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General Certificate of Secondary Education  
June 2006



**MATHEMATICS (SPECIFICATION A)**  
**Higher Tier**  
**Paper 1 Non-Calculator**

3301/1H

**H**

Monday 5 June 2006 1.30 pm to 3.30 pm

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>mathematical instruments</li> </ul> <p>You must <b>not</b> use a calculator.</p>	
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For Examiner's Use	
Pages	Mark
3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20	
TOTAL	
Examiner's Initials	

Time allowed: 2 hours

**Instructions**

- Use blue or black ink or ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this booklet.

**Information**

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You may ask for more answer paper, graph paper and tracing paper. This must be tagged securely to this answer booklet.

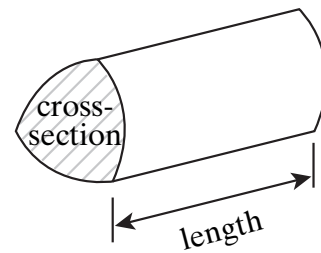
**Advice**

- In all calculations, show clearly how you work out your answer.

### Formulae Sheet: Higher Tier

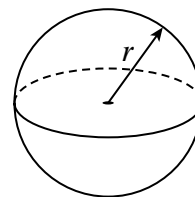
You may need to use the following formulae:

**Volume of prism** = area of cross-section  $\times$  length



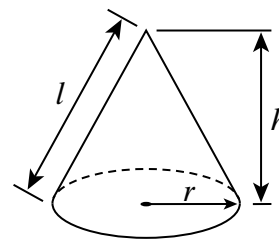
**Volume of sphere** =  $\frac{4}{3} \pi r^3$

**Surface area of sphere** =  $4 \pi r^2$



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

**Curved surface area of cone** =  $\pi r l$

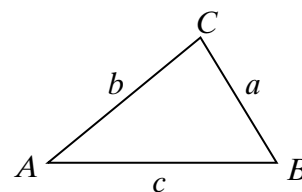


**In any triangle ABC**

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

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

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



**The Quadratic Equation**

The solutions of  $ax^2 + bx + c = 0$ , where  $a \neq 0$ , are given by

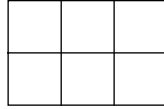
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Answer **all** questions in the spaces provided.

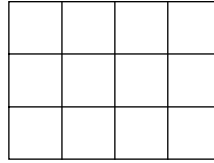
1 The diagrams show a sequence of rectangles.



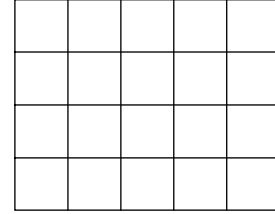
Area = 2  
Diagram 1



Area = 6  
Diagram 2



Area = 12  
Diagram 3



Area = 20  
Diagram 4

(a) Write down an expression for the area of Diagram  $n$ .

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Answer ..... (2 marks)

(b) A rectangle in the sequence has an area of  $110 \text{ cm}^2$ .  
What is its perimeter?

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Answer ..... cm (2 marks)

**Turn over for the next question**

- 2 (a) Expand and simplify  $7(x - 2y) - 3(2x - y)$

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Answer ..... (2 marks)

- (b) Solve  $\frac{24 - x}{5} = 3$

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Answer  $x =$  ..... (2 marks)

- (c) (i) Factorise  $y^2 - 5y + 6$

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Answer ..... (2 marks)

- (ii) Hence solve the equation  $y^2 - 5y + 6 = 0$

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Answer ..... (1 mark)

- (d) Simplify  $\frac{2(x + 3)^2}{8(x + 3)}$

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Answer ..... (2 marks)

(e) Simplify  $(2m^3p)^4$

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Answer ..... (2 marks)

3 (a) Work out the reciprocal of 1.5  
Give your answer as a fraction in its simplest form.

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Answer ..... (2 marks)

(b) Use approximations to estimate the value of  $\sqrt{\frac{9.98}{0.203}}$

You **must** show your working.

