N5

Practice Paper B

MATHEMATICS

National Qualifications - National 5

Paper 1 (non-calculator)

Covering all Units

Time allowed - 1 hour

Fill in these boxes and read carefully what is printed below

Full name of centre | **Town**

Forename(s) | **Surname**

Date of birth
Day Month Year

Candidate number

Seat number

Total marks - 40

1. You may NOT use a calculator.
2. Use **blue** or **black** ink. Pencil may be used for graphs and diagrams only.
3. Write your working and answers in the spaces provided. Additional space for answers is provided at the end of the booklet. If you use this space, write clearly the number of the question you are attempting.
4. Square ruled paper is provided.
5. Full credit will be given only where the solution contains appropriate working.
6. State the units for your answer where appropriate.
7. Before leaving the examination room you must give up this booklet to the invigilator. If you do not, you may lose all the marks for this paper.

FORMULAE LIST

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

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

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

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

Volume of a Pyramid: Volume = $\dfrac{1}{3}Ah$

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

All questions should be attempted

Marks

Do not write in this margin.

1. Factorise fully

$4x^2 - 10x - 6$. **3**

2. Two lines have equations

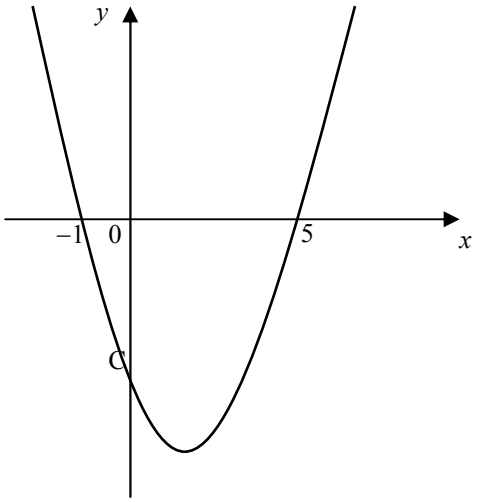
$3y + 2x = -0{\cdot}1$
$2y + 5x = -11{\cdot}8$

Find, **algebraically,** the point where these two lines meet. **4**

3. Given that $P = \frac{kQ}{r^2}$ express r in terms of P, Q and k. **3**

Marks

4. The graph shown has equation $y = (x + 1)(x - 5)$.



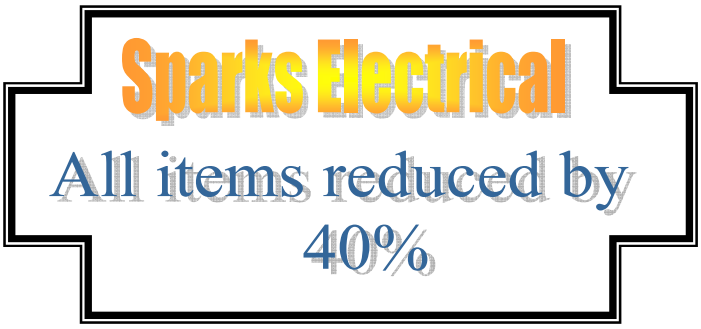
(a) Find the coordinates of the turning point. **2**

(b) State the equation of the axis of symmetry of the parabola. **1**

5. Express as a single fraction in its simplest form

$$\frac{3}{x} - \frac{2}{x-5}.$$ **3**

6. Sparks Electrical are having their annual clearance sale where everything is reduced by 40%.



A Flat screen TV cost £480 in the sale.

How much did the TV originally cost? **3**

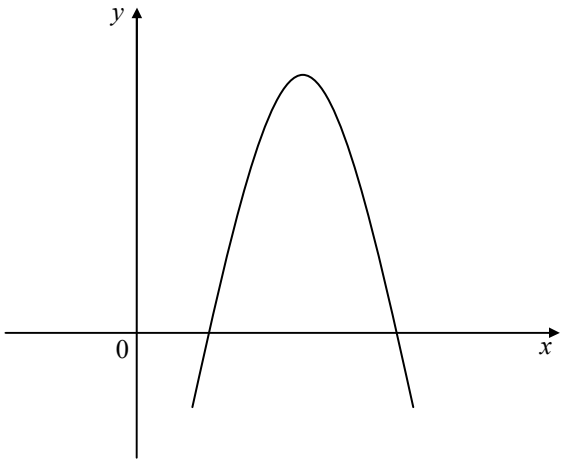
7. **(a)** A function is given as $f(x) = \frac{6}{\sqrt{x}}$, where $x > 0$.

