Armadale Academy

National 5 Maths

Procedures

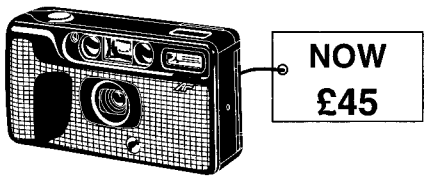
Exam Questions

Contents

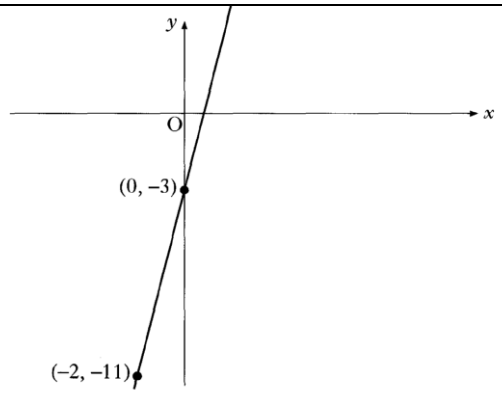
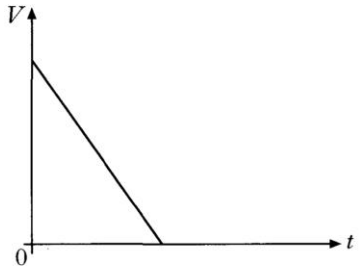
Factorising

2008 P1	**2.** Factorise fully $5x^2 - 45.$	2	
Ans	$5(x - 3)(x + 3)$		
2006 P1	**5.** (*a*) Factorise $4x^2 - y^2.$ (*b*) Hence simplify $\frac{4x^2 - y^2}{6x + 3y}.$	1 2	
Ans	(*a*) $(2x - y)(2x + y)$ (*b*) $\frac{2x - y}{3}$		
2003 P1	**5.** Factorise $2x^2 - 7x - 15.$	2	
Ans	$(2x + 3)(x - 5)$		
2002 P1	**5.** (*a*) Factorise $p^2 - 4q^2$. (*b*) Hence simplify $\frac{p^2 - 4q^2}{3p + 6q}.$	1 2	
Ans	**5.** (*a*) $(p - 2q)(p + 2q)$ (*b*) $\frac{(p - 2q)(p + 2q)}{3(p + 2q)} = \frac{p - 2q}{3}$		
2000 P1	**4.** (*a*) Factorise $x^2 - 16$.	1	
Ans	$(x - 4)(x + 4)$		

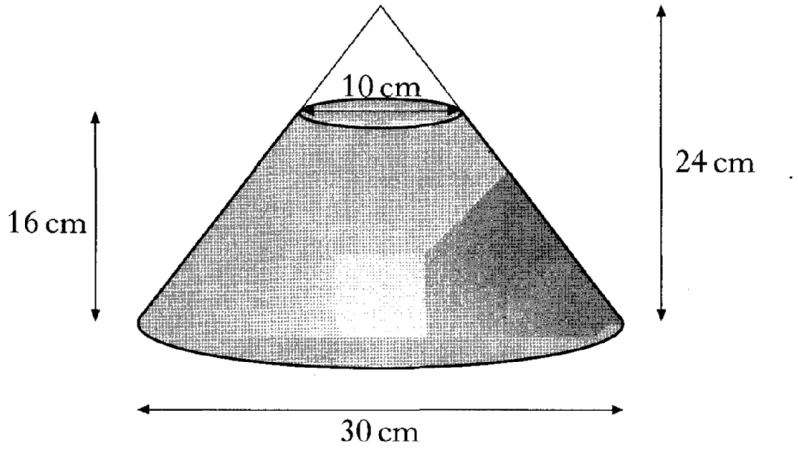
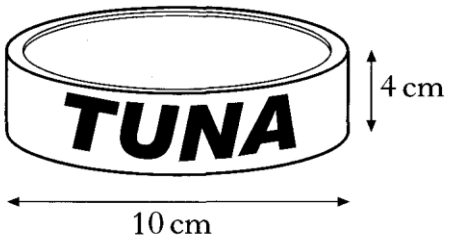
Percentages

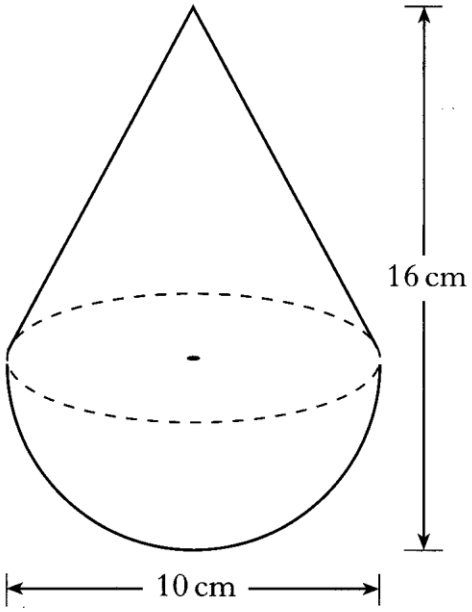
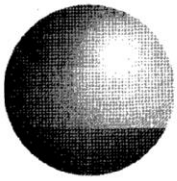
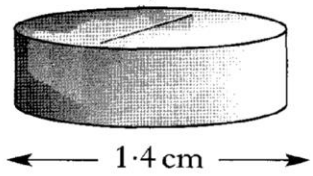
2008 P2	**1.** A local council recycles 42 000 tonnes of waste a year. The council aims to increase the amount of waste recycled by 8% each year. How much waste does it expect to recycle in 3 years time? Give your answer **to three significant figures**.	4	
Ans	52900 tonnes.		
2008 P2	**3.** In a sale, all cameras are reduced by 20%. A camera now costs £45. Calculate the **original** cost of the camera. 	3	
Ans	£56.25		
2007 P2	**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	
Ans	£684.70		
2007 P2	**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?	3	
Ans	£135		
2006 P2	**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	
Ans	£300		
2004 P2	**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?	3	
Ans	128mg		

