Mathematics GCSE. Edexcel Linear paper. Higher tier.

Calc/ Non-calc	Topic	Grade	Example questions	Self-assessment
	Squares, Cubes and Index Laws	C	Work out a $\dfrac{\sqrt[2]{81}}{3} \times 4^2$ b $\left(\sqrt[3]{216}\right)^2$ c $\left(\sqrt{49}\right)^3$ d $\dfrac{7^2 + \sqrt[3]{1}}{\sqrt[3]{8}}$	
	HCF and LCM	C	A car's service book states that the air filter must be replaced every 10 000 miles and the diesel fuel filter every 24 000 miles. After how many miles will both need replacing at the same time?	
	Fractions (proper & improper), Mixed numbers	C	Tammy watches two films. The first film is $1\frac{3}{4}$ hours long and the second one is $2\frac{1}{3}$ hours long. Work out the total length of the two films. Jed buys some oranges. He sells $\frac{3}{5}$ of these oranges. Of the oranges he has left, $\frac{1}{4}$ are bad. Jed throws these away. He now has 24 oranges left. How many oranges did Jed buy?	

	Decimals, Estimation	C	Rob's tariff for his mobile phone is shown in the box on the right. a Calculate his monthly bill if he made 100 minutes of calls and 60 texts. b In one particular month, the number of texts and calls were the same. If his bill was £8, how many texts did he send? **Tariff box:** No monthly fee / Calls — 15p per minute anytime / Texts — 10p per text to any network Work out an estimate for the value of each of these. In each case state whether your answer is an overestimate or an underestimate. a $\dfrac{5.4 \times 3.2}{0.187}$ b $\dfrac{0.32}{0.001\,95}$ c $\dfrac{0.88 \times 0.37}{0.131}$ d $\dfrac{59 \times 36}{0.415}$ e $\dfrac{0.32 \times 320}{0.195 \times 0.012}$	YES / OK / NO
	Percentages	D	Jessica's annual income is £12 000. She pays $\frac{1}{4}$ of the £12 000 in rent. She spends 10% of the £12 000 on clothes. Work out how much of the £12 000 Jessica has left.	YES / OK / NO
	Indices, Standard Form, Surds	A A*	a i Write 7900 in standard form ii Write 0.000 35 in standard form. b Work out $\dfrac{4 \times 10^3}{8 \times 10^{-5}}$ Give your answer in standard form. $8\sqrt{8}$ can be written in the form 8^k. a Find the value of k. $8\sqrt{8}$ can also be expressed in the form $m\sqrt{2}$ where m is a positive integer. b Find the value of m. c Rationalise the denominator of $\dfrac{1}{8\sqrt{8}}$. Give your answer in the form $\dfrac{\sqrt{2}}{p}$ where p is a positive integer.	YES / OK / NO

	Ratio	C	Which bottle of tomato ketchup gives better value for money? Show all your calculations. 720 g £1.79 460 g £1.00	YES OK NO
	Sequences, Expressions	B	The nth even number is $2n$. Show algebraically that the sum of three consecutive even numbers is always a multiple of 6. _Nov 2008, adapted_	YES OK NO
		A	a Simplify $\left(\dfrac{9p^4}{4y^2}\right)^{\frac{1}{2}}$ b Simplify $(2q^3)^{-2}$ c Simplify $\left(\dfrac{12xy^3}{3x^5y}\right)^{\frac{1}{2}}$	
	Expanding brackets, Factorising	C	Expand and simplify $(x+4)(x-3)$	YES OK NO
		B	Factorise a $t^2 + 11t + 30$ b $x^2 + 14x + 49$ c $p^2 + 2p - 15$ d $y^2 - 12y + 36$ e $x^2 - 5x + 4$ f $s^2 - 64$	
		A	Factorise a $x^2 - 400$ b $9t^2 - 4$ c $100 - y^2$ d $25 - 4p^2$	
		A*	Factorise a $2x^2 + 5x + 2$ b $2w^2 + 5w - 3$ c $3a^2 + 14a + 8$ d $30z^2 - 23z + 2$ e $8y^2 + 23y - 3$ f $6p^2 - pq - q^2$	

	Graphs		

B

Copy and complete the following table.

