

FOR OFFICIAL USE



National  
Qualifications  
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Mark

**S847/75/02**

**Mathematics  
Paper 2**

Date — Not applicable

Duration — 1 hour 50 minutes



\* S 8 4 7 7 5 0 2 \*

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day

Month

Year

Scottish candidate number

**Total marks — 60**

Attempt ALL questions.

**You may use a calculator.**

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.



\* S 8 4 7 7 5 0 2 0 1 \*



## FORMULAE LIST

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

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

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

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

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

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

Volume of a pyramid:  $V = \frac{1}{3}Ah$

Standard deviation:  $s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$

or  $s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n - 1}}$ , where  $n$  is the sample size.



\* S 8 4 7 7 5 0 2 0 2 \*

**Total marks — 60**  
**Attempt ALL questions**

- |   |                 |
|---|-----------------|
| <p>1. Beth normally cycles a total distance of 64 miles per week.<br/>         She increases her total distance by 15% each week for the next three weeks.<br/>         How many miles does she cycle in the third week?<br/>         Give your answer to the nearest mile.</p>   | <p><b>3</b></p> |
| <p>2. There are <math>3 \times 10^5</math> platelets per millilitre of blood.<br/>         On average, a person has 5.5 litres of blood.<br/>         On average, how many platelets does a person have in their blood?<br/>         Give your answer in scientific notation.</p> | <p><b>2</b></p> |

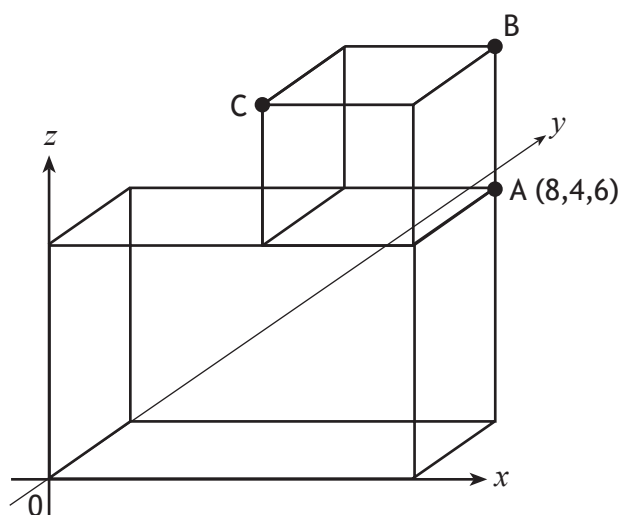


3. Expand and simplify

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

3

4. The diagram shows a cube placed on top of a cuboid, relative to the coordinate axes.



A is the point (8,4,6).

Write down the coordinates of B and C.

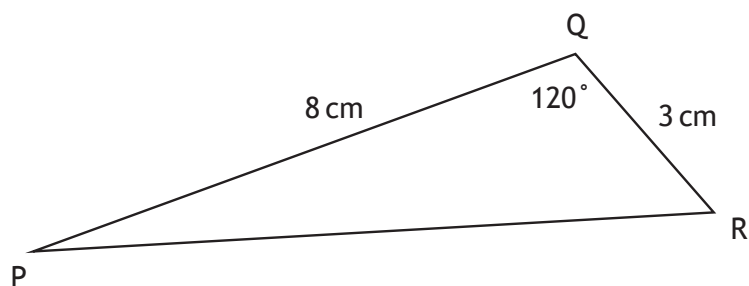
2



MARKS

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5. In triangle PQR,  $PQ = 8$  centimetres,  $QR = 3$  centimetres and angle  $PQR = 120^\circ$ .

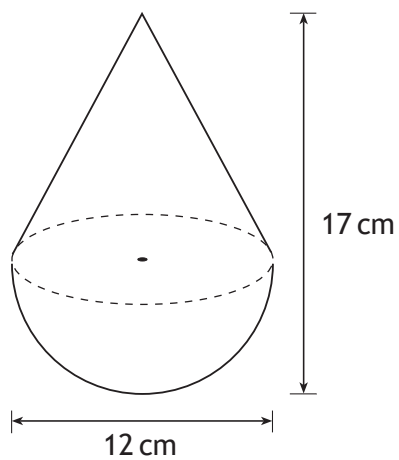


Calculate the length of PR.