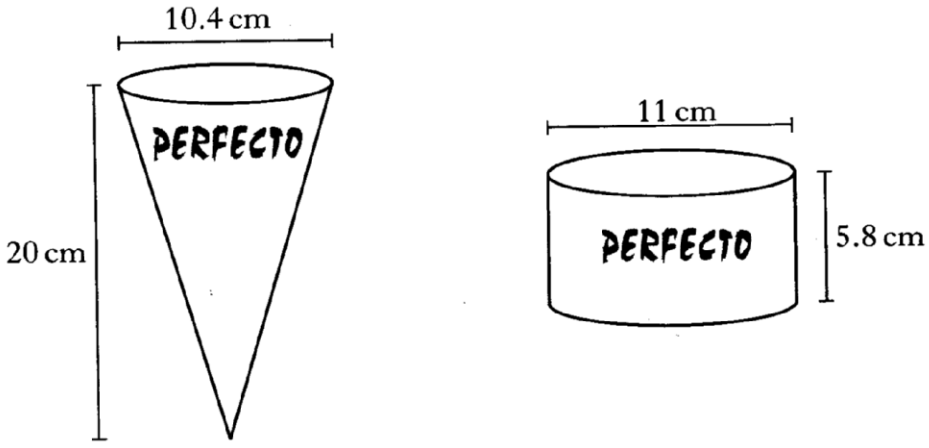
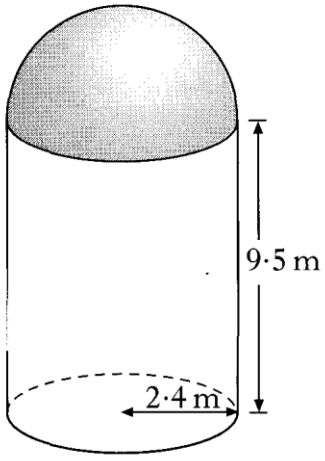
Straight Line

2008 P1 Q1	A straight line has equation $y = 4x + 5$. State the gradient of this line.	1
Ans	*4*	
2007 P1 Q2	 Find the equation of the straight line passing through the points (0, –3) and (–2, –11).	3
Ans	*$y = 4x - 3$*	
2006 P1 Q5	A straight line is represented by the equation $2y + x = 6$. (*a*) Find the gradient of this line. (*b*) This line crosses the y-axis at $(0, c)$. Find the value of c.	2 1
Ans	*(a) -0.5 (b) 3*	
2005 P2 Q3	Á straight line has equation $3y = 12 – 4x$. Find the coordinates of the point where it crosses the x-axis.	2
Ans	*(3 , 0)*	
2003 P2 Q4	A bath contains 150 litres of water. Water is drained from the bath at a steady rate of 30 litres per minute. The graph of the volume, V litres, of water in the bath against the time, t minutes, is shown below.  Write down an equation connecting V and t.	3
Ans	*$V = -30t + 150$*	

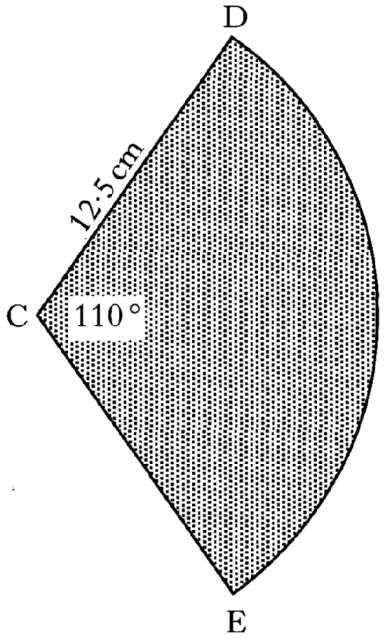
Volume

2007 P2 Q5	A glass ornament in the shape of a cone is partly filled with coloured water.  The cone is 24 centimetres high and has a base of diameter 30 centimetres. The water is 16 centimetres deep and measures 10 centimetres across the top. What is the volume of the water? Give your answer correct to 2 significant figures.	5
Ans	$5400cm^3$	
2007 P1 Q3	A tin of tuna is in the shape of a cylinder.  It has diameter 10 centimetres and height 4 centimetres. Calculate its volume. **Take $\pi = 3{\cdot}14$.**	2
Ans	$314cm^3$	

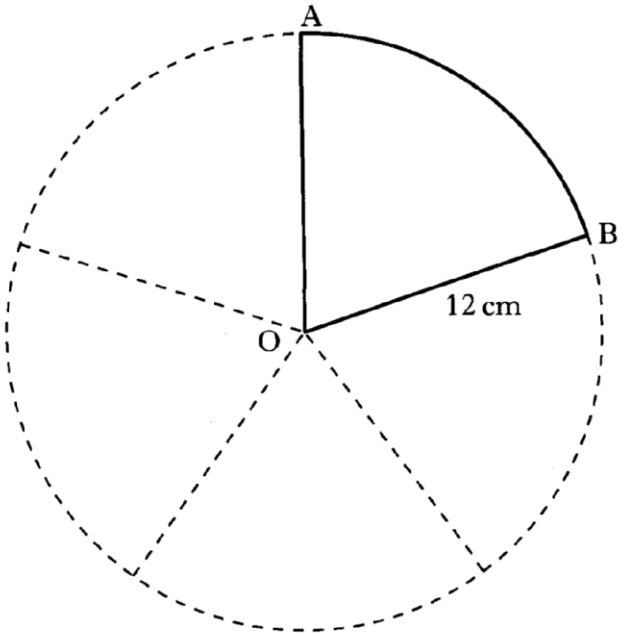
2006 P2 Q3	A child's toy is in the shape of a hemisphere with a cone on top, as shown in the diagram. The toy is 10 centimetres wide and 16 centimetres high. Calculate the volume of the toy. Give your answer correct to 2 significant figures.  	5
Ans	$550cm^3$	
2005 P2 Q7	A pharmaceutical company makes vitamin pills in the shape of spheres of radius 0·5 centimetres.  (*a*) Calculate the volume of **one** pill. Give your answer correct to two significant figures. The company decides to change the shape of each pill to a cylinder.  (*b*) The new pill has the **same** volume as the original and its diameter is 1·4 centimetres. Calculate the height of the new pill.	3 3
Ans	*(a) $0.52cm^3$ (b) 0.34cm*	

2004 P2 Q9	Perfecto Ice Cream is sold in cones and cylindrical tubs with measurements as shown below.  Both the cone and the tub of ice cream cost the same. Which container of ice cream is better value for money? **Give a reason for your answer.**	5
Ans	*Cone is better value since 566.3cm^3 > 551.2cm^3*	
2002W P2 Q4	A grain store is in the shape of a cylinder with a hemisphere on top as shown in the diagram. The cylinder has radius 2·4 metres and height 9·5 metres. Find the volume of the grain store. Give your answer in cubic metres, correct to 1 significant figure.  	4
Ans	*200m^3*	

Arcs and Sectors

2005 P2 Q5	The diagram below shows a sector of a circle, centre C.  The radius of the circle is 12·5 centimetres and angle DCE is 110°. Calculate the area of the sector CDE.	3
Ans	*149.9cm²*	