Equation of line	Gradient	y-intercept
$y = 2x + 5$		
	7	-3
$y = 6 - x$		
	$\frac{2}{3}$	-1
	-4	3

A

The point P (3, k) lies on the line with equation $y = 2x + 1$.
Show that P also lies on the line with equation $y = 3x - 2$.

Formulae

C

$$y = \frac{a^2 - c^2}{a^2 + c^2} \qquad a = 3.2, \qquad c = 1.6$$

Work out the value of y.

Algebraic functions, Algebraic proof

A*

Show that $25 - \dfrac{(x - 8)^2}{4} = \dfrac{(2 + x)(18 - x)}{4}$

	Shape, Measure	**D**	Here is a biohazard sign.
			
			a How many lines of symmetry has this sign?
			b What is the order of rotational symmetry of this sign?
			c John has to fix this sign on a wall.
			  All he knows is that the sign has to be fixed with a corner pointing upwards.
			  How does the symmetry of the shape help John?
					YES / OK / NO

	Angles, Polygons, Circles	**C**	In the diagram, ABC is a straight line and BD = CD. a Work out the size of angle x. b Work out the size of angle y.		YES / OK / NO
		A	P, R and Q are points on the circumference of a circle, centre O. Angle POR = 20°. Angle ROQ = 80°. Prove that QP bisects angle OPR. Diagram **NOT** accurately drawn		

	Area and Volume	**C**	A landscape contractor charges: £40 per square metre for levelling the ground and laying paving stones £15 per square metre for sowing grass seed. Calculate the cost of both paving and seeding the garden shown on the right.		YES / OK / NO

		A	The diagram shows a cuboid drawn on a 3D grid. Vertex A has coordinates (5, 2, 3). a Write down the coordinates of vertex E. B and D are vertices of the cuboid. b Work out the coordinates of the midpoint of BD. Diagram **NOT** accurately drawn *Nov 2008*	
	Collecting data, Recording data	**C**	Write down, with reasons, whether or not each of the following is biased. a A call centre manager wants to know how easy it is to use the staff reference sheets when answering a call. He asks all the people working on the night shift. b A mobile phone company wants to find out what people think about their new pricing contract and randomly select 10% to ask. c A town council poses the question 'Do you agree that we are doing a good job in the area of recycling?'	

		A	The two-way table shows information about the number of students in a school.

The two-way table shows information about the number of students in a school.

	Year Group					Total
	7	**8**	**9**	**10**	**11**	
Boys	126	142	140	135	127	670
Girls	134	140	167	125	149	715
Total	260	282	307	260	276	1385

Robert carries out a survey of these students.
He uses a sample of 50 students stratified by gender and by year group.
Calculate the number of girls from Year 9 that are in his sample.

Average & range

C
B
A

Sethina recorded the times, in minutes, taken to repair 80 car tyres.
Information about these times is shown in the table.

Time (t minutes)	Frequency
$0 < t \leqslant 6$	15
$6 < t \leqslant 12$	25
$12 < t \leqslant 18$	20
$18 < t \leqslant 24$	12
$24 < t \leqslant 30$	8

Calculate an estimate for the mean time taken to repair each car tyre.

Ten people work in a small factory. The table shows their salaries.

Employees	Salary
1 owner	£180 000
1 manager	£40 000
8 workers	£10 000

The workers want a pay rise, but the owner doesn't want to give them a rise.
Explain how both the owner and the workers could use the word 'average' to justify their case.
Explain the following sentence:
The vast majority of dogs in this country have more than the average number of legs.