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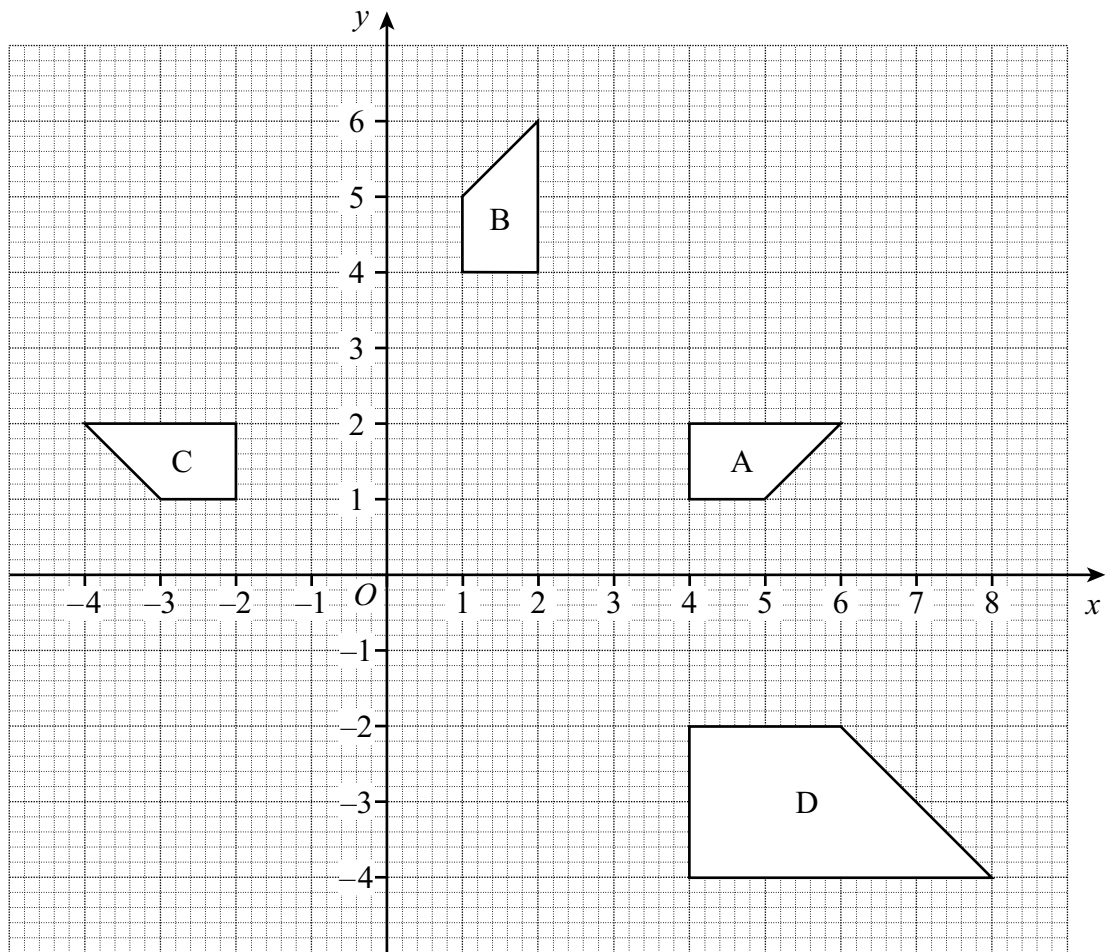
Answer ..... (3 marks)

(c) Work out  $4\frac{1}{5} - 1\frac{2}{3}$

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Answer ..... (3 marks)

4 The diagram shows four shapes, A, B, C and D.



(a) Describe fully the single transformation that takes shape A onto shape B.

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(2 marks)

(b) Describe fully the single transformation that takes shape B onto shape C.

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(3 marks)

(c) Describe fully the single transformation that takes shape C onto shape D.

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(3 marks)

5 (a) Which one of  $\frac{5}{6}$ ,  $\frac{7}{8}$  and  $\frac{9}{10}$  is a recurring decimal?

Show clearly how you made your decision.