2004 P2 Q4

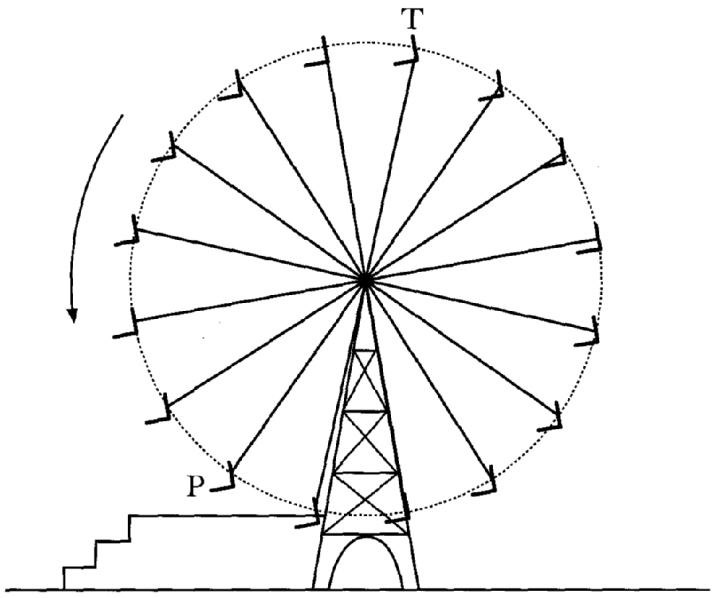


A circle, with centre O and radius 12 centimetres, is cut into 5 equal sectors.
Calculate the perimeter of sector OAB. 3

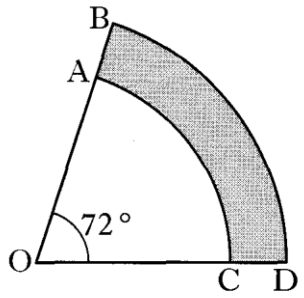
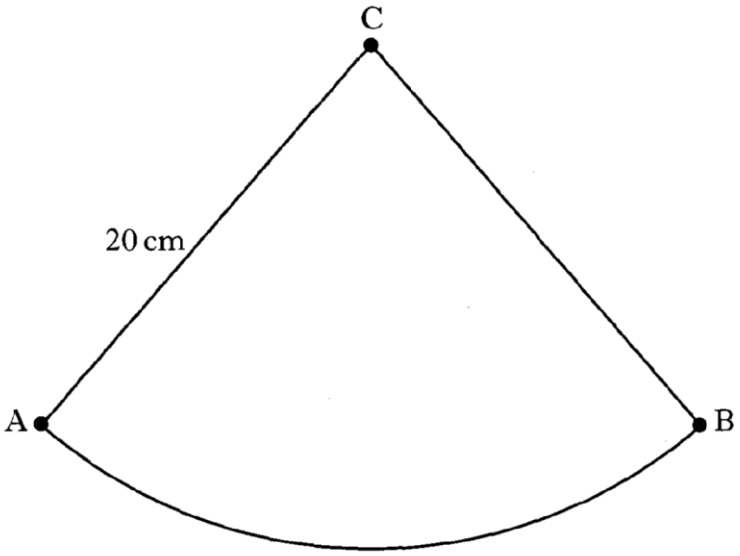
Ans *39.1cm*

2003 P2 Q8

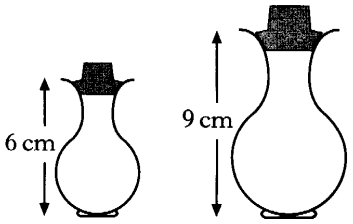
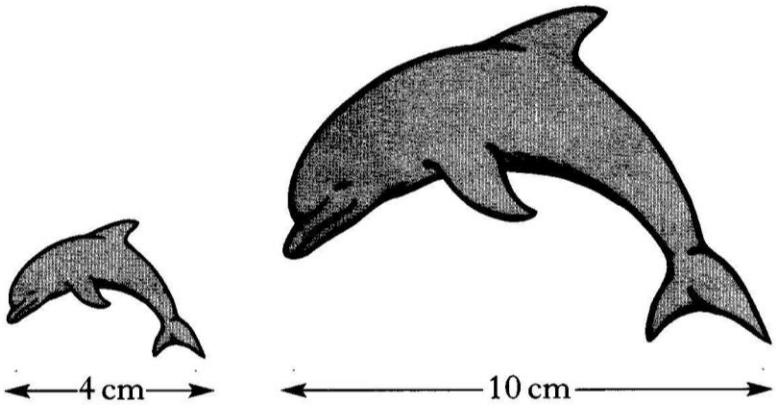
The diagram below shows a big wheel at a fairground.



The wheel has sixteen chairs equally spaced on its circumference.
The radius of the wheel is 9 metres.
As the wheel rotates in an anticlockwise direction, find the distance a chair travels in moving from position T to position P in the diagram. 4

Ans	*24.7m*	
2002W P2 Q2	In the diagram opposite AC and BD are arcs of circles with centres at O. The radius, OA, is 8 metres and the radius, OB, is 10 metres. Angle AOC = 72 °. Find the shaded area. 	4
Ans	*22.6m²*	
2002 P2 Q4	A pendulum travels along an arc of a circle, centre C.  The length of the pendulum is 20 centimetres. The pendulum swings from A to B. The length of the arc AB is 28·6 centimetres. Find the angle through which the pendulum swings from A to B.	4
Ans	*82°*	

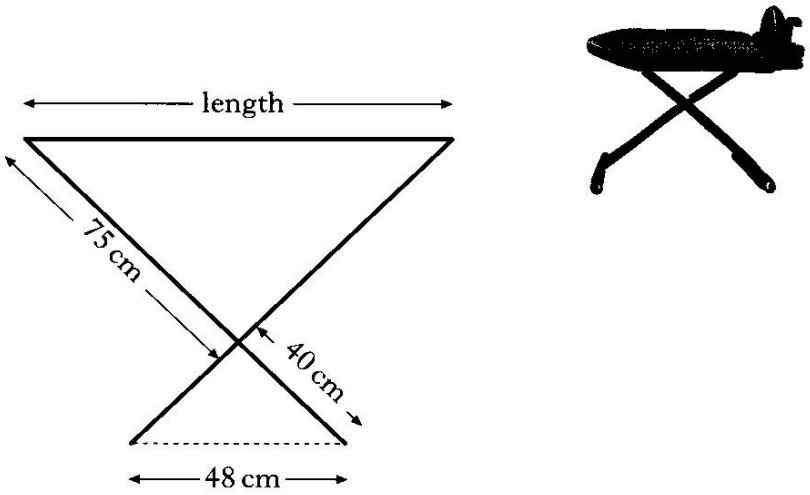
Similarity

2003 P2 Q9	**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?	3
Ans:	101.25 ml	
2009 P2 Q4	**4.** Two fridge magnets are mathematically similar. One magnet is 4 centimetres long and the other is 10 centimetres long.  The area of the smaller magnet is 18 square centimetres. Calculate the area of the larger magnet.	3
Ans	112.5 cm^2	

2007 P1 Q8

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

Ans: 90cm, yes since 90< 80

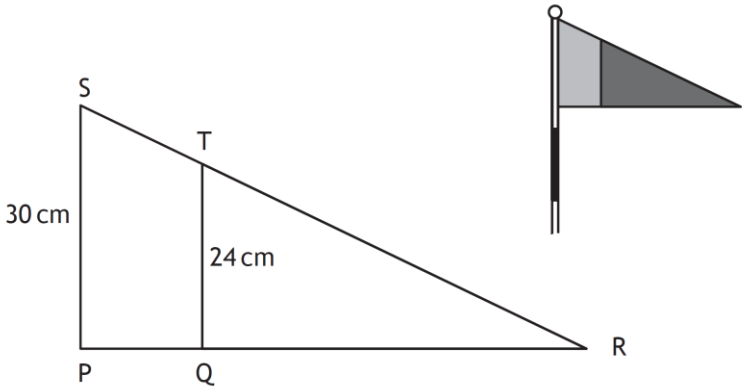
2015 P2 Q9

9. The flag at each hole on a golf course is coloured red and blue.

The diagram below represents a flag.