3



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



The toy is 12 centimetres wide and 17 centimetres high.

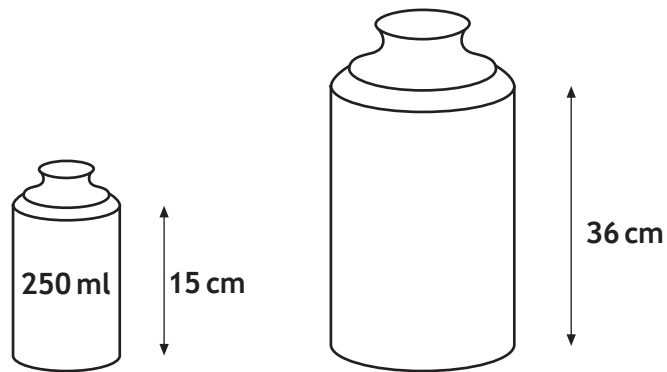
Calculate the volume of the toy.

Give your answer correct to 2 significant figures.

5



7. Screenwash is available in bottles which are mathematically similar.



The smaller bottle has a height of 15 centimetres and a volume of 250 millilitres.

The larger bottle has a height of 36 centimetres.

Calculate the volume of the larger bottle.

3



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8. Simplify  $\frac{n^5 \times 10n}{2n^2}$ .



\* S 8 4 7 7 5 0 2 0 8 \*



MARKS

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9. (a) A straight line has equation  $4x + 3y = 12$ .  
Find the gradient of this line.

2

- (b) State the coordinates of the point where the line crosses the  $y$ -axis.

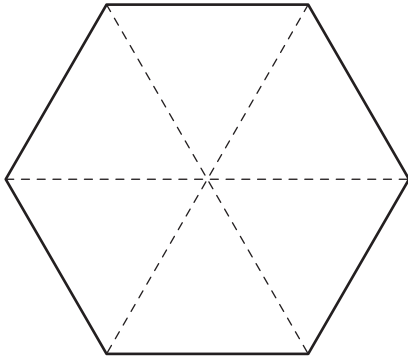
1



\* S 8 4 7 7 5 0 2 0 9 \*

10. The top of a table is in the shape of a regular hexagon.

The three diagonals of the hexagon, which are shown as dotted lines in the diagram below, each have length 40 centimetres.

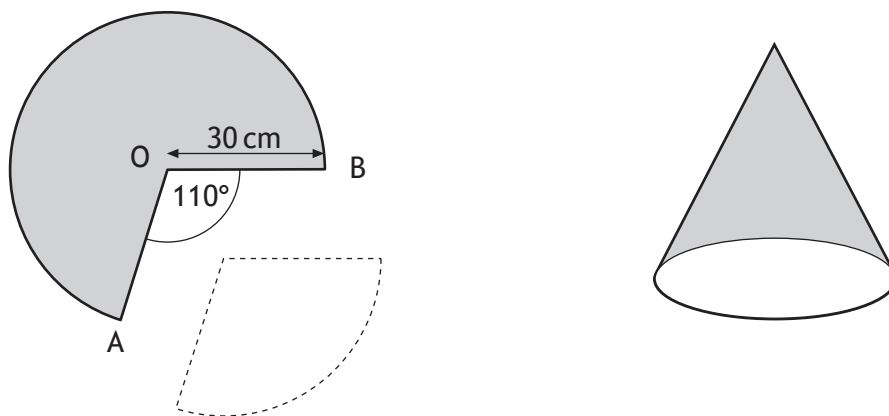


Calculate the area of the top of the table.

4



11. A cone is formed from a paper circle with a sector removed as shown.  
The radius of the paper circle is 30 centimetres.  
Angle AOB is  $110^\circ$ .



- (a) Calculate the area of the sector removed from the circle.

