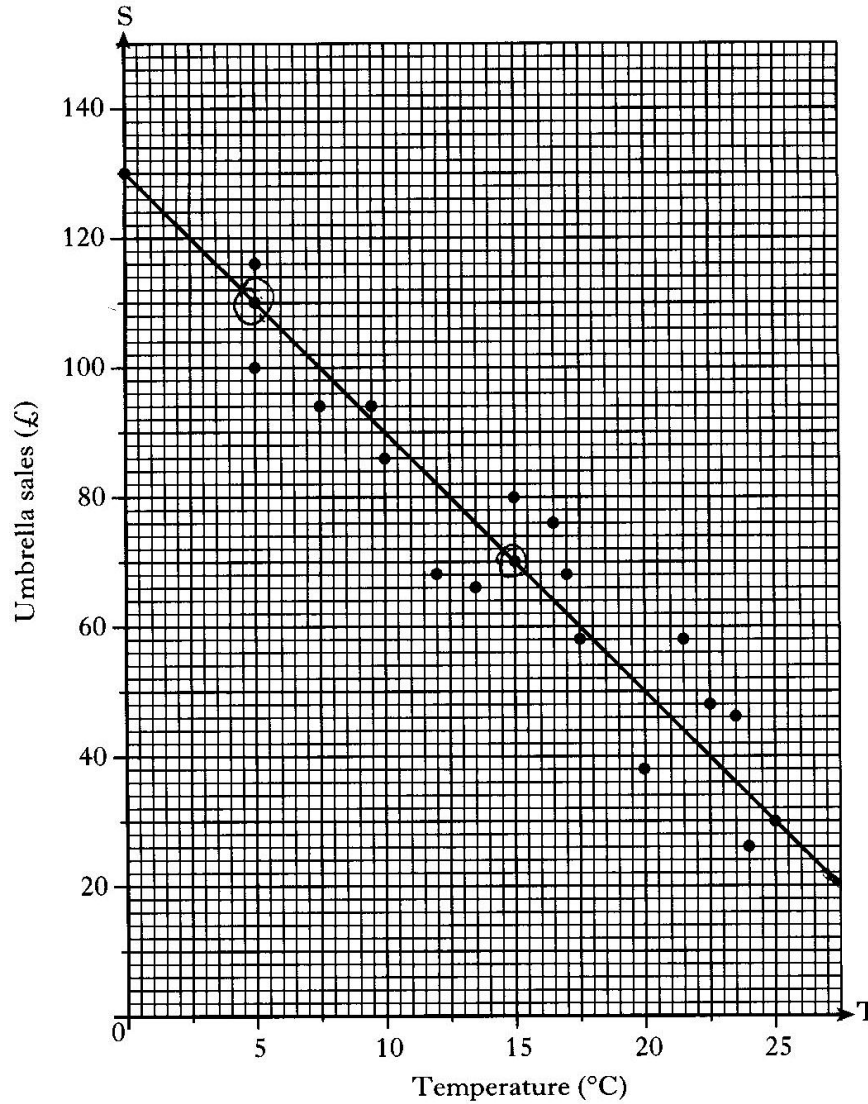
Solution

Main Grid

Solution

Main Grid

1. The temperature, in degrees Celsius, at mid-day in a seaside town and the sales, in pounds, of umbrellas are shown in the scattergraph below. A line of best fit has been drawn.



Main Grid

Solution

- (a) Find the equation of the line of best fit. 3
- (b) Use your answer to part (a) to predict the sales for a day when the temperature is 30 degrees Celsius. 1

(a)

$$m = \frac{115 - 70}{15 - 5} = \frac{45}{10} = 4.5$$

$$c = 130 \quad \text{from graph}$$

$$s = 4.5T + 130$$

$$\begin{aligned} (b) s &= 4.5 \times 30 + 130 \\ &= \text{£}265.00 \end{aligned}$$

2. Multiply out the brackets and collect like terms.

$$(2y - 3)(y^2 + 4y - 1)$$

3

$$\begin{aligned} & (2y - 3)(y^2 + 4y - 1) \\ &= 2y^3 + 8y^2 - 2y - 3y^2 - 12y + 3 \\ &= 2y^3 + 8y^2 - 2y - 3y^2 - 12y + 3 \\ &= 2y^3 + 5y^2 - 14y + 3 \end{aligned}$$

Main Grid

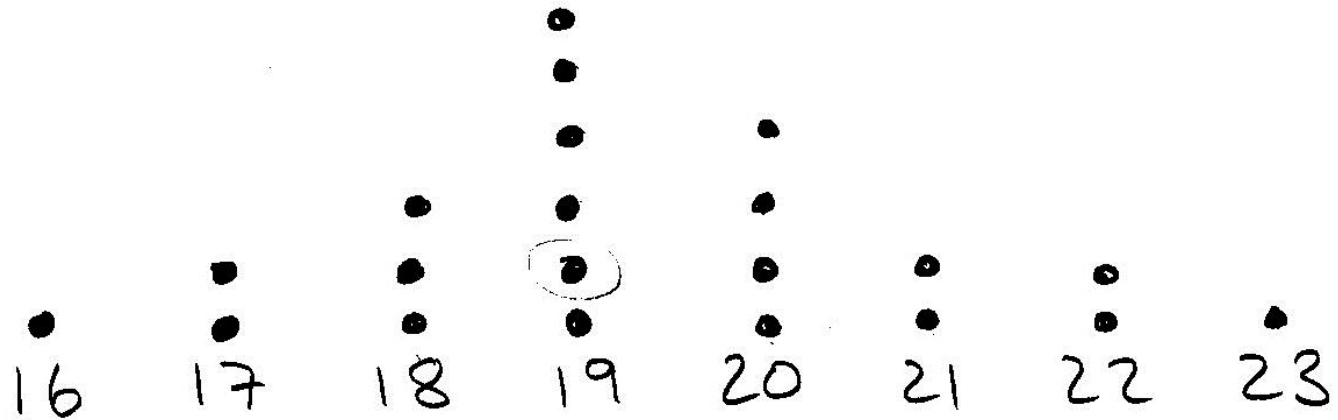
Solution

3. In a factory, the number of workers absent each day is recorded for 21 days. The results are listed below.

19	22	19	22	20	21	17
19	21	16	20	19	18	18
20	20	23	19	18	17	19

- (a) Construct a dotplot for this data. 2
- (b) Find:
- (i) the median; 1
 - (ii) the lower quartile; 1
 - (iii) the upper quartile. 1
- (c) What is the probability that, on a day chosen at random from this sample, more than 18 workers were absent? 1

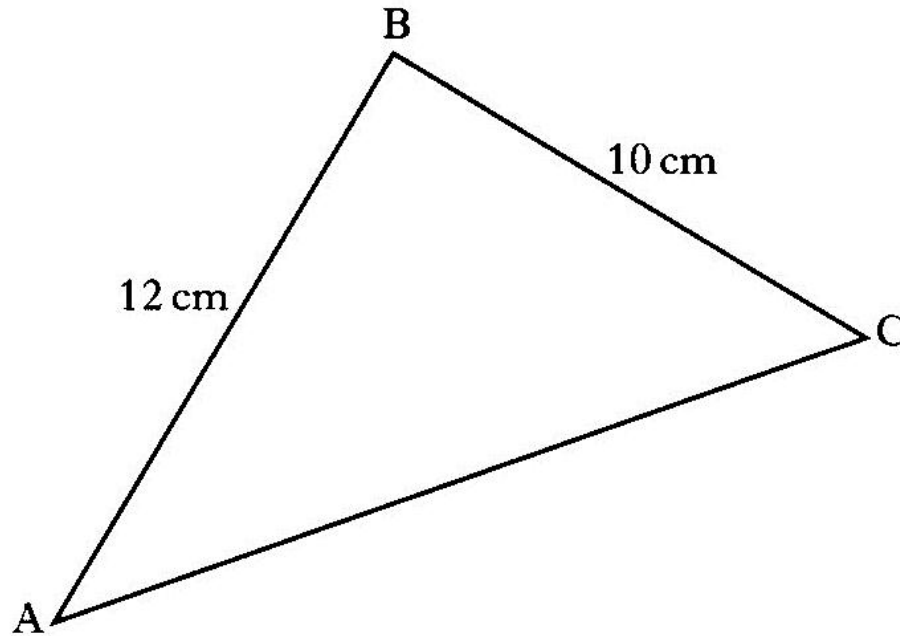
3. (a)



- (b) (i) median (11th) = 19
(ii) Lower Quartile = 18
(iii) Upper Quartile = 20.5

(c) Prob (>18 absent) = $\frac{15}{21} = \frac{5}{7}$

4.



Calculate the area of triangle ABC if $\sin B = \frac{2}{3}$.

$$\text{Area} = \frac{1}{2} ab \sin C$$

2

$$\text{Area} = \frac{1}{2} ac \sin B$$

$$= \frac{1}{2} \times 10 \times 12 \times \frac{2}{3}$$

$$= 40 \text{ cm}^2$$

Main Grid

Solution

5. A straight line is represented by the equation $2y + x = 6$.

(a) Find the gradient of this line.

2

(b) This line crosses the y -axis at $(0, c)$.

Find the value of c .

1

$$2y + x = 6$$

$$2y = -x + 6$$

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

gradient

$$m = -\frac{1}{2}$$

Intercept

$$c = 3$$

6. Write the following in order of size, **starting with the smallest**.

$$\sin 0^\circ$$

$$\sin 30^\circ$$

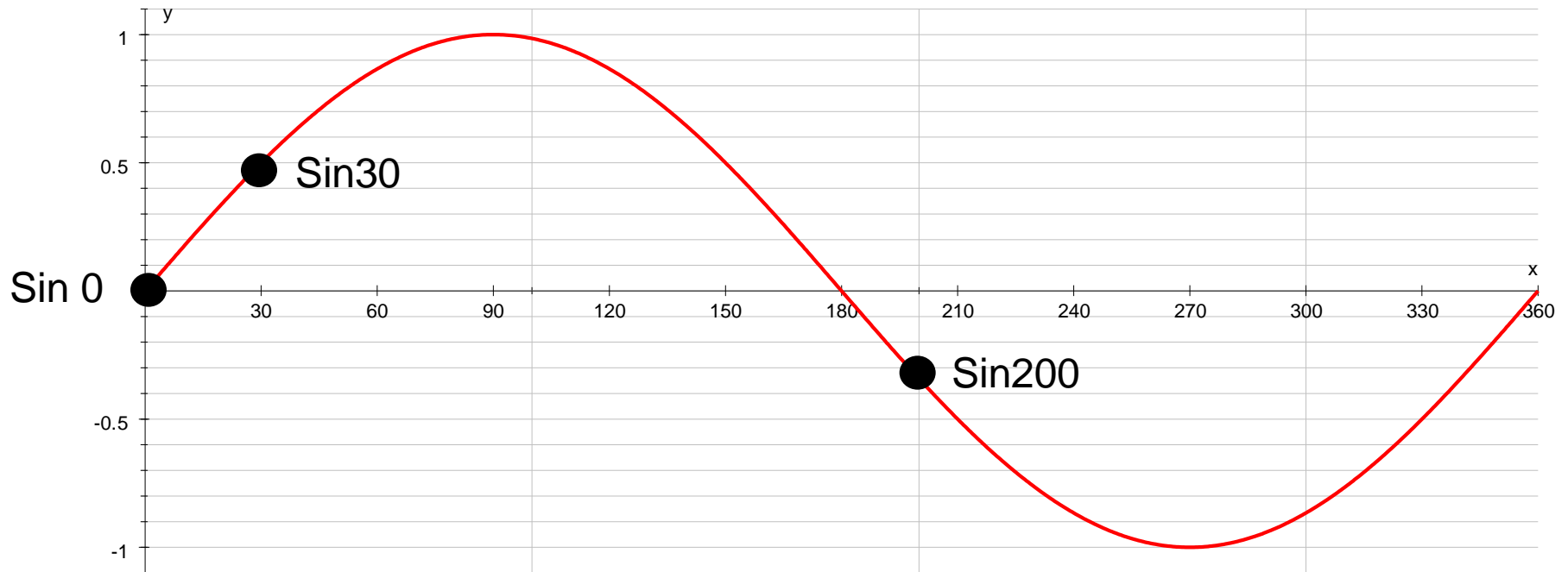
$$\sin 200^\circ$$

Give a reason for your answer.

2

$\sin 200^\circ$, $\sin 0^\circ$, $\sin 30^\circ$

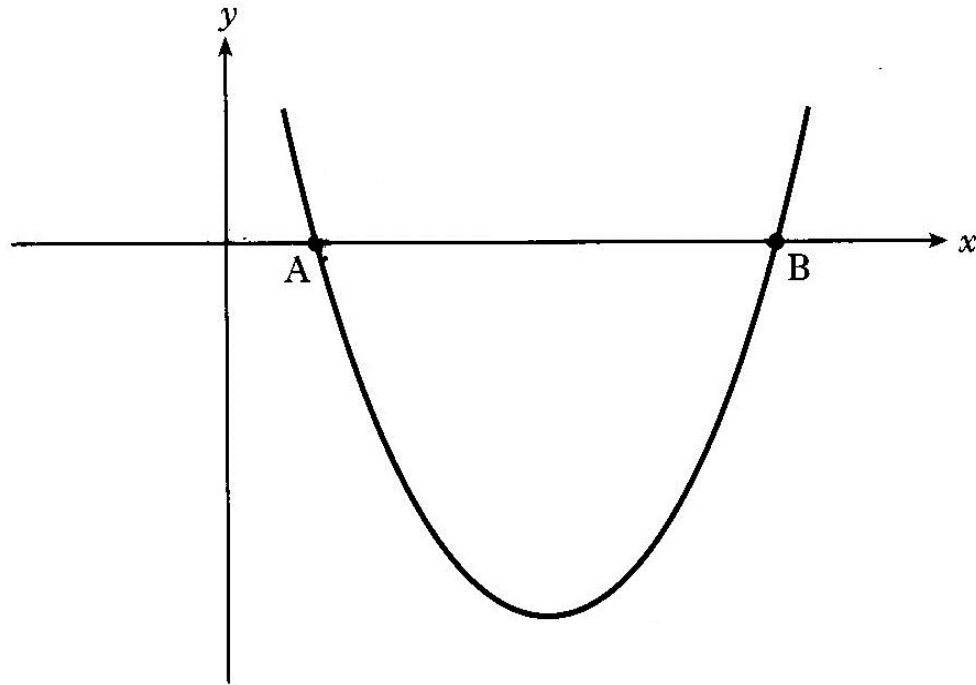
See graph



Main Grid

Solution

7.



The equation of the parabola in the above diagram is

$$y = (x - 3)^2 - 4.$$

- (a) State the coordinates of the minimum turning point of the parabola.
- (b) State the equation of the axis of symmetry of the parabola.
- (c) A is the point (1, 0). State the coordinates of B.

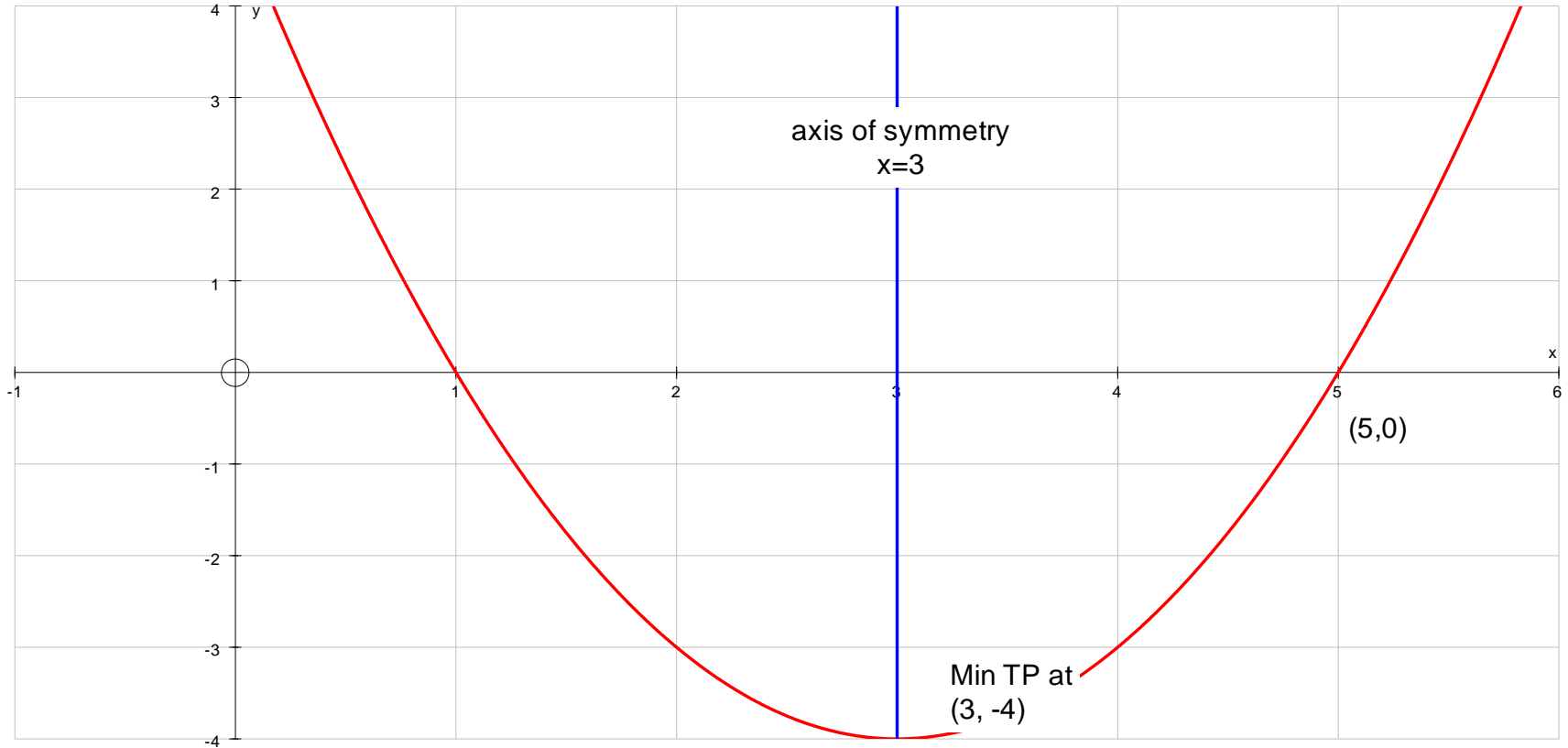
Main Grid

Solution

(a) $(3, -4)$

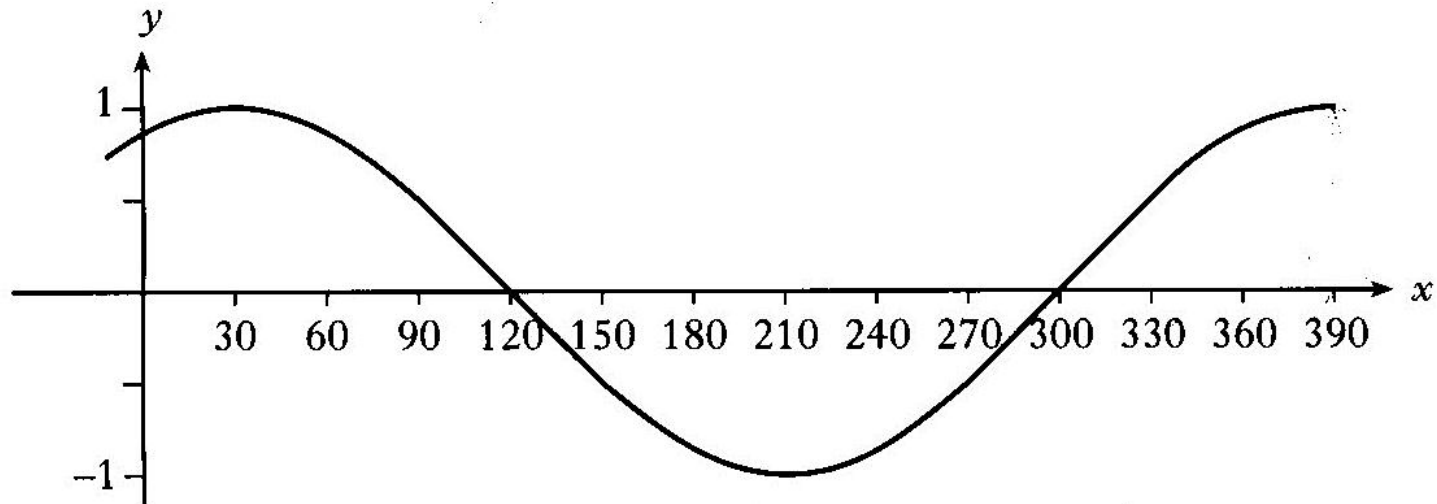
(b) $x = 3$

(c) $(5, 0)$



Main Grid

8. The graph shown below has an equation of the form $y = \cos(x - a)^\circ$.



Write down the value of a .

1

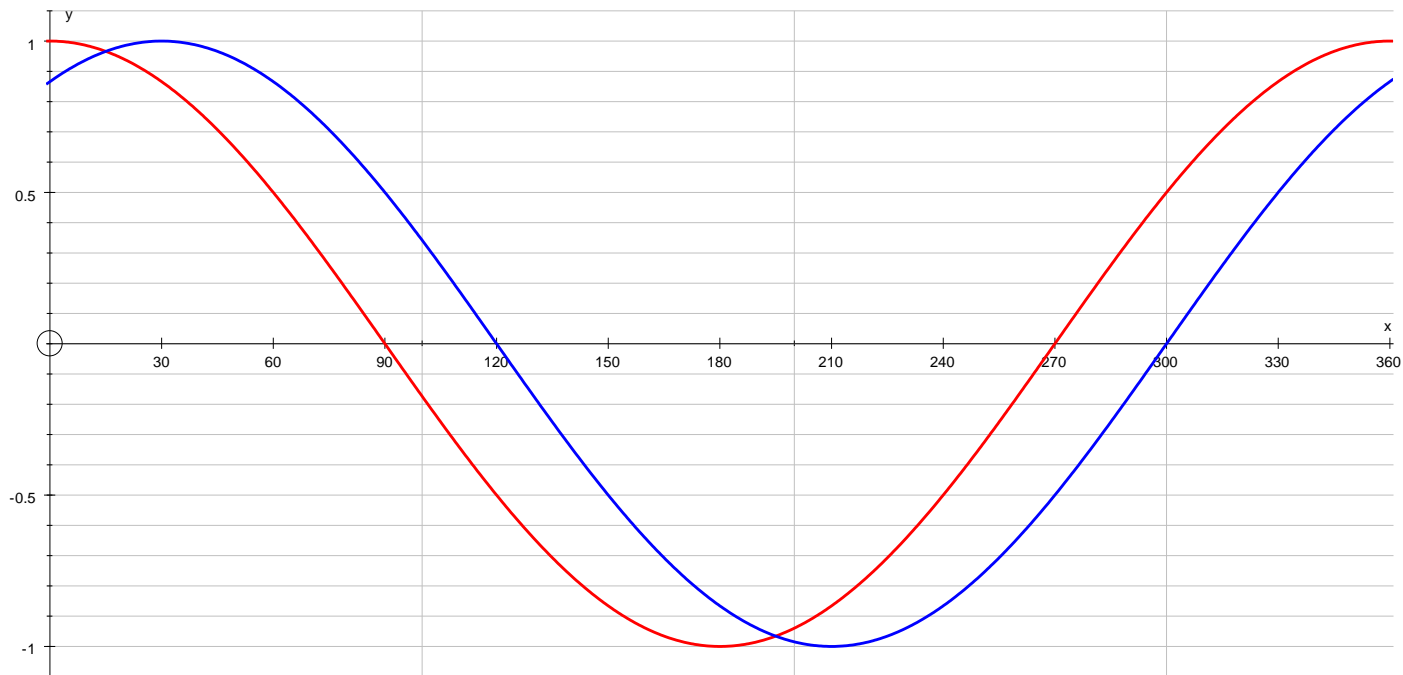
Main Grid

Solution

$$y = \cos(x - 30^\circ)$$

$$a = 30^\circ$$

Phase shift of 30° i.e. Cos graph has been 'moved' 30° to the right.



Main Grid

9. Evaluate

$$16^{\frac{3}{4}}$$

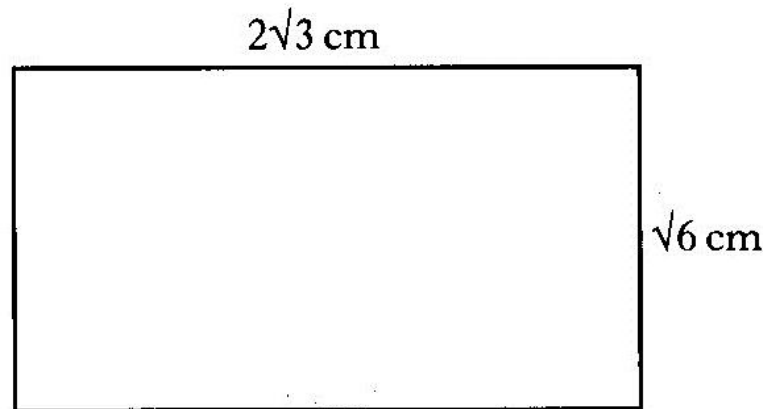
2

$$16^{\frac{3}{4}} = \left(16^{\frac{1}{4}}\right)^3 = (2)^3 = 8$$

Main Grid

Solution

10.



The rectangle above has length $2\sqrt{3}$ centimetres and breadth $\sqrt{6}$ centimetres.
Calculate the area of the rectangle.

Express your answer as a surd in its simplest form.

3

$$\begin{aligned} \text{Area} &= 2\sqrt{3} \times \sqrt{6} = 2\sqrt{18} \\ &= 2\sqrt{9} \times \sqrt{2} \\ &= 2 \times 3 \times \sqrt{2} \\ &= 6\sqrt{2} \end{aligned}$$

1. The value of a boat decreased from £35 000 to £32 200 in one year.

(a) What was the percentage decrease?

1

(b) If the value of the boat continued to fall at this rate, what would its value be after a **further** 3 years?

Give your answer to the nearest hundred pounds.

3

$$\begin{aligned}
 (a) \quad \% \text{ decrease} &= \frac{\textit{decrease}}{\textit{original price}} \times 100 \\
 &= \frac{2800}{35000} \times 100 \\
 &= 8\%
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad 32200 \times (0.92)^3 &= \text{£}25073.75 \\
 \textit{to nearest £100 is } &\text{£}25100
 \end{aligned}$$

2. Solve algebraically the system of equations

$$4x + 2y = 13$$

$$5x + 3y = 17.$$

3

$$4x + 2y = 13 \quad \times 3 \quad \text{eq1}$$

$$5x + 3y = 17 \quad \times 2 \quad \text{eq2}$$

$$12x + 6y = 39$$

$$\underline{10x + 6y = 34}$$

$$2x = 5 \quad \text{subtracting}$$

$$x = 2.5$$

$$\text{Sub into eq1} \quad 4 \times 2.5 + 2y = 13$$

$$2y = 13 - 10 = 3$$

$$y = \frac{3}{2}$$

$$\text{Check eq2} \quad 5 \times 2.5 + 3 \times \frac{3}{2} = 12.5 + 4.5 = 17 \quad \checkmark$$

Main Grid

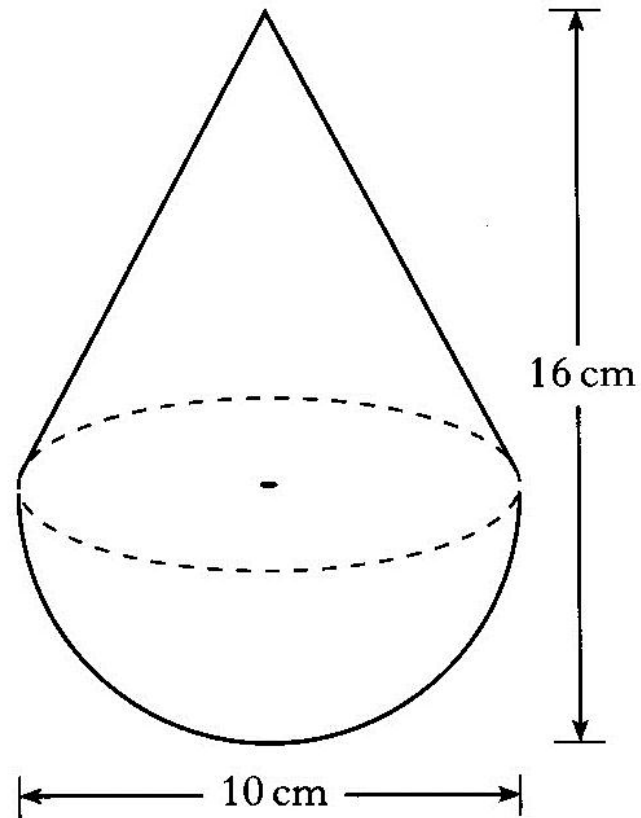
Solution

3. A child's toy is in the shape of a hemisphere with a cone on top, as shown in the diagram.

The toy is 10 centimetres wide and 16 centimetres high.

Calculate the volume of the toy.

Give your answer correct to 2 significant figures.



5

Main Grid

Solution

$$\begin{aligned} 3. \quad \text{Volume of hemisphere} &= \frac{1}{2} \times \frac{4}{3} \times \pi \times 5^3 \\ &= 261.799 \text{ cm}^3 \end{aligned}$$

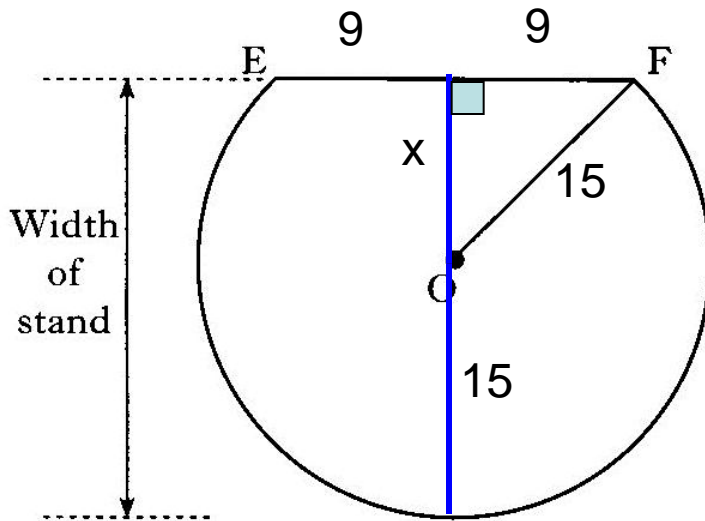
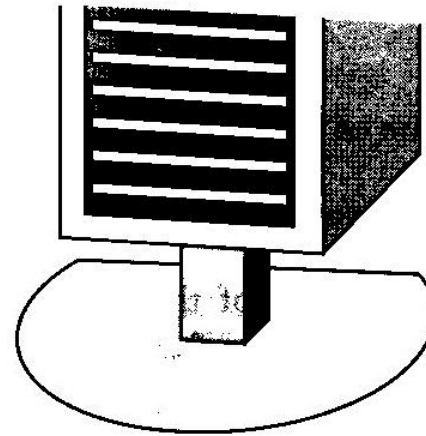
$$\text{Volume of cone} = \frac{1}{3} \pi r^2 h$$

$$\text{where } h = 16 - 5 = \underline{\underline{11 \text{ cm}}}$$

$$\begin{aligned} &= \frac{1}{3} \times \pi \times 5^2 \times 11 \\ &= 287.979 \end{aligned}$$

$$\begin{aligned} \text{Total volume} &= 261.799 + 287.979 \\ &= 549.778 \\ &= \underline{\underline{550 \text{ cm}^3}} \quad (2 \text{ s.f.}) \end{aligned}$$

4. The diagram shows the base of a compact disc stand which has the shape of part of a circle.



- The centre of the circle is O.
- EF is a chord of the circle.
- EF is 18 centimetres.
- The radius, OF, of the circle is 15 centimetres.

$$x^2 = 15^2 - 9^2 = 225 - 81 = 144$$

$$x = \sqrt{144} = 12$$

$$\text{Total Length} = 12 + 15 = 27 \text{ cm}$$

Find the width of the stand.

Pythagoras shorter side

4

Main Grid

Solution

5. A new central heating system is installed in a house.
Sample temperatures, in degrees Celsius, are recorded below.

19 21 23 21 19 20

(a) For this sample data, calculate:

(i) the mean;

1

(ii) the standard deviation.

3

Show clearly all your working.

The target temperature for this house is 20°Celsius . The system is judged to be operating effectively if the mean temperature is within $0.6^{\circ}\text{Celsius}$ of the target temperature **and** the standard deviation is less than 2°Celsius .

(b) Is the system operating effectively?

Give reasons for your answer.

2

$$\sum x = 19 + 21 + 23 + 21 + 19 + 20 = 123$$

$$(Mean) \bar{x} = \frac{\sum x}{n} = \frac{123}{6} = 20.5$$

$$\frac{(\sum x)^2}{n} = \frac{(123)^2}{6} = 2521.5$$

$$\sum x^2 = 19^2 + 21^2 + 23^2 + 21^2 + 19^2 + 20^2 = 2533$$

$$s = \sqrt{\frac{2533 - 2521.5}{6 - 1}}$$
$$= \sqrt{\frac{11.5}{5}} = \sqrt{2.3} = 1.52$$

Yes system is operating effectively as

Mean is 20.5°C which is < 20.6°C (max temp allowed)

Standard deviation is 1.52°C which is < 2°C (max standard deviation allowed)

Main Grid

6. Factorise

$$4p^2 - 49.$$

Difference of two squares

$$4p^2 - 49$$

$$= (2p + 7)(2p - 7)$$

7. Express

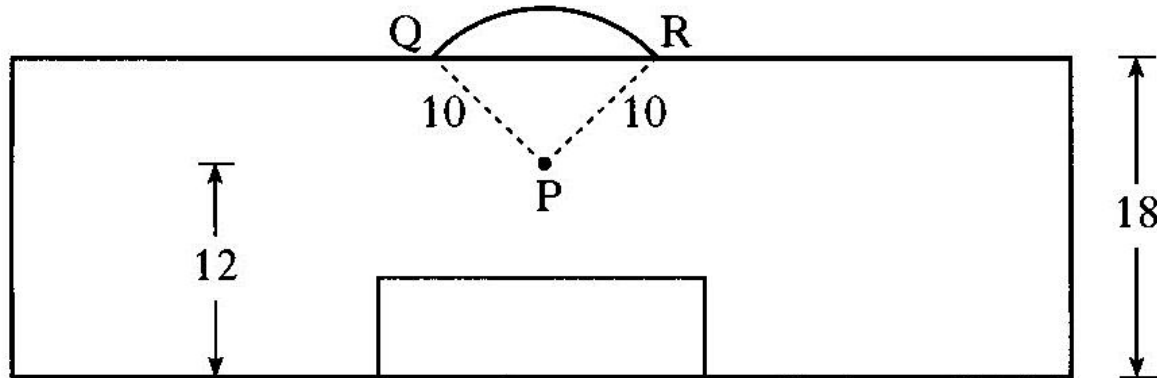
$$\frac{3}{(x+1)} - \frac{1}{(x-2)}, \quad x \neq -1, \quad x \neq 2$$

as a single fraction in its simplest form.

3

$$\begin{aligned} & \frac{3}{x+1} - \frac{1}{x-2} \\ = & \frac{3(x-2)}{(x+1)(x-2)} - \frac{x+1}{(x+1)(x-2)} \\ = & \frac{3x-6-x-1}{(x+1)(x-2)} \\ = & \frac{2x-7}{(x+1)(x-2)} \end{aligned}$$

8. The diagram shows the penalty area in a football pitch.
All measurements are given in yards.



The penalty spot is marked at point P.

QR is an arc of a circle, centre P, radius 10 yards.

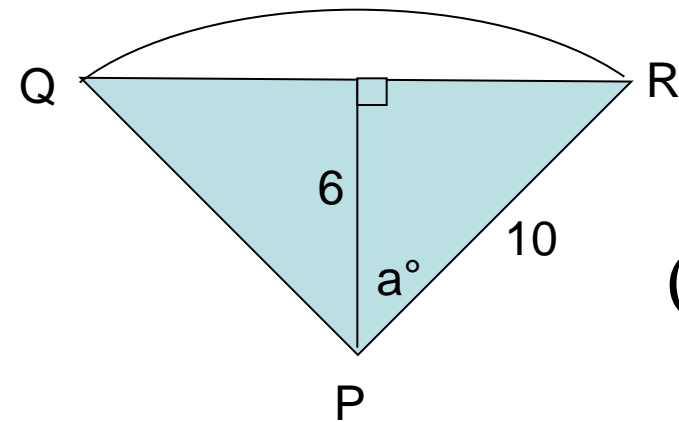
The width of the penalty area is 18 yards and the distance of the penalty spot from the goal line is 12 yards, as shown.

(a) Calculate the size of angle QPR.

3

(b) Calculate the length of arc QR.

2



$a^\circ = \frac{1}{2}$ of angle QPR

$$(a) \quad a^\circ = \cos^{-1}\left(\frac{6}{10}\right) = 53.1^\circ$$

$$\text{So } \text{QPR} = 2 \times a^\circ = 106.2^\circ$$

$$(b) \quad \text{arc } QR = \frac{106.2}{360} \times \pi \times 20$$

$$= 18.54 \text{ yds}$$

9. Change the subject of the formula

$$\frac{x}{c} + a = b$$

to x .

2

$$\frac{x}{c} + a = b$$

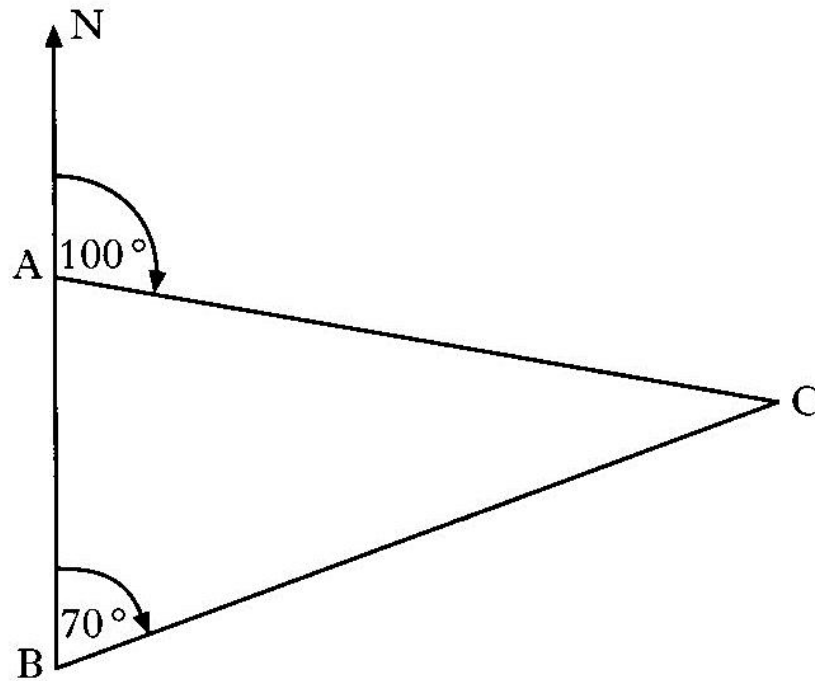
$$\frac{x}{c} = b - a$$

$$x = c(b - a)$$

Main Grid

Solution

10. The diagram below shows the position of three campsites A, B and C.



Alan sets off from campsite A on a bearing of 100° at an average speed of 5.6 kilometres per hour.

At the same time Bob sets off from campsite B on a bearing of 070° .

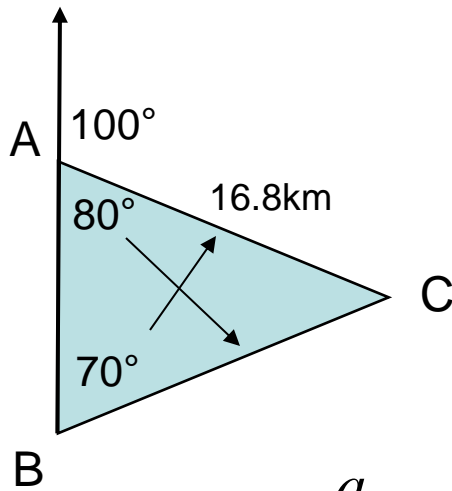
After 3 hours they both arrive at campsite C.

Who has the faster average speed and by how much?