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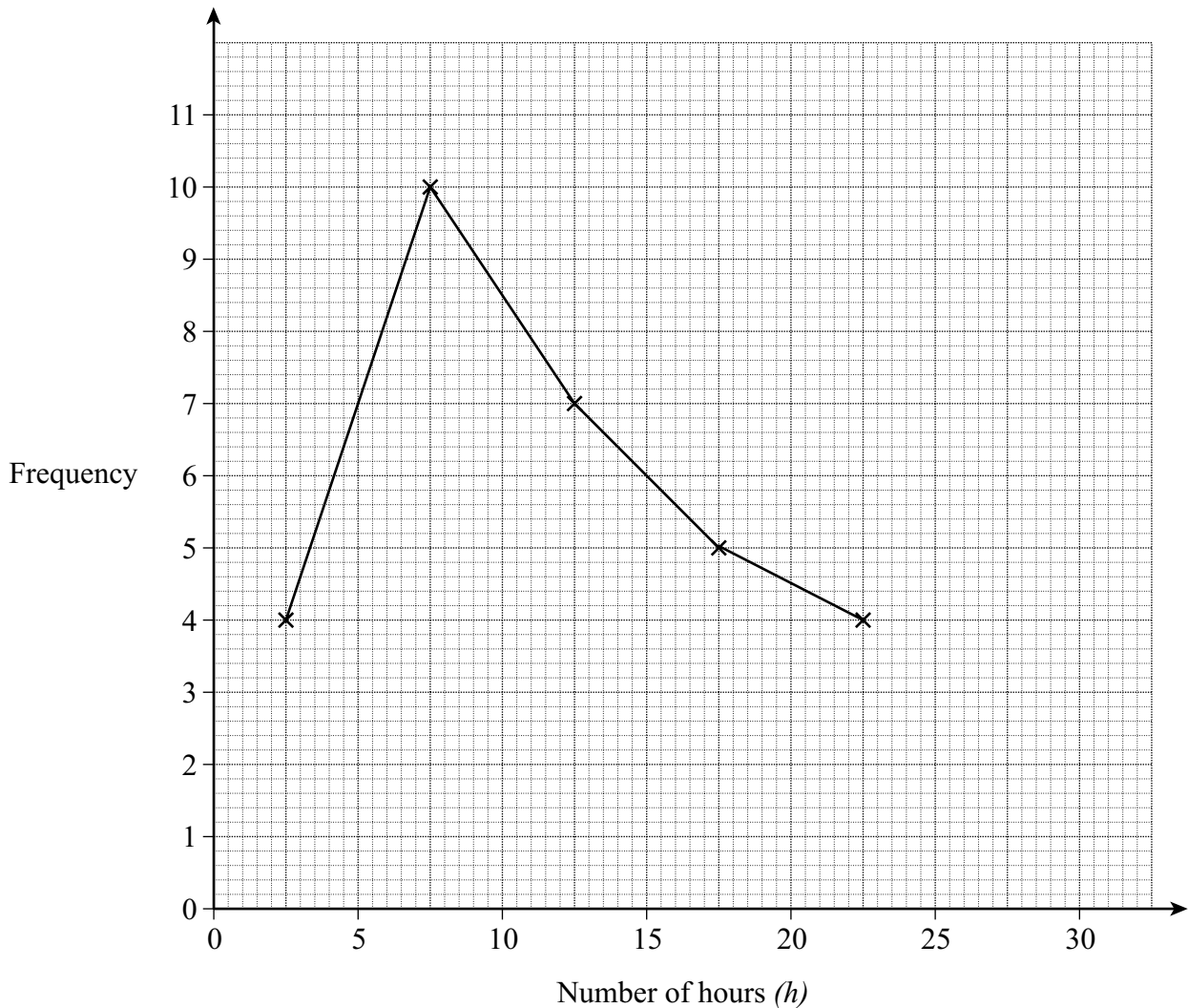
Answer ..... (2 marks)

(b) Change  $\frac{3}{11}$  to a recurring decimal.

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Answer ..... (2 marks)

- 6 The frequency polygon shows the number of hours of television watched each week by 30 teachers.



- (a) The number of hours of television watched each week by 30 students is shown below.

Number of hours ( $h$ )	Frequency
$0 < h \leq 5$	1
$5 < h \leq 10$	2
$10 < h \leq 15$	7
$15 < h \leq 20$	9
$20 < h \leq 25$	7
$25 < h \leq 30$	4

On the same grid draw a frequency polygon to show this information.

(2 marks)



- (b) Give **two** comparisons between the number of hours of television watched by these teachers and students.

Comparison 1

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Comparison 2

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(2 marks)

- 7 (a) The ratio 35 000 000 : 50 can be written in the form  $n : 1$   
Work out the value of  $n$ .  
Give your answer in standard form.

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Answer  $n =$  ..... (2 marks)

- (b) Solve the equation  $y \times 10^6 = 3.5 \times 10^3$   
Give your answer in standard form.

