PRESS F5 TO START

This presentation contains Credit past paper questions complete with solutions.

The questions are sorted into topics based on the Credit course.

To access a particular question from the main grid just simply click on the question number.

To access the formula sheet press the F button.

To begin click on Main Grid.

Main Grid

2006 - 2010

Topic	2001		2002		2003		2004		2005	
	I	II	I	II	I	II	I	II	I	II
Calculations	1		1		1		1		1	
Fractions	2		2		2		2		2	
Scientific Notation		1		1		1		1		1
% Calculations		3		2			6	4	3	
Circle Geometry				6		10		8	10	10
Similarity				12		9				6
Area/Volume		5 8 11		5	13	4	12	9	12	3 8
Speed/Distance/Time						11				
Triangle Calculations		6 10	7	4		3 6 7		5 6 7		5 7
Trig Equations & Graphs		7		8			9	10		11
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Brackets/ Factorising			5a		3 5					
Quadratics	8		9	3		8		11		4
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Main Grid

Topic	2006		2007		2008		2009		2010	
	I	II	I	II	I	II	I	II	I	II
Calculations	1		1		1					
Fractions	2		2							
Scientific Notation		1								
% Calculations		3		1 5		1 3				
Circle Geometry		8	12	7		5 9				
Similarity		11	8							
Area/Volume		7		12						
Speed/Distance/Time										
Triangle Calculations	10	5 6		6 8		7 8				
Trig Equations & Graphs		10	13	10		12				
Patterns					7					
Brackets/ Factorising	5a	4a	5		2					
Quadratics	8			2 11 13	8 12	11				
Surds & Indices		4bc	7 9		9 11 10					
Algebraic Fractions	5b				5					
Formulae		9	10 14			10				
Ratio/Proportion/Variation	7			9		6				
The Straight Line	4		6		4					
Equations/Inequations	6 11			4	6 13					
Simultaneous Equations	9		11			4				
Change The Subject			4		3					
Functions	3									
Statistics		2	3	3		2				

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

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

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

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

Standard deviation: $s = \sqrt{\dfrac{\sum \left(x - \bar{x}\right)^2}{n-1}} = \sqrt{\dfrac{\sum x^2 - \left(\sum x\right)^2 / n}{n-1}}$,

where n is the sample size.

Main Grid

KU	RE
2	

1. Evaluate

$$3 \cdot 1 + 2 \cdot 6 \times 4.$$

F

Solution

Main Grid

Q1 BODMAS

$3.1 + 2.6 \times 4$

$2.6 \times 4 = 10.4$

$3.1 + 10.4 = 13.5$

Main Grid

2. Evaluate

$$3\tfrac{5}{8} + 4\tfrac{2}{3}.$$

2

F

Solution

Main Grid

Q2

$$3\frac{5}{8}+4\frac{2}{3}$$

$$\frac{29}{8}+\frac{14}{3}$$

$$\frac{(3\times 29)+(8\times 14)}{8\times 3}$$

$$\frac{87+112}{24}$$

$$\frac{199}{24}$$

$$8\frac{7}{24}$$

Main Grid

3. **Given that** $f(m) = m^2 - 3m$, evaluate $f(-5)$.

2	

F

Solution

Main Grid

Q3

$$f(m) = m^2 - 3m$$

$$f(-5) = (-5)^2 - (3 \times -5)$$

$$f(-5) = 25 - (-15)$$

$$f(-5) = 25 + 15 = \underline{\underline{40}}$$

Main Grid

4. Solve **algebraically** the equation

$$2x - \frac{(3x-1)}{4} = 4.$$

3

F

Solution

Main Grid

Q4

$$2x - \frac{(3x-1)}{4} = 4 \qquad (\times 4)$$

$$8x - (3x-1) = 16$$

$$8x - 3x + 1 = 16$$

$$5x = 15$$

$$\underline{\underline{x = 3}}$$

Main Grid

5. A furniture maker investigates the delivery times, in days, of two local wood companies and obtains the following data.

Company	*Minimum*	*Maximum*	*Lower Quartile*	*Median*	*Upper Quartile*
Timberplan	16	56	34	38	45
Allwoods	18	53	22	36	49

(*a*) Draw an appropriate statistical diagram to illustrate these two sets of data. **3**

(*b*) Given that consistency of delivery is the most important factor, which company should the furniture maker use? Give a reason for your answer. **1**

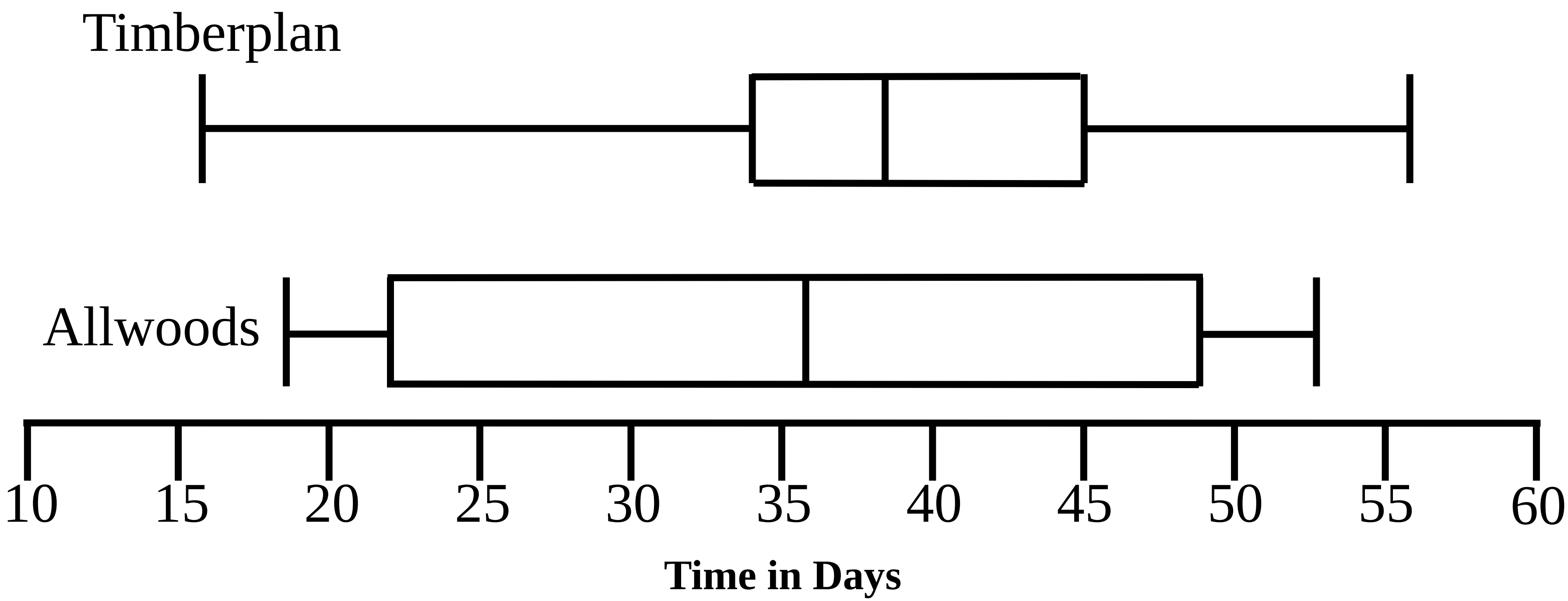
F

Solution

Main Grid

Q5

Furniture Delivery Time



For consistency of delivery the furniture maker should use Timberplan, because a smaller interquartile range suggests a smaller range of delivery times, therefore, more consistent.

Main Grid

6. A is the point (a^2, a).

T is the point (t^2, t), $a \neq t$

Find the gradient of the line AT.

Give your answer in its simplest form.

KU	RE
3	

Solution

Main Grid

F

Q6

$$M_{AT} = \frac{t-a}{t^2 - a^2}$$

$$M_{AT} = \frac{t-a}{(t-a)(t+a)}$$

$$M_{AT} = \frac{1}{t+a}$$

Main Grid

7. A garage carried out a survey on 600 cars.

The results are shown in the table below.

		Engine size (cc)			
		0–1000	1001–1500	1501–2000	2001+
Age	Less than 3 years	50	80	160	20
	3 years or more	60	100	120	10

(*a*) What is the probability that a car, chosen at random, is less than 3 years old? 1

(*b*) In a sample of 4200 cars, how many would be expected to have an engine size greater than 2000cc **and** be 3 or more years old? 2

F

Solution

Main Grid

Q7

$$\text{P(less than 3 years)} = \frac{50+80+160+20}{600}$$

$$\text{P(less than 3 years)} = \frac{310}{600} = \frac{31}{60}$$

$$\text{Probability} = \frac{10}{600} = \frac{1}{60}$$

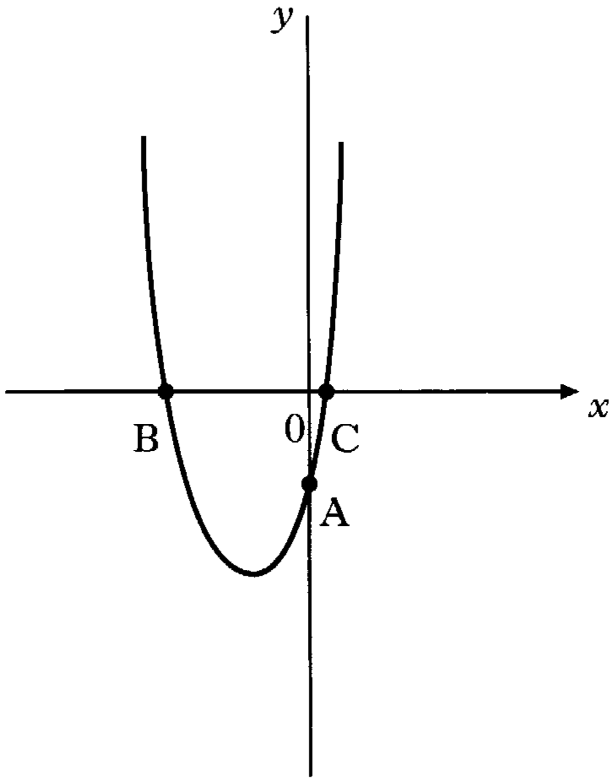
$$\text{In a sample 4200:} \quad 4200 \div 60 = \underline{\underline{70 \text{ cars}}}$$

Main Grid

KU	RE

8. The diagram below shows part of the graph of $y = 4x^2 + 4x - 3$.

The graph cuts the y-axis at A and the x-axis at B and C.



F

Solution

Main Grid

(*a*) Write down the coordinates of A. **1**

(*b*) Find the coordinates of B and C. **3**

(*c*) Calculate the minimum value of $4x^2 + 4x - 3$. **2**

Q8 Cuts *y-axis at* $x = 0$:

$$y = 4\times 0^2 + 4\times 0 - 3 = -3$$

$\underline{\underline{A(0,-3)}}$

Cuts *x-axis at* $y = 0$:

$$4x^2 + 4x - 3 = 0$$

$$(2x-1)(2x+3) = 0$$

$$x = 0.5 \quad \text{and} \quad x = -1.5$$

$\underline{\underline{B(-1.5,0)}}$ $\underline{\underline{C(0.5,0)}}$

Because of symmetry min. value at $x = -0.5$

$$y = 4\times -0.5^2 + 4\times -0.5 - 3$$

$$y = 1 - 2 - 3$$

$$\underline{\underline{y = -4}}$$

Main Grid

9. A number pattern is shown below.

$$1^3 + 1 = (1 + 1)\,(1^2 - 1 + 1)$$
$$2^3 + 1 = (2 + 1)\,(2^2 - 2 + 1)$$
$$3^3 + 1 = (3 + 1)\,(3^2 - 3 + 1)$$

(*a*) Write down a similar expression for $7^3 + 1$. **1**

(*b*) Hence write down an expression for $n^3 + 1$. **1**

(*c*) Hence find an expression for $8p^3 + 1$. **2**

F

Solution

Main Grid

Q9

$$7^3+1=(7+1)(7^2-7+1)$$

$$n^3+1=(n+1)(n^2-n+1)$$

$$8p^3+1=(2p+1)((2p)^2-2p+1) \qquad \left(\sqrt[3]{8p^3}=2p\right)$$

$$8p^3+1=(2p+1)(4p^2-2p+1)$$

Main Grid

10. Simplify

$$\frac{\sqrt{3}}{\sqrt{24}}.$$

Express your answer as a fraction with a rational denominator.

KU	RE
3	

F

Solution

Main Grid

Q10

$$\frac{\sqrt{3}}{\sqrt{24}} \times \frac{\sqrt{24}}{\sqrt{24}} = \frac{\sqrt{72}}{24}$$

$$= \frac{\sqrt{36}\sqrt{2}}{24} = \frac{6\sqrt{2}}{24}$$

$$= \underline{\underline{\frac{\sqrt{2}}{4}}}$$

Main Grid

11. The intensity of light, I, emerging after passing through a liquid with concentration, c, is given by the equation

$$I = \frac{20}{2^c} \qquad c \geq 0.$$

(*a*) Find the intensity of light when the concentration is 3. **1**

(*b*) Find the concentration of the liquid when the intensity is 10. **2**

(*c*) What is the maximum possible intensity? **3**

F

Solution

Main Grid

Q11

$$I = \frac{20}{2^3} = \underline{\underline{\frac{20}{8}}}$$

$$10 = \frac{20}{2^c}$$

$$10 \times 2^c = 20$$

$$2^c = 2$$

$$\underline{\underline{c = 1}}$$

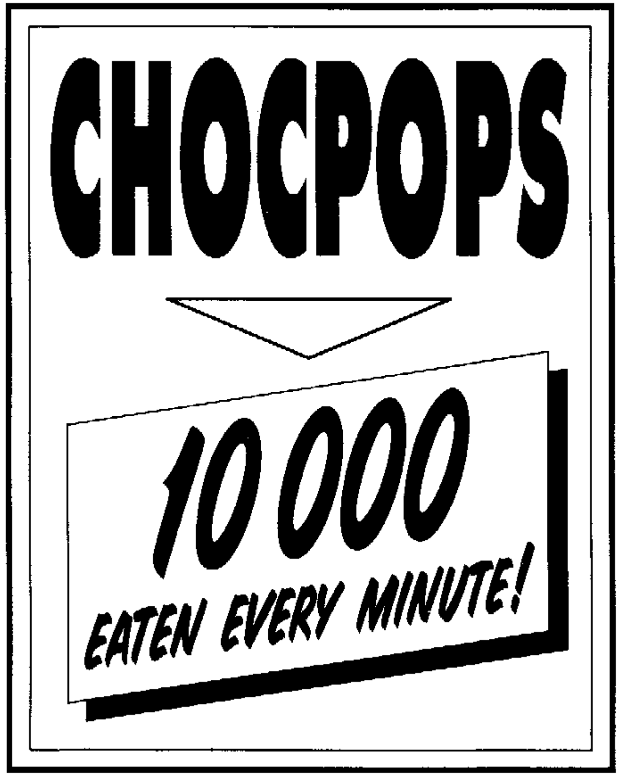
Maximum value when 2^c is a minimum.

$$2^0 = 1$$

$$\underline{\underline{I = 20}}$$

Main Grid

1.



KU	RE
2	

How many chocpops will be eaten in the year 2001?

Give your answer in **scientific notation**.

F

Solution

Main Grid

Q1

$$365 \times 24 \times 60 \times 10000$$

$$= 5256000000$$

$$= \underline{\underline{5.256 \times 10^9}}$$

Main Grid

2. The price, in pence per litre, of petrol at 10 city garages is shown below.

84·2	84·4	85·1	83·9	81·0
84·2	85·6	85·2	84·9	84·8

(*a*) Calculate the mean and standard deviation of these prices. **3**

(*b*) In 10 rural garages, the petrol prices had a mean of 88·8 and a standard deviation of 2·4.

How do the rural prices compare with the city prices? **2**

F

Solution

Main Grid

Q2

x	x^2
81.0	6561
83.9	7039.21
84.2	7089.64
84.2	7089.64
84.4	7123.36
84.8	7191.04
84.9	7208.01
85.1	7242.01
85.2	7259.04
85.6	7327.36
843.3	71130.31

$$mean = \frac{843.3}{10} = \underline{\underline{84.3}}$$

$$s = \sqrt{\frac{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}{n-1}} = \sqrt{\frac{71130.31 - \frac{(843.3)^2}{10}}{10-1}}$$

$$s = \sqrt{\frac{71130.31 - 71115.489}{9}}$$

$$s = \sqrt{1.647} = \underline{\underline{1.28}}$$

In rural areas petrol prices are higher on average and there is a greater variation on prices.

Main Grid

3. In 1999, a house was valued at £90 000 and the contents were valued at £60 000.

The value of the house **appreciates** by 5% each year.

The value of the contents **depreciates** by 8% each year.

What will be the **total** value of the house **and** the contents in 2002? 3

F

Solution

Main Grid

Q3

$$\text{House}: \quad 90\,000 \times (1.05)^3 = £104\,186.25$$

$$\text{Contents}: \quad 60\,000 \times (0.92)^3 = £46\,721.28$$

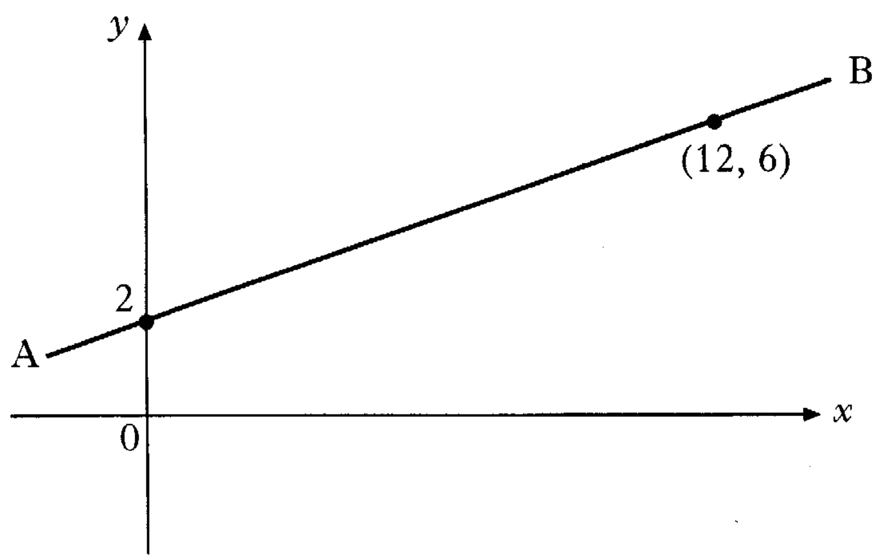
$$\text{Value}: \quad 104\,186.25 + 46\,721.28 = \underline{\underline{£150\,907.53}}$$

Main Grid

KU	RE

4. A water pipe runs between two buildings.

These are represented by the points A and B in the diagram below.



(*a*) Using the information in the diagram, show that the equation of the line AB is $3y - x = 6$. **3**

(*b*) An emergency outlet pipe has to be built across the main pipe. The line representing this outlet pipe has equation $4y + 5x = 46$.

Calculate the coordinates of the point on the diagram at which the outlet pipe will cut across the main water pipe. **4**

F

Solution

Main Grid

Q4

$$y = Mx + c \qquad M = \frac{6-2}{12-0} = \frac{4}{12} = \frac{1}{3} \qquad c = 2$$

$$y = \frac{1}{3}x + 2 \qquad (\times 3)$$

$$3y = x + 6$$

$$3y - x = 6$$

Q4b

$$3y - x = 6$$

$$4y + 5x = 46$$

$$12y - 4x = 24$$

$$12y + 15x = 138$$

$$-19x = -114$$

$$x = 6$$

$$3y - 6 = 6$$

$$3y = 12$$

$$y = 4$$

$$(6,4)$$

Main Grid

5. A cylindrical soft drinks can is 15 centimetres in height and 6·5 centimetres in diameter.

A new cylindrical can holds the same volume but has a reduced height of 12 centimetres.

What is the diameter of the new can?

Give your answer **to 1 decimal place**. **4**

F

Solution

Main Grid

Q5

$$V=\pi r^2 h = 3.14\times 3.25\times 3.25\times 15 = \underline{\underline{497.49cm^3}}$$

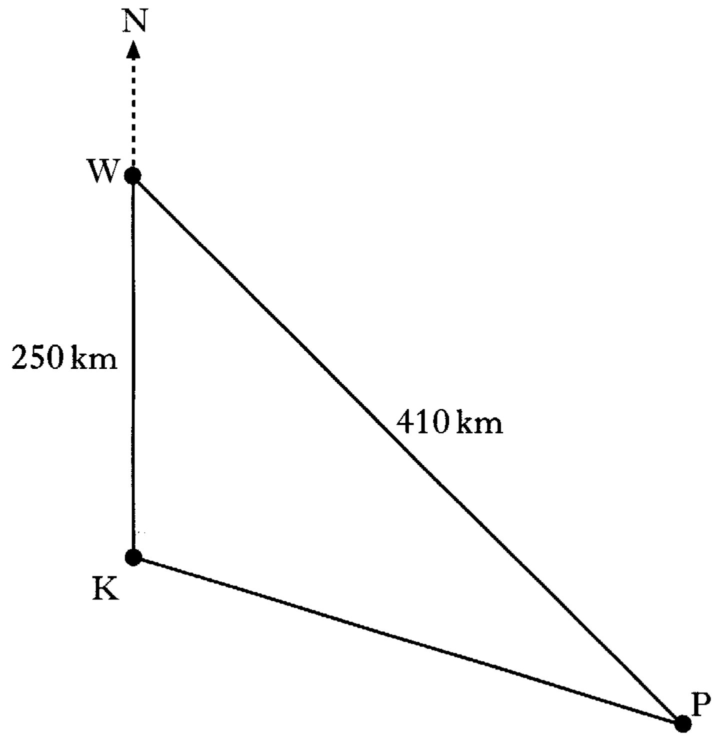
$$\pi r^2 h = 497.49$$

$$r=\sqrt{\frac{497.49}{\pi h}}=\sqrt{\frac{497.49}{3.14\times 12}}=\sqrt{13.2}=3.63$$

$$d = 2\times 3.63 = 7.26 = \underline{\underline{7.3cm}}$$

Main Grid

6. Three radio masts, Kangaroo (K), Wallaby (W) and Possum (P) are situated in the Australian outback.



Kangaroo is 250 kilometres due south of Wallaby.

Wallaby is 410 kilometres from Possum.

Possum is on a bearing of 130° from Kangaroo.

Calculate the bearing of Possum from Wallaby.

Do not use a scale drawing.

KU	RE
	4

F

Solution

Main Grid

Q6 We need to calculate angle W. Use the sine rule to calculate angle P.

$$\frac{p}{\sin P} = \frac{k}{\sin K}$$

$$\sin P = \frac{p \sin K}{k} = \frac{250 \times \sin 130}{410} = 0.467$$

$$P = \sin^{-1}(0.467) = 27.8^o$$

$$W = 180 - 130 - 27.8 = 22.2^o$$

$$\text{Bearing } \ \mathrm{W} \rightarrow \mathrm{P} = 180 - 22.2 = \underline{\underline{157.8^o}}$$

Main Grid

7. Solve **algebraically** the equation

$$\tan 40° = 2\sin x° + 1 \qquad 0 \leq x < 360.$$

3

F

Solution

Main Grid

Q7

$$\tan 40^o = 2\sin x^o + 1$$

$$0.839 = 2\sin x^o + 1$$

$$2\sin x^o = 0.839 - 1$$

$$2\sin x^o = -0.161$$

$$\sin x^o = -0.161 \div 2$$

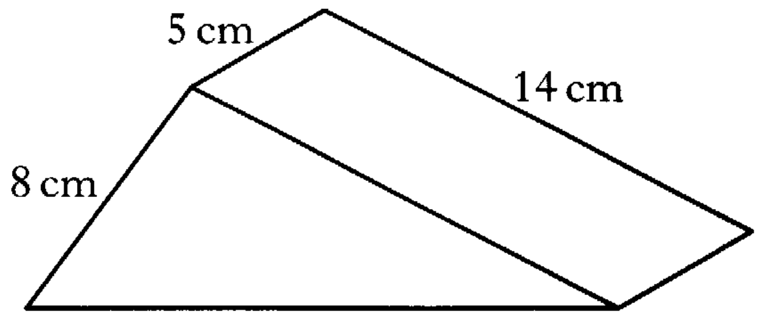
$$\sin x^o = -0.081$$

$$\text{Related Angle} = \sin^{-1}(0.081) = 4.6^o$$

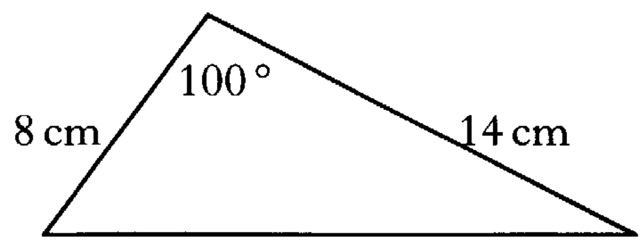
$$\underline{\underline{x^o = 180 + 4.6 = 184.6^o}} \quad \text{and} \quad \underline{\underline{x^o = 360 - 4.6 = 355.4^o}}$$

Main Grid

8. A metal door-stop is prism shaped, as shown.



The uniform cross-section is shown below.



Find the volume of metal required to make the door-stop.

KU	RE
4	

F

Solution

Main Grid

Q8 Volume = end area × depth

$$A = \frac{1}{2}ab\sin c^o$$

$$A = 0.5 \times 8 \times 14 \times \sin 100^o$$

$$\underline{\underline{A = 55.15cm^2}}$$

$$V = 55.15 \times 5$$

$$\underline{\underline{V = 275.75cm^3}}$$

Main Grid

9. The electrical resistance, R, of copper wire varies directly as its length, L metres, and inversely as the square of its diameter, d millimetres.

Two lengths of copper wire, A and B, have the same resistance.

Wire A has a diameter of 2 millimetres and a length of 3 metres.

Wire B has a diameter of 3 millimetres.

What is the length of wire B? 4

F

Solution

Main Grid

Q9

$$R \alpha \frac{L}{d^2} \qquad R = \frac{kL}{d^2}$$

$$R = R$$

$$\frac{3k}{2^2} = \frac{Lk}{3^2}$$

$$\frac{3k}{4} = \frac{Lk}{9}$$

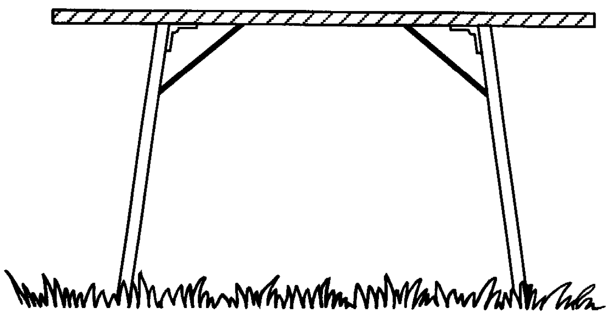
$$27k = 4Lk$$

$$L = \frac{27}{4}$$

Main Grid

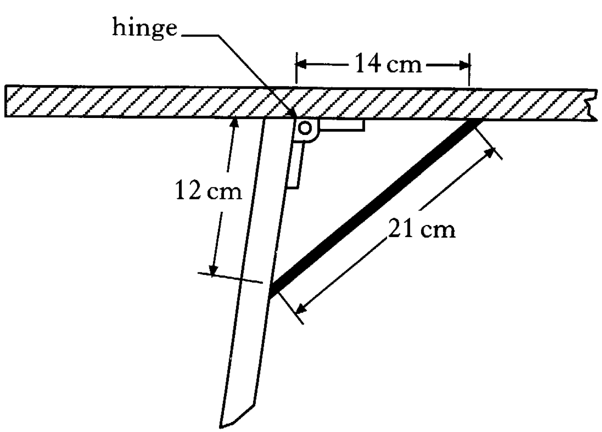
KU	RE

10. Each leg of a folding table is prevented from opening too far by a metal bar.



The **metal bar** is 21 centimetres long.

It is fixed to the table **top** 14 centimetres from the hinge and to the table **leg** 12 centimetres from the hinge.



(*a*) Calculate the size of the obtuse angle which the table top makes with the leg. **3**

(*b*) Given that the table leg is 70 centimetres long, calculate the height of the table. **3**

F

Solution

Main Grid

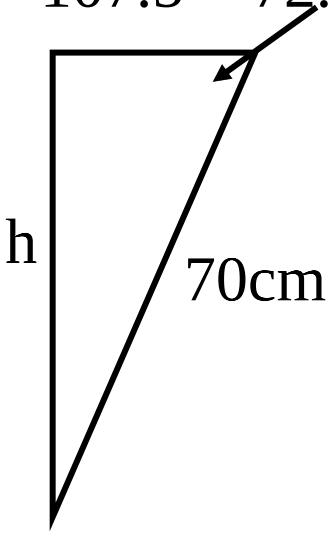
Q10

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc} = \frac{14^2 + 12^2 - 21^2}{2 \times 14 \times 12}$$

$$\cos A = \frac{-101}{336} = -0.301$$

$$A = \cos^{-1}\left(-0.301\right) = \underline{\underline{107.5^o}}$$

(180 – 107.5 = 72.5°)



$$\sin 72.5^o = \frac{h}{70}$$

$$h = 70 \sin 72.5^o$$

$$\underline{\underline{h = 66.8cm}}$$

Main Grid

KU	RE
	1
	2
	5

11. A rectangular wall vent is 30 centimetres long and 20 centimetres wide.

It is to be enlarged by increasing **both** the length and the width by x centimetres.

(*a*) Write down the length of the new vent.

(*b*) Show that the area, A square centimetres, of the new vent is given by

$$A = x^2 + 50x + 600.$$

(*c*) The area of the new vent **must** be **at least** 40% more than the original area.

Find the **minimum** dimensions, to the nearest centimetre, of the new vent.