5

Main Grid

Solution



$$\begin{aligned}
 D &= S \times T \\
 &= 5.3 \times 3 \\
 &= 16.8 \text{ km}
 \end{aligned}$$

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

$$\frac{a}{\sin 80} = \frac{16.8}{\sin 70} \quad (\text{cross multiply})$$

$$a \sin 70 = 16.8 \sin 80$$

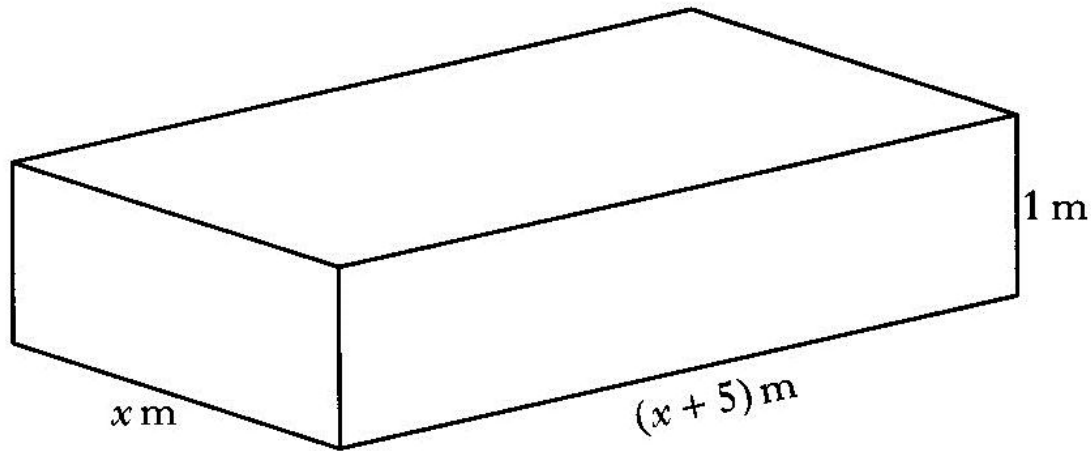
$$a = \frac{16.8 \sin 80}{\sin 70} = 17.61 \text{ m}$$

$$\text{Speed} = D \div T = 17.61 \div 3 = 5.87 \text{ km/h}$$

$$\text{Bob is faster by } 5.87 - 5.6 = 0.27 \text{ km/h}$$

Main Grid

11. A cuboid is shown below.



It has length $(x + 5)$ metres, breadth x metres, height 1 metre and volume 24 cubic metres.

(a) Show that

$$x^2 + 5x - 24 = 0.$$

2

(b) Using the equation in part (a), find the breadth of the cuboid.

3

Main Grid

Solution

$$(a) \quad V = lbh = x(x+5) \times 1 \\ = x^2 + 5x$$

$$\text{so} \quad x^2 + 5x = 24$$

$$x^2 + 5x - 24 = 0 \quad \text{as required}$$

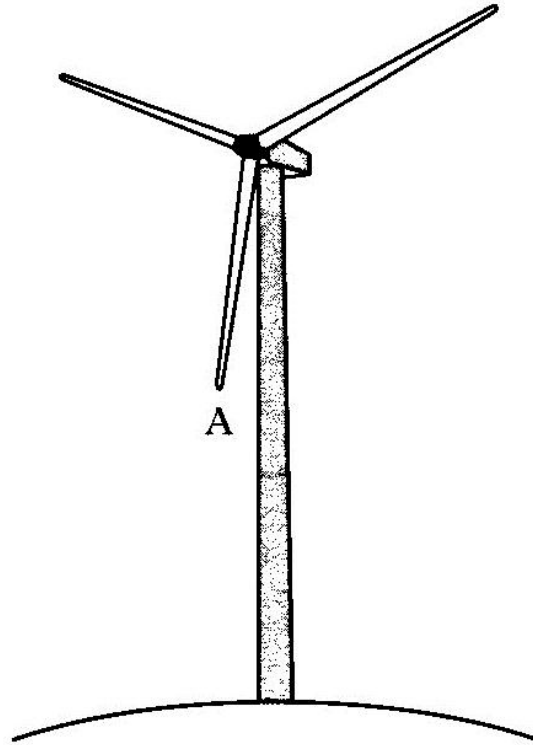
$$(b) \quad (x+8)(x-3) = 0$$

$$x = 8 \text{ or } x = 3$$

not valid

So breadth is 3m

12. The arms on a wind turbine rotate at a steady rate.



Main Grid

Solution

The height, h metres, of a point A above the ground at time t seconds is given by the equation

$$h = 8 + 4 \sin t^\circ.$$

- (a) Calculate the height of point A at time 30 seconds. 2
- (b) Find the **two** times during the first turn of the arms when point A is at a height of 10.5 metres. 4

$$12(a) \quad h = 8 + 4\sin 30 \\ = 10m$$

$$(b) \quad 8 + 4\sin t = 10.5$$

$$4\sin t = 2.5$$

$$\sin t = \frac{2.5}{4} = 0.625$$

$$t = \sin^{-1}(0.625) = 38.7s$$

√		√
	S	A
<hr/>		
	T	C

Sin t positive in 2nd quad : $(180 - 38.7) = 141.3s$

*Marks***ALL questions should be attempted.**

1. The stem and leaf diagram below shows the heights of a group of children.

12	1	2	4	5	9
13	0	0	1	5	7 8
14	0	2	8	9	
15	1	1	2		

$n = 18$

12 | 1 represents 121 centimetres

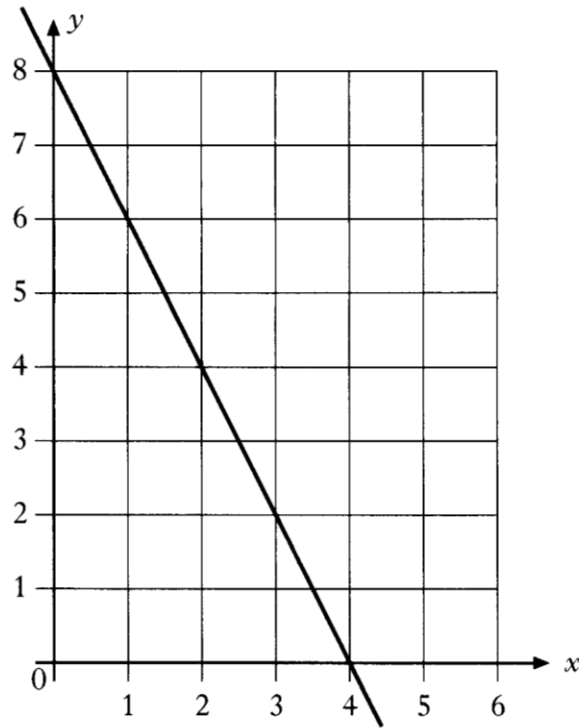
What is the probability that a child chosen at random from this group has a height less than 130 centimetres?

1

$$\text{prob}(n < 130) = \frac{5}{18}$$

Main Grid**Solution**

2.



$$(a) \quad m = \frac{-8}{4} = -2 \quad c = 8$$

$$y = -2x + 8$$

$$(b) \quad (2, 4)$$

(a) Find the equation of the straight line shown in the diagram. 3

(b) Find the coordinates of the point where the line $y = 2x$ meets this line. 2

Main Grid

Solution

3. (a) Multiply out the brackets and collect like terms.

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

3

$$\begin{aligned} & (4x + 2)(x - 5) + 3x \\ &= 4x^2 + 2x - 20x - 10 + 3x \\ &= 4x^2 - 15x - 10 \end{aligned}$$

(b) Factorise

$$2p^2 - 5p - 12.$$

2

$$\begin{aligned} & 2p^2 - 5p - 12 \\ &= (2p + 3)(p - 4) \end{aligned}$$

Main Grid

Solution

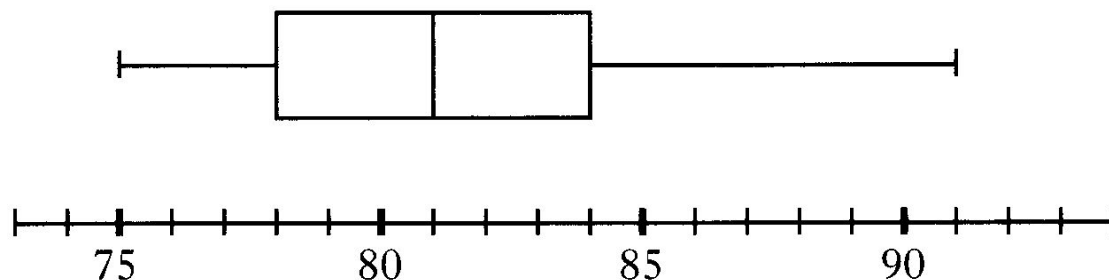
4. For a group of freezers in a shop, the volume, in litres, of each one is listed below.

78 81 91 75 85 83 84 78

(a) For the given data, calculate:

- (i) the median; 1
- (ii) the lower quartile; 1
- (iii) the upper quartile. 1

One of the numbers from the above list was accidentally missed out. A boxplot was then drawn and is shown below.



(b) Which number was missed out?

Give a reason for your answer.

2

(a) 75 78 78 81 83 84 85 91
 ↑ ↑ ↑
 Q1 m Q3

(i) median = 82

(ii) Q1 = 78

(iii) Q3 = 84.5

(b) 85 missed out

gives new median as 81

and Q3 as 84 as shown

75 78 78 81 83 84 91
 ↑ ↑ ↑
 Q1 m Q3

5. Simplify

$$k^8 \times (k^2)^{-3}.$$

2

$$k^8 \times k^{2 \times -3}$$

$$= k^8 \times k^{-6}$$

$$= k^{8+(-6)}$$

$$= k^2$$

Main Grid

Solution

6. Given that

$$\tan 45^\circ = 1,$$

what is the value of $\tan 135^\circ$?

1

$$\tan 135^\circ = \tan(180^\circ - 45^\circ) = -1$$

-1 because $\tan 135^\circ$ is negative in 2nd quadrant

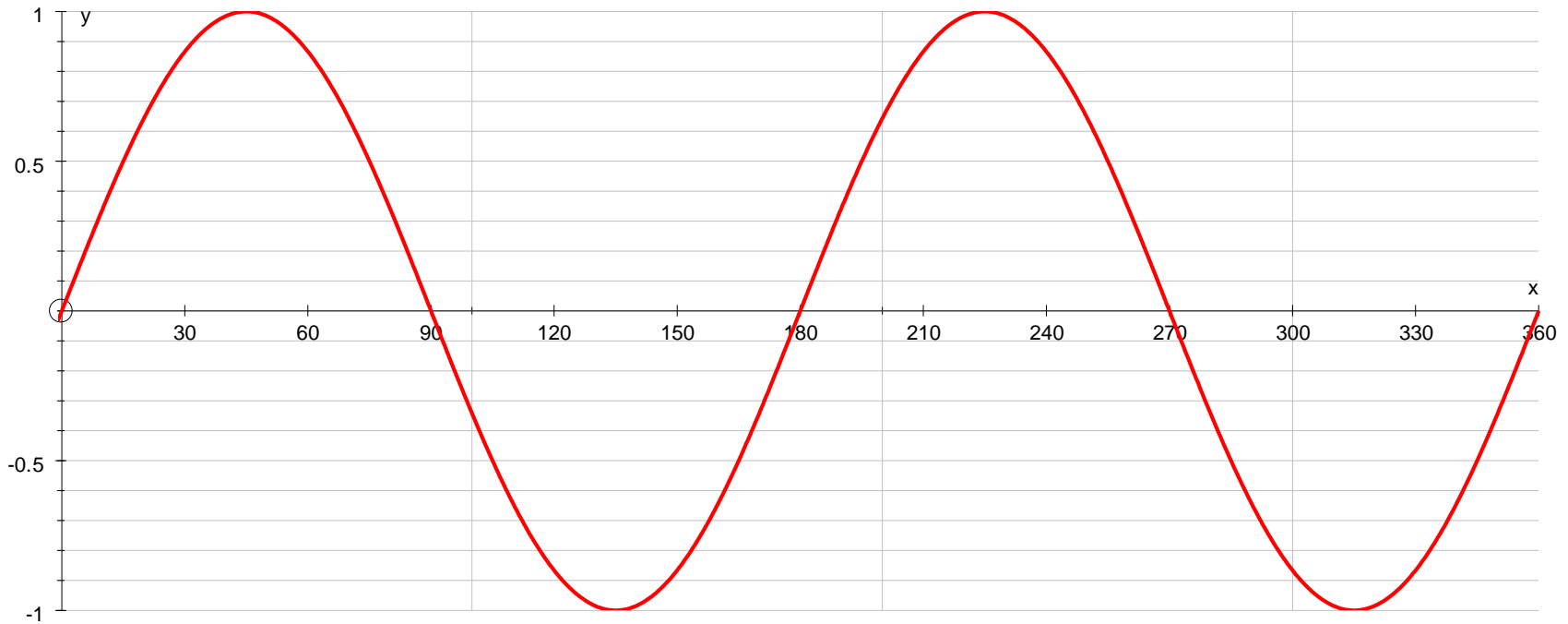
Main Grid

Solution

7. Sketch the graph of

$$y = \sin 2x^\circ, \quad 0 \leq x \leq 360.$$

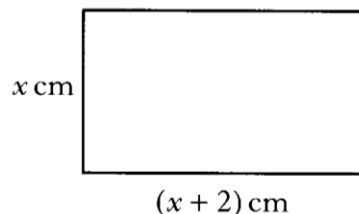
3



Main Grid

Solution

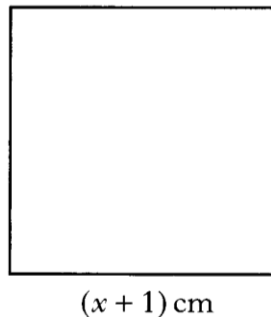
8. A rectangle has length $(x + 2)$ centimetres and breadth x centimetres.



- (a) Write down an expression for the area of the rectangle.

$$\text{Area} = \text{length} \times \text{breadth} = x(x + 2) = x^2 + 2x$$

A square has length $(x + 1)$ centimetres.

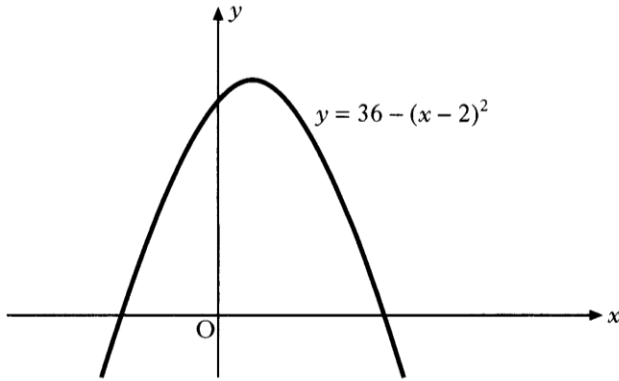


- (b) The area of the square above is greater than the area of the rectangle.
By how much is it greater?

$$\text{Area} = (x + 1)(x + 1) = x^2 + 2x + 1$$

So square is greater than rectangle by 1 cm^2

9. The diagram below shows part of the graph of $y = 36 - (x - 2)^2$.



(a) $(2, 36)$

(b) $x = 2$

(a) State the coordinates of the maximum turning point.

2

(b) State the equation of the axis of symmetry.

1

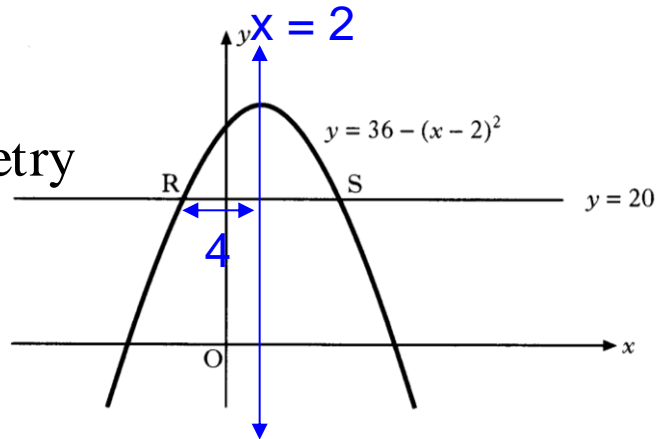
The line $y = 20$ is drawn.

It cuts the graph of $y = 36 - (x - 2)^2$ at R and S as shown below.

Since axis of symmetry is $x = 2$

R is 4 units to the left of axis of symmetry

R $(-2, 20)$



(c) S is the point $(6, 20)$. Find the coordinates of R.

2

Main Grid

Solution

1. In the evening, the temperature in a greenhouse drops by 4% per hour.
At 8 pm the temperature is 28° Celsius.
What will the temperature be at 11 pm?

3

$$\begin{aligned}\text{Final temp} &= 28 \times (0.96)^3 \\ &= 24.8^{\circ} C\end{aligned}$$

Main Grid

Solution

2. In a bakery, a sample of six fruit loaves is selected and the weights, in grams, are recorded.

395 400 408 390 405 402

For the above data the mean is found to be 400 grams.

- (a) Calculate the standard deviation.

Show clearly all your working.

3

- (b) New methods are introduced to ensure more consistent weights.

Another sample is then taken and the mean and standard deviation found to be 400 grams and 5.8 grams respectively.

Are the new methods successful?

Give a reason for your answer.

1

$$\sum x = 395 + 400 + 408 + 390 + 405 + 402 = 2400$$

$$(Mean) \bar{x} = \frac{\sum x}{n} = \frac{2400}{6} = 20.5$$

$$\frac{(\sum x)^2}{n} = \frac{(2400)^2}{6} = 960000$$

$$\sum x^2 = 395^2 + 400^2 + 408^2 + 390^2 + 405^2 + 402^2 = 960218$$

$$s = \sqrt{\frac{960218 - 960000}{6 - 1}}$$
$$= \sqrt{\frac{218}{5}} = \sqrt{43.6} = 6.60$$

(b) Yes, because the mean weights are exactly the same and the standard deviation is less, $5.8 < 6.6$

So spread is less. More consistent weights.

Main Grid

3. A straight line has equation $3y = 12 - 4x$.

Find the coordinates of the point where it crosses the x -axis.

2

On x axis $y = 0$

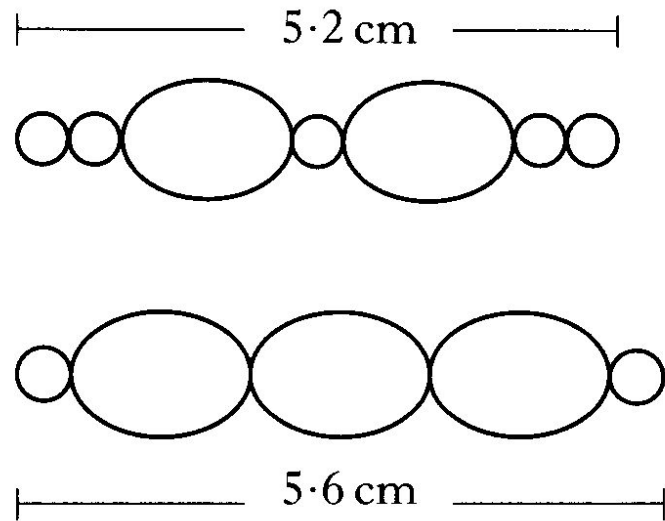
$$0 = 12 - 4x$$

$$4x = 12$$

$$x = 3$$

Coord is (3, 0)

4. A jeweller uses two different arrangements of beads and pearls.



The first arrangement consists of 2 beads and 5 pearls and has an overall length of 5.2 centimetres.

The second arrangement consists of 3 beads and 2 pearls and has an overall length of 5.6 centimetres.

Find the length of **one** bead and the length of **one** pearl.

6

Main Grid

Solution

$$2b + 5p = 5.2 \quad \times 3$$

$$6b + 15p = 15.6$$

$$3b + 2p = 5.6 \quad \times 2$$

$$\underline{6b + 4p = 11.2}$$

subtract

$$11p = 4.4$$

$$p = 0.4$$

Substitute into first equation

$$2b + 5 \times 0.4 = 5.2$$

$$2b = 5.2 - 2$$

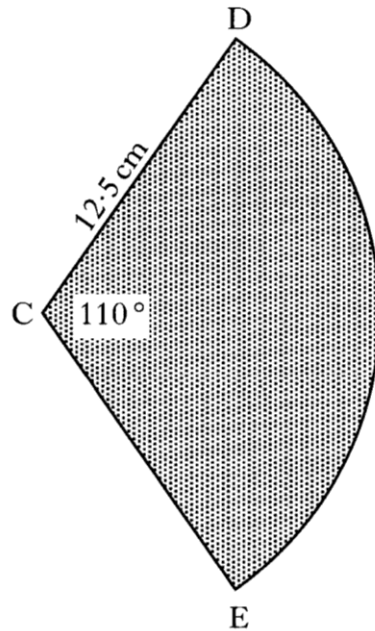
$$2b = 3.2$$

$$b = 1.6$$

Check with second equation $3 \times 1.6 + 2 \times 0.4 = 4.8 + 0.8 = 5.6$

So 1bead + 1pearl = $0.4 + 1.6 = 2.0$ cm

5. The diagram below shows a sector of a circle, centre C.



The radius of the circle is 12.5 centimetres and angle DCE is 110° .
Calculate the area of the sector CDE.

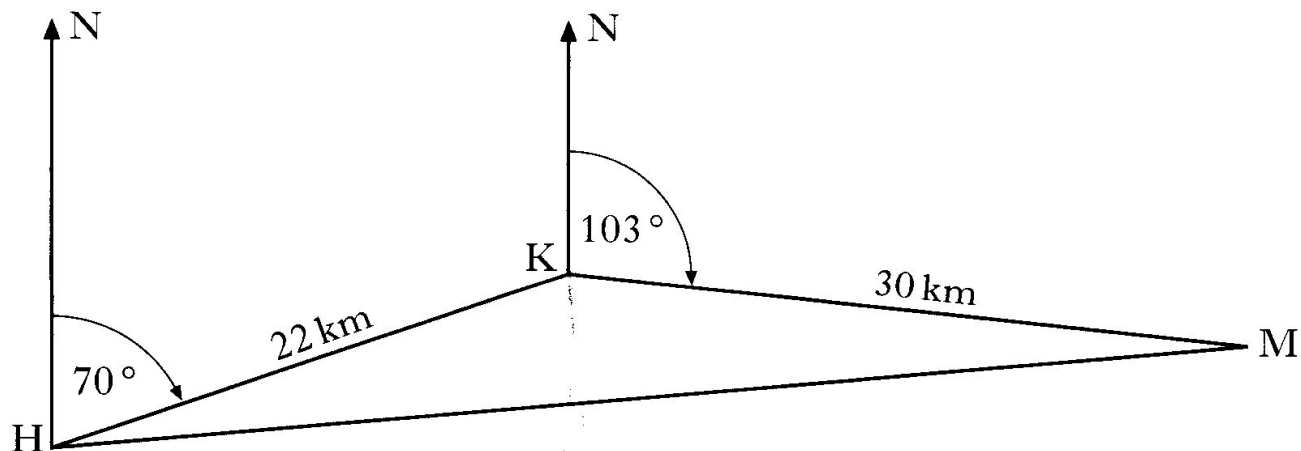
3

$$\begin{aligned}\text{Area of Sector} &= \frac{110}{360} \times \pi \times 12.5^2 \\ &= 149.989 \\ &= 150\text{cm}^2\end{aligned}$$

Main Grid

Solution

6. In the diagram below three towns, Holton, Kilter and Malbrigg are represented by the points H, K and M respectively.



A helicopter flies from Holton for 22 kilometres on a bearing of 070° to Kilter. It then flies from Kilter for 30 kilometres on a bearing of 103° to Malbrigg. The helicopter then returns directly to Holton.

- (a) (i) Calculate the size of angle HKM. 1
(ii) Calculate the total distance travelled by the helicopter. 3

Do not use a scale drawing.

- (b) A climber is reported missing somewhere in the triangle represented by HKM in the diagram.
Calculate the area of this triangle. 2

(a) (i) $70^\circ + 180^\circ = 250^\circ$

(ii) Cosine Rule

$$\begin{aligned}k^2 &= m^2 + n^2 - (2 \times m \times n \times \text{Cos}K) \\ &= 22^2 + 30^2 - (2 \times 22 \times 30 \times \text{Cos}250^\circ) \\ &= 1835\end{aligned}$$

$$k = \sqrt{1835} = 42.8 \text{ km}$$

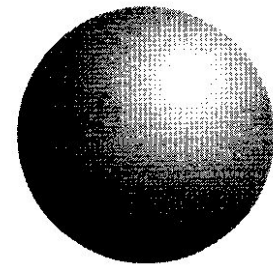
$$\begin{aligned}\text{Total distance travelled} &= 22 + 30 + 42.8 \\ &= 94.8 \text{ km}\end{aligned}$$

(b) Area of Triangle = $\frac{1}{2} \times h \times m \times \text{Sin}K$

$$\begin{aligned}&= \frac{1}{2} \times 22 \times 30 \times \sin 250^\circ \\ &= 310.1 \text{ km}^2\end{aligned}$$

[NOTE: ignore negative sign]

7. A pharmaceutical company makes vitamin pills in the shape of spheres of radius 0.5 centimetres.

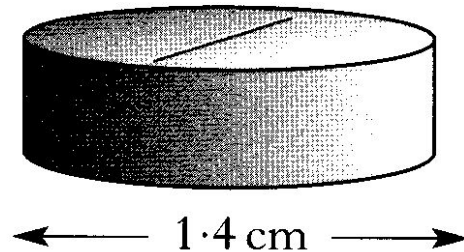


- (a) Calculate the volume of **one** pill.

Give your answer correct to two significant figures.

3

The company decides to change the shape of each pill to a cylinder.



- (b) The new pill has the **same** volume as the original and its diameter is 1.4 centimetres.

Calculate the height of the new pill.

3

Main Grid

Solution

$$\begin{aligned}(a) \text{ Vol of sphere} &= \frac{4}{3} \pi r^3 \\ &= \frac{4}{3} \times \pi \times (0.5)^3 \\ &= 0.52359 \\ &= 0.52 \quad (2 \text{ sig figs})\end{aligned}$$

$$(b) \text{ Vol of Cylinder} = \pi r^2 h$$

$$h = \frac{V}{\pi r^2} \quad (\text{Vol cyl} = \text{vol sphere} = 0.52 \text{cm}^3)$$

$$\begin{aligned}&= \frac{0.52}{\pi \times 0.7^2} \\ &= 0.3377\end{aligned}$$

$$\text{height} = 0.34 \text{cm}$$

8. Solve the equation

$$4x^2 - 7x + 1 = 0$$

giving the roots correct to one decimal place.

$$4x^2 - 7x + 1 = 0$$

$$a = 4 \quad b = -7 \quad c = 1$$

$$x = \frac{-(-7) \pm \sqrt{(-7)^2 - (4 \times 4 \times 1)}}{2 \times 4}$$

$$= \frac{7 \pm \sqrt{49 - 16}}{8}$$

$$= \frac{7 + \sqrt{33}}{8} \text{ or } \frac{7 - \sqrt{33}}{8}$$

$$= 1.59 \quad \text{or} \quad 0.156$$

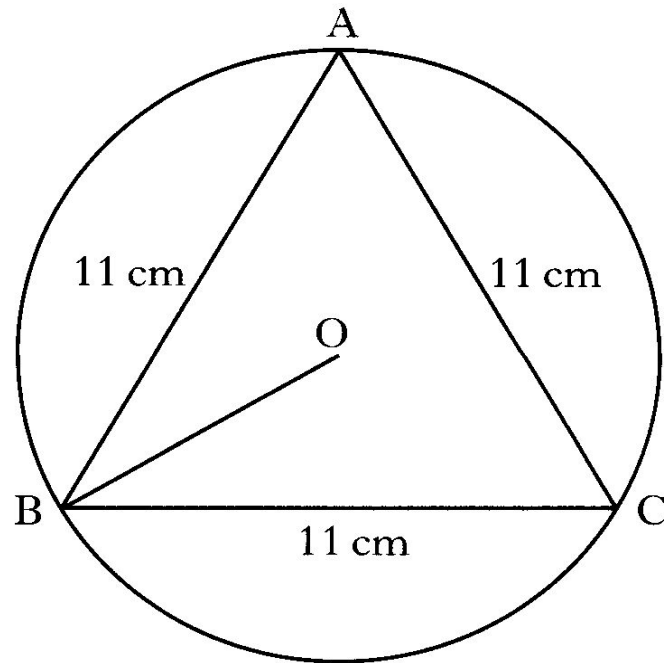
$$= 1.6 \quad \text{or} \quad 0.16 \quad \text{to 1d.p.}$$

4

Main Grid

Solution

9. Points A, B and C lie on the circumference of a circle, centre O.



Triangle ABC is equilateral with sides of length 11 centimetres as shown in the diagram.

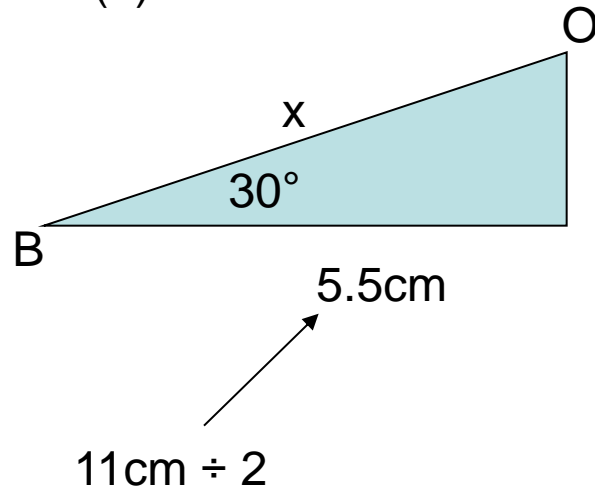
- (a) Write down the size of angle OBC. 1
- (b) Calculate the length of the radius OB. 3

Main Grid

Solution

(a) $60^\circ \div 2 = 30^\circ$

(b)



$$\cos B = \frac{\text{adj}}{\text{hyp}} = \frac{5.5}{x}$$

$$x = \frac{5.5}{\cos 30^\circ}$$
$$= 6.35$$

So $OB = 6.35\text{m}$

Main Grid

10. (a) Express $\frac{7}{\sqrt{2}}$ as a fraction with a rational denominator. 2

(b) Express $\frac{a}{b} \times \frac{3b}{a^2}$ as a fraction in its simplest form. 2

(c) Change the subject of the formula

$$p = q + 2r^2 \quad \text{to } r. \quad \text{3}$$

$$(a) \frac{7}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{7\sqrt{2}}{2}$$

$$(c) \quad q + 2r^2 = p$$

$$2r^2 = p - q$$

$$(b) \frac{a}{b} \times \frac{3b}{a^2} = \frac{3ab}{ba^2} = \frac{3}{a} \quad \text{cancelling by } a \text{ and } b$$

$$r^2 = \frac{p - q}{2}$$

$$r = \sqrt{\frac{p - q}{2}}$$

11. (a) Solve the equation

$$7 \cos x^\circ - 5 = 0, \quad 0 \leq x < 360.$$

3

(b) Simplify

$$\tan x^\circ \cos x^\circ.$$

2

$$(a) 7 \cos x - 5 = 0$$

$$7 \cos x = 5$$

$$\cos x = \frac{5}{7}$$

$$x = \cos^{-1}\left(\frac{5}{7}\right)$$

$$= 44.4^\circ$$

Also positive in the 4th quadrant $x = (360 - 44.4)$

$$= 315.6^\circ$$

$$(b) \tan x \times \cos x$$

$$= \frac{\sin x}{\cos x} \times \cos x$$

$$= \sin x$$

Main Grid

Solution

1. In a class test, the following marks were recorded.

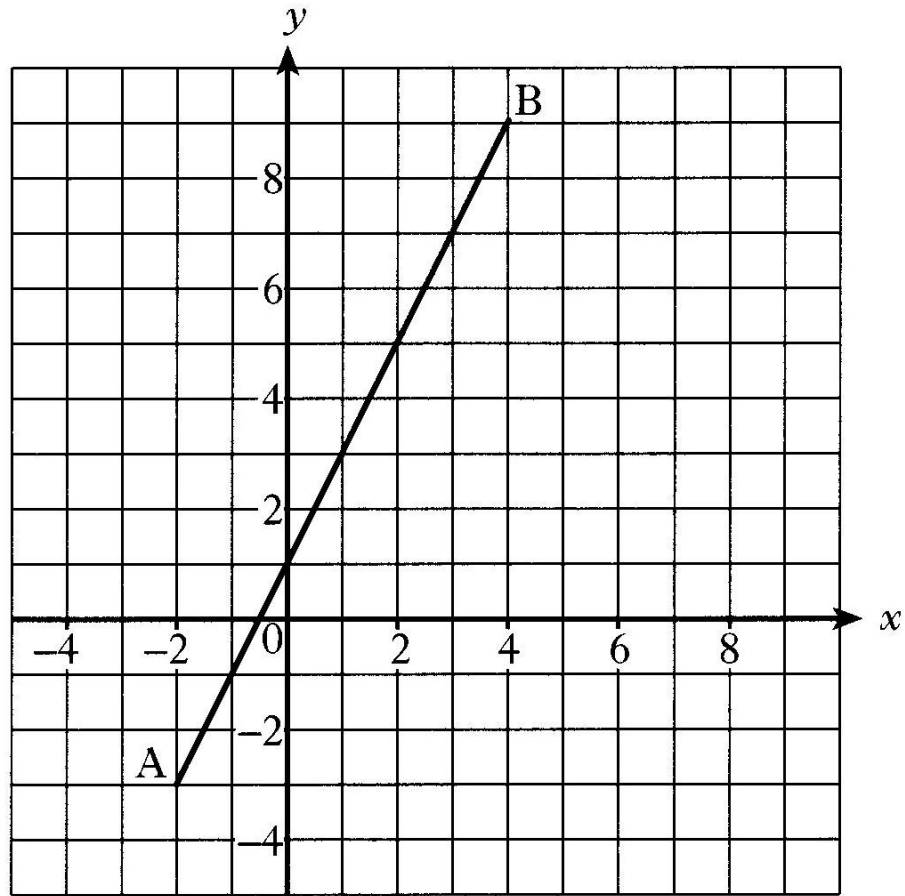
5 9 10 4 5 5 6 10 5 8
 5 7 4 9 7 5 4 6 5 7

- (a) Construct a frequency table for the above data and add a cumulative frequency column. 2
- (b) What is the probability that a student, chosen at random from this class, obtained a mark higher than 7? 1

Number	Freq	Cum Freq
4	3	3
5	7	10
6	2	12
7	3	15
8	1	16
9	2	18
10	2	20

$$(b) \text{ Prob}(> 7) = 5/20 = \frac{1}{4}$$

2.



(3)

Main Grid

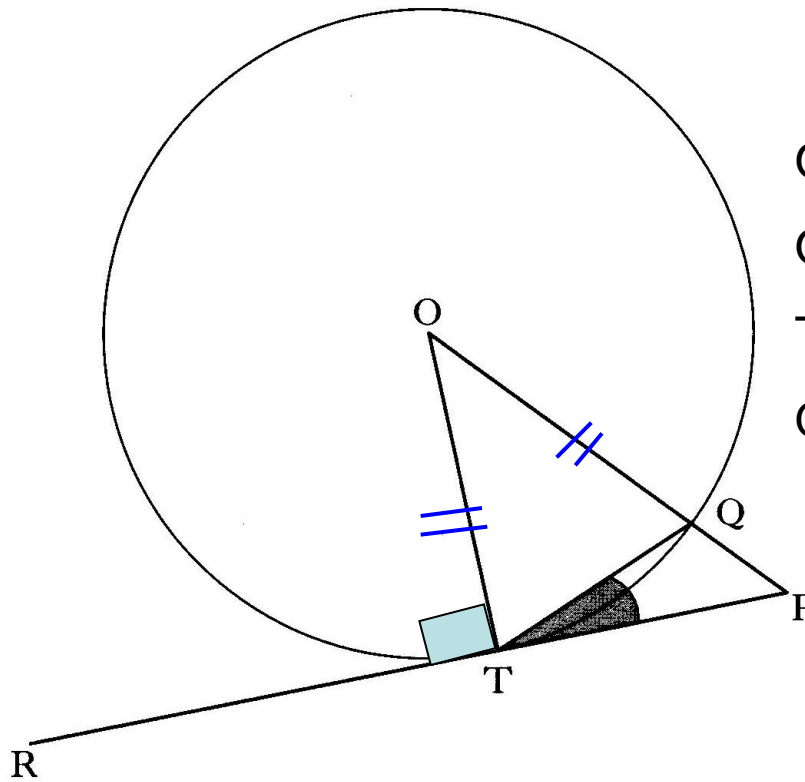
Solution

4. $y = 2x + 1$

Intercept = 1 (where line crosses y axis)

Gradient = 2 (measure from graph)

3.



$$OTP = 90^\circ - 24^\circ = 66^\circ$$

$$OQT = OQP \text{ (Isosceles)}$$

$$TQP = 180^\circ - 66^\circ = 114^\circ$$

$$QPT = 180^\circ - (114^\circ + 24^\circ) = 42^\circ$$

RP is a tangent to the circle, centre O, with a point of contact T.

The shaded angle $PTQ = 24^\circ$.

Calculate the size of angle OPT.

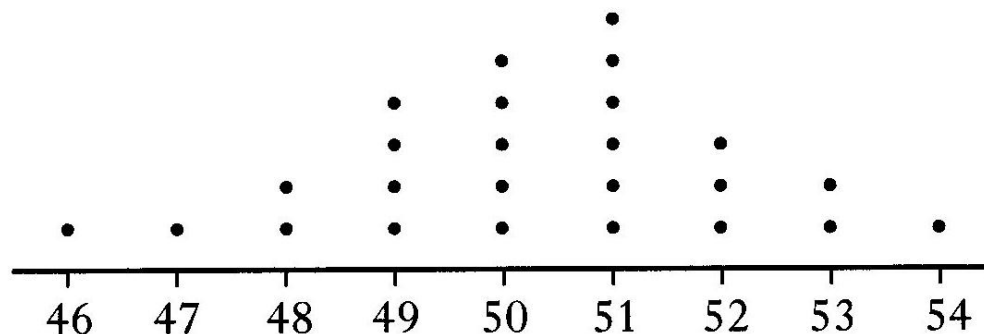
3

Main Grid

Solution

4. The number of chocolates in each box from a sample of 25 boxes was counted.

The results are displayed in the dotplot below.



- (a) For this sample find:

(i) the median;

1

(ii) the lower quartile;

1

(iii) the upper quartile.

1

- (b) Use the data from this sample to construct a boxplot.

2

- (c) In a second sample of boxes, the semi-interquartile range was 1.5.

Make an appropriate comment about the distribution of data in the two samples.

2

Main Grid

Solution

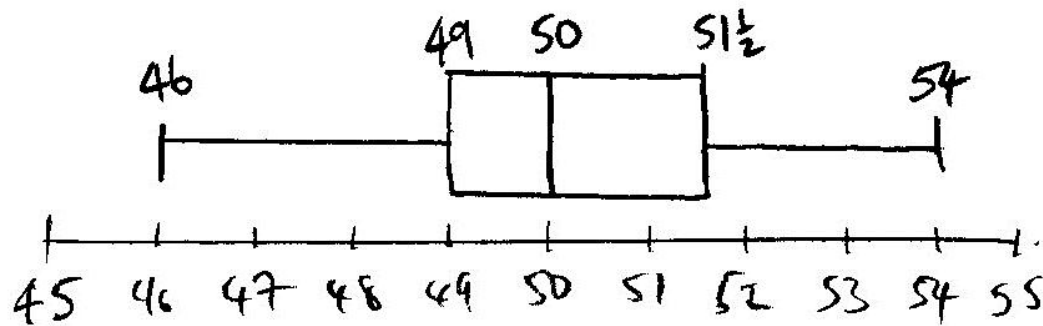
4 (a)

$$\text{median } \left(\frac{n+1}{2}\right) = 50$$

$$Q_1 = 49$$

$$Q_3 = \frac{51+52}{2} = 51\frac{1}{2}$$

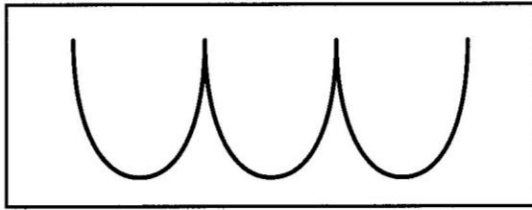
(b)



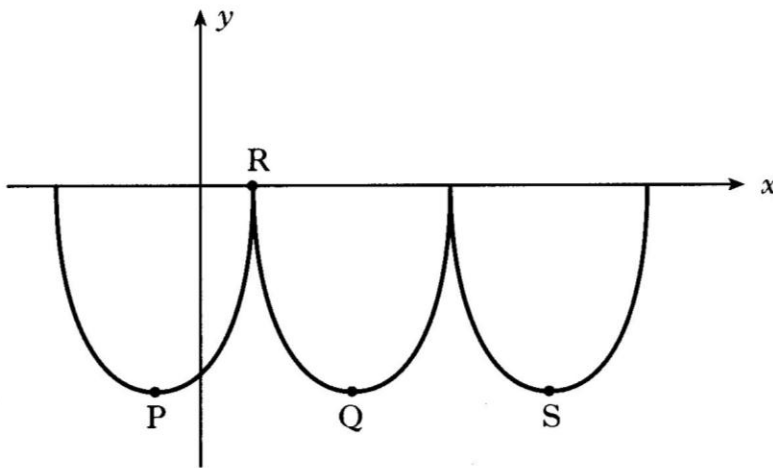
(c) Here $\text{Semi IQR} = \frac{51\frac{1}{2} - 49}{2} = \frac{2\frac{1}{2}}{2} = 1.25$

The second sample has a higher IQR,
So more variation in samples.

5. William Watson's Fast Foods use a logo based on parts of three identical parabolas.



This logo is represented on the diagram below.



The first parabola has turning point P and equation $y = (x + 2)^2 - 16$.

- (a) State the coordinates of P.
- (b) If R is the point (2, 0), find the coordinates of Q, the minimum turning point of the second parabola.
- (c) Find the equation of the parabola with turning point S.