Find the exact value of $f(18)$, giving your answer as a **surd in its simplest form** and with **a rational denominator**. **4**

(b) Express $\frac{p^5 \times 8p}{2p^{-3}}$ in its simplest form. **2**

Marks

8. The diagram shows the graph of a function of the form $y = \boldsymbol{a}x^2 + \boldsymbol{b}x + c$.



Write down a possible value for $\boldsymbol{a}$ and a possible value for $\boldsymbol{b}^2 - 4\boldsymbol{ac}$. **2**

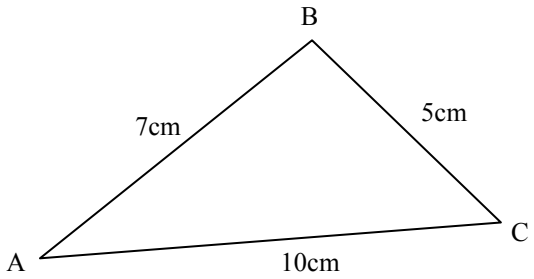
9. A function is given as $f(x) = 2x^2 - 3x$.

(a) Find $f(-2)$. **2**

(b) Given that $f(p) = 5$, find the two values of p. **3**

Marks

10. **(a)** Calculate the value of cos ABC in this triangle. **3**



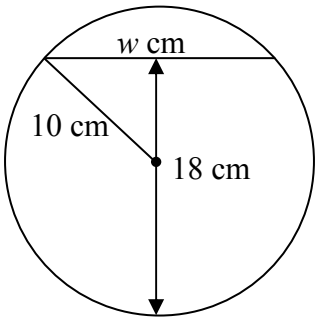
(b) Without actually calculating the size of the angle a pupil was able to say that angle ABC was obtuse.

By referring to your answer in (a), explain why the pupil was able to do this. **1**

Marks

11. A goldfish bowl is filled with water to a depth of 18 cm.

A cross section through the centre of the bowl is circular.



If the radius of the cross section is 10 cm, find the width of the water, w cm, in the bowl.

4

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1	**ans:** $2(2x+1)(x-3)$ **3 marks**	
	$\bullet^1$ extract common factor	$\bullet^1$ $2(2x^2-5x-3)$
	$\bullet^2$ attempt to factorise trinomial	$\bullet^2$ $(2x+1)$
	$\bullet^3$ complete factorisation	$\bullet^3$ $(x-3)$
2	**ans:** **(– 3·2, 2·1)** **4 marks**	
	$\bullet^1$ knows to use system of equations	$\bullet^1$ scales equations
	$\bullet^2$ finds value for y	$\bullet^2$ $y = 2\cdot1$
	$\bullet^3$ finds value for x	$\bullet^3$ $x = -3\cdot2$
	$\bullet^4$ states coordinates of intersection	$\bullet^4$ $(-3\cdot2, 2\cdot1)$
3	**ans:** $r=\sqrt{\frac{kQ}{P}}$ **3 marks**	
	$\bullet^1$ remove fraction	$\bullet^1$ $Pr^2 = kQ$
	$\bullet^2$ manipulate formula	$\bullet^2$ $r^2 = \frac{kQ}{P}$
	$\bullet^3$ solve for r	$\bullet^3$ answer
4a	**ans:** **(2, – 9)** **2 marks**	
	$\bullet^1$ correct x - coordinate	$\bullet^1$ (2, …..
	$\bullet^2$ correct y - coordinate	$\bullet^2$ ……– 9)
b	**ans:** $x = 2$ **1 mark**	
	$\bullet^1$ states equation	$\bullet^1$ $x = 2$
5	**ans:** $\frac{x-15}{x(x-5)}$ **3 marks**	
	$\bullet^1$ common denominator	$\bullet^1$ $x(x-5)$
	$\bullet^2$ correct numerator	$\bullet^2$ $\frac{3(x-5)-2x}{x(x-5)}$
	$\bullet^3$ simplify fraction	$\bullet^3$ answer
6	**ans:** **£800** **3 marks**	
	$\bullet^1$ correct strategy	$\bullet^1$ 60% = £480
	$\bullet^2$ uses correct ratio	$\bullet^2$ $\frac{100}{60}\times$ £480
	$\bullet^3$ calculations correct	$\bullet^3$ answer