Triangle QRT represents the red section.

PQTS represents the blue section.



Triangles PRS and QRT are mathematically similar.

The area of triangle QRT is 400 square centimetres.

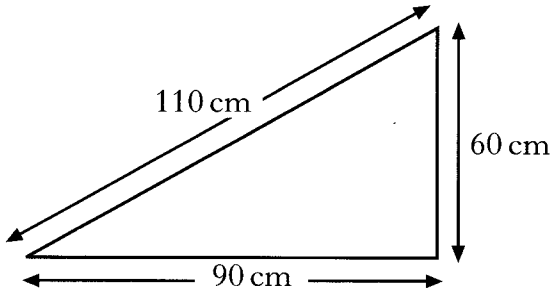
Calculate the area of PQTS, the blue section of the flag.

Ans: 225 cm^2

Converse of Pythagoras

2005 P2

5. A triangular paving slab has measurements as shown.



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

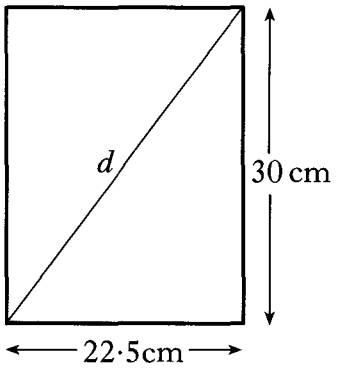
Show your working. *3*

Ans *It is not right angled.*

2000 P2

8. A **rectangular** picture frame is to be made.

It is 30 centimetres high and 22·5 centimetres wide, as shown.



To check that the frame is rectangular, the diagonal, d, is measured.

It is 37·3 centimetres long.

Is the frame rectangular? 4

Ans

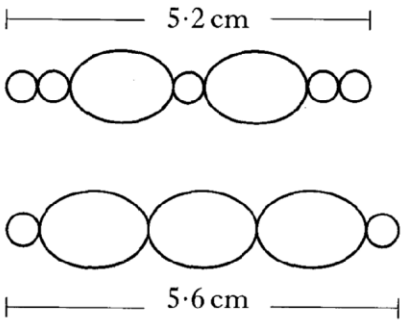
$d^2 \neq 22 \cdot 5^2 + 30^2$

Frame is not rectangular

Standard Deviation

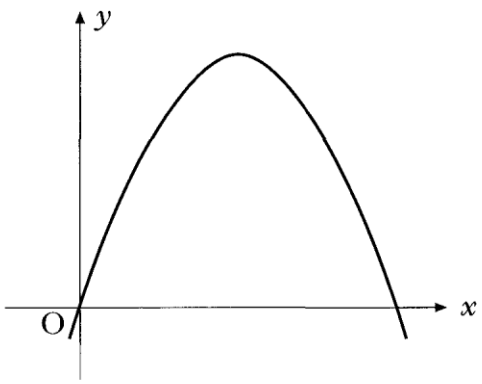
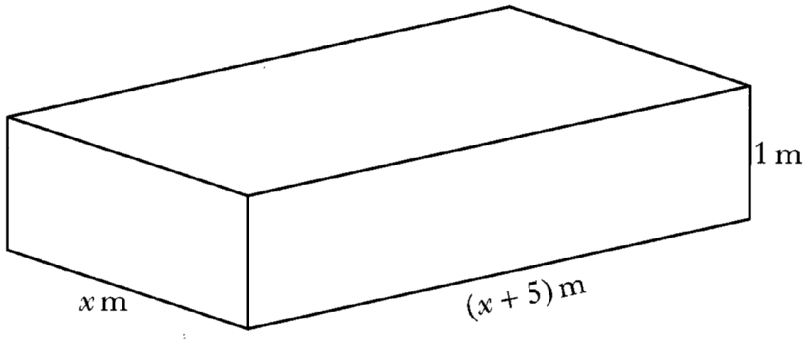
2002 P2 Q2	**2.** (*a*) The pulse rates, in beats per minute, of 6 adults in a hospital waiting area are: 68 73 86 72 82 78. Calculate the mean and standard deviation of this data.	3
Ans	S = 6.74	
2003 P2 Q2	**2.** **Fiona checks** out the price of a litre of milk in several shops. **The prices** in pence are: 49 44 41 52 47 43. **(*a*) Find the mean price of a litre of milk.** **(*b*) Find the standard deviation of the prices.**	2 1
Ans	a) 46 b) s = 4.1	
2004 P2 3	**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
Ans	1.41	
2005 P2 Q2	**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
Ans	7.09	

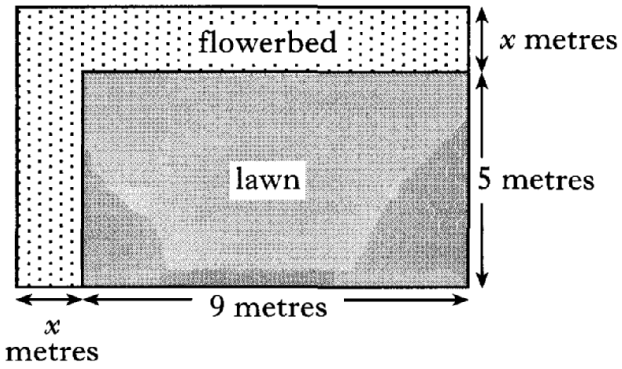
Simultaneous Equations

2008 P2 Q4	Suzie has a new mobile phone. She is charged x pence per minute for calls and y pence for each text she sends. During the first month her calls last a total of 280 minutes and she sends 70 texts. Her bill is £52·50. (*a*) Write down an equation in x and y which satisfies the above condition. The next month she reduces her bill. She restricts her calls to 210 minutes and sends 40 texts. Her bill is £38·00. (*b*) Write down a second equation in x and y which satisfies this condition. (*c*) Calculate the price per minute for a call and the price for each text sent.	1 1 4
Ans	*(a) 280x + 70y = 5250 (b) 210x + 40y = 3800 (c) Call = 16p per minute , Text = 11p*	
2007 P1 Q4	Find the point of intersection of the straight lines with equations $x + 2y = -5$ and $3x - y = 13$.	4
Ans	*(3,-4)*	
2006 P2 Q2	Solve algebraically the system of equations $4x + 2y = 13$ $5x + 3y = 17$.	3
Ans	*x = 2.5 , y = 1.5*	
2005 P2 Q4	A jeweller uses two different arrangements of beads and pearls.  The first arrangement consists of 2 beads and 5 pearls and has an overall length of 5·2 centimetres. The second arrangement consists of 3 beads and 2 pearls and has an overall length of 5·6 centimetres. Find the length of **one** bead and the length of **one** pearl.	6
Ans	*Bead = 1.6cm , Pearl = 0.4cm*	