2

(a) (-2, -16)

1

(b) (4, -16)

2

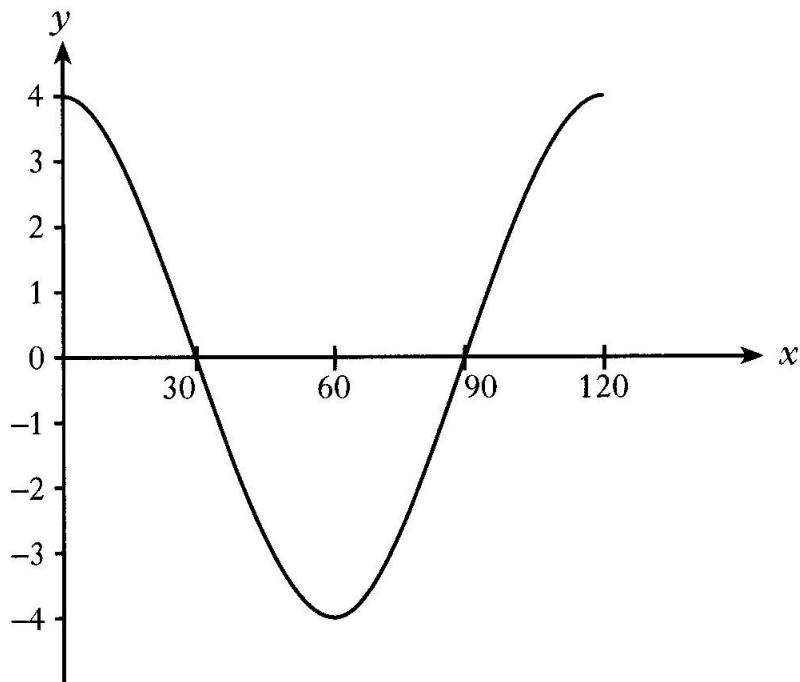
(c) $2+8+4 = 14$

(14, -16)

Main Grid

Solution

6. (a) Part of the graph of $y = b \cos ax^\circ$ is shown in the diagram.



State the values of a and b

$$y = b \cos ax$$

$$b = 4 \quad (\text{amplitude})$$

$$a = 3 \quad (\text{period} = 360 \div 3 = 120)$$

2

(b) Express $\sqrt{12} + 5\sqrt{3} - \sqrt{27}$ as a surd in its simplest form.

3

$$\begin{aligned} & \sqrt{12} + 5\sqrt{3} - \sqrt{27} \\ &= 2\sqrt{3} + 5\sqrt{3} - 3\sqrt{3} \\ &= 4\sqrt{3} \end{aligned}$$

1. The average Scottish house price is £77 900.

The average price is expected to rise by 2.5% per month. What will the average Scottish house price be in 3 months?

Give your answer correct to three significant figures.

3

$$\begin{aligned}\text{House price} &= \text{£}77900 \times (1.025)^3 \\ &= \text{£}83889.78 \\ &= \text{£}83900 \text{ to 3 sig figs}\end{aligned}$$

2. The heights, in millimetres, of six seedlings are given below.

15 18 14 17 16 19

(a) Calculate:

(i) the mean;

1

(ii) the standard deviation;

3

of these heights.

Show clearly all your working.

(b) Later the same six seedlings are measured again.

Each has grown by 4 millimetres.

State:

(i) the mean;

1

(ii) the standard deviation;

1

of the new heights.

$$2. (a) \bar{x} = \frac{\sum x}{n} = \frac{15+18+14+17+(16+19)}{6} = \frac{99}{6} = 16.5.$$

$$(\sum x)^2 = (99)^2 = 9801 \quad \frac{(\sum x)^2}{n} = \frac{9801}{6} = 1633.5$$
$$\sum x^2 = 15^2 + 18^2 + \dots + 19^2 = 1651$$

$$s = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}} = \sqrt{\frac{1651 - 1633.5}{5}} = \sqrt{\frac{17.5}{5}}$$
$$= \sqrt{3.5} = \underline{\underline{1.87}}$$

$$(b) \bar{x} = \frac{99 + 6 \times 4}{6} = \frac{123}{6} = \underline{\underline{20.5}}$$

$$s = \underline{\underline{1.87}} \quad (\text{unchanged})$$

3. (a) Multiply out the brackets and collect like terms.

$$5x + (x - 4)(3x + 1)$$

3

$$5x + (x - 4)(3x + 1)$$

$$= 5x + 3x^2 - 12x + x - 4$$

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

(b) Factorise

$$3x^2 - 7x + 2.$$

2

$$\begin{aligned} & 3x^2 - 7x + 2 \\ &= (3x - 1)(x - 2) \end{aligned}$$

Main Grid

Solution

4.

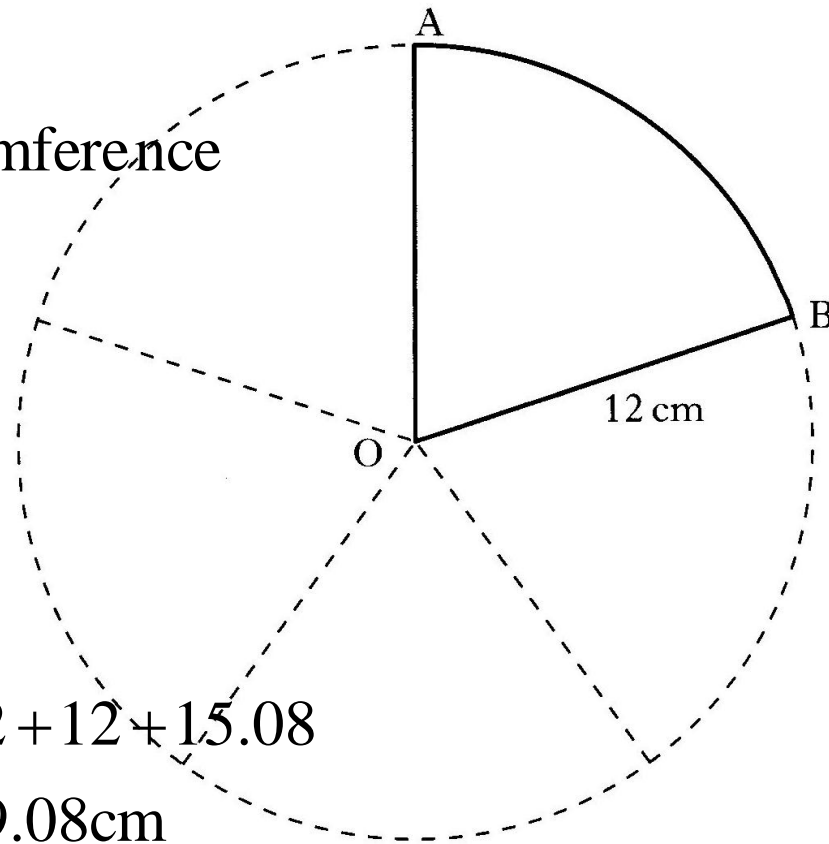
$$\text{Sector} = \frac{1}{5} \text{ of Circumference}$$

$$= \frac{1}{5} \pi d$$

$$= \frac{1}{5} \times \pi \times 24$$

$$= 15.08 \text{ cm}$$

$$\begin{aligned} \text{Total perimeter} &= 12 + 12 + 15.08 \\ &= 39.08 \text{ cm} \end{aligned}$$



A circle, with centre O and radius 12 centimetres, is cut into 5 equal sectors. Calculate the perimeter of sector OAB.

3

Main Grid

Solution

5. A sports centre charges different entrance fees for adults and children.
- (a) One evening 14 adults and 4 children visited the sports centre. The total collected in entrance fees was £55.00.
- Let $\pounds x$ be the adult's entrance fee and $\pounds y$ be the child's entrance fee.
- Write down an equation in x and y which represents the above condition. **1**
- (b) The following evening 13 adults and 6 children visited the sports centre. The total collected in entrance fees was £54.50.
- Write down a second equation in x and y which represents the above condition. **1**
- (c) Calculate the entrance fee for an adult and the entrance fee for a child. **4**

$$5. (a) \quad 14x + 4y = 55 \quad \times 3 \quad \text{---} \textcircled{1}$$

$$(b) \quad 13x + 6y = 54.50 \quad \times 2$$

$$(c) \quad 42x + 12y = 165$$

$$\underline{26x + 12y = 109}$$

$$\text{Sub} \quad 16x = 56$$

$$x = 3.5$$

put into $\textcircled{1}$

$$14 \times 3.5 + 4y = 55$$

$$4y = 55 - 49$$

$$4y = 6$$

$$y = 1.5$$

Adult ticket £3.50

Child's ticket = £1.50

6. Solve the equation $2x^2 + 7x - 3 = 0$, giving the roots correct to one decimal place.

4

$$2x^2 + 7x - 3 = 0$$

$$a = 2 \quad b = 7 \quad c = -3$$

$$x = \frac{-7 \pm \sqrt{(7)^2 - (4 \times 2 \times -3)}}{2 \times 2}$$

$$= \frac{-7 \pm \sqrt{49 - (-24)}}{4}$$

$$= \frac{-7 + \sqrt{73}}{4} \text{ or } \frac{-7 - \sqrt{73}}{4}$$

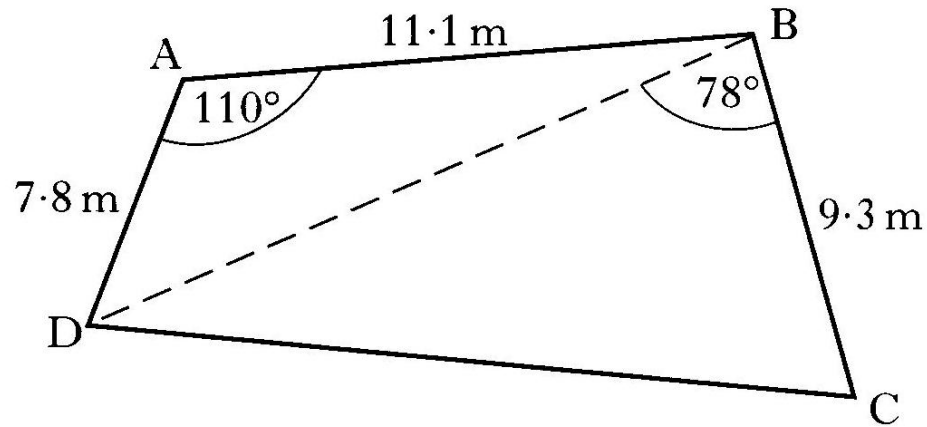
$$= 0.386 \quad \text{or} \quad -3.886$$

$$= 0.4 \quad \text{or} \quad -3.9 \quad \text{to 1d.p.}$$

Main Grid

Solution

7. A garden, in the shape of a quadrilateral, is represented in the diagram below.



Calculate:

- (a) the length of the diagonal BD;

Do not use a scale drawing

3

- (b) the area of the garden.

4

Main Grid

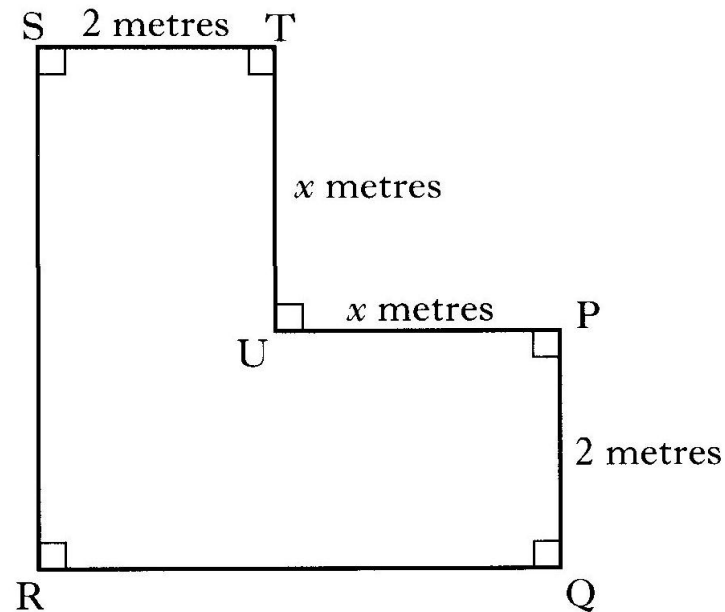
Solution

7 (a) Cosine Rule :- $BD^2 = b^2 + d^2 - 2bd \cos A$
 $= 11.1^2 + 7.8^2 - (2 \times 11.1 \times 7.8^2 \times \cos 110^\circ)$
 $= 243.27$
 $BD = \underline{\underline{15.6 \text{ m}}}$

(b) Area ABD = $\frac{1}{2} \times 11.1 \times 7.8 \times \sin 110^\circ$
 $= 40.68 \text{ m}^2$
Area DBC = $\frac{1}{2} \times 9.3 \times 15.6 \times \sin 78^\circ$
 $= \underline{\underline{70.95 \text{ m}^2}}$

Total area = $40.68 + 70.95$
 $= \underline{\underline{111.6 \text{ m}^2}}$

8. The diagram shows an L-shaped metal plate.

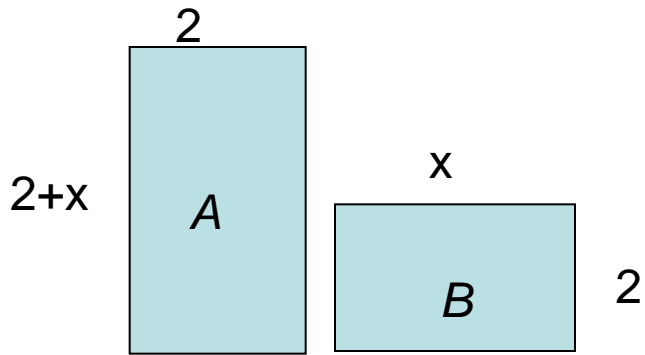


$$PQ = ST = 2 \text{ metres}$$
$$TU = UP = x \text{ metres}$$

- (a) Show that the area, A square metres, of the metal plate is given by

$$A = 4x + 4. \quad 2$$

- (b) The area of the metal plate is 18 square metres.
Find x . 1



(a) Area A = length \times breadth = $2(2 + x) = 4 + 2x$

Area B = $2x$

Total area = A + B

$$= 4 + 2x + 2x$$

$$= 4 + 4x$$

(b) Area = $4 + 4x = 18$

So $4 + 4x = 18$

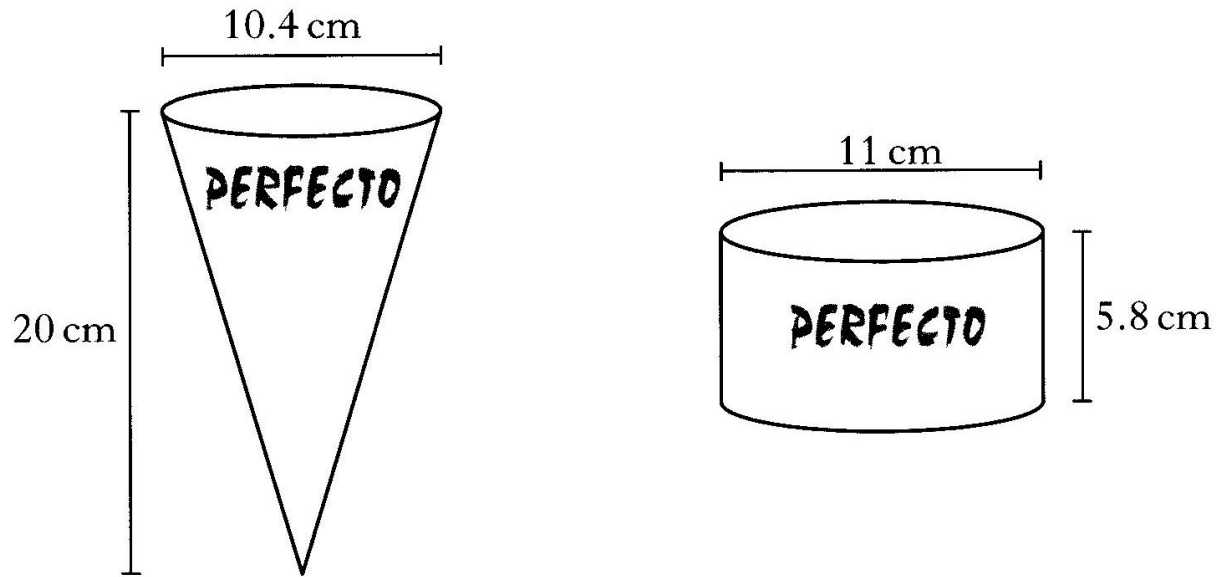
$$4x = 18 - 4$$

$$4x = 14$$

$$x = 14 \div 4 = 3.5\text{m}$$

Main Grid

9. Perfecto Ice Cream is sold in cones and cylindrical tubs with measurements as shown below.



Both the cone and the tub of ice cream cost the same.

Which container of ice cream is better value for money?

Give a reason for your answer.

5

Main Grid

Solution

9. Cone

$$\begin{aligned}V &= \frac{1}{3} \pi r^2 h \\&= \frac{1}{3} \times \pi \times 5.2^2 \times 20 \\&= \underline{566.3 \text{ cm}^3}\end{aligned}$$

Cylinder

$$\begin{aligned}V &= \pi r^2 h \\&= \pi \times 5.5^2 \times 5.8 \\&= \underline{551.2 \text{ cm}^3}\end{aligned}$$

Cone better value, as you get more ice cream for your money

10. Solve the following equation for $0 \leq x \leq 360$.

$$7 \sin x^\circ - 3 = 0$$

3

Main Grid

Solution

$$10. \quad 7 \sin x - 3 = 0$$

$$\sin x = \frac{3}{7} = 0.42857$$

$$x = \sin^{-1}(0.42857) \\ = 25.4^\circ$$

Sin positive in 1st and 2nd quadrant

$$\text{So } x = \underline{\underline{25.4^\circ}}$$

$$\text{and } x = 180 - 25.4^\circ = \underline{\underline{154.6^\circ}}$$

$$x = 25.4^\circ \text{ or } 154.6^\circ$$

11. (a) Express $\frac{4}{x+3} + \frac{3}{x}$, $x \neq -3$, $x \neq 0$,

as a single fraction in its simplest form.

3

(b) Change the subject of the formula $m = \frac{3x+2y}{p}$ to x .

3

(c) Simplify $\frac{3a^5 \times 2a}{a^2}$

3

Main Grid

Solution

$$11(a) \quad \frac{4}{x+3} + \frac{3}{x}$$

$$\Rightarrow \frac{4x}{x(x+3)} + \frac{3(x+3)}{x(x+3)}$$

$$\Rightarrow \frac{4x + 3x + 9}{x(x+3)}$$

$$= \underline{\underline{\frac{7x+9}{x(x+3)}}}$$

$$(b) \quad m = \frac{3x+2y}{p}$$

$$\Rightarrow mp = 3x+2y$$

$$\Rightarrow mp - 2y = 3x$$

$$\Rightarrow \frac{mp-2y}{3} = x \quad \Rightarrow \underline{\underline{x = \frac{mp-2y}{3}}}$$

$$(c) \quad \frac{3a^5 \times 2a}{a^2} = \frac{6a^6}{a^2} = \underline{\underline{6a^4}}$$

Main Grid

1. Multiply out the brackets and collect like terms.

$$(2a - b)(3a + 2b)$$

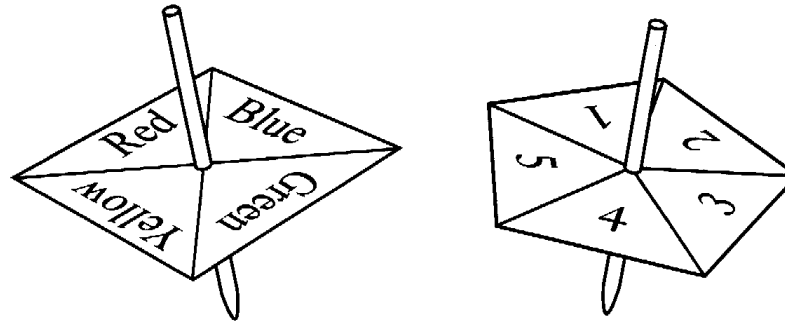
2

$$(2a - b)(3a + 2b)$$

$$= 6a^2 - 3ab + 4ab - 2b^2$$

$$= 6a^2 + ab - 2b^2$$

2. Two spinners are used in an experiment.



The table below shows some of the possible outcomes when both spinners are spun and allowed to come to rest.

	1	2	3	4	5
Red	R,1	R,2			
Yellow	Y,1				
Blue	B,1				
Green	G,1				

- (a) Copy and complete the table. 1
- (b) What is the probability that one spinner comes to rest on red and the other on an even number? 1

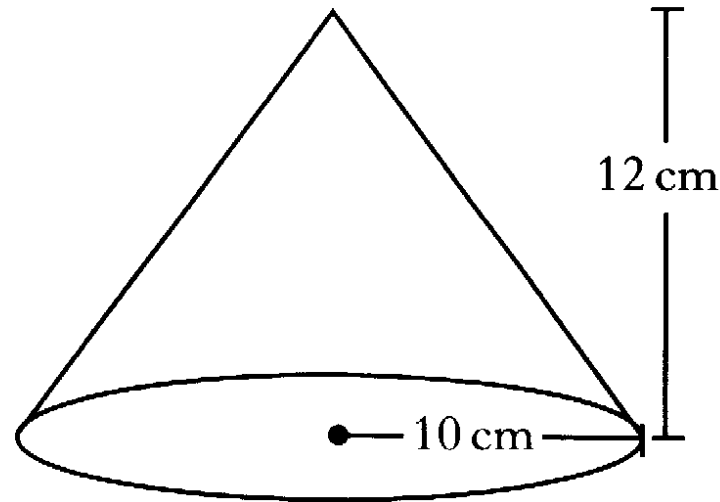
2. (a)

	1	2	3	4	5
Red	R,1	R,2	R,3	R,4	R,5
Yellow	Y,1	Y,2	Y,3	Y,4	Y,5
Blue	B,1	B,2	B,3	B,4	B,5
Green	G,1	G,2	G,3	G,4	G,5

(b)

$$\frac{2}{20} = \frac{1}{10}$$

3. The diagram shows a cone.



The height is 12 centimetres and the radius of the base 10 centimetres.

Calculate the volume of the cone.

Take $\pi = 3.14$.

$$\begin{aligned} \text{Volume} &= \frac{1}{3} \times \pi \times r^2 \times h = \frac{1}{3} \times 3.14 \times 10^2 \times 12 \\ &= 3.14 \times 100 \times 4 \\ &= 1256 \text{ cm}^3 \end{aligned}$$

Main Grid

Solution

4. A hotel books taxis from a company called QUICKCARS.

The receptionist notes the waiting time for every taxi ordered over a period of two weeks.

The times are recorded in the stem and leaf diagram shown below.

Waiting time (minutes)

0		6	7	
1		2	3	4
2		5	6	9 9
3		2	5	7
4		2	4	

$n = 14$

1|3 represents 13 minutes

(a) For the given data, calculate:

(i) the median;

1

(ii) the lower quartile;

1

(iii) the upper quartile.

1

(b) Calculate the semi-interquartile range.

1

In another two week period, the hotel books taxis from a company called FASTCABS.

The semi-interquartile range for FASTCABS is found to be 2.5 minutes.

(c) Which company provides the more consistent service?

Give a reason for your answer.

1

Main Grid

Solution

4. (a) (i) $Q_2 = \frac{14+1}{2} = \frac{14+1}{2} = 7.5$ between 7th & 8th

$$Q_2 = \frac{26+29}{2} = 27\frac{1}{2}$$

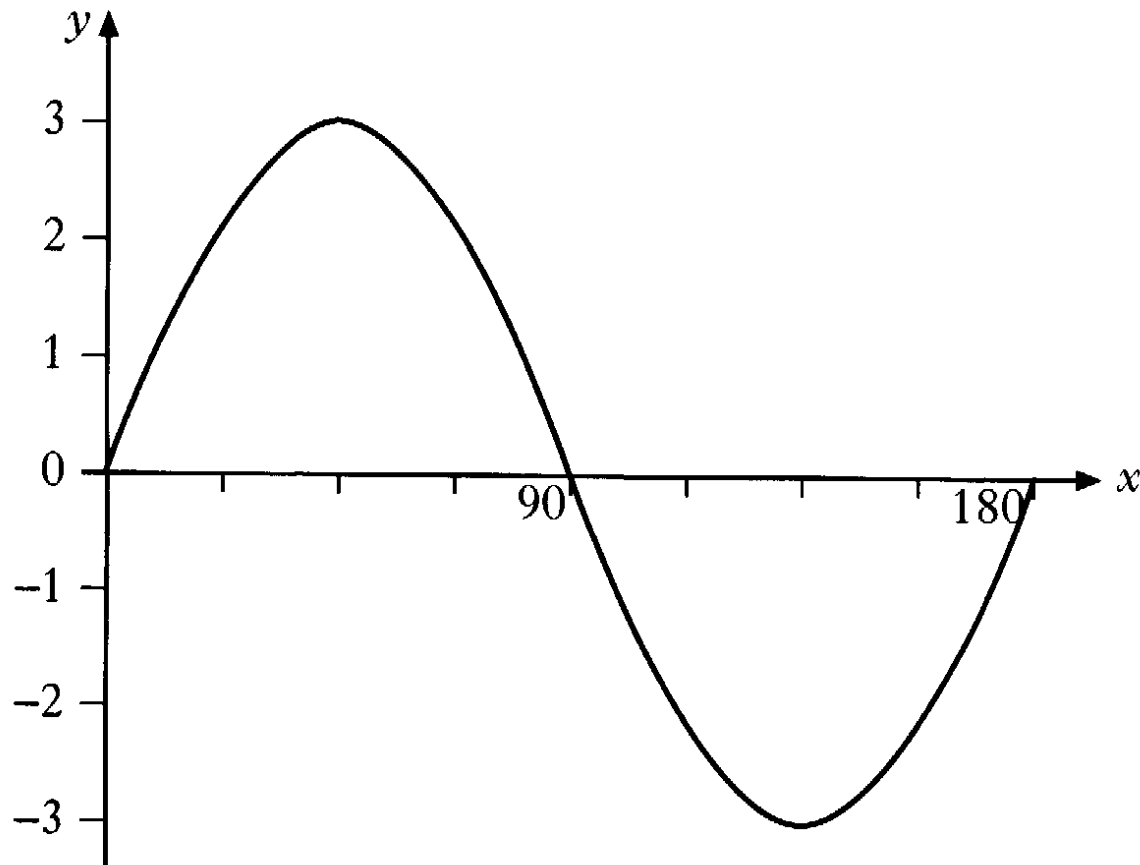
(ii) $Q_1 = 13$

(iii) $Q_3 = 35$

(b) $S I Q R = \frac{Q_3 - Q_1}{2} = \frac{35 - 13}{2} = \frac{22}{2} = 11$

(c) Fast class because $S I Q R$ is much lower so less spread out.

5. Part of the graph of $y = a \sin bx^\circ$ is shown in the diagram.



State the values of a and b .

$a = 3$ (amplitude $3 \times$ 'normal' height)

$b = 2$ (period = $360 \div 2 = 180$)

Main Grid

Solution

6. (a) Express $\frac{\sqrt{40}}{\sqrt{2}}$ as a surd in its simplest form.

2

(b) Simplify $\frac{2x+2}{(x+1)^2}$.

2

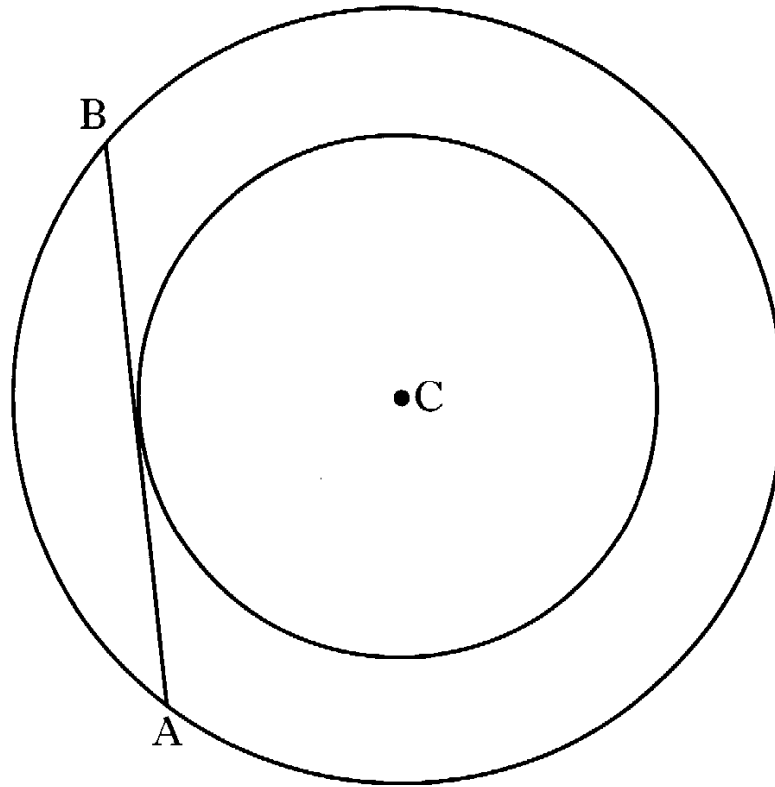
Main Grid

Solution

$$6. (a) \frac{\sqrt{40} \times \sqrt{2}}{\sqrt{2} \sqrt{2}} = \frac{\sqrt{40 \times 2}}{2} = \frac{\sqrt{4 \times 5 \times 2}}{2} = \frac{\sqrt{20}}{2} = \underline{\underline{2\sqrt{5}}}$$

$$(b) \frac{2x+2}{(x+1)^2} = \frac{2(x+1)}{(x+1)(x+1)} = \frac{2}{x+1}$$

7.



C is the centre of two concentric circles.

AB is a tangent to the smaller circle and a chord of the larger circle.

The radius of the smaller circle is 6 centimetres and the chord AB has length 16 centimetres.

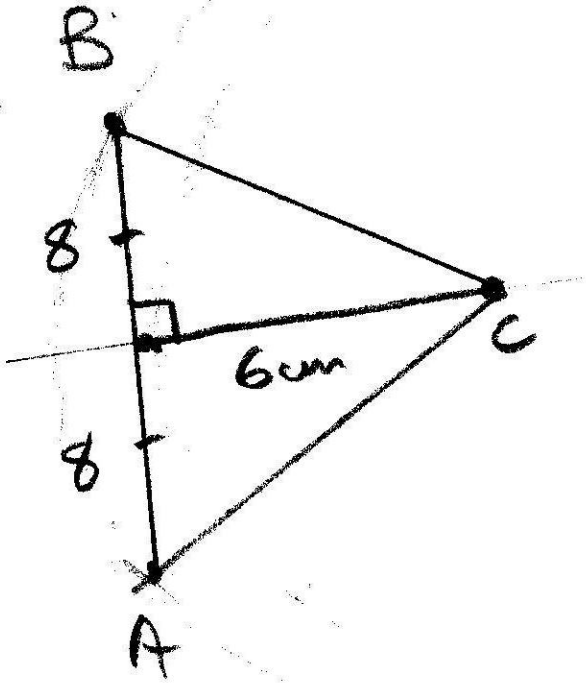
Calculate the radius of the larger circle.

3

Main Grid

Solution

7.



BC is hypotenuse of Δ
It's a pythag triple
6, 8, 10
So $BC = 10\text{cm}$.
(radius of larger circle)

8. (a) Factorise $7 + 6x - x^2$.

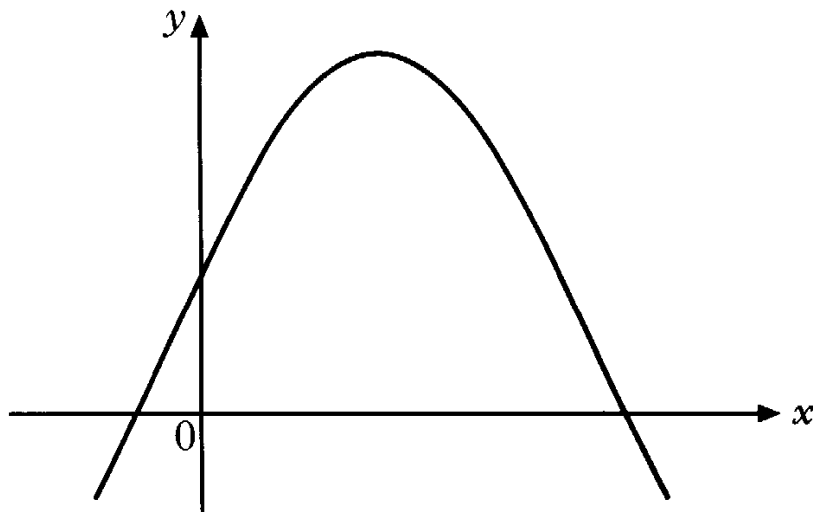
2

(b) Hence write down the roots of the equation

$$7 + 6x - x^2 = 0.$$

1

(c) The graph of $y = 7 + 6x - x^2$ is shown in the diagram.



Find the coordinates of the turning point.

3

8 (a) $7 + 6x - x^2$ factorises to

$$(7 - x)(1 + x)$$

(b) Roots are; $x = 7$ and $x = -1$

(c) Turning Point halfway between -1 and 7 .

i.e. $x = 3$

So $y = 7 + (6 \times 3) - (3^2)$

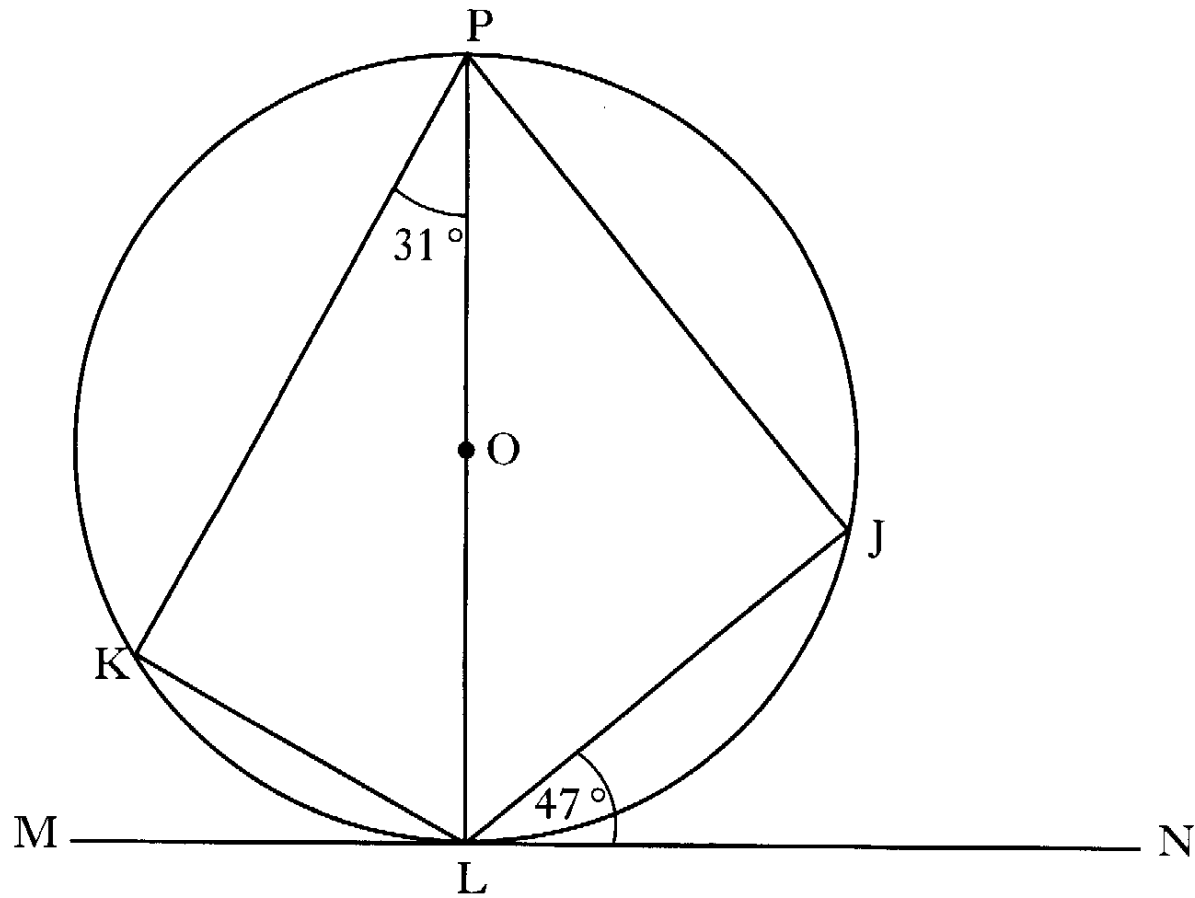
$$= 7 + 18 - 9$$

$$= 16$$

Coords of Max T.P. $(3, 15)$

1.

19101



The tangent, MN, touches the circle, centre O, at L.

Angle JLN = 47° .

Angle KPL = 31° .

Find the size of angle KLJ.

3

Main Grid

Solution

$$OLN = 90^\circ$$

(tangent)

$$PLJ = 90^\circ - 47^\circ = 43^\circ$$

$$PKL = 90^\circ$$

(angle in a semi circle)

$$PLK = 180^\circ - (90^\circ + 31^\circ) = 59^\circ$$

$$KLJ = PLK + PLJ$$

$$= 43^\circ + 59^\circ = 102^\circ$$

2. A sample of shoppers was asked which brand of washing powder they preferred.

The responses are shown below.

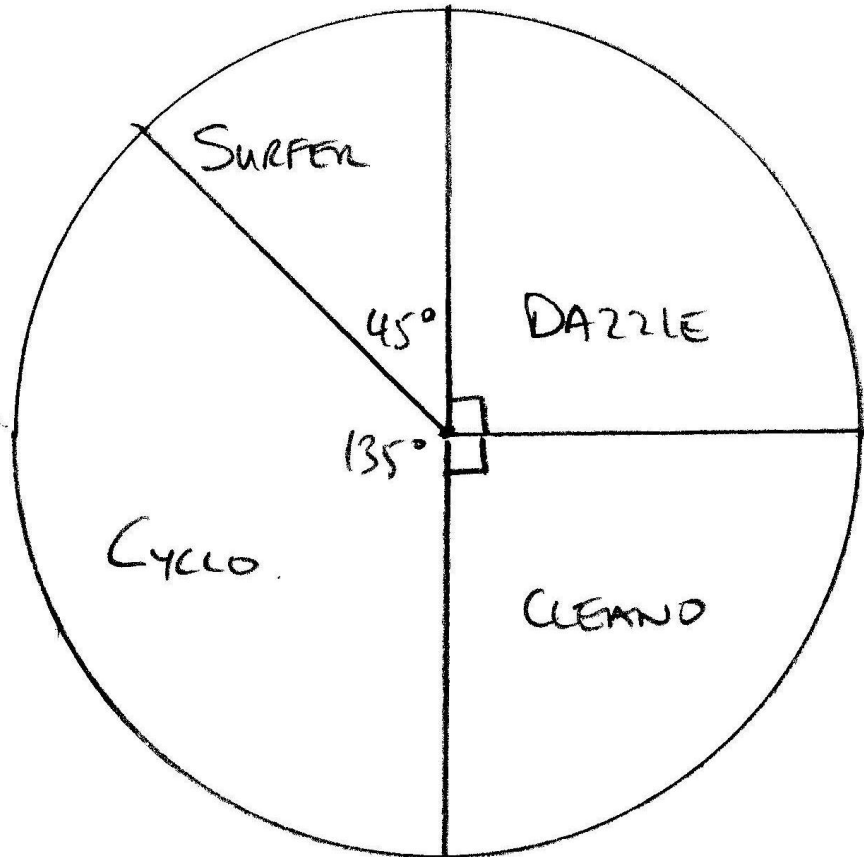
<i>Washing Powder</i>	<i>Frequency</i>
Dazzle	250
Cyclo	375
Surfer	125
Cleano	250

Construct a pie chart to illustrate this information.

Show all your working.

3

2. Dazzle = $250 \div 1000 \times 360 = 90^\circ$ Total = 1000.
Cyclo = $375 \div 1000 \times 360 = 135^\circ$
Surfer = $125 \div 1000 \times 360 = 45^\circ$
Cleano = $250 \div 1000 \times 360 = 90^\circ$



Main Grid

3. Seats on flights from London to Edinburgh are sold at two prices, £30 and £50.

On one flight a total of 130 seats was sold.

Let x be the number of seats sold at £30 and y be the number of seats sold at £50.

(a) Write down an equation in x and y which satisfies the above condition. **1**

The sale of the seats on this flight totalled £6000.

(b) Write down a second equation in x and y which satisfies this condition. **1**

(c) How many seats were sold at each price? **4**

$$3. (a) \quad x + y = 130 \quad \text{--- (1)}$$

$$(b) \quad 30x + 50y = 6000 \quad \text{--- (2)}$$

(c)

$$\text{Eqn (1)} \times 50 \quad 50x + 50y = 6500$$

$$30x + 50y = 6000$$

$$20x = 500$$

$$x = 25$$

$$\text{So } y = 105$$

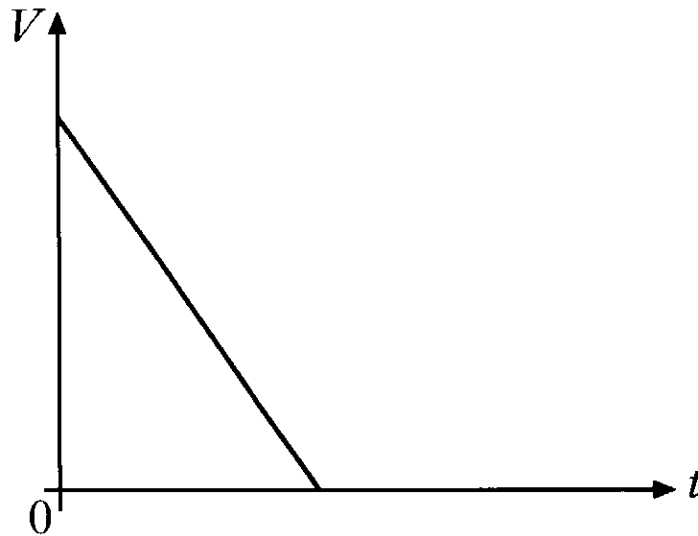
25 tickets at £30

105 tickets at £50.