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Answer  $y =$  ..... (2 marks)

8 Match each of the **shaded** regions to one of these inequalities.

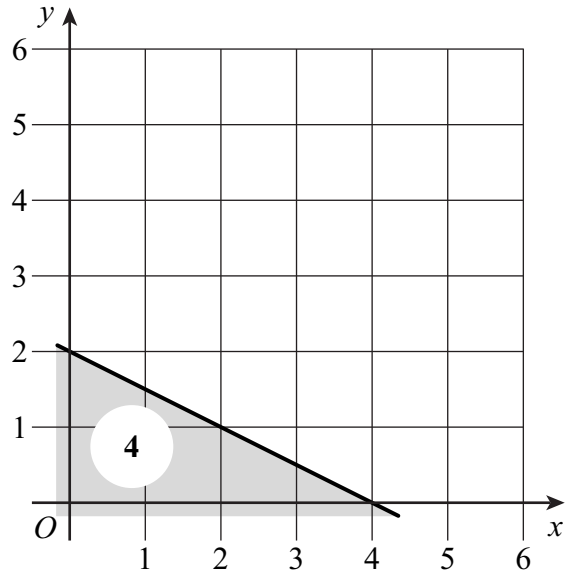
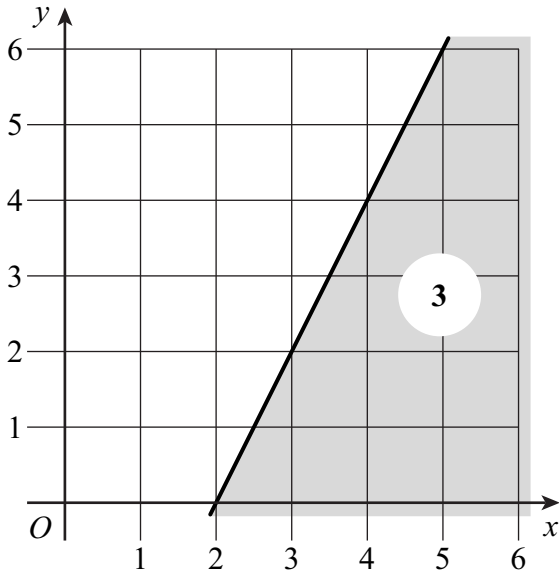
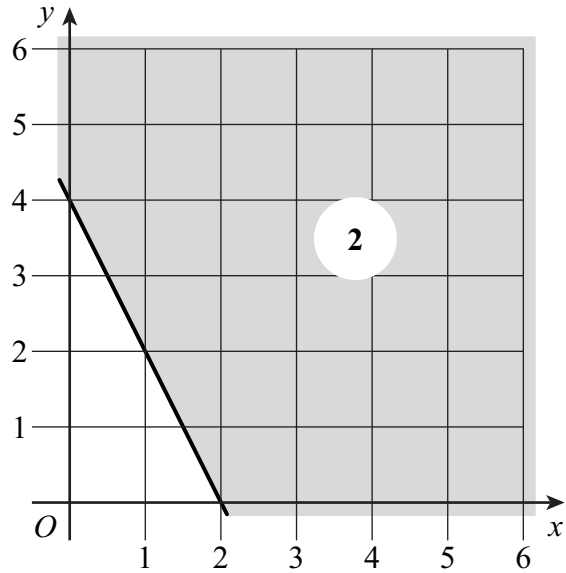
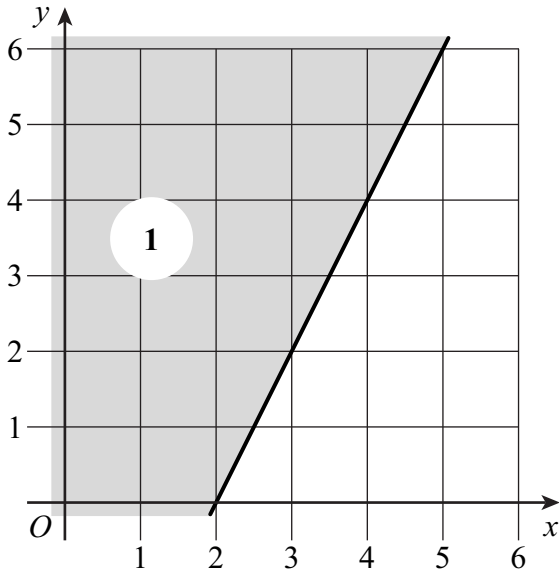
**A**  $y \leq -\frac{1}{2}x + 2$

**B**  $y \leq \frac{1}{2}x + 2$

**C**  $y \geq -2x + 4$

**D**  $y \geq 2x - 4$

**E**  $y \leq 2x - 4$



Region 1 .....

Region 2 .....

Region 3 .....

Region 4 .....