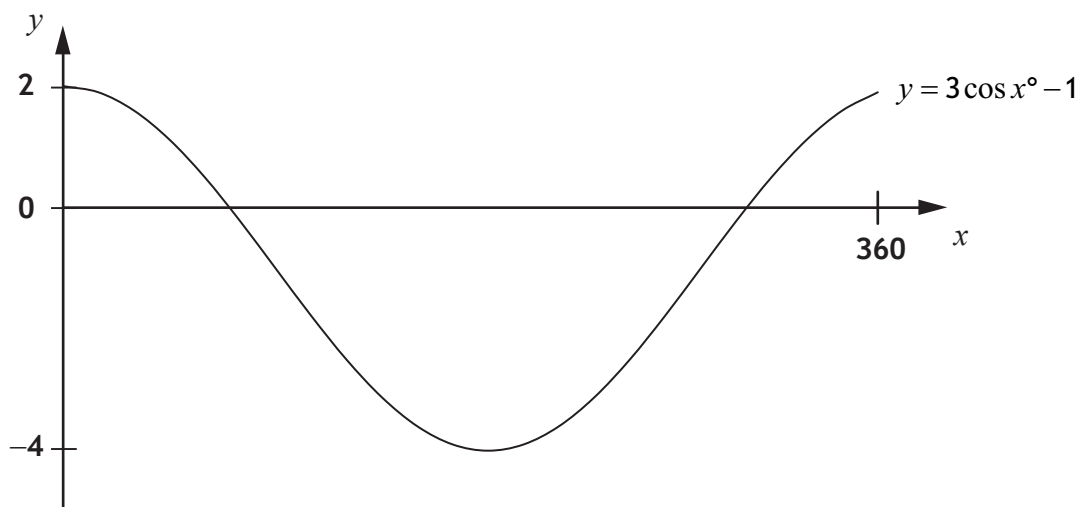
3

- (b) Calculate the circumference of the base of the cone.

3



12. Part of the graph  $y = 3 \cos x^\circ - 1$  is shown below.



Calculate the  $x$ -coordinates of the points where the graph cuts the  $x$ -axis.

4



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13. Simplify  $\frac{x^2 - 4x}{x^2 + x - 20}$ .



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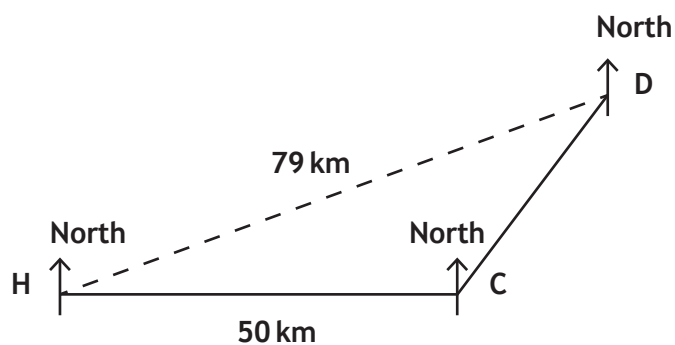
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14. Change the subject of the formula  $s = ut + \frac{1}{2}at^2$  to  $a$ .



\* S 8 4 7 7 5 0 2 1 4 \*

15. A yacht sails from a harbour H to a point C, then to a point D as shown below.



C is 50 kilometres due east of H.

D is on a bearing of  $040^\circ$  from C and is 79 kilometres from H.

(a) Calculate the size of angle CDH.

4

(b) Hence, calculate the bearing on which the yacht must sail to return directly to the harbour.