4. A bath contains 150 litres of water.

Water is drained from the bath at a steady rate of 30 litres per minute.

The graph of the volume, V litres, of water in the bath against the time, t minutes, is shown below.

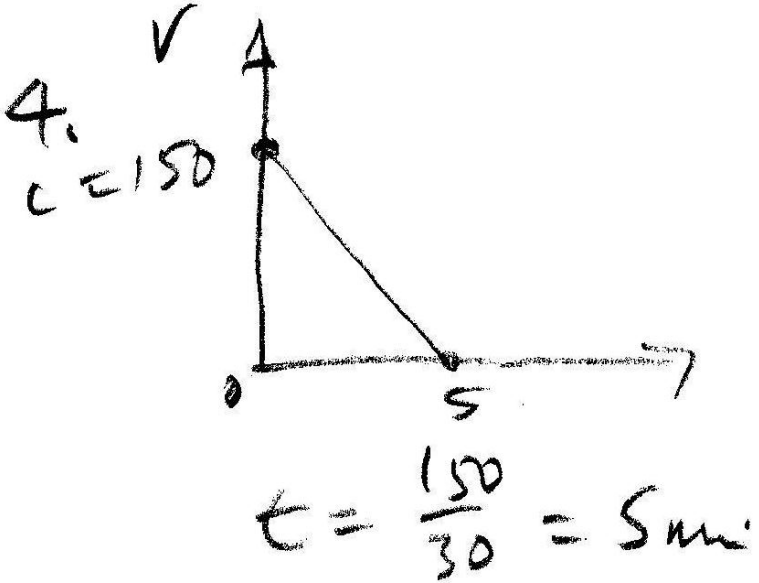


Write down an equation connecting V and t .

3

Main Grid

Solution



$$(0, 150) \quad \text{and} \quad (5, 0)$$

$$M = \frac{y_2 - y_1}{x_2 - x_1} = \frac{150 - 0}{0 - 5}$$

$$= -30$$

Equation

$$\underline{V = -30t + 150}$$

5. A gardener grows tomatoes in his greenhouse.

The temperature of the greenhouse, in degrees Celsius, is recorded every day at noon for one week.

17 22 25 16 21 16 16

(a) For the given temperatures, calculate:

(i) the mean;

1

(ii) the standard deviation.

3

Show clearly all your working.

For best growth, the mean temperature should be $(20 \pm 5)^{\circ}\text{C}$ and the standard deviation should be less than 5°C .

(b) Are the conditions in the greenhouse likely to result in best growth?

Explain clearly your answer.

2

$$5. a(i) \bar{x} = \frac{\sum x}{n} = \frac{133}{7} = 19$$

$$(ii) (\sum x)^2 = 133^2 = 17689$$

$$\left(\frac{\sum x}{n}\right)^2 = \frac{17689}{7} = 2527$$

$$\sum x^2 = 17^2 + 22^2 + 25^2 + 16^2 + 21^2 + 16^2 + 16^2 = 2607$$

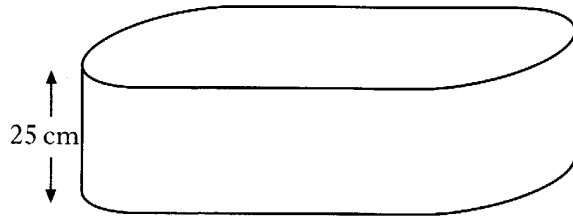
$$s = \sqrt{\frac{2607 - 2527}{7-1}}$$

$$= \sqrt{\frac{80}{6}}$$

$$= \underline{\underline{3.65}}$$

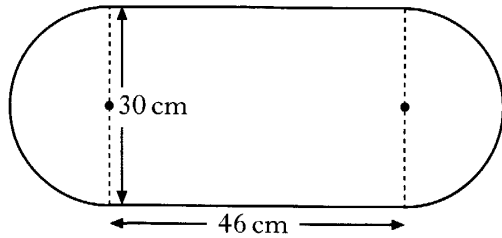
(b) Yes, mean temp well within range
 Spread of temps 3.65°C is less than 5°C so that's
 fine too.

6. A garden trough is in the shape of a prism.



The height of the trough is 25 centimetres.

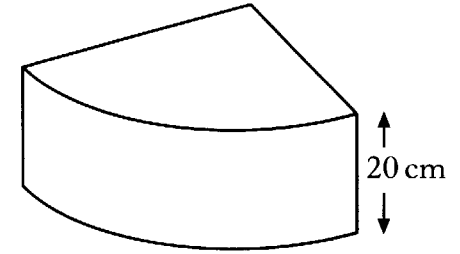
The cross-section of the trough consists of a rectangle and two semi-circles with measurements as shown.



- (a) Find the volume of the garden trough in cubic centimetres.
Give your answer correct to two significant figures.

(4)

A new design of garden trough is planned by the manufacturer.



The height of the trough is 20 cm.

The uniform cross-section of this trough is a quarter of a circle.

The volume of the trough is $30\,000\text{ cm}^3$.

- (b) Find the radius of the cross-section.

(3)

Main Grid

Solution

$$\begin{aligned}
 6. \text{ (a) Area of cross section} &= \text{Rectangle} + \text{Circle} \\
 &= (30 \times 46) + (\pi \times 15^2) \\
 &= 2086.86 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 V = Ah &= 2086.86 \times 25 \\
 &= 52171 \\
 &= \underline{52000} \text{ cm}^3 \text{ (2 sig figs)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) } V &= 30000 \quad h = 20 \text{ cm} \\
 A &= \frac{V}{h} = \frac{30000}{20} = 1500 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 A &= \pi r^2 \\
 r^2 &= \frac{A}{\pi} = \frac{1500}{\pi} = 477.46
 \end{aligned}$$

$$\begin{aligned}
 r &= \sqrt{477.46} \\
 &= 21.85
 \end{aligned}$$

$$\text{Radius} = \underline{22 \text{ cm}} \text{ (2 sig figs).}$$

7. Change the subject of the formula

$$y = ax^2 + c \quad \text{to } x.$$

$$y = ax^2 + c$$

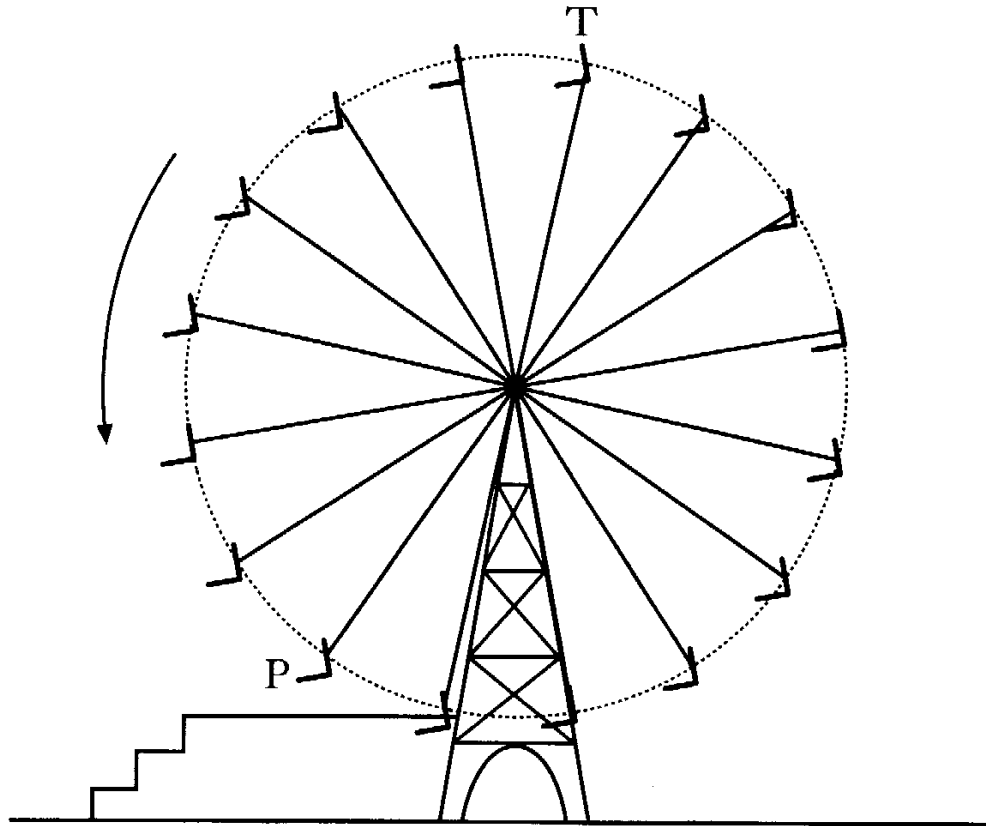
$$ax^2 + c = y$$

$$ax^2 = y - c$$

$$x^2 = \frac{y - c}{a}$$

$$x = \sqrt{\frac{y - c}{a}}$$

8. The diagram below shows a big wheel at a fairground.



The wheel has sixteen chairs equally spaced on its circumference.

The radius of the wheel is 9 metres.

As the wheel rotates in an anticlockwise direction, find the distance a chair travels in moving from position T to position P in the diagram.

4

Main Grid

Solution

$$\begin{aligned}C &= \pi d \\ &= 3.14 \times 18 \\ &= 56.52\end{aligned}$$

$$\begin{aligned}\text{Distance travelled} &= \frac{7}{16} \times 56.52 \\ &= 24.7m\end{aligned}$$

9. Solve the equation

$$2x^2 + 4x - 9 = 0,$$

giving the roots correct to one decimal place.

$$2x^2 + 4x - 9 = 0$$

$$a = 2 \quad b = 4 \quad c = -9$$

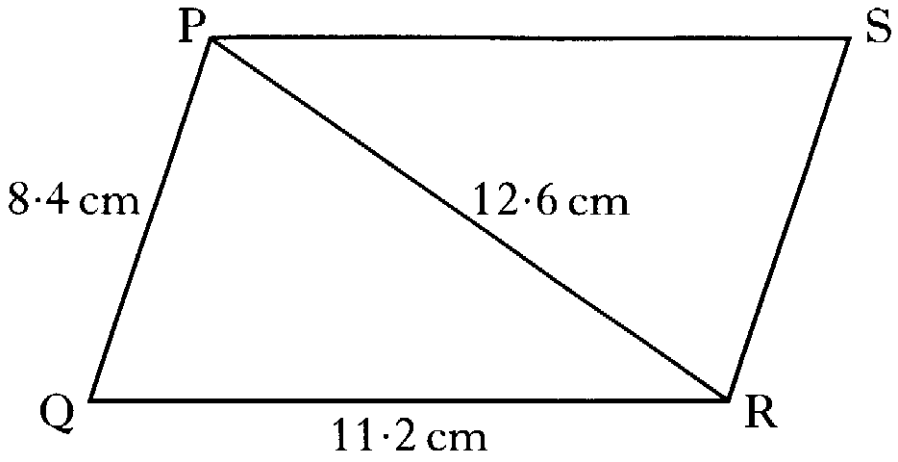
4

$$\begin{aligned} x &= \frac{-4 \pm \sqrt{(4)^2 - (4 \times 2 \times -9)}}{2 \times 2} \\ &= \frac{-4 \pm \sqrt{16 - (-72)}}{4} \\ &= \frac{-4 + \sqrt{88}}{4} \quad \text{or} \quad \frac{-7 - \sqrt{88}}{4} \\ &= 1.37 \quad \text{or} \quad -3.37 \\ &= 1.4 \quad \text{or} \quad -3.4 \quad \text{to 1d.p.} \end{aligned}$$

Main Grid

Solution

10. The sketch shows a parallelogram, PQRS.



(a) Calculate the size of angle PQR.

Do not use a scale drawing.

3

(b) Calculate the area of the parallelogram.

3

$$10. (a) \quad \cos \phi = \frac{p^2 + r^2 - q^2}{2pr} = \frac{11.2^2 + 8.4^2 - 12.6^2}{2 \times 11.2 \times 8.4}$$

$$= 0.1979$$

$$\phi = \cos^{-1}(0.1979) = 78.58$$
$$= \underline{\underline{78.6^\circ}}$$

(b) Area of $PQR = PRS$.

$$\text{Area } PQR = \frac{1}{2} \times 11.2 \times 8.4 \times \sin 78.6^\circ$$
$$= 46.109$$

$$\text{Total area} = 46.109 \times 2 = \underline{\underline{92.2 \text{ cm}^2}}$$

11. (a) Express

$$a^{\frac{2}{3}}(a^{\frac{2}{3}} - a^{-\frac{2}{3}})$$

in its simplest form.

2

(b) Express

$$\frac{a}{x} - \frac{b}{y}, \quad x \neq 0, \quad y \neq 0,$$

as a fraction in its simplest form.

2

$$\begin{aligned} 11 \text{ (a).} &= a^{\frac{2}{3}} (a^{\frac{2}{3}} - a^{-\frac{2}{3}}) \\ &= a^{\frac{4}{3}} - a^0 \\ &= \underline{\underline{a^{\frac{4}{3}} - 1}} \end{aligned}$$

$$\begin{aligned} \text{(b)} & \frac{a}{x} - \frac{b}{y} \\ &= \frac{ay}{xy} - \frac{bx}{xy} \\ &= \underline{\underline{\frac{ay - bx}{xy}}} \end{aligned}$$

12. (a) Solve the equation

$$2 \tan x^\circ + 7 = 0, \quad 0 \leq x < 360.$$

3

(b) Prove that

$$\sin^3 x^\circ + \sin x^\circ \cos^2 x^\circ = \sin x^\circ.$$

2

Main Grid

Solution

$$12 (a) \quad 2 \tan x + 7 = 0$$

$$2 \tan x = -7$$

$$\tan x = -\frac{7}{2} = -3.5$$

$$x = \tan^{-1}(-3.5)$$

$$\text{Acute angle } A = \tan^{-1}(3.5) = 74.1^\circ$$

$\tan x$ negative in 2nd and 4th Quadrants

$$\text{2nd Quad} \quad 180 - A = 180^\circ - 74.1^\circ = 105.9^\circ$$

$$\text{4th Quad} \quad 360 - A = 360^\circ - 74.1^\circ = 285.9^\circ$$

$$(b) \quad \sin^3 x + \sin x \cos^2 x = \sin x$$

$$\sin^2 x + \cos^2 x = 1$$

$\div \sin x$

which is true for all $x \in \mathbb{R} \dots$

1. In a tournament a group of golfers recorded the following scores.

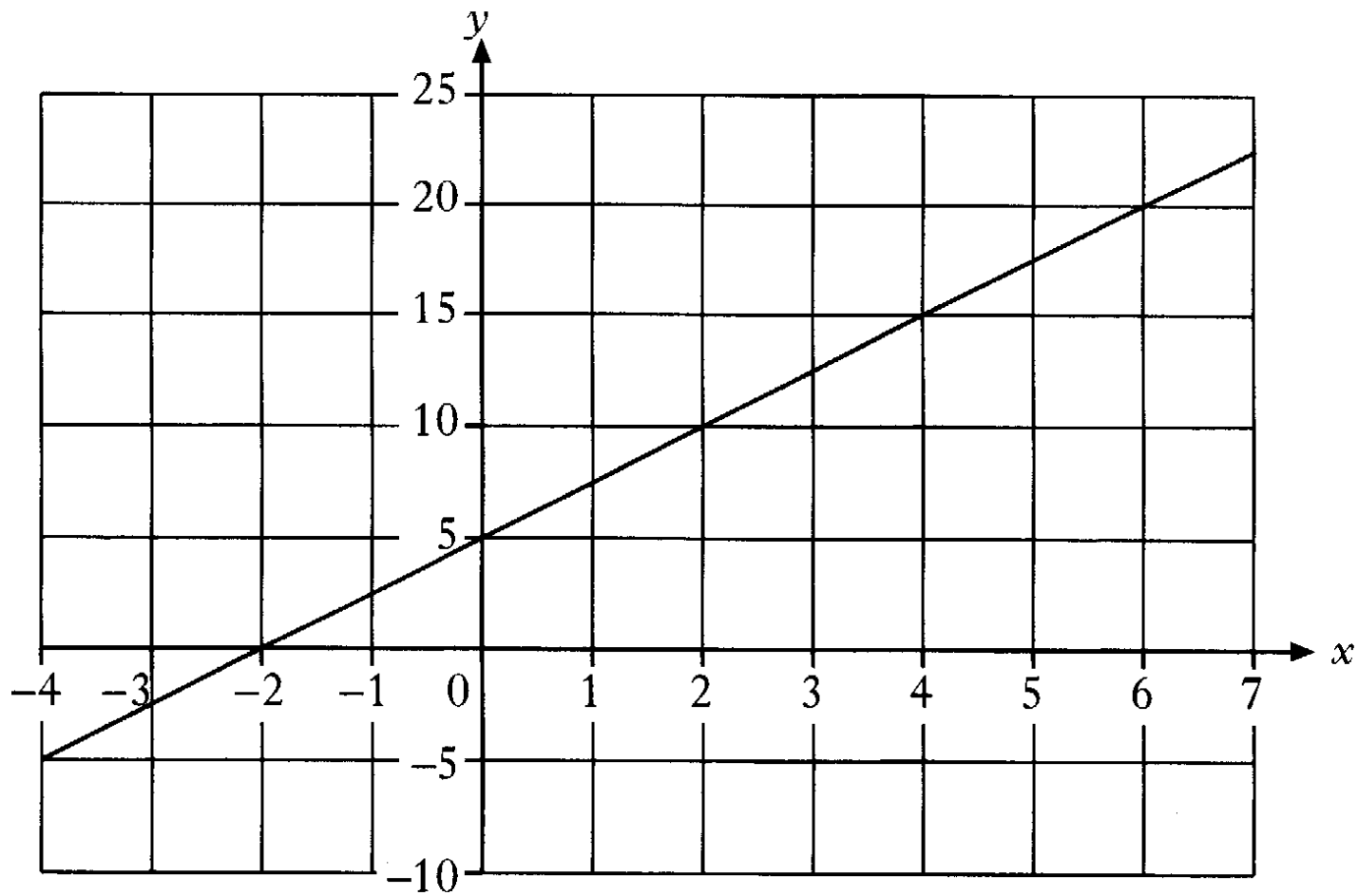
74 70 71 73 75 71 73 72
72 75 71 76 74 72 70 73

- (a) Construct a frequency table from the above data and add a cumulative frequency column. 2
- (b) What is the probability that a golfer chosen at random from this group recorded a score of less than 72? 1

To	(a)	Scores	Freq		Cum Freq
		70		2	2
		71		3	5
		72		3	8
		73		3	11
		74		2	13
		75		2	15
		76		1	16
			16 ✓		

(b) $\frac{5}{16}$

2.



Find the equation of the straight line shown in the diagram.

3

$$m = \frac{1}{2}$$

$$c = 5$$

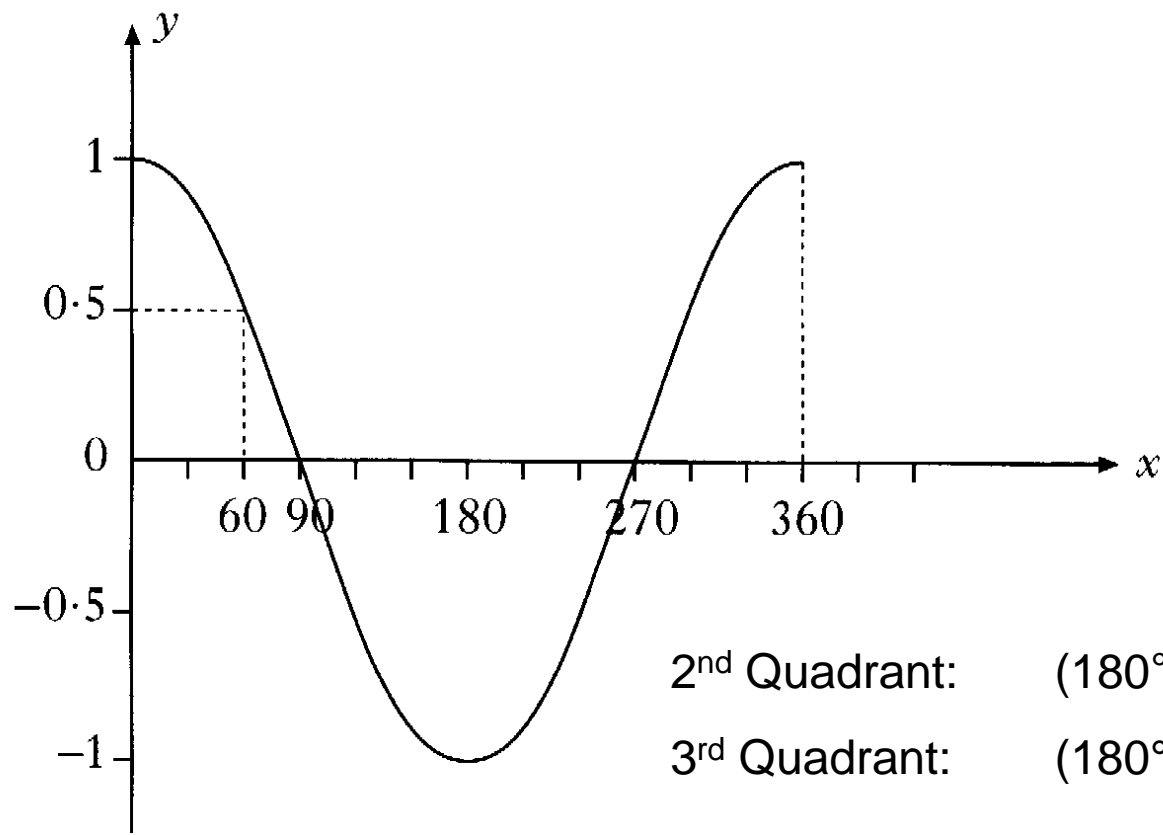
Equation:

$$y = \frac{1}{2}x + 5$$

Main Grid

Solution

3.



Part of the graph of $y = \cos x^\circ$ is shown above.

If $\cos 60^\circ = 0.5$, state two values for x for which $\cos x^\circ = -0.5$, $0 \leq x \leq 360$.

2

Main Grid

Solution

4. Multiply out the brackets and collect like terms.

$$(x - 3)(x^2 + 4x - 1)$$

3

$$\begin{aligned} & (x - 3)(x^2 + 4x - 1) \\ &= x^3 + 4x^2 - x - 3x^2 - 12x + 3 \\ &= x^3 + x^2 - 13x + 3 \end{aligned}$$

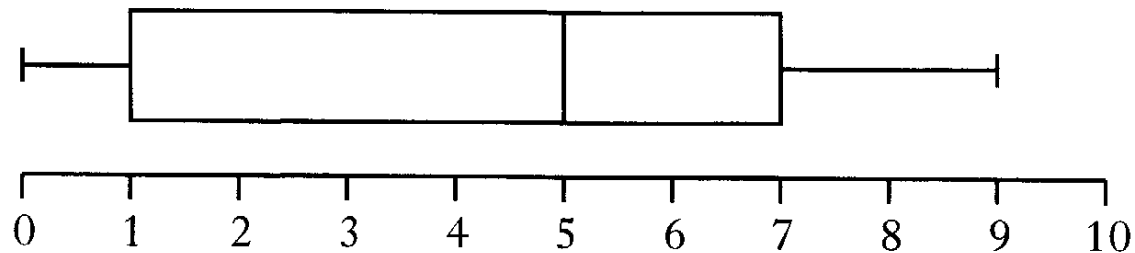
5. A sample of students was asked how many times each had visited the cinema in the last three months.

The results are shown below.

4 5 4 1 4 3 2 2 4 6 2
3 4 4 1 3 1 2 3 1 1

- (a) From the above data, find the median, the lower quartile and the upper quartile. 3
- (b) Construct a boxplot for the data. 2
- (c) The same sample of students was asked how many times each had attended a football match in the same three months.

The boxplot below was drawn for this data.



Compare the two boxplots and comment. 1

5 (a)

1 | | | | |

2 | | | |

3 | | | |

4 | | | | | |

5 |

6 |

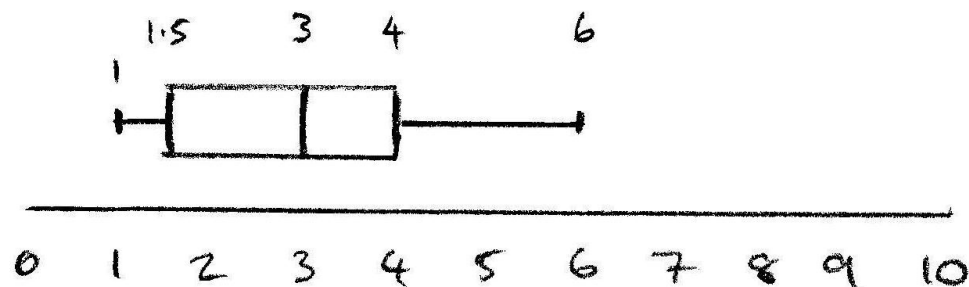
$$n = 21$$

$$\text{median} = \frac{21+1}{2} = 11^{\text{th}} \text{ position}$$

$$Q_2 = 3$$

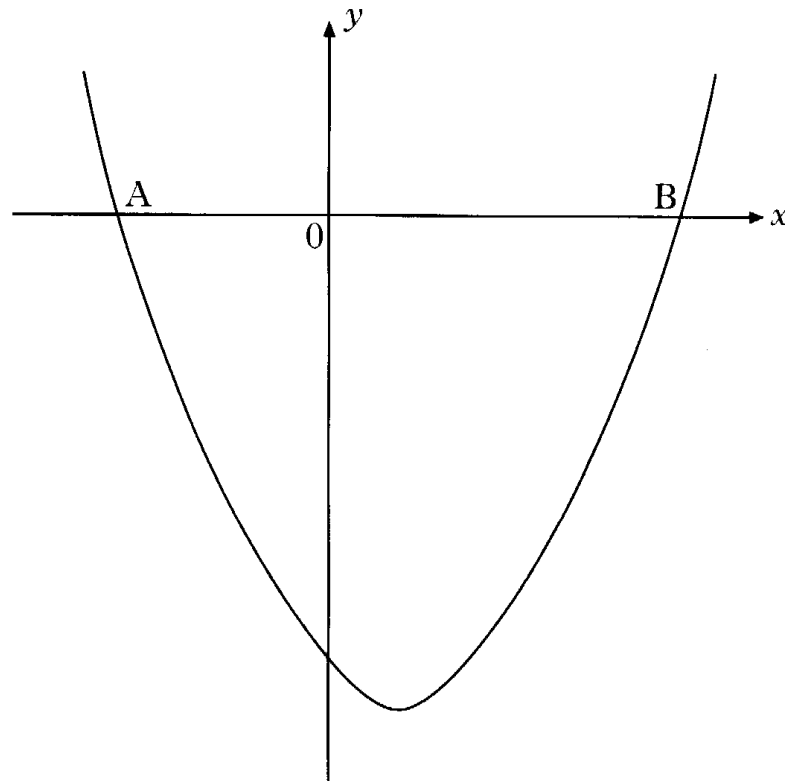
$$Q_1 = \frac{1+2}{2} = 1.5$$

$$Q_3 = 4$$



(c) Wider range = $9 - 0 = 9$ and same with $IQR = 6$
 Compared with first data where
 range was only $6 - 1 = 5$ and $IQR = 4 - 1.5 = 2.5$

6.



The equation of the parabola in the above diagram is

$$y = (x - 1)^2 - 16.$$

- (a) State the coordinates of the minimum turning point of the parabola. 2
- (b) State the equation of the axis of symmetry of the parabola. 1
- (c) The parabola cuts the x -axis at A and B. Find the length of AB. 3

Main Grid**Solution**

6. (a) $(1, -16)$

(b) $x = 1$

(c) x -axis where $y = 0$.

So $(x-1)^2 - 16 = 0$

$$x^2 - 2x + 1 - 16 = 0$$

$$x^2 - 2x - 15 = 0$$

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

$$x = 5, x = -3$$

$$\text{Length AB} = 5 - (-3) = \underline{\underline{8 \text{ units}}}$$

7. (a) Express $\sqrt{45} - 2\sqrt{5}$ as a surd in its simplest form. 2

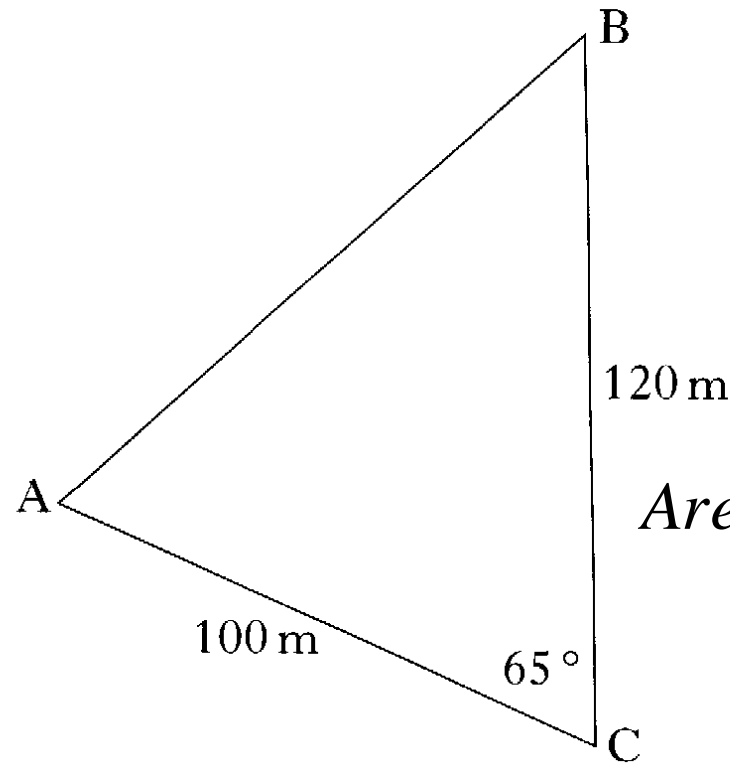
(b) Express as a fraction in its simplest form

$$\frac{1}{x^2} + \frac{1}{x}, \quad x \neq 0. \quad \text{2}$$

$$7. (a) \quad \sqrt{45} - 2\sqrt{5} = \sqrt{9 \times 5} - 2\sqrt{5} = 3\sqrt{5} - 2\sqrt{5} \\ = \sqrt{5}$$

$$(b) \quad \frac{1}{x^2} + \frac{1}{x} \\ = \frac{1}{x^2} + \frac{x}{x^2} \\ = \frac{1+x}{x^2}$$

1. The sketch shows a triangle, ABC.



$$\begin{aligned} \text{Area} &= \frac{1}{2} ab \sin C \\ &= \frac{1}{2} \times 120 \times 100 \times \sin 65^\circ \\ &= 5437.8 \text{ m}^2 \end{aligned}$$

Calculate the area of the triangle.

2

Main Grid

Solution

2. Solve **algebraically** the system of equations

$$3x - 2y = 11$$

$$2x + 5y = 1.$$

3

Main Grid

Solution

2.

$$3x - 2y = 11$$

$$2x + 5y = 1$$

$$\begin{array}{l} \times 2 \\ \Rightarrow 6x - 4y = 22 \end{array}$$

$$\begin{array}{l} \times 3 \\ \Rightarrow 6x + 15y = 3 \end{array}$$

$$\text{Sub} \quad -19y = 19$$

$$y = -1$$

\Rightarrow put $y = -1$ into equ ①

$$3x - (2 \times -1) = 11$$

$$3x = 11 - 2$$

$$\underline{x = 3}$$

Check: $2 \times 3 + 5 \times -1 = 6 - 5 = 1$ ✓

So $(3, -1)$ is the solution

3. (a) The price, in pence, of a carton of milk in six different supermarkets is shown below.

66 70 89 75 79 59

Use an appropriate formula to calculate the mean and standard deviation of these prices.

Show clearly all your working.

4

- (b) In six local shops, the mean price of a carton of milk is 73 pence with a standard deviation of 17.7.

Compare the supermarket prices with those of the local shops.

2

$$3. (a) \bar{x} = \frac{\sum x}{n} = \frac{438}{6} = 73 \quad \frac{(\sum x)^2}{n} = \frac{(438)^2}{6} = 31974$$

$$\sum x^2 = 66^2 + 70^2 + 89^2 + 75^2 + 79^2 + 59^2 = 32524$$

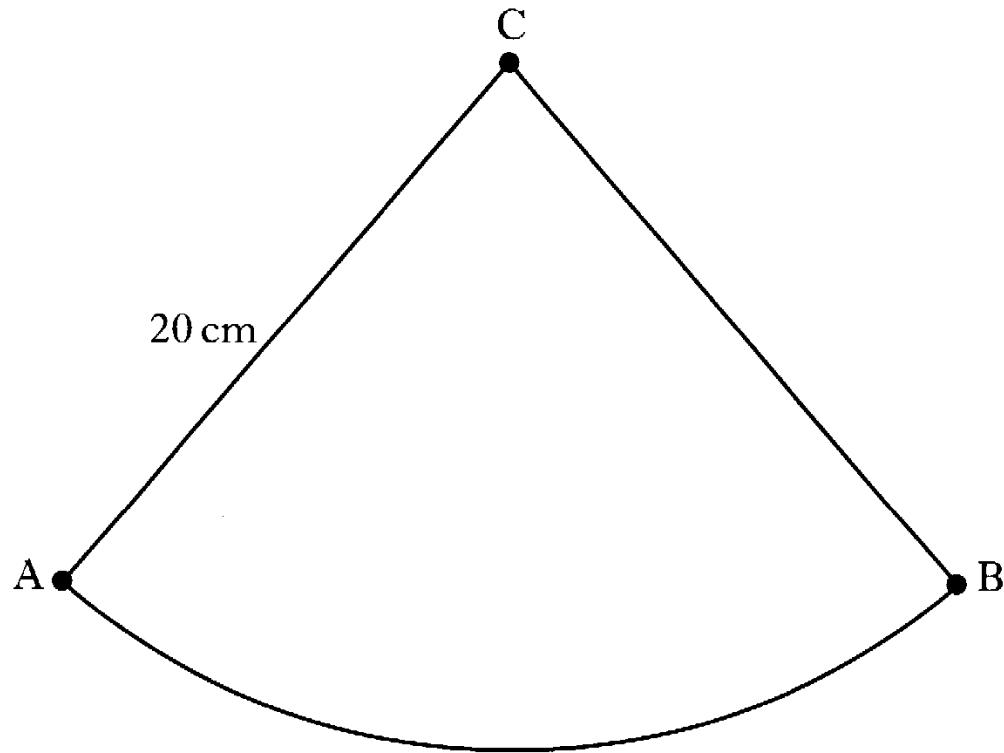
$$s = \sqrt{\frac{32524 - 31974}{6-1}} = \sqrt{\frac{550}{5}} = \sqrt{110} = \underline{\underline{10.49}}$$

$$(b) \bar{x} = 73p \quad s = 17.7$$

mean price is the same.

much wider spread of prices $17.7 > 10.5$

4. A pendulum travels along an arc of a circle, centre C.



The length of the pendulum is 20 centimetres.

The pendulum swings from A to B.

The length of the arc AB is 28.6 centimetres.

Find the angle through which the pendulum swings from A to B.

4

Main Grid

Solution

$$\begin{aligned} 4. \quad \text{Circumference of "circle"} &= \pi d \\ &= 3.14 \times 40 \\ &= 125.6 \text{ cm} \end{aligned}$$

$$\text{Fraction of circle} = \frac{28.6}{125.6} = 0.227707$$

$$\begin{aligned} \text{Thus fraction of angle at centre} \\ &= 0.227707 \times 360 \\ &= 81.97 \end{aligned}$$

$$\text{pendulum swings} \approx \underline{\underline{82^\circ}}$$

5. (a) (i) Factorise completely

$$3y^2 - 6y.$$

1

(ii) Factorise

$$y^2 + y - 6.$$

2

(b) Hence express $\frac{3y^2 - 6y}{y^2 + y - 6}$ in its simplest form.

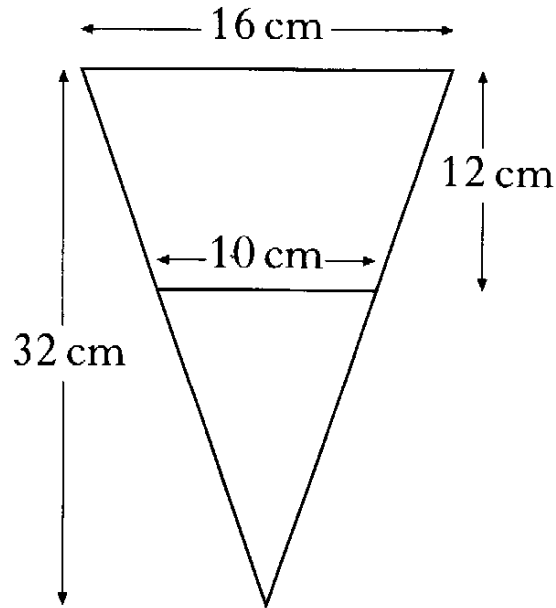
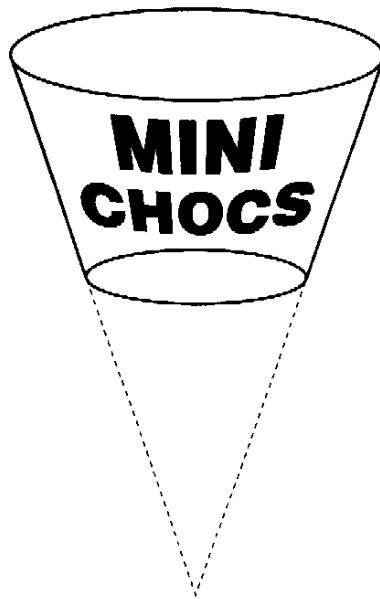
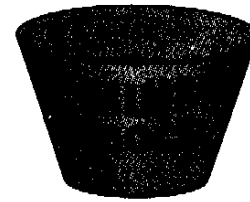
2

$$5. (a) (i) 3y^2 - 6y = 3y(y-2)$$

$$(ii) \quad \begin{array}{l} y^2 + y - 6 \\ (y+3)(y-2) \end{array}$$

$$(b) \quad \frac{3y^2 - 6y}{y^2 + y - 6} = \frac{3y(y-2)}{(y+3)(y-2)} = \frac{3y}{y+3}$$

6. A container to hold chocolates is in the shape of part of a cone with dimensions as shown below.



Calculate the volume of the container.

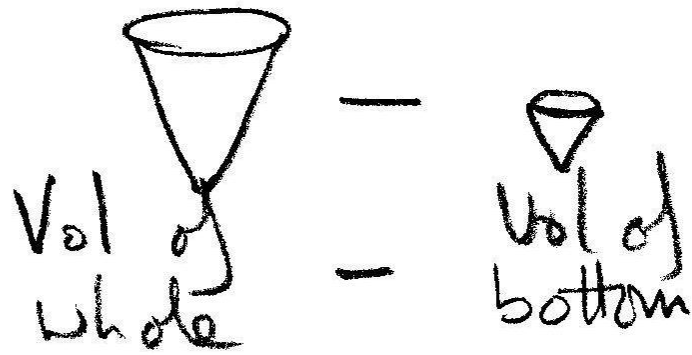
Give your answer correct to one significant figure.