2004 P2 Q5	A sports centre charges different entrance fees for adults and children. (*a*) One evening 14 adults and 4 children visited the sports centre. The total collected in entrance fees was £55·00. Let £x be the adult's entrance fee and £y be the child's entrance fee. Write down an equation in x and y which represents the above condition. (*b*) The following evening 13 adults and 6 children visited the sports centre. The total collected in entrance fees was £54·50. Write down a second equation in x and y which represents the above condition. (*c*) Calculate the entrance fee for an adult and the entrance fee for a child.	1 1 4
Ans	*(a) 14x + 4y = 55 (b) 13x + 6y = 54.5 (c) Adult = £3.50 , Child = £1.50*	
2003 P2 Q3	Seats on flights from London to Edinburgh are sold at two prices, £30 and £50. On one flight a total of 130 seats was sold. Let x be the number of seats sold at £30 and y be the number of seats sold at £50. (*a*) Write down an equation in x and y which satisfies the above condition. The sale of the seats on this flight totalled £6000. (*b*) Write down a second equation in x and y which satisfies this condition. (*c*) How many seats were sold at each price?	1 1 4
Ans	*(a) x + y = 130 (b) 30x + 50y = 6000 (c) 25 seats at £30 and 105 seats at £50*	
2002W P2 Q5	At an amusement park, the Green family buy 3 tickets for the ghost train and 2 tickets for the sky ride. The total cost is £8·60. (*a*) Let x pounds be the cost of a ticket for the ghost train and y pounds be the cost of a ticket for the sky ride. Write down an equation in x and y which satisfies the above condition. (*b*) The Black family bought 5 tickets for the ghost train and 3 tickets for the sky ride at the same amusement park. The total cost was £13·60. Write down a second equation in x and y which satisfies this condition. (*c*) Find the cost of a ticket for the ghost train and the cost of a ticket for the sky ride.	1 1 4
Ans	*(a) 3x + 2y = 8.60 (b) 5x + 3y = 13.60 (c) x = £1.40 , y = £2.20*	

Quadratics - Factorising

2007 P1 Q7a	The graph shown below is part of the parabola with equation $y = 8x - x^2$.  (*a*) By factorising $8x - x^2$, find the roots of the equation $8x - x^2 = 0$.	2
Ans	$x = 0$, $x = 8$	
2006 P2 Q11	A cuboid is shown below.  It has length $(x + 5)$ metres, breadth x metres, height 1 metre and volume 24 cubic metres. (*a*) Show that $x^2 + 5x - 24 = 0$. (*b*) Using the equation in part (*a*), find the breadth of the cuboid.	2 3
Ans	*(a) Proof (b) 3metres*	

2003 P1 Q8b	(*a*) Factorise $7 + 6x - x^2$. (*b*) Hence write down the roots of the equation $7 + 6x - x^2 = 0$.	2 1
Ans	*(a) (7 - x)(1 + x) (b) x = 7 , -1*	
2002W P1 Q7	 The diagram shows a rectangular garden which consists of a rectangular lawn and a flowerbed along two sides of the lawn • the lawn measures 9 metres by 5 metres • the width of the flowerbed is x metres. (*a*) State the length and breadth of the garden. (*b*) Show that the area, A square metres, of the garden is given by $A = x^2 + 14x + 45$. (*c*) The area of the garden is 77 square metres. Find the width of the flowerbed. **Show clearly all your working.**	1 2 3
Ans	*(a) Length = 9+x , Breadth = 5+x (b) Proof (c) Width = 2 metres*	

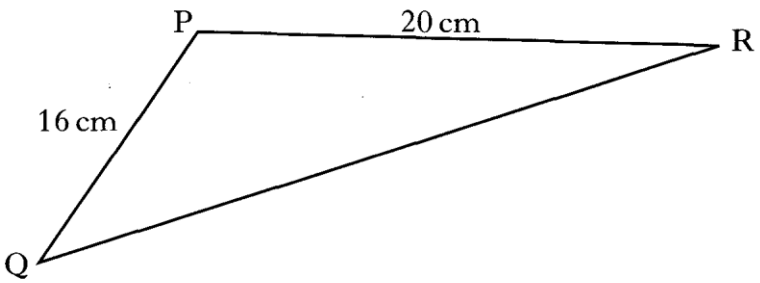
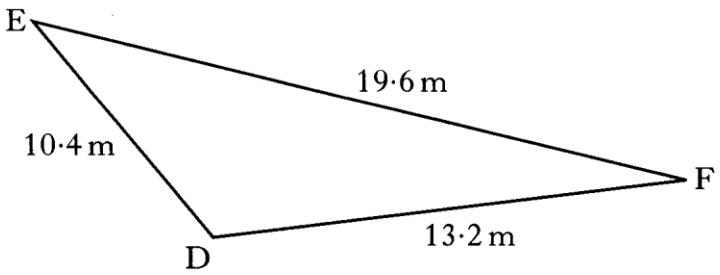
Quadratics – Formula

2008 P2 Q6	Solve the equation $5x^2 + 4x - 2 = 0,$ giving the roots correct to 2 decimal places.	4
Ans	*0.35 , -1.1*	
2007 P2 Q8	Solve the equation $2x^2 - 6x - 5 = 0,$ giving the roots correct to one decimal place.	4
Ans	*-0.7 , 3.7*	
2005 P2 Q8	Solve the equation $4x^2 - 7x + 1 = 0$ giving the roots correct to one decimal place.	4
Ans	*1.6 , 0.2*	
2004 P2 Q6	Solve the equation $2x^2 + 7x - 3 = 0$, giving the roots correct to one decimal place.	4
Ans	*-3.9 , 0.4*	
2003 P2 Q9	Solve the equation $2x^2 + 4x - 9 = 0,$ giving the roots correct to one decimal place.	4
Ans	-3.3 , 1.3	
2002W P2 Q8	Solve the equation $2p^2 - 3p - 1 = 0,$ giving the roots correct to 1 decimal place.	4
Ans	*-0.3 , 1.8*	