(4 marks)

9 Make  $u$  the subject of the formula  $s = \frac{1}{2}(u + v)t$

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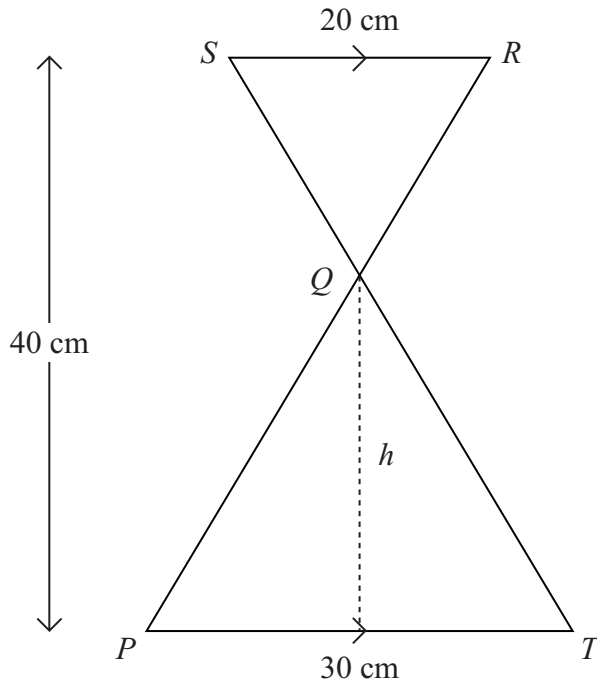
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Answer  $u =$  ..... (3 marks)

10 In the diagram  $SR$  is parallel to  $PT$ .  
 $SQT$  and  $RQP$  are straight lines.  
 $SR = 20$  cm and  $PT = 30$  cm  
 The total height of the two triangles is 40 cm.



Not drawn accurately

Use similar triangles to calculate the height,  $h$  cm, of triangle  $PQT$ .

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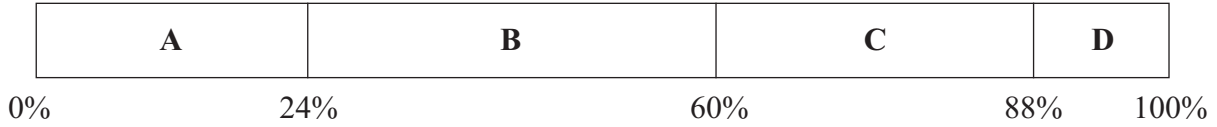
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Answer  $h =$  ..... cm (3 marks)

- 11** A factory employs 150 men and 200 women.  
Each person's job is given a grade, **A**, **B**, **C** or **D**.  
The diagrams show the proportion at each grade for both men and women.

Men (150 employees)



Women (200 employees)



A 10% sample is taken of the employees, stratified by sex and by grade.  
Complete the table to show how many of each group should be sampled.

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>Men</b>				
<b>Women</b>				

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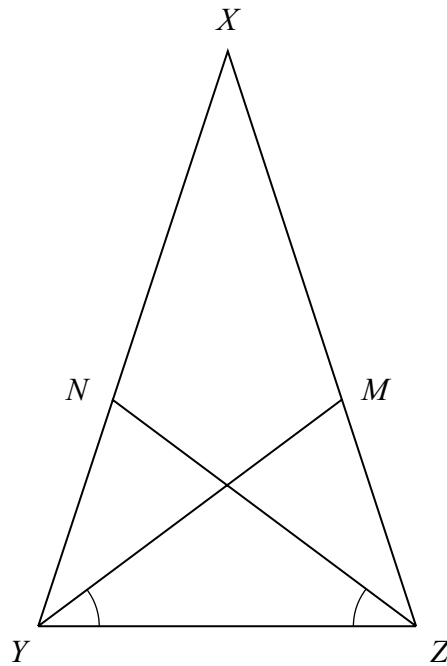
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(4 marks)

- 12  $XYZ$  is an isosceles triangle in which  $XZ = XY$   
 $M$  and  $N$  are points on  $XZ$  and  $XY$  such that angle  $MYZ = \text{angle } NZY$



Prove that triangles  $YMZ$  and  $ZNY$  are congruent.