5

Main Grid

Solution

6. Volume required =



$$\text{Volume} = \left(\frac{1}{3} \pi \times 8^2 \times 32 \right) - \left(\frac{1}{3} \pi \times 5^2 \times 20 \right)$$

$$= 2143.57 - 523.3$$

$$= 1620.24$$

$$= \underline{\underline{2000 \text{ cm}^3 \text{ to 1 sig fig}}}$$

7. Solve the equation

$$2x^2 + 3x - 1 = 0,$$

giving your answers correct to one decimal place.

$$2x^2 + 3x - 1 = 0$$

$$a = 2 \quad b = 3 \quad c = -1$$

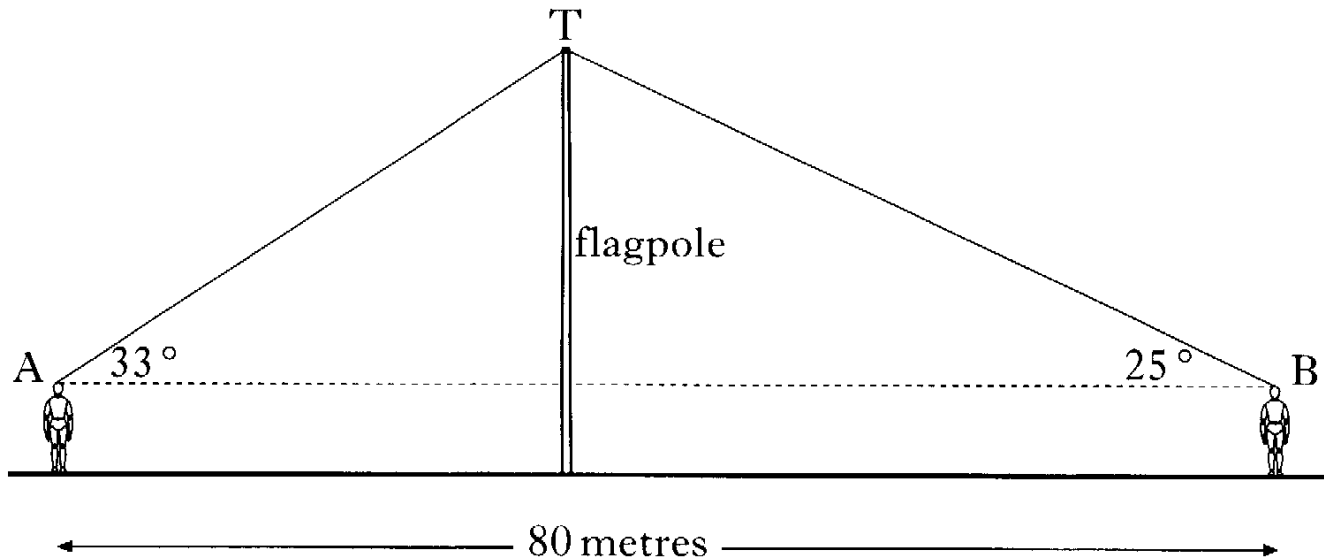
4

$$\begin{aligned} x &= \frac{-3 \pm \sqrt{(3)^2 - (4 \times 2 \times -1)}}{2 \times 2} \\ &= \frac{-3 \pm \sqrt{9 - (-8)}}{4} \\ &= \frac{-3 + \sqrt{17}}{4} \text{ or } \frac{-3 - \sqrt{17}}{4} \\ &= 0.28 \quad \text{or} \quad -1.78 \\ &= 0.3 \quad \text{or} \quad -1.8 \quad \text{to 1d.p.} \end{aligned}$$

Main Grid

Solution

8. The diagram shows two positions of a surveyor as he views the top of a flagpole.



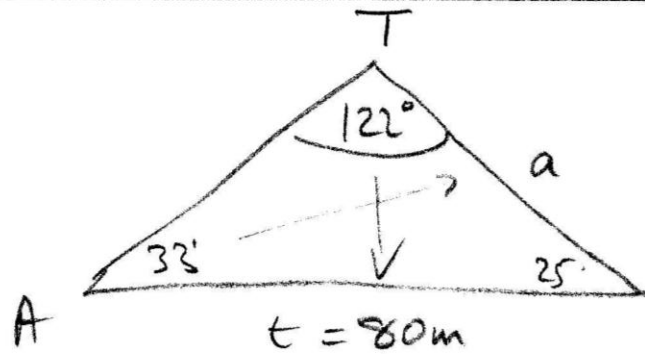
From position A, the angle of elevation to T at the top of the flagpole is 33° .

From position B, the angle of elevation to T at the top of the flagpole is 25° .

The distance AB is 80 metres and the height of the surveyor to eye level is 1.6 metres.

Find the height of the flagpole.

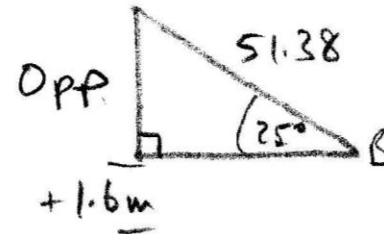
8.



$$180 - (33 + 25) =$$

$$\frac{a}{\sin A} = \frac{t}{\sin T}$$

$$\begin{aligned} \Rightarrow a \sin T &= t \sin A \\ a &= \frac{t \sin A}{\sin T} \\ &= \frac{80 \times \sin 33^\circ}{\sin 122^\circ} \\ &= \underline{51.38 \text{ m}} \end{aligned}$$

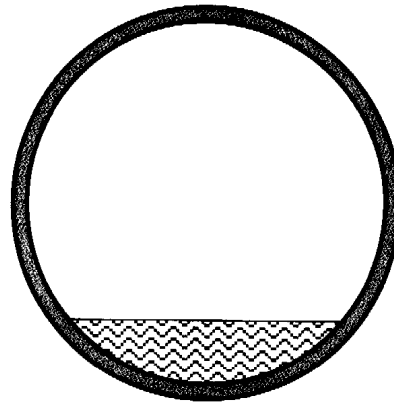
Using S^oH C^oA H T^oA

$$\begin{aligned} \text{Use S}^\circ\text{H} \\ \text{Opp} &= \text{Hyp} \times \sin 25^\circ \\ &= 51.38 \times \sin 25^\circ \\ &= 21.71 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Total height of pole} \\ &= 21.71 + 1.6 \\ &= \underline{23.3 \text{ m}} \end{aligned}$$

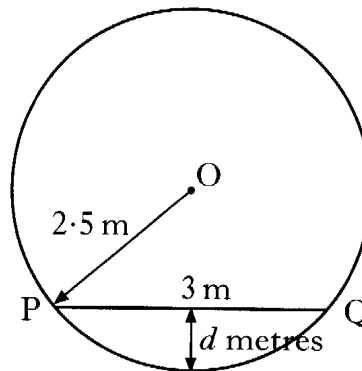
Main Grid

9. The diagram below shows a circular cross-section of a cylindrical oil tank.



In the figure below,

- O represents the centre of the circle
- PQ represents the surface of the oil in the tank
- PQ is 3 metres
- the radius OP is 2.5 metres.

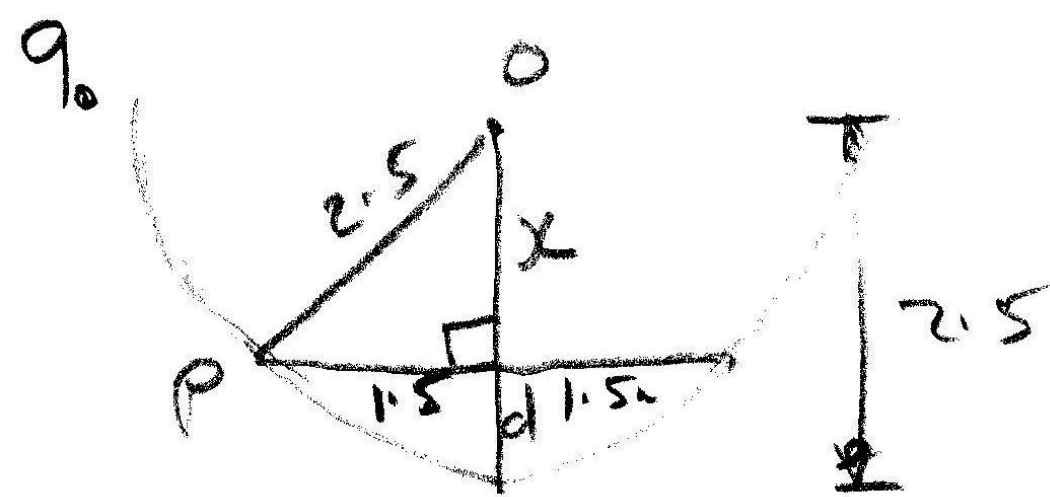


Find the depth, d metres, of oil in the tank.

4

Main Grid

Solution



Pythagoras:

$$x^2 = 2.5^2 - 1.5^2$$

$$x^2 = 6.25 - 2.25$$

$$x^2 = 4$$

$$x = 2$$

$$\text{So } d = 2.5 - 2 = \underline{\underline{0.5\text{m}}}$$

Main Grid

10. The population of Newtown is 50 000.
The population of Newtown is **increasing** at a steady rate of 5% per annum.
The population of Coaltown is 108 000.
The population of Coaltown is **decreasing** at a steady rate of 20% per annum.
How many years will it take until the population of Newtown is greater than the population of Coaltown?

5

Main Grid

Solution

10. $50000 \times (1.05)^n$ $n=4$ Pop. 60775
 $n=3$ Pop 57881

$108000 \times (0.8)^n$ $n=4$ Pop 44237
 $n=3$ Pop = 55296

After 3yrs Newton will have the greater population.

11. (a) Simplify

$$6x^{\frac{3}{2}} \div 2x^{\frac{1}{2}}.$$

2

(b) Change the subject of the formula

$$r = 3p + 2t$$

to p .

2

Main Grid

Solution

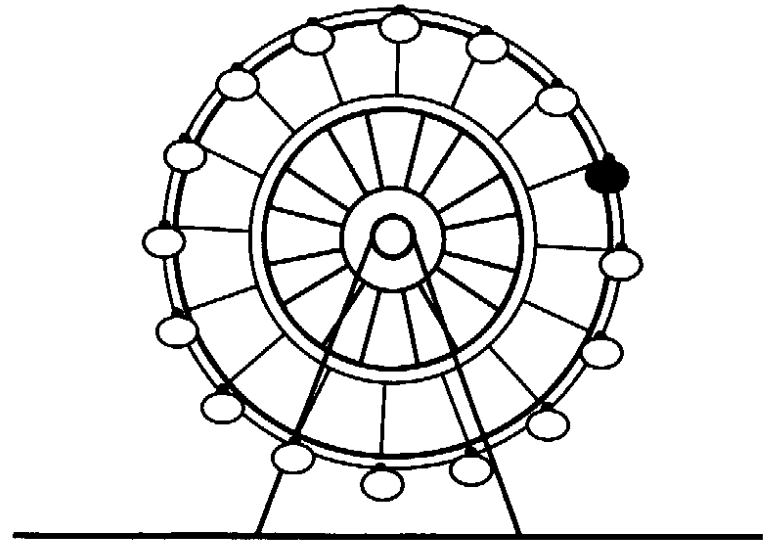
$$11 \text{ (a)} \quad 6x^{\frac{3}{2}} \div 2x^{\frac{1}{2}} = \frac{6}{2} \times x^{3/2 - 1/2} = 3x^{\frac{2}{2}} \\ = \underline{\underline{3x}}$$

$$(b) \quad r = 3p + 2t \\ 3p + 2t = r \\ 3p = r - 2t \\ p = \frac{r - 2t}{3}$$

12. At the carnival, the height, H metres, of a carriage on the big wheel above the ground is given by the formula

$$H = 10 + 5 \sin t^\circ,$$

t seconds after starting to turn.



- (a) Find the height of the carriage above the ground after 10 seconds. 2
- (b) Find the **two** times during the first turn of the wheel when the carriage is 12.5 metres above the ground. 4

$$12. (a) H = 10 + 5 \sin 10^\circ = 10.87 \text{ m}$$

$$(b) H = 12.5 \text{ m}$$

$$\Rightarrow 10 + 5 \sin t = 12.5$$

$$5 \sin t = 2.5$$

$$\sin t = 0.5$$

$$\text{Acute angle } A = \sin^{-1}(0.5) = 30^\circ$$

positive in 2nd quad; $\alpha = 180 - 30 = 150^\circ$

So, 12.5 m at 30° and 150°

1. Factorise

$$x^2 + 2x - 15.$$

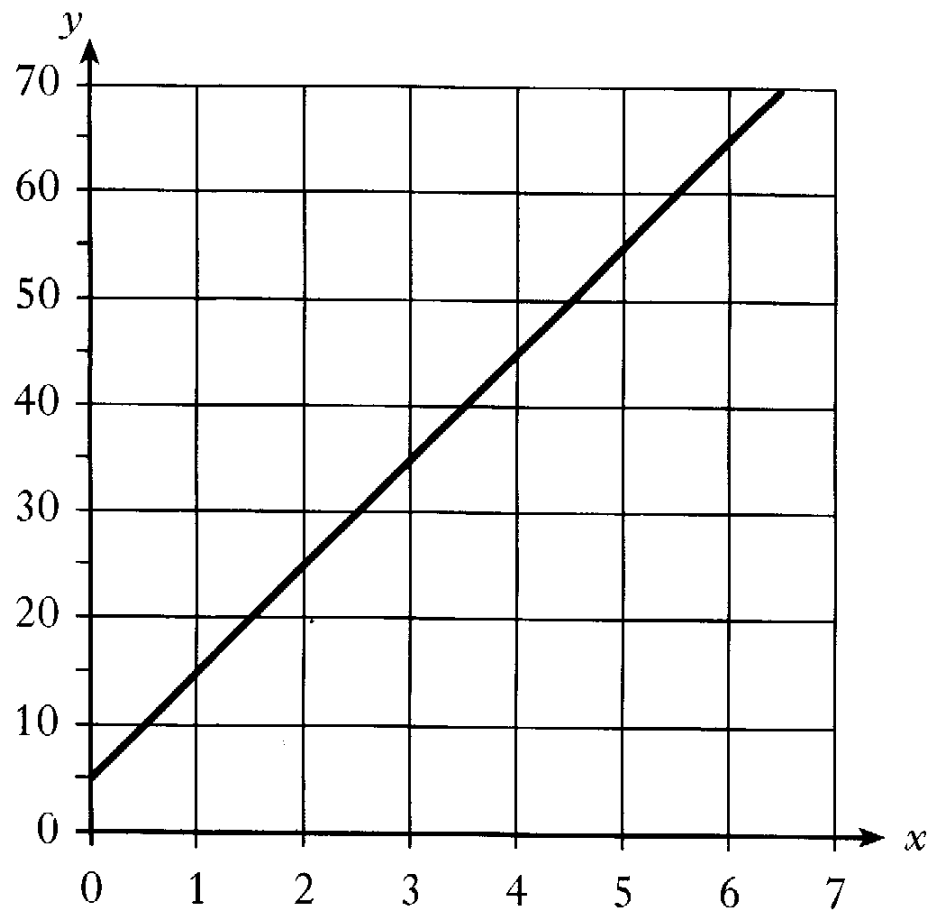
2

Main Grid

Solution

1. $x^2 + 2x - 15$
 $(x + 5)(x - 3)$

2.



Find the equation of the straight line.

3

Main Grid

Solution

$$2. \quad m = \frac{40}{4} = 10 \quad c = 5 \quad \text{Equ } y = 10x + 5$$

3. Find the point of intersection of the straight lines with equations $2x + y = 5$ and $x - 3y = 6$.

4

Main Grid

Solution

$$\begin{array}{l} 3. \quad 2x + y = 5 \\ \quad \quad x - 3y = 6 \end{array} \quad \begin{array}{l} -\textcircled{1} \Rightarrow \\ -\textcircled{2} \Rightarrow \end{array} \quad \begin{array}{l} 2x + y = 5 \\ \underline{2x - 6y = 12} \\ 7y = -7 \\ y = -1 \end{array}$$

put into equ $\textcircled{1}$

$$2x - 1 = 5$$

$$2x = 6$$

$$x = 3$$

check; $3 - (3 \times -1) = 3 + 3 = 6 \checkmark$

pt. of intersection $(3, -1)$.

4.
$$P = R^2b - 5$$

Change the subject of the formula to R .

3

Main Grid

Solution

$$4. \quad P = R^2 b - 5$$

$$R^2 b - 5 = P$$

$$R^2 b = P + 5$$

$$R^2 = \frac{P + 5}{b}$$

$$R = \sqrt{\frac{P + 5}{b}}$$

5. The stem and leaf diagram shows the amounts of money spent by customers in a shop.

2	1	4	4							
3	0	1	5	5	8					
4	1	2	3	5	6	9				
5	0	1	2	3	5	8	9	9		
6	0	0	1	2	6					
7	1	2	2							
8	0	4	6							

$$n = 33$$

2|1 represents 21 pence

- (a) Using the above information, find
- (i) the median 1
 - (ii) the lower quartile and the upper quartile 2
 - (iii) the semi-interquartile range. 2
- (b) What is the probability that a customer chosen at random spent more than 80 pence? 1

5 (a) (i) median Q_2 , occurs $\frac{33+1}{2} = 17$ th term

$$\text{So } Q_2 = 52$$

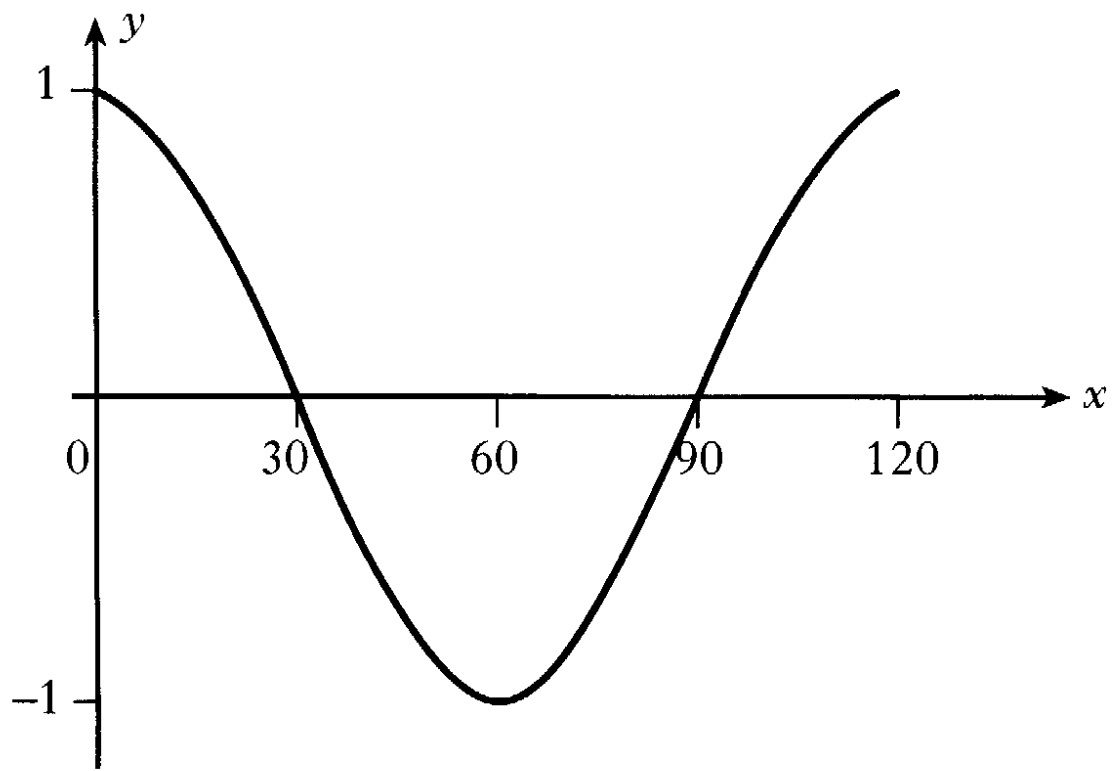
$$(ii) Q_1 (\text{lower}) = \frac{38+41}{2} = 39$$

$$Q_3 (\text{upper}) = \frac{61+62}{2} = 61.5$$

$$(iii) \text{ Semi IQR} = \frac{Q_3 - Q_1}{2} = \frac{61.5 - 39}{2} = 11.25$$

$$(b) \text{ probs } (> 80p) = \frac{2}{33}$$

6.



Part of the graph of $y = \cos bx^\circ$ is shown in the diagram.
State the value of b .

1

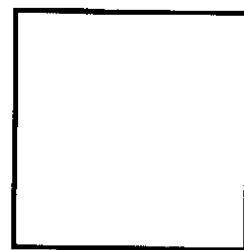
Main Grid

Solution

6. $b = 3$ (period 120°)

Main Grid

7. The square and rectangle shown below have the same **perimeter**.



$(2x + 2)$ cm



$(x + 3)$ cm

length

Show that the length of the rectangle is $(3x + 1)$ centimetres.

2

7. perimeter of square = $4(2x+2) = 8x+8$.

perimeter of rectangle = $2(x+3) + 2L$.

Since equal then:

$$2(x+3) + 2L = 8x+8$$

$$2x+6 + 2L = 8x+8$$

$$2L = 6x+2$$

$$L = 3x+1$$

as required

8. (a) Express $\frac{3}{x} - \frac{5}{x+2}$, $x \neq 0$, $x \neq -2$, as a single fraction in its simplest form. **3**

(b) Express $\sqrt{18} - \sqrt{2} + \sqrt{72}$ as a surd in its simplest form. **3**

$$\begin{aligned}
 8. \quad (a) \quad & \frac{3}{x} - \frac{5}{x+2} \\
 & \frac{3(x+2)}{x(x+2)} - \frac{5x}{x(x+2)} \\
 = & \frac{3(x+2) - 5x}{x(x+2)} \\
 = & \frac{3x+2-5x}{x(x+2)} \\
 = & \frac{2-2x}{x(x+2)}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad & \sqrt{18} - \sqrt{2} + \sqrt{72} \\
 = & \sqrt{9 \times 2} - \sqrt{2} + \sqrt{36 \times 2} \\
 = & 3\sqrt{2} - \sqrt{2} + 6\sqrt{2} \\
 = & 2\sqrt{2} + 6\sqrt{2} \\
 = & \underline{\underline{8\sqrt{2}}}
 \end{aligned}$$

1. The population of a city is increasing at a steady rate of 2.4% per annum. The present population is 528 000.
What is the expected population in 4 years time?
Give your answer to the nearest thousand.

3

Main Grid**Solution**

$$\begin{aligned} 1. \quad 528\,000 \times (1.024)^4 &= 580\,542 \\ &= \underline{\underline{581\,000}} \quad (\text{nearest } 1000) \end{aligned}$$

2. Two groups of six students are given the same test.

(a) The marks of Group A are

73 47 59 71 48 62.

Use an appropriate formula to calculate the mean and the standard deviation.

Show clearly all your working.

4

(b) In Group B, the mean is 60 and the standard deviation is 29.8.

Compare the results of the two groups.

2

$$2 \text{ (a) } \bar{x} = \frac{\sum x}{6} = \frac{360}{6} = 60$$

$$\frac{(\sum x)^2}{n} = \frac{360^2}{6} = 21600$$

$$\begin{aligned}\sum x^2 &= 73^2 + 47^2 + 59^2 + 71^2 + 48^2 + 62^2 \\ &= 22208\end{aligned}$$

$$\begin{aligned}s &= \sqrt{\frac{22208 - 21600}{6-1}} \\ &= \sqrt{\frac{608}{5}} \\ &= \underline{\underline{11.03}}\end{aligned}$$

(b) mean is the same
but the spread of marks from the mean is
much greater because standard deviation
marks $29.8 > 11.0$

3. The contents of twenty matchboxes were counted.

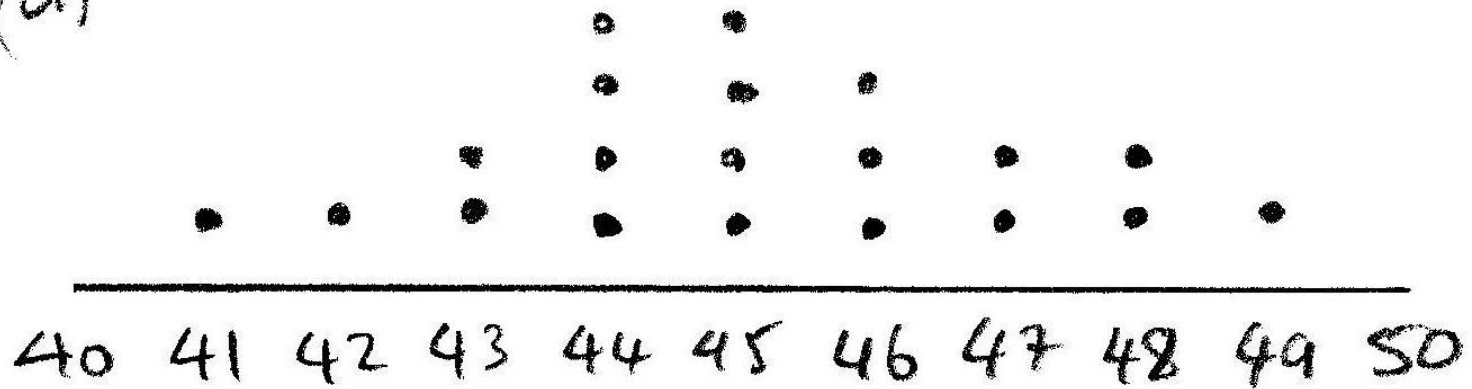
44 44 46 45 47 48 47 41 48 45
45 44 42 43 44 46 46 43 49 45

(a) Construct a dot plot for the data. 2

(b) Describe the shape of the distribution. 1

(c) What would you expect the “average contents per matchbox” to be? 1

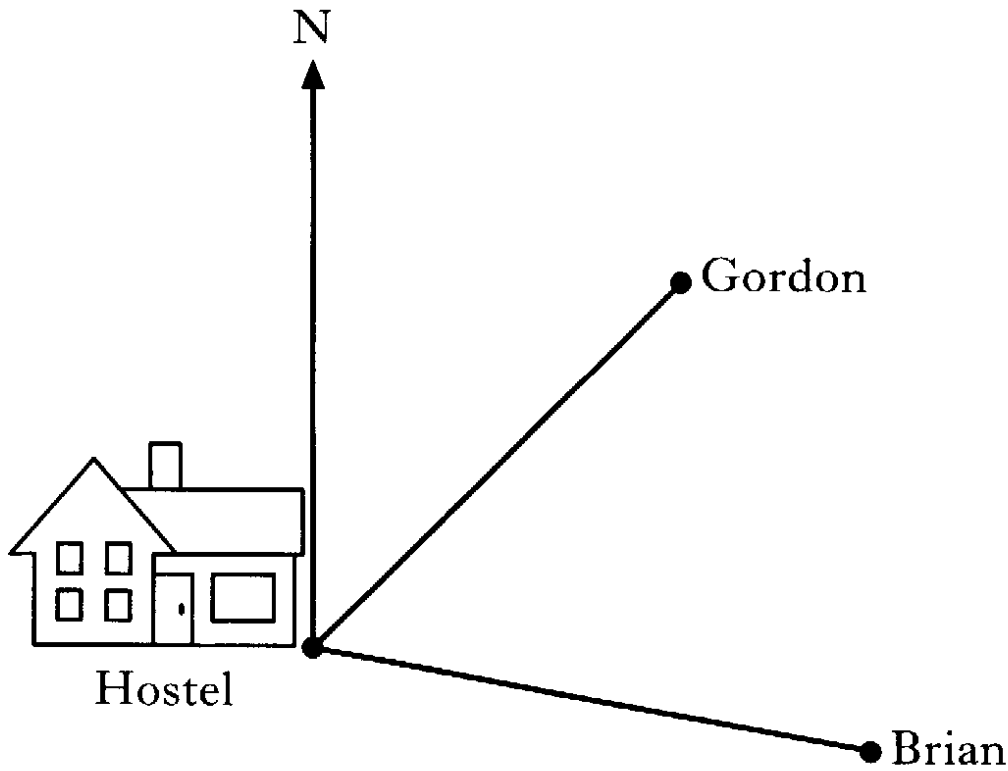
3. (a)



(b) Symmetrical distribution.

(c) Average contents 45.

4. Gordon and Brian leave a hostel at the same time.
 Gordon walks on a bearing of 045° at a speed of 4.4 kilometres per hour.
 Brian walks on a bearing of 100° at a speed of 4.8 kilometres per hour.



If they both walk at steady speeds, how far apart will they be after 2 hours?

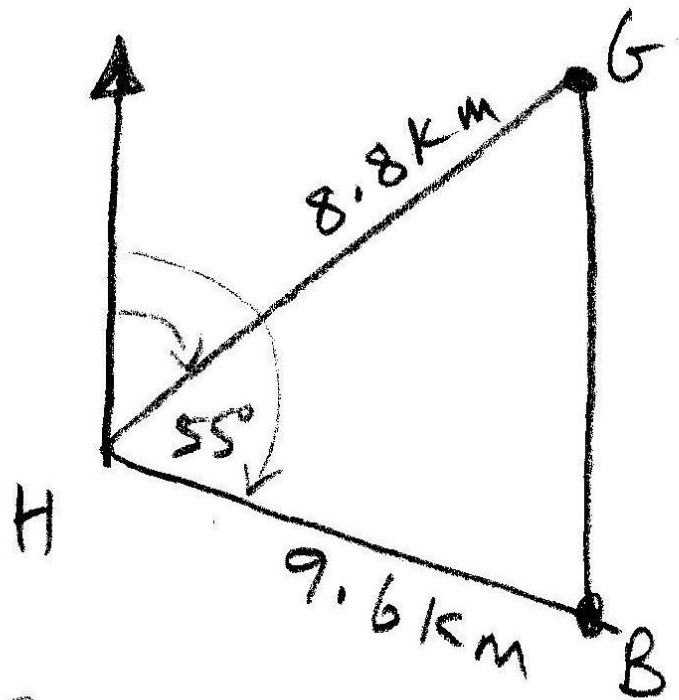
5

Main Grid

Solution

4. 2 hrs:

$$100 - 45 = 55^\circ$$

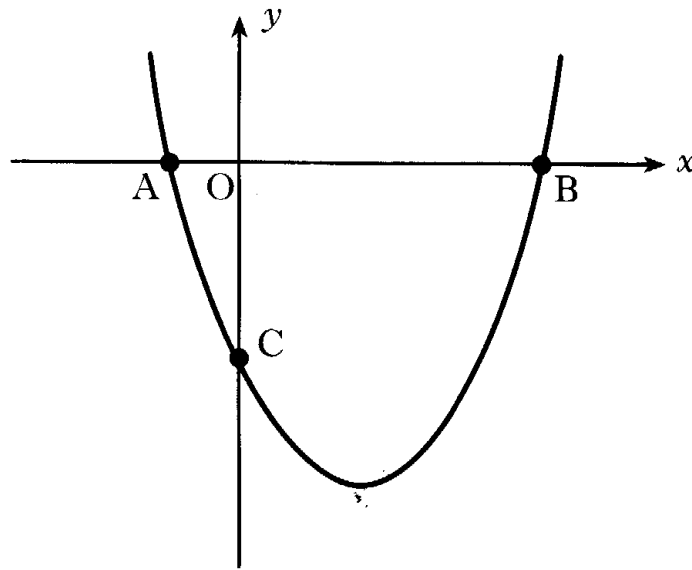


$$\begin{aligned} h^2 &= g^2 + b^2 - 2gb \cos H \\ &= 8.8^2 + 9.6^2 - (2 \times 8.8 \times 9.6 \times \cos 55) \end{aligned}$$

$$h^2 = 77.69$$

$h = 8.53 \text{ km}$ apart after 2 hrs

5.



The equation of the parabola in the above diagram is

$$y = (x - 2)^2 - 9.$$

- (a) State the coordinates of the minimum turning point of the parabola. 2
- (b) Find the coordinates of C. 2
- (c) A is the point $(-1, 0)$. State the coordinates of B. 1

Main Grid

Solution

5. (a) $(2, -9)$

(b) C when $x=0$

$$y = (0-2)^2 - 9 = 4 - 9 = -5$$

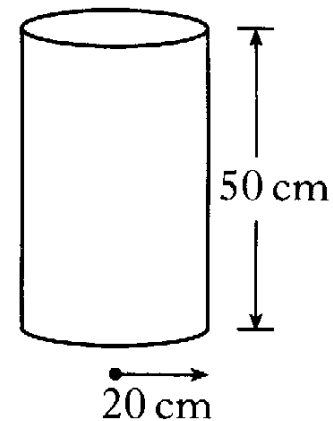
Coords C $(0, -5)$

(c) By symmetry.

A $(0, 1)$ 2 3 4 5

B $(5, 0)$

6. A drinks container is in the shape of a cylinder with radius 20 centimetres and height 50 centimetres.

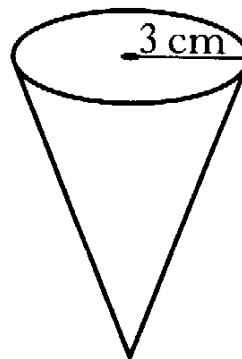


3

- (a) Calculate the volume of the drinks container.

Give your answer in cubic centimetres, correct to two significant figures.

- (b) Liquid from the full container can fill 800 cups, in the shape of cones, each of radius 3 centimetres.



What will be the height of liquid in each cup?

4

$$6. (a) \text{ Vol of cylinder} = \pi r^2 h = 3.14 \times 20^2 \times 50 = 62800 \\ = \underline{63000} \text{ (2 s.f.)}$$

$$(b) \text{ Vol of cone} = \frac{1}{3} \pi r^2 h \quad \times 800 \text{ for 800 cups} \\ \times 3: \quad 3V = \pi r^2 h \times 800$$

$$h = \frac{3V}{\pi r^2} = \frac{3 \times 63000}{3.14 \times 3 \times 3 \times 800}$$

$$= 8.36$$

$$\underline{h = 8.4 \text{ cm (2 s.f.)}}$$

7. Multiply out the brackets and collect like terms.

$$(x + 4)(2x^2 + 3x - 1)$$

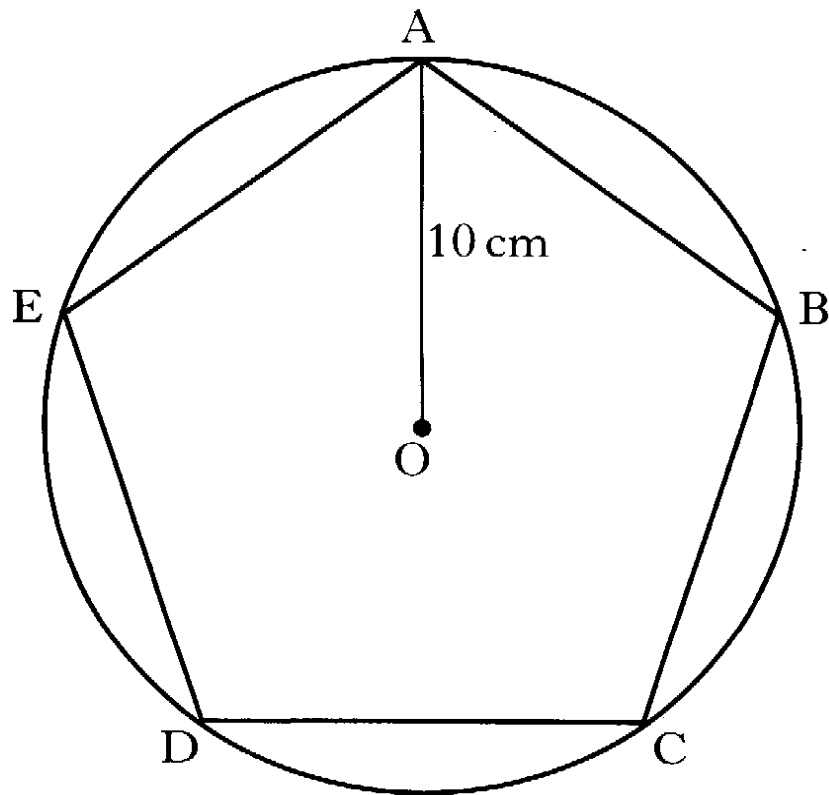
3

Main Grid

Solution

$$\begin{aligned} 7. & (x+4)(2x^2+3x-1) \\ &= 2x^3+3x^2-x+8x^2+12x-4 \\ &= 2x^3+11x^2+11x-4 \end{aligned}$$

8.



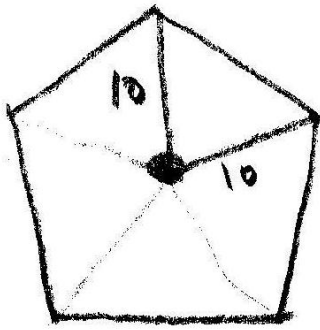
A regular pentagon ABCDE is drawn in a circle, centre O, with radius 10 centimetres.

Calculate the area of the regular pentagon.

5

Main Grid**Solution**

8.



$$\text{Angle at centre} = \frac{360}{5} = 72^\circ$$

$$\begin{aligned}\text{Area of 1 } \Delta &= \frac{1}{2} \times 10 \times 10 \times \sin 72^\circ \\ &= 47.6 \text{ cm}^2\end{aligned}$$

$$\begin{aligned}\text{Area of 5 } \Delta\text{'s} &= 47.6 \times 5 \\ &= \underline{237.8 \text{ cm}^2}\end{aligned}$$

9. (a) Express $a^2(2a^{-\frac{1}{2}} + a)$ in its simplest form.

2

Main Grid

Solution

$$9. (a) \frac{a^2(2a^{-\frac{1}{2}} + a)}{2a^{\frac{3}{2}} + a^3}$$

$$\left(\begin{array}{c} 2 - \frac{1}{2} \\ = \frac{4}{2} - \frac{1}{2} \\ = \frac{3}{2} \end{array} \right)$$

9. (b) Solve the quadratic equation

$$3x^2 + 3x - 7 = 0$$

using an appropriate formula.

Give your answers correct to 1 decimal place. $3x^2 + 3x - 7 = 0$

4

$$a = 3 \quad b = 3 \quad c = -7$$

$$x = \frac{-3 \pm \sqrt{(3)^2 - (4 \times 3 \times -7)}}{2 \times 3}$$

$$= \frac{-3 \pm \sqrt{9 - (-84)}}{6}$$

$$= \frac{-3 + \sqrt{93}}{6} \text{ or } \frac{-3 - \sqrt{93}}{6}$$

$$= 1.107 \quad \text{or} \quad -2.107$$

$$= 1.1 \quad \text{or} \quad -2.1 \quad \text{to 1d.p.}$$

Main Grid

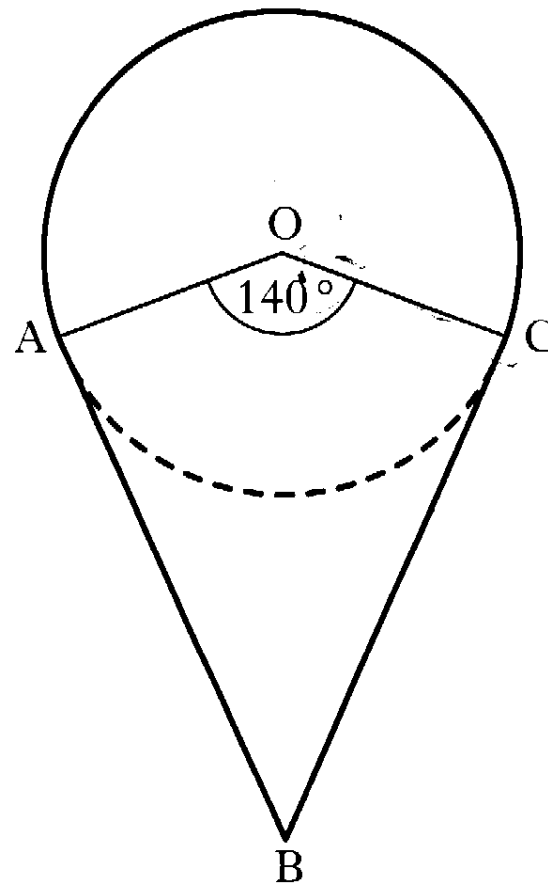
Solution

10. The diagram shows a mirror which has been designed for a new hotel.

The shape consists of a sector of a circle and a kite AOCB.

- The circle, centre O, has a radius of 50 centimetres.
- Angle AOC = 140° .
- AB and CB are tangents to the circle at A and C respectively.

Find the perimeter of the mirror.

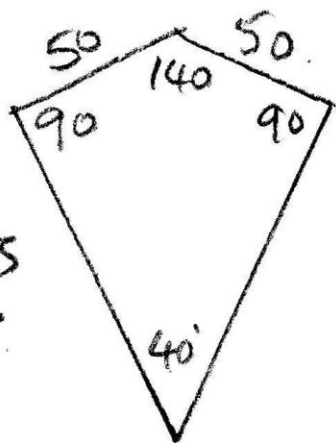
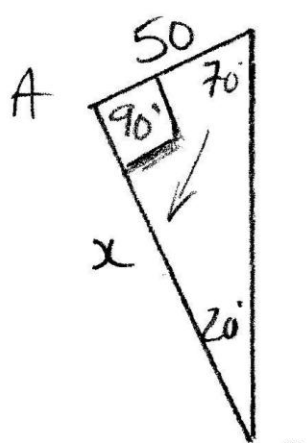


5

Main Grid

Solution

10.

Tangents
= 90° T $^\circ$ A

B

$$\begin{aligned} \text{Opp} = x &= \text{Adj} \times \tan 70^\circ \\ &= 50 \times \tan 70^\circ \end{aligned}$$

$$\text{So } AB = 137.37 \text{ cm}$$

$$\text{And } BC = 137.37$$

$$\begin{aligned} \text{Sector AC: } \Rightarrow & \frac{220}{360} \times \pi \times 100 \\ & = \underline{191.9 \text{ cm}} \end{aligned}$$

$$\text{Perimeter} = 191.9 + 2 \times 137.37 = \underline{\underline{466.8 \text{ cm}}}$$

11. (a) Solve the equation

$$4 \tan x^\circ + 5 = 0, \quad 0 \leq x \leq 360.$$

3

(b) Show that

$$\tan x^\circ \cos x^\circ = \sin x^\circ.$$

2

Main Grid

Solution

$$11. (a) \quad 4 \tan x + 5 = 0$$

$$4 \tan x = -5$$

$$\tan x = -\frac{5}{4} = -1.25$$

Acute angle $A = \tan^{-1}(1.25) = 51.3^\circ$

$\tan x$ negative in quads 2 and 4.

quad 2 $\Rightarrow (180 - A) = 180 - 51.3 = 128.7^\circ$

quad 4 $\Rightarrow (360 - A) = 360 - 51.3 = 308.7^\circ$

$$x = 128.7^\circ \text{ or } 308.7^\circ$$

A1. A group of students scored the following marks in a test.