Processing, representing, interpreting data

C
B
A

Pie chart showing proportion of boys and girls in Year 9

Pie chart showing proportion of boys and girls in Year 10

To draw the pie chart for boys and girls in Years 9 and 10 combined, Kimberly drew the pie chart on the right:
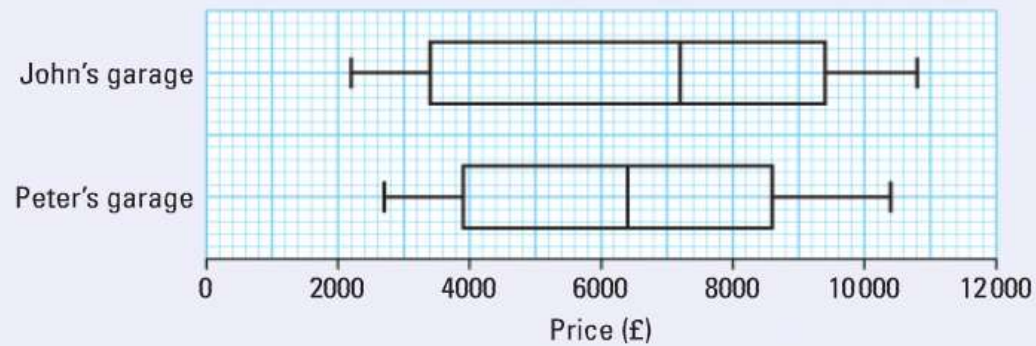
James said that this could not be correct.
Explain who is right.

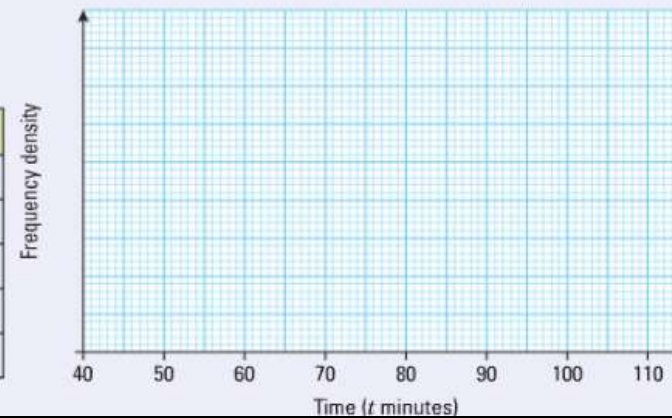Pie chart showing proportion of boys and girls in Year 9 and Year 10

John and Peter each own a garage. They both sell used cars.
The box plots show some information about the prices of cars at their garages.

Compare the distribution of the prices of cars in these two garages.
Give **two** comparisons.
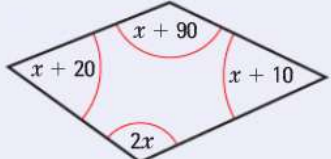
The table gives some information about the
lengths of time some boys took to run a race.
Draw a histogram for the information
in the table.
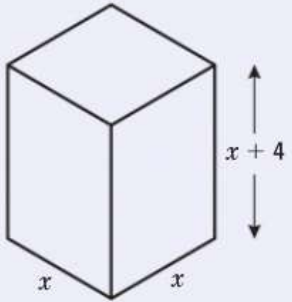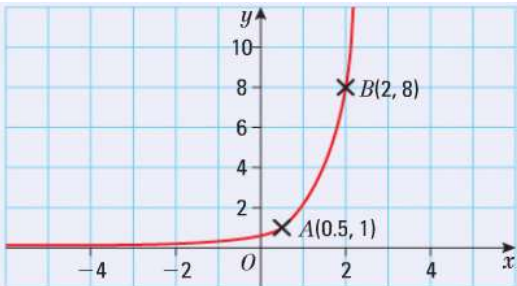
Time (t minutes)	Frequency
$40 \leqslant t < 50$	16
$50 \leqslant t < 55$	18
$55 \leqslant t < 65$	32
$65 \leqslant t < 80$	30
$80 \leqslant t < 100$	24
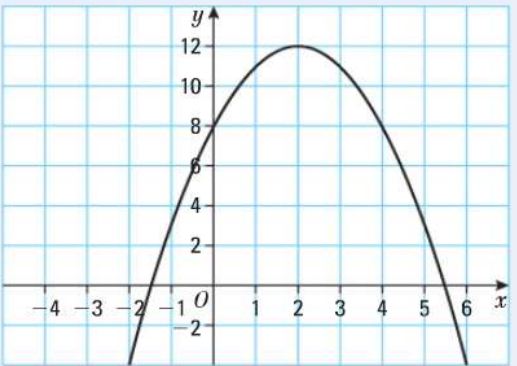
	<u>Line diagrams, Scatter graphs</u>	**C**	The scatter diagram shows the amount of fertiliser used and the crop yields on 10 equal-size plots at a crop regulatory centre. a Describe the correlation. b Describe the relationship between crop yield and amount of fertiliser used. c Estimate the crop yield when 4 kg per 80 m² of fertiliser is used. d Estimate the amount of fertiliser used to give a crop yield of 15 000 kg. e Nassim says he will use the line of best fit to find out what the crop would be if 20 kg of fertiliser per 80 m² was put on a plot. Will Nassim get a sensible result? Explain your answer. 	
	<u>Probability</u>	**B A A***	A fair tetrahedral dice (4-sided, numbered 1 to 4) and an ordinary dice are each rolled. A win occurs when the number on the ordinary dice is greater than or equal to the number on the tetrahedral dice. Find the probability of a win. A fruit machine has three independent reels and pays out a jackpot of £1000 when three raspberries are obtained. Each reel has 12 pictures of fruit. The first reel has four pictures of raspberries; the second reel has three pictures of raspberries and the third reel has five pictures of raspberries. Find the probability of winning the jackpot. The names Justin, Kayla, Hasan, Jessica, Amanda and Dave are each written on a piece of paper and placed in a hat. Two names are taken at random from the hat. Work out the probability that the names are both boys' names.	