Solution 11ab

Solution 11c

Main Grid

F

Q11ab

$$a)\quad l = 30 + x$$

$$b)\quad A = (30 + x)(20 + x)$$

$$A = 600 + 30x + 20x + x^2$$

$$\underline{\underline{A = x^2 + 50x + 600}}$$

Solution 11c

Main Grid

Q11c $\text{Original Area} = 30 \times 20 = 600cm^2$

$40\% \text{ of } 600 = 0.4 \times 600 = 240$

$$x^2 + 50x = 240$$

$$x^2 + 50x - 240 = 0$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad a = 1 \quad b = 50 \quad c = -240$$

$$\frac{-50 \pm \sqrt{50^2 - (4 \times 1 \times -240)}}{2 \times 1}$$

$$\frac{-50 \pm \sqrt{2500 - (-960)}}{2}$$

$$\frac{-50 + \sqrt{3460}}{2} \qquad \frac{-50 - \sqrt{3460}}{2}$$

$$4.41 \qquad \cancel{-54.41}$$

$\text{Minimum dimensions} = 34.41 \text{ by } 24.41$

$\text{Minimum dimensions} = \underline{\underline{35cm \text{ by } 25cm}}$

Main Grid

KU	RE
2	

1. Evaluate

$$7 \cdot 18 - 2 \cdot 1 \times 3.$$

F

Solution

Main Grid

Q1 BODMAS

$$7.18 - 2.1 \times 3$$

$$2.1 \times 3 = 6.3$$

$$7.18 - 6.3 = \underline{0.88}$$

Main Grid

2. Evaluate

$$1\frac{1}{8} \div \frac{3}{4}.$$

2

F

Solution

Main Grid

Q2

$$1\frac{1}{8} \div \frac{3}{4}$$

$$= \frac{9}{8} \div \frac{3}{4}$$

$$= \frac{9}{8} \times \frac{4}{3}$$

$$= \frac{36}{24} = \underline{\underline{\frac{3}{2} = 1\frac{1}{2}}}$$

Main Grid

3. Solve the inequality $5 - x > 2(x + 1)$. | 3 |

F

Solution

Main Grid

Q3

$$5 - x > 2(x + 1)$$

$$5 - x > 2x + 2$$

$$-3x > -3$$

$$\underline{\underline{x < 1}}$$

Main Grid

4. Given that $f(x) = x^2 + 5x$, evaluate $f(-3)$.

2	

Solution

Main Grid

F

Q4

$$f(x) = x^2 + 5x$$

$$f(-3) = (-3)^2 + (5 \times -3)$$

$$f(-3) = 9 + (-15)$$

$$f(-3) = \underline{\underline{-6}}$$

Main Grid

5. (*a*) Factorise $p^2 - 4q^2$. 1

(*b*) **Hence simplify** 2

$$\frac{p^2 - 4q^2}{3p + 6q}.$$

F

Solution

Main Grid

Q5

$$p^2 - 4q^2$$

$$\underline{\underline{(p-2q)(p+2q)}}$$

$$\frac{p^2 - 4q^2}{3p+6q} = \frac{(p-2q)\cancel{(p+2q)}}{3\cancel{(p+2q)}}$$

$$= \underline{\underline{\frac{p-2q}{3}}}$$

Main Grid

6. $L = \frac{1}{2}(h - t)$.

Change the subject of the formula to h. **2**

F

Solution

Main Grid

Q6

$$L = \frac{1}{2}(h - t) \qquad (\times 2)$$

$$2L = h - t$$

$$2L + t = h$$

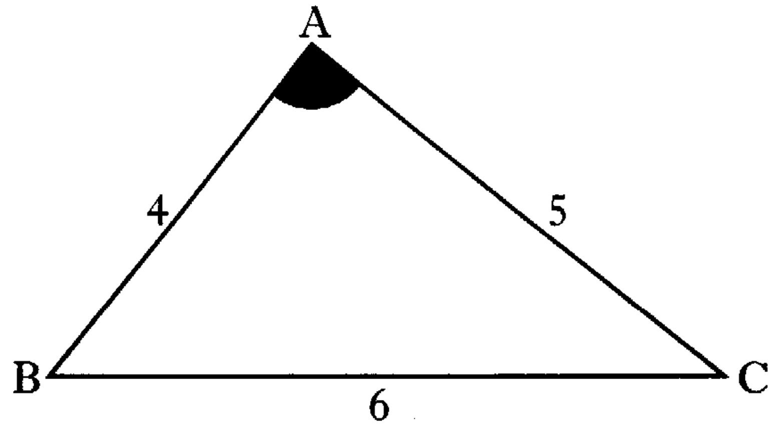
$$\underline{\underline{h = 2L + t}}$$

Main Grid

KU	RE
3	

7. In triangle ABC,

AB = 4 units
AC = 5 units
BC = 6 units.



Show that $\cos A = \frac{1}{8}$.

F

Solution

Main Grid

Q7

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

$$\cos A = \frac{5^2 + 4^2 - 6^2}{2 \times 5 \times 4}$$

$$\cos A = \frac{25 + 16 - 36}{40}$$

$$\cos A = \frac{5}{40} = \underline{\underline{\frac{1}{8}}}$$

Main Grid

8. Fifteen medical centres each **handed out** a questionnaire to fifty patients.

The numbers who replied to each centre are shown below.

11	19	22	25	25
29	31	34	36	38
40	46	49	50	50

Also, they each **posted** the questionnaire to another fifty patients.

The numbers who replied to each centre are shown below.

15	15	21	22	23
25	26	31	33	34
37	39	41	46	46

Draw an appropriate statistical diagram to compare these two sets of data. 3

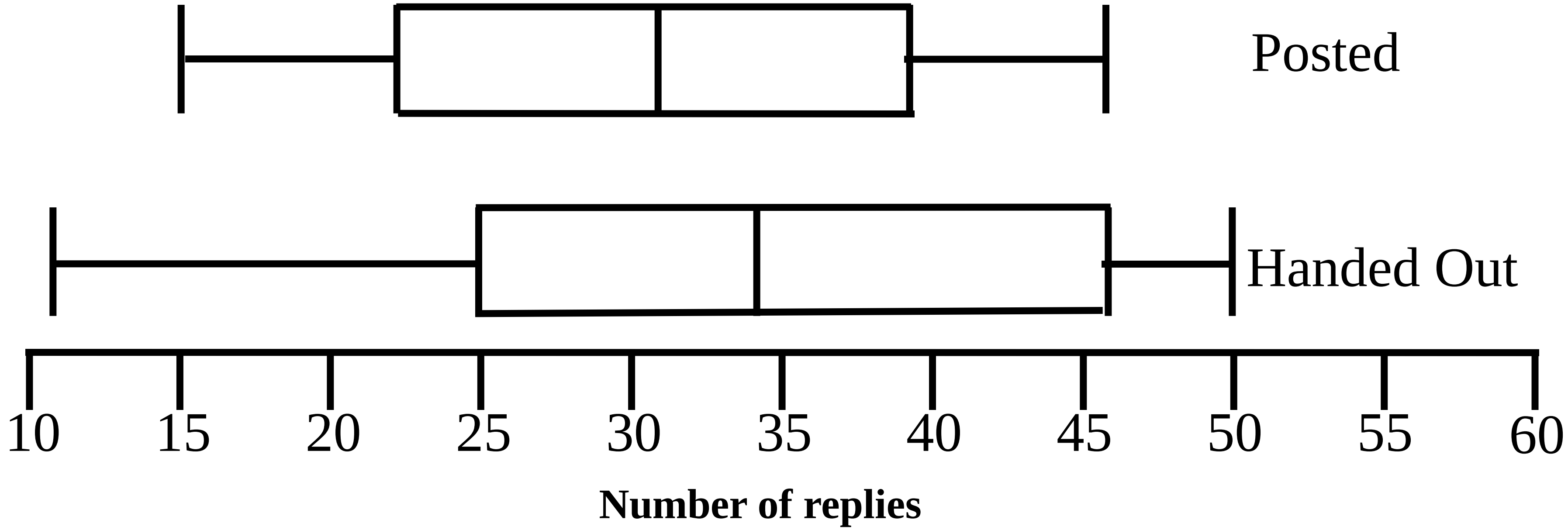
F

Solution

Main Grid

Q8

Medical Questionnaires



You could also draw a back-to-back stem and leaf diagram.

Main Grid

9. Two functions are given below.

$$f(x) = x^2 + 2x - 1$$
$$g(x) = 5x + 3$$

Find the values of x for which $f(x) = g(x)$. **3**

F

Solution

Main Grid

Q9

$$f(x) = g(x)$$

$$x^2 + 2x - 1 = 5x + 3$$

$$x^2 - 3x - 4 = 0$$

$$(x+1)(x-4) = 0$$

$\underline{\underline{x = -1}}$ and $\underline{\underline{x = 4}}$

Main Grid

10. Simplify

$$\sqrt{27} + 2\sqrt{3}.$$

KU	RE
2	

F

Solution

Main Grid

Q10

$$\sqrt{27} + 2\sqrt{3}$$

$$\sqrt{9}\sqrt{3} + 2\sqrt{3}$$

$$3\sqrt{3} + 2\sqrt{3}$$

$$\underline{\underline{5\sqrt{3}}}$$

Main Grid

11. Express in its simplest form

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

2

F

Solution

Main Grid

Q11

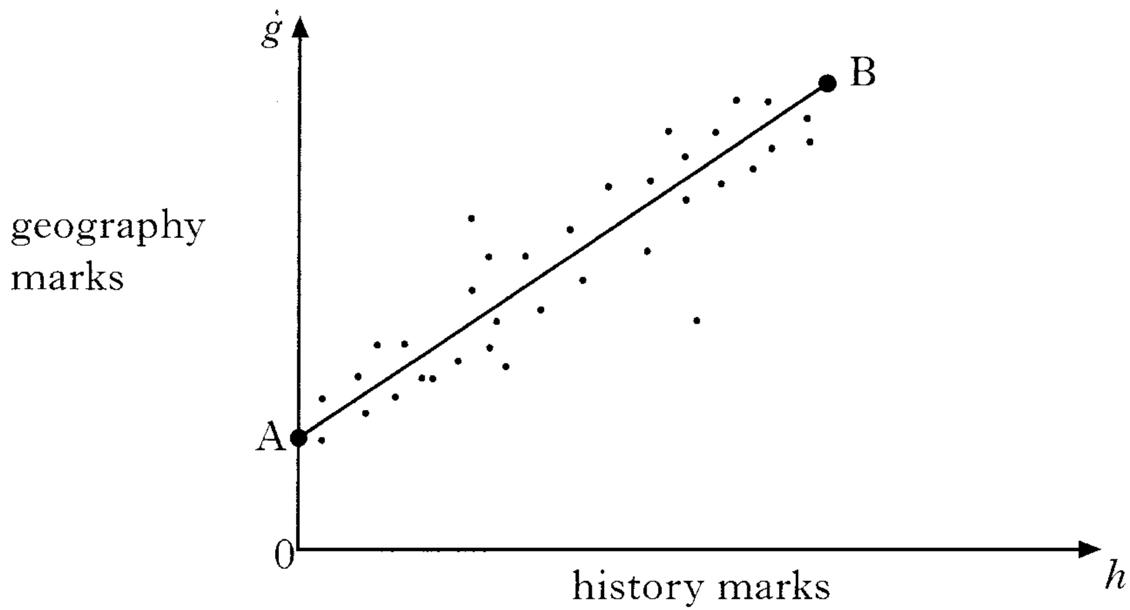
$$y^8 \times \left(y^3\right)^{-2}$$

$$y^8 \times y^{-6}$$

$$\underline{\underline{y^2}}$$

Main Grid

12. The graph below shows the relationship between the history and geography marks of a class of students.



A best-fitting straight line, AB has been drawn.

Point A represents 0 marks for history and 12 marks for geography.
Point B represents 90 marks for history and 82 marks for geography.

Find the equation of the straight line AB in terms of h and g. **4**

F

Solution

Main Grid

Q12

$$g = Mh + c$$

$$M = \frac{82-12}{90-0} = \frac{70}{90} = \frac{7}{9} \qquad c = 12$$

$$g = \frac{7}{9}h + 12$$

Main Grid

	KU	RE
13. (*a*) 4 peaches and 3 grapefruit cost £1·30. Write down an algebraic equation to illustrate this.	**1**	
(*b*) 2 peaches and 4 grapefruit cost £1·20. Write down an algebraic equation to illustrate this.	**1**	
(*c*) Find the cost of 3 peaches and 2 grapefruit.		**4**

F

Solution

Main Grid

Q13

$$4p+3g=1.30$$
$$2p+4g=1.20$$

$$8p+6g=2.60$$
$$8p+16g=4.80$$

$$10g=2.20$$
$$g=0.22$$

$$4p+(3\times 0.22)=1.30$$
$$4p+0.66=1.30$$
$$4p=0.64$$
$$p=0.16$$

$$3p+2g=(3\times 0.16)+(2\times 0.22)$$
$$=0.48+0.44=£0.92$$

Main Grid

KU	RE
2	

1. A spider weighs approximately $19{\cdot}06 \times 10^{-5}$ kilograms.

A humming bird is 18 times heavier.

Calculate the weight of the humming bird.

Give your answer **in scientific notation**.

F

Solution

Main Grid

Q1

$$18 \times 19.06 \times 10^{-5}$$

$$= 0.0034308$$

$$= \underline{\underline{3.4308 \times 10^{-3}}}$$

Main Grid

2. A microwave oven is sold for £150.

This price includes VAT at 17·5%.

Calculate the price of the microwave oven **without** VAT. 3

F

Solution

Main Grid

Q2

$$150 \div 1.175 = \underline{\underline{£127.66}}$$

Main Grid

3. Solve the equation

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

Give your answers **correct to 1 decimal place**. 4

F

Solution

Main Grid

Q3

$$2x^2+3x-7=0 \qquad \frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

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

$$\frac{-3\pm\sqrt{3^2-(4\times2\times-7)}}{2\times2}$$

$$\frac{-3\pm\sqrt{9-(-56)}}{4}$$

$$\frac{-3\pm\sqrt{65}}{4}$$

$$\frac{-3+\sqrt{65}}{4} \qquad \frac{-3-\sqrt{65}}{4}$$

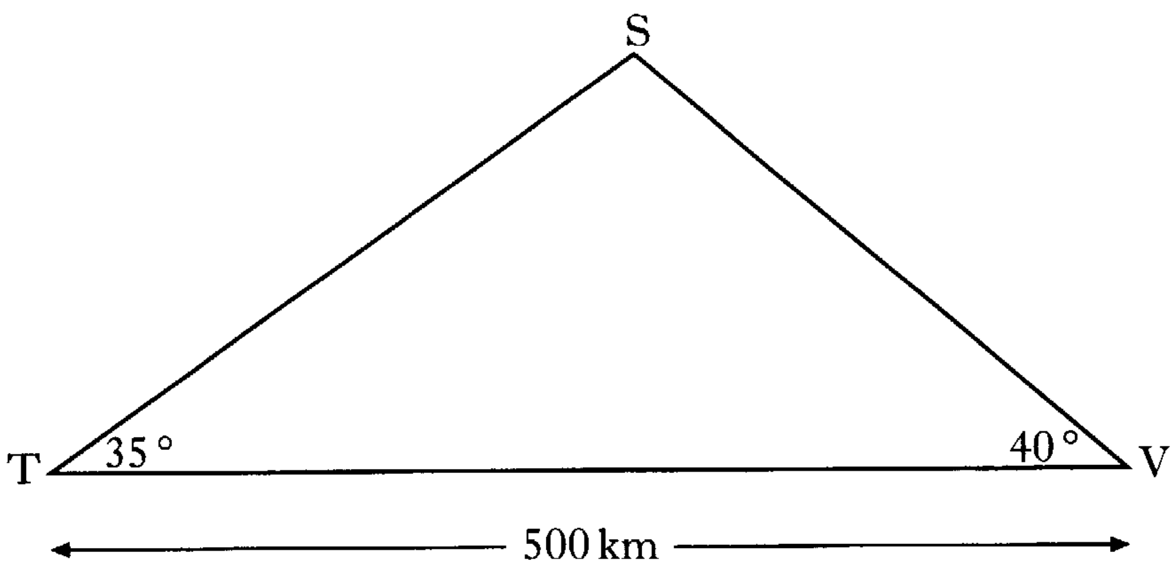
$$1.266 \qquad -2.766$$

$$\underline{\underline{1.3}} \qquad \underline{\underline{-2.8}}$$

Main Grid

KU	RE
	5

4. A TV signal is sent from a transmitter T, via a satellite S, to a village V, as shown in the diagram. The village is 500 kilometres from the transmitter.



The signal is sent out at an angle of 35° and is received in the village at an angle of 40°.

Calculate the height of the satellite above the ground.

F

Solution

Main Grid

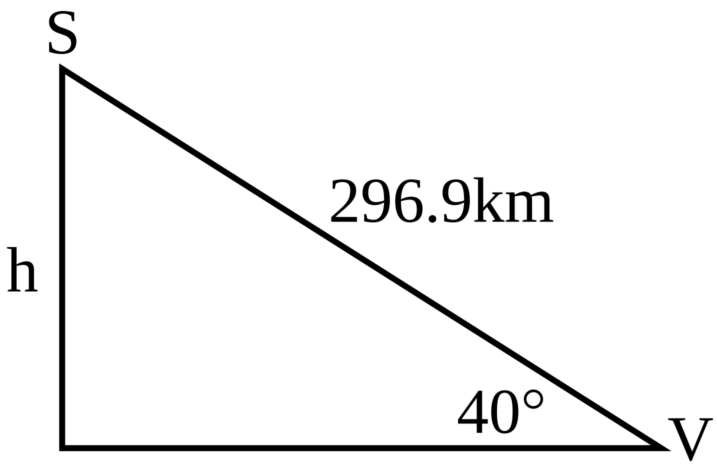
Q4

$$\text{Angle } S = 180 - 35 - 40 = \underline{105^o}$$

$$\frac{t}{\sin T} = \frac{s}{\sin S} \quad \Rightarrow \quad t = \frac{s \sin T}{\sin S}$$

Main Grid

$$t = \frac{500 \sin 35^o}{\sin 105^o} = \underline{296.9km}$$



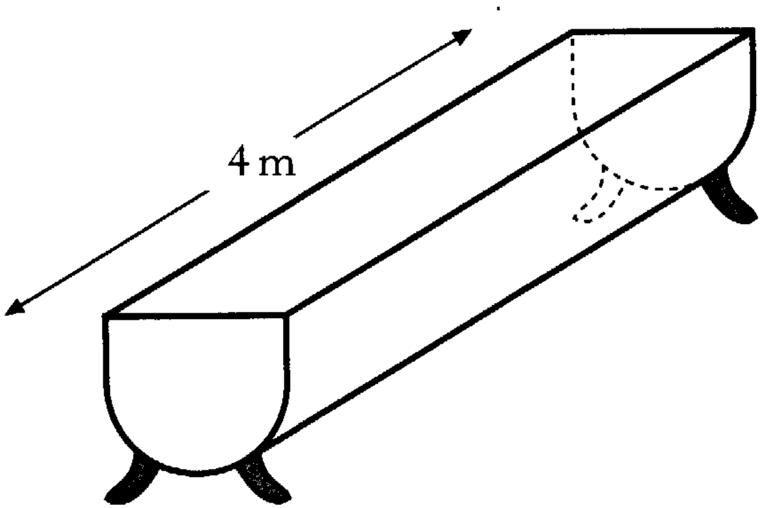
$$\sin 40^o = \frac{h}{296.9}$$

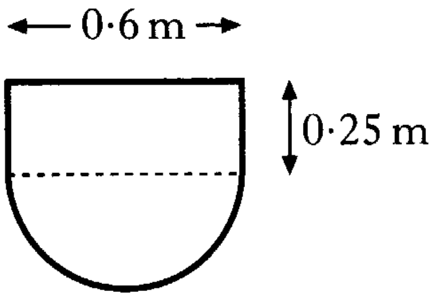
$$h = 296.9 \sin 40^o$$

$$\underline{\underline{h = 190.8km}}$$

5. A feeding trough, 4 metres long, is prism-shaped.

The uniform cross-section is made up of a rectangle and semi-circle as shown below.





Find the volume of the trough, **correct to 2 significant figures**.

5

F

Solution

Main Grid

Q5 $\text{Volume} = \text{end area} \times \text{length}$

$$A_{RECTANGLE} = 0.6 \times 0.25 = \underline{0.15m^2}$$

$$A_{SEMI-CIRCLE} = 0.5\pi r^2 = 0.5 \times 3.14 \times 0.3 \times 0.3$$

$$= \underline{0.1413m^2}$$

$$A_{TOTAL} = 0.15 + 0.1413 = \underline{0.2913m^2}$$

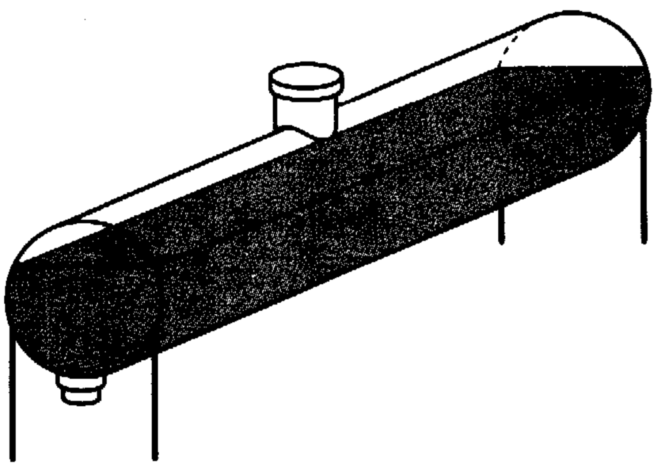
$$Volume = 0.2913 \times 4 = 1.1652 = \underline{\underline{1.2m^3}}$$

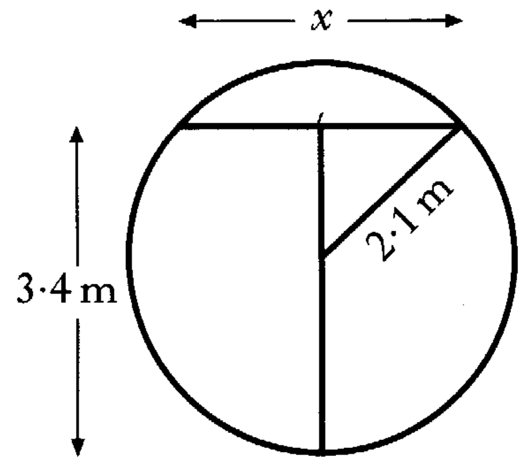
Main Grid

KU	RE

6. An oil tank has a circular cross-section of radius 2·1 metres.

It is filled to a depth of 3·4 metres.





(*a*) Calculate x, the width in metres of the oil surface. **3** (KU)

(*b*) What other depth of oil would give the same surface width? **1** (RE)

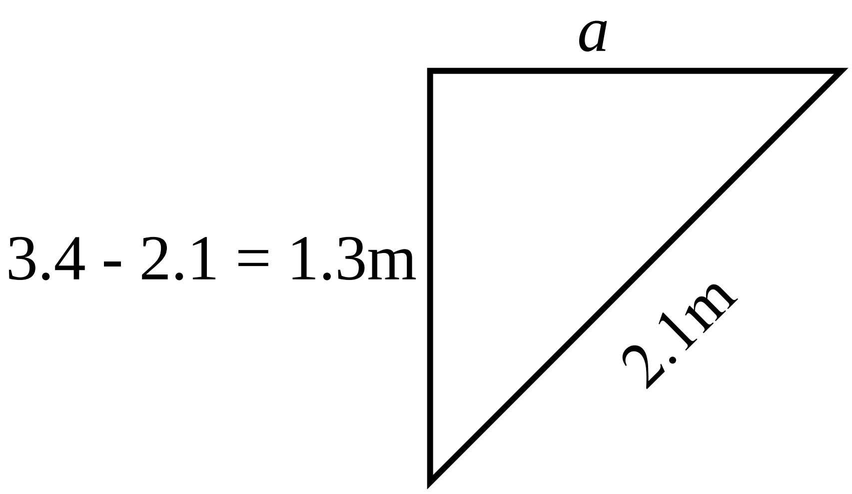
F

Solution

Main Grid

Q6

$x = 2a$



Using Pythagoras

$$a = \sqrt{2.1^2 - 1.3^2} = \sqrt{2.72} = 1.65m$$

$$x = 2 \times 1.65 = \underline{\underline{3.3m}}$$

$$2.1 - 1.3 = \underline{\underline{0.8m}}$$

Main Grid

7. A coffee shop blends its own coffee and sells it in one-kilogram tins.

One blend consists of two kinds of coffee, Brazilian and Colombian, in the ratio 2 : 3.

The shop has 20 kilograms of Brazilian and 25 kilograms of Colombian in stock.

What is the **maximum** number of one-kilogram tins of this blend which can be made? **3**

F

Solution

Main Grid

Q7

One tin contains 400g of Brazilian and 600g of Colombian.

$$20000 \div 400 = 50$$

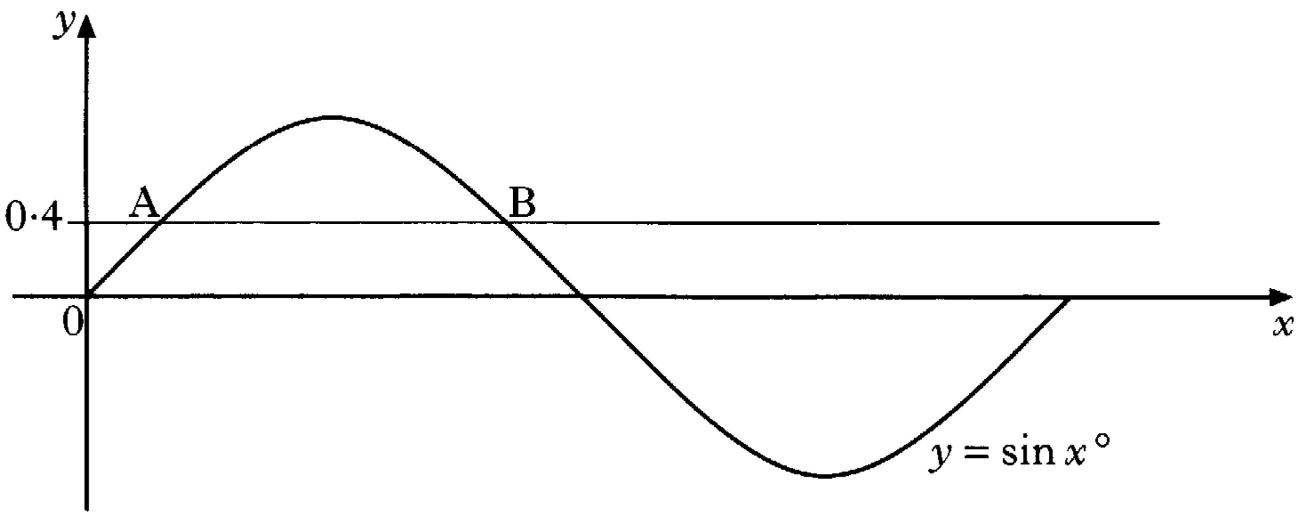
$$25000 \div 600 = 41.67$$

Therefore, 41 one-kilogram tins can be produced.

Main Grid

KU	RE
	3

8. The diagram shows part of the graph of $y = \sin x°$.



The line $y = 0{\cdot}4$ is drawn and cuts the graph of $y = \sin x°$ at A and B.

Find the x-coordinates of A and B.

F

Solution

Main Grid

Q8

$$\sin x^o = 0.4$$

$$x^o = \sin^{-1}(0.4)$$

$$x^o = \underline{23.6^o} \quad \text{and} \quad 180 - 23.6 = \underline{156.4^o}$$

$$\underline{\underline{A(23.6^o, 0.4)}} \qquad \underline{\underline{B(156.4^o, 0.4)}}$$

Main Grid

9. Esther has a new mobile phone and considers the following daily rates.

Easy Call	**Green Call**
25 pence per minute for the first 3 minutes 5 pence per minute **after** the first three minutes	40 pence per minute for the first 2 minutes 2 pence per minute **after** the first two minutes

(*a*) For Easy Call, find the cost of ten minutes in a day. **1**

(*b*) For Easy Call, find a formula for the cost of "m" minutes in a day, $m > 3$. **1**

(*c*) For Green Call, find a formula for the cost of "m" minutes in a day, $m > 2$. **1**

(*d*) Green Call claims that its system is cheaper.

Find **algebraically** the least number of minutes (to the nearest minute) which must be used each day for this claim to be true. **3**

F

Solution **Main Grid**

Q9

$$a)\quad (25\times 3)+(5\times 7)=\underline{\underline{110\,p}}$$

$$b)\quad c=75+5(m-3)$$

$$c)\quad c=80+2(m-2)$$

$$d)\quad c=75+5m-15 \qquad c=80+2m-4$$

$$c=60+5m \qquad c=76+2m$$

$$60+5m=76+2m$$

$$3m=16$$

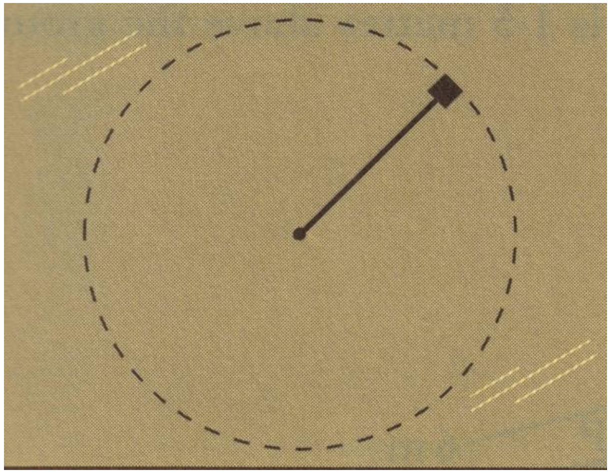
$$m=5.33$$

Therefore, $\underline{\underline{\text{6 minutes}}}$

Main Grid

	KU	RE

10. A weight on the end of a string is spun in a circle on a smooth table.



The tension, T, in the string varies directly as the square of the speed, v, and inversely as the radius, r, of the circle.

(*a*) Write down a formula for T in terms of v and r. **1**

(*b*) The speed of the weight is multiplied by 3 and the radius of the string is halved.

What happens to the tension in the string? **2**

F

Solution

Main Grid

Q10

$$T \alpha \frac{v^2}{r} \qquad T = \frac{kv^2}{r}$$

$$\text{Multiply by } 3^2 \text{ and divide by } 0.5$$

$$9 \div 0.5 = 18$$

$$\text{Tension is multiplied by } 18.$$

Main Grid

11. (*a*) **Solve** the equation

$$2^n = 32.$$ 1

(*b*) A sequence of numbers can be grouped and added together as shown.

The sum of 2 numbers: $(1 + 2) = 4 - 1$
The sum of 3 numbers: $(1 + 2 + 4) = 8 - 1$
The sum of 4 numbers: $(1 + 2 + 4 + 8) = 16 - 1$

Find a **similar** expression for the sum of 5 numbers. 1

(*c*) Find a formula for the sum of the first n numbers of this sequence. 2

F

Solution

Main Grid

Q11

$$2^5 = 32 \qquad (2\times 2\times 2\times 2\times 2 = 32)$$

$$\underline{\underline{n = 5}}$$

$$(1+2+4+8+16) = 32-1$$

$$2^n - 1$$

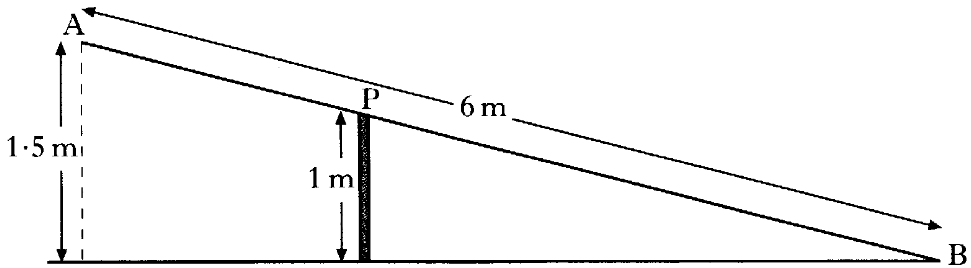
Main Grid

12. A metal beam, AB, is 6 metres long.

It is hinged at the top, P, of a vertical post 1 metre high.