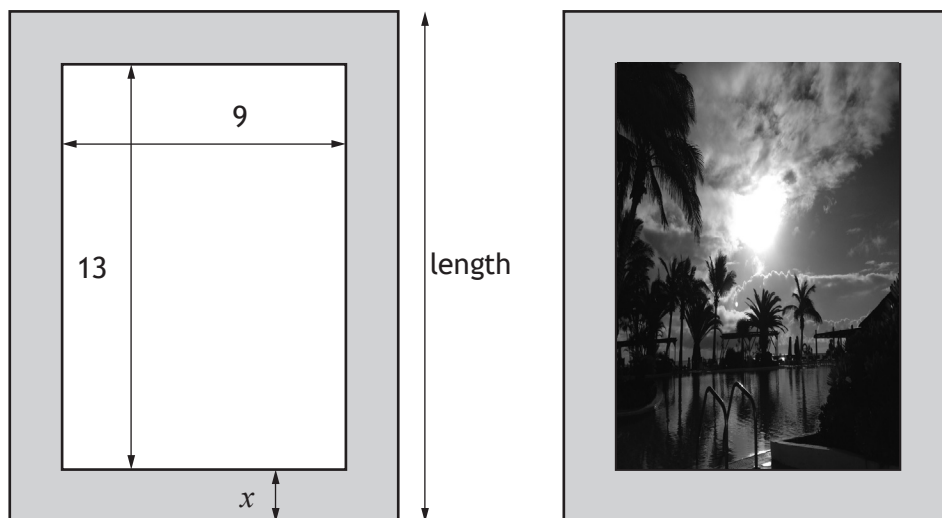
2



16. A rectangular picture measuring 9 centimetres by 13 centimetres is placed on a rectangular piece of card.

The area of the card is 270 square centimetres.

There is a border  $x$  centimetres wide on all sides of the picture.



- (a) (i) Write down an expression for the length of the card in terms of  $x$ . 1

- (ii) Hence show that  $4x^2 + 44x - 153 = 0$ . 2





MARKS

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16. (continued)

(b) Calculate  $x$ , the width of the border.

Give your answer correct to one decimal place.

4

[END OF SPECIMEN QUESTION PAPER]



\* S 8 4 7 7 5 0 2 1 7 \*

MARKS

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ADDITIONAL SPACE FOR ANSWERS



\* S 8 4 7 7 5 0 2 1 8 \*

MARKS

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ADDITIONAL SPACE FOR ANSWERS



\* S 8 4 7 7 5 0 2 1 9 \*



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Paper 2**

## Marking Instructions

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These marking instructions have been provided to show how SQA would mark this specimen question paper.

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## General marking principles for National 5 Mathematics

*This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.*

*For each question the marking instructions are generally in two sections, namely generic scheme and illustrative scheme. The generic scheme indicates the rationale for which each mark is awarded. The illustrative scheme covers methods which are commonly seen throughout the marking. In general, markers should use the illustrative scheme and only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.*

- (a) Marks for each candidate response must always be assigned in line with these general marking principles and the detailed marking instructions for this assessment.
- (b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.
- (c) If a specific candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.
- (d) Credit must be assigned in accordance with the specific assessment guidelines.
- (e) One mark is available for each •. There are no half marks.
- (f) Working subsequent to an error must be **followed through**, with possible credit for the subsequent working, provided that the level of difficulty involved is approximately similar. Where, subsequent to an error, the working for a follow through mark has been eased, the follow through mark cannot be awarded.
- (g) As indicated on the front of the question paper, full credit should only be given where the solution contains appropriate working. Unless specifically mentioned in the marking instructions, a correct answer with no working receives no credit.
- (h) Candidates may use any mathematically correct method to answer questions except in cases where a particular method is specified or excluded.
- (i) As a consequence of an error perceived to be trivial, casual or insignificant, eg  $6 \times 6 = 12$  candidates lose the opportunity of gaining a mark. However, note the second example in comment (j).

- (j) Where a transcription error (paper to script or within script) occurs, the candidate should normally lose the opportunity to be awarded the next process mark, eg

This is a transcription error and so the mark is not awarded.	$x^2 + 5x + 7 = 9x + 4$
Eased as no longer a solution of a quadratic equation so mark is not awarded.	$x - 4x + 3 = 0$ $x = 1$
Exceptionally this error is not treated as a transcription error as the candidate deals with the intended quadratic equation. The candidate has been given the benefit of the doubt and all marks awarded.	$x^2 + 5x + 7 = 9x + 4$ $x - 4x + 3 = 0$ $(x - 3)(x - 1) = 0$ $x = 1 \text{ or } 3$

(k) **Horizontal/vertical marking**

Where a question results in two pairs of solutions, this technique should be applied, but only if indicated in the detailed marking instructions for the question.