Discriminant

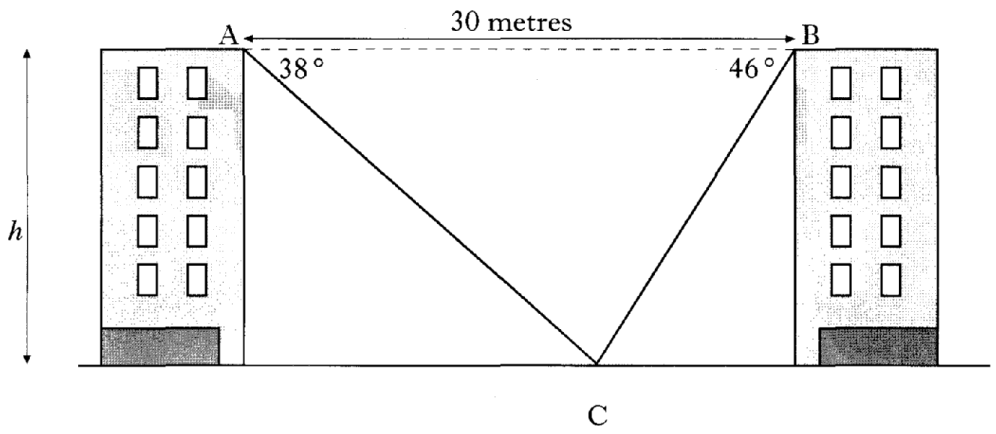
	The following words can be used to describe the roots of a quadratic. I Real II Equal III Distinct IV Non-real V Rational VI Irrational Which of the above words can be used to describe the roots of the equation $2x^2 + 3x - 4 = 0$?	
Ans	41, real, irrational and distinct	
	(a) Find the value of the discriminant for the quadratic equation $x^2 - 5x + 3 = 0$ **(b)** Use the discriminant to state the nature of the roots in part (a).	
Ans	**(a)** 13 **(b)** real, irrational and distinct	
	For what values of p does the equation $x^2 - 2x + p = 0$ have equal roots?	
Ans	1	
	The roots of a quadratic equation can be described as: I Real II Equal III Distinct IV Non-real V Rational VI Irrational Which of the above can be used to describe the roots of the equation $3x^2 - 4x + 5 = 0$?	
Ans	Non real	
	Determine the nature of the roots for the quadratic equation $x^2 - 5x + 3 = 0$.	
Ans	13, real, irrational and distinct	
2016 P1 Q6	Determine the nature of the roots of the function $f(x) = 7x^2 + 5x - 1$.	*2*
Ans	53, roots are real and distinct.	

Trig in Triangles

2008 P1 Q6	Triangle PQR is shown below.  If sin P = $\frac{1}{4}$, calculate the area of triangle PQR.	2
Ans	$40cm^2$	
2008 P2 Q5	Triangle DEF is shown below.  It has sides of length 10·4 metres, 13·2 metres and 19·6 metres. Calculate the size of angle EDF. **Do not use a scale drawing.**	3
Ans	111.8^o	

2007 P2 Q9

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



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

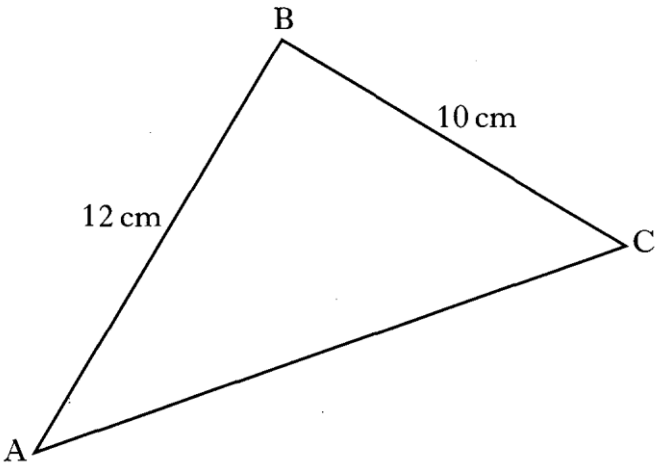
To calculate the height, h, of each block of flats, a surveyor measures the angles of depression from A and B to C.

From A, the angle of depression is 38 °.
From B, the angle of depression is 46 °.
The distance AB is 30 metres.

Calculate the height, h, in metres. 5

Ans *13.4 metres*

2006 P1 Q4



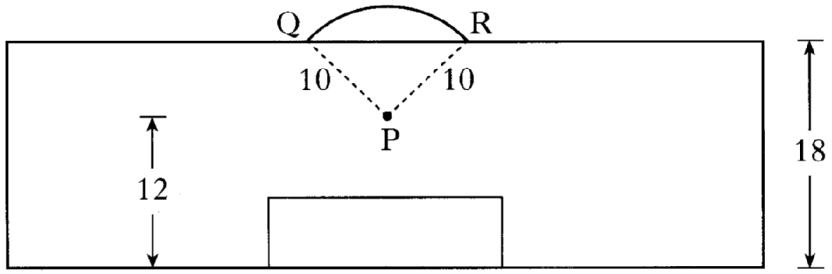
Calculate the area of triangle ABC if $\sin B = \frac{2}{3}$. 2

Ans *40cm²*

2006 P2 Q8

The diagram shows the penalty area in a football pitch.

All measurements are given in yards.



The penalty spot is marked at point P.

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

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

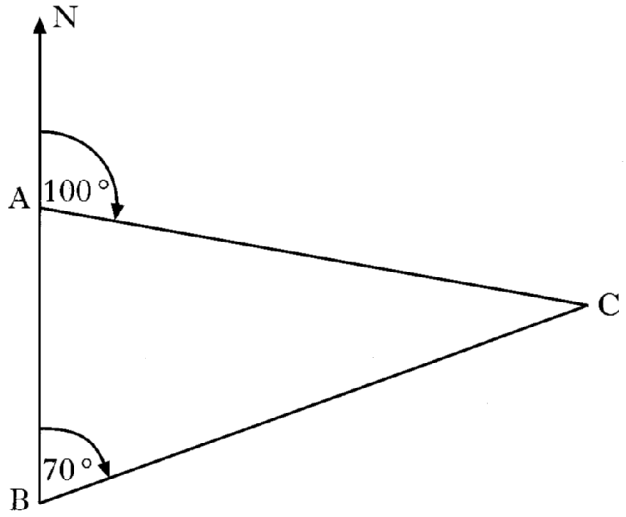
(*a*) Calculate the size of angle QPR. 3

(*b*) Calculate the length of arc QR. 2

Ans *(a) 106.3°* *(b) 18.6 yards*

2006 P2 Q10

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



Alan sets off from campsite A on a bearing of 100° at an average speed of 5·6 kilometres per hour.