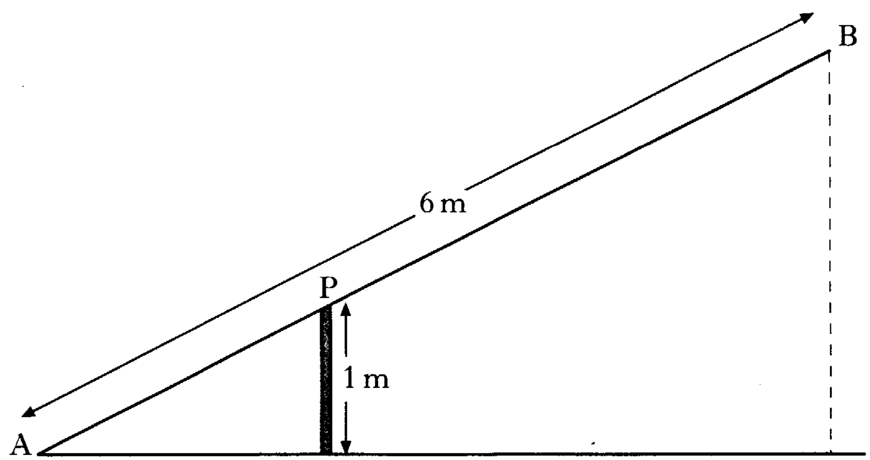
When B touches the ground, A is 1·5 metres above the ground, as shown in Figure 1.

Figure 1



When A comes down to the ground, B rises, as shown in Figure 2.

Figure 2



By calculating the length of AP, or otherwise, find the height of B above the ground.

Do not use a scale drawing.

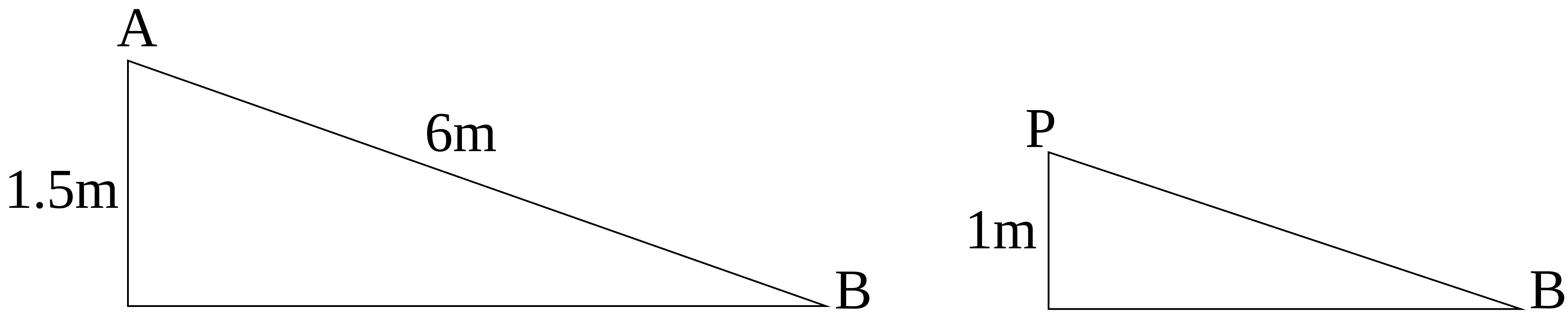
KU	RE
	5

F

Solution

Main Grid

Q12 Similar triangles.



$$\frac{PB}{6}=\frac{1}{1.5} \quad \text{so} \quad PB=\frac{6\times 1}{1.5}=\underline{4m} \qquad AP=6-4=\underline{2m}$$

Using similar triangles again.

$$\frac{B_{height}}{1}=\frac{6}{2}$$

$$B_{height}=\frac{6\times 1}{2}=\underline{\underline{3m}}$$

Main Grid

KU	RE
2	

1. Evaluate

$$5{\cdot}04 + 8{\cdot}4 \div 7.$$

F

Solution

Main Grid

Q1 BODMAS

$$5.04 + 1.2$$

$$\underline{6.24}$$

$$7\overline{)8.{}^{1}4}$$
$$1.2$$

Main Grid

2. **Evaluate**

$$\frac{2}{7}\left(1\frac{3}{4}+\frac{3}{8}\right).$$

2

F

Solution

Main Grid

Q2

$$\frac{2}{7}\left(1\frac{3}{4}+\frac{3}{8}\right)$$

$$=\frac{2}{7}\left(\frac{7}{4}+\frac{3}{8}\right)$$

$$=\frac{14}{28}+\frac{6}{56}$$

$$=\frac{28}{56}+\frac{6}{56}=\frac{34}{56}=\underline{\underline{\frac{17}{28}}}$$

Main Grid

3. Simplify

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

3

F

Solution

Main Grid

Q3

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

$$=6x-12-12x-4$$

$$=\underline{\underline{-6x-16}}$$

Main Grid

4.

$$f(x) = 7 - 4x$$

(*a*) Evaluate $f(-2)$. 1

(*b*) Given that $f(t) = 9$, find t. 2

F

Solution

Main Grid

Q4

$$f(x) = 7 - 4x$$

$$f(-2) = 7 - (4 \times -2)$$

$$f(-2) = 7 - (-8)$$

$$f(-2) = \underline{\underline{15}}$$

$$f(t) = 7 - 4t = 9$$

$$4t = 7 - 9$$

$$4t = -2$$

$$t = \underline{\underline{-\frac{1}{2}}}$$

Main Grid

5. Factorise

$$2x^2 - 7x - 15.$$ **2**

F

Solution

Main Grid

Q5

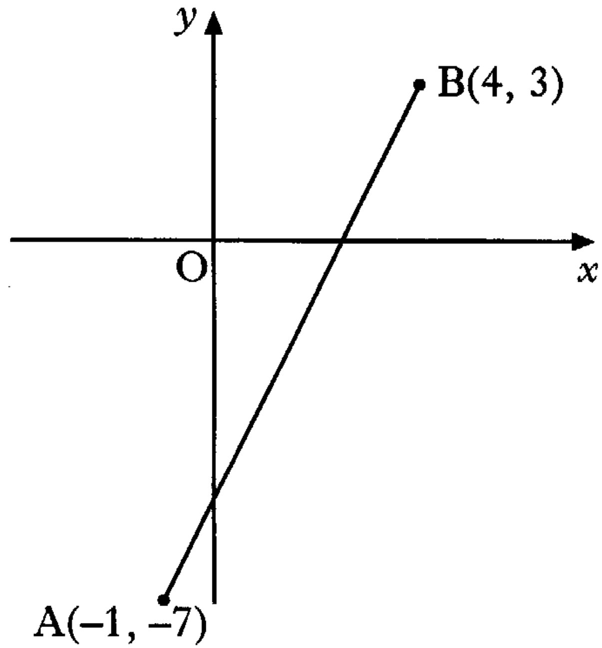
$$2x^2 - 7x - 15$$

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

Main Grid

KU	RE

6. In the diagram below, A is the point (–1, –7) and B is the point (4, 3).



(*a*) Find the gradient of the line AB. **1**

(*b*) AB cuts the *y*-axis at the point (0, –5).

Write down the equation of the line AB. **1**

(*c*) The point ($3k$, k) lies on AB.

Find the value of k. **2**

F

Solution

Main Grid

Q6

$$M_{AB} = \frac{3 - -7}{4 - -1} = \frac{10}{5} = \underline{\underline{2}}$$

$$\underline{\underline{y = 2x - 5}}$$

$$k = 2 \times 3k - 5$$

$$k = 6k - 5$$

$$k - 6k = -5$$

$$-5k = -5$$

$$\underline{\underline{k = 1}}$$

Main Grid

7. Andrew and Doreen each book in at the Sleepwell Lodge.

(*a*) Andrew stays for 3 nights and has breakfast on 2 mornings.

His bill is £145.

Write down an algebraic equation to illustrate this. **1**

(*b*) Doreen stays for 5 nights and has breakfast on 3 mornings.

Her bill is £240.

Write down an algebraic equation to illustrate this. **1**

(*c*) Find the cost of one breakfast. **3**

F

Solution

Main Grid

Q7

$$3n + 2b = 145$$

$$\underline{5n + 3b = 240}$$

$$15n + 10b = 725$$

$$\underline{15n + 9b = 720}$$

$$b = 5$$

Cost of one breakfast is £5

Main Grid

KU	RE
1	
1	

8. A mini lottery game uses **red**, **green**, **blue** and **yellow** balls.

There are 10 of **each** colour, numbered from 1 to 10.

The balls are placed in a drum and one is drawn out.

(*a*) What is the probability that it is a **6**?

(*b*) What is the probability that it is a **yellow 6**?

F

Solution

Main Grid

Q8

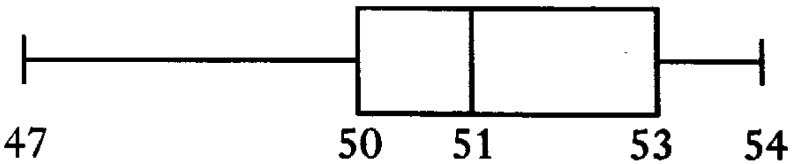
$$\frac{4}{40} = \frac{1}{10}$$

$$\frac{1}{40}$$

Main Grid

9. A random check is carried out on the contents of a number of matchboxes.

A summary of the results is shown in the boxplot below.



What percentage of matchboxes contains fewer than 50 matches? **1**

F

Solution

Main Grid

Q9

25% of matchboxes contain fewer than 50 matches.

50 is the lower quartile and every quartile contains 25% of the sample.

Main Grid

10. School theatre visits are arranged for parents, teachers and pupils.

The ratio of parents to teachers to pupils **must** be 1 : 3 : 15.

(*a*) 45 pupils want to go to the theatre.

How many teachers must accompany them? **1**

(*b*) The theatre gives the school 100 tickets for a play.

What is the maximum number of pupils who can go to the play? **3**

F

Solution

Main Grid

Q10

$3 : 9 : 45$ 9 teachers

$5 : 15 : 75$ 75 pupils

Main Grid

KU	RE
	1
	2
	2

11. Using the sequence

$$1, \quad 3, \quad 5, \quad 7, \quad 9, \ldots .$$

(*a*) Find S_3, the sum of the first 3 numbers.

(*b*) Find S_n, the sum of the first n numbers.

(*c*) Hence or otherwise, find the $(n + 1)^{th}$ term of the sequence.

F

Solution

Main Grid

Q11

$$\underline{\underline{9}}$$

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

$$(n+1)^2 - n^2$$

$$n^2 + 2n + 1 - n^2$$

$$\underline{\underline{2n+1}}$$

Main Grid

12. (*a*) Evaluate

$$8^{\frac{2}{3}}.$$

2

(*b*) Simplify

$$\frac{\sqrt{24}}{\sqrt{2}}.$$

2

F

Solution

Main Grid

Q12

$$8^{\frac{2}{3}} = \sqrt[3]{8^2} = \sqrt[3]{64} = \underline{\underline{4}}$$

$$\frac{\sqrt{24}}{\sqrt{2}} = \frac{\sqrt{2}\sqrt{12}}{\sqrt{2}} = \sqrt{12}$$

$$\sqrt{12} = \sqrt{4}\sqrt{3} = \underline{\underline{2\sqrt{3}}}$$

Main Grid

KU	RE

13. A rectangular clipboard has a triangular plastic pocket attached as shown in Figure 1.

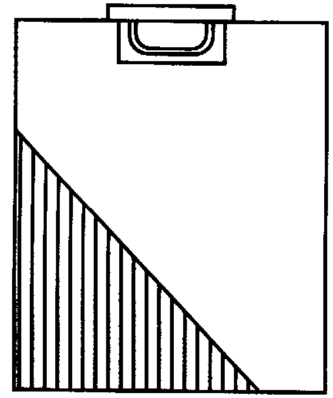


Figure 1

The pocket is attached along edges TD and DB as shown in Figure 2.

B is x centimetres from the corner C.

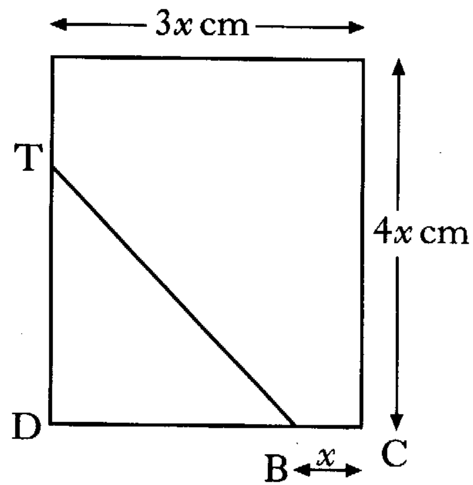


Figure 2

The length of the clipboard is $4x$ centimetres and the breadth is $3x$ centimetres.

The area of the pocket is a quarter of the area of the clipboard.

Find, in terms of x, the length of TD.

F

Solution

Main Grid

4

Q13

$$\mathrm{A}_{\mathrm{CLIPBAOARD}} = 3x \times 4x = \underline{12x^2}$$

$$\mathrm{A}_{\mathrm{POCKET}} = \frac{1}{4} \times 12x^2 = \underline{3x^2}$$

$$\frac{1}{2} \times TD \times DB = 3x^2$$

$$TD = \frac{6x^2}{DB}$$

$$DB = 3x - x = \underline{2x}$$

$$TD = \frac{6x^2}{2x} = \underline{\underline{3x}}$$

Main Grid

KU	RE
4	

1. Bacteria in a test-tube increase at the rate of 0·6% per hour.

At 12 noon, there are 5000 bacteria.

At 3pm, how many bacteria will be present?

Give your answer **to 3 significant figures**.

F

Solution

Main Grid

Q1

$$5000 \times (1.006)^3 = 5090.54 = \underline{\underline{5090}}$$

Main Grid

2. Fiona checks out the price of a litre of milk in several shops.

The prices in pence are:

49 44 41 52 47 43.

(*a*) Find the mean price of a litre of milk. **1**

(*b*) Find the standard deviation of the prices. **2**

(*c*) Fiona also checks out the price of a kilogram of sugar in the same shops and finds that the standard deviation of the prices is 2·6.

Make one valid comparison between the two sets of prices. **1**

F

Solution

Main Grid

Q2

x	x^2
41	1681
43	1849
44	1936
47	2209
49	2401
52	2704
276	12780

$$mean = \frac{276}{6} = \underline{\underline{46}}$$

$$s = \sqrt{\frac{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}{n-1}} = \sqrt{\frac{12780 - \frac{(276)^2}{6}}{6-1}}$$

$$s = \sqrt{\frac{12780 - 12696}{5}}$$

$$s = \sqrt{16.8} = \underline{\underline{4.1}}$$

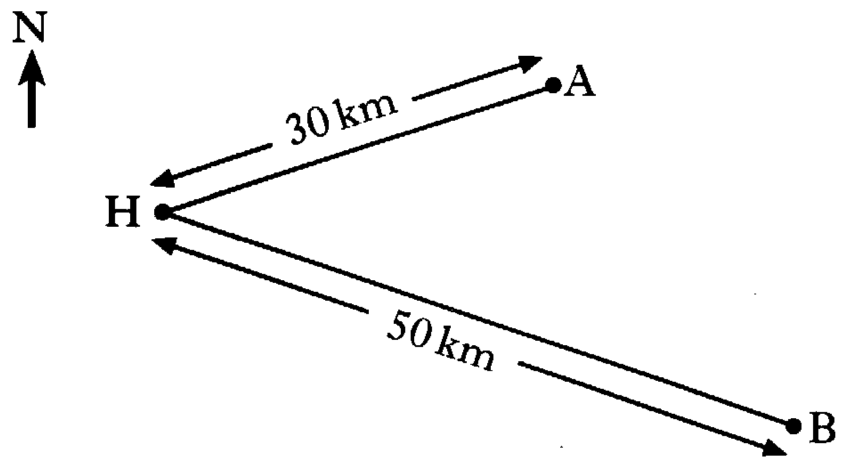
There is more variation in the price of milk than there is in the price of sugar.

Main Grid

3. Two yachts leave from harbour H.

Yacht A sails on a bearing of 072° for 30 kilometres and stops.

Yacht B sails on a bearing of 140° for 50 kilometres and stops.



How far apart are the two yachts when they have both stopped?

Do not use a scale drawing. 4

F

Solution

Main Grid

Q3

$$\text{Angle H} = 140 - 72 = \underline{68^o}$$

$$h^2 = a^2 + b^2 - 2ab\cos H$$

$$h^2 = 50^2 + 30^2 - 2 \times 50 \times 30 \times \cos 68^o$$

$$h^2 = 2500 + 900 - 1123.8$$

$$h^2 = 2276.2$$

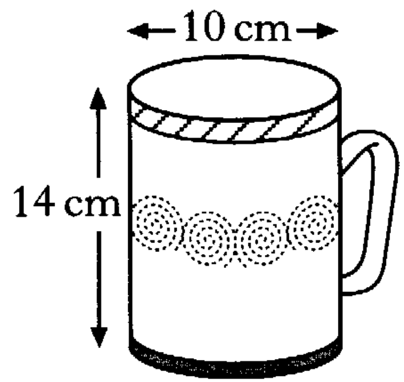
$$h = \sqrt{2276.2}$$

$$h = \underline{\underline{47.7km}}$$

Main Grid

KU	RE
2	
	3

4. A mug is in the shape of a cylinder with diameter 10 centimetres and height 14 centimetres.



(*a*) Calculate the volume of the mug. **2**

(*b*) 600 millilitres of coffee are poured in.

Calculate the depth of the coffee in the cup. **3**

F

Solution

Main Grid

Q4

$$V = \pi r^2 h = 3.14 \times 5 \times 5 \times 14 = \underline{\underline{1099 cm^3}}$$

$$600 ml = 600 cm^3$$

$$V = \pi r^2 h = 600$$

$$h = \frac{600}{\pi r^2} = \frac{600}{3.14 \times 5 \times 5} = \frac{600}{78.5} = \underline{\underline{7.6 cm}}$$

Main Grid

5. The number of diagonals, d, in a polygon with n sides is given by the formula

$$d = \frac{n(n-3)}{2}.$$

A polygon has 20 diagonals.

How many sides does it have? 4

F

Solution

Main Grid

Q5

$$20 = \frac{n(n-3)}{2}$$

$$40 = n(n-3)$$

$$40 = n^2 - 3n$$

$$n^2 - 3n - 40 = 0$$

$$(n-8)(n+5) = 0$$

$$n = 8 \quad \text{or} \quad n = -5$$

$$\underline{\underline{\text{The Polygon has 8 sides.}}}$$

Main Grid

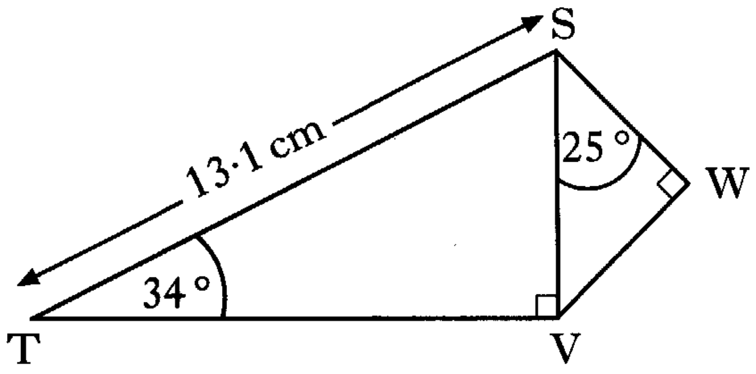
6. In the diagram,

Angle STV = 34 °

Angle VSW = 25 °

Angle SVT = Angle SWV = 90 °

ST = 13·1 centimetres.



Calculate the length of SW.

4

F

Solution

Main Grid

Q6 SOH CAH TOA

$$\sin 34^o = \frac{SV}{13.1}$$

$$SV = 13.1 \times \sin 34^o$$

$$\underline{SV = 7.33cm}$$

$$\cos 25^o = \frac{SW}{7.33}$$

$$SW = 7.33 \times \cos 25^o$$

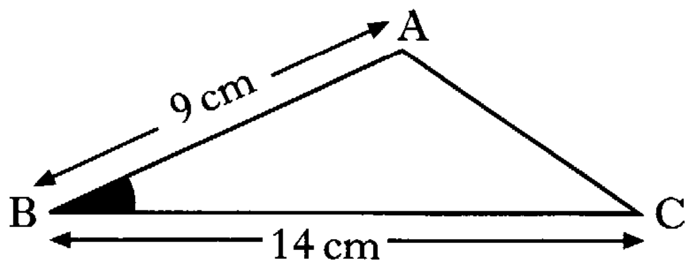
$$\underline{\underline{SW = 6.65cm}}$$

Main Grid

KU	RE
	3

7. The area of triangle ABC is 38 square centimetres.

AB is 9 centimetres and BC is 14 centimetres.



Calculate the size of the acute angle ABC.

F

Solution

Main Grid

Q7

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

$$38 = 0.5 \times 14 \times 9 \times \sin B$$

$$38 = 63 \times \sin B$$

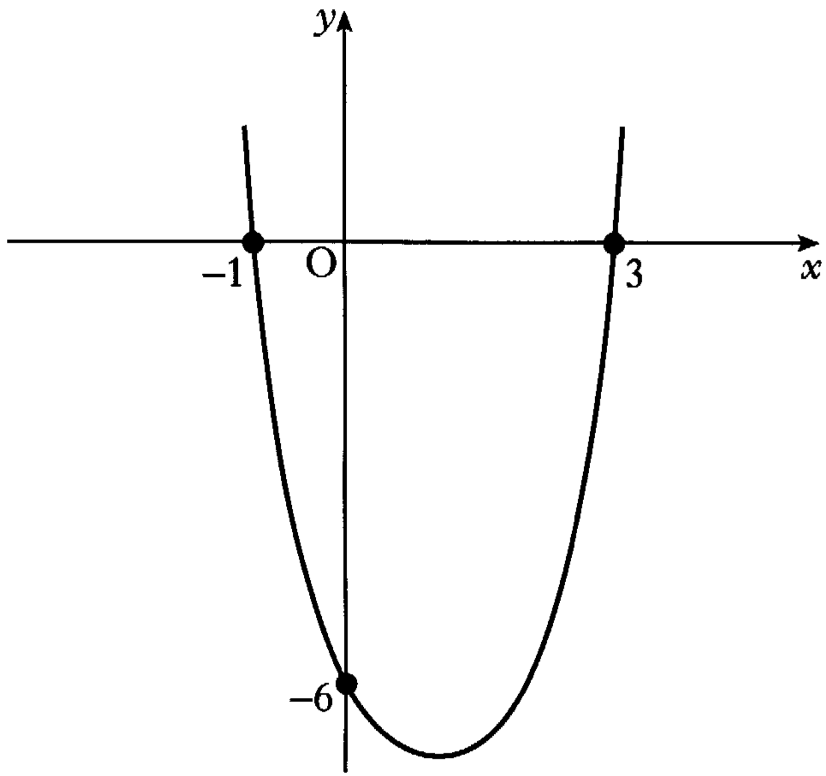
$$\sin B = \frac{38}{63} = 0.603$$

$$B = \sin^{-1}(0.603) = \underline{\underline{37.1^o}}$$

Main Grid

8. The diagram below shows part of the graph of a quadratic function, with equation of the form $y = k(x - a)(x - b)$.

The graph cuts the y-axis at $(0, -6)$ and the x-axis at $(-1, 0)$ and $(3, 0)$.



F

Solution

Main Grid

(*a*) Write down the values of a and b. 2

(*b*) Calculate the value of k. 2

(*c*) Find the coordinates of the minimum turning point of the function. 2

Q8 $a = -1 \quad \text{and} \quad b = 3$

$$y = k(x+1)(x-3)$$

$$-6 = k(0+1)(0-3) \qquad \text{at } (0,-6)$$

$$-6 = -3k$$

$$\underline{\underline{k = 2}}$$

$$\text{By symmetry T.P. at } x = 1$$

$$y = 2(x+1)(x-3)$$

$$y = 2(1+1)(1-3)$$

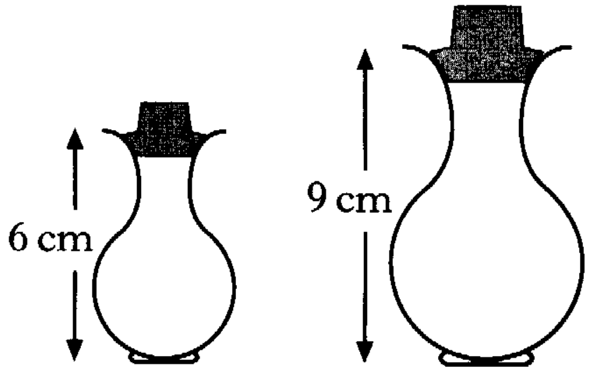
$$y = 2(2)(-2) = -8$$

$$\underline{\underline{\text{Turning Point at } (1,-8)}}$$

Main Grid

KU	RE
3	

9. Two perfume bottles are mathematically similar in shape.



The smaller one is 6 centimetres high and holds 30 millilitres of perfume.

The larger one is 9 centimetres high.

What volume of perfume will the larger one hold?

F

Solution

Main Grid

Q9

$$\text{For Height} \qquad 2:3$$

$$\text{For Volume} \qquad 2^3 : 3^3$$

$$8:27$$

$$\text{Scale Factor} = \frac{27}{8} = 3.375$$

$$\text{Large Volume} = 30 \times 3.375 = \underline{\underline{101.25ml}}$$

Main Grid

10. A sheep shelter is part of a cylinder as shown in Figure 1.

It is 6 metres wide and 2 metres high.

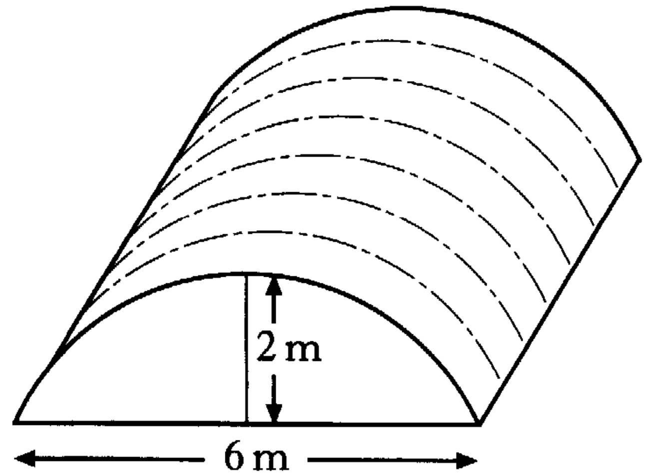


Figure 1

The cross-section of the shelter is a segment of a circle with centre O, as shown in Figure 2.

OB is the radius of the circle.

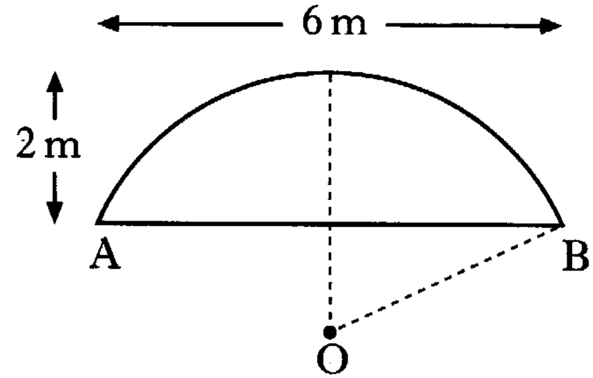


Figure 2

Calculate the length of OB.

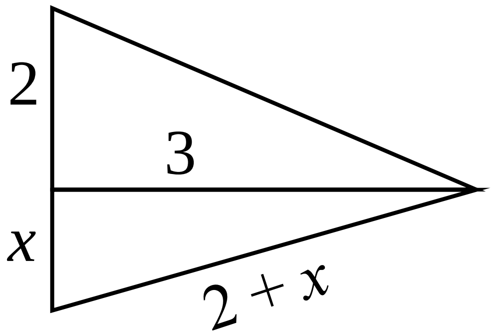
F

Solution

Main Grid

4

Q10



Using Pythagoras

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

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

$$4x = 5$$

$$\underline{x = \frac{5}{4}}$$

$$\text{So OB} = 2 + x = 2 + \frac{5}{4} = \underline{\underline{3\frac{1}{4}m}}$$

Main Grid

KU	RE
1	
	4

11. (*a*) A driver travels from A to B, a distance of x miles, at a constant speed of 75 kilometres per hour.

Find the time taken for this journey in terms of x.

(*b*) The time for the journey from B to A is $\frac{x}{50}$ hours.

Hence calculate the driver's average speed for the whole journey.

F

Solution

Main Grid

Q11 $$T = \frac{D}{S} = \underline{\underline{\frac{x}{75}}}$$

$$\text{Total Distance} = 2x$$

$$\text{Total Time} = \frac{x}{75} + \frac{x}{50} = \frac{2x + 3x}{150} = \frac{5x}{150} = \frac{x}{30}$$

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$$\text{Average Speed} = 2x \div \frac{x}{30}$$

$$\text{Average Speed} = 2x \times \frac{30}{x} = \underline{\underline{60mph}}$$

Main Grid

KU	RE
2	

1. Evaluate

$$6 \cdot 2 - (4 \cdot 53 - 1 \cdot 1).$$

F

Solution

Main Grid

Q1 BODMAS

$$4.53 - 1.1 = 3.43$$

$$6.2 - 3.43 = \underline{\underline{2.77}}$$

Main Grid

2. Evaluate $\frac{2}{5}$ of $3\frac{1}{2} + \frac{4}{5}$.

3	

F

Solution

Main Grid

Q2 BODMAS

$$\frac{2}{5} \text{ of } 3\frac{1}{2} = \frac{2}{5} \times \frac{7}{2} = \frac{14}{10}$$

$$\frac{14}{10} + \frac{4}{5} = \frac{14+8}{10} = \frac{22}{10} = 2\frac{2}{10} = \underline{\underline{2\frac{1}{5}}}$$

Main Grid

3. $A = 2x^2 - y^2$.

Calculate the value of A when $x = 3$ and $y = -4$.