	Number	A	Convert each recurring decimal to a fraction. Give each fraction in its simplest form. Use a calculator to check your answers. a $0.\dot{4}$ b $0.1\dot{6}$ c $0.\dot{2}\dot{7}$ d $0.\dot{3}11\,68\dot{8}$ Work out $\dfrac{2 \times 2.2 \times 10^{12} \times 1.5 \times 10^{12}}{2.2 \times 10^{12} - 1.5 \times 10^{12}}$ Give your answer in standard form correct to 3 significant figures.	
	Upper and Lower bounds	A*	Katy drove for 238 km, correct to the nearest mile. She used 27.3 litres of petrol, to the nearest tenth of a litre. Work out the upper bound for the petrol consumption in km per litre for Katy's journey. Give your answer correct to 2 decimal places.	
	Percentages	B	Jim is a plumber. He has to work out the VAT on some equipment. VAT is charged at $17\frac{1}{2}\%$. The total cost of the equipment including VAT is £4465. Calculate how much the VAT was.	
	Linear equations	C	The sizes of the angles, in degrees, of the quadrilaterals are $x + 10$, $2x$, $x + 90$ and $x + 20$. Work out the smallest angle of the quadrilateral. Diagram NOT drawn accurately Nov 2005 $x + 90$, $x + 20$, $x + 10$, $2x$	
		A	Solve $\dfrac{x - 3}{5} = x - 5$	

	Inequalities and Formulae	B	The region **R** satisfies the inequalities $x \geqslant 2, y \geqslant -1, \ x + y \leqslant 6$ Draw a suitable graph and use shading to show the region **R**.	
		A	$P = \pi r + 2r + 2a$ $P = 84, r = 6.7$ a Work out the value of a. Give your answer correct to 3 significant figures. b Make r the subject of the formula $P = \pi r + 2r + 2a$.	
	More graphs and Equations	A	The diagram shows a cuboid. The base of the cuboid is a square of side x cm. The height of the cuboid is $(x + 4)$ cm. The volume of the cuboid is 100 cm³. Find the height of the cuboid. Diagram NOT accurately drawn $x + 4$ x x	
		A*	The diagram shows a sketch of the graph of $y = ab^x$ The curve passes through the points A (0.5, 1) and B (2, 8). The point C (−0.5, k) lies on the curve. Find the value of k. *June 2006*	
	Quadratic and Simultaneous equations	B	For each of these pairs of simultaneous equations, draw two linear graphs on the same grid and use them to solve the simultaneous equations. Use a scale of −10 to +10 on each axis. a $y = 8 - 3x$ b $2x + y = 4$ $x + y = 4$ $3x + 4y = 12$	