Example:

	• <sup>5</sup>		• <sup>6</sup>
	• <sup>5</sup>	$x = 2$	$x = -4$
	• <sup>6</sup>	$y = 5$	$y = -7$

Horizontal: •<sup>5</sup>  $x = 2$  and  $x = -4$       Vertical: •<sup>5</sup>  $x = 2$  and  $y = 5$   
 •<sup>6</sup>  $y = 5$  and  $y = -7$                       •<sup>6</sup>  $x = -4$  and  $y = -7$

Markers should choose whichever method benefits the candidate, but **not** a combination of both.

- (l) In final answers, unless specifically mentioned in the detailed marking instructions, numerical values should be simplified as far as possible, eg:

$\frac{15}{12}$ must be simplified to $\frac{5}{4}$ or $1\frac{1}{4}$	$\frac{43}{1}$ must be simplified to 43
$\frac{15}{0.3}$ must be simplified to 50	$\frac{4}{\cancel{5}}/3$ must be simplified to $\frac{4}{15}$
$\sqrt{64}$ must be simplified to 8*	

\*The square root of perfect squares up to and including 100 must be known.

(m) Unless specifically mentioned in the marking instructions, the following should not be penalised:

- Working subsequent to a correct answer
- Correct working in the wrong part of a question
- Legitimate variations in numerical answers/algebraic expressions, eg angles in degrees rounded to nearest degree
- Omission of units
- Bad form (bad form only becomes bad form if subsequent working is correct), eg  $(x^3 + 2x^2 + 3x + 2)(2x + 1)$  written as  $(x^3 + 2x^2 + 3x + 2) \times 2x + 1$

$2x^4 + 4x^3 + 6x^2 + 4x + x^3 + 2x^2 + 3x + 2$  written as  $2x^4 + 5x^3 + 8x^2 + 7x + 2$  gains full credit

- Repeated error within a question, but not between questions or papers
- (n) In any ‘Show that...’ question, where the candidate has to arrive at a required result, the last mark of that part is not available as a follow-through from a previous error unless specified in the detailed marking instructions.
- (o) All working should be carefully checked, even where a fundamental misunderstanding is apparent early in the candidate's response. Marks may still be available later in the question so reference must be made continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that the candidate has gained all the available marks.
- (p) Scored-out working which has not been replaced should be marked where still legible. However, if the scored out working has been replaced, only the work which has not been scored out should be marked.
- (q) Where a candidate has made multiple attempts using the same strategy and not identified their final answer, mark all attempts and award the lowest mark. Where a candidate has tried different valid strategies, apply the above ruling to attempts within each strategy and then award the highest resultant mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Marking instructions for each question

Question	Generic scheme	Illustrative scheme	Max mark
1	<p><b>Ans: 97 miles</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> know how to increase by 15%</li> <li>•<sup>2</sup> know how to calculate the distance after 3 weeks</li> <li>•<sup>3</sup> evaluate</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\times 1.15</math></li> <li>•<sup>2</sup> <math>64 \times 1.15^3</math></li> <li>•<sup>3</sup> 97</li> </ul>	3
2	<p><b>Ans: <math>1.65 \times 10^9</math></b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct method</li> <li>•<sup>2</sup> answer</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>3 \times 10^5 \times 5.5 \times 1000</math></li> <li>•<sup>2</sup> <math>1.65 \times 10^9</math></li> </ul>	2
3	<p><b>Ans: <math>2x^3 - 5x^2 - 10x + 3</math></b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> three terms correct</li> <li>•<sup>2</sup> remaining terms correct</li> <li>•<sup>3</sup> collect like terms</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> e.g. <math>2x^3 - 8x^2 + 2x \dots</math></li> <li>•<sup>2</sup> e.g. <math>\dots 3x^2 - 12x + 3</math></li> <li>•<sup>3</sup> <math>2x^3 - 5x^2 - 10x + 3</math></li> </ul>	3
4	<p><b>Ans: B(8,4,10), C(4,0,10)</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> state coordinates of B</li> <li>•<sup>2</sup> state coordinates of C</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> (8,4,10)</li> <li>•<sup>2</sup> (4,0,10)</li> </ul>	2
5	<p><b>Ans: 9.8 cm</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct substitution into cosine rule</li> <li>•<sup>2</sup> calculate <math>PR^2</math></li> <li>•<sup>3</sup> calculate PR</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>(PR^2 =) 8^2 + 3^2 - 2 \times 8 \times 3 \times \cos 120^\circ</math></li> <li>•<sup>2</sup> 97</li> <li>•<sup>3</sup> 9.8 (488...)</li> </ul>	3