Qu	Give one mark for each •	Illustrations for awarding mark
7a	**ans : $\sqrt{2}$ 4 marks**	
	•[1] substitutes for x	•[1] $f(x)=\frac{6}{\sqrt{18}}$
	•[2] simplifies $\sqrt{18}$ and expression	•[2] $f(x)=\frac{6}{3\sqrt{2}}=\frac{2}{\sqrt{2}}$
	•[3] multiplies by $\sqrt{2}$	•[3] $\frac{2}{\sqrt{2}}\times\frac{\sqrt{2}}{\sqrt{2}}$
	•[4] simplifies	•[4] $\sqrt{2}$
b	**ans: $4p^9$ 2 marks**	
	•[1] simplifies numerator	•[1] $8p^6$
	•[2] simplifies fraction	•[2] $4p^9$
8	**ans: $a < 0$; $b^2 - 4ac > 0$ 2 marks**	
	•[1] correct value for a	•[1] any value of a < 0
	•[2] correct value for $b^2 - 4ac$	•[2] any value of $b^2 - 4ac > 0$
9a	**ans : 14 2 marks**	
	•[1] substitutes	•[1] $f(x) = 2(-2)^2 - 3(-2)$
	•[2] evaluates	•[2] 14
b	**ans : 5/2 or – 1 3 marks**	
	•[1] equates to 5 and rearranges	•[1] $2p^2 - 3p = 5$; $2p^2 - 3p - 5 = 0$
	•[2] factorises	•[2] $(2p - 5)(p + 1) = 0$
	•[3] solves	•[3] $p = 5/2$ or -1
10	**ans : $\frac{-26}{70}$ [or equivalent] 3 marks**	
	•[1] knows to use the cosine rule	•[1] evidence
	•[2] substitutes values	•[2] $\frac{7^2+5^2-10^2}{2\times7\times5}$
	•[3] answer	•[3] $\frac{-26}{70}$ [or equivalent]
	ans: cosine is negative 1 mark	
	•[1] gives valid reason	•[1] cosine is negative so angle is obtuse
11	**ans: 12 cm 4 marks**	
	•[1] assembles facts in RAT	•[1]
	•[2] knows to use Pythagoras	•[2] $\sqrt{(10^2 - 8^2)}$
	•[3] calculates unknown side	•[3] 6cm
	•[4] states width of water	•[4] 12cm
		Total 40 marks

N5

Practice Paper B

MATHEMATICS

National Qualifications - National 5

Paper 2 (Calculator)

Covering all Units

Time allowed - 1 hour and 30 minutes

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Total marks - 50

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Do not write in this margin.

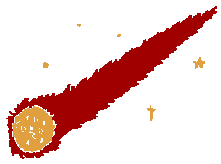
Marks

All questions should be attempted

1. Remove the brackets and simplify

$$(2x-3)^2+3x(4x-3).$$ **3**

2. Halley's comet travels in a wide loop around our solar system.



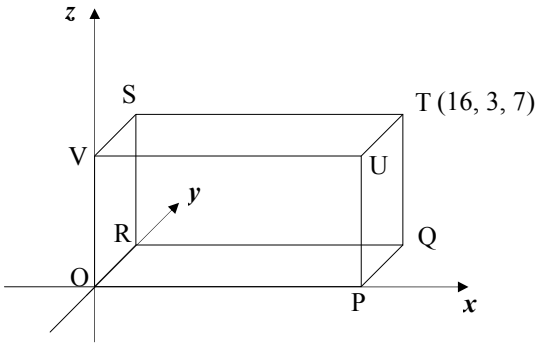
At its closest point to the earth it is travelling at an average speed of $1\cdot4\times10^5$ miles per hour.

At this speed how far, in miles, will it travel in a week?