|					
			a Solve the equation $x^2 - 2x - 1 = 0$. Give your answer correct to 3 significant figures. Hence, or otherwise **b** solve the equation $3x^2 - 6x - 3 = 0$. A gas bill consists of a fixed charge (£F) and a charge (g pence) for each unit used. Mrs Anwar used 350 units and paid £30. Mr White used 450 units and paid £35. Find the fixed charge and the charge per unit. a Show that the equation $\dfrac{5}{x+2} = \dfrac{4-3x}{x-1}$ can be rearranged to give $3x^2 + 7x - 13 = 0$. b Solve $3x^2 + 7x - 13 = 0$. Give your solutions correct to 2 decimal places.		
		A			
		A			
		A*			
	Proportion	B	The time, T seconds, it takes a water heater to boil some water is directly proportional to the mass of water, m kg, in the water heater. When $m = 250$, $T = 600$. a Find T when $m = 400$. The time, T seconds, it takes a water heater to boil a costant mass of water is inversely proportional to the power, P watts, of the water heater. When $P = 1400$, $T = 360$. b Find the value of T when $P = 900$. *June 2006*		
		A			

q is inversely proportional to the square of t.

When $t = 4$, $q = 8.5$.

a Find a formula for q in terms of t.

b Calculate the value of q when $t = 5$.

Transformations of functions

B

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

Work out   a f(2)   b f(−3)   c a where f(a) = 2.

The equation of the curve C_1 is $y = f(x) = 8 + 4x - x^2$.

a Write $8 + 4x - x^2$ in the form $q - (x - p)^2$
   where p and q are numbers to be found.

Here is a sketch of the curve $y = 8 + 4x - x^2$.

b Write down the coordinates of the maximum point of the curve.

A*

The curve C_1 is stretched to the curve C_2 so that the maximum point of C_1 is mapped to (2, 24).

c Describe the stretch.

d Write down the equation of C_2 in function form.

Area

C

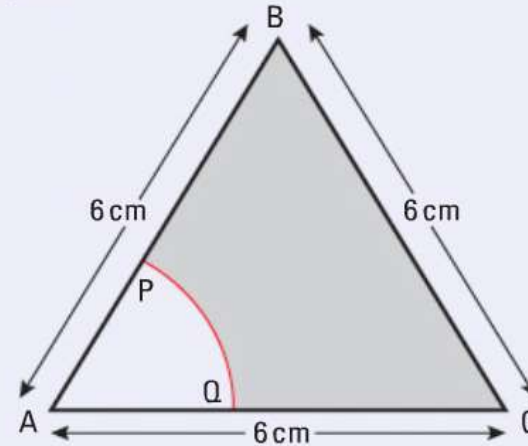A ring-shaped flowerbed is to be created around a circular lawn of radius 2.55 m.

2.55 m
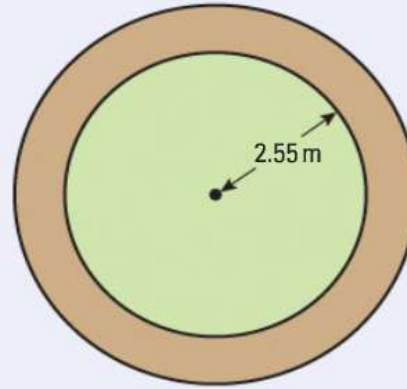
Roses costing £4.20 are to be planted approximately every 50 cm around this flowerbed. How much money will be needed for roses?

A

The diagram shows an equilateral triangle ABC with sides of length 6 cm.
P is the midpoint of AB.
Q is the midpoint of AC.
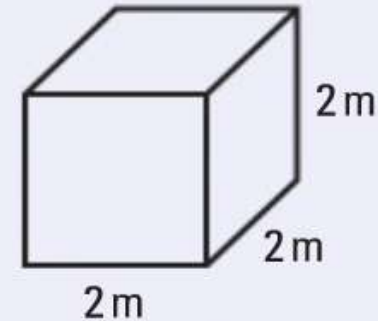APQ is a sector of a circle, centre A.