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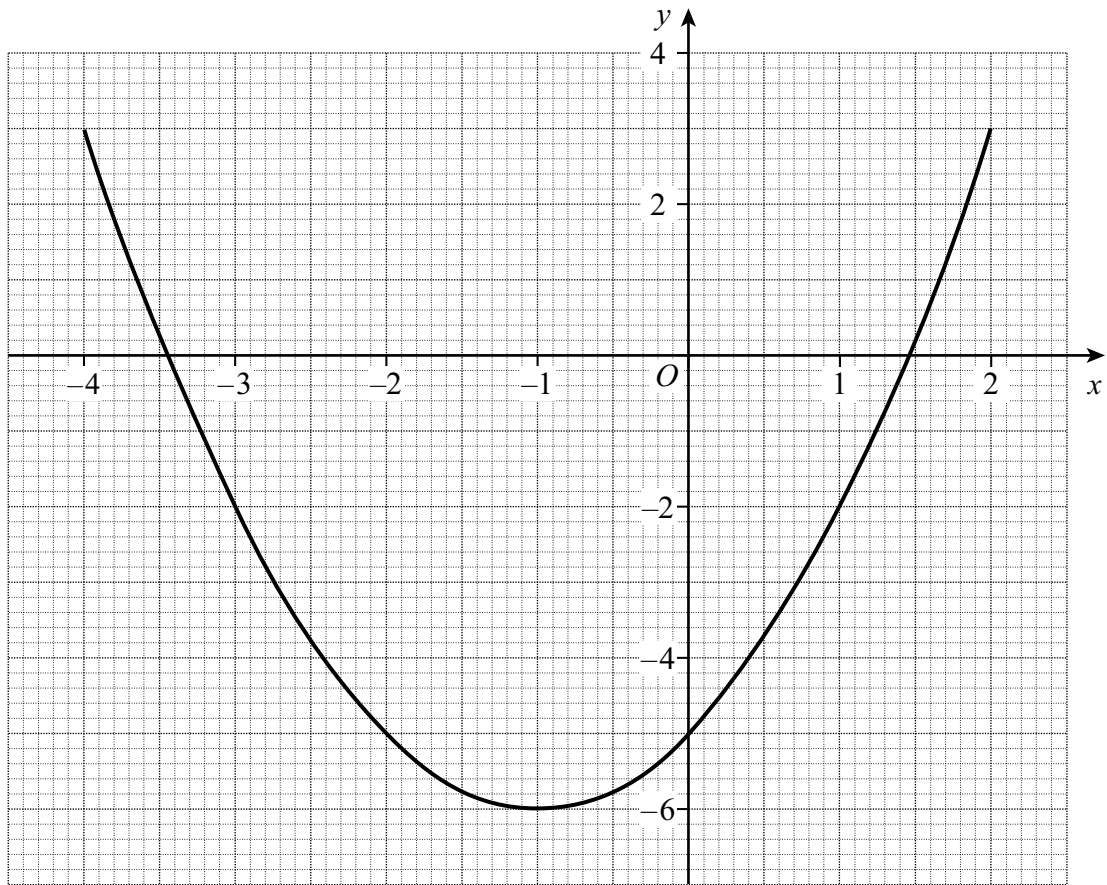
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(4 marks)

Turn over 

- 13 The grid shows the graph of  $y = x^2 + 2x - 5$



By drawing an appropriate straight line, solve the equation  $x^2 + 2x - 5 = x - 1$

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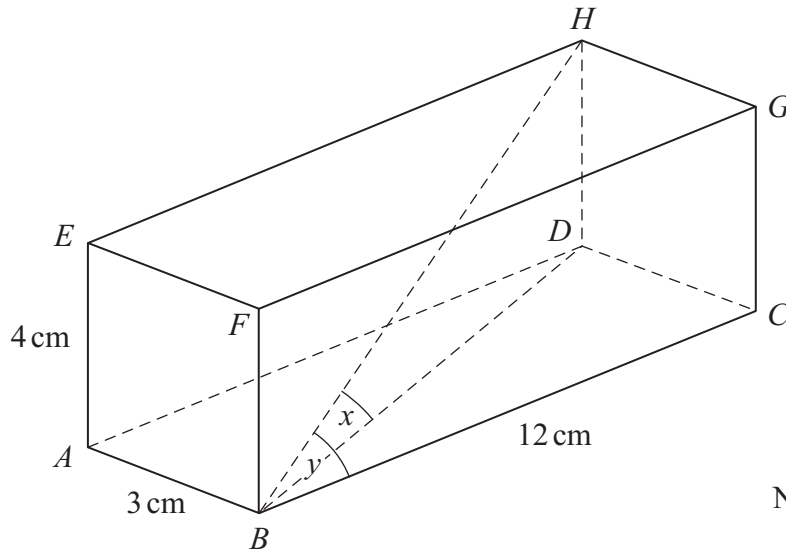
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Answer ..... (3 marks)

- 14 The diagram shows a cuboid.  
 $AB = 3\text{ cm}$ ,  $AE = 4\text{ cm}$ ,  $BC = 12\text{ cm}$ .