2

F

Solution

Main Grid

Q3

$$A = \left(2 \times 3^2\right) - \left(-4^2\right)$$

$$A = 18 - 16$$

$$\underline{\underline{A = 2}}$$

Main Grid

4. Simplify $$\frac{3}{m}+\frac{4}{(m+1)}.$$

3	

F

Solution

Main Grid

Q4

$$\frac{3}{m}+\frac{4}{(m+1)}$$

$$=\frac{3(m+1)+4m}{m(m+1)}$$

$$=\frac{3m+3+4m}{m(m+1)}$$

$$=\underline{\underline{\frac{7m+3}{m(m+1)}}}$$

Main Grid

5. The average monthly temperature in a holiday resort was recorded in degrees Celsius (°C).

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Average Temperature (°C)	1	8	8	10	15	22	23	24	20	14	9	4

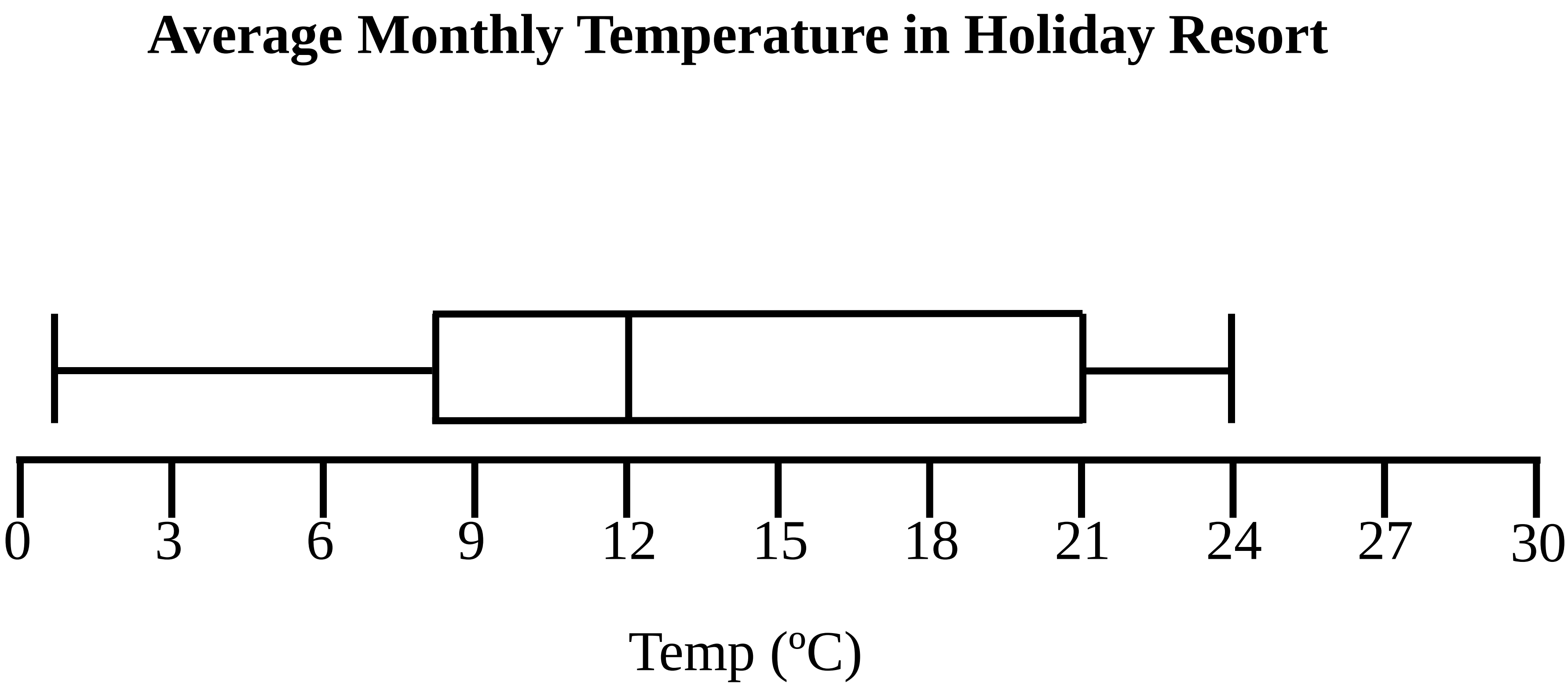
Draw a suitable statistical diagram to illustrate the median and the quartiles of this data. **4**

F

Solution

Main Grid

Q5



Average Monthly Temperature in Holiday Resort
0
3
6
9
12
15
18
21
24
27
30
Temp (ºC)

Main Grid

KU	RE
3	

6. Marmalade is on special offer.

Each jar on special offer contains 12·5% more than the standard jar.

A jar on special offer contains 450 g of marmalade.

How much does the standard jar contain?

F

Solution

Main Grid

Q6

$$12.5\% \text{ is } \frac{1}{8} \text{ so jar is } 1\frac{1}{8} = \frac{9}{8}$$

$$\text{So}: \quad 450 \div \frac{9}{8} = 450 \times \frac{8}{9} = \underline{\underline{400g}}$$

Main Grid

7. John's school sells 1200 tickets for a raffle.

John buys 15 tickets.

John's church sells 1800 tickets for a raffle.

John buys 20 tickets.

In which raffle has he a better chance of winning the first prize?

Show clearly all your working. **3**

F

Solution

Main Grid

Q7

$$P(\text{win}) = \frac{15}{1200} = \frac{1}{80}$$

$$P(\text{win}) = \frac{20}{1800} = \frac{1}{90}$$

He has a better chance in the School raffle because $\frac{1}{80}$ is a better chance than $\frac{1}{90}$.

Main Grid

KU	RE

8. $7, \quad -2, \quad 5, \quad 3, \quad 8$

In the sequence above, each term after the first two terms is the sum of the previous two terms.

For example: 3rd term = $5 = 7 + (-2)$

(*a*) A sequence follows the above rule.

The first term is x and the second term is y.

The fifth term is 5.

$x, \quad y, \quad -, \quad -, \quad 5$

Show that $2x + 3y = 5$ **2**

(*b*) Using the same x and y, another sequence follows the above rule.

The first term is y and the second term is x.

The sixth term is 17.

$y, \quad x, \quad -, \quad -, \quad -, \quad 17.$

Write down another equation in x and y. **2**

(*c*) Find the values of x and y. **3**

F

Solution

Main Grid

Q8 $x, \quad y, \quad x+y, \quad y+x+y, \quad 5$

$$\text{So}: \; x+y+y+x+y=5$$

$$\underline{\underline{2x+3y=5}}$$

$$y, \quad x, \quad y+x, \quad x+y+x, \quad y+x+x+y+x, \quad 17$$

$$\text{So}: \; x+y+x+y+x+x+y+x=17$$

$$\underline{\underline{5x+3y=17}}$$

$$2x+3y=5$$

$$\underline{5x+3y=17}$$

$$3x=12$$

$$\underline{\underline{x=4}}$$

$$(2\times 4)+3y=5$$

$$8+3y=5$$

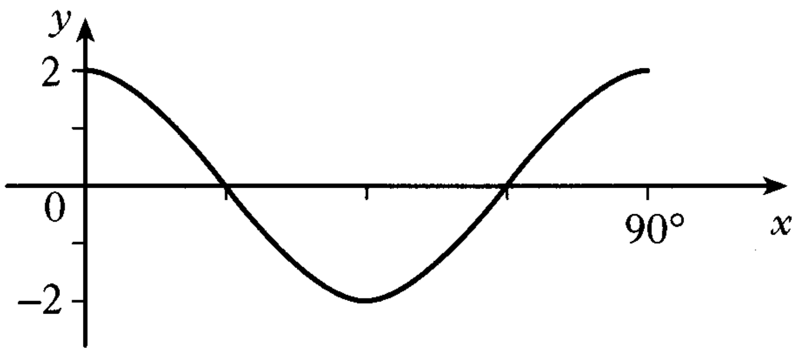
$$3y=-3$$

$$\underline{\underline{y=-1}}$$

$$\underline{\underline{\text{So} \;\; x=4 \;\; \text{and} \;\; y=-1}}$$

Main Grid

9. The graph of $y = a \cos bx°$, $0 \leq x \leq 90$, is shown below.



Write down the values of a and b. **2**

F

Solution

Main Grid

Q9

$a = 2$ because graph goes from 2 to -2.

$b = 4$ because there will be 4 complete curves in 360°.

Main Grid

KU	RE
	3

10. Two variables x and y are connected by the relationship $y = ax + b$.

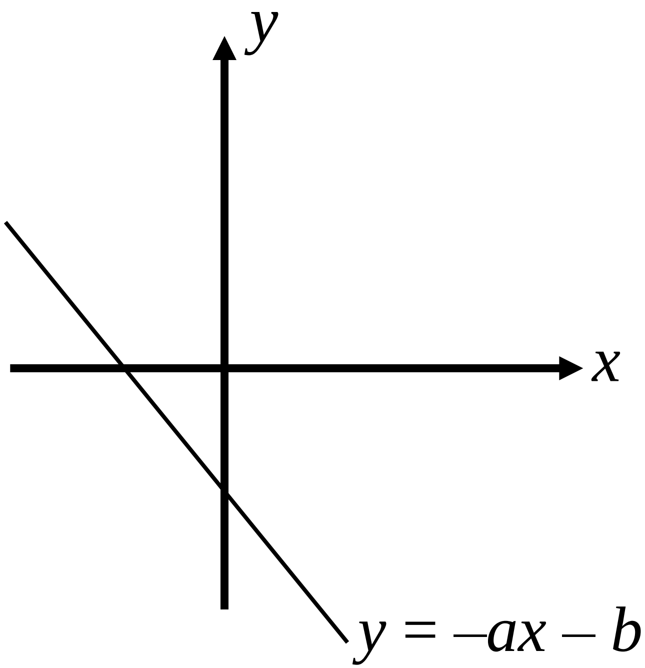
Sketch a possible graph of y against x to illustrate this relationship when a and b are each less than zero.

F

Solution

Main Grid

Q10



The line must have a negative gradient (going down).

The line must cut the *y*-axis below zero.

Main Grid

11. (*a*) Simplify $2\sqrt{75}$. **2**

(*b*) Evaluate $2^0 + 3^{-1}$. **2**

F

Solution

Main Grid

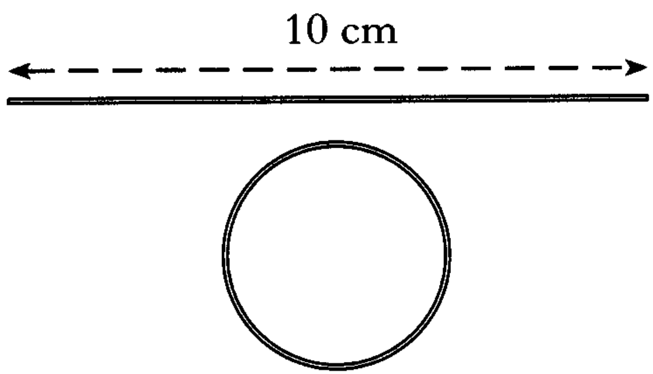
Q11

$$2\sqrt{75} = 2\sqrt{25}\sqrt{3} = 2\times5\sqrt{3} = \underline{\underline{10\sqrt{3}}}$$

$$2^0 + 3^{-1} = 1 + \frac{1}{3} = \underline{\underline{1\frac{1}{3}}}$$

Main Grid

12. A piece of gold wire 10 centimetres long is made into a circle.



The circumference of the circle is equal to the length of the wire.

Show that the area of the circle is **exactly** $\frac{25}{\pi}$ square centimetres.

4

F

Solution

Main Grid

Q12

$$C = \pi d$$

$$10 = \pi d$$

$$d = \frac{10}{\pi} \quad \text{so} \quad r = \frac{10}{\pi} \div 2 = \frac{5}{\pi}$$

$$A = \pi r^2 = \pi \times \frac{5}{\pi} \times \frac{5}{\pi} = \frac{25\pi}{\pi^2} = \underline{\underline{\frac{25}{\pi}}}$$

Main Grid

1. Radio signals travel at a speed of 3×10^8 metres per second.

A radio signal from Earth to a space probe takes 8 hours.

What is the distance from Earth to the probe?

Give your answer **in scientific notation**.

KU	RE
4	

F

Solution

Main Grid

Q1

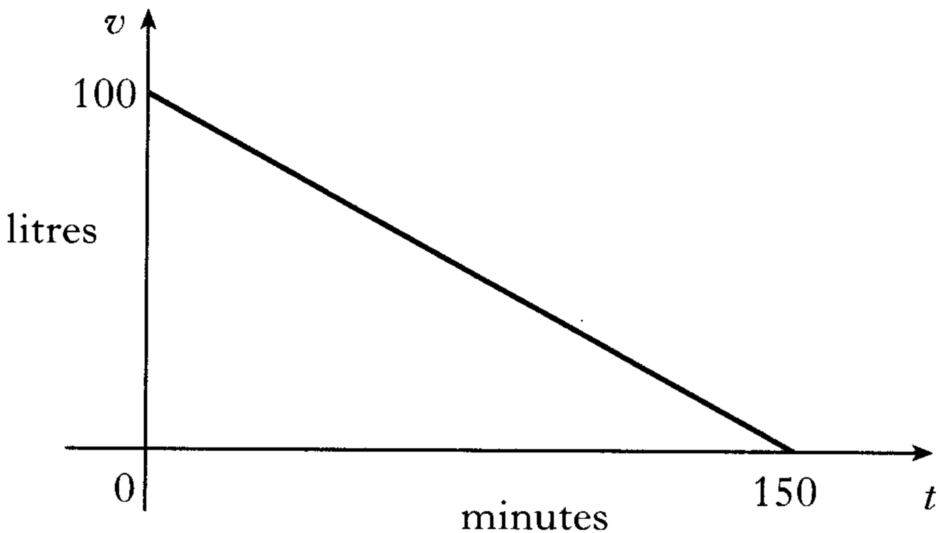
$$D = ST = 3\times10^{8}\times(8\times60\times60)$$

$$\underline{\underline{8.64\times10^{12}\,m}}$$

Main Grid

2. A tank which holds 100 litres of water has a leak.

After 150 minutes, there is no water left in the tank.



The above graph represents the volume of water (v litres) against time (t minutes).

(a) Find the equation of the line in terms of v and t. **3**

(b) How many minutes does it take for the container to lose 30 litres of water? **3**

F

Solution

Main Grid

Q2

$$v = Mt + c \qquad M = \frac{-100}{150} = -\frac{2}{3} \qquad c = 100$$

$$\underline{\underline{v = -\frac{2}{3}t + 100}}$$

The container loses 30litres therefore $v = 70$

$$70 = -\frac{2}{3}t + 100$$

$$\frac{2}{3}t = 30$$

$$t = 30 \div \frac{2}{3} = \underline{\underline{45\,mins}}$$

Main Grid

3. Bottles of juice should contain 50 millilitres.

The contents of 7 bottles are checked in a random sample.

The actual volumes in millilitres are as shown below.

52, 50, 51, 49, 52, 53, 50

Calculate the mean and standard deviation of the sample. **4**

F

Solution

Main Grid

Q3

x	x^2
49	2401
50	2500
50	2500
51	2601
52	2704
52	2704
53	2809
357	18219

$$mean = \frac{357}{7} = \underline{\underline{51}}$$

$$s = \sqrt{\frac{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}{n-1}} = \sqrt{\frac{18219 - \frac{(357)^2}{7}}{7-1}}$$

$$s = \sqrt{\frac{18219 - 18207}{6}}$$

$$s = \sqrt{2} = \underline{\underline{1.41}}$$

Main Grid

KU	RE
3	

4. 250 milligrams of a drug are given to a patient at 12 noon.

The amount of the drug in the bloodstream decreases by 20% every hour.

How many milligrams of the drug are in the bloodstream at 3pm?

F

Solution

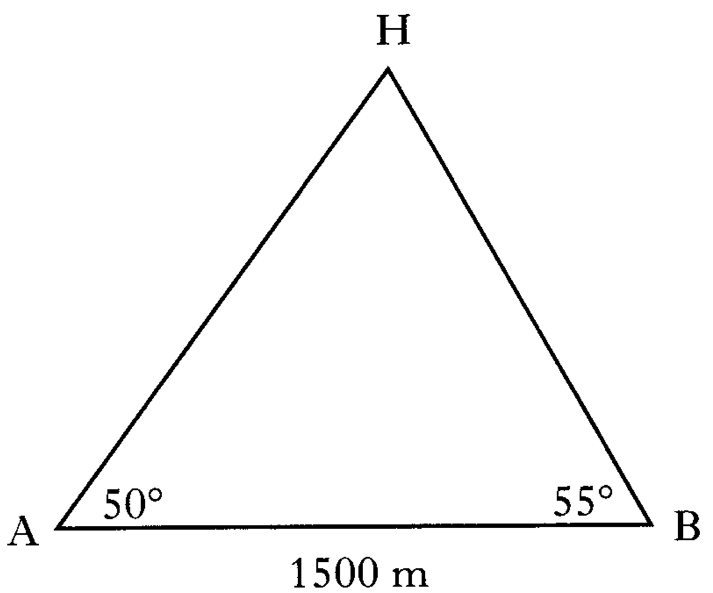
Main Grid

Q4

$$250 \times (0.8)^3 = \underline{\underline{128mg}}$$

Main Grid

5. A helicopter, at point H, hovers between two aircraft carriers at points A and B which are 1500 metres apart.



From carrier A, the angle of elevation of the helicopter is 50°.

From carrier B, the angle of elevation of the helicopter is 55°.

Calculate the distance from the helicopter to the nearer carrier. 4

F

Solution

Main Grid

Q5 Find side *a* because it is opposite the smaller angle and will therefore be the shortest distance.

$$\frac{a}{\sin A} = \frac{h}{\sin H}$$

$$a = \frac{h \sin A}{\sin H}$$

$$a = \frac{1500 \times \sin 50^o}{\sin 75^o}$$

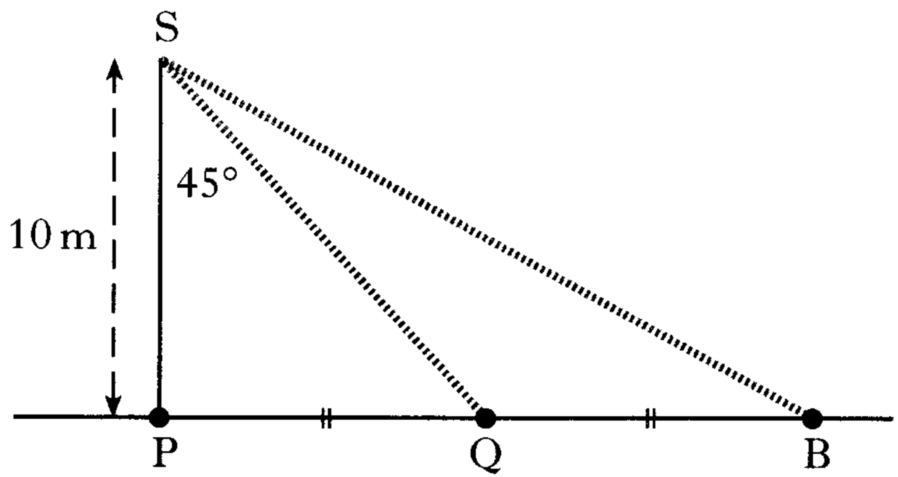
$$\underline{\underline{a = 1189.6m}}$$

Main Grid

KU	RE
	5

6. The diagram below shows a spotlight at point S, mounted 10 metres directly above a point P at the front edge of a stage.

The spotlight swings 45° from the vertical to illuminate another point Q, also at the front edge of the stage.



Through how many **more** degrees must the spotlight swing to illuminate a point B, where Q is the mid-point of PB?

F

Solution

Main Grid

Q6 SOH CAH TOA

$$\tan 45^o = \frac{PQ}{10}$$

So: $PB = 2PQ = \underline{20m}$

$$PQ = 10 \times \tan 45^o = \underline{10m}$$

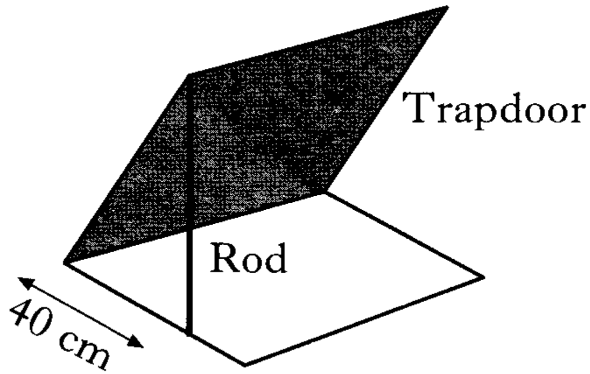
$$\tan S^o = \frac{PB}{PS} = \frac{20}{10} = 2$$

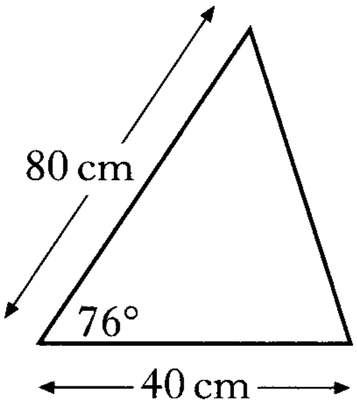
$$S^o = \tan^{-1}(2) = \underline{63.4^o}$$

$$\text{More degrees} = 63.4^o - 45^o = \underline{\underline{18.4^o}}$$

Main Grid

7. A square trapdoor of side 80 centimetres is held open by a rod as shown.





The rod is attached to a corner of the trapdoor and placed 40 centimetres along the edge of the opening.

The angle between the trapdoor and the opening is 76°.

Calculate the length of the rod to **2 significant figures**. 4

F

Solution

Main Grid

Q7

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

$$(\text{Rod length})^2 = 80^2 + 40^2 - \left(2 \times 80 \times 40 \times \cos 76^o\right)$$

$$= 6400 + 1600 - 1548.3$$

$$= 6451.7$$

$$\text{Rod length} = \sqrt{6451.7}$$

$$\text{Rod length} = 80.322 = \underline{\underline{80cm}}$$

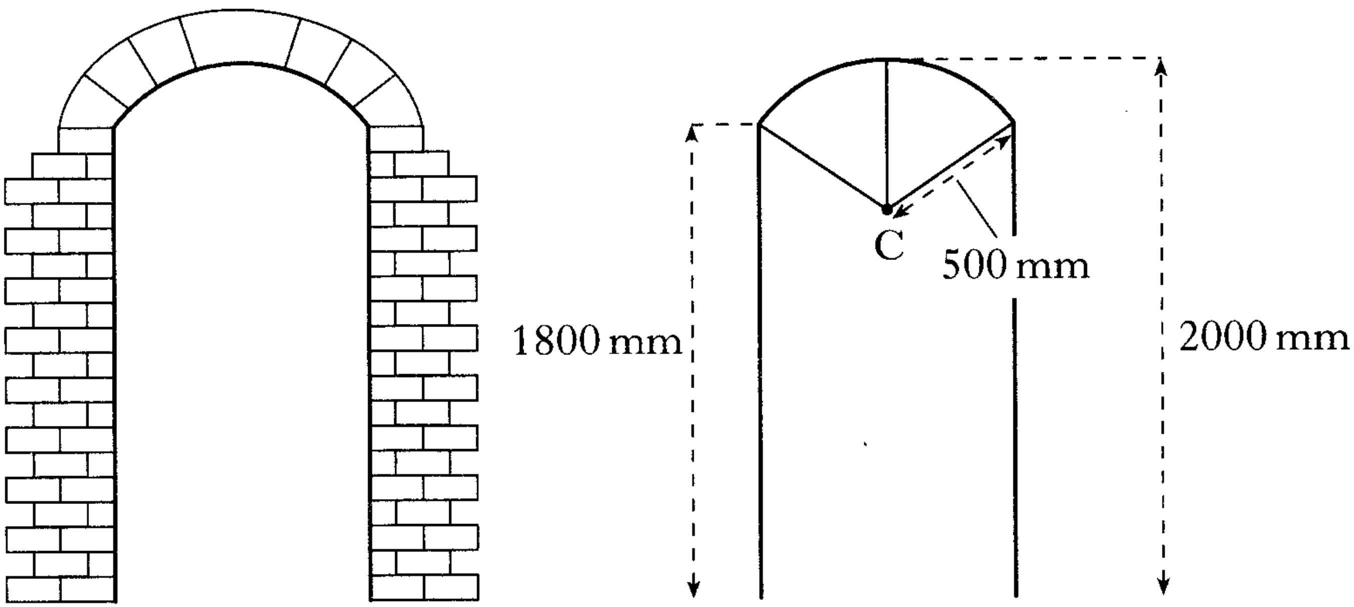
Main Grid

KU	RE
	5

8. The curved part of a doorway is an arc of a circle with radius 500 millimetres and centre C.

The height of the doorway to the top of the arc is 2000 millimetres.

The vertical edge of the doorway is 1800 millimetres.



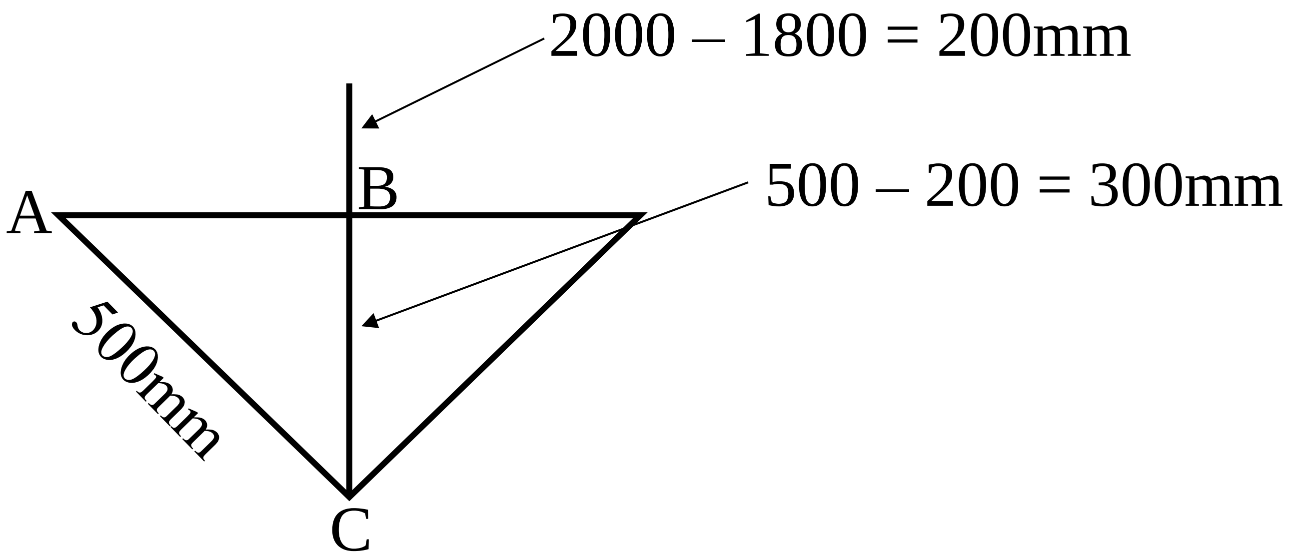
Calculate the width of the doorway.

F

Solution

Main Grid

Q8



Using Pythagoras

$$AB^2 = AC^2 - BC^2$$

$$AB^2 = 500^2 - 300^2$$

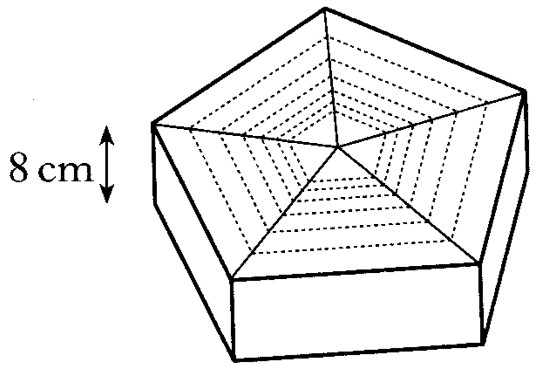
$$AB^2 = 160000$$

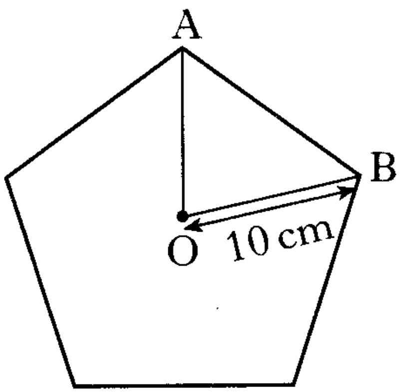
$$AB = \sqrt{160000} = \underline{400mm}$$

$$\text{Width of door} = 2 \times 400 = \underline{\underline{800mm}}$$

Main Grid

9. A gift box, 8 centimetres high, is prism shaped.





The uniform cross-section is a regular pentagon.

Each vertex of the pentagon is 10 centimetres from the centre O.

Calculate the volume of the box.

5

F

Solution

Main Grid

Q9

$$\text{Angle at centre} = 360 \div 5 = 72^o$$

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

$$= 0.5 \times 10 \times 10 \times \sin 72^o$$

$$= \underline{47.55cm^2}$$

$$\text{Total area} = 5 \times 47.55 = \underline{237.75cm^2}$$

$$\text{Volume} = \text{area} \times \text{depth}$$

$$\text{Volume} = 237.75 \times 8 = \underline{\underline{1902cm^3}}$$

Main Grid

10. Solve **algebraically** the equation

$$4 \sin x° + 1 = -2 \qquad 0 \le x < 360.$$

KU	RE
3	

F

Solution

Main Grid

Q10

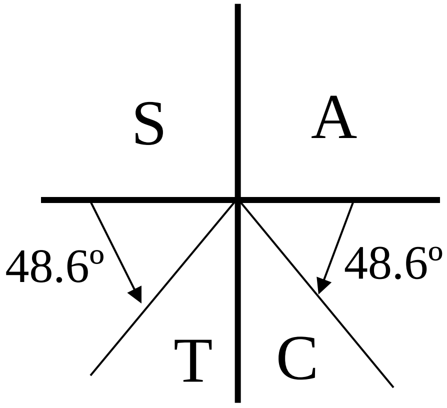
$$4\sin x^o + 1 = -2$$

$$4\sin x^o = -3$$

$$\sin x^o = -0.75$$

$$\text{Related angle} = \sin^{-1}(0.75) = \underline{48.6^o}$$

Sin is negative so solutions will be in 3rd and 4th quadrants.



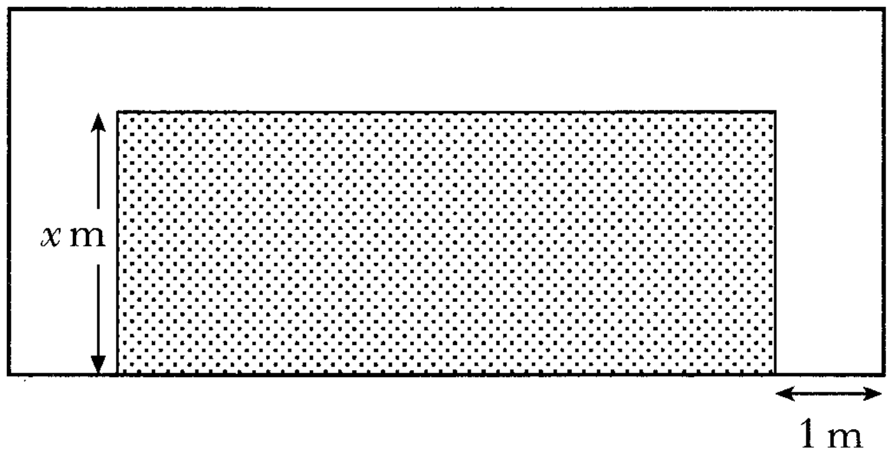
$$x^o = 180 + 48.6 = \underline{228.6^o}$$

$$x^o = 360 - 48.6 = \underline{311.4^o}$$

$$\underline{\underline{x^o = 228.6^o, 311.4^o}}$$

Main Grid

11. A rectangular lawn has a path, 1 metre wide, on 3 sides as shown.



The breadth of the lawn is x metres.

The length of the lawn is three times its breadth.

The area of the lawn equals the area of the path.