Calculate the area of the shaded region.
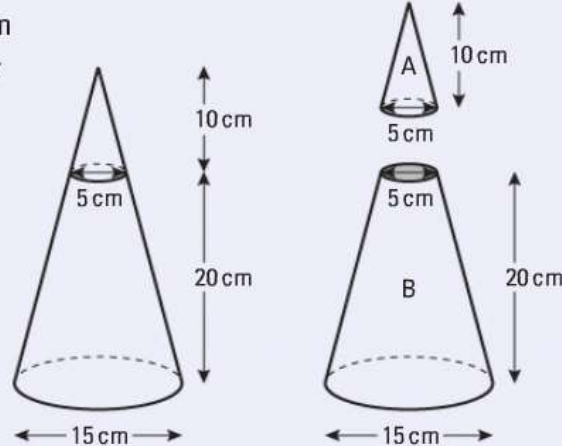Give your answer correct to 3 significant figures.

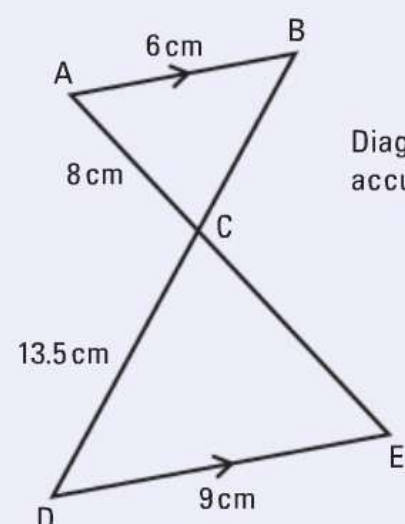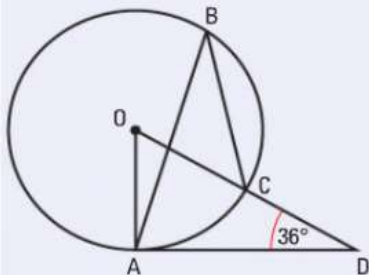|	Volume		
		c	The volume of this cube is 8 m³ Convert 8 m³ to cm³.

		A*	The diagram represents a large cone of height 30 cm and base diameter 15 cm. The large cone is made by placing a small cone A of height 10 cm and base diameter 5 cm on top of a frustum B. Calculate the volume of the frustum B. Give your answer correct to 3 significant figures.	
	Congruence and Similarity	C A	A car is 4 m long and 1.8 m wide. A model of the car, similar in all respects, is 5 cm long. How wide is it? AB is parallel to DE. ACE and BCD are straight lines. AB = 6 cm AC = 8 cm CD = 13.5 cm DE = 9 cm a Work out the length of CE. b Work out the length of BC.	