Give your answer in **scientific notation** correct to **2 significant figures**. **4**

Marks

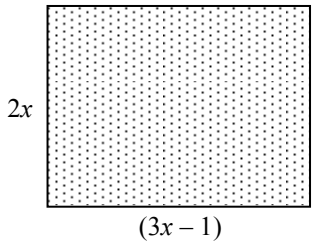
3. **(a)** Point U has coordinates (16, 3, 7) in the cuboid OPQR STUV shown below.



Write down the coordinates of point S **1**

(b) Calculate the length of vector $\boldsymbol{a}$ defined as $\boldsymbol{a} = 3\boldsymbol{i} + 5\boldsymbol{j} - \sqrt{2}\boldsymbol{k}$. **2**

4.

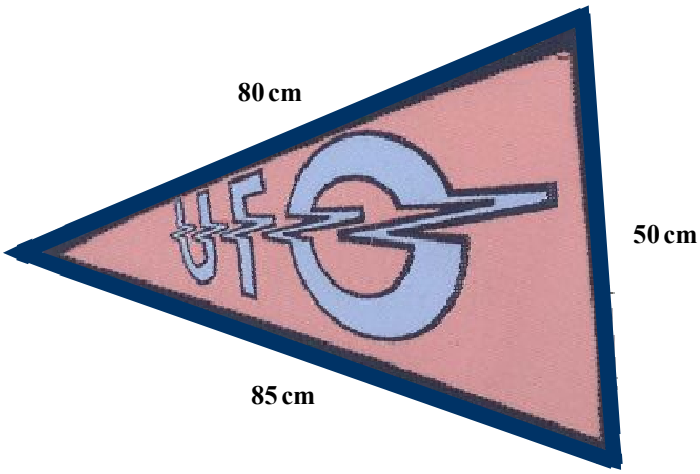


The area of the rectangle in the diagram is 31m^2

Calculate the value of x giving your answer **correct to 1 decimal place**. **5**

Marks

5. A large triangular flag advertising a UFO conference is shown below.



Calculate the **area** of the flag, giving your answer to the nearest square centimetre**.** **6**

6. Find the value of k for which the quadratic equation $kx^2 + kx + 6 = 0$; $k \neq 0$ has equal roots. **4**

Marks

7. The value of an industrial machine is expected to decrease each year by 14·2% of of its value at the beginning of the year.

If it was valued at £15500 at the **beginning** of 2011, what will its expected value be at the **end** of 2013?
Give your answer correct to the nearest pound. **4**

8. A survey of the number of hours that senior pupils had spent studying for a Maths exam gave a mean of 15 and a standard deviation of 3·4.

The following year, after a programme of supported study, the mean number of hours remained the same but the standard deviation fell to 2·3.

Make two comments about the effectiveness of the supported study programme. **2**

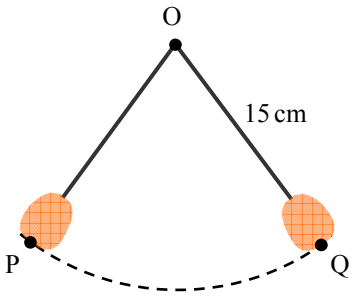
Marks

9. A clock has a pendulum swinging below it.

When the clock is ticking the pendulum travels along an arc of a circle, centre O.

The length of the connection cord OQ is 15 centimetres.

The length of the arc followed by the pendulum as it swings from **P to Q is 18cm**.



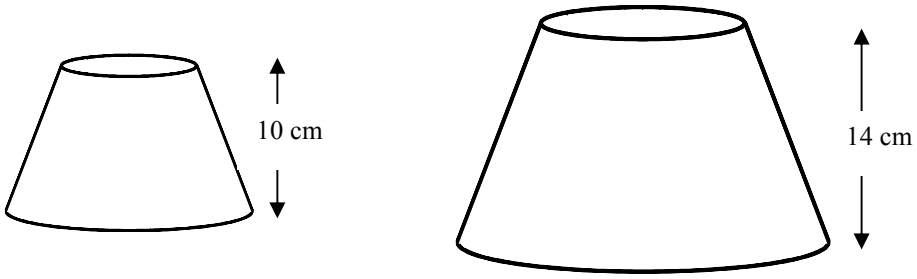
Find the size of angle POQ, the angle through which the pendulum swings from P to Q. **5**

10. Solve **algebraically** the equation

$$7\cos x^\circ + 4 = 2\cos x^\circ, \quad \text{for} \quad 0 \leq x < 360. \qquad \textbf{4}$$

Marks

11. A company sells boxed chocolates in two different sizes.
The boxes are mathematically similar truncated cones, as shown in the diagram below.