(*a*) Show that $3x^2 - 5x - 2 = 0$. **3**

(*b*) Hence find the **length** of the lawn. **4**

F

Solution

Main Grid

Q11

$$\text{Path}: (1\times x)+(1\times x)+(1\times 3x)+2(1\times 1)=5x+2$$

$$\text{Lawn}: x\times 3x=3x^2$$

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

$$\underline{\underline{3x^2-5x-2=0}}$$

$$3x^2-5x-2=0$$

$$(3x+1)(x-2)=0$$

$$x=\cancel{-\frac{1}{3}} \quad \text{or} \quad x=2$$

$$\text{Length of lawn}=3\times 2=\underline{\underline{6m}}$$

Main Grid

KU	RE
2	

1. Evaluate

$$3{\cdot}8 - (7{\cdot}36 \div 8).$$

F

Solution

Main Grid

Q1 BODMAS

$$3.8 - 0.92$$

$$\underline{2.88}$$

$$8 \overline{\smash{\big)}\, 7.3{}^{1}6}$$

0.92

Main Grid

2. Evaluate

$$2\frac{1}{3} + \frac{5}{6} \text{ of } 1\frac{2}{5}.$$

3

F

Solution

Main Grid

Q2 BODMAS

$$\frac{5}{6} \text{ of } 1\frac{2}{5} = \frac{5}{6} \times \frac{7}{5} = \frac{35}{30}$$

$$2\frac{1}{3} + \frac{35}{30} = \frac{7}{3} + \frac{35}{30} = \frac{70+35}{30} = \frac{105}{30}$$

$$= \frac{21}{6} = 3\frac{3}{6} = 3\frac{1}{2}$$

Main Grid

3. Evaluate

$$12\cdot5\% \text{ of } £140.$$

2

F

Solution

Main Grid

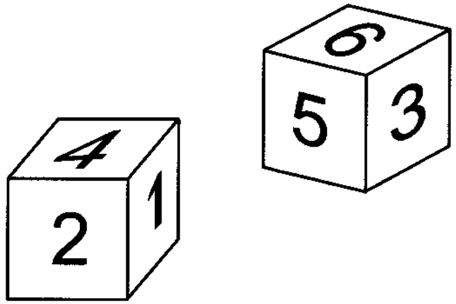
Q3

$10\% = 14$ so $2.5\% = 3.5$

$12.5\% = 14 + 3.5 = \underline{£17.50}$

Main Grid

4. Two identical dice are rolled simultaneously.



Find the probability that the total score on adding both numbers will be greater than 7 but less than 10.

2

F

Solution

Main Grid

Q4

Possible outcomes = 36

Possible ways of getting 8 or 9 = 9

$$\text{Probability} = \frac{9}{36} = \frac{1}{4}$$

Main Grid

KU	RE
3	

5. In an experiment involving two variables, the following values for x and y were recorded.

x	0	1	2	3	4
y	6	4	2	0	–2

The results were plotted, and a straight line was drawn through the points.

Find the gradient of the line **and** write down its equation.

F

Solution

Main Grid

Q5

$$M = \frac{-2-6}{4-0} = \frac{-8}{4} = -2$$

$$C = 6$$

$$y = Mx + C$$

$$\underline{y = -2x + 6}$$

Main Grid

6. Solve the equation

$$\frac{2}{x}+1=6.$$

3

F

Solution

Main Grid

Q6

$$\frac{2}{x}+1=6$$

$$\frac{2}{x}=5$$

$$2=5x$$

$$x=\frac{2}{5}$$

Main Grid

7. The speeds (measured to the nearest 10 kilometres per hour) of 200 vehicles are recorded as shown.

Speed (km/hr)	30	40	50	60	70	80	90	100	110
Frequency	1	4	9	14	38	47	51	32	4

Construct a cumulative frequency table and hence find the median for this data. **3**

F

Solution

Main Grid

Q7

Speed	Frequency	Cuml. Frq.
30	1	1
40	4	5
50	9	14
60	14	28
70	38	66
80	47	113
90	51	164
100	32	196
110	4	200

200 cars therefore median between 100^{th} and 101^{st}

So median = 80km/hr

Main Grid

8. A number pattern is given below.

1^{st} term: $2^2 - 0^2$
2^{nd} term: $3^2 - 1^2$
3^{rd} term: $4^2 - 2^2$

(*a*) Write down a similar expression for the 4^{th} term. **1**

(*b*) Hence or otherwise find the n^{th} term in its simplest form. **3**

F

Solution

Main Grid

Q8

4^{th} term $= 5^2 - 3^2$

$$
\begin{aligned}
n^{th} \text{ term} &= (n + 1)^2 - (n - 1)^2 \\
&= (n^2 + 2n + 1) - (n^2 - 2n + 1) \\
&= n^2 + 2n + 1 - n^2 + 2n - 1 \\
&= 4n
\end{aligned}
$$

Main Grid

KU	RE
2	
	3

9. (*a*) Emma puts £30 worth of petrol into the empty fuel tank of her car.

Petrol costs 75 pence per litre.
Her car uses 5 litres of petrol per hour, when she drives at a particular constant speed.

At this constant speed, how many litres of petrol will remain in the car after 3 hours. **2**

(*b*) The next week, Emma puts £20 worth of petrol into the empty fuel tank of her car.

Petrol costs c pence per litre.
Her car uses k litres of petrol per hour, when she drives at another constant speed.

Find a formula for R, the amount of petrol remaining in the car after t hours. **3**

F

Solution

Main Grid

Q9

Litres put in car = 3000 ÷ 75 = 40 litres

Litres used = 5 × 3 = 15 litres

Litres remaining = 40 – 15 = 25 litres

Litres put in car $= \dfrac{2000}{c}$

Litres used $= kt$

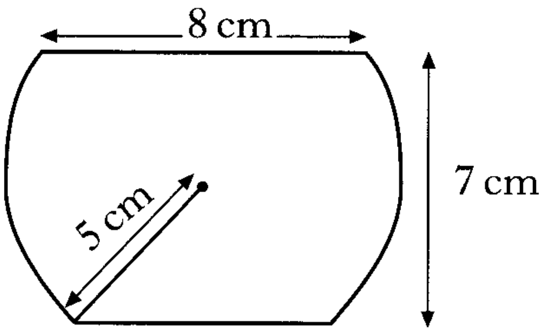
$$R = \frac{2000}{c} - kt$$

Main Grid

10. A badge is made from a circle of radius 5 centimetres.

Segments are taken off the top and the bottom of the circle as shown.

The straight edges are parallel.



The badge measures 7 centimetres from the top to the bottom.
The top is 8 centimetres wide.

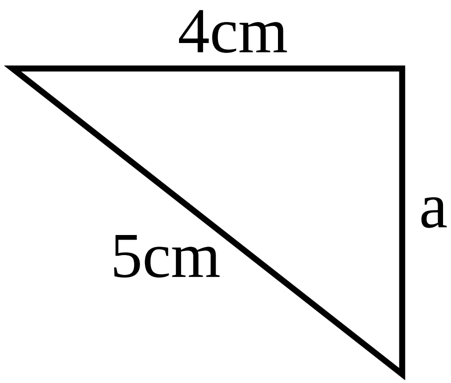
Calculate the width of the base. **5**

F

Solution

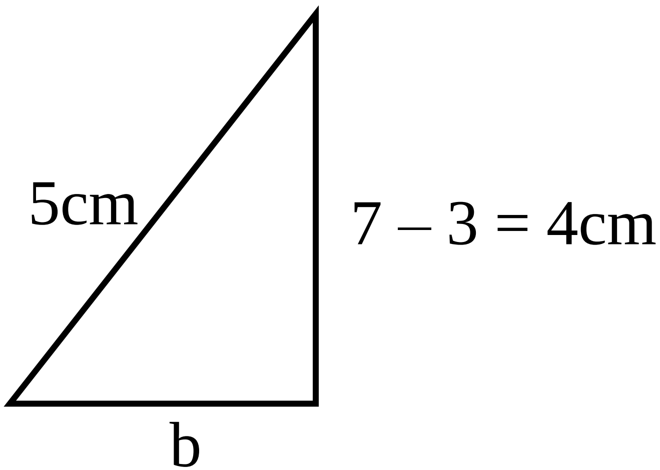
Main Grid

Q10



Using Pythagoras

$$a = \sqrt{5^2 - 4^2} = 3$$



Using Pythagoras

$$b = \sqrt{5^2 - 4^2} = 3$$

Therefore base $= 2 \times 3 = 6$cm

Main Grid

KU	RE
3	
	3

11. $$f(x) = 4\sqrt{x} + \sqrt{2}$$

(*a*) Find the value of $f(72)$ as a surd in its simplest form.

(*b*) Find the value of t, given that $f(t) = 3\sqrt{2}$.

F

Solution

Main Grid

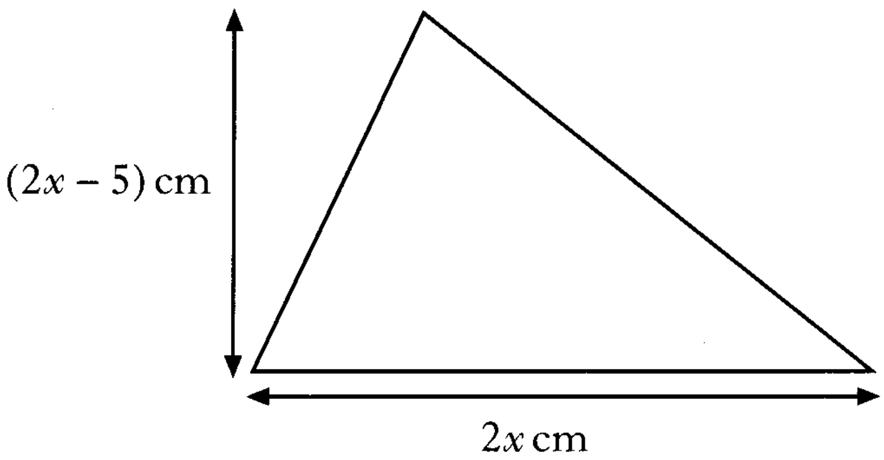
Q11

$$
\begin{aligned}
f(72) &= 4\sqrt{72} + \sqrt{2} \\
&= 4\sqrt{36}\sqrt{2} + \sqrt{2} \\
&= 4 \times 6\sqrt{2} + \sqrt{2} \\
&= 24\sqrt{2} + \sqrt{2} \\
&= 25\sqrt{2}
\end{aligned}
$$

$$
\begin{aligned}
f(t) = 4\sqrt{t} + \sqrt{2} &= 3\sqrt{2} \\
4\sqrt{t} &= 3\sqrt{2} - \sqrt{2} \\
4\sqrt{t} &= 2\sqrt{2} \\
\sqrt{t} &= \frac{2\sqrt{2}}{4} \\
\sqrt{t} &= \frac{\sqrt{2}}{2} \\
t &= \left(\frac{\sqrt{2}}{2}\right)^2 = \frac{2}{4} = \frac{1}{2}
\end{aligned}
$$

Main Grid

12. The height of a triangle is $(2x - 5)$ centimetres and the base is $2x$ centimetres.



The area of the triangle is 7 square centimetres.

Calculate the value of x. **5**

F

Solution

Main Grid

Q12

$$A = \frac{1}{2}bh = 7$$

$$\frac{1}{2}(2x)(2x-5) = 7$$

$$x(2x-5) = 7$$

$$2x^2 - 5x = 7$$

$$2x^2 - 5x - 7 = 0$$

$$(2x-7)(x+1) = 0$$

$$(2x-7) = 0 \quad \text{or} \quad (x+1) = 0$$

$$x = \frac{7}{2} \quad \text{or} \quad \cancel{x = -1}$$

$$x = 3\frac{1}{2}$$

Main Grid

KU	RE
3	

1. $$E = mc^2.$$

Find the value of E when $m = 3{\cdot}6 \times 10^{-2}$ and $c = 3 \times 10^{8}$.

Give your answer **in scientific notation**.

F

Solution

Main Grid

Q1

$$E = \left(3.6\times10^{-2}\right)\times\left(3\times10^{8}\right)\times\left(3\times10^{8}\right)$$

$$E = 3.24\times10^{15}$$

Main Grid

2. The running times in minutes, of 6 television programmes are:

77 91 84 71 79 75.

Calculate the mean and standard deviation of these times. **4**

F

Solution

Main Grid

Q2

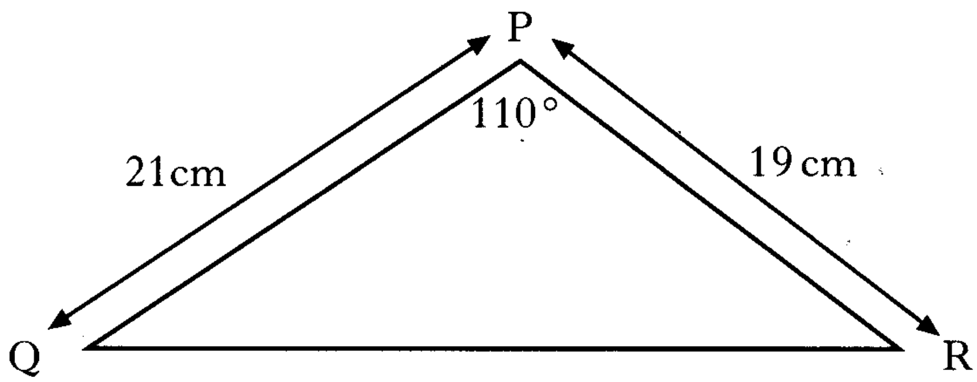
$$Mean = \frac{77+91+84+71+79+75}{6} = \frac{477}{6} = 79.5$$

x	$x-\overline{x}$	$(x-\overline{x})^2$
71	-8.5	72.25
75	-4.5	20.25
77	-2.5	6.25
79	-0.5	0.25
84	4.5	20.25
91	11.5	132.25
		251.5

$$s = \sqrt{\frac{251.5}{6-1}} = \sqrt{\frac{251.5}{5}} = \sqrt{50.3} = 7.09$$

Main Grid

3.



Calculate the area of triangle PQR.

4

F

Solution

Main Grid

Q3

$$Area = \frac{1}{2} qr \sin P$$

$$Area = 0.5 \times 19 \times 21 \times \sin 110^o$$

$$Area = 187.5 cm^2$$

Main Grid

4. Solve the equation

$$x^2 + 2x = 9.$$

Give your answers **correct to 1 decimal place**. 3

F

Solution

Main Grid

Q4

$$x^2 + 2x = 9$$

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

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

$$a = 1 \quad b = 2 \quad c = -9$$

$$\frac{-2 \pm \sqrt{2^2 - (4 \times 1 \times -9)}}{2 \times 1}$$

$$\frac{-2 \pm \sqrt{4 - (-36)}}{2}$$

$$\frac{-2 \pm \sqrt{40}}{2}$$

$$\frac{-2 + \sqrt{40}}{2} \qquad \frac{-2 - \sqrt{40}}{2}$$

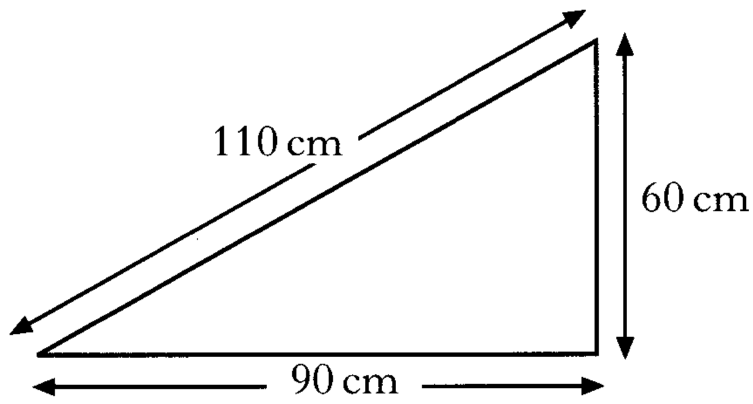
$$2.162 \qquad -4.162$$

$$2.2 \qquad -4.2$$

Main Grid

KU	RE
	3

5. A triangular paving slab has measurements as shown.



Is the slab in the shape of a right angled triangle?

Show your working.

F

Solution

Main Grid

Q5

Using the converse of Pythagoras if $90^2 + 60^2 = 110^2$ then the triangle is right angled.

$90^2 + 60^2 = 8100 + 3600 = 11700$

$110^2 = 12100$

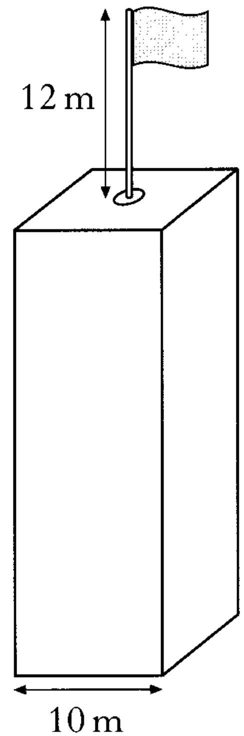
$11700 \neq 12100$

So the slab is **not** a right angled triangle.

Main Grid

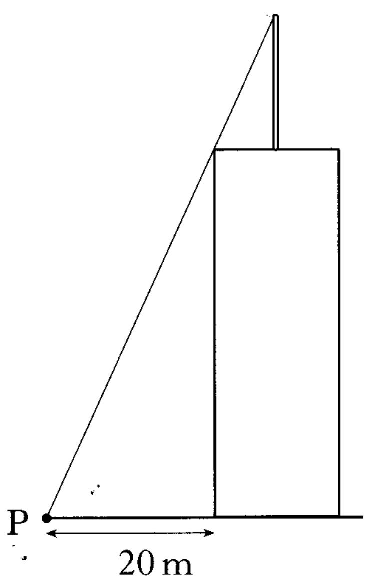
6. A vertical flagpole 12 metres high stands at the centre of the roof of a tower.

The tower is cuboid shaped with a square base of side 10 metres.



At a point P on the ground, 20 metres from the base of the tower, the top of the flagpole is just visible, as shown.

Calculate the height of the tower.



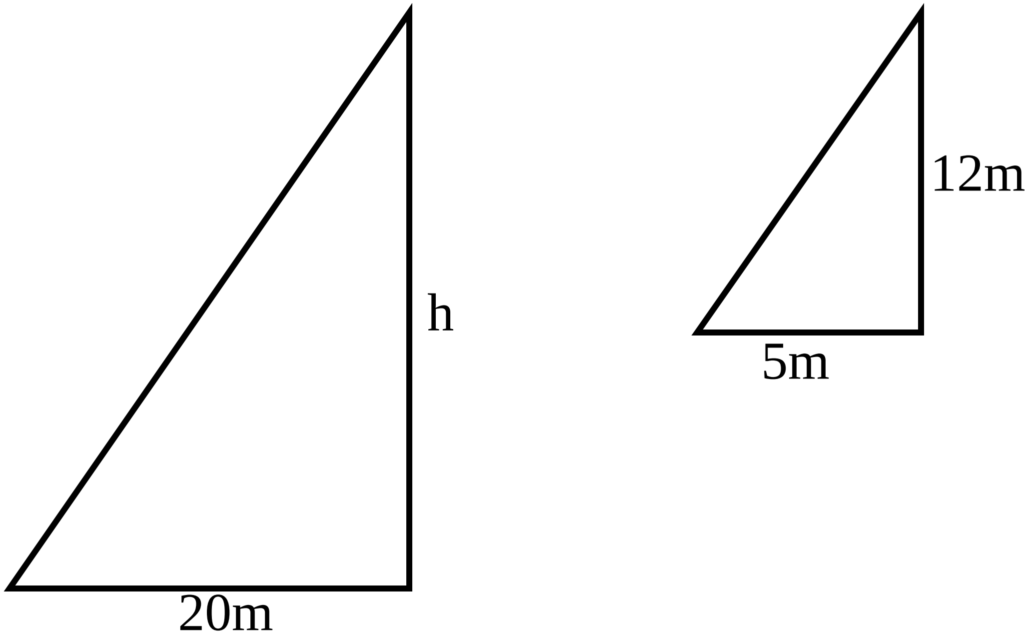
4

Solution

Main Grid

F

Q6



Using similar triangles:

$$\frac{h}{12} = \frac{20}{5}$$

$$h = \frac{20 \times 12}{5} = 48m$$

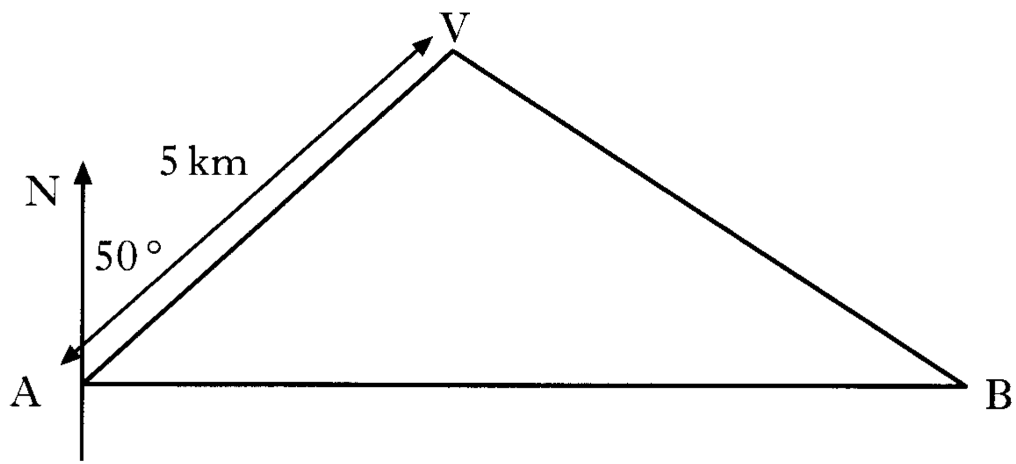
Main Grid

KU	RE
5	

7. David walks on a bearing of 050° from hostel A to a viewpoint V, 5 kilometres away.

Hostel B is due east of hostel A.

Susie walks on a bearing of 294° from hostel B to the same viewpoint.



Calculate the length of AB, the distance between the two hostels.

F

Solution

Main Grid

Q7

Angle A = 40°

Angle B = 294 – 270 = 24°

Angle V = 180 – 24 – 40 = 116°

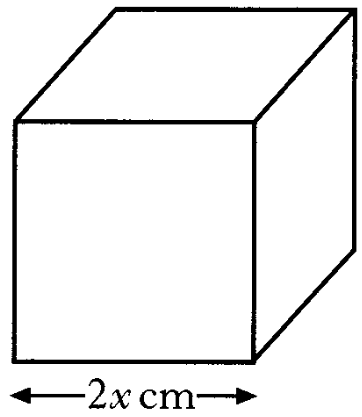
$$\frac{v}{\sin V} = \frac{b}{\sin B}$$

$$v = \frac{b \sin V}{\sin B}$$

$$v = \frac{5 \times \sin 116^0}{\sin 24^0} = 11.05km$$

Main Grid

8. The side length of a cube is $2x$ centimetres.



The expression for the volume in cubic centimetres is equal to the expression for the surface area in square centimetres.

Calculate the side length of the cube. **5**

F

Solution

Main Grid

Q8

$$2x \times 2x \times 2x = 6 \times (2x \times 2x)$$

$$8x^3 = 24x^2$$

$$8x^3 - 24x^2 = 0$$

$$8x^2(x-3) = 0$$

$$8x^2 = 0 \quad \text{or} \quad (x-3) = 0$$

$$\cancel{x = 0} \quad \text{or} \quad x = 3$$

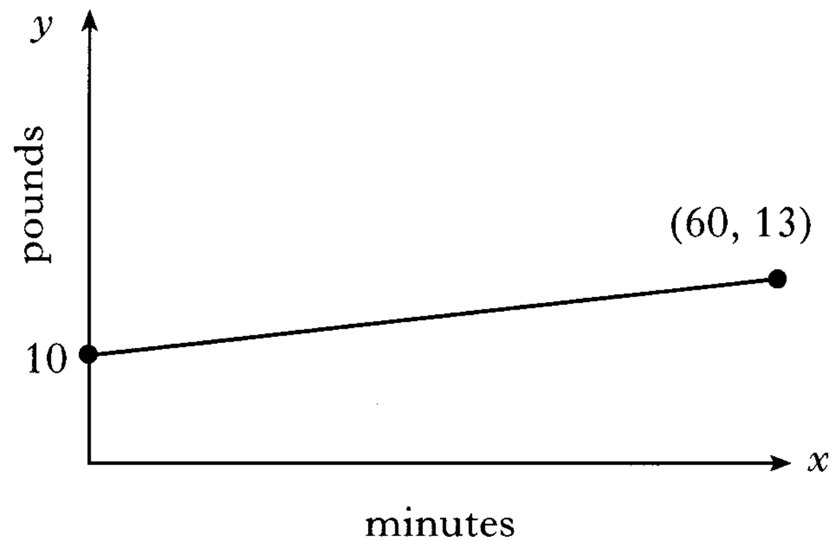
$$\text{side length} \quad 2x = 6cm$$

Main Grid

KU	RE

9. The monthly bill for a mobile phone is made up of a fixed rental plus call charges. Call charges vary as the time used.

The relationship between the monthly bill, y (pounds), and the time used, x (minutes) is represented in the graph below.



(*a*) Write down the fixed rental. **1**

(*b*) Find the call charge per minute. **3**

F

Solution

Main Grid

Q9

Fixed rental = £10

Call charge per minute = gradient

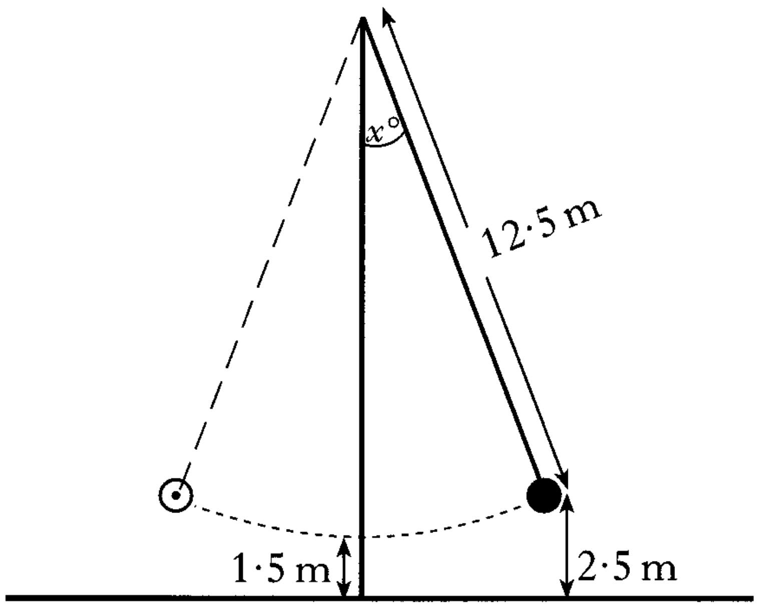
$$gradient = \frac{13-10}{60-0} = \frac{3}{60} = 0.05$$

Call charge per minute = £0.05 = 5p

Main Grid

10. The chain of a demolition ball is $12 \cdot 5$ metres long.

When vertical, the end of the chain is $1 \cdot 5$ metres from the ground.



It swings to a maximum height of $2 \cdot 5$ metres above the ground on both sides.

(*a*) At this maximum height, show that the angle $x°$, which the chain makes with the vertical, is approximately $23°$. **4**

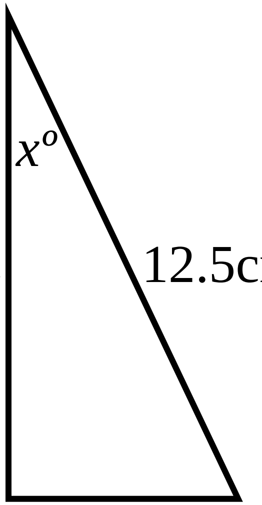
(*b*) Calculate the maximum length of the arc through which the end of the chain swings. Give your answer **to 3 significant figures**. **4**

F

Solution

Main Grid

Q10



$$\cos x^o = \frac{11.5}{12.5} = 0.92$$

$$x^o = \cos^{-1}(0.92) = 23.074^o$$

$$x^o = 23^o$$

$$\frac{arc\ length}{\pi d} = \frac{46}{360}$$

$$arc\ length = \frac{46 \times \pi d}{360} = \frac{46 \times \pi \times 25}{360} = 10.036$$

$$arc\ length = 10.0m$$

Main Grid

KU	RE
3	
	1

11. (*a*) Solve algebraically the equation

$$\sqrt{3}\sin x° - 1 = 0 \qquad 0 \leq x < 360.$$

(*b*) Hence write down the solution of the equation

$$\sqrt{3}\sin 2x° - 1 = 0 \qquad 0 \leq x < 90.$$

F

Solution

Main Grid

Q11

$$\sqrt{3}\sin x^o - 1 = 0$$

$$\sin x^o = \frac{1}{\sqrt{3}}$$

$$x^o = 35.3^o \qquad \text{or} \qquad 144.7^o$$

$$2x^o = 35.3^o \qquad \text{or} \qquad 144.7^o$$

$$x^o = 17.65^o \qquad \text{or} \qquad 72.35^o$$

Main Grid

KU	RE
2	

1. Evaluate

$$56 \cdot 4 - 1 \cdot 25 \times 40.$$

F

Solution

Main Grid

Q1

BODMAS

$$1.25 \times 40 = 50$$

$$56.4 - 50 = \underline{6.4}$$

Main Grid

2. Evaluate

$$1\tfrac{3}{5} + 2\tfrac{4}{7}.$$

2	

F

Solution

Main Grid

Q2

$$1\frac{3}{5}+2\frac{4}{7}=\frac{8}{5}+\frac{18}{7}$$

$$=\frac{56+90}{35}=\frac{146}{35}=4\frac{6}{35}$$

Main Grid

3. Given that $f(x) = 4 - x^2$, evaluate $f(-3)$.

2	

F

Solution

Main Grid

Q3

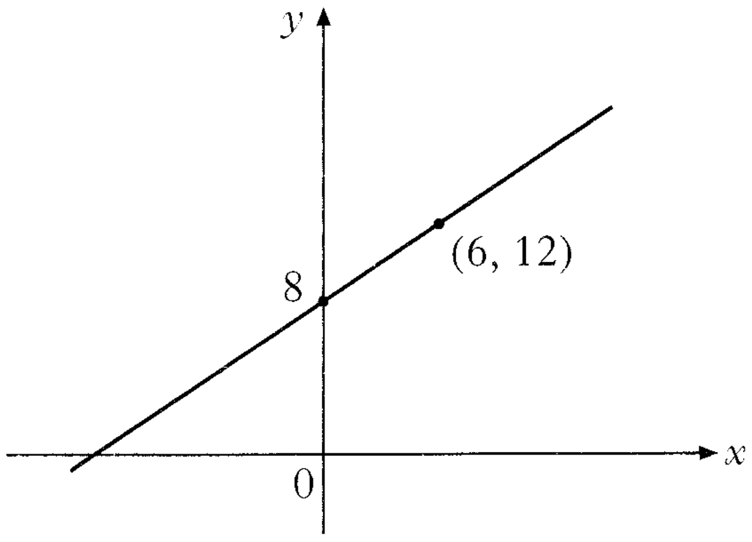
$$4 - (-3)^2$$

$$= 4 - 9$$

$$= \underline{-5}$$

Main Grid

4.



Find the equation of the given straight line.