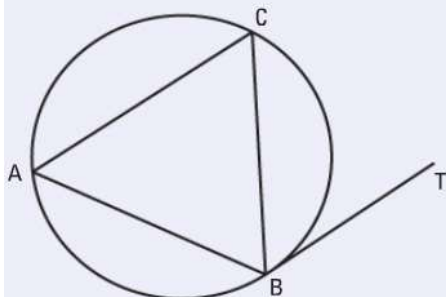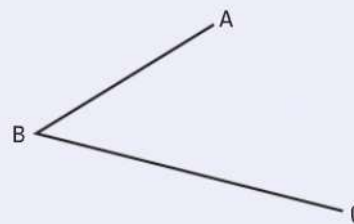|					
	Circle geometry	**A**	The diagram shows a circle centre O. A, B and C are points on the circumference. DCO is a straight line. DA is a tangent to the circle. Angle ADO = 36° Work out the size of angle ABC. *June 2009, adapted*		
		A*	Diagram **NOT** accurately drawn A, B and C are points on the circumference of the circle. BT is a tangent to the circle. BC bisects the angle ABT. Prove that CA = CB.		
	Constructions and Loci	**C**	On an accurate copy of the diagram use a ruler and pair of compasses to construct the bisector of angle ABC. You must show all your construction lines. *Nov 2008, adapted*		
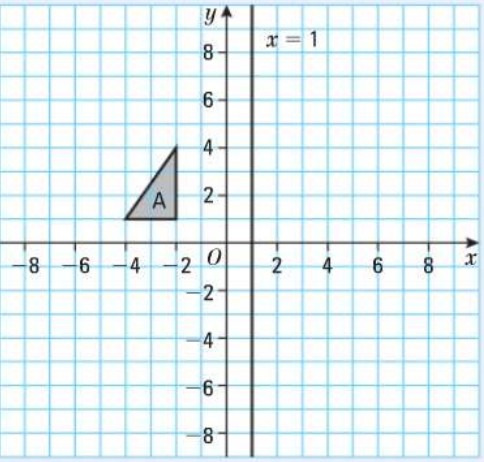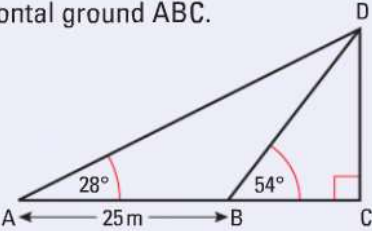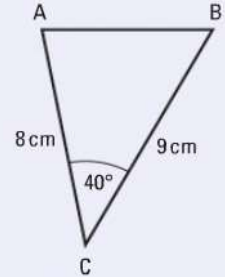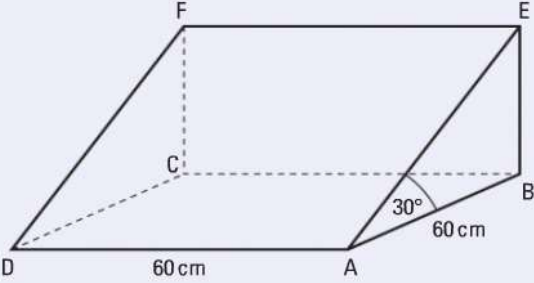
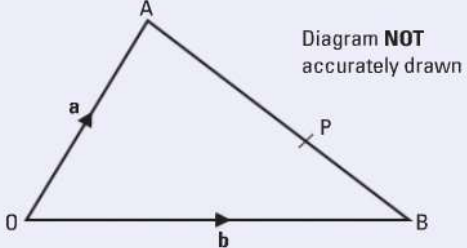|	Transformations	B	Triangle A is reflected in the x-axis to give triangle B. Triangle B is reflected in the line $x = 1$ to give triangle C. Describe the **single** transformation that takes triangle A to triangle C. *June 2008*	
	Pythagoras theorem and Trigonometry 1	B	The diagram shows a vertical tower DC on horizontal ground ABC. ABC is a straight line. The angle of elevation of D from A is 28°. The angle of elevation of D from B is 54°. AB = 25 m Calculate the height of the tower. Give your answer to 3 significant figures. *June 2006*	
	Pythagoras theorem and Trigonometry 2	A	ABC is a triangle. AC = 8 cm. BC = 9 cm. Angle ACB = 40°. Calculate the length of AB. Give your answer correct to 3 significant figures. *June 2007*	

		A*	The diagram represents a prism. AEFD is a rectangle. ABCD is a square. EB and FC are perpendicular to plane ABCD. AB = 60 cm. AD = 60 cm. Angle ABE = 90°. Angle BAE = 30°. Calculate the size of the angle that the line DE makes with the plane ABCD. Give your answer correct to 1 decimal place.	 *June 2004*	
	<u>Vectors</u>	**A***	OAB is a triangle. $\overrightarrow{OA} = \mathbf{a}$ $\overrightarrow{OB} = \mathbf{b}$ **a** Find the vector $\overrightarrow{AB}$ in terms of **a** and **b**. P is the point on AB such that AP : PB = 3 : 2. **b** Show that $\overrightarrow{OP} = \frac{1}{5}(2\mathbf{a} + 3\mathbf{b})$.	 Diagram **NOT** accurately drawn *May 2009*	