Question	Generic scheme	Illustrative scheme	Max mark
6	<p><b>Ans: 870 cm<sup>3</sup></b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> substitute correctly into formula for volume of cone</li> <li>•<sup>2</sup> substitute correctly into formula for volume of sphere or hemisphere</li> <li>•<sup>3</sup> know to add volume of hemisphere to volume of cone</li> <li>•<sup>4</sup> carry out all calculations correctly (must involve sum of two volume calculations)</li> <li>•<sup>5</sup> round final answer to two significant figures</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{1}{3} \times \pi \times 6^2 \times 11 (= 414.690\dots)</math></li> <li>•<sup>2</sup> <math>\frac{4}{3} \times \pi \times 6^3 (= 904.778\dots)</math> or <math>\frac{1}{2} \times \frac{4}{3} \times \pi \times 6^3 (= 452.389\dots)</math></li> <li>•<sup>3</sup> evidence</li> <li>•<sup>4</sup> 867.079...</li> <li>•<sup>5</sup> 870</li> </ul>	5
7	<p><b>Ans: 3456 millilitres</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> find linear scale factor</li> <li>•<sup>2</sup> know to multiply volume by cube of linear scale factor</li> <li>•<sup>3</sup> calculate volume (calculation must involve a power of linear scale factor)</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{36}{15} (= 2.4)</math></li> <li>•<sup>2</sup> <math>\left(\frac{36}{15}\right)^3 \times 250 (= 2.4^3 \times 250)</math></li> <li>•<sup>3</sup> 3456</li> </ul>	3
8	<p><b>Ans: <math>5n^4</math></b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> simplify powers in numerator</li> <li>•<sup>2</sup> cancel constants</li> <li>•<sup>3</sup> eliminate <math>n</math> from denominator</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>10n^6</math></li> <li>•<sup>2</sup> <math>\frac{5n^6}{n^2}</math></li> <li>•<sup>3</sup> <math>5n^4</math></li> </ul>	3

Question		Generic scheme	Illustrative scheme	Max mark
9	(a)	<p>Ans: gradient = <math>-\frac{4}{3}</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> start to rearrange</li> <li>•<sup>2</sup> state gradient</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>3y = -4x + 12</math></li> <li>•<sup>2</sup> <math>-\frac{4}{3}</math></li> </ul>	2
9	(b)	<p>Ans: (0,4)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> state coordinates (must use brackets)</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> (0,4)</li> </ul>	1
10		<p>Ans: 1039.2 cm<sup>2</sup></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct angle</li> <li>•<sup>2</sup> know how to find area of triangle</li> <li>•<sup>3</sup> know how to find area of hexagon</li> <li>•<sup>4</sup> correct calculation with correct units</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 60</li> <li>•<sup>2</sup> <math>\frac{1}{2} \times 20 \times 20 \times \sin 60</math></li> <li>•<sup>3</sup> <math>\left(\frac{1}{2} \times 20 \times 20 \times \sin 60\right) \times 6</math></li> <li>•<sup>4</sup> 1039.2 cm<sup>2</sup></li> </ul>	4
11	(a)	<p>Ans: 864 cm<sup>2</sup></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> appropriate fraction</li> <li>•<sup>2</sup> correct substitution into area of sector formula</li> <li>•<sup>3</sup> all calculations correct</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{110}{360}</math></li> <li>•<sup>2</sup> <math>\frac{110}{360} \times \pi \times 30^2</math></li> <li>•<sup>3</sup> 863.9...</li> </ul>	3
11	(b)	<p>Ans: 131 cm</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> appropriate fraction</li> <li>•<sup>2</sup> correct substitution into length of arc formula</li> <li>•<sup>3</sup> all calculations correct</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{250}{360}</math></li> <li>•<sup>2</sup> <math>\frac{250}{360} \times \pi \times 60</math></li> <li>•<sup>3</sup> 130.8...</li> </ul>	3