3

F

Solution

Main Grid

Q4

$$m = \frac{12-8}{6-0} = \frac{4}{6} = \frac{2}{3}$$

$$c = 8$$

$$y = \frac{2}{3}x + 8$$

Main Grid

KU	RE

5. (*a*) Factorise

$$4x^2 - y^2.$$

1

(*b*) Hence simplify

$$\frac{4x^2 - y^2}{6x + 3y}.$$

2

F

Solution

Main Grid

Q5

Difference of 2 squares

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

$$\frac{4x^2 - y^2}{6x + 3y}$$

$$= \frac{\cancel{(2x+y)}(2x-y)}{3\cancel{(2x+y)}} = \frac{2x-y}{3}$$

Main Grid

6. Solve the equation

$$x - 2(x + 1) = 8.$$

3

Solution

Main Grid

F

Q6

$$x - 2(x + 1) = 8$$

$$x - 2x - 2 = 8$$

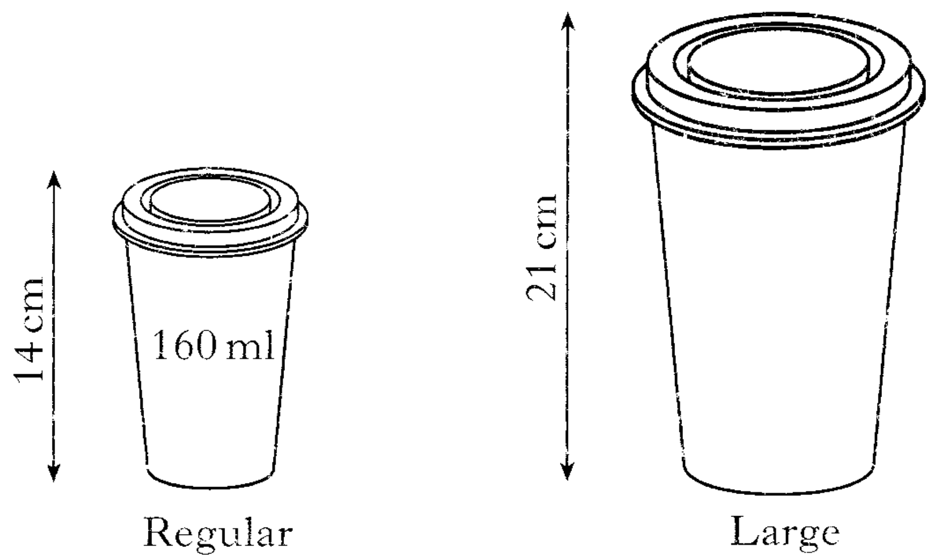
$$-x = 10$$

$$\underline{x = -10}$$

Main Grid

7. Coffee is sold in regular cups and large cups.

The two cups are mathematically similar in shape.



The regular cup is 14 centimetres high and holds 160 millilitres.

The large cup is 21 centimetres high.

Calculate how many millilitres the large cup holds. **4**

F

Solution

Main Grid

Q7

$$\text{Length Scale Factor} = \frac{21}{14} = \frac{3}{2}$$

$$\text{Volume Scale Factor} = \frac{3^3}{2^3} = \frac{27}{8}$$

$$\text{Volume of Large Cup} = 160 \times \frac{27}{8}$$

$$= 20 \times 27$$

$$= \underline{\underline{540\text{ml}}}$$

Main Grid

8. The graph of $y = x^2$ has been moved to the position shown in Figure 1.

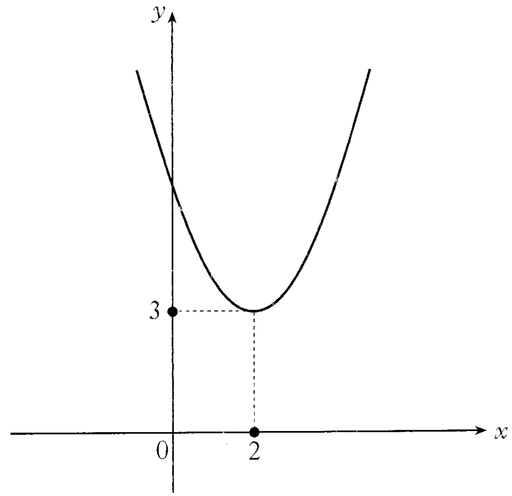


Figure 1

The equation of this graph is $y = (x-2)^2 + 3$.

The graph of $y = x^2$ has now been moved to the position shown in Figure 2.

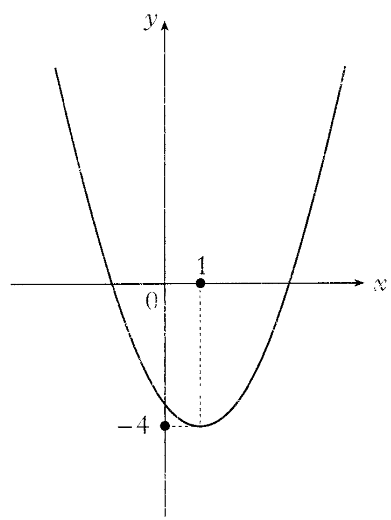


Figure 2

Write down the equation of the graph in Figure 2.

2

F

Solution

Main Grid

Q8

$$y = (x - 1)^2 - 4$$

Main Grid

	KU	RE
9. Euan plays in a snooker tournament which consists of 20 games.		
He wins x games and loses y games.		
(*a*) Write down an equation in x and y to illustrate this information.	**1**	
(*b*) He is paid £5 for each game he wins and £2 for each game he loses.		
He is paid a **total** of £79.		
Write down another equation in x and y to illustrate this information.		**2**
(*c*) How many games did Euan **win**?		**3**

F

Solution

Main Grid

Q9

a) $x + y = 20$

b) $\underline{5x + 2y = 79}$

c) $2x + 2y = 40$

$\underline{5x + 2y = 79}$

$3x = 39$

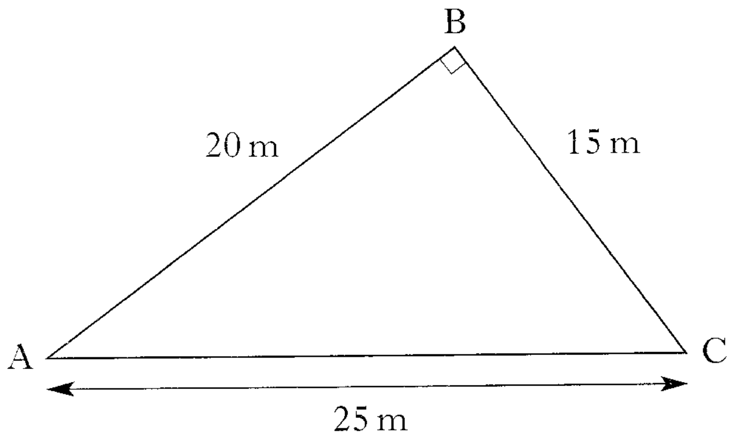
$\underline{x = 13}$

Euan won 13 games.

Main Grid

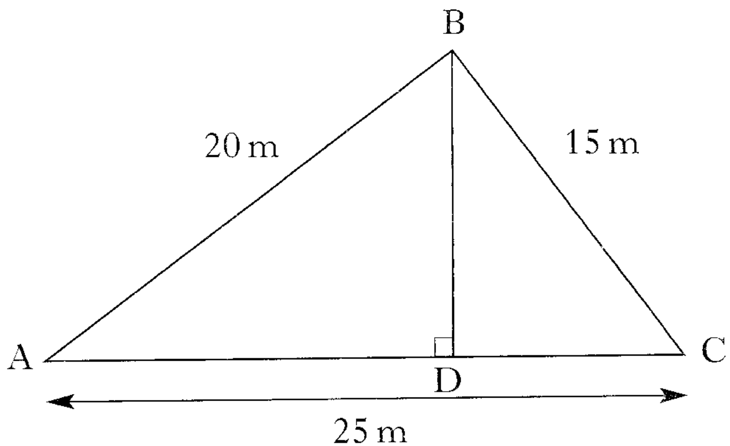
10. Triangle ABC is right-angled at B.

The dimensions are as shown.



(*a*) Calculate the area of triangle ABC. 1

(*b*) BD, the height of triangle ABC, is drawn as shown.



Use your answer to part (*a*) to calculate the height BD. 3

F

Solution

Main Grid

Q10

$$\text{Area} = \frac{1}{2} \times 20 \times 15 = \underline{\underline{150\text{m}^2}}$$

$$\frac{1}{2} \times 25 \times h = 150$$

$$25h = 300$$

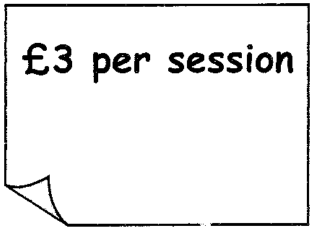
$$h = 300 \div 25$$

$$\underline{\underline{h = 12\text{m}}}$$

Main Grid

KU	RE

11. (*a*) One session at the Leisure Centre costs £3.



Write down an algebraic expression for the cost of x sessions. **1** (RE)

(*b*) The Leisure Centre also offers a monthly card costing £20. The **first 6** sessions are then free, with each additional session costing £2.

(i) Find the **total** cost of a monthly card and 15 sessions. **1** (KU)

(ii) Write down an algebraic expression for the **total** cost of a monthly card and x **sessions**, where x is greater than 6. **2** (RE)

(*c*) Find the minimum number of sessions required for the monthly card to be the cheaper option.

Show all working. **3** (RE)

F
Solution
Main Grid

Q11

a) $C = 3x$

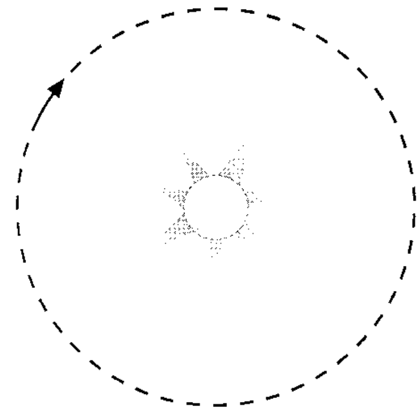
b) $20 + 2 \times 9 = \underline{£38}$ $\qquad 2(x - 6) + 20$

c)
$$2(x - 6) + 20 < 3x$$
$$2x - 12 + 20 < 3x$$
$$2x + 8 < 3x$$
$$2x - 3x < -8$$
$$-x < -8$$
$$\underline{x > 8 \quad \text{so 9 sessions}}$$

Main Grid

KU	RE
3	

1. The orbit of a planet around a star is circular.



The radius of the orbit is $4 \cdot 96 \times 10^7$ kilometres.

Calculate the circumference of the orbit.

Give your answer **in scientific notation**.

F

Solution

Main Grid

Q1

$$c = \pi d$$

$$c = 3.14 \times 2 \times 4.96 \times 10^7$$

$$\underline{c = 3.11488 \times 10^8 \text{ km}}$$

Main Grid

2. (*a*) The pulse rates, in beats per minute, of 6 adults in a hospital waiting area are:

68 73 86 72 82 78.

Calculate the mean and standard deviation of this data. **3**

(*b*) 6 children in the same waiting area have a mean pulse rate of 89·6 beats per minute and a standard deviation of 5·4.

Make **two** valid comparisons between the children's pulse rates and those of the adults. **2**

F

Solution

Main Grid

Q2 $\bar{x} = \dfrac{68+73+86+72+82+78}{6} = \dfrac{459}{6} = 76.5$

$$\sum x^2 = 68^2 + 73^2 + 86^2 + 72^2 + 82^2 + 78^2 = 35341$$

$$s = \sqrt{\dfrac{35341 - \dfrac{459^2}{6}}{6-1}} = \sqrt{\dfrac{35341 - 35113.5}{5}}$$

$$s = \sqrt{45.5} = \underline{\underline{6.74}}$$

On average children's pulse rates are faster but there is less variation.

Main Grid

3. Harry bids successfully for a painting at an auction.

An "auction tax" of 8% is added to his bid price.

He pays £324 in total.

Calculate his bid price. **3**

F

Solution

Main Grid

Q3

$$324 \div 1.05 = \underline{\pounds 300}$$

Main Grid

	KU	RE
4. (*a*) Expand and simplify $(x+4)(3x-1)$.	**1**	
(*b*) Expand $m^{\frac{1}{2}}(2+m^2)$.	**2**	
(*c*) Simplify, leaving your answer as a surd $2\sqrt{20}-3\sqrt{5}$.	**2**	

F

Solution

Main Grid

Q4 a) $3x^2 - x + 12x - 4$

$$\underline{\underline{3x^2 + 11x - 4}}$$

b) $\underline{\underline{2m^{\frac{1}{2}} + m^{\frac{5}{2}}}}$

c) $2\sqrt{4}\sqrt{5} - 3\sqrt{5}$

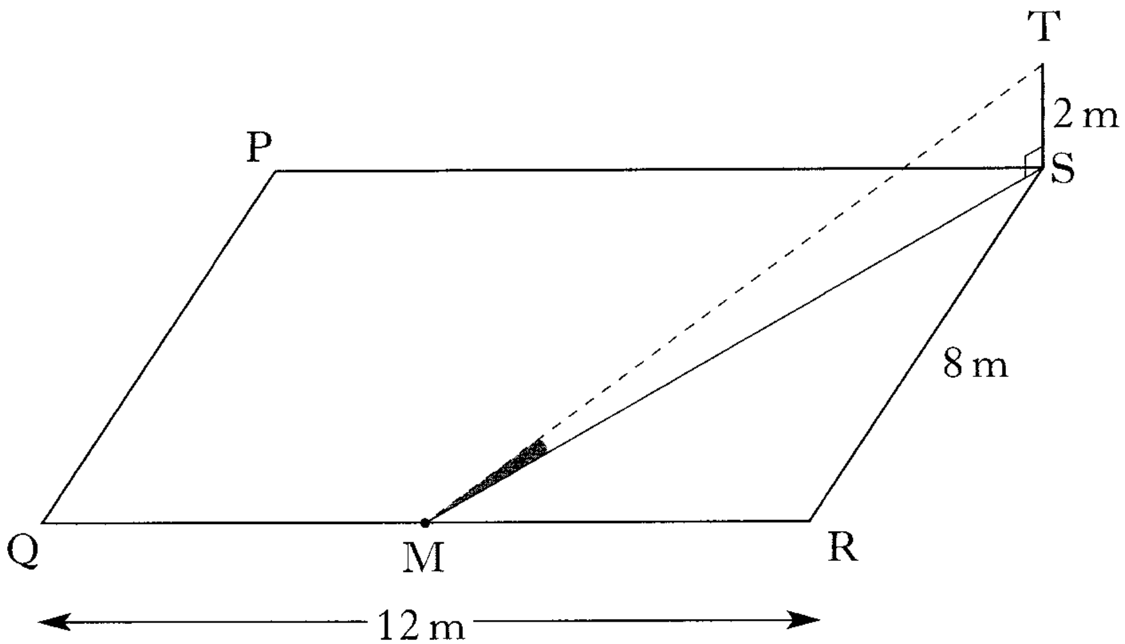
$$4\sqrt{5} - 3\sqrt{5}$$

$$\underline{\underline{\sqrt{5}}}$$

Main Grid

5. ST, a vertical pole 2 metres high, is situated at the corner of a rectangular garden, PQRS.

RS is 8 metres long and QR is 12 metres long.



The pole casts a shadow over the garden.

The shadow reaches M, the midpoint of QR.

Calculate the size of the shaded angle TMS.

4

F

Solution

Main Grid

Q5

$$MS = \sqrt{8^2 + 6^2} = 10$$

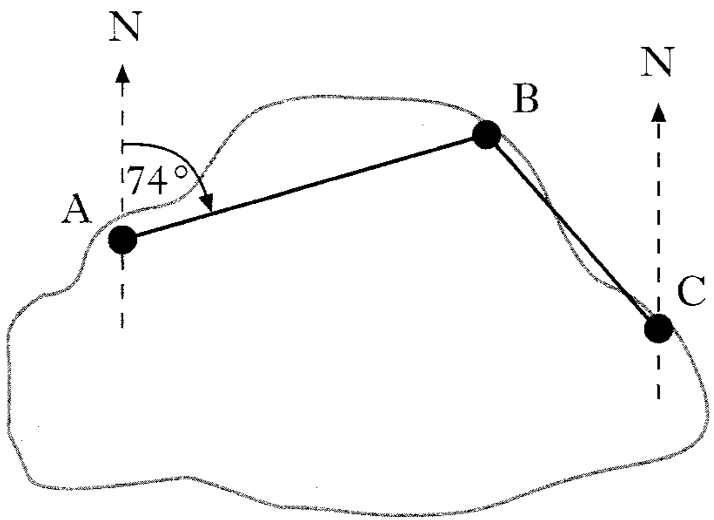
$$\tan M^{o} = \frac{2}{10} = 0.2$$

$$M^{o} = \tan^{-1}(0.2) = \underline{\underline{11.3^{o}}}$$

Main Grid

KU	RE

6. (*a*) There are three mooring points A, B and C on Lake Sorling.



F

Solution

Main Grid

From A, the bearing of B is 074°.

From C, the bearing of B is 310°.

Calculate the size of angle ABC. **2**

(*b*) B is 230 metres from A and 110 metres from C.

Calculate the direct distance from A to C.

Give your answer **to 3 significant figures**. **4**

Q6

$$B° = 74° + 50° = \underline{124°}$$

$$b^2 = a^2 + c^2 - 2ac\,cos\,B$$

$$b^2 = 110^2 + 230^2 - \left(2 \times 110 \times 230 \times cos\,124^{o}\right)$$

$$b^2 = 65000 - \left(-28295.16\right)$$

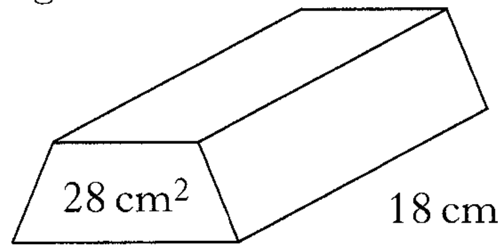
$$b^2 = 93295.16$$

$$b = \sqrt{93295.16}$$

$$b = 305.44 = \underline{\underline{305m}}$$

Main Grid

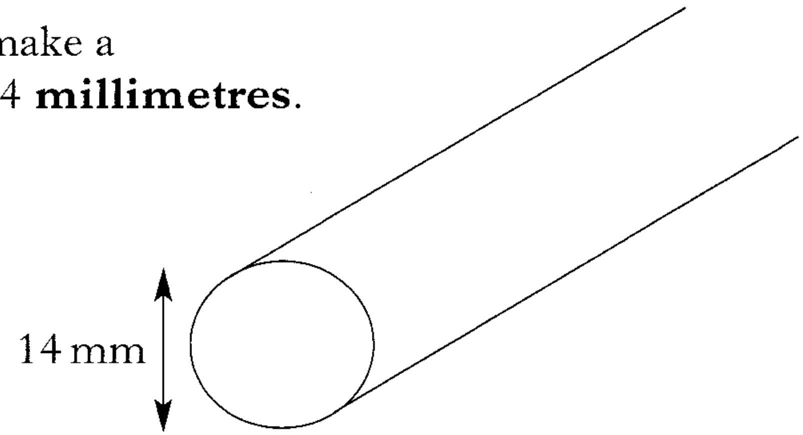
7. (*a*) A block of copper 18 centimetres long is prism shaped as shown.



The area of its cross section is 28 square centimetres.

Find the volume of the block. **1**

(*b*) The block is melted down to make a cylindrical cable of diameter 14 **millimetres**.



Calculate the length of the cable. **4**

F

Solution

Main Grid

Q7

$$28 \times 18 = \underline{504\text{cm}^3}$$

$$V = \pi r^2 L = 504$$

$$L = \frac{504}{\pi r^2} = \frac{504}{3.14 \times 0.7^2} = \underline{\underline{327.6\text{cm}}}$$

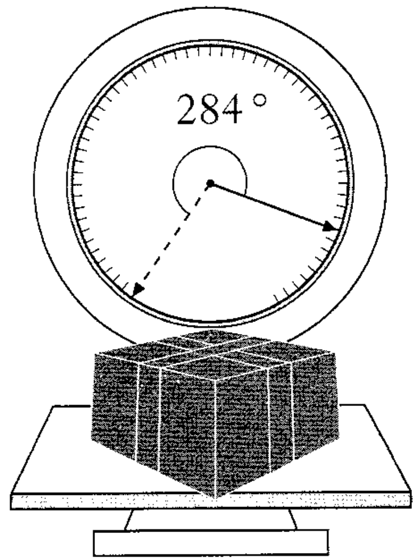
Main Grid

KU	RE
	4

8. A set of scales has a circular dial.

The pointer is 9 centimetres long.

The tip of the pointer moves through an arc of 2 centimetres for each 100 grams of weight on the scales.



A parcel, placed on the scales, moves the pointer through an angle of 284°.

Calculate the weight of the parcel.

F

Solution

Main Grid

Q8

$$\text{Arc Length} = \frac{284 \times 3.14 \times 18}{360} = 44.59\text{cm}$$

$$44.59 \div 2 = 22.28$$

$$22.28 \times 100 = \underline{\underline{2228\text{g}}}$$

Main Grid

9. The number of diagonals, d, in a polygon of n sides is given by the formula

$$d = \frac{1}{2}n(n-3).$$

(*a*) How many diagonals does a polygon of 7 sides have? **2**

(*b*) A polygon has 65 diagonals.

Show that for this polygon, $n^2 - 3n - 130 = 0$. **2**

(*c*) Hence find the number of sides in this polygon. **3**

F

Solution

Main Grid

Q9 a) $3.5 \times 4 = \underline{\underline{14}}$

b) $\frac{1}{2}n(n-3) = 65 \qquad (\times 2)$

$n(n-3) = 130$

$n^2 - 3n = 130$

$\underline{\underline{n^2 - 3n - 130 = 0}}$

c) $(n-13)(n+10)$

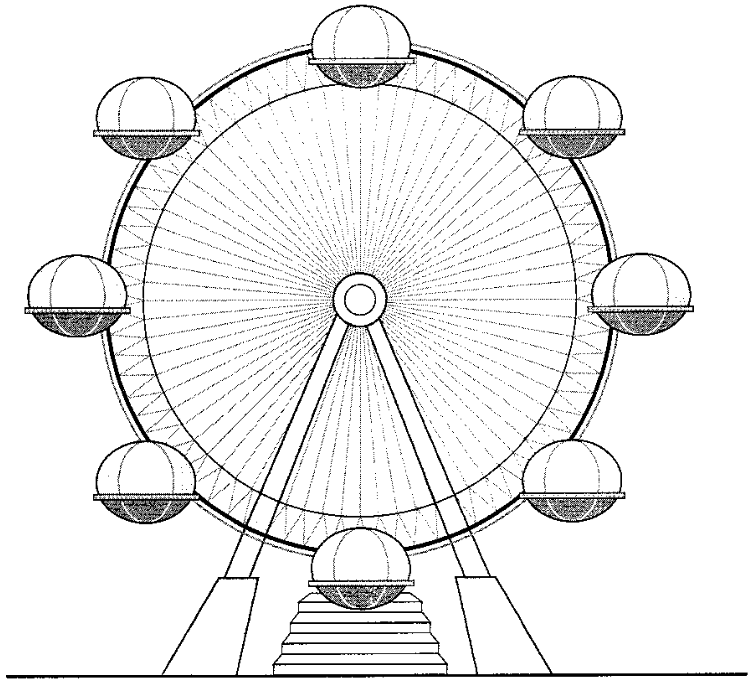
$n = 13 \quad \cancel{n = -10}$

$\underline{\underline{n = 13}}$

Main Grid

KU	RE

10. Emma goes on the "Big Eye".



Her height, h metres, above the ground is given by the formula

$$h = -31 \cos t^\circ + 33$$

where t is the number of seconds after the start.

(*a*) Calculate Emma's height above the ground 20 seconds after the start. **2** (KU)

(*b*) When will Emma first reach a height of 60 metres above the ground? **3** (RE)

(*c*) When will she next be at a height of 60 metres above the ground? **1** (RE)

F

Solution

Main Grid

Q10

a) $-31 \times \cos 20 + 33 = \underline{3.87\text{m}}$

b) $-31\cos t + 33 = 60$

$-31\cos t = 27$

$\cos t = 27 \div -31 = -0.871$

$\text{R.A.} = \cos^{-1}(0.871) = 29.4$

so: $180 - 29.4 = \underline{150.6 \text{ seconds}}$

c) $180 + 29.4 = \underline{209.4 \text{ seconds}}$

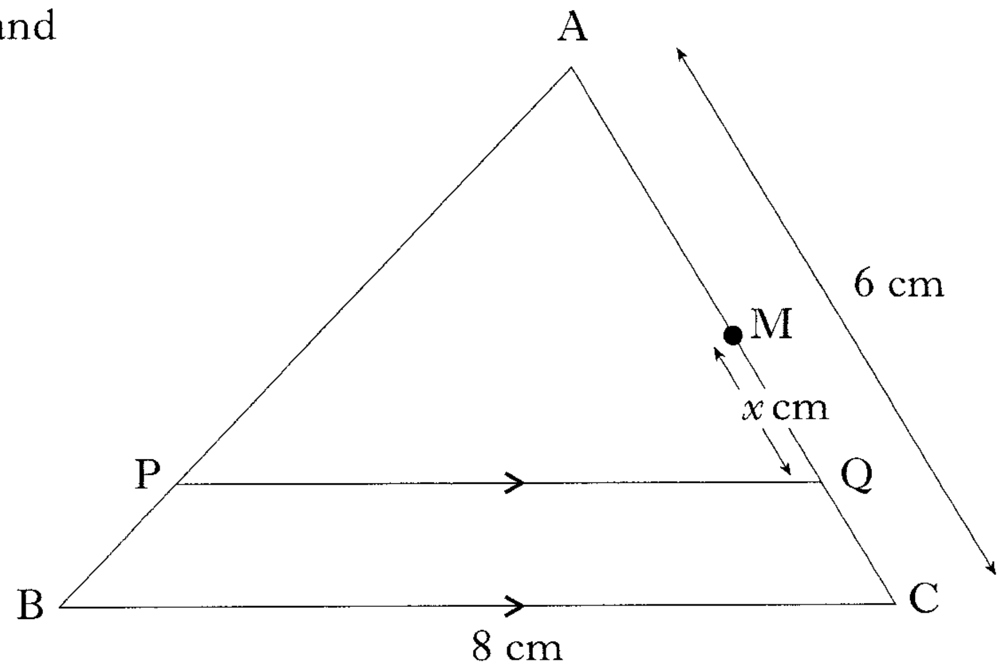
Main Grid

11. In triangle ABC,

BC = 8 centimetres,

AC = 6 centimetres and

PQ is parallel to BC.



M is the midpoint of AC.

Q lies on AC, x centimetres from M, as shown on the diagram.

(*a*) Write down an expression for the length of AQ. **1**

(*b*) Show that PQ $= (4 + \frac{4}{3}x)$ centimetres. **3**

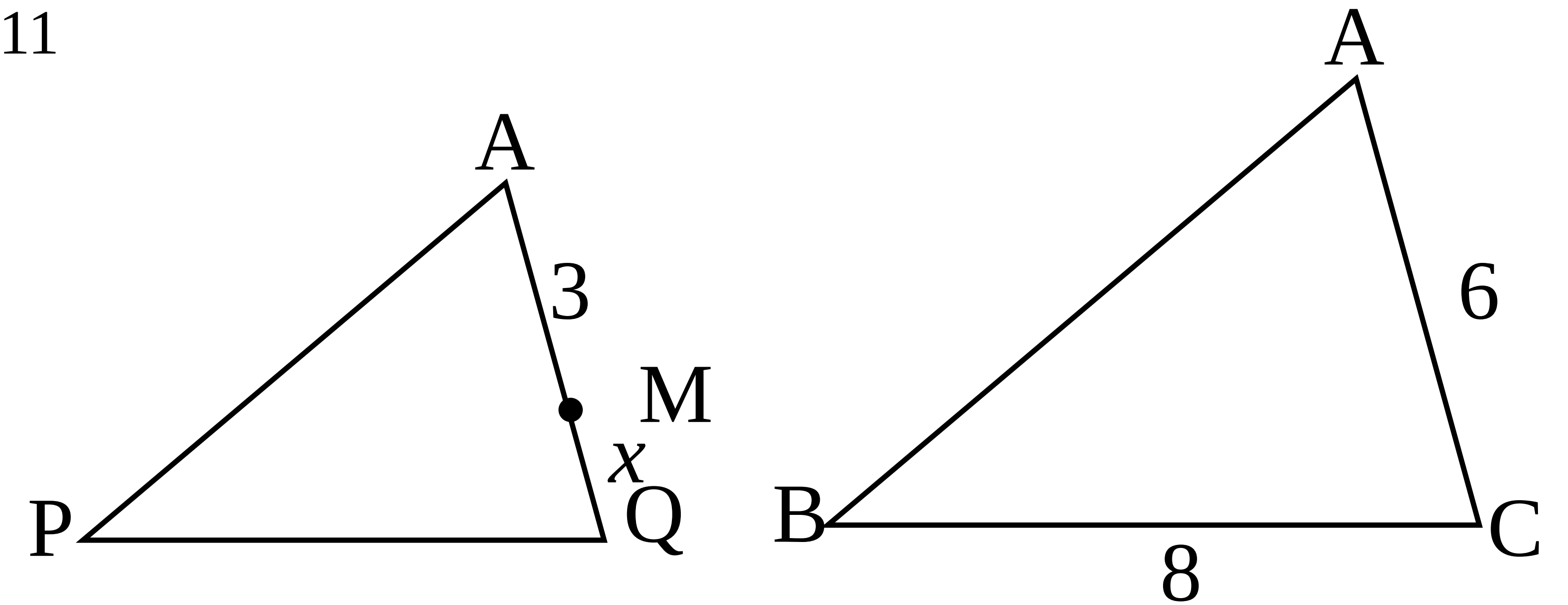
KU	RE

F

Solution

Main Grid

Q11



a) $AQ = 3 + x$

b) $\dfrac{PQ}{BC} = \dfrac{AQ}{AC}$ so $PQ = \dfrac{BC \times AQ}{AC} = \dfrac{8(3+x)}{6}$

$$PQ = \frac{24+8x}{6} = 4 + \frac{4}{3}x$$

Main Grid

1. Evaluate

$$6 \cdot 04 + 3 \cdot 72 \times 20.$$

2

F

Solution

Main Grid

Q1

BODMAS

$$3.72 \times 20 = 74.4$$

$$6.04 + 74.4 = \underline{80.44}$$

Main Grid

2. Evaluate

$$3\tfrac{1}{6} \div 1\tfrac{2}{3}.$$

2	

F

Solution

Main Grid

Q2

$$3\frac{1}{6} \div 1\frac{2}{3}$$

$$= \frac{19}{6} \div \frac{5}{3}$$

$$= \frac{19}{6} \times \frac{3}{5}$$

$$= \frac{57}{30} = 1\frac{9}{10}$$

Main Grid

3. There are 400 people in a studio audience.

The probability that a person chosen at random from this audience is male is $\frac{5}{8}$.