2000 Paper 1

9 5 6 8 6 9 7 8 6 5

(a) Construct a frequency table from the above data and add a cumulative frequency column.

2

(b) What is the probability that a student chosen at random from this group scored less than 8?

1

Main Grid

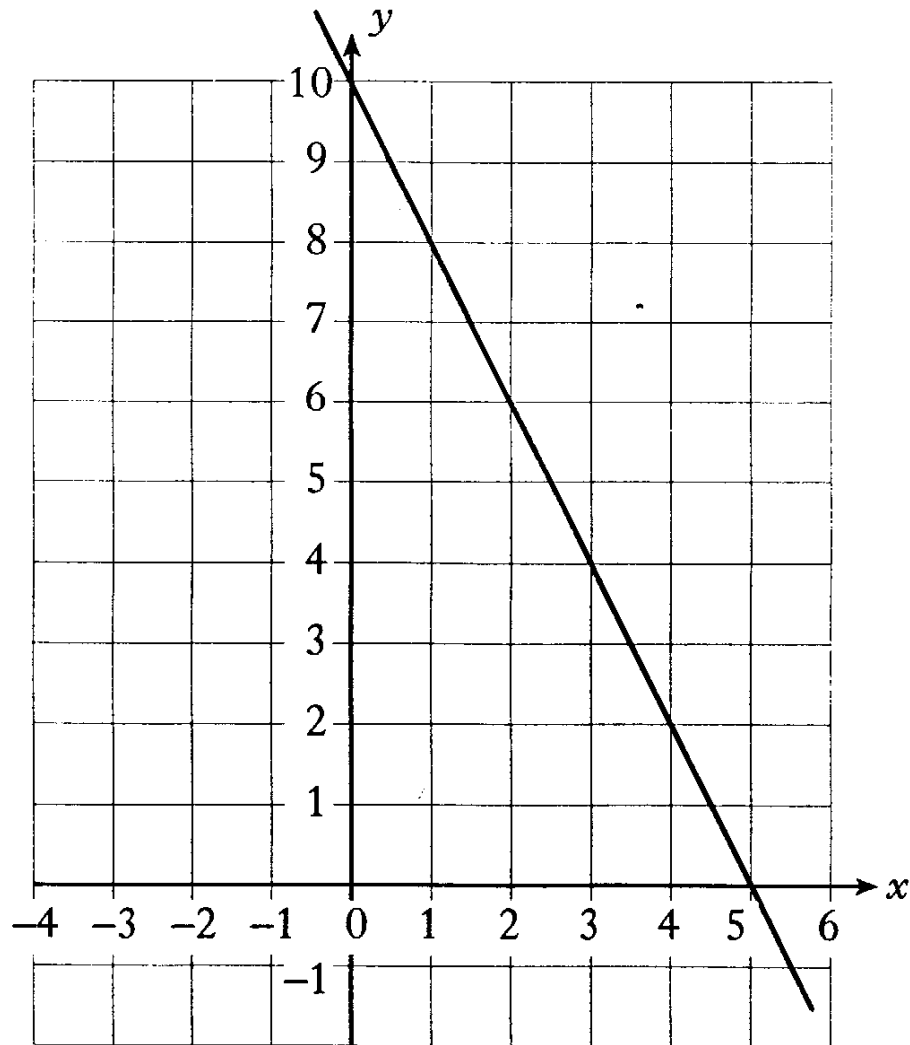
Solution

A1. (a)

MARKS	TALLY	FREQ	CUMULATIVE FREQ.
5		2	2
6		3	5
7		1	6
8		2	8
9		2	10

(b) $P(5, 6, 7) = \frac{6}{10} = \underline{\underline{\frac{3}{5}}}$

A2.



Find the equation of the straight line.

3

Main Grid

Solution

$$A2 \quad m = -2 \quad c = 10 \quad y = -2x + 10.$$

A3. Factorise

$$9a^2 - 25b^2.$$

Mar

2

Main Grid

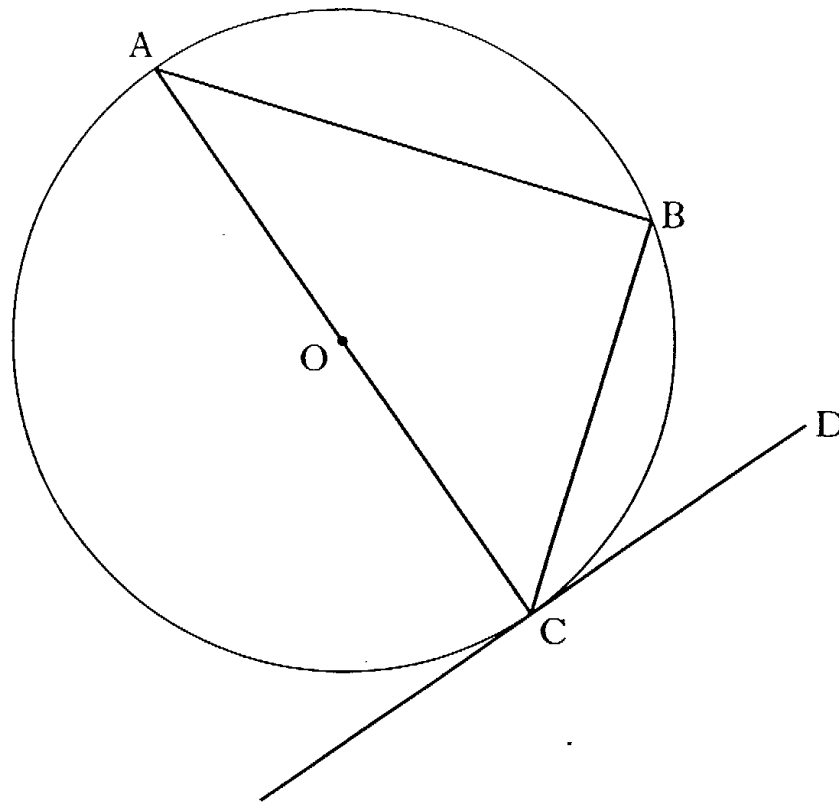
Solution

(Difference of two squares)

A3

$$9a^2 - 25b^2$$
$$(3a + 5b)(3a - 5b)$$

A4.



- A, B and C are points on the circumference of a circle, centre O.
- CD is a tangent to the circle.
- Angle $BCD = 25^\circ$.

Calculate the size of angle BAC.

Show all working.

3

Main Grid

Solution

A4 $\angle CBA = 90^\circ$ (Triangle is semi circle
is right angled)

$\angle OCD = 90^\circ$ (Tangent)

$$\angle BCO = 90 - 25 = 65^\circ$$

$$\angle BAC = 180 - (90 + 65) = \underline{\underline{25^\circ}}$$

A5. A manufacturer of matches claims that there are “on average 60 matches per box”.

A sample of eleven boxes contains the following numbers of matches per box.

58, 62, 60, 65, 59, 60, 59, 62, 61, 61, 64

(a) From the above data, find the median, the lower quartile and the upper quartile.

2

(b) Comment on the claim made above.

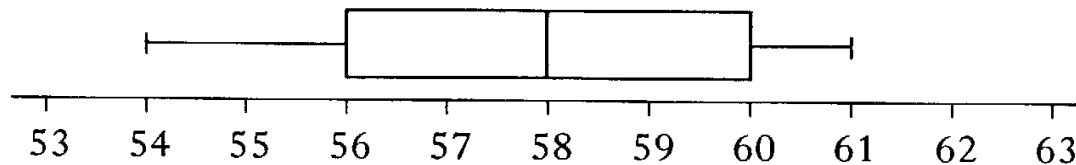
1

(c) Construct a boxplot for the data.

2

(d) A different sample of matchboxes was taken.

The boxplot, shown below, was drawn for the new data.



Does this new data support the manufacturer’s claim?

Give a reason for your answer.

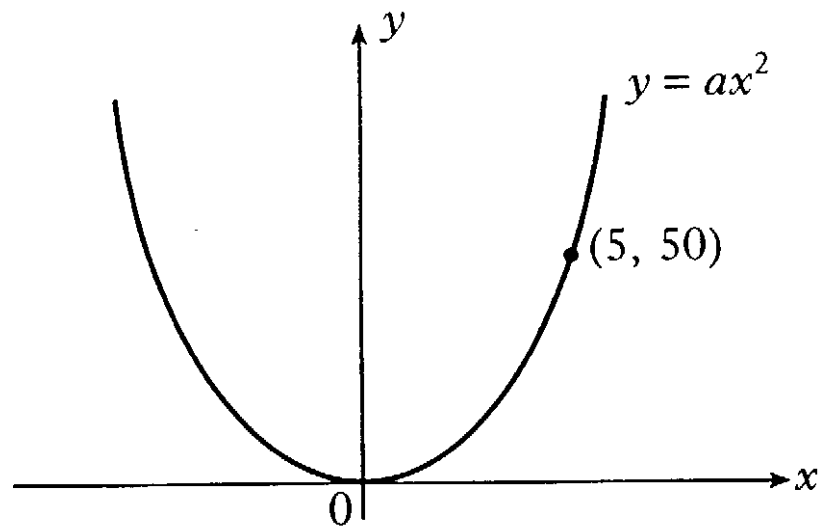
1

A5. 58 59 59 60 60 61 61 62 62 64 65.
n=11.

(a) $Q_1 = 59$ $Q_2 = 61$ $Q_3 = 62$

(b) Would be about right maybe slightly more for the 'average' maybe 61.

B6. The diagram below shows the graph of $y = ax^2$.



Find the value of a .

2

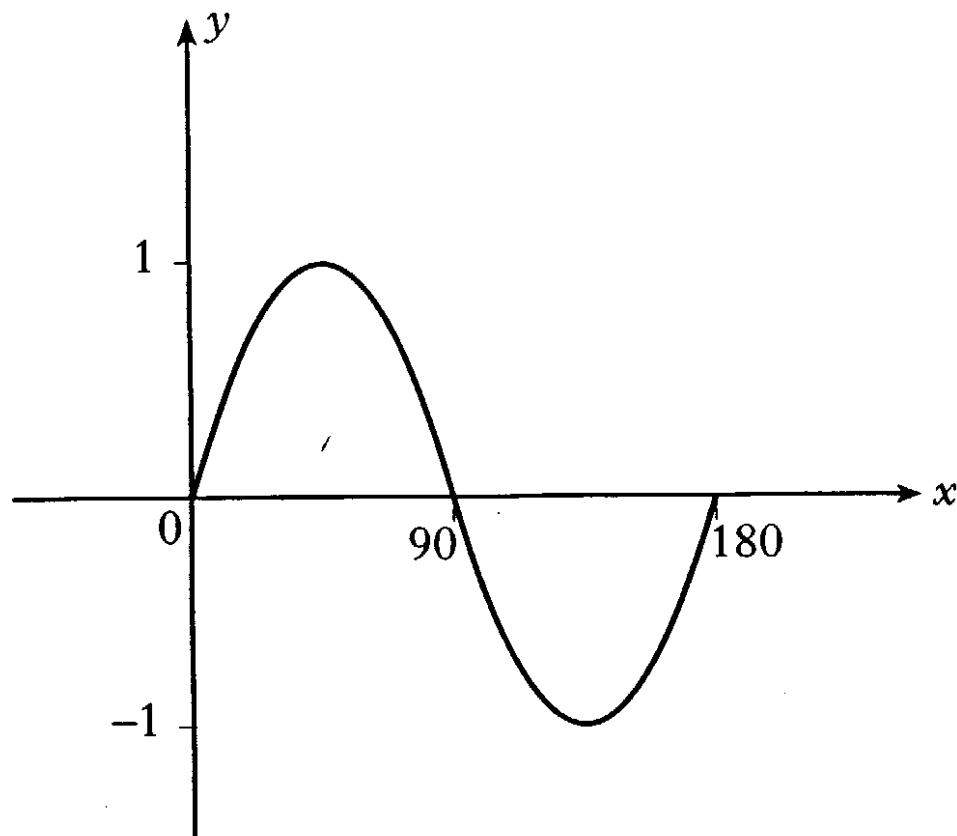
Main Grid

Solution

B6.

$$y = ax^2 \quad (5, 50)$$
$$50 = a(5^2)$$
$$a = \frac{50}{25} = 2$$

B7.



The graph of $y = \sin bx^\circ$ is shown in the diagram.

State the value of b .

1

Main Grid

Solution

B7

$$b = 2$$

$$\text{(period} = \frac{360}{2} = 180^\circ)$$

Main Grid

B8. (a) Express $\frac{a^{\frac{1}{2}} \times a^{\frac{5}{2}}}{a^2}$ in its simplest form. **2**

(b) Express $\frac{2}{\sqrt{3}}$ as a fraction with a rational denominator. **2**

(c) Express $\frac{2}{x} + \frac{4}{x+3}$, $x \neq 0$, $x \neq -3$, as a single fraction in its simplest form. **3**

Main Grid

Solution

$$88 \quad (a) \quad \frac{a^{\frac{1}{2}} \times a^{\frac{5}{2}}}{a^2} = \frac{a^{\frac{6}{2}}}{a^2} = \frac{a^3}{a^2} = a$$

$$(b) \quad \frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{3}$$

$$\begin{aligned} (c) \quad & \frac{2}{x} + \frac{4}{x+3} \\ &= \frac{2(x+3)}{x(x+3)} + \frac{4x}{x(x+3)} \\ &= \frac{2x+6 + 4x}{x(x+3)} \\ &= \frac{6x+6}{x(x+3)} \end{aligned}$$

A1. A hotel inspector recorded the volume of wine, in millilitres, in a sample of six glasses.

120 126 125 131 130 124

Use an appropriate formula to calculate the standard deviation.

Show clearly all your working.

4

Main Grid

Solution

A1.

$$\sum x = 756$$

$$(\sum x)^2 / n = \frac{756^2}{6} = 95256$$

$$\sum x^2 = 120^2 + 126^2 + 125^2 + 131^2 + 130^2 + 124^2 = 95338$$

$$s = \sqrt{\frac{95338 - 95256}{6-1}} = \sqrt{\frac{82}{5}} = \sqrt{16.4} = 4.05$$

A2. Multiply out the brackets and collect like terms.

$$(3x + 2)(x - 1) + 4x$$

3

Main Grid

Solution

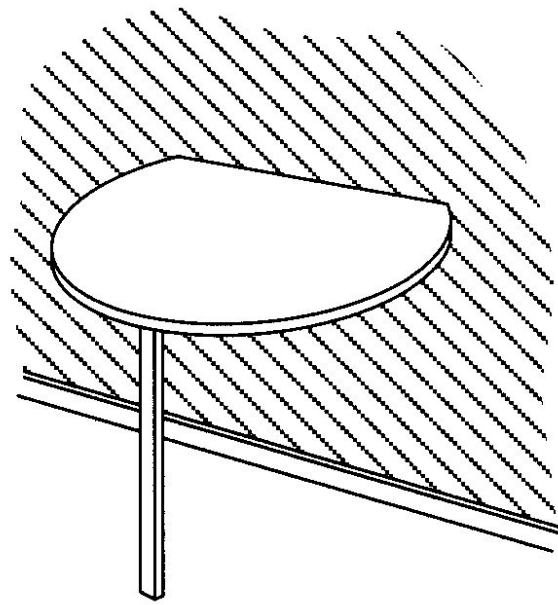
A2.

$$(3x + 2)(x - 1) + 4x$$

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

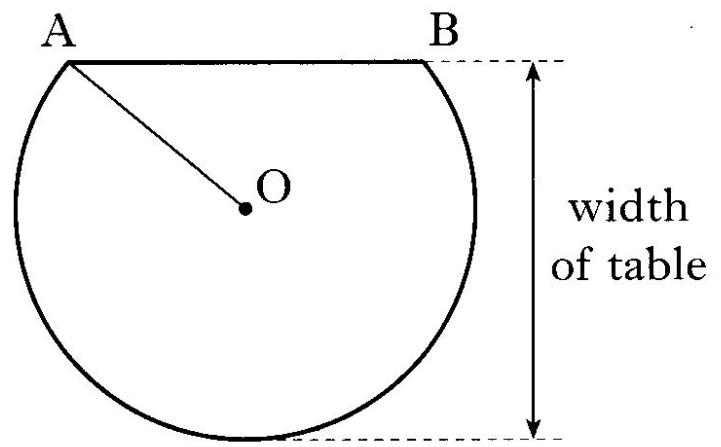
$$= \underline{\underline{3x^2 + 3x - 2}}$$

A3. The diagram shows a fold-away table whose top is in the shape of part of a circle.



- The centre of the circle is O .
- AB is a chord of the circle.
- AB is 70 centimetres.
- The radius, OA , is 40 centimetres.

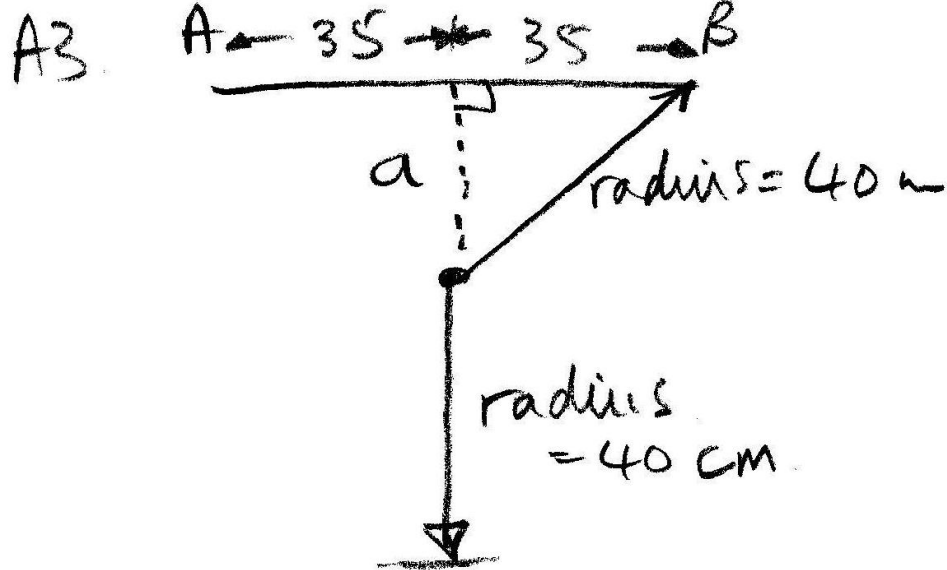
Find the width of the table.



4

Main Grid

Solution



Pythagoras :

$$\begin{aligned}
 a^2 &= c^2 - b^2 \\
 &= 40^2 - 35^2 \\
 &= 1600 - 1225 \\
 a &= \sqrt{375} \\
 &= 19.36 \\
 &= 19.4 \text{ cm}
 \end{aligned}$$

$$\begin{aligned}
 \text{width of table} &= 40 + 19.4 \\
 &= \underline{\underline{59.4 \text{ cm}}}
 \end{aligned}$$

Main Grid

A4. Michael wishes to borrow £1000 for 3 months. He can choose from **Advantage Loans** or **Low Cost Loans**.

Advantage Loans

INTEREST RATE

1.5% per month

Low Cost Loans

INTEREST RATE

18.5% per annum

Which company costs less?

Give a reason for your answer.

A4. Advantage:

$$3 \text{ mths: } \text{€}1000 \times (1.015)^3 = \text{€}1045.68$$

Interest to pay €45.68

'Low Cost'

$$\begin{aligned} \text{Interest for 1 yr} &= \text{€}1000 \times 0.185 = \text{€}185 \\ \text{for 3 mths} &= \text{€}185 \div 4 = \text{€}\underline{\underline{46.25}} \end{aligned}$$

"Advantage Loans" costs less by €0.57

A5. The cost of hiring a car depends on the number of days the car is hired and the number of litres of petrol used.

(a) David hired a car for 3 days and used 50 litres of petrol. The total cost was £88.50.

Let x pounds be the cost per day of hiring a car, and y pounds be the cost of one litre of petrol.

Write down an equation in x and y which satisfies the above condition. **1**

(b) Anne hired the same model of car for 4 days and used 60 litres of petrol. The total cost was £113.00.

Write down a second equation in x and y which satisfies this condition. **1**

(c) Find the cost per day of hiring the car and the cost of one litre of petrol. **4**

$$A5. (a) \quad 3x + 50y = 88.50. \quad (1)$$

$$(b) \quad 4x + 60y = 113.00 \quad (2)$$

$$\text{Equ (1)} \times 4 \quad 12x + 200y = 354$$

$$\text{Equ (2)} \times 3 \quad \underline{12x + 180y = 339}$$

$$\text{Sub} \quad \quad \quad 20y = 15.$$

$$y = \frac{15}{20} = 0.75$$

put into Equ (1)

$$3x + 50 \times 0.75 = 88.50$$

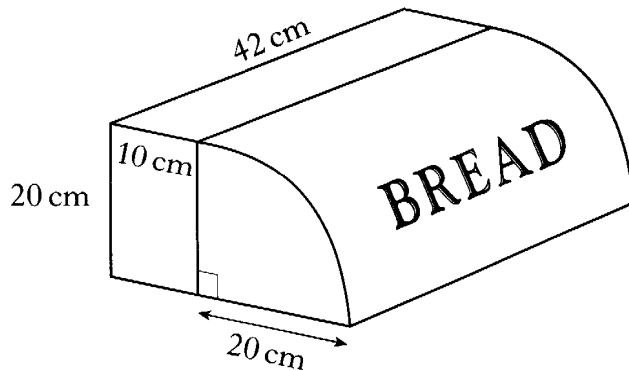
$$3x = 88.50 - 37.50$$

$$3x = 51$$

$$x = 17$$

Car is £17 per day petrol cost 75p a litre

A6. A bread bin is in the shape of a prism as shown below.



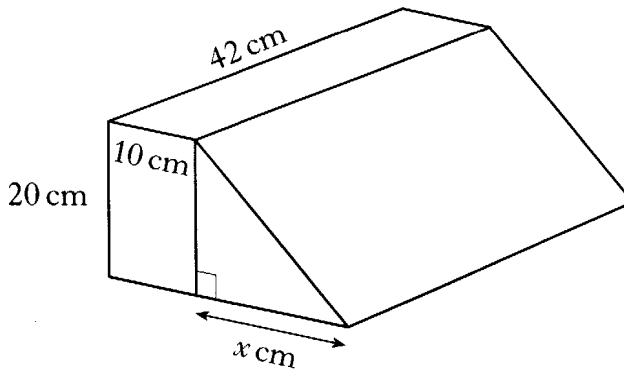
The cross-section of the bread bin consists of a rectangle 20 centimetres by 10 centimetres and a quarter circle.

(a) Calculate the volume of the bread bin.

Give your answer in cubic centimetres, correct to 3 significant figures.

4

(b) The design is changed so that the volume remains the same. The cross-section is now a rectangle 20 centimetres by 10 centimetres and a right-angled triangle as shown in the diagram below.



Find x .

Main Grid

Solution

3

A6 (a) Area of cross section = $20 \times 10 + \frac{1}{4} \pi \times 20^2$
 $= 200 + 314$
 $= 514 \text{ cm}^2$

Vol of prism = Ah
 $= 514 \times 42$
 $= 21588$
 $= \underline{\underline{21600 \text{ cm}^2}} \text{ (3 s.f.)}$

(b) Area of cross section the same too,
as $h = 42 \text{ cm}$ again.

So area of rectangle = 200 cm^2
means that area of $\Delta =$ area of \odot .

$$\frac{1}{2} \times b \times h = 314$$

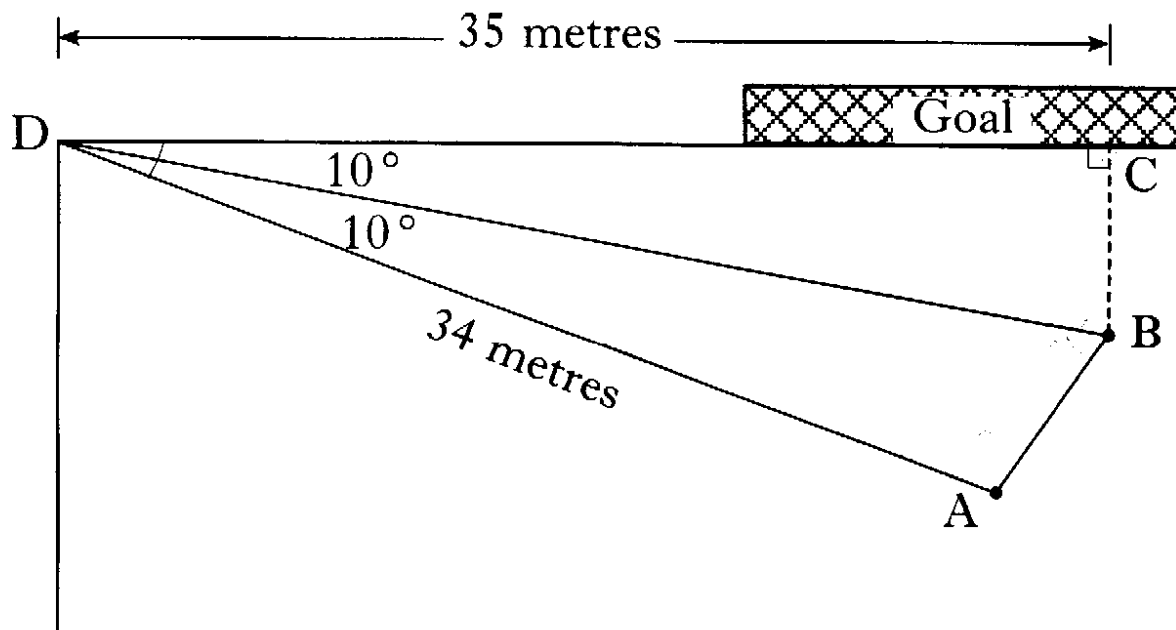
$$\frac{1}{2} \times x \times 20 = 314$$

$$x \times 10 = 314$$

$$x = 314 \div 10$$

$$x = \underline{\underline{31.4 \text{ cm}}}$$

A7.



The diagram shows part of a football pitch with players at A, B, C and D. BC is perpendicular to CD.

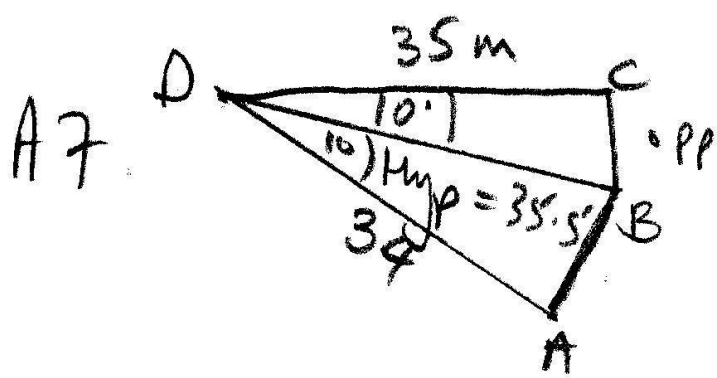
$CD = 35$ metres, angle $CDB = 10^\circ$, angle $BDA = 10^\circ$, $AD = 34$ metres.

Find the distance from A to B.

5

Main Grid

Solution



$$\text{Hyp} = \frac{\text{Adj}}{\cos 10^\circ}$$

$$= \frac{35}{\cos 10} = \underline{\underline{35.53 \text{ m}}}$$

Use cosine rule

$$d^2 = 34^2 + 35.5^2 - (2 \times 34 \times 35.5 \times \cos 10)$$

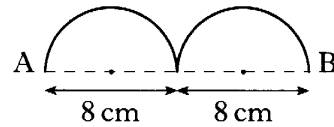
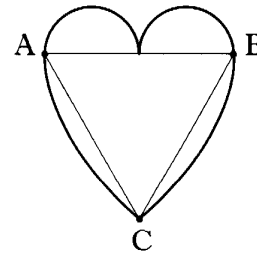
$$d = \sqrt{38.92}$$

$$= 6.24 \text{ m}$$

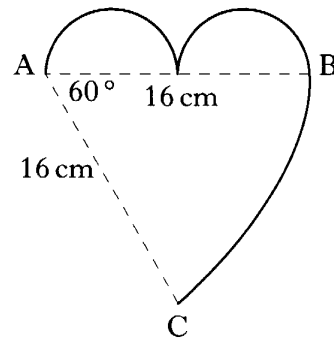
$$\underline{\underline{AB = 6.2 \text{ m}}}$$

A8. Heart-shaped cards have been designed for St Valentine's Day.

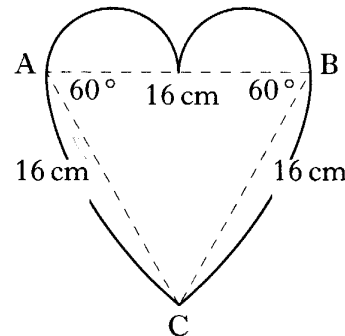
The template used is shown opposite with the key points A, B and C indicated.



The top of the template was formed by drawing two semi-circles, each with diameter 8 centimetres.



One side of the template was formed by drawing an arc BC of a circle centre A, where angle BAC = 60° .



The template was completed by drawing arc AC of a circle centre B, where angle ABC = 60° .

Find the perimeter of the template.

$$A8. \text{ Perimeter } AB = \pi \times d = 3.14 \times 8 = 25.12 \text{ cm.}$$

$$\begin{aligned} \text{arc } BC &= \frac{1}{6} \times \pi \times 32 \\ &= 16.7467. \end{aligned}$$

$$\text{By symmetry arc } AC = \text{arc } BC = 16.7467$$

$$\begin{aligned} \text{Total perimeter of shape} &= 25.12 + 2 \times 16.7467 \\ &= \underline{\underline{58.61}} \text{ cm} \end{aligned}$$

B9. (a) Change the subject of the formula $r = \frac{st}{q}$ to s .

2

Main Grid

Solution

B9 (b) Use an appropriate formula to solve the quadratic equation

$$3x^2 - 2x - 6 = 0.$$

$$3x^2 - 2x - 6 = 0$$

Give your answer correct to 1 decimal place. $a = 3$ $b = -2$ $c = -6$

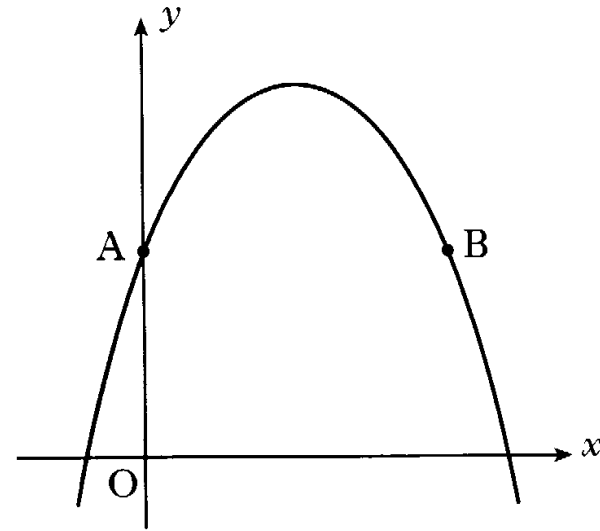
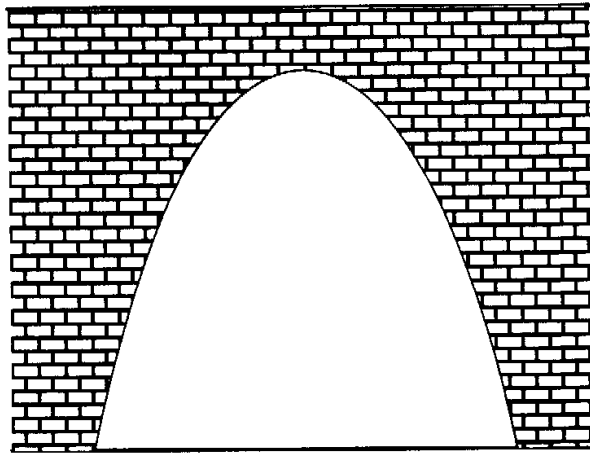
4

$$\begin{aligned}x &= \frac{-2 \pm \sqrt{(-2)^2 - (4 \times 3 \times -6)}}{2 \times 3} \\&= \frac{-2 \pm \sqrt{4 - (-72)}}{6} \\&= \frac{-2 + \sqrt{76}}{6} \text{ or } \frac{-2 - \sqrt{76}}{6} \\&= 1.786 \quad \text{or} \quad -1.119 \\&= 1.8 \quad \text{or} \quad -1.1 \quad \text{to 1d.p.}\end{aligned}$$

Main Grid

Solution

B10.



The arch of a railway bridge is represented by a parabola. The equation of the parabola is

$$y = 20 - (x - 3)^2.$$

- (a) State the coordinates of the maximum turning point of the parabola. 2
- (b) State the equation of the axis of symmetry. 1
- (c) Points A and B have the same y -coordinate.
A is the point $(0, 11)$. State the coordinates of B. 2

Main Grid

Solution

$$y = 20 - (x - 3)^2$$

(a) $(3, 20)$

(b) $x = 3$

(c) $x = 0 \quad y = 11$

axis of symmetry: half way between 0 and 6

coords B (6, 11)

B11. (a) Solve the equation

$$4\sin x^\circ - 1 = 0, \quad 0 \leq x < 360.$$

3

(b) Show that

$$\frac{1 - \cos^2 A}{\cos^2 A} = \tan^2 A.$$

2

Main Grid

Solution

$$B11. (a) \quad 4 \sin x - 1 = 0$$

$$\sin x = \frac{1}{4}$$

$$x = \sin^{-1}(0.25)$$

$$= 14.5^\circ$$

$\sin x$ positive in quad 2

$$\text{Angle} = 180 - 14.5 = 165.5^\circ$$

$$\underline{x = 14.5^\circ \text{ or } 165.5^\circ}$$

$$(b) \quad \text{LHS} = \frac{1 - \cos^2 A}{\cos^2 A} = \frac{\sin^2 A}{\cos^2 A} = \tan^2 A$$

$$= \text{RHS}$$

as required.

C6. Stephen plans to go to a concert. The ticket costs £49.00. He works 2 hours overtime on Friday night at time and a half, and $2\frac{1}{2}$ hours overtime on Saturday morning at double time.

If his basic pay is £6.80 per hour, will his overtime pay cover the cost of the ticket?

You must give a reason for your answer.

4

C.6. Time and a half; $6.80 \times 1.5 \times 2 \text{ hrs} = \text{€}20.40$
Double time; $6.80 \times 2 \times 2.5 \text{ hrs} = \text{€}34.00$
Total overtime $\text{€}54.40$

He has enough €5.40 extra

C7. The distance, s metres, travelled by a moving object is given by the formula

$$s = \frac{(u + v)t}{2}$$

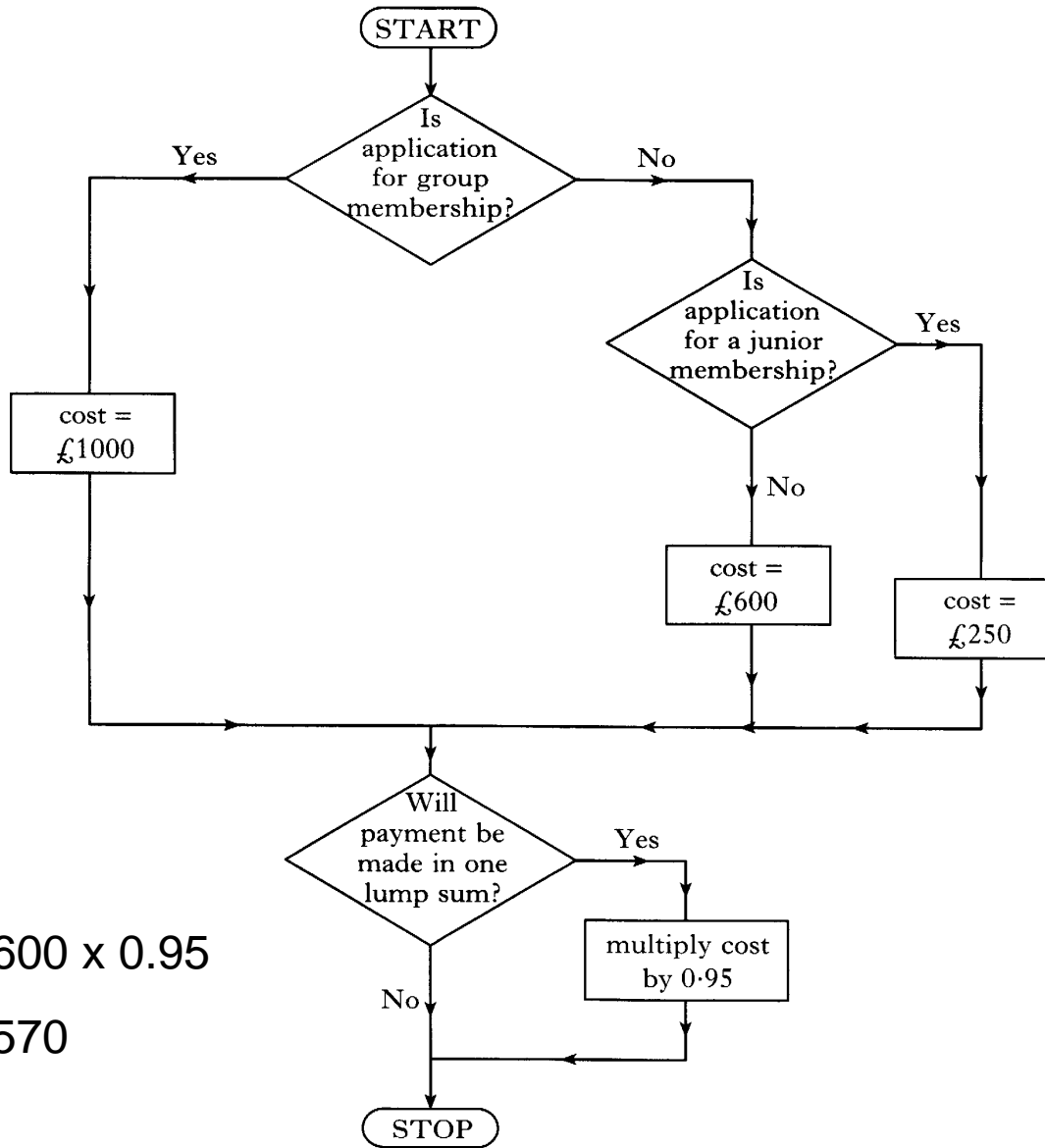
where u metres per second is the initial velocity,
 v metres per second is the final velocity
and t seconds is the time taken.

- (a) Calculate s when $u = 3$, $v = 7$ and $t = 4$. **3**
- (b) Calculate t when $s = 35$, $u = 5$ and $v = 9$. **3**

$$\begin{aligned} \text{C7. (a) } S &= \frac{(u+v)t}{2} \\ &= \frac{(3+7)4}{2} \\ &= \underline{\underline{20 \text{ m}}} \end{aligned}$$

$$\begin{aligned} \text{(b) } 35 &= \frac{(5+9)t}{2} \\ 35 \times 2 &= 14t \\ 14t &= 70 \\ \underline{\underline{t}} &= \underline{\underline{5 \text{ s.}}} \end{aligned}$$

C9. The flowchart below shows how to calculate the cost of joining a sports club.



Cost = £600 × 0.95
= £570

Applications Grid

Solution

Use the flowchart to calculate the cost for an adult who wants to make the payment in one lump sum.

C10. Lorna Simpson sells double glazing. She has a basic salary of £12 500 per year. In addition to her basic salary she earns 10% commission on all her sales. Last year she sold £50 000 worth of double glazing products.

(a) Calculate her gross annual salary for last year.

2

(b) The table below shows the rates of tax applicable for last year.

<i>Rates of Tax</i>	<i>Taxable Income £</i>
Lower rate 20%	1 to 4300
Basic rate 23%	4301 to 27 100
Higher rate 40%	over 27 100

Lorna's total tax allowance is £4195.

Calculate her annual tax bill for last year.

5

$$c10. \quad 10\% \text{ of } \pounds 50000 = \pounds 5000$$

$$(a) \text{ Gross} = 12500 + 5000 = \pounds 17500.$$

$$(b) \quad 17500 - 4195 = \pounds 13305 \quad (\text{Taxable Income})$$

$$\text{First } \pounds 4300 = 20\% \text{ of } 4300 = \underline{\pounds 860}$$

Leaves $13305 - 4300 = \pounds 9005$ to be taxed at 23%

$$\text{So } 23\% \text{ of } \pounds 9005 = 0.23 \times 9005 = \underline{\underline{\pounds 2071.15}}$$

$$\begin{aligned} \text{Total tax} &= \pounds 860 + \pounds 2071.15 \\ &= \underline{\underline{\pounds 2931.15}} \end{aligned}$$

C11. A survey was carried out to find the waiting time for telephone calls to be answered at a call centre. The results are shown below.