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

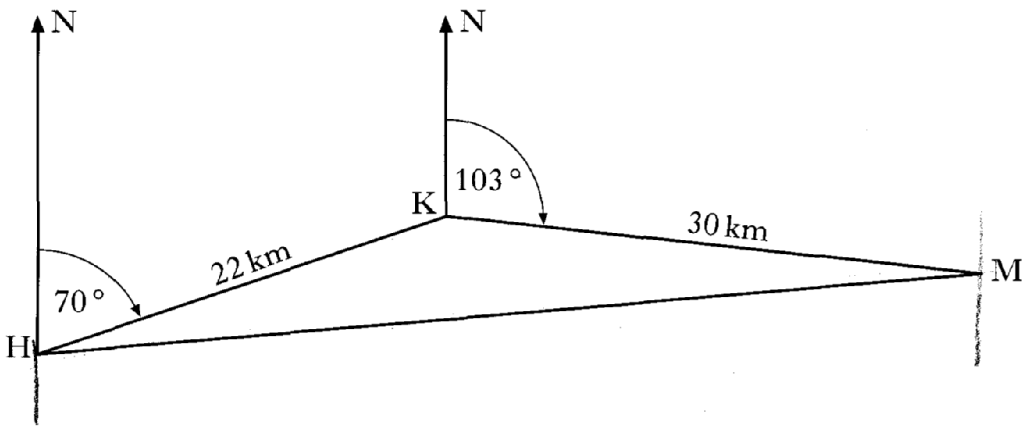
After 3 hours they both arrive at campsite C.

Who has the faster average speed and by how much? 5

Ans *Bob has the faster average speed by 0.3kmph.*

2005 P2 Q6

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



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

(*a*) (i) Calculate the size of angle HKM. 1

(ii) Calculate the total distance travelled by the helicopter. 3

Do not use a scale drawing.

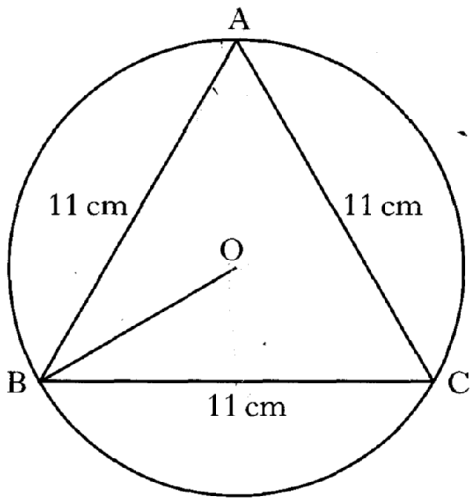
(*b*) A climber is reported missing somewhere in the triangle represented by HKM in the diagram.

Calculate the area of this triangle. 2

Ans *(a)(i) 147° (ii) 101.9km (b) 179.7km^2*

2005 P2 Q9

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



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

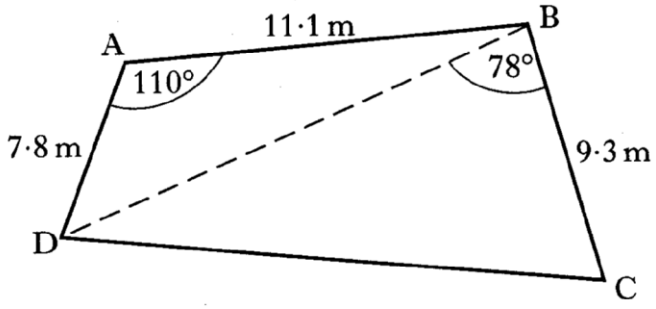
(*a*) Write down the size of angle OBC. 1

(*b*) Calculate the length of the radius OB. 3

Ans *(a) 30° (b) 6.35cm*

2004 P2 Q7

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



Calculate:

(*a*) the length of the diagonal BD; 3

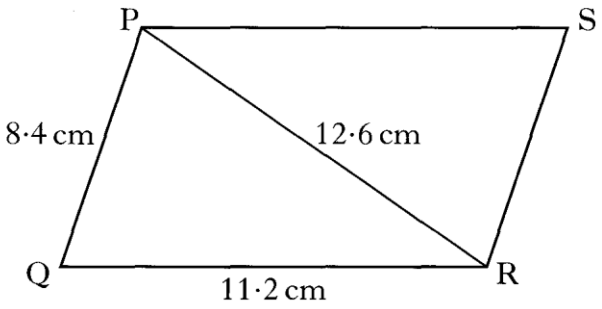
Do not use a scale drawing

(*b*) the area of the garden. 4

Ans *(a) 15.6 metres (b) 111.6m^2*

2003 P2 Q10

The sketch shows a parallelogram, PQRS.



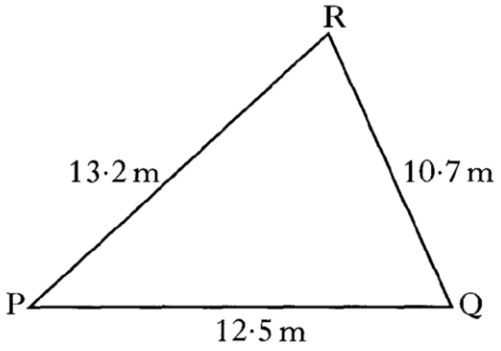
(*a*) Calculate the size of angle PQR. 3
Do not use a scale drawing.

(*b*) Calculate the area of the parallelogram. 3

Ans *(a) 78.6° (b) 92.2cm²*

2002W P2 Q7

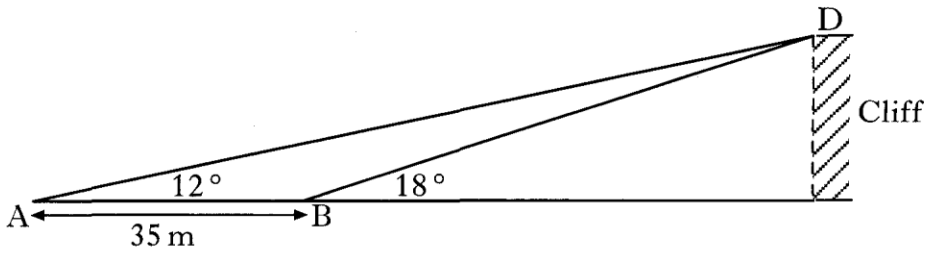
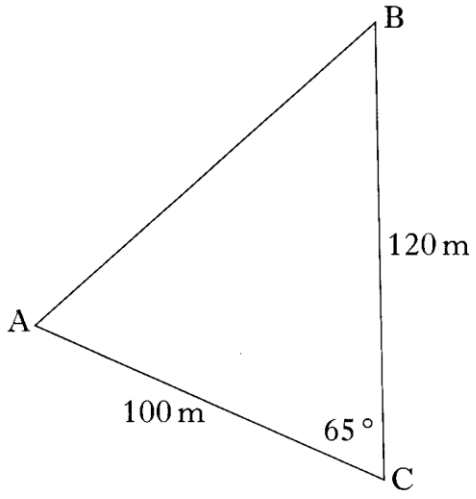
A field with sides measuring 12·5 metres, 13·2 metres and 10·7 metres is represented by the triangle PQR shown below.



(*a*) Calculate the size of angle PQR. 3
Do not use a scale drawing.