Question	Generic scheme	Illustrative scheme	Max mark
12	<p>Ans: 70.5, 289.5</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> form equation</li> <li>•<sup>2</sup> rearrange equation</li> <li>•<sup>3</sup> find one value</li> <li>•<sup>4</sup> find second value</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>3 \cos x - 1 = 0</math></li> <li>•<sup>2</sup> <math>\cos x = \frac{1}{3}</math></li> <li>•<sup>3</sup> 70.5</li> <li>•<sup>4</sup> 289.5</li> </ul>	4
13	<p>Ans: <math>\frac{x}{x+5}</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> factorise numerator</li> <li>•<sup>2</sup> factorise denominator</li> <li>•<sup>3</sup> cancel brackets correctly</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>x(x-4)</math></li> <li>•<sup>2</sup> <math>(x-4)(x+5)</math></li> <li>•<sup>3</sup> <math>\frac{x}{x+5}</math></li> </ul>	3
14	<p>Ans: <math>a = \frac{2(s-ut)}{t^2}</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> subtract <math>ut</math></li> <li>•<sup>2</sup> multiply by 2</li> <li>•<sup>3</sup> divide by <math>t^2</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>s - ut = \frac{1}{2}at^2</math></li> <li>•<sup>2</sup> <math>2(s - ut) = at^2</math></li> <li>•<sup>3</sup> <math>a = \frac{2(s-ut)}{t^2}</math></li> </ul>	3

Question		Generic scheme	Illustrative scheme	Max mark
15	(a)	<p>Ans: 29°</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> calculate angle HCD</li> <li>•<sup>2</sup> correct substitution into sine rule</li> <li>•<sup>3</sup> rearrange equation</li> <li>•<sup>4</sup> find angle CDH</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 130°</li> <li>•<sup>2</sup> <math>\frac{50}{\sin CDH} = \frac{79}{\sin 130}</math></li> <li>•<sup>3</sup> <math>\sin CDH = \frac{50 \sin 130}{79}</math></li> <li>•<sup>4</sup> 29</li> </ul>	4
15	(b)	<p>Ans: 249°</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> use angle alternate to given bearing</li> <li>•<sup>2</sup> find correct bearing</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 40</li> <li>•<sup>2</sup> 249 [180 + 40 + 29]</li> </ul>	2
16	(a) (i)	<p>Ans: <math>2x + 13</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct expression</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>2x + 13</math></li> </ul>	1
16	(a) (ii)	<p>Ans: <math>4x^2 + 44x + 117 = 270</math>  <math>\Rightarrow 4x^2 + 44x - 153 = 0</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> find expression for area of card and expand pair of brackets</li> <li>•<sup>2</sup> construct equation and rearrange into required form</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>(2x + 13)(2x + 9) = 4x^2 + 44x + 117</math></li> <li>•<sup>2</sup> <math>4x^2 + 44x + 117 = 270</math>  <math>\Rightarrow 4x^2 + 44x - 153 = 0</math></li> </ul>	2
16	(b)	<p>Ans: 2.8 cm</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct substitution into quadratic formula</li> <li>•<sup>2</sup> evaluate discriminant</li> <li>•<sup>3</sup> solve for <math>x</math></li> <li>•<sup>4</sup> select positive value of <math>x</math>, correctly stated to one decimal place</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{-44 \pm \sqrt{44^2 - 4 \times 4 \times (-153)}}{2 \times 4}</math></li> <li>•<sup>2</sup> <math>\frac{-44 \pm \sqrt{4384}}{2 \times 4}</math> (stated or implied by •<sup>3</sup>)</li> <li>•<sup>3</sup> 2.77... and -13.77...</li> <li>•<sup>4</sup> 2.8</li> </ul>	4

[END OF SPECIMEN MARKING INSTRUCTIONS]