<i>Time in seconds</i>	<i>Number of calls</i>
20 – 34	9
35 – 49	10
50 – 64	14
65 – 79	19
80 – 94	22
95 – 109	35
110 – 124	21
125 – 139	20

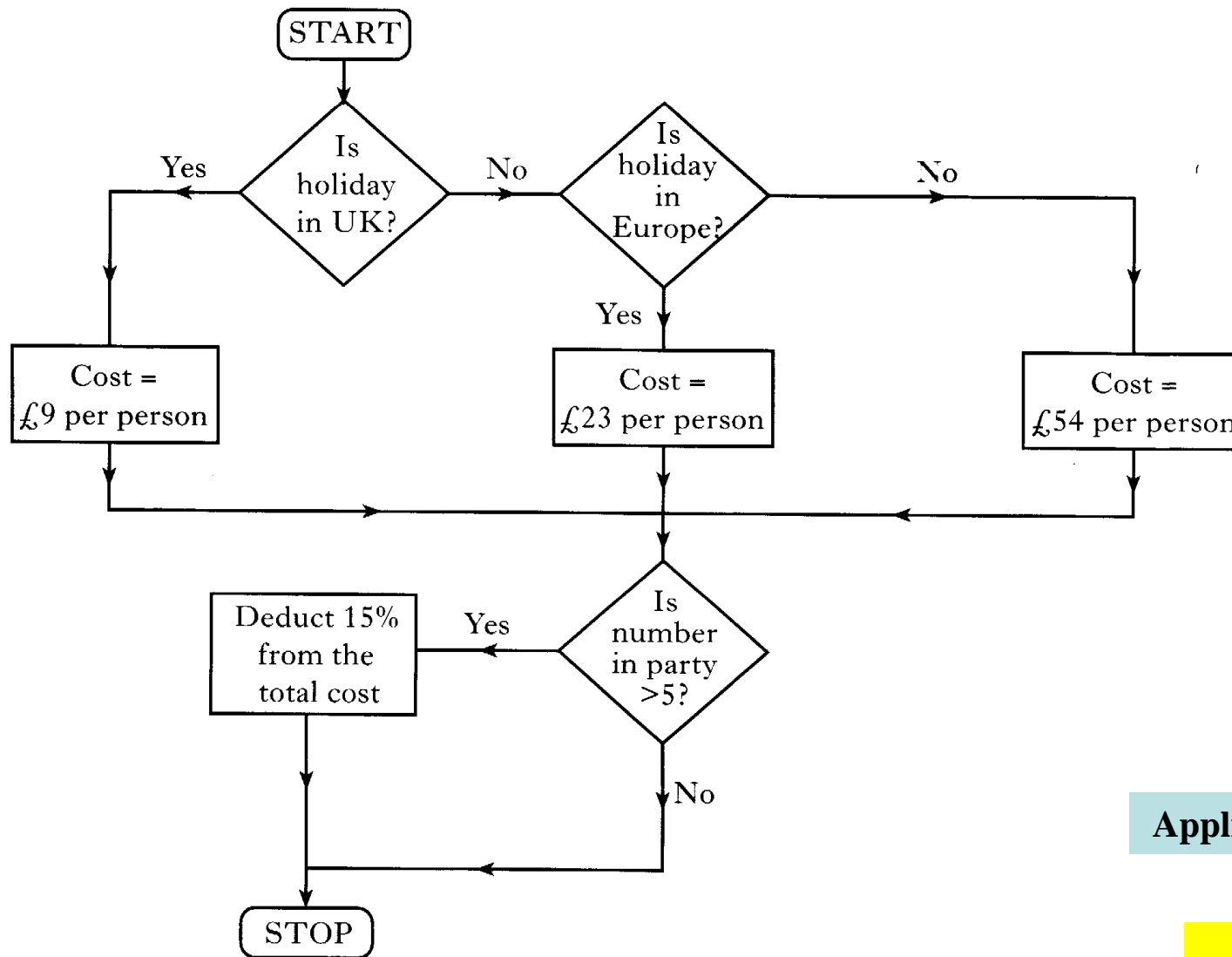
Calculate the mean waiting time in seconds.

5

	Midpt		
C11.	27	x 9	= 243
	42	x 10	= 420
	57	x 14	= 798
	72	x 19	= 1368
	87	x 22	= 1914
	102	x 35	= 3570
	117	x 21	= 2457
	132	x 20	= 2640
	Totals	<u>150</u>	<u>13410</u>

$$\text{Mean} = \frac{13410}{150} = \underline{\underline{89.4}} \text{ seconds}$$

3. The flowchart below shows how to find the cost of travel insurance for a 17 day holiday.



Applications Grid

Solution

Use the flowchart to find the total insurance cost for a party of six planning a 17 day holiday to Europe.

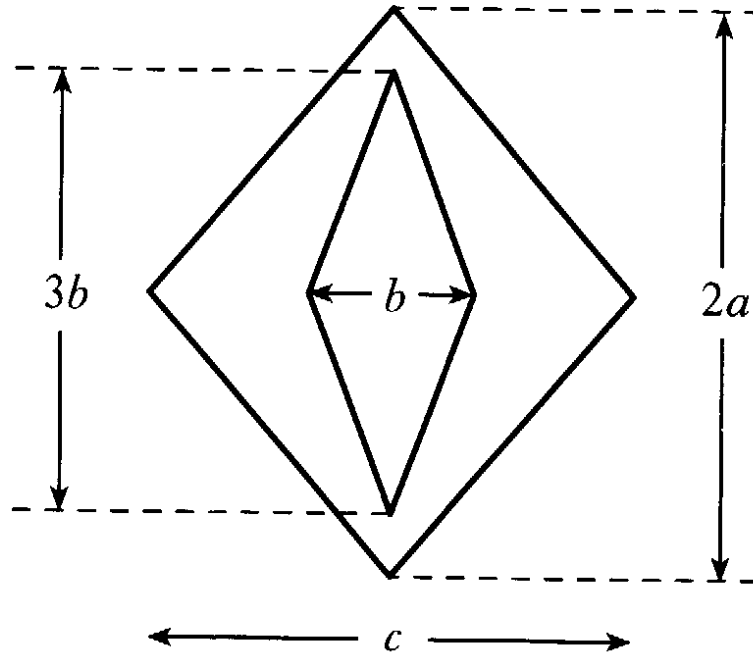
$$Q3 \quad \text{Cost} = £23 \times 6 = £138$$

$$\text{Deduct 15\% (75)} : 15\% \text{ of } 138 = £20.70$$

$$\begin{aligned} \text{Insurance cost} &= £138 - £20.70 \\ &= \underline{\underline{£117.30}} \end{aligned}$$

6. The area of the earring, shown below, is given by the formula

$$A = ac - \frac{3}{2}b^2.$$



(a) Calculate A when $a = 25$, $b = 14$ and $c = 40$.

2

(b) Calculate b when $A = 550$, $a = 20$ and $c = 35$.

4

$$\begin{aligned} Q6 \text{ (a)} \quad A &= ac - \frac{3}{2}b^2 = (25 \times 40) - \frac{3}{2} \times 14^2 \\ &= 1000 - \frac{3}{2} \times 196 \\ &= 1000 - 294 \\ &= \underline{\underline{706}} \end{aligned}$$

$$\begin{aligned} (b) \quad 550 &= 20 \times 35 - \frac{3}{2}b^2 \\ \frac{3}{2}b^2 &= 700 - 550 \\ b^2 &= 150 \times \frac{2}{3} = 100 \\ b &= \sqrt{100} \\ &= \underline{\underline{10}} \end{aligned}$$

5. Anne Ibbotson works for a computer software company. Her March salary slip, shown below, is partly completed.

Name	Employee No.	N.I. No.	Tax Code	Month
A. Ibbotson	01987623	YT91875F	443L	March
Basic Salary	Commission	Overtime	Gross Salary	
£2000		Nil		
Nat. Insurance	Income Tax	Pension	Total Deductions	
£158.00	£421.21			
			Net Salary	

- (a) Anne is paid a basic monthly salary of £2000 plus commission of 12% of her total monthly sales.

Calculate her gross salary for March when her sales totalled £3398.

2

- (b) 6% of Anne's gross monthly salary is paid into her pension fund.

Calculate Anne's net salary for March.

3

$$Q5 (a) \text{ Comm} = 12\% \text{ of } \pounds 3398 = \pounds 407.76$$

$$\text{Gross} = \pounds 2407.76$$

$$\text{pension} = 6\% \text{ of } \pounds 2407.76 = \pounds 144.47$$

$$\text{Net salary} = \text{gross} - \text{deductions}$$

$$\text{Deductions} = \pounds 158 + \pounds 421.21 + \pounds 144.47$$
$$= \pounds 723.68$$

$$\text{Net} = \pounds 2407.76 - \pounds 723.68$$
$$= \pounds \underline{\underline{1684.08}}$$

9. The table below shows the monthly repayments to be made, with and without payment protection, when money is borrowed from the Cheaper Deals Loan Company.

	<i>Amount</i>	£1000	£2000	£3000	£4000
12 months	With Payment Protection	£101.40	£202.78	£304.42	£405.57
	Without Payment Protection	£88.17	£176.33	£264.50	£352.67
24 months	With Payment Protection	£53.48	£106.95	£160.43	£213.90
	Without Payment Protection	£46.50	£93.00	£139.50	£186.00
36 months	With Payment Protection	£37.51	£75.01	£112.51	£150.02
	Without Payment Protection	£32.61	£65.22	£97.84	£130.44

Sophina Iqbal wants to borrow £3000 to buy a conservatory and wants to make repayments over 24 months **with** payment protection.

(a) Calculate how much this loan will cost Sophina.

3

(b) How much would she save if she took out the same loan over 24 months **without** payment protection?

3

$$\begin{aligned} \text{Q 9 (a)} \quad 24 \text{ months at } \pounds 160.43 &= 24 \times 160.43 \\ &= \pounds 3850.32 \end{aligned}$$

$$\text{Cost of loan} = \underline{\underline{\pounds 850.32}}$$

$$\begin{aligned} \text{(b) Without protection} &= 24 \times \pounds 139.50 \\ &= \pounds 3348 \end{aligned}$$

$$\text{Cost of loan} = \pounds 348$$

$$\begin{aligned} \text{Saving of } \pounds 850.32 - \pounds 348 \\ &= \underline{\underline{\pounds 502.32}} \end{aligned}$$

11. Greenfingers Garden Centre keeps a record of the number of plants bought by each customer during one day. The results are shown below.

<i>Number of plants</i>	<i>Frequency</i>
1 – 10	25
11 – 20	46
21 – 30	55
31 – 40	49
41 – 50	36

Calculate the mean number of plants bought by each customer.

5

Q 11.

Midpt	x	Freq	=	
5.5	x	25	=	137.5
15.5	x	46	=	713
25.5	x	55	=	1402.5
35.5	x	49	=	1739.5
45.5	x	36	=	1638
Total		<u>211</u>		<u>5630.5</u>

$$\text{Mean} = \frac{5630.5}{211} = \underline{\underline{26.7 \text{ plants/customer.}}}$$

2. Suzy has a part-time job in a supermarket. Her basic rate of pay is £4.60 per hour with rates of time and a half for work on Sundays and double time on Bank Holidays.

If she works

- Friday 3 hours
- Saturday 7 hours
- Sunday 2 hours
- Bank Holiday Monday 6 hours

calculate her gross pay.

4

2002 Paper 1

$$(7 + 3) \times \text{£}4.60 = \text{£}46.00$$

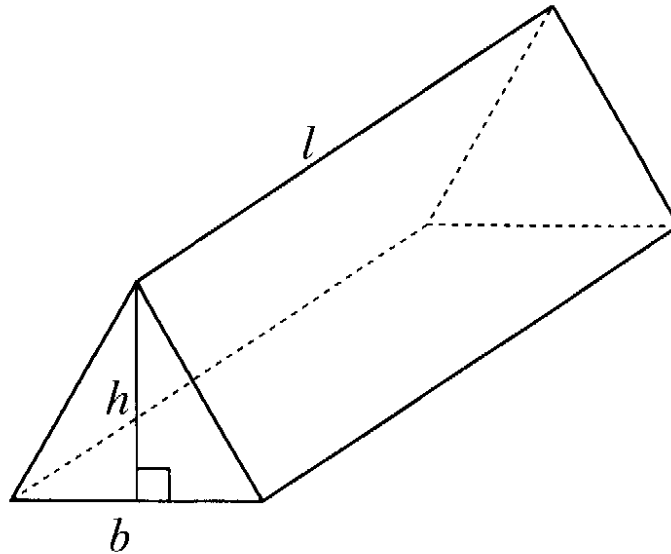
$$2 \times \text{£}4.60 \times 1.5 = \text{£}13.80$$

$$6 \times \text{£}4.60 \times 2 = \text{£}55.20$$

$$\text{Total} = \text{£}115.00$$

6. The surface area of the shape below is given by the formula

$$S = b(3l + h).$$



Find h when $S = 3340$, $b = 20$ and $l = 50$.

3

$$Q6. \quad S = b(3l + h)$$

$$3340 = 20(3 \times 50 + h)$$

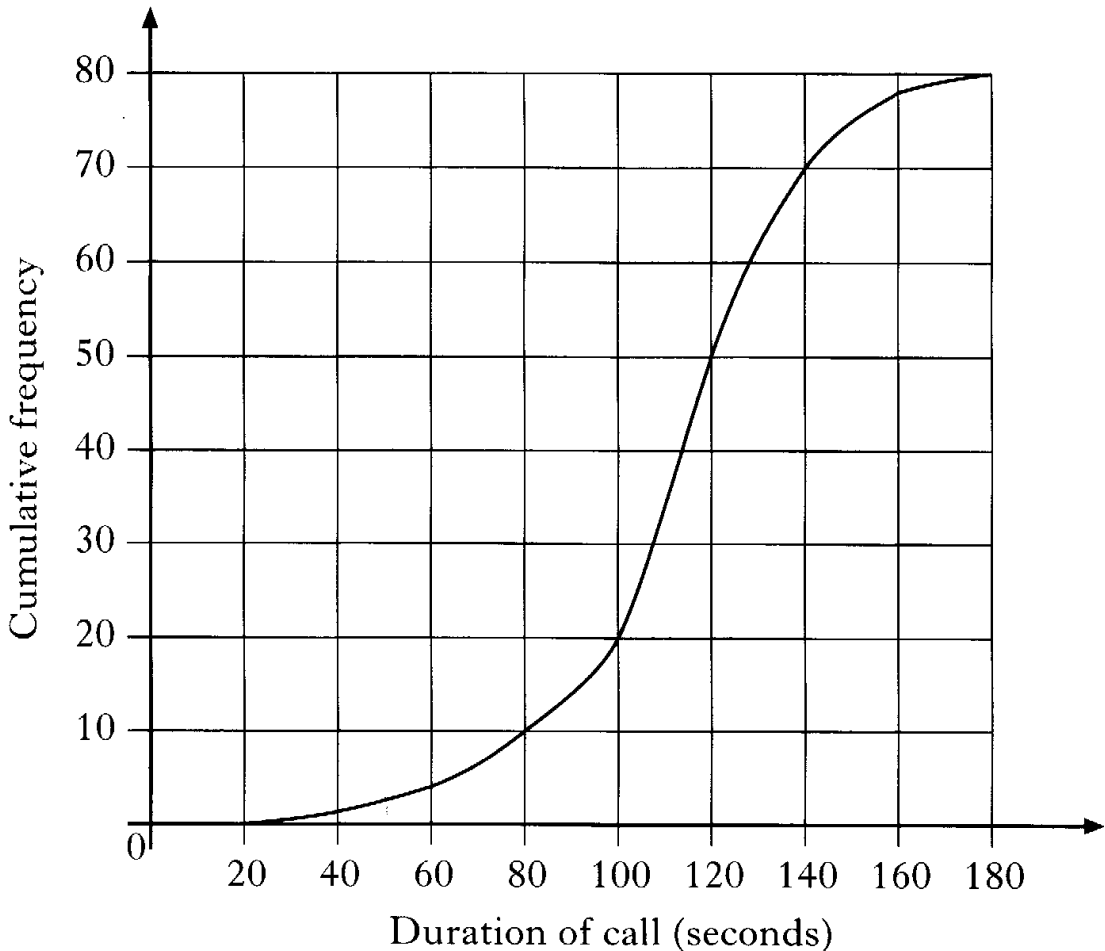
$$3340 = 20 \times 150 + 20h$$

$$3340 - 3000 = 20h$$

$$20h = 340$$

$$\underline{\underline{h = 17}}$$

8. A call centre records the duration, in seconds, of each of 80 phone calls. The results are shown in the cumulative frequency curve below.



- (a) 10 calls
 - (b) 2 mins = 120s
- 50 out of 80 calls less than 2 mins

So

$$\frac{50}{80} \times 100 = 62.5\%$$

Achieved.
62.5% is less than 75% required.

Applications Grid

Solution

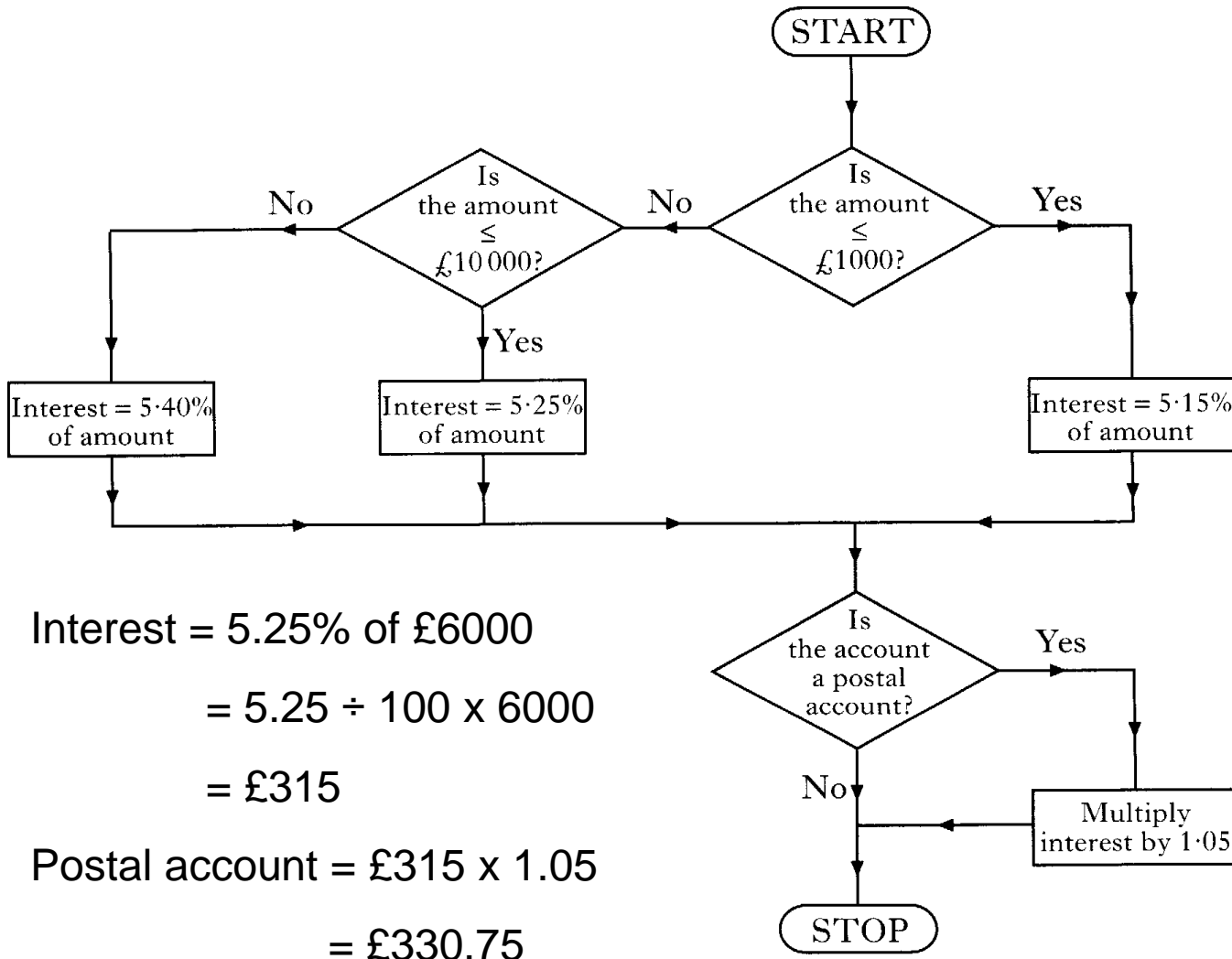
- (a) How many calls lasted 80 seconds or less? **1**
- (b) The call centre wishes to ensure that at least 75% of calls last no longer than 2 minutes. From the information given, has this been achieved? **2**
Give a reason for your answer.

Q 8. (a) 10 calls

(b) 2 mins = 120 s. $\frac{50 \text{ calls}}{80} = 0.625$
 $= 62.5\%$

No only 62.5% are less than 2 mins.
much less than 75% required

7. The flowchart below shows how to calculate the interest when a certain amount of money is invested for 1 year.



Interest = 5.25% of £6000
 = $5.25 \div 100 \times 6000$
 = £315
 Postal account = £315 x 1.05
 = £330.75

Applications Grid

Solution

Use the flowchart to calculate the interest earned on an amount of £6000 invested in a postal account for 1 year.

10. Ian Smith is an engineer. His basic salary is £32 525 per year. In addition to his basic salary he receives a bonus of £1300 and earns commission on all orders he negotiates. Last year his commission was 0.2% on orders to the value of 1.5 million pounds.

(a) Calculate his gross annual salary for last year.

2

(b) The table below shows the rates of tax applicable for last year.

RATES OF TAX ON:	
first £1520 of taxable income	10%
next £26 880 of taxable income	22%
all remaining taxable income	40%

Ian's total tax allowance is £4385.

Calculate his annual tax bill for last year.

5

$$\text{Q10. (a) Commission} = 0.2 \div 100 \times 1\,500\,000 = \text{€}3\,000$$

$$\text{Bonus} = \text{€}1\,300$$

$$\begin{aligned}\text{Total (gross) earnings} &= 32\,525 + 3\,000 + 1\,300 \\ &= \underline{\underline{\text{€}36\,825}}\end{aligned}$$

$$\text{Taxable Income} = \text{gross} - \text{allowances}$$

$$= 36\,825 - 4\,385 = \text{€}32\,440$$

Tax
First €1520 at 10% = €152

Leaves $32\,440 - 1\,520$ for tax = €30 920

Next €26880 at 22% = $0.22 \times 26\,880 = \underline{\underline{\text{€}5\,913.60}}$

Leaves $30\,920 - 26\,880 = \text{€}4\,040$.

Remaining €4040 at 40% = $0.4 \times 4\,040$
= €1616

$$\begin{aligned}\text{Total tax} &= \text{€}152 + \text{€}5\,913.60 + \text{€}1\,616 \\ &= \underline{\underline{\text{€}7\,681.60}}\end{aligned}$$

12. Data from a recent census is analysed to find the age of residents in Crown Street.

The results are shown below.

<i>Age (to the nearest year)</i>	<i>Number of Residents</i>
0 – 9	4
10 – 19	9
20 – 29	11
30 – 39	16
40 – 49	21
50 – 59	18
60 – 69	17
70 – 79	5

Calculate the mean age of the residents.

5

Q12

Midpt	x	Freq	
4.5	x	4	=
14.5	x	9	=
24.5	x	11	=
34.5	x	16	=
44.5	x	21	=
54.5	x	18	=
64.5	x	17	=
74.5	x	5	=
Totals		<u>101</u>	

	18.0
1	30.5
2	69.5
5	52.0
9	34.5
9	81.0
10	96.5
	372.5
<u>4354.5</u>	

$$\text{mean} = \frac{4354.5}{101}$$

$$= \underline{\underline{43.1}} \text{ yrs}$$

1. Joseph works as a childminder.

He is paid at a rate of £4.10 per hour for weekdays and at time and a half for weekends.

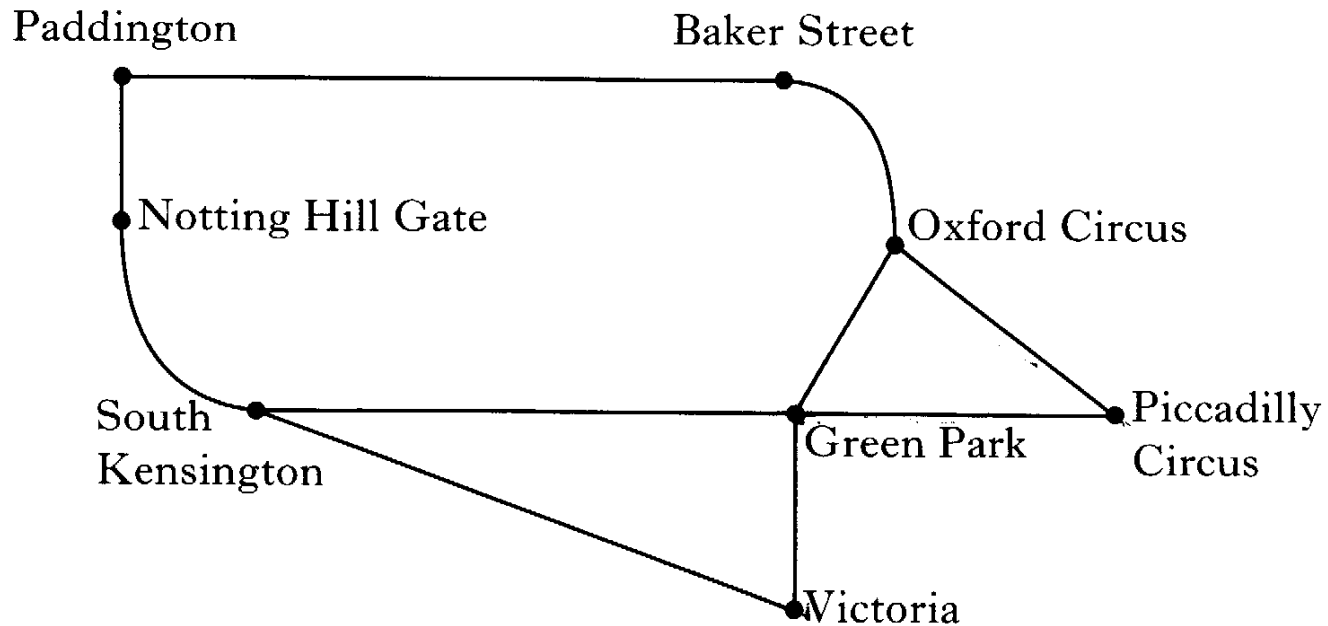
One week he works from 9 am till 1pm every day except Sunday.

Calculate Joseph's gross pay for that week.

3

Basic hrs:	4hrs x 5	= 20 hrs
Overtime:	4hrs x 1.5 x 1	= 6 hrs
Gross pay	26 x £4.10	= £106.60

6. The diagram below shows part of the London Underground railway network.



An inspector has to travel along every route shown.

Is it possible to do this without travelling any route more than once?

Explain your answer.

2

Yes, start at node with value 3.

Oxford or South Kensington

8. The surface area, S square centimetres, of a cuboid is given by the formula

$$S = 2lb + 2bh + 2lh$$

where l centimetres is the length of the cuboid

b centimetres is the breadth of the cuboid

h centimetres is the height of the cuboid.

(a) Calculate S when $l = 8.5$, $b = 4.5$ and $h = 5.5$.

2

(b) Calculate h when $S = 2170$, $l = 30$ and $b = 20$.

3

$$\begin{aligned} \text{Q8. (a) } S &= 2lb + 2bh + 2lh \\ &= 2 \times 8.5 \times 4.5 + 2 \times 4.5 \times 5.5 + 2 \times 8.5 \times 5.5 \\ &= 76.5 + 49.5 + 93.5 \\ &= \underline{\underline{219.5}}. \end{aligned}$$

$$\text{(b) } 2170 = 2 \times 30 \times 20 + 2 \times 20 \times h + 2 \times 30 \times h$$

$$2170 = 1200 + 40h + 60h$$

$$2170 - 1200 = 100h$$

$$100h = 970$$

$$h = \underline{\underline{9.7}}.$$

7. Ali is paid a basic annual salary plus commission on his sales as shown in the table below.

<i>Sales</i>	<i>Rate of commission on Sales</i>
Less than £25 000	1.5%
£25 000 to £50 000	1.75%
More than £50 000	2.0%

His basic annual salary is **£8500**.

- (a) If he achieves sales of £24 900, what will his total annual salary be? **2**
- (b) What would Ali's sales need to be to achieve a total annual salary of £9600? **4**

$$7. (a) \quad 1.5\% \text{ of } £24900 = 1.5 \div 100 \times 24900 \\ = £373.50$$

$$\text{Total salary} = £8500 + £373.50 \\ = \underline{\underline{£8873.50}}$$

$$(b) \quad \text{Commission} = £9600 - £8500 = \underline{\underline{£1100}}$$

$$2\% \text{ of } 50000 = £1000.$$

So more than £50000

$$\text{Try } 2\% \text{ of } 55000 = £1100.$$

So his sales would need to be £55000.

9. Irum needs a mortgage of £54 500 and wants to make payments of £500 per month. She designs a spreadsheet to compare the costs of two mortgages. Solid Homes Building Society calculates the interest each month (0.52% per month). Evergreen Building Society calculates the interest each year (6.4% per annum).

	A	B	C	D	E	F	G	H
1	Solid Homes Building Society			Evergreen Building Society				
2								
3	Interest charged	0.52% per month			Interest charged	6.4% per annum		
4								
5	Amount owed		£54,500		Amount owed			£54,500
6	Monthly payment		£500		Monthly payment			£500
7								
8	Amount owed	after interest	after payment					
9								
10	January	£54,783.40	£54,283.40		Amount owed at start of year			£54,500
11	February	£54,565.67	£54,065.67					
12	March	£54,346.82	£53,846.82		Annual interest			
13	April	£54,126.82	£53,626.82					
14	May	£53,905.68	£53,405.68					
15	June	£53,683.39	£53,183.39					
16	July	£53,459.94	£52,959.94		Total payments for year			£6,000
17	August	£53,235.33	£52,735.33					
18	September	£53,009.56	£52,509.56					
19	October	£52,782.61	£52,282.61					
20	November	£52,554.48	£52,054.48					
21	December							
22								
23	Amount owed at end of year				Amount owed at end of year			

Applications Grid

Solution

- (a) Write down the **formula** to enter in cell B21 the amount owed in December after interest has been added. 1
- (b) The result of the formula =B21-C6 is entered in cell C21. What will appear in cell C21? 1
- (c) Write down the **formula** to enter in cell H12 the amount of annual interest. 1
- (d) Which mortgage is more expensive in the first year, and by how much? 2

$$Q9 (a) = 1.0052 \times C20$$

$$(b) \quad 52325.16 - 500 = \underline{\underline{£51825.16}} \quad \text{'appears' in C21}$$

$$(c) = 6.4 \div 100 \times H10. \quad (= \underline{\underline{£3488}})$$

A) Solid Homes due £51825.16

Everygreen due $£54500 + £3488 - £6000$
 $= \underline{\underline{£51988}}$

$$\text{Diff} = 51998 - 51825.16 = \underline{\underline{£162.84}}$$

Everygreen more expensive by £162.84.

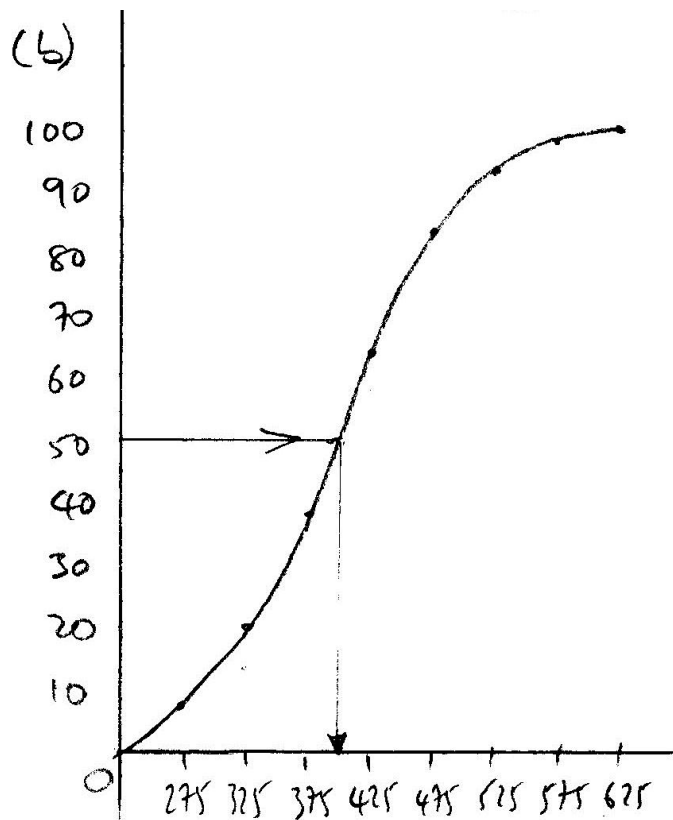
11. A survey was carried out to find the average price of a washing machine. The results are shown in the table below.

<i>Price</i>	<i>Frequency</i>	<i>Cumulative frequency</i>
251 – 300	8	
301 – 350	12	
351 – 400	18	
401 – 450	25	
451 – 500	19	
501 – 550	10	
551 – 600	6	
601 – 650	2	

- (a) Copy and complete the table. **1**
- (b) Using this data, draw a cumulative frequency curve on squared paper. **3**
- (c) From the curve you have drawn, estimate the median price of the washing machines. **1**

Q 11. (a)

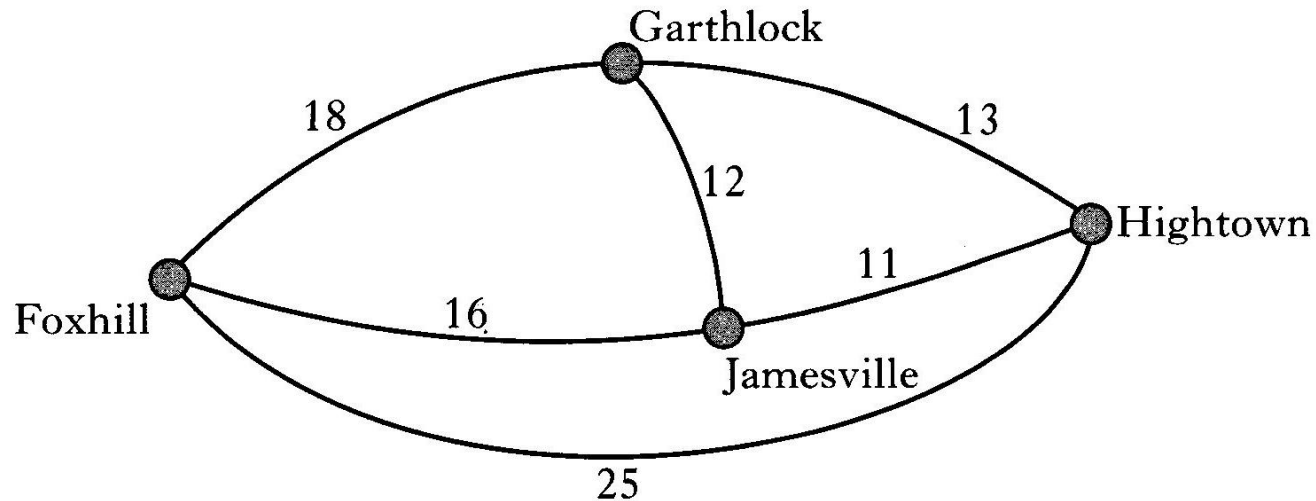
Freq.	Cumulative Freq.
8	8
12	20
18	38
25	63
19	82
10	92
6	98
2	<u>100</u>



(c) £ 400 - median price for washing machines

4. The diagram below represents 4 towns and the routes connecting them, with distances given to the nearest kilometre.

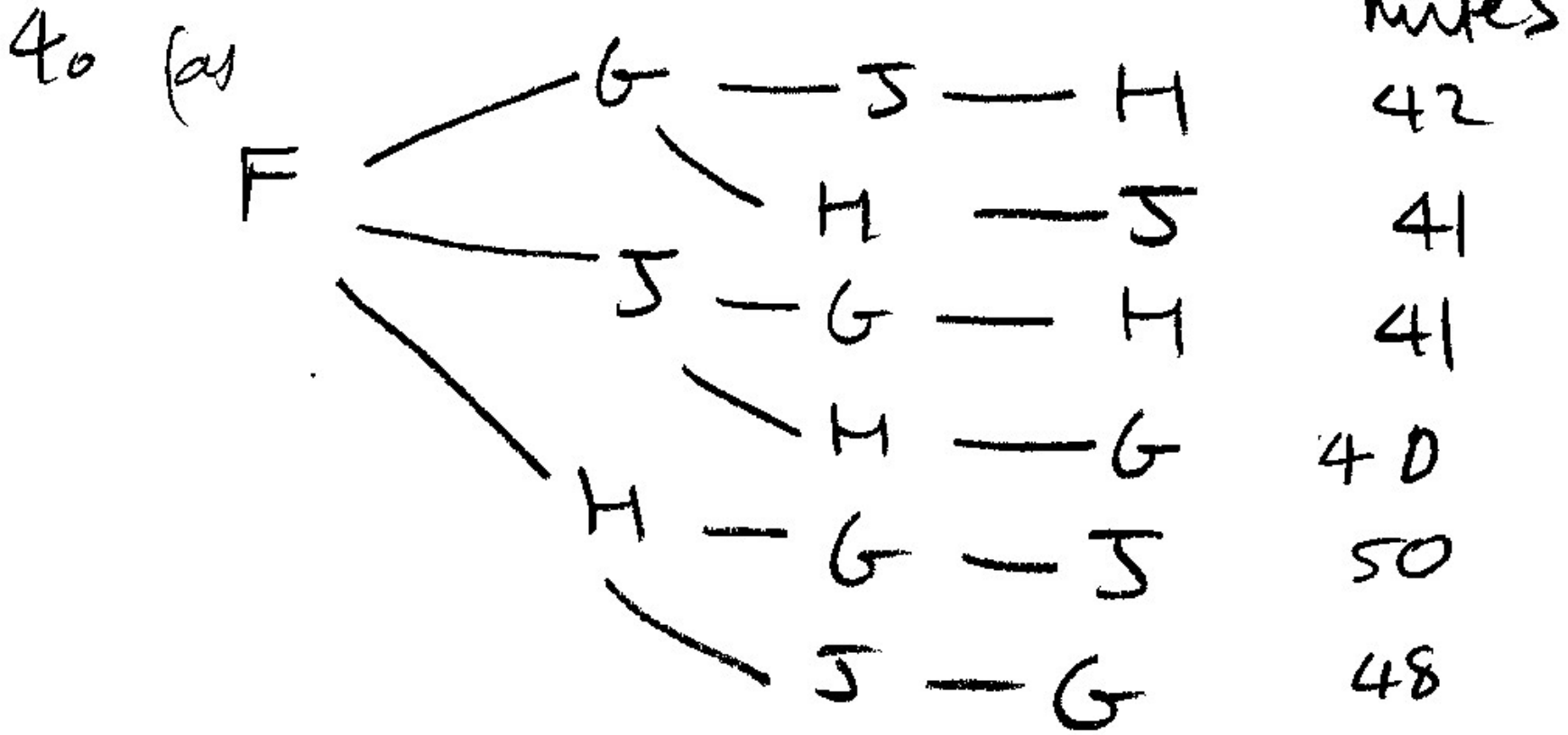
2004 Paper 1



A van driver leaves Foxhill and has to make deliveries to the three other towns. He cannot go through any town more than once and does not need to return to Foxhill.

- (a) Draw a tree diagram to show all possible delivery routes. 3
- (b) Which is the shortest route? 2

Show clearly all working.



(b) F - J - H - G 40 miles

6. The sum of the terms of a sequence of numbers is given by the formula

$$S = \frac{1}{2}n[2a + (n-1)d].$$

(a) Calculate S when $n = 20$, $a = 5$ and $d = 3$. **2**

(b) Calculate d when $S = 664$, $a = 4$ and $n = 16$. **3**

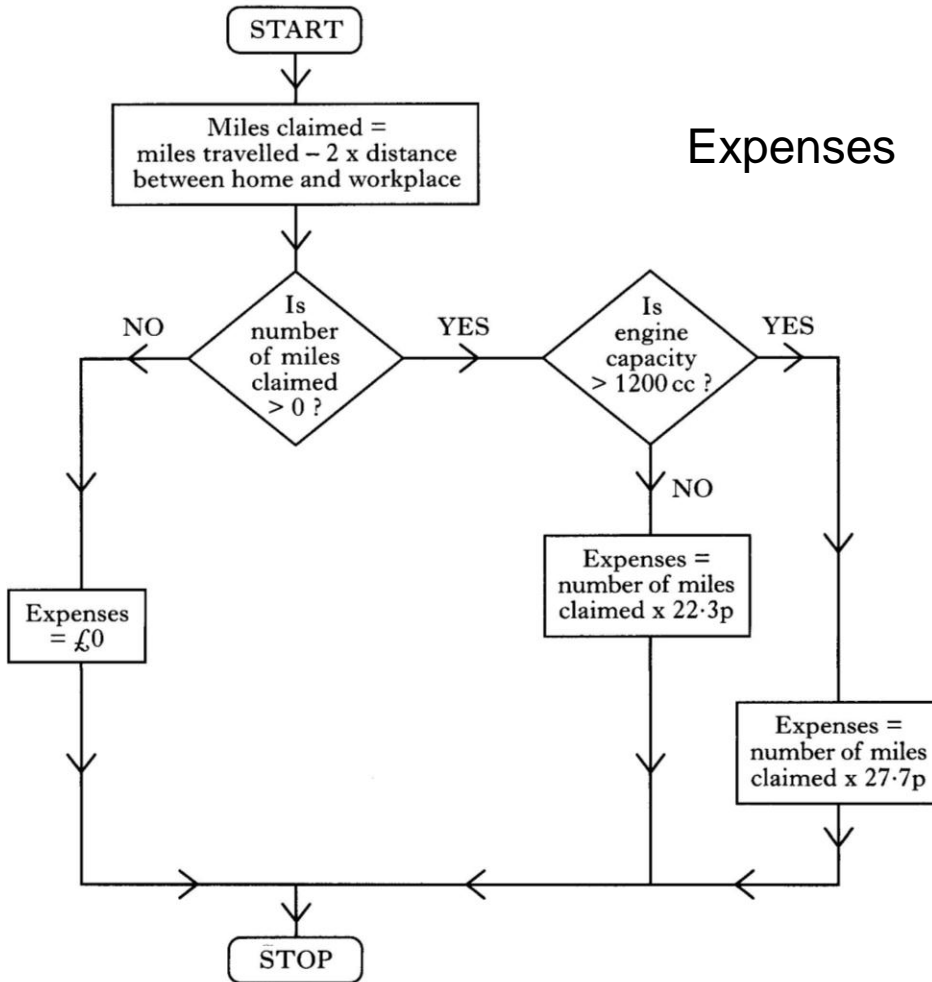
$$\begin{aligned} 6. (a) \quad S &= \frac{1}{2} n [2a + (n-1)d] \\ &= \frac{1}{2} \times 20 [2 \times 5 + (20-1)3] \\ &= 10 [10 + 57] \\ &= 10 \times 67 \\ &= \underline{\underline{670}} \end{aligned}$$

$$\begin{aligned} (b) \quad 664 &= \frac{1}{2} \times 16 [2 \times 4 + d(15)] \\ 664 &= 8 [8 + 15d] \\ 664 &= 64 + 120d \\ \Rightarrow 120d &= 600 \\ \underline{\underline{d}} &= \underline{\underline{5}} \end{aligned}$$

3. A company pays its employees travelling expenses based upon

- miles travelled;
- distance between home and workplace;
- engine capacity of car;

as shown in the flowchart below.