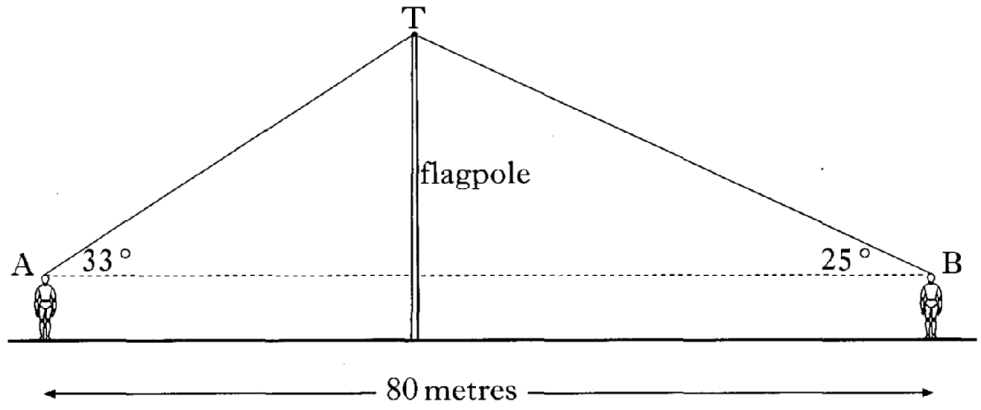
(*b*) Calculate the area of the field. 2

Ans *(a) 68.9° (b) 62.4m²*

2002W P2 Q9	To calculate the height of a cliff, a surveyor measures the angle of elevation at two positions A and B as shown in the diagram below.  At A, the angle of elevation to D, the top of the cliff, is 12°. At B, the angle of elevation to D is 18°. AB is 35 metres. Calculate the height of the cliff.	5
Ans	*21.5m*	
2002 P2 Q1	The sketch shows a triangle, ABC.  Calculate the area of the triangle.	2
Ans	*5438m²*	

2002 P2 Q8

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



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

From position B, the angle of elevation to T at the top of the flagpole is 25°.

The distance AB is 80 metres and the height of the surveyor to eye level is 1·6 metres.

Find the height of the flagpole. 6

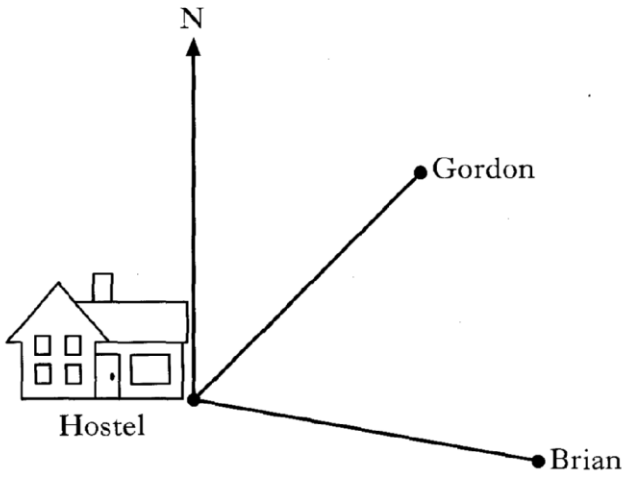
Ans *23.3m*

2001 P2 Q4

Gordon and Brian leave a hostel at the same time.

Gordon walks on a bearing of 045° at a speed of 4·4 kilometres per hour.

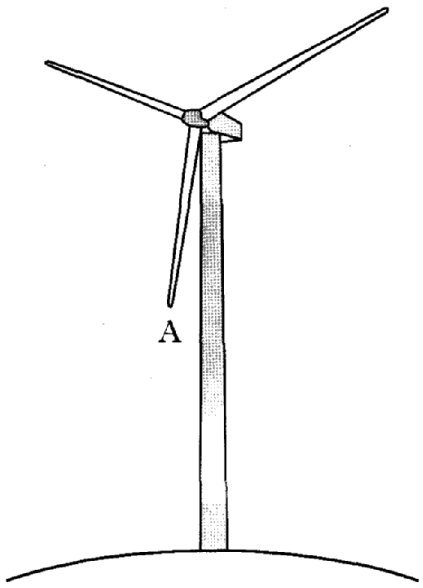
Brian walks on a bearing of 100° at a speed of 4·8 kilometres per hour.

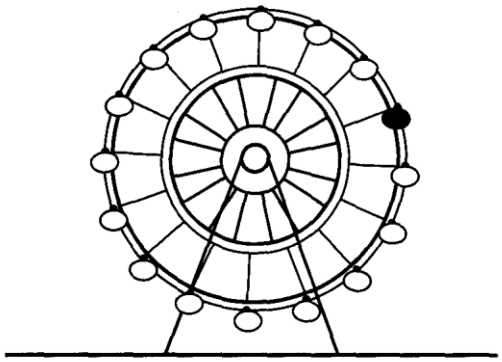


If they both walk at steady speeds, how far apart will they be after 2 hours? 5

Ans *8.5km*

Trig Equations

2008 P2 Q8	Solve the equation $4\cos x° + 3 = 0, \qquad 0 \le x \le 360.$	3
Ans	*138.6°, 221.4°*	
2007 P2 Q13	Solve the equation $5\tan x° - 6 = 2, \qquad 0 \le x < 360.$	3
Ans	*58°, 238°*	
2006 P2 Q12	The arms on a wind turbine rotate at a steady rate.  The height, h metres, of a point A above the ground at time t seconds is given by the equation $h = 8 + 4\sin t°.$ (*a*) Calculate the height of point A at time 30 seconds. (*b*) Find the **two** times during the first turn of the arms when point A is at a height of 10·5 metres.	2 4
Ans	*(a) 10m (b) 38.7 seconds , 141.3 seconds*	
2005 P2 Q11a	Solve the equation $7\cos x° - 5 = 0, \qquad 0 \le x < 360.$	3
Ans	*44.4°, 315.6°*	

2004 P2 Q10	Solve the following equation for $0 \le x \le 360$. $7 \sin x^\circ - 3 = 0$	3
Ans	*25.4°, 154.6°*	
2003 P2 Q12a	Solve the equation $2 \tan x^\circ + 7 = 0, \qquad 0 \le x < 360.$	3
Ans	*106°, 286°*	
2002W P2 Q11	Solve the equation $2 \tan x^\circ + 4 = 5, \quad 0 \le x < 360.$	3
Ans	*26.6°, 206.6°*	
2002 P2 Q12	At the carnival, the height, H metres, of a carriage on the big wheel above the ground is given by the formula $H = 10 + 5 \sin t^\circ,$ t seconds after starting to turn.  (*a*) Find the height of the carriage above the ground after 10 seconds. (*b*) Find the **two** times during the first turn of the wheel when the carriage is 12·5 metres above the ground.	2 4
Ans	*(a) 10.9 metres (b) 30 and 150 seconds*	
2001 P2 Q11a	Solve the equation $4 \tan x^\circ + 5 = 0, \qquad 0 \le x \le 360.$	3
Ans	*128.7°, 308.7°*	