How many males are in this audience? **2**

F

Solution

Main Grid

Q3

$$\frac{5\times400}{8}=\frac{2000}{8}=\underline{\underline{250}}$$

Main Grid

4.

$$P = \frac{2(m-4)}{3}$$

Change the subject of the formula to m. **3**

F

Solution

Main Grid

Q4

$$P = \frac{2(m-4)}{3} \qquad (\times 3)$$

$$3P = 2(m-4)$$

$$3P = 2m - 8$$

$$2m = 3P + 8$$

$$\underline{\underline{m = \frac{3P+8}{2}}}$$

Main Grid

5. Remove brackets and simplify

$$(2x + 3)^2 - 3(x^2 - 6).$$

3

F

Solution

Main Grid

Q5

$$(2x + 3)^2 - 3(x^2 - 6)$$

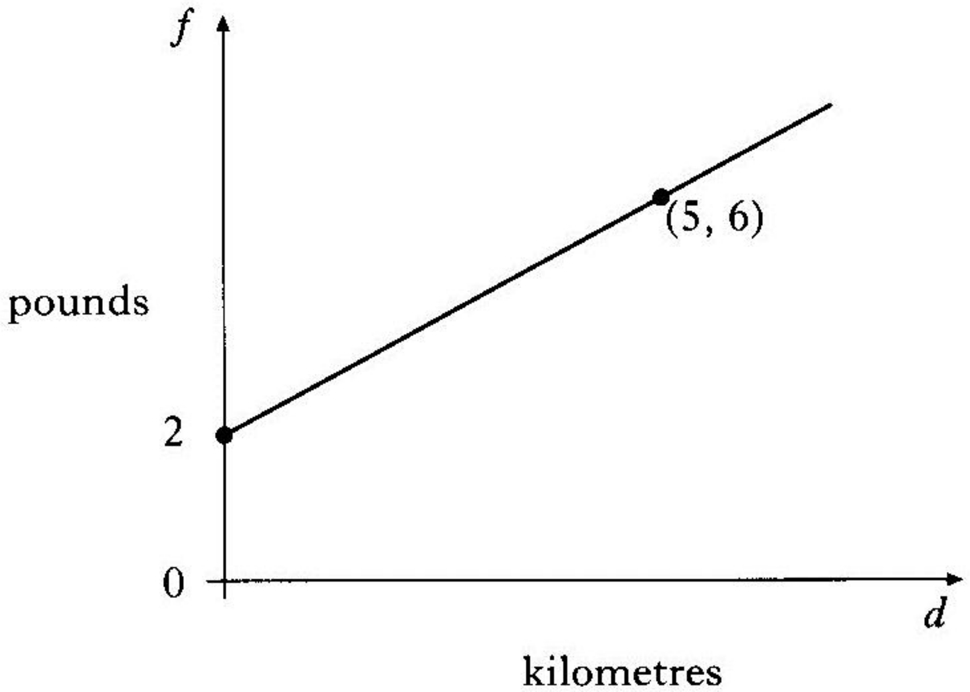
$$4x^2 + 12x + 9 - 3x^2 + 18$$

$$\underline{x^2 + 12x + 27}$$

Main Grid

6. A taxi fare consists of a £2 "call-out" charge **plus** a fixed amount per kilometre.

The graph shows the fare, f pounds for a journey of d kilometres.



The taxi fare for a 5 kilometre journey is £6.

Find the equation of the straight line in terms of d and f.

KU	RE
4	

F

Solution

Main Grid

Q6

$$m = \frac{6-2}{5-0} = \frac{4}{5}$$

$$c = 2$$

$$f = \frac{4}{5}d + 2$$

Main Grid

7. Remove brackets and simplify

$$a^{\frac{1}{2}}\left(a^{\frac{1}{2}}-2\right).$$

2

F

Solution

Main Grid

Q7

$$a^{\frac{1}{2}}\left(a^{\frac{1}{2}}-2\right)$$

$$a-2a^{\frac{1}{2}}$$

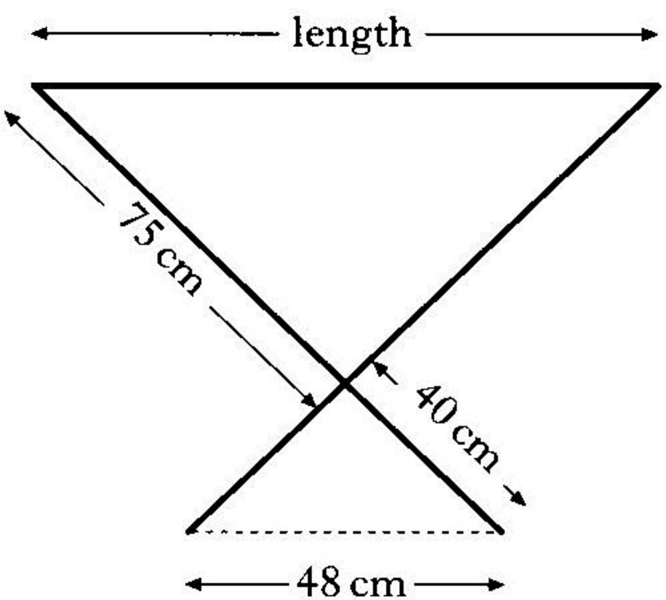
$$\underline{\underline{a-2\sqrt{a}}}$$

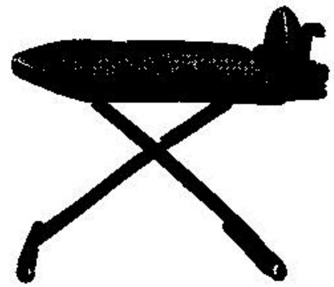
Main Grid

F

8. Mick needs an ironing board.

He sees one in a catalogue with measurements as shown in the diagram below.





When the ironing board is set up, two similar triangles are formed.

Mick wants an ironing board which is at least 80 centimetres in length.

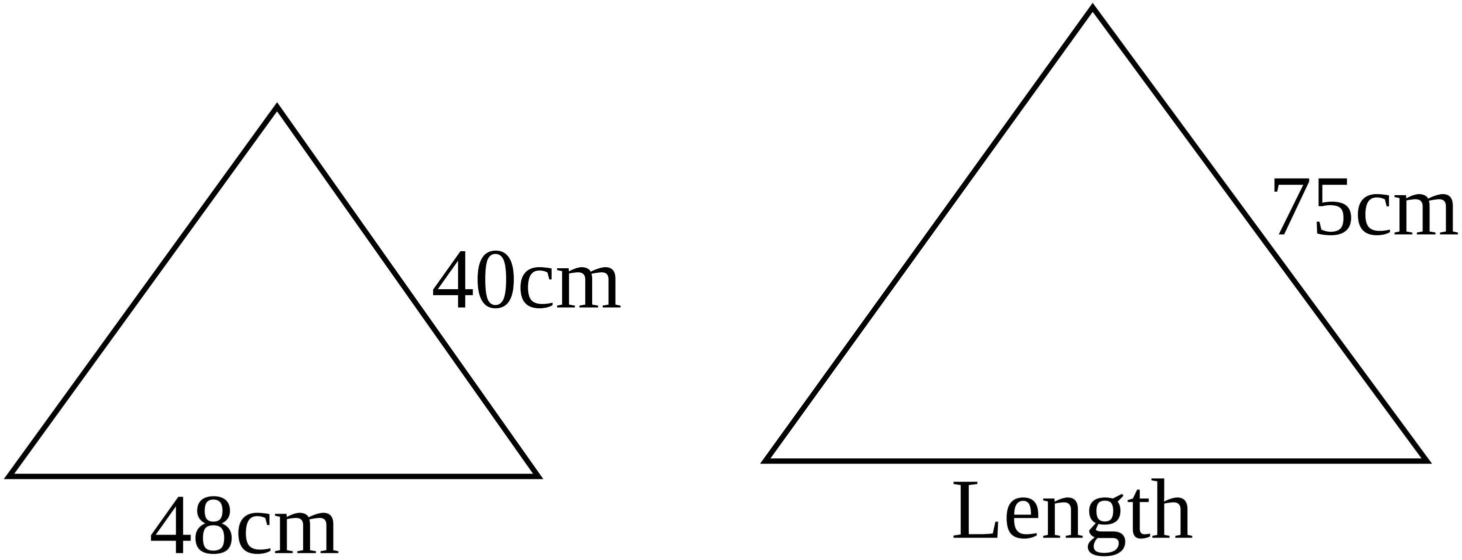
Does this ironing board meet Mick's requirements?

Show all your working. **3**

Solution

Main Grid

Q8



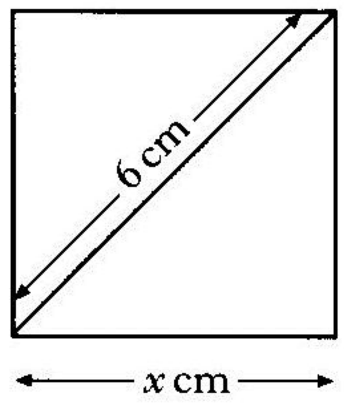
Using similar triangles

b) $$\frac{L}{48}=\frac{75}{40} \quad \text{so} \quad L=\frac{75\times 48}{40}=\frac{3600}{40}=\underline{\underline{90}}$$

Yes because $\underline{\underline{80\angle 90}}$

Main Grid

9. A square of side x centimetres has a diagonal 6 centimetres long.



Calculate the value of x, giving your answer as a surd in its simplest form. **3**

F

Solution

Main Grid

Q9

$$x^2 + x^2 = 36$$

$$2x^2 = 36$$

$$x^2 = 18$$

$$x = \sqrt{18}$$

$$x = \sqrt{9}\sqrt{2}$$

$$\underline{\underline{x = 3\sqrt{2}}}$$

Main Grid

KU	RE
	2

10. A relationship between T and L is given by the formula, $T = \frac{k}{L^3}$ where k is a constant.

When L is doubled, what is the effect on T?

F

Solution

Main Grid

Q10

$$T = \frac{k}{(2L)^3} = \frac{k}{8L^3}$$

Therefore, when L is doubled

T becomes $\frac{1}{8}$ of its value.

Main Grid

11. (*a*) A cinema has 300 seats which are either standard or deluxe.

Let x be the number of standard seats and y be the number of deluxe seats.

Write down an algebraic expression to illustrate this information. **1**

(*b*) A standard seat costs £4 and a deluxe seat costs £6.

When all the seats are sold the ticket sales are £1380.

Write down an algebraic expression to illustrate this information. **2**

(*c*) How many standard seats and how many deluxe seats are in the cinema? **3**

F

Solution

Main Grid

Q11

a) $x + y = 300$

b) $\underline{4x + 6y = 1380}$

c) $4x + 6y = 1380$

$\underline{4x + 4y = 1200}$

$2y = 180$

$\underline{y = 90}$

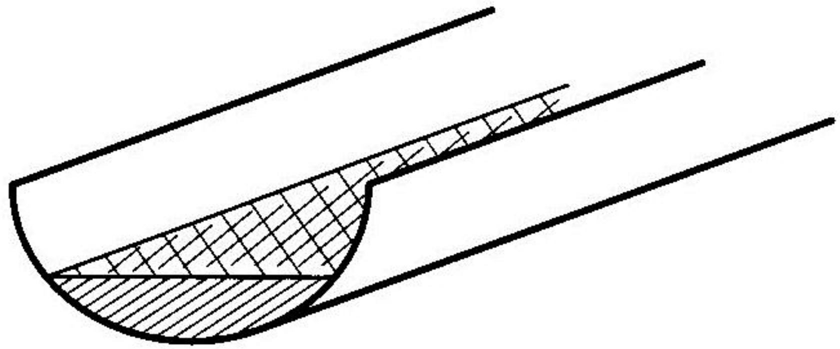
$x = 300 - 90 = \underline{210}$

210 standard seats were sold

90 deluxe seats were sold.

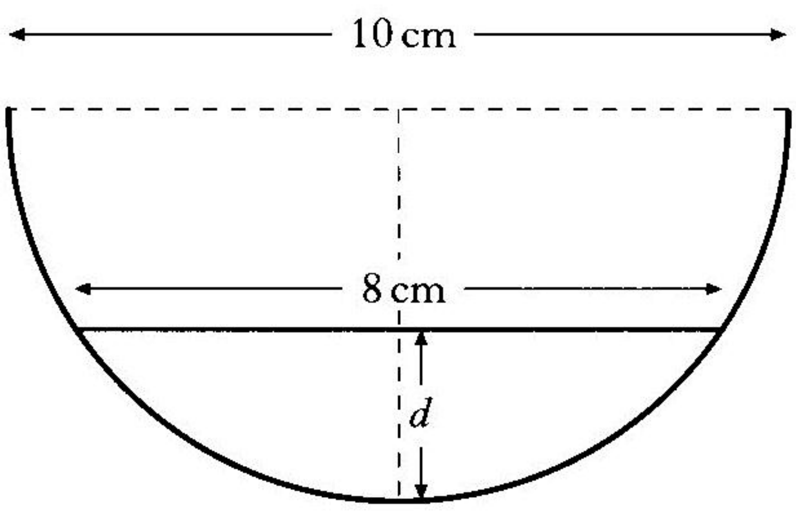
Main Grid

12. The diagram shows water lying in a length of roof guttering.



The cross-section of the guttering is a semi-circle with diameter 10 centimetres.

The water surface is 8 centimetres wide.



Calculate the depth, d, of water in the guttering.

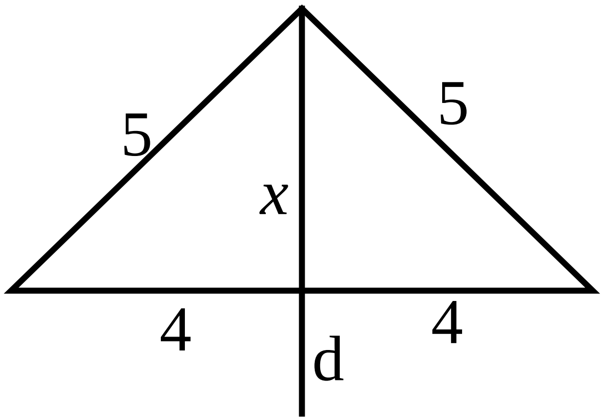
F

Solution

Main Grid

4

Q12



Using Pythagoras

$$x^2 = 5^2 - 4^2$$

$$x^2 = 25 - 16$$

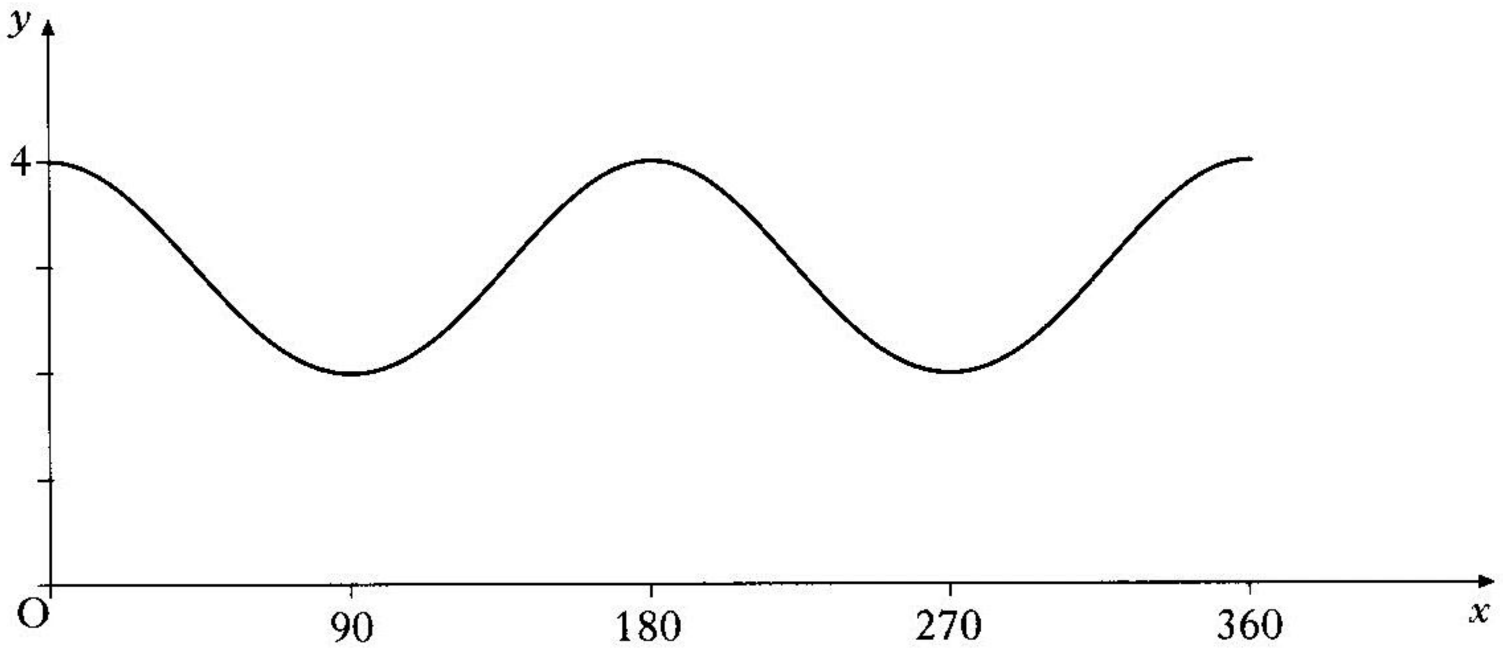
$$x^2 = 9$$

$$x = \sqrt{9} = \underline{3cm}$$

$$\mathrm{d} = 5 - 3 = \underline{\underline{2cm}}$$

Main Grid

13. Part of the graph of $y = \cos bx^\circ + c$ is shown below.



Write down the values of b and c.

2

F

Solution

Main Grid

Q13

$b = 2$ because there are 2 complete cos curves within 360°.

$c = 3$ because the graph has been moved up 3 units from its normal position.

14. The **sum** S_n of the first n terms of a sequence, is given by the formula

$$S_n = 3^n - 1.$$

(*a*) Find the **sum** of the first 2 terms. 1

(*b*) When $S_n = 80$, calculate the value of n. 2

F

Solution

Main Grid

Q14

(a) $S_2 = 3^2 - 1 = \underline{\underline{8}}$

(b) $3^n - 1 = 80$

$3^n = 81$

$3^4 = 81$

$\underline{\underline{n = 4}}$

Main Grid

1. Alistair buys an antique chair for £600.

It is expected to increase in value at the rate of 4·5% each year.

How much is it expected to be worth in 3 years? **3**

F

Solution

Main Grid

Q1

$$600 \times (1.045)^3 = \underline{\underline{£684.70}}$$

Main Grid

2. Solve the equation

$$3x^2 - 2x - 10 = 0.$$

Give your answer **correct to 2 significant figures**.

4

F

Solution

Main Grid

Q2

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

$$a = 3 \quad b = -2 \quad c = -10$$

$$\frac{2 \pm \sqrt{(-2)^2 - (4 \times 3 \times -10)}}{2 \times 3}$$

$$\frac{2 \pm \sqrt{4 - (-120)}}{6}$$

$$\frac{2 \pm \sqrt{124}}{6}$$

$$\frac{2 + \sqrt{124}}{6} \qquad \frac{2 - \sqrt{124}}{6}$$

$$\underline{\underline{2.2}} \qquad \underline{\underline{-1.5}}$$

Main Grid

3. (*a*) During his lunch hour, Luke records the number of birds that visit his bird-table.

The numbers recorded last week were:

28 32 14 19 18 26 31.

Find the mean and standard deviation for this data. **4**

(*b*) Over the same period, Luke's friend, Erin also recorded the number of birds visiting her bird-table.

Erin's recordings have a mean of 25 and a standard deviation of 5.

Make **two** valid comparisons between the friends' recordings. **2**

F

Solution

Main Grid

Q3

$$\bar{x} = \frac{28+32+14+19+18+26+31}{7} = \frac{168}{7} = \underline{\underline{24}}$$

$$\sum x^2 = 28^2+32^2+14^2+19^2+18^2+26^2+31^2 = 4326$$

$$s = \sqrt{\frac{4326-\frac{168^2}{7}}{7-1}} = \sqrt{\frac{4326-4032}{6}}$$

$$s = \sqrt{49} = \underline{\underline{7}}$$

On average Erin's recordings are higher on average but there is less variation.

Main Grid

4. Solve the inequality

$$\frac{x}{4} - \frac{1}{2} < 5.$$

2

Solution

Main Grid

F

Q4

$$\frac{x}{4} - \frac{1}{2} \angle 5 \qquad (\times 4)$$

$$x - 2 \angle 5$$

$$\underline{\underline{x \angle 22}}$$

Main Grid

KU	RE
3	

5. Mark takes some friends out for a meal.

The restaurant adds a 10% service charge to the price of the meal.

The **total** bill is £148·50.

What was the price of the meal?

F

Solution

Main Grid

Q5

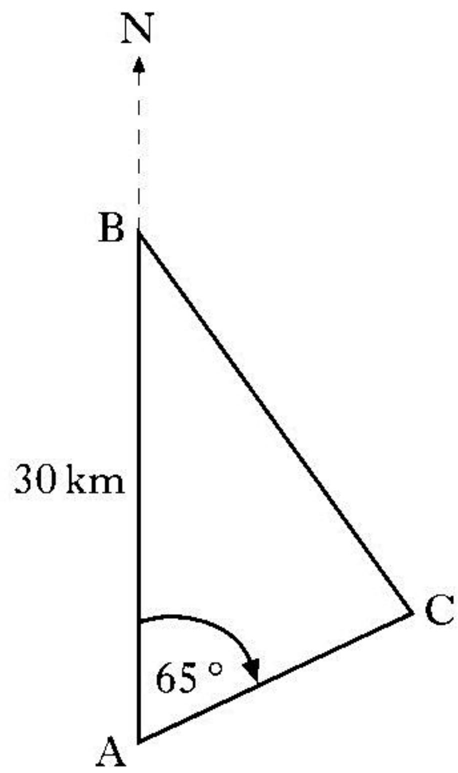
$$148.5 \div 1.1 = \underline{\underline{£135}}$$

Main Grid

6. Brunton is 30 kilometres due North of Appleton.

From Appleton, the bearing of Carlton is 065 °.

From Brunton, the bearing of Carlton is 153 °.



Calculate the distance between Brunton and Carlton. **4**

F

Solution

Main Grid

Q6

$$\frac{BC}{\sin 65^\circ} = \frac{30}{\sin 88^\circ}$$

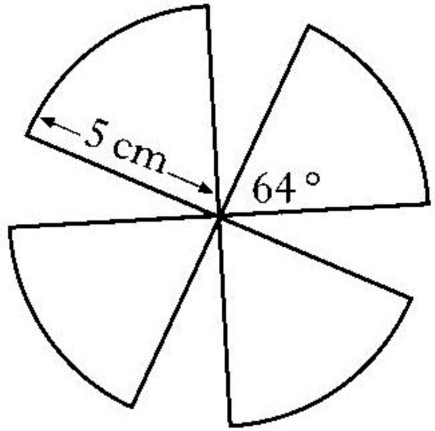
$$BC = \frac{30 \sin 65^\circ}{\sin 88^\circ}$$

$$BC = \underline{\underline{26km}}$$

Main Grid

KU	RE
3	

7. A fan has four identical plastic blades.



Each blade is a sector of a circle of radius 5 centimetres.

The angle at the centre of each sector is 64 °.

Calculate the **total** area of plastic required to make the blades.

F

Solution

Main Grid

Q7

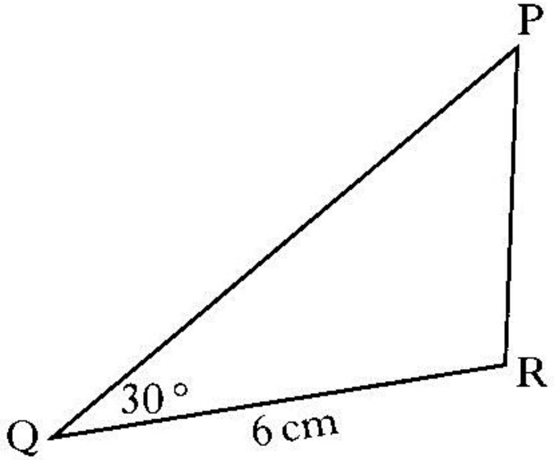
$$\frac{64 \times 3.14 \times 5^2}{360} = 13.96$$

$$13.96 \times 4 = \underline{\underline{55.82cm^2}}$$

Main Grid

8. In triangle PQR:

- QR = 6 centimetres
- angle PQR = 30 °
- area of triangle PQR = 15 square centimetres.



Calculate the length of PQ. **3**

F

Solution

Main Grid

Q8

$$\frac{1}{2} pr \sin Q = 15$$

$$\frac{1}{2} \times 6 \times PR \times \sin 30^\circ = 15$$

$$1.5 \times PR = 15$$

$$PR = \frac{15}{1.5} = \underline{\underline{10cm}}$$

Main Grid

KU	RE
	3

9. To make "14 carat" gold, copper and pure gold are mixed in the ratio 5:7.

A jeweller has 160 grams of copper and 245 grams of pure gold.

What is the maximum weight of "14 carat" gold that the jeweller can make?

F

Solution

Main Grid

Q9

$$160 \div 5 = 32$$

$$245 \div 7 = 35$$

$$C : G$$

$$5 : 7$$

$$160 : 224$$

$$160 + 224 = \underline{\underline{384g}}$$

Main Grid

10. Solve **algebraically** the equation

$$5\cos x^\circ + 4 = 0, \qquad 0 \leq x < 360.$$

3

F

Solution

Main Grid

Q10

$$5\cos x^o + 4 = 0$$

$$\cos x^o = -\frac{4}{5}$$

$$\text{Related Angle} = \cos^{-1}\left(\frac{4}{5}\right) = 36.9^o$$

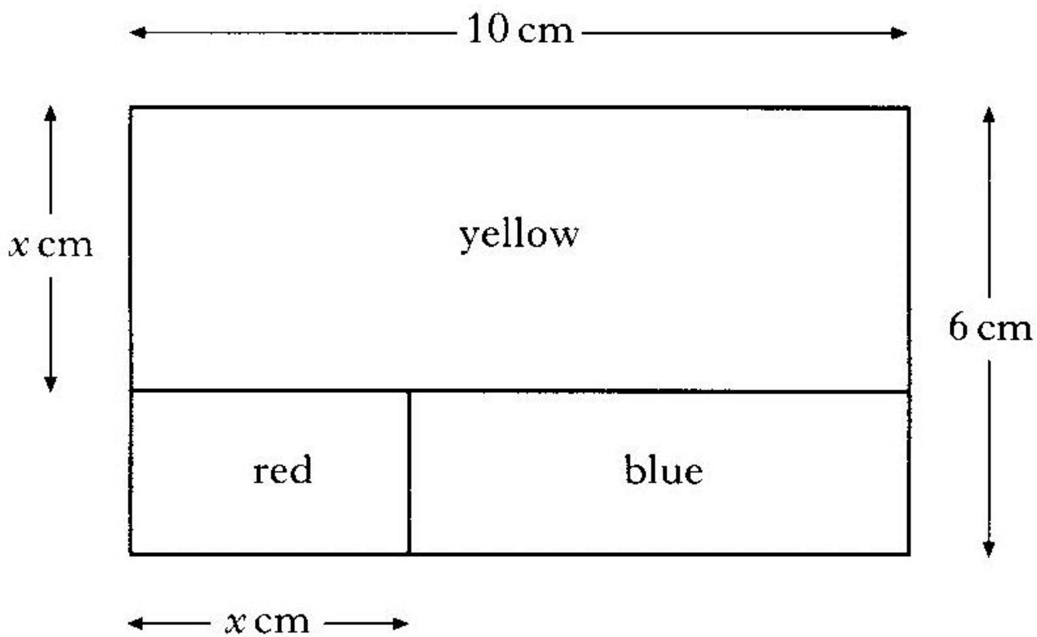
$$x^o = 180 - 36.9 = \underline{143.1^o} \quad \text{and} \quad 180 + 35.9 = \underline{216.9^o}$$

$$\underline{\underline{x^o = \left(143.1^o, 216.9^o\right)}}$$

Main Grid

11. (a) A decorator's logo is rectangular and measures 10 centimetres by 6 centimetres.

It consists of three rectangles: one red, one yellow and one blue.



The yellow rectangle measures 10 centimetres by x centimetres.

The width of the red rectangle is x centimetres.

Show that the area, A, of the blue rectangle is given by the expression

$$A = x^2 - 16x + 60.$$ 2

(b) The area of the blue rectangle is equal to $\frac{1}{5}$ of the total area of the logo.

Calculate the value of x. 4

F

Solution

Main Grid

Q11

a) $(10 \times 6) - x(6 - x) - 10x$

$= 60 - 6x + x^2 - 10x$

$= \underline{x^2 - 16x + 60}$

b) $x^2 - 16x + 60 = 12$

$x^2 - 16x + 48 = 0$

$(x - 12)(x - 4) = 0$

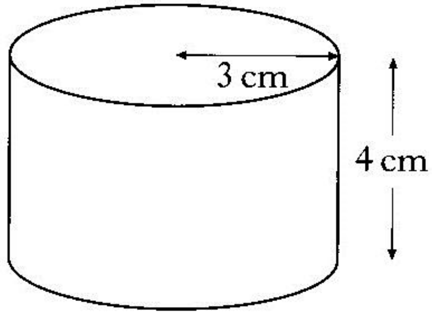
$\cancel{x = 12}$ $\quad \underline{x = 4}$

Main Grid

KU	RE

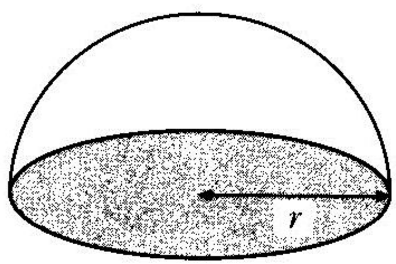
F

12. (*a*) A cylindrical paperweight of radius 3 centimetres and height 4 centimetres is filled with sand.



Calculate the volume of sand in the paperweight. 2

(*b*) Another paperweight, in the shape of a hemisphere, is filled with sand.



It contains the same volume of sand as the first paperweight.

Calculate the radius of the hemisphere.

[The volume of a hemisphere with radius r is given by the formula, $V = \frac{2}{3}\pi r^3$]. 3

Solution

Main Grid

Q12

$$V = \pi r^2 h = 3.14 \times 3^2 \times 4 = \underline{\underline{113.04 cm^3}}$$

$$\frac{2}{3}\pi r^3 = 113.04$$

$$2.09 r^3 = 113.04$$

$$r^3 = 113.04 \div 2.09$$

$$r^3 = 54$$

$$r = \sqrt[3]{54} = \underline{\underline{3.8 cm}}$$

Main Grid

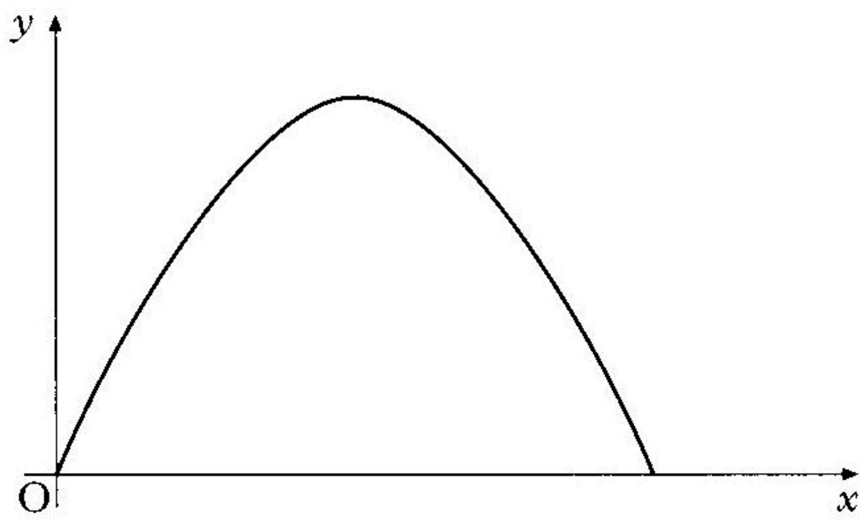
KU	RE
	4

13. The profit made by a publishing company of a magazine is calculated by the formula

$$y = 4x(140 - x),$$

where y is the profit (in pounds) and x is the selling price (in pence) of the magazine.