The cost of the chocolates should be in direct proportion to their weight.

The chocolates in the larger box have been weighed and are priced at £5·45.

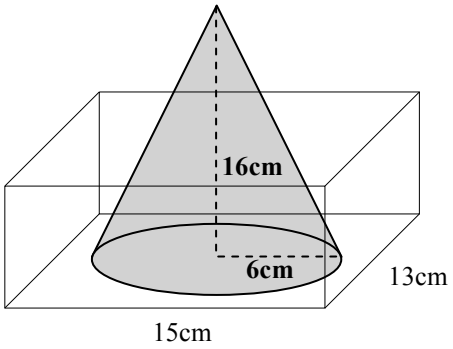
The company is considering pricing the smaller box at £2·25.

Is this a fair price ?

Your answer must be accompanied with appropriate working. **3**

Marks

12. A cone of ice with a base radius of 6cm and a height of 16cm is placed in a small rectangular glass tank as shown below.



(a) Calculate the volume of the cone giving your answer correct to **3 significant figures**. **3**

(b) If the cone is left to melt away completely, calculate the depth of water in the tank once all the ice has melted. **3**

End of Question Paper

Qu	Give one mark for each •	Illustrations for awarding mark
1	**ans: $16x^2 - 21x + 9$ 3 marks**	
	$\bullet^1$ multiplies first bracket	$\bullet^1$ $4x^2 - 12x + 9$.....
	$\bullet^2$ multiplies second bracket	$\bullet^2$ ..... $+ 12x^2 - 9x$
	$\bullet^3$ simplifies	$\bullet^3$ $16x^2 - 21x + 9$
2	**ans : $2{\cdot}4 \times 10^7$ miles 4 marks**	
	$\bullet^1$ knows to multiply by 24 and 7	$\bullet^1$ $1{\cdot}4 \times 10^5 \times 24 \times 7$
	$\bullet^2$ starts to evaluates	$\bullet^2$ 23 520 000
	$\bullet^3$ rounds to 2 sig. figs.	$\bullet^3$ 24 000 000
	$\bullet^4$ gives answer in Scientific notation	$\bullet^4$ $2{\cdot}4 \times 10^7$ miles
3a	**ans : S(0, 3, 7) 1 mark**	
	$\bullet^1$ states coordinates of S	$\bullet^1$ S(0, 3, 7)
b	**ans: 6 units 3 marks**	
	$\bullet^1$ finds components of vector $\boldsymbol{a}$	$\bullet^1$ $\begin{pmatrix} 3 \\ 5 \\ -\sqrt{2} \end{pmatrix}$
	$\bullet^2$ knows how to find magnitude	$\bullet^2$ $\sqrt{3^2 + 5^2 + (-\sqrt{2})^2}$
	$\bullet^3$ answer	$\bullet^3$ 6 units
4	**ans : 2·4m 5 marks**	
	$\bullet^1$ equates areas	$\bullet^1$ $2x(3x - 1) = 31$; $6x^2 - 2x - 31 = 0$
	$\bullet^2$ knows to use quadratic formula	$\bullet^2$ evidence – could list values of a, b and c
	$\bullet^3$ evaluates discriminant	$\bullet^3$ $b^2 - 4ac = (-2)^2 - (4 \times 6 \times -31) = 748$
	$\bullet^4$ finds values of x	$\bullet^4$ 2·4 or −2·1
	$\bullet^5$ discards	$\bullet^5$ $x = 2{\cdot}4$m
5	**ans : 1 956 cm^2 6 marks**	
	$\bullet^1$ knows to find an angle and uses cosine rule	$\bullet^1$ evidence of cosine rule for angle
	$\bullet^2$ subs values	$\bullet^2$ $\frac{80^2 + 85^2 - 50^2}{2 \times 80 \times 85}$ or $\frac{80^2 + 50^2 - 85^2}{2 \times 80 \times 50}$ or $\frac{85^2 + 50^2 - 80^2}{2 \times 85 \times 50}$
	$\bullet^3$ evaluates for cosine of angle	$\bullet^3$ 0·818.... or 0·209..... or 0·391....
	$\bullet^4$ finds angle	$\bullet^4$ $35{\cdot}11^\circ$ or $77{\cdot}91^\circ$ or $66{\cdot}97^\circ$
	$\bullet^5$ knows how to find area	$\bullet^5$ $a = \frac{1}{2} \times 80 \times 85 \times \sin 35{\cdot}11°$ or $a = \frac{1}{2} \times 80 \times 50 \times \sin 77{\cdot}91°$ or $a = \frac{1}{2} \times 85 \times 50 \times \sin 66{\cdot}97°$
	$\bullet^6$ answer properly rounded	$\bullet^6$ 1 956 cm² Answers may vary depending on rounding. Do not penalise premature rounding