- (a) Find the length of  $BH$ .

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Answer ..... cm (2 marks)

- (b) The angle between  $BH$  and  $BD$  is  $x$  and the angle between  $BH$  and  $BC$  is  $y$ .

Which angle is bigger,  $x$  or  $y$ ?  
 You **must** show your working.

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Answer ..... (3 marks)

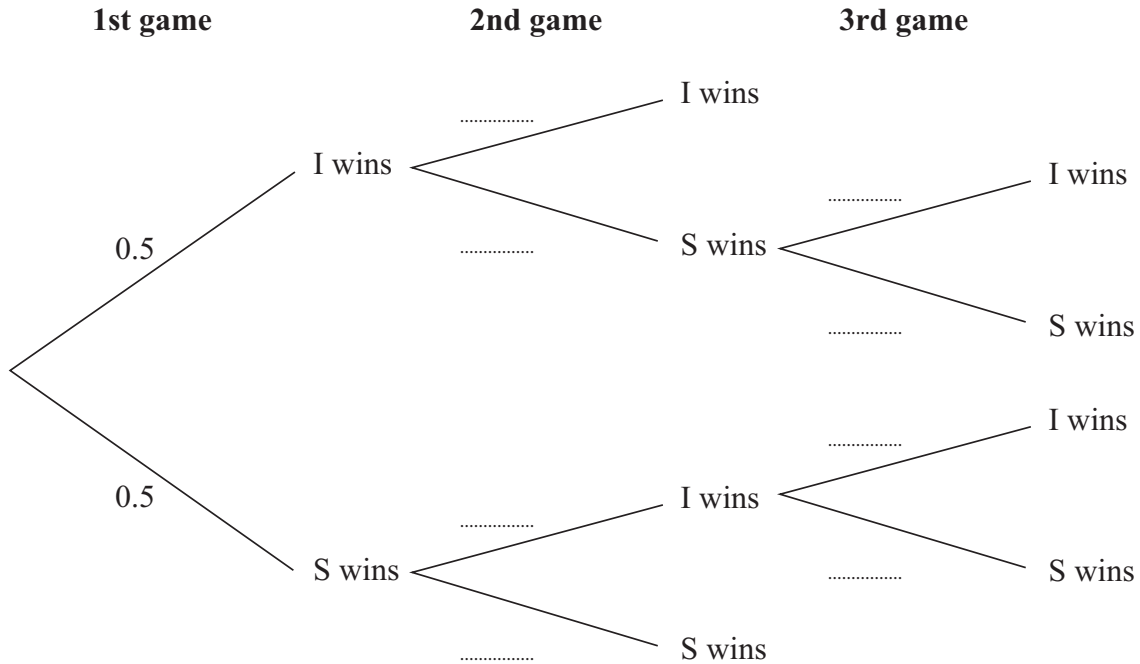
Turn over

- 15** Ian and Simon play each other in a darts match.  
The match consists of three games.  
The winner of the match is the first player to win two games.

The tree diagram shows all the possible outcomes.

‘I wins’ means that Ian wins the game.

‘S wins’ means that Simon wins the game.



The probability that Ian wins the first game is 0.5

Whenever Ian wins a game the probability that he wins the next game is 0.7

Whenever Simon wins a game the probability that he wins the next game is 0.6

- (a) Complete the tree diagram.

(2 marks)

- (b) Calculate the probability that Ian wins the darts match.

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Answer .....

(4 marks)



**16 (a) Simplify**

(i)  $w^2 \times w^6$

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Answer ..... (1 mark)

(ii)  $w^{10} \div w^4$

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Answer ..... (1 mark)

(iii)  $(w^4)^3$

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Answer ..... (1 mark)

(b) If  $x = 3^p$  and  $y = 3^q$

Express in terms of  $x$  and/or  $y$ 

(i)  $3^{p-q}$

.....

Answer ..... (1 mark)

(ii)  $3^{2p}$

.....

Answer ..... (1 mark)

(iii)  $3^{q+2}$

.....

Answer ..... (1 mark)

17 In an experiment measurements of  $t$  and  $m$  were taken.  
The results were as follows:

$t$	2	2.4	3
$m$	36	25	16

The results are connected by one of these rules.