Miles claimed

$$= \text{miles travelled} - 2 \times \text{distance}$$

$$= 130 - 2 \times 10$$

$$= 110$$

Expenses

$$= 110 \times 22.3\text{p} = 2453\text{p}$$

$$= \text{£}24.53$$

Applications Grid

Solution

Calculate the travelling expenses paid to an employee

- who travels 130 miles;
- whose distance between home and workplace is 10 miles;
- whose car has an engine capacity of 1200 cc.

8. The table below shows the monthly repayments to be made, with and without payment protection insurance, when money is borrowed from the Marko Loan Company.

With Payment Protection Insurance

LOAN AMOUNT	36 Months	48 Months	60 Months
	MONTHLY REPAYMENT	MONTHLY REPAYMENT	MONTHLY REPAYMENT
9.9% APR for ALL loans of £5000 – £14 999			
£5000	£186.41	£149.26	£127.31
£7500	£279.62	£223.90	£190.97
£10 000	£372.83	£298.53	£254.63
8.9% APR for ALL loans of £15 000 – £20 000			
£15 000	£549.88	£438.13	£371.86

Without Payment Protection Insurance

LOAN AMOUNT	36 Months	48 Months	60 Months
	MONTHLY REPAYMENT	MONTHLY REPAYMENT	MONTHLY REPAYMENT
9.9% APR for ALL loans of £5000 – £14 999			
£5000	£162.64	£127.54	£106.61
£7500	£243.97	£191.32	£159.92
£10 000	£325.29	£255.09	£213.22
8.9% APR for ALL loans of £15 000 – £20 000			
£15 000	£480.68	£375.40	£312.55

Fatima wants to borrow £5000 to buy a car and another £10 000 to buy a new kitchen.

She wants to make repayments over 60 months **without** payment protection insurance for **each** loan.

(a) State the monthly repayments she will make for:

- (i) the £5000 loan;
- (ii) the £10 000 loan.

Because the interest rate changes with the amount of loan, Fatima decides to check the cost of **one** loan of £15 000 over 60 months **without** payment protection insurance.

(b) How much would Fatima save over 60 months on the cost of **one** loan of £15 000 rather than two separate loans?

1

3

$$8. (a) (i) \text{ € } 106.61 \quad (ii) \text{ € } 213.22$$

$$(b) \text{ For both loans total repayments} \\ = (106.61 + 213.22) \times 60 \\ = \text{€ } 19\,189.80$$

$$\text{For 1 loan } \text{€ } 312.55 \times 60 \\ = \text{€ } 18\,753$$

$$\text{Saving of } 19\,189.80 - 18\,753 \\ = \text{€ } \underline{\underline{436.80}}$$

$$** \text{ (or) } (106.61 + 213.22) - 312.55 = \text{€ } 7.28 \text{ pm} \\ \text{Saving for 60 months} = 7.28 \times 60 \\ = \text{€ } \underline{\underline{436.80}}$$

10. A nurse earns £18 650 per year and has tax allowances totalling £4670.

(a) Calculate the nurse's taxable income.

1

(b) The rates of tax applicable are as follows.

TAXABLE INCOME (£)	RATE
On the first £1920	10%
On the next £27 980	22%
On any income over £29 900	40%

Calculate the amount of tax payable by the nurse.

3

$$10. (a) \quad \begin{array}{r} \text{Tax Income} = 18650 \\ - 4670 \\ \hline \underline{\underline{\pounds 13980}} \end{array}$$

$$(b) \quad \begin{array}{l} 10\% \text{ of } \pounds 1920 = \pounds 192 \text{ (tax)} \\ \text{remaining} \quad 13980 - 1920 = 12060 \\ \text{Tax} = 22\% \text{ of } \pounds 12060 \\ = \pounds 2653.20 \\ \text{Total tax} = \pounds 192 + \pounds 2653.20 \\ = \underline{\underline{\pounds 2845.20}} \end{array}$$

12. A company keeps a record of how many days each employee is absent over a two-year period.

The results are shown in the frequency table below.

Number of days absent	Frequency
0 – 4	14
5 – 9	17
10 – 14	8
15 – 19	4
20 – 24	2

Calculate the mean number of days an employee is absent.

5

12.

No. of days	Mid pt	x	Freq	
0-4	2	x	14	= 28
5-9	7	x	17	= 119
10-14	12	x	8	= 96
15-19	17	x	4	= 68
20-24	22	x	2	= 44
Totals			45	355

$$\text{Mean} = \frac{355}{45} = 7.8$$

$$= \underline{\underline{7.9}} \text{ days per employee.}$$

5. A manager uses a spreadsheet to calculate the gross wage of each worker.

2005 P1

	A	B	C	D	E
1					
2	First Name	Second Name	Basic hourly rate	Hours worked at basic rate	Gross wage
3	Joseph	Shaw	£8.40	36	£302.40
4	Mary	Murphy	£8.00	20	
5	Irum	Rahman	£6.40	30	
6	Stephen	Sheilds	£6.00	24	
7	Miriam	Philips	£4.50	16	
8					
9					
10	Average gross wage per worker =				

(a) The result of the formula =C5*D5 is entered in cell E5.

What will appear in cell E5?

(a) £6.40 x 30 = £192 1

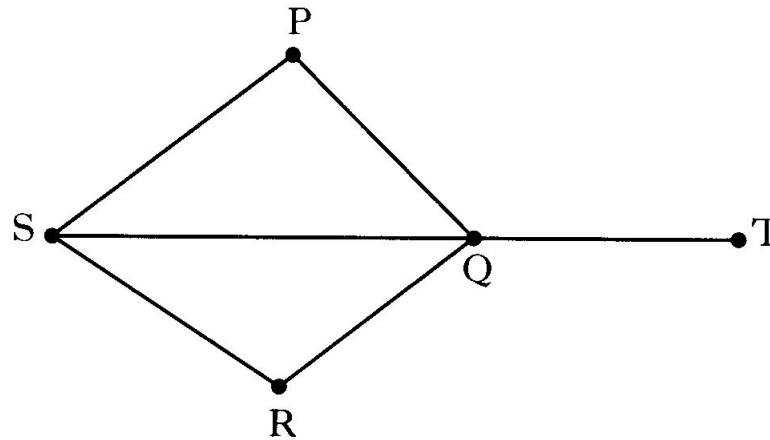
(b) Write down the **formula** to enter in cell E10 the average gross wage per worker.

(b) = AVERAGE(E3;E7) 1

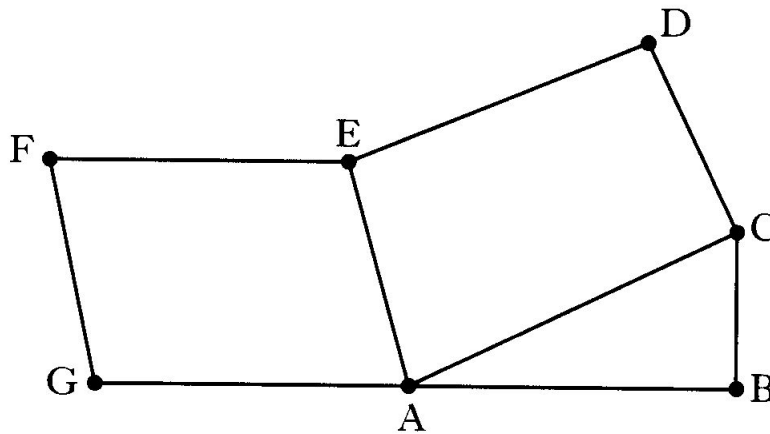
7. A network is **traversable** if it can be drawn by going over every line once and only once without lifting your pencil.

The network shown opposite can be traversed by the route

$S \rightarrow P \rightarrow Q \rightarrow S \rightarrow R \rightarrow Q \rightarrow T$



Is the network below traversable?



Applications Grid

Solution

Explain your answer.

7. Yes

$E \rightarrow F \rightarrow G \rightarrow A \rightarrow E \rightarrow D \rightarrow C \rightarrow A \rightarrow B$

(or start at 'c', start at an 'odd' node)

9. The surface area, S square centimetres, of a cylinder is given by the formula

$$S = 2\pi r^2 + 2\pi rh$$

where r centimetres is the radius of the base
and h centimetres is the height.

Take $\pi = 3.14$.

- (a) Calculate S when $r = 3$ and $h = 7$. **3**
- (b) Calculate h when $S = 471$ and $r = 5$. **3**

$$\begin{aligned} 9. (a) \quad S &= 2\pi r^2 + 2\pi r h \\ &= 2 \times 3.14 \times 3^2 + 2 \times 3.14 \times 3 \times 7 \\ &= 18 \times 3.14 + 42 \times 3.14 \\ &= 3.14 (18 + 42) \\ &= 3.14 \times 60 \\ &= \underline{\underline{188.40}} \quad \text{Sq cm} \end{aligned}$$

$$\begin{aligned} (b) \quad 471 &= 2 \times 3.14 \times 5^2 + 2 \times 3.14 \times 5 \times h \\ 471 &= 50 \times 3.14 + 3.14 \times 10 \times h \\ 471 - 157 &= h \times 31.4 \\ 314 &= h \times 31.4 \\ \underline{\underline{h}} &= \underline{\underline{10}} \quad \text{cm} \end{aligned}$$

3. Sandy works in a call centre for a company selling conservatories.

Her pay is calculated as follows:

- for each client who agrees to a home visit from a salesman she is paid £10
- for each one of her clients who places an order for a conservatory she is paid 0.5% commission on the sale.

One week 20 of Sandy's clients agree to a home visit.

One of them orders a conservatory worth £12 000.

Calculate Sandy's pay for the week.

2

$$\text{£}10 \times 20 = \text{£}200$$

$$0.5\% \text{ of } \text{£}12\,000 = \text{£}60$$

$$\text{Pay for week} = \text{£}260$$

6. The table shown below is used to calculate loan repayments.

Monthly repayments on a loan of £1000

APR	12 months	24 months	36 months	48 months
12%	£88.56	£46.79	£32.92	£26.03
14%	£89.40	£47.62	£33.78	£26.91
16%	£90.23	£48.46	£34.63	£27.80
18%	£91.05	£49.28	£35.49	£28.68
20%	£91.86	£50.10	£36.34	£29.57

Jack Smith borrows £3500 over 36 months at an annual percentage rate (APR) of 14%.

Use the table to calculate the total cost of the loan.

4

$$\text{Total repayments} = £33.78 \times 36 \times 3.5 = £4\,256.28$$

Cost of loan

$$£4\,256.28 - £3\,500 = £756.28$$

10. Below is a copy of Louise Green's credit card statement.

Mar

Visa statement		Suremoney Financial Services	
Name: Louise Green			
Date: 20 May 2005			
Account No: 2351 1137		Credit limit: £850	
Interest rate: 1.5% per month			
<i>Please post your payment to arrive by 10 June 2005</i>			
29 April 2005	Balance brought forward		120.00
7 May 2005	Payment— <i>Thank you</i>		<u>-50.00</u>
			70.00
	Interest		1.05
10 May 2005	Dynamic Dancewear		42.75
14 May 2005	Taps and Tutus		13.81
15 May 2005	Hall Rentals		256.00
	Balance owed		383.61
<i>Minimum payment: 3% of balance owed</i>			
Note: Interest is charged each month on outstanding balance after payment is deducted.			

$$(a) 3\% \text{ of } £383.61 = £11.51$$

(b) Balance owed

$$£383.61 - £11.51$$

$$= £372.10$$

$$\text{Interest} = 1.5\% \text{ of } £372.10$$

$$= £5.58$$

Total owed

$$£372.10 + £5.58$$

$$= £377.68$$

Applications Grid

(a) Louise makes the minimum payment. How much does she pay?

2

(b) If Louise does not add any items to her credit card during the next month, calculate the "balance owed" on her next statement.

3

Solution

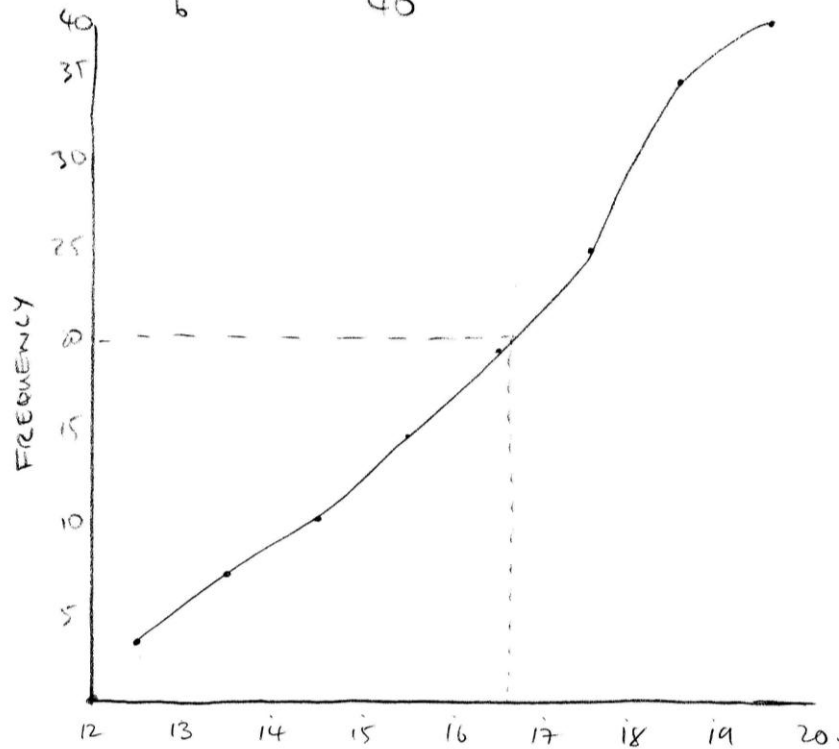
12. A sample of 40 light bulbs was chosen at random and tested to see how long each bulb lasted.

The results are shown below.

<i>Life of bulb</i> (t hours)	<i>Frequency</i>
$1200 \leq t < 1300$	3
$1300 \leq t < 1400$	4
$1400 \leq t < 1500$	3
$1500 \leq t < 1600$	4
$1600 \leq t < 1700$	5
$1700 \leq t < 1800$	6
$1800 \leq t < 1900$	9
$1900 \leq t < 2000$	6

- (a) Construct a cumulative frequency column for the above data. 1
- (b) Using squared paper, draw a cumulative frequency diagram for this data. 3
- (c) From your diagram, estimate the median number of hours a light bulb lasts. 1

120...	Freq	Cum Freq
	3	3
	4	7
	3	10
	4	14
	5	19
	6	25
	9	34
	6	40



(c) Median number of hours is 16600 hours

Applications Grid

2. Andrew Bell works in a factory. He works a basic 8 hour day at a rate of £6.40 per hour. Additional hours worked are paid at time and a half. Andrew's timesheet for one week's work is shown below.

2006 Paper 1

Andrew Bell	
	Hours worked
Monday	8
Tuesday	8
Wednesday	10
Thursday	10
Friday	8

Calculate Andrew's gross wage for this week.

3

2. Total hrs = 44.

Basic pay £6.40
 x 40
 £256.00

overtime £6.40 + £3.20 = £9.60 per hour

overtime pay £9.60
 x 4
 £38.40

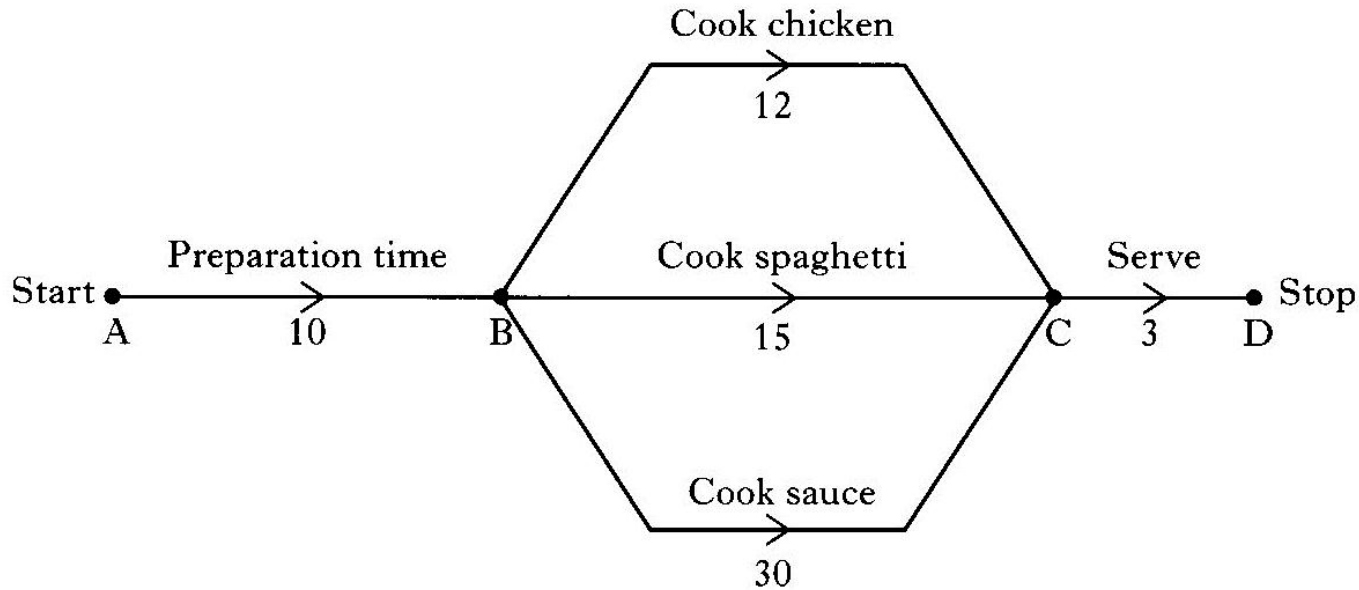
Total gross pay = £256.00
 + £38.40
 £294.40

5. Anthony is going to cook chicken escalope in breadcrumbs with spaghetti in a tomato and basil sauce.

He has four rings on his cooker, allowing the different dishes to be cooked at the same time.

The network below shows how this can be done.

Times are given in minutes.



By considering the **critical path** from start to finish of this network, find the minimum time needed to complete the job.

1'

Critical path (longest times) = $10 + 30 + 3 = 43$ mins

6. The formula below converts temperature from Celsius (C) to Fahrenheit (F).

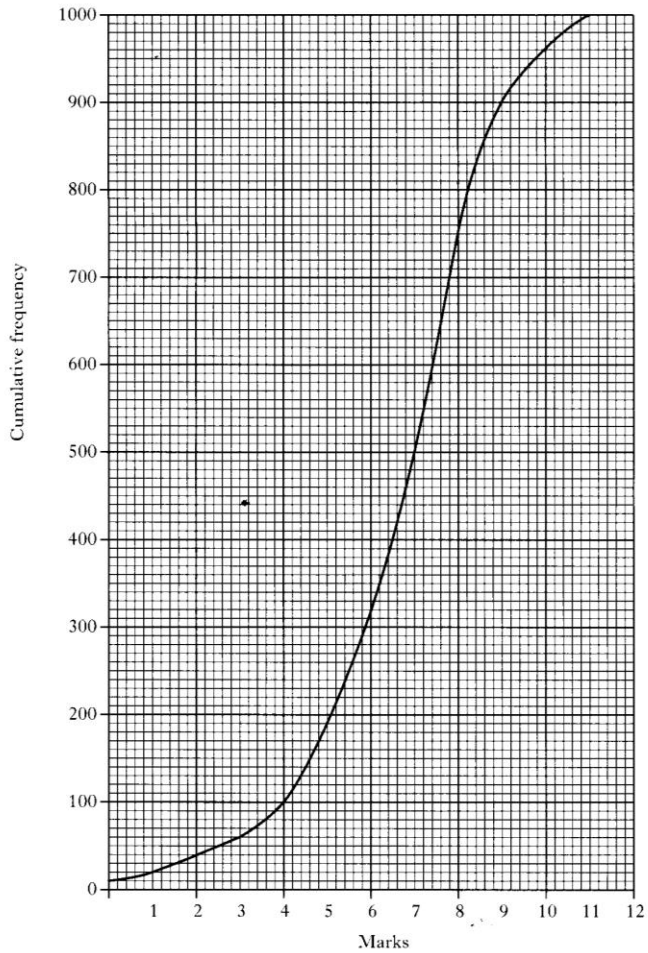
$$F = 32 + \frac{9}{5}C$$

Use this formula to convert 25 °Celsius to Fahrenheit.

2

$$\begin{aligned} F &= 32 + 9/5 \times 25 \\ &= 32 + 45 \\ &= 77 \text{ }^\circ\text{F} \end{aligned}$$

10. A group of 1000 pupils sit a test marked out of 12.
The cumulative frequency curve derived from their marks is shown below.



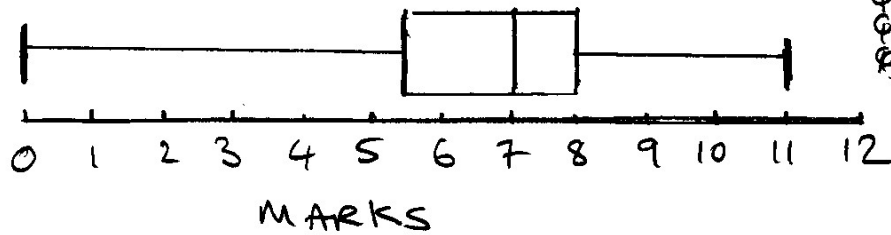
Use this information to draw a boxplot of the marks.

4

Solution

Applications Grid

10.



Handwritten notes for the boxplot:

- $L = 0$
- $I = 11$
- $M = 7$
- $A = 6.5$

4. Sajid has borrowed £200 with interest accumulating at 1.5% each month. The spreadsheet shows the amount owed at the beginning of each month.

	A	B
1	Month	
2	January	£200.00
3	February	£203.00
4	March	£206.05
5	April	£209.14
6	May	£212.27
7	June	£215.46
8	July	£218.69
9	August	£221.97
10	September	£225.30
11	October	£228.68
12	November	£232.11
13	December	£235.59
14	January	
15		
16	APR	

$$(a) = B13 * 1.1015$$

$$(b) \quad B14 = 235.59 \times 1.015$$

$$= £239.12$$

$$APR = (\£239.12 - 200) \div 200 * 100$$

$$= 19.56\%$$

(a) Write down the **formula** to enter in cell B14 the amount owed at the beginning of January.

(b) The Annual Percentage Rate (APR) for a monthly interest rate of 1.5% can be calculated using the formula = (B14 – B2)/B2*100. Calculate the APR.

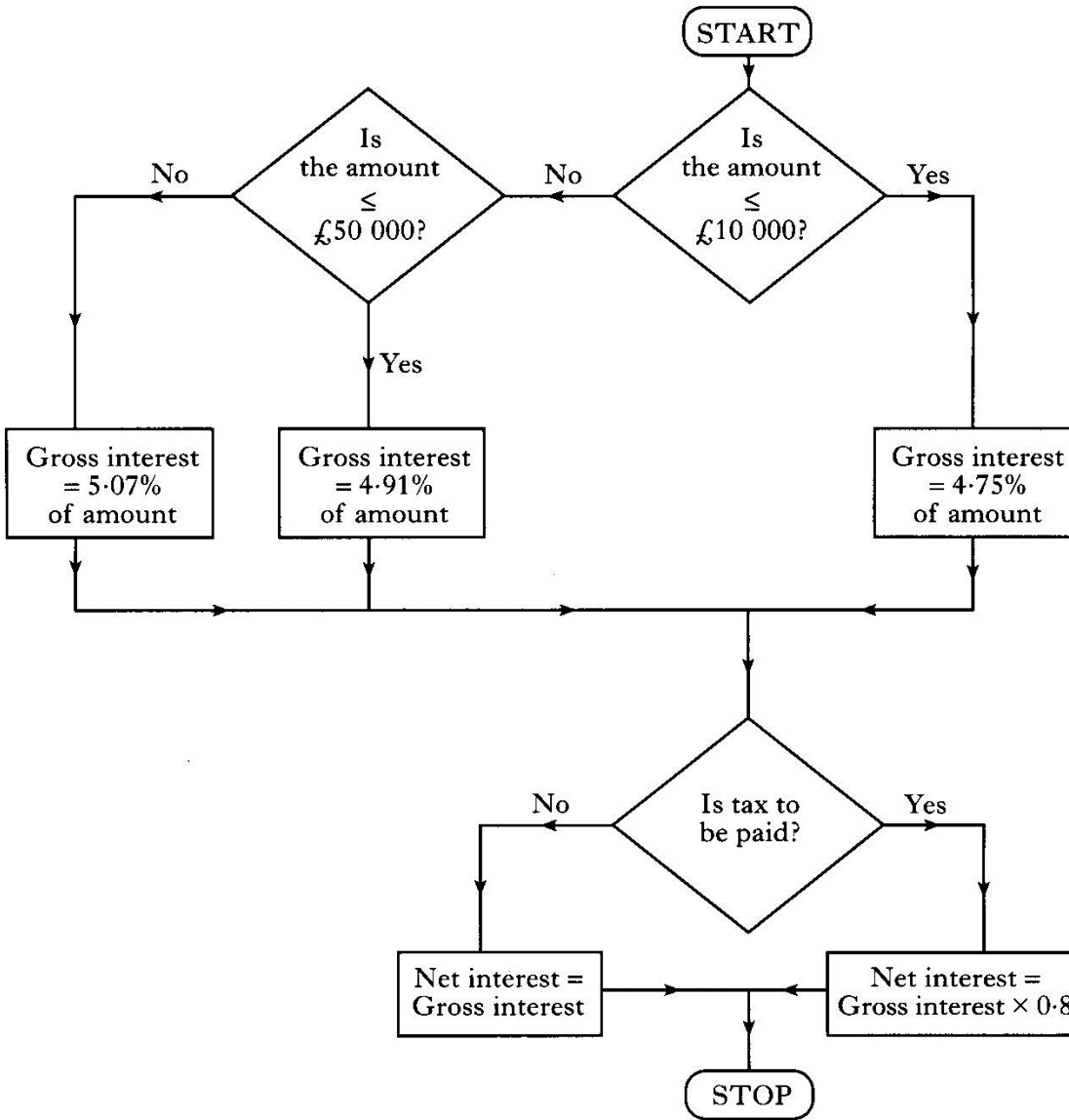
1 Applications Grid

Solution

3

7. The flowchart below shows how to calculate the **net** interest when a certain sum of money is invested for 1 year.

mark



Gross Interest

$$5.07\% \text{ of } \pounds 58\,500 = \pounds 2\,965.95$$

Net Interest

$$\pounds 2\,965.95 \times 0.8 = \pounds 2\,372.76$$

Applications Grid

Solution

Use the flowchart to calculate the net interest earned on an amount of £58 500 invested by a tax payer for 1 year.

9. Jock McFadzean is a plumber. He earns £38 750 in one year. He has tax allowances of £4745.

The rates of tax applicable for the year are given in the table below.

Taxable income (£)	Rate
On the first £1960	10%
On the next £28 540	22%
On any income over £30 500	40%

How much was Jock's **weekly** tax bill during the year?

5

9. At 10% Tax to pay = £196

$$\text{Taxable income} = 38750 - 4745 = 34005$$

$$34005 - 1960 = £32045$$

$$22\% \text{ of } £28540 = \underline{\underline{£6278.80}}$$

$$\text{This leaves } 32045 - 28540 = £3505$$

$$\text{This is taxed at } 40\% \therefore 40\% \text{ of } 3505 \\ = \underline{\underline{£1402}}$$

$$\text{Total tax for year} = £196 + £6278.80 + £1402 \\ = £7876.80$$

$$\text{Tax per week} = £7876.80 \div 52 \\ = \underline{\underline{£151.48}}$$

11. The tables below show the monthly repayments to be made, with and without payment protection, when £1000 is borrowed from the Bettervalue Loan Firm.

Without Payment Protection				
APR on £1000	12 months	24 months	36 months	48 months
10%	£88.82	£47.05	£33.17	£26.26
12%	£89.66	£47.89	£34.02	£27.13
14%	£90.50	£48.72	£34.88	£28.01
16%	£91.33	£49.56	£35.73	£28.90

With Payment Protection				
APR on £1000	12 months	24 months	36 months	48 months
10%	£94.96	£51.64	£37.33	£30.03
12%	£95.86	£52.57	£38.30	£31.04
14%	£96.76	£53.49	£39.27	£32.05
16%	£97.64	£54.40	£40.24	£33.07

Jean needs a loan. She can afford to pay £220 per month, and wants the biggest loan she can get over 36 months, without payment protection.

How much can she borrow from Bettervalue Loan Firm at 14% APR?

Give your answer to the nearest £100.

Applications Grid

Solution

11. Monthly payments of $34.88 \times x = 220$
 $x = 6.307$

So she can borrow £6.307

which is £6300 to nearest 100.

8. The flowchart below shows how a publisher calculates the final cost of orders.

2007 Paper 1

$$\text{Basic cost} = 80 \times \text{£}9.50$$

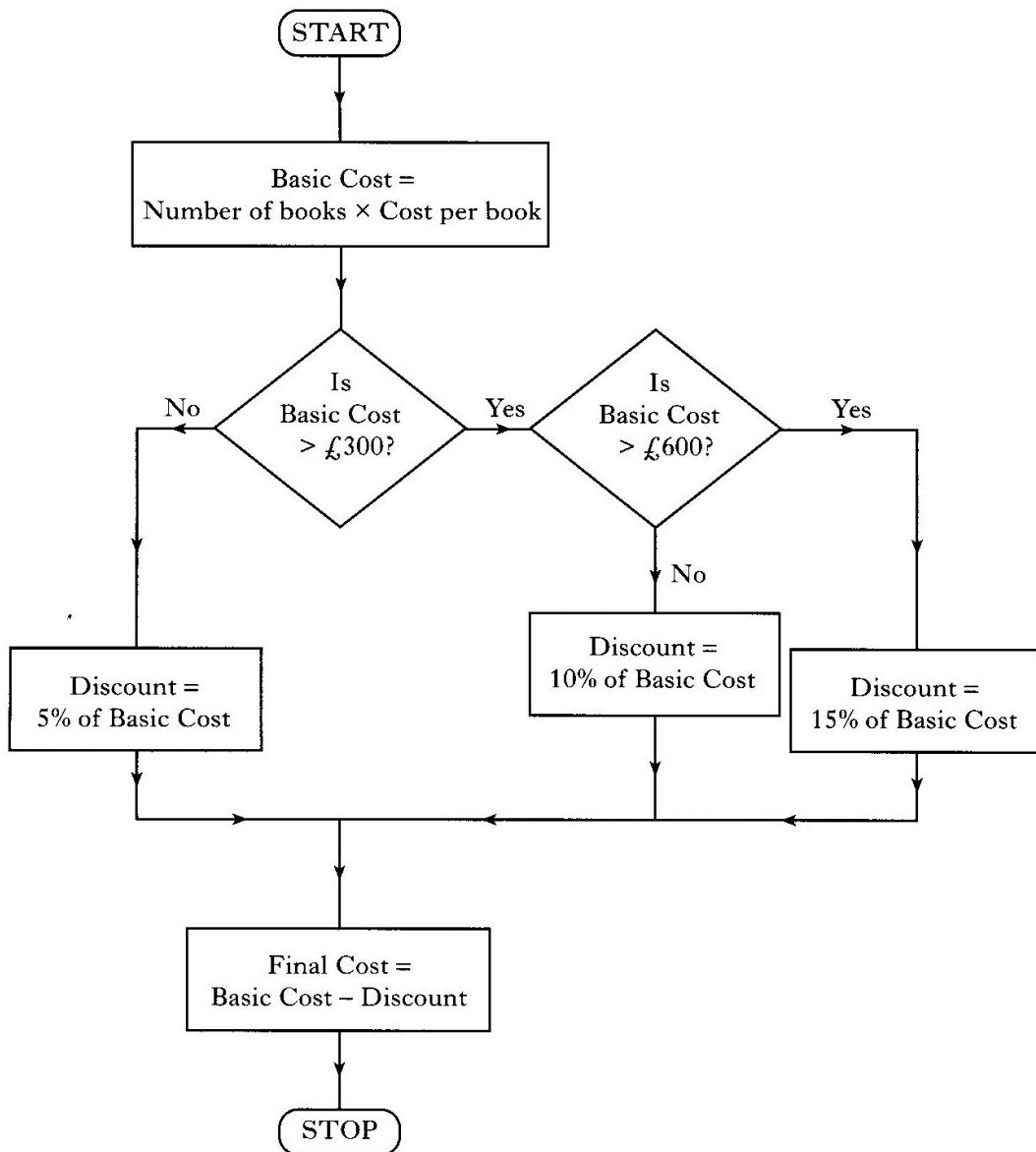
$$= \text{£}760$$

$$\text{Discount} = 15\% \text{ of } \text{£}760$$

$$= \text{£}114$$

$$\text{Final cost} = \text{£}760 - \text{£}114$$

$$= \text{£}646$$

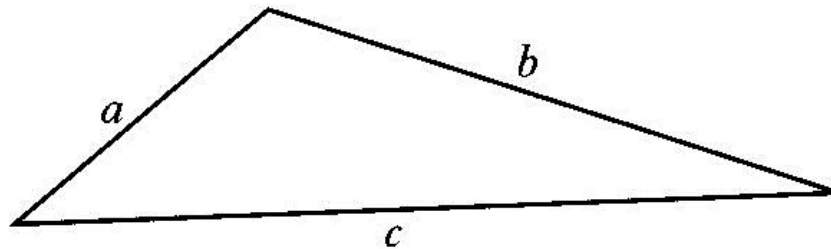


Solution

Applications Grid

A Mathematics department orders 80 books at £9.50 each.
Calculate the final cost of this order.

10. A triangle has sides with lengths a , b , c .



The area, A , of this triangle can be calculated by using the formula

$$A = \sqrt{s(s-a)(s-b)(s-c)} \quad \text{where } s = \frac{1}{2}(a+b+c).$$

- (a) Calculate the value of s when $a = 3$, $b = 6$, $c = 7$. 1
- (b) Using the values for s , a , b and c from part (a), calculate A .
Give your answer for A correct to the nearest whole number. 3

(a) $S = \frac{1}{2}(3+6+7) = \frac{1}{2}(16) = 8$

(b) $A = \sqrt{8(8-3)(8-6)(8-7)}$

$$= \sqrt{8 \times 5 \times 2 \times 1}$$

$$= \sqrt{80}$$

$$\text{approx} = 9 \text{ (since } 9 \times 9 = 81)$$

Solution

Applications Grid

8. A job as a sales consultant is advertised.



Matthew telephones for information and finds out that the basic wage is £15 000. In addition to this he will receive 2.5% commission on all his sales.

What value of sales will Matthew have to make in order to earn £22 000 per year?

3

Needs to make £7 000.

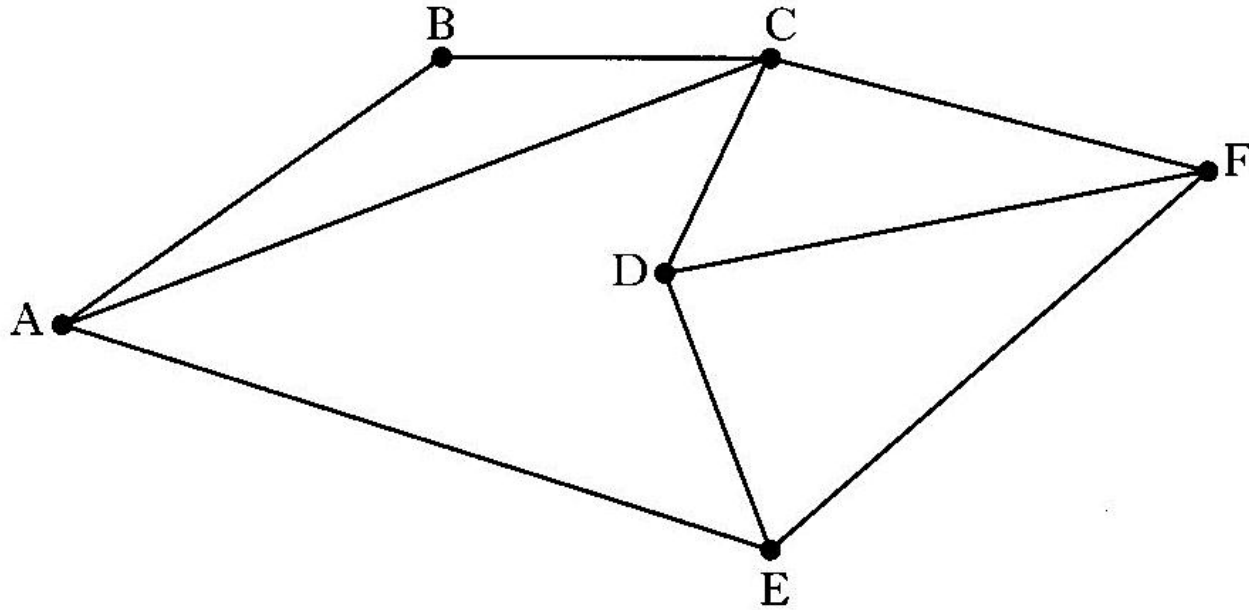
2.5% of sales = £7 000

$0.025 \times \text{sales} = £7\,000$

$\text{sales} = £7\,000 \div 0.025 = £280\,000$

Solution**Applications Grid**

10. A network diagram is shown below.



State the order of node C.

1

Node C has order 4. (4 routes/lines)

Solution

Applications Grid

11. The table below shows the monthly repayments to be made, with and without payment protection, when money is borrowed from the Good Deal Loan Company.

loan amount	60 months		48 months		36 months		24 months	
	W	WO	W	WO	W	WO	W	WO
£15 000	342.63	288.49	409.43	350.79	510.76	454.86	736.73	663.35
£12 500	285.53	240.41	341.20	292.33	425.63	379.05	613.94	552.79
£10 000	228.42	192.33	272.95	233.86	340.50	303.24	491.15	442.23
£7 500	171.31	144.24	204.72	175.40	255.38	227.43	368.37	331.68
£5 000	114.21	96.16	136.48	116.93	170.25	151.62	245.58	221.12
W = with payment protection WO = without payment protection								

- (a) Joseph decides to borrow £12 500.

If he repays it over 48 months, **without** payment protection, calculate the cost of the loan.

- (b) Brian thinks it would be cheaper to take a loan of £12 500 over 36 months **with** payment protection.

Is he correct?

Explain your answer.

(a) Amount paid

$$£292.33 \times 48 = £14\,031.84$$

Cost of loan

$$£14\,031.84 - £12\,500$$

$$= £1\,531.84$$

(b) Other loan

$$£425.63 \times 36 = £15\,322.68$$

- 3 No, he will pay more.

Extra to pay

$$£15\,322.68 - £14\,031.84$$

3

$$= £1\,290.84$$

Solution

Applications Grid

28 students timed their journeys from home to college.

The results, in minutes, are listed below.

14	34	22	13	17	15	36
17	8	14	24	2	25	17
31	17	20	23	10	28	19
21	22	28	30	21	16	19

(a) Construct a frequency table for the above data using class intervals

1–5, 6–10, 11–15, etc.

2

(b) Using the frequency table in part (a), calculate the mean number of minutes per journey.

4

Solution

Applications Grid

Time (mins)	Freq	Midpt x freq	
1 - 5	1	3 x 1	3
6 - 10	2	8 x 2	16
11 - 15	4	13 x 4	52
16 - 20	8	18 x 8	144
21 - 25	7	23 x 7	161
26 - 30	3	28 x 3	84
31 - 35	2	33 x 2	99
36 - 40	1	38 x 1	38
Totals	28		564

$$\text{Mean} = 564 \div 28 = 20.1$$