The graph below represents the profit y against the selling price x.



Find the maximum profit the company can make from the sale of the magazine.

F

Solution

Main Grid

Q13

$$x = 0 \quad \text{and} \quad x = 140$$

$$\text{therefore midpoint is} \quad x = 70$$

$$\text{at} \quad x = 70: \quad y = (4 \times 70)(140 - 70)$$

$$y = 280 \times 70$$

$$\underline{\underline{y = £19{,}600}}$$

Main Grid

KU	RE
2	

1. Evaluate

$$24 \cdot 7 - 0 \cdot 63 \times 30.$$

F

Solution

Main Grid

Q1

BODMAS

$$6.3 \times 3 = 18.9$$

$$24.7 - 18.9 = \underline{5.8}$$

Main Grid

2. Factorise fully

$$5x^2 - 45.$$

2

F

Solution

Main Grid

Q2

$$5x^2 - 45$$

$$= 5(x^2 - 9)$$

$$= \underline{\underline{5(x+3)(x-3)}}$$

Main Grid

3. $$W = BH^2.$$

Change the subject of the formula to H.

2

F

Solution

Main Grid

Q3

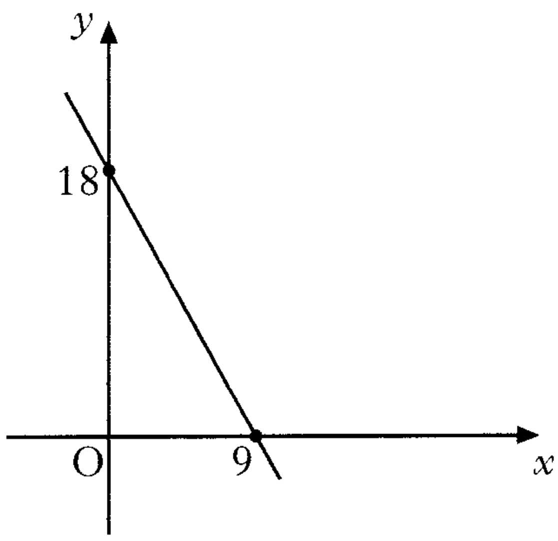
$$W = BH^2 \qquad (\div B)$$

$$\frac{W}{B} = H^2 \qquad (\text{square root})$$

$$\underline{\underline{H = \sqrt{\frac{W}{B}}}}$$

Main Grid

4. A straight line cuts the x-axis at the point $(9, 0)$ and the y-axis at the point $(0, 18)$ as shown.



Find the equation of this line.

3

F

Solution

Main Grid

Q4

$$m = \frac{-18}{9} = -2$$

$$c = 18$$

$$\underline{\underline{y = -2x + 18}}$$

Main Grid

5. Express as a single fraction in its simplest form

$$\frac{1}{p} + \frac{2}{(p+5)}.$$

KU	RE
2	

F

Solution

Main Grid

Q5

$$\frac{1}{p}+\frac{2}{(p+5)}$$

$$=\frac{p+5+2p}{p(p+5)}$$

$$=\underline{\underline{\frac{3p+5}{p(p+5)}}}$$

Main Grid

6. Jane enters a two-part race.

(*a*) She cycles for 2 hours at a speed of $(x + 8)$ kilometres per hour.

Write down an expression in x for the distance cycled. **1**

(*b*) She then runs for 30 minutes at a speed of x kilometres per hour.

Write down an expression in x for the distance run. **1**

(*c*) The **total** distance of the race is 46 kilometres.

Calculate Jane's **running** speed. **3**

F

Q6a $d = st \therefore \quad d = 2(x+8) = \underline{\underline{2x+16}}$

Q6b $d = st \therefore \quad d = \underline{\underline{\frac{1}{2}x}}$

Q6c $2x+16+\frac{1}{2}x = 46$

$$\frac{5}{2}x+16 = 46$$

$$\frac{5}{2}x = 30$$

$$5x = 60$$

$$\underline{\underline{x = 12kph}}$$

Main Grid

7. The 4th term of each number pattern below is the **mean** of the previous three terms.

(*a*) When the first three terms are 1, 6, and 8, calculate the 4th term. **1**

(*b*) When the first three terms are x, $(x + 7)$ and $(x + 11)$, calculate the 4th term. **1**

(*c*) When the first, second and fourth terms are

$$-2x, \qquad (x + 5), \qquad \_\_\_\_, \qquad (2x + 4),$$

calculate the 3rd term. **2**

F

Solution

Main Grid

Q7a

$$\text{Term } 4 = \frac{1+6+8}{3} = \frac{15}{3} = \underline{\underline{5}}$$

Q7b

$$\text{Term } 4 = \frac{x+(x+7)+(x+11)}{3}$$

$$= \frac{3x+18}{3} = \frac{3(x+6)}{3} = \underline{\underline{x+6}}$$

Q7c

$$\frac{-2x+(x+5)+T_3}{3} = (2x+4)$$

$$-2x+(x+5)+T_3 = 3(2x+4)$$

$$-x+5+T_3 = 6x+12$$

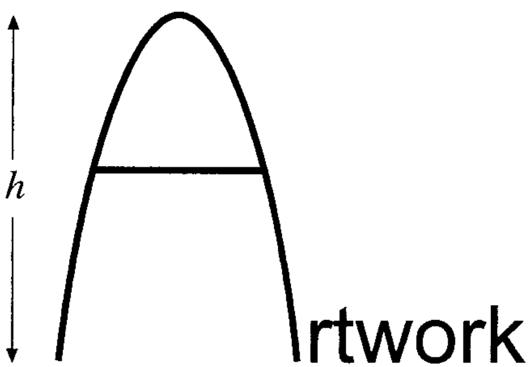
$$T_3 = 6x+12+x-5 = \underline{\underline{7x+7}}$$

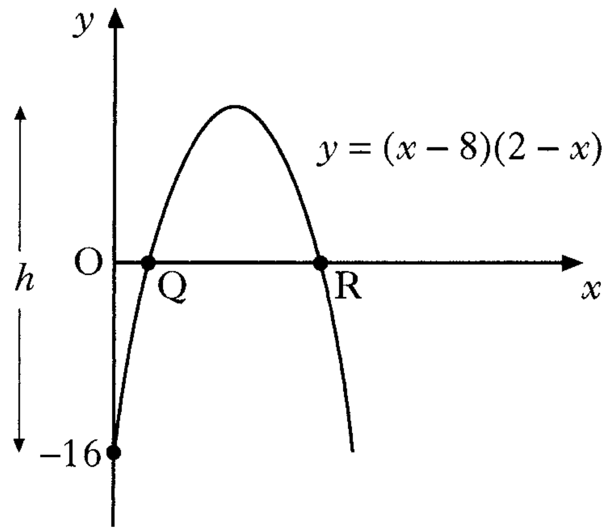
Main Grid

KU	RE

8. The curved part of the letter A in the *Artwork* logo is in the shape of a parabola.

The equation of this parabola is $y = (x - 8)(2 - x)$.





(*a*) Write down the coordinates of Q and R. **2** (KU)

(*b*) Calculate the height, *h*, of the letter A. **3** (RE)

F

Solution

Main Grid

Q8a $\underline{\underline{Q=(2,0)}}$ $\underline{\underline{R=(8,0)}}$

Q8b Mid-point of QR is at $x=5$

at $x=5$: $y=(5-8)(2-5)$

$$y=-3\times-3$$

$$y=9$$

$$\therefore \quad h=9+16=\underline{\underline{25}}$$

Main Grid

9. Simplify

$$m^3 \times \sqrt{m}.$$

2

F

Solution

Main Grid

Q9

$$m^3 \times \sqrt{m} = m^3 \times m^{\frac{1}{2}}$$

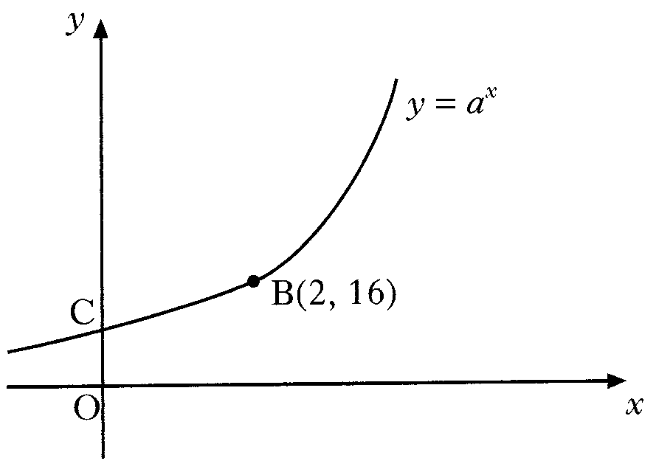
$$= m^{3+\frac{1}{2}}$$

$$= \underline{\underline{m^{\frac{7}{2}}}}$$

Main Grid

KU	RE

10. Part of the graph of $y = a^x$, where $a > 0$, is shown below.



The graph cuts the y-axis at C.

(*a*) Write down the coordinates of C. **1**

B is the point (2, 16).

(*b*) Calculate the value of a. **2**

F

Solution

Main Grid

Q10a

$$\underline{\underline{C = (0,1)}}$$

Q10b

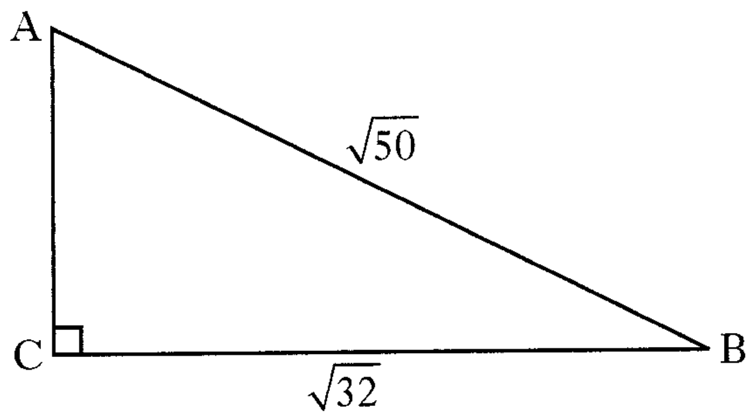
$$\text{at } (2,16):\ 16 = a^2$$

$$a = \sqrt{16}$$

$$\underline{\underline{a = 4}}$$

Main Grid

11. A right angled triangle has dimensions as shown.



Calculate the length of AC, leaving your answer as a surd **in its simplest form**.

3

F

Solution

Main Grid

Q11

$$(AC)^2 = \left(\sqrt{50}\right)^2 - \left(\sqrt{32}\right)^2$$

$$(AC)^2 = 50 - 32$$

$$(AC)^2 = 18$$

$$AC = \sqrt{18}$$

$$AC = \sqrt{9}\sqrt{2}$$

$$\underline{\underline{AC = 3\sqrt{2}}}$$

Main Grid

12. Given that

$$x^2 - 10x + 18 = (x - a)^2 + b,$$

find the values of a and b.

KU	RE
3	

F

Solution

Main Grid

Q12 $x^2 - 10x + 18 = (x-a)^2 + b$

$$x^2 - 10x + 18 = x^2 - 2ax + a^2 + b$$

$$\therefore \quad -2ax = -10$$

$$2a = 10$$

$$\underline{\underline{a = 5}}$$

$$\therefore a^2 + b = 18$$

$$5^2 + b = 18$$

$$25 + b = 18$$

$$\underline{\underline{b = -7}}$$

Main Grid

13. A new fraction is obtained by adding x to the numerator and denominator of the fraction $\frac{17}{24}$.

This new fraction is equivalent to $\frac{2}{3}$.

Calculate the value of x. **3**

F

Solution

Main Grid

Q13

$$\frac{17+x}{24+x}=\frac{2}{3}$$

$$3(17+x)=2(24+x)$$

$$51+3x=48+2x$$

$$3x-2x=48-51$$

$$\underline{\underline{x=-3}}$$

Main Grid

KU	RE
4	

1. A local council recycles 42 000 tonnes of waste a year.

The council aims to increase the amount of waste recycled by 8% each year.

How much waste does it expect to recycle in 3 years time?

Give your answer **to three significant figures**.

F

Solution

Main Grid

Q1

$$42000 \times (1.08)^3 = 52907.9$$

$$= \underline{\underline{52900}}$$

Main Grid

2. In a class, 30 pupils sat a test.

The marks are illustrated by the stem and leaf diagram below.

Test Marks

0	9
1	6 6 7 8
2	0 4 5 7 9 9 9
3	2 2 3 5 5 6 8
4	0 2 3 4 5 5 7 7 8
5	0 0

n = 30 $\qquad$ 1 | 6 = 16

(*a*) Write down the median and the modal mark. **2**

(*b*) Find the probability that a pupil selected at random scored **at least** 40 marks. **1**

F

Solution **Main Grid**

Q2a

$$\text{Median}: \quad 33 \downarrow 35 \qquad\qquad \text{Mode} = \underline{\underline{29}} \ \text{(most often)}$$

$$\underline{\underline{34}}$$

Q2b

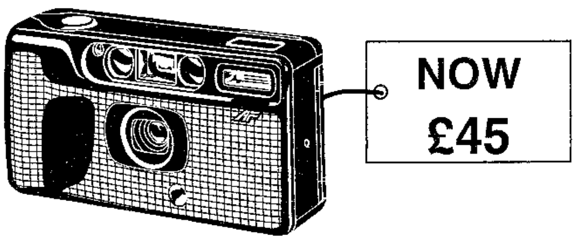
$$P(\text{at least } 40) = \underline{\underline{\frac{11}{30}}}$$

Main Grid

3. In a sale, all cameras are reduced by 20%.

A camera now costs £45.

Calculate the **original** cost of the camera.



3

F

Solution

Main Grid

Q3

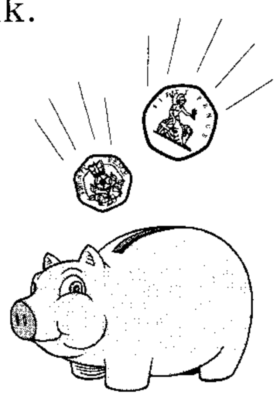
$$C \times 0.8 = 45$$

$$C = 45 \div 0.8 = \underline{\underline{£56.25}}$$

Main Grid

KU	RE

4. Aaron saves 50 pence and 20 pence coins in his piggy bank.



Let x be the number of 50 pence coins in his bank.

Let y be the number of 20 pence coins in his bank.

(*a*) There are 60 coins in his bank.

Write down an equation in x and y to illustrate this information. 1

(*b*) The total value of the coins is £17·40.

Write down another equation in x and y to illustrate this information. 1

(*c*) Hence find **algebraically** the number of 50 pence coins Aaron has in his piggy bank. 3

Solution

Main Grid

Q4

a) $$x + y = 60$$

b) $$\underline{0.5x + 0.2y = 17.40} \quad (\times 5)$$

c) $$x + y = 60$$

$$\underline{2.5x + y = 87}$$

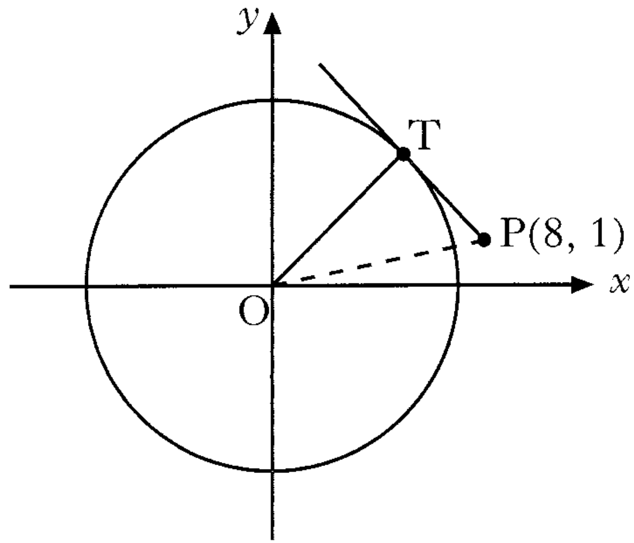
$$1.5x = 27$$

$$\underline{x = 18}$$

Aaron has 18 50p coins in his bank.

5. A circle, centre the origin, is shown.

P is the point (8, 1).



(*a*) Calculate the length of OP. 2

The diagram also shows a tangent from P which touches the circle at T.

The radius of the circle is 5 units.

(*b*) Calculate the length of PT. 2

F

Solution

Main Grid

Q5a

$$OP = \sqrt{8^2 + 1^2} = \underline{\underline{\sqrt{65}}}$$

Q5b

Right-angled triangle because radius meets tangent.

$$(PT)^2 = \left(\sqrt{65}\right)^2 - 5^2$$

$$(PT)^2 = 65 - 25$$

$$(PT)^2 = 40$$

$$PT = \sqrt{40}$$

$$\underline{\underline{PT = 6.32 \text{ units}}}$$

Main Grid

KU	RE
	5

6. The distance, d kilometres, to the horizon, when viewed from a cliff top, varies directly as the square root of the height, h metres, of the cliff top above sea level.

From a cliff top 16 metres above sea level, the distance to the horizon is 14 kilometres.

A boat is 20 kilometres from a cliff whose top is 40 metres above sea level.

Is the boat beyond the horizon?

Justify your answer.

F

Solution

Main Grid

Q6

$$d \alpha \sqrt{h}$$

$$d = k\sqrt{h}$$

$$14 = k\sqrt{16}$$

$$14 = 4k$$

$$\underline{k = 3.5}$$

$$\therefore \quad d = 3.5\sqrt{h}$$

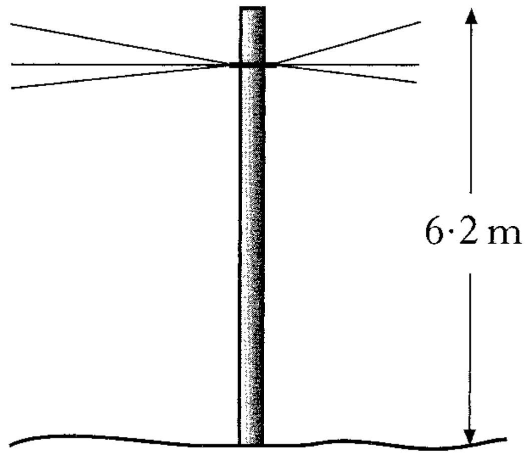
$$h = 40 : d = 3.5 \times \sqrt{40}$$

$$\underline{d = 22.1}$$

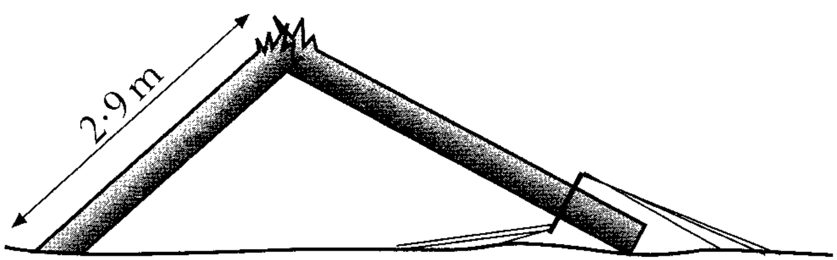
$$\therefore \quad \underline{\underline{\text{no because } 20 \angle 22.1}}$$

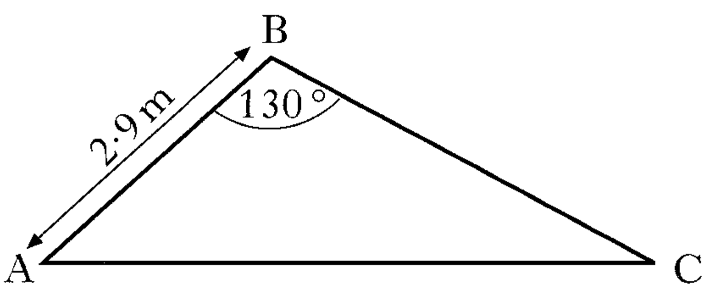
Main Grid

7. A telegraph pole is 6·2 metres high.



The wind blows the pole over into the position as shown below.





AB is 2·9 metres and angle ABC is 130 °.

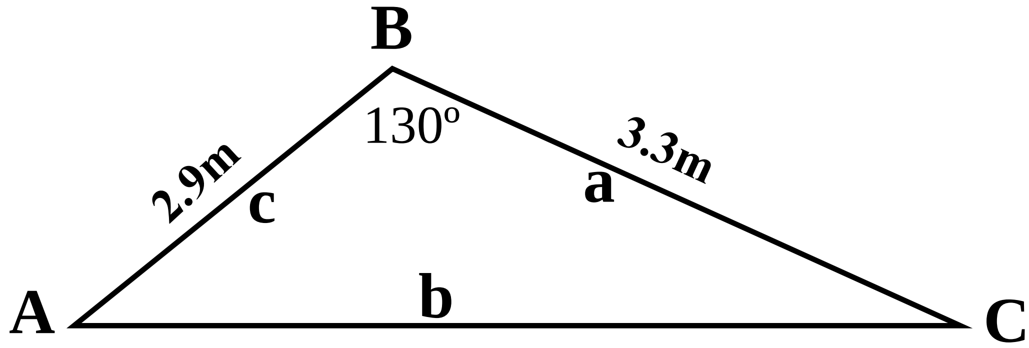
Calculate the length of AC. **4**

F

Solution

Main Grid

Q7



$$b^2 = a^2 + c^2 - 2ac\cos B$$

$$b^2 = 2.9^2 + 3.3^2 - \left(2 \times 2.9 \times 3.3 \times \cos 130^o\right)$$

$$b^2 = 8.41 + 10.89 - \left(-12.3\right)$$

$$b^2 = 31.6$$

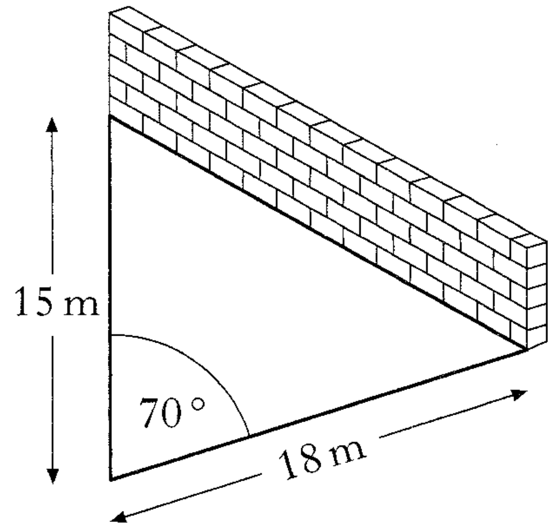
$$b = \sqrt{31.6}$$

$$b = \underline{\underline{5.62m}}$$

Main Grid

KU	RE

8. A farmer builds a sheep-pen using two lengths of fencing and a wall.



The two lengths of fencing are 15 metres and 18 metres long.

(*a*) Calculate the area of the sheep-pen, when the angle between the fencing is 70°. **3**

(*b*) What angle between the fencing would give the farmer the largest possible area? **1**

F

Solution

Main Grid

Q8a

$$A = \frac{1}{2} ab \sin c^{o}$$

$$A = 0.5 \times 15 \times 18 \times \sin 70^{o}$$

$$A = \underline{\underline{126.86 m^{2}}}$$

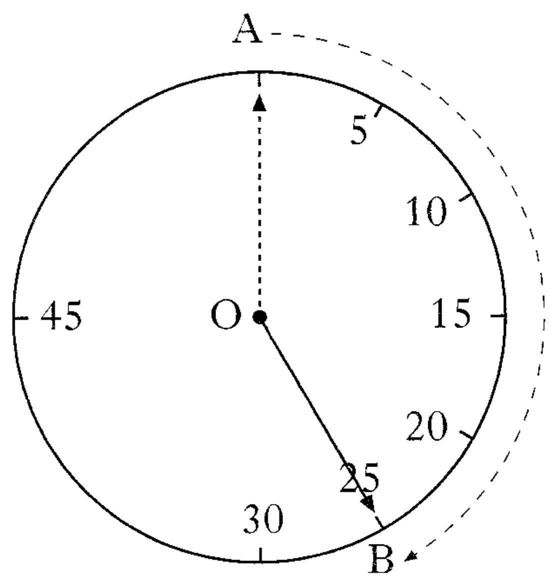
Q8b $\underline{\underline{90^{o} \text{ because } \sin 90^{o} = 1}}$

Main Grid

9. Contestants in a quiz have 25 seconds to answer a question.

This time is indicated on the clock.

The tip of the clock hand moves through the arc AB as shown.



(*a*) Calculate the size of angle AOB. **1**

(*b*) The length of arc AB is 120 centimetres.

Calculate the length of the clock hand. **4**

F

Solution

Main Grid

Q9a

$$\angle AOB = \frac{360}{12} \times 5 = \underline{\underline{150^o}}$$

Q9b

The length of the clock hand is the radius of the circle.

$$\frac{angle}{360} = \frac{arc}{circumference}$$

$$\frac{150}{360} = \frac{120}{2\pi r}$$

$$2\pi r = \frac{120 \times 360}{150}$$

$$2\pi r = 288$$

$$r = \frac{288}{2 \times 3.14} = \underline{\underline{45.6cm}}$$

Main Grid

KU	RE

10. To hire a car costs £25 per day plus a mileage charge.

The first 200 miles are free with each additional mile charged at 12 pence.

> **CAR HIRE**
>
> **£25 per day**
>
> - **<u>first 200</u>** miles free
> - each additional mile only 12p

(*a*) Calculate the cost of hiring a car for 4 days when the mileage is 640 miles. **1**

(*b*) A car is hired for d days and the mileage is m miles where $m > 200$.

Write down a formula for the cost £C of hiring the car. **3**

F

Solution **Main Grid**

Q10a

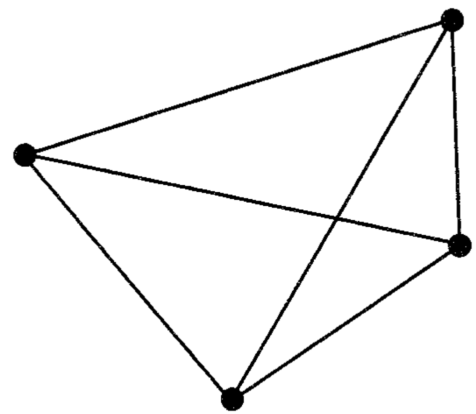
$$\left(25 \times 4\right) + \left(440 \times 0.12\right) = \underline{\underline{£152.80}}$$

Q10b

$$\underline{\underline{C = 4d + 0.12\left(m - 200\right)}}$$

Main Grid

11. The minimum number of roads joining 4 towns to each other is 6 as shown.



The minimum number of roads, r, joining n towns to each other is given by the formula

$$r = \tfrac{1}{2}n(n-1).$$

(*a*) State the minimum number of roads needed to join 7 towns to each other. **1**

(*b*) When $r = 55$, show that $n^2 - n - 110 = 0$. **2**

(*c*) Hence find **algebraically** the value of n. **3**

F

Solution

Main Grid

Q11a

$$r = 0.5 \times 7 \times (7 - 1)$$

$$r = 0.5 \times 7 \times 6 = \underline{\underline{21}}$$

Q11b

$$\frac{1}{2} n(n-1) = 55 \qquad (\times 2)$$

$$n(n-1) = 110$$

$$n^2 - n = 110$$

$$n^2 - n - 110 = 0$$

Q11c

$$(n-11)(n+10) = 0$$

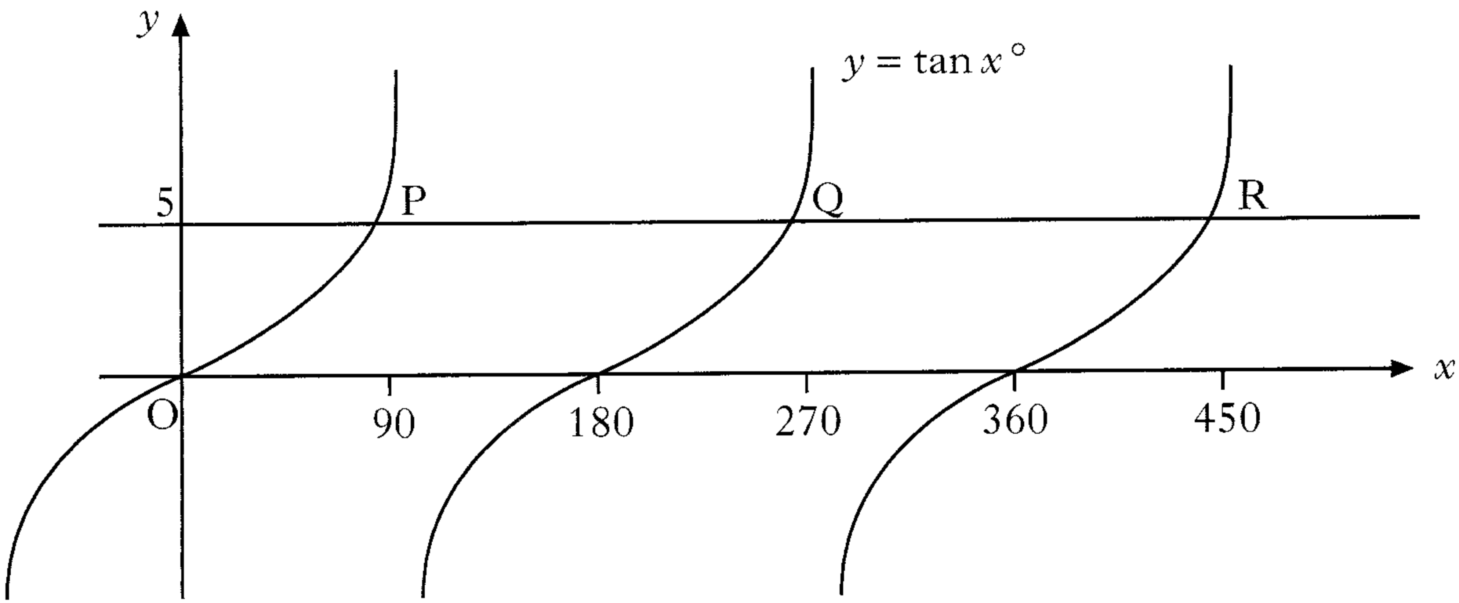
$$\underline{\underline{n = 11}} \qquad \cancel{n = -10}$$

Main Grid

KU	RE

12. The diagram shows part of the graph of $y = \tan x°$.

The line $y = 5$ is drawn and intersects the graph of $y = \tan x°$ at P and Q.



(*a*) Find the x-coordinates of P and Q. **3**

(*b*) Write down the x-coordinate of the point R, where the line $y = 5$ next intersects the graph of $y = \tan x°$. **1**

F

Solution

Main Grid

Q12a

$$\tan^{-1}(5) = 78.7^o$$

$$P = \underline{\underline{78.7^o}}$$

$$Q = 78.7^o + 180^o = \underline{\underline{258.7^o}}$$

Q12b

$$R = 258.7^o + 180^o = \underline{\underline{438.7^o}}$$

Main Grid

F

Main Grid

F

Main Grid