Qu	Give one mark for each •	Illustrations for awarding mark
6	**ans : $k = 24$ 4 marks**	
	$\bullet^1$ knows condition for equal roots	$\bullet^1$ $b^2 - 4ac = 0$ [stated or implied]
	$\bullet^2$ substitutes values	$\bullet^2$ $k^2 - 4 \times 6 \times k = 0$
	$\bullet^3$ simplifies and factorises	$\bullet^3$ $k^2 - 24k = 0$; $k(k - 24) = 0$
	$\bullet^4$ solves for k and chooses correct value	$\bullet^4$ $k = 24$
7	**ans: £9 790 4 marks**	
	$\bullet^1$ correct multiplier	$\bullet^1$ .....0·858....
	$\bullet^2$ knows how to decrease over 3 years	$\bullet^2$ $15\,500 \times 0{\cdot}858^3$
	$\bullet^3$ answer	$\bullet^3$ £9 790.245036
	$\bullet^4$ correctly rounded	$\bullet^4$ £9 790
8	**ans: comments 2 marks**	
	$\bullet^1$ comments on mean	$\bullet^1$ on average hours studied same
	$\bullet^2$ comments on distribution	$\bullet^2$ more consistent
9	**ans : $68{\cdot}8^o$ 5 marks**	
	$\bullet^1$ uses correct diameter	$\bullet^1$ $d = 30$ cm [may be in formula]
	$\bullet^2$ calculates circumference	$\bullet^2$ $C = 3{\cdot}14 \times 30 = 94{\cdot}2$
	$\bullet^3$ sets up equal ratios	$\bullet^3$ 18/94·2= angle/360
	$\bullet^4$ starts to solve	$\bullet^4$ angle = (18 × 360) / 94·2
	$\bullet^5$ answer	$\bullet^5$ $68{\cdot}8^o$
10	**ans : $143{\cdot}1^o$ and $216{\cdot}9^o$ 4 marks**	
	$\bullet^1$ evaluates $\cos x^o$	$\bullet^1$ $\cos x^o = -4/5$
	$\bullet^2$ takes inverse	$\bullet^2$ $\cos^{-1}(4/5) = 36{\cdot}9^o$
	$\bullet^3$ finds one value for x	$\bullet^3$ $143{\cdot}1^o$
	$\bullet^4$ finds second value for x	$\bullet^4$ $216{\cdot}9^o$
11	**ans: No, as £2.25 > £1.99 3 marks**	
	$\bullet^1$ finding scale factor for reduction	$\bullet^1$ linear S.F. $= \frac{10}{14} = \frac{5}{7}$
	$\bullet^2$ calculating cost	$\bullet^2$ cost $= \left(\frac{5}{7}\right)^3 \times £5.45 = £1.99$
	$\bullet^3$ comparing cost with £2.25	$\bullet^3$ answer
12a	**ans: 603 cm^3 3 marks**	
	$\bullet^1$ substitutes values in formula	$\bullet^1$ $\frac{1}{3} \times \pi \times 6^2 \times 16$
	$\bullet^2$ answer	$\bullet^2$ 603·1857895
	$\bullet^3$ correct rounding	$\bullet^3$ 603 cm^3
b	**ans: 3·1 cm 3 marks**	
	$\bullet^1$ subs know values into formula	$\bullet^1$ $603 = 15 \times 13 \times h$
	$\bullet^2$ knows how to find height	$\bullet^2$ $h = 603 \div 195$
	$\bullet^3$ answer	$\bullet^3$ 3·1 cm
		Total 50 marks