$A \quad t \propto \sqrt{m}$ 
         
  $B \quad t \propto \frac{1}{m}$ 
         
  $C \quad t \propto \frac{1}{\sqrt{m}}$

Which rule is the correct one?  
 State your answer clearly.  
 You **must** show your working.

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Answer ..... (4 marks)

18 (a) Show that  $(\sqrt{12 + \sqrt{3}})^2 = 27$

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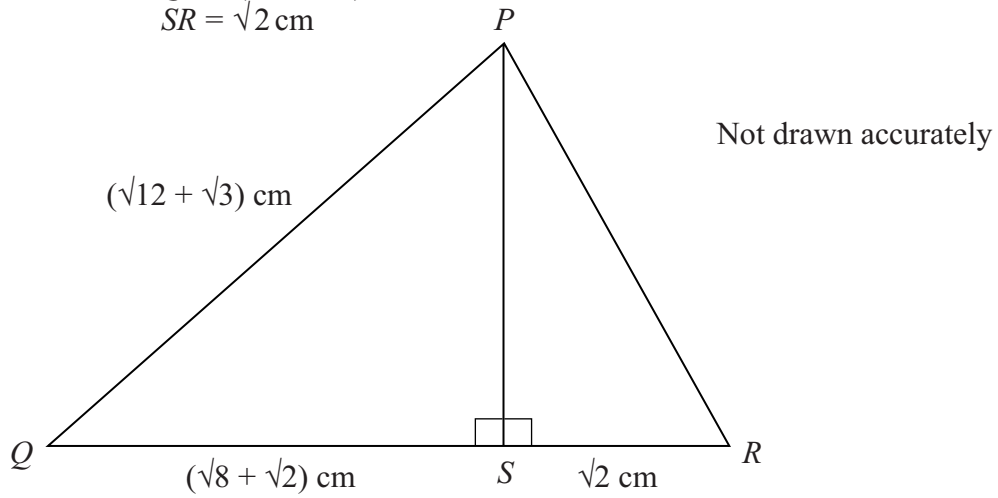
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(2 marks)

(b) In the diagram  $PQ = (\sqrt{12 + \sqrt{3}})$  cm  
 $QS = (\sqrt{8 + \sqrt{2}})$  cm  
 $SR = \sqrt{2}$  cm



(i) Show that  $PS = 3$  cm

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(4 marks)

(ii) Find the area of triangle  $PQR$  giving your answer in the form  $a\sqrt{2}$ , where  $a$  is a positive integer.

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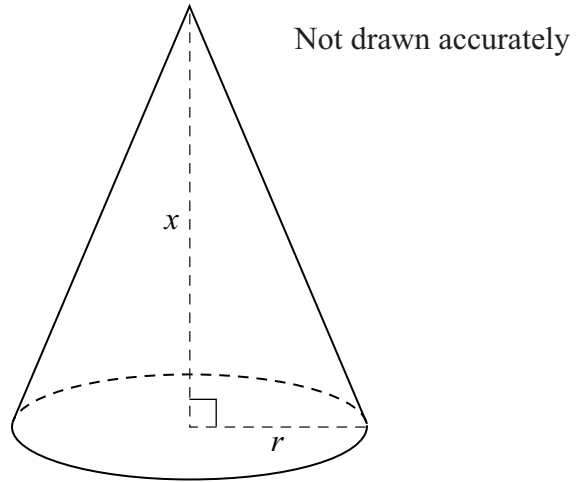
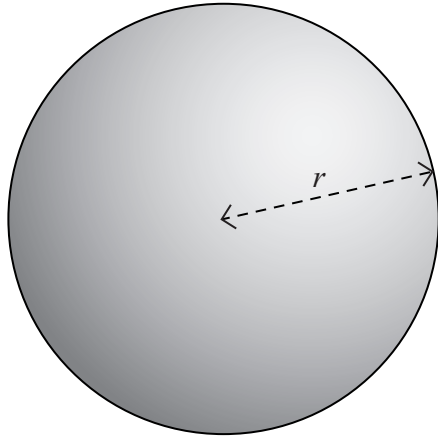
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Answer ..... cm<sup>2</sup> (3 marks)

Turn over

- 19** A sphere has radius  $r$ .  
 A cone has base radius  $r$  and perpendicular height  $x$ .  
 The volume of the sphere is double the volume of the cone.



- (a) Show that  $x = 2r$

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(2 marks)

- (b) Calculate the ratio of the surface area of the sphere to the curved surface area of the cone.  
 Give your answer in surd form.

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Answer ..... (4 marks)

**END OF QUESTIONS**