

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
MATHEMATICS SYLLABUS A**

**J512/04**

Paper 4  
(Higher Tier)

**Monday 1 June 2009  
Morning**

**Duration: 2 hours**

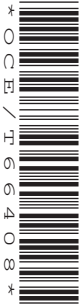
Candidates answer on the question paper

**OCR Supplied Materials:**

None

**Other Materials Required:**

- Electronic calculator
- Geometrical instruments
- Tracing paper (optional)



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

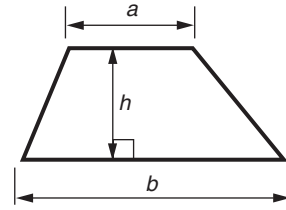
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Show your working. Marks may be given for a correct method even if the answer is incorrect.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

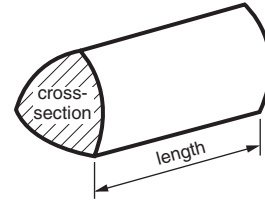
- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are expected to use an electronic calculator for this paper.
- Use the  $\pi$  button on your calculator or take  $\pi$  to be 3.142 unless the question says otherwise.
- The total number of marks for this paper is **100**.
- This document consists of **20** pages. Any blank pages are indicated.

## Formulae Sheet: Higher Tier

**Area of trapezium**  $= \frac{1}{2}(a + b)h$



**Volume of prism** = (area of cross-section) x length

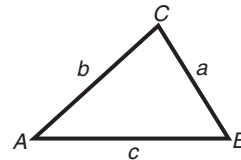


**In any triangle ABC**

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

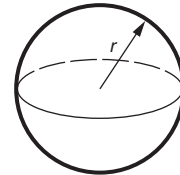
**Cosine rule**  $a^2 = b^2 + c^2 - 2bc \cos A$

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



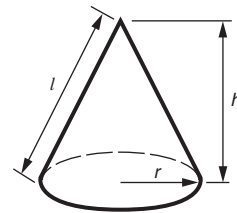
**Volume of sphere**  $= \frac{4}{3} \pi r^3$

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



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

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



**The Quadratic Equation**

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

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

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- 1 Joan has a recipe for making chocolate buns.  
The recipe uses 150g of flour and 25g of cocoa powder to make 12 buns.

(a) How much flour should Joan use to make 18 buns?

.....  
 .....

(a) \_\_\_\_\_ g [2]

(b) What is 25g out of 175g expressed as a percentage?

.....

(b) \_\_\_\_\_ % [2]

2 Calculate.

(a)  $\frac{22.4}{3.6 + 2.8}$

.....

(a) \_\_\_\_\_ [1]

(b)  $\sqrt{36 + (4.5)^2}$

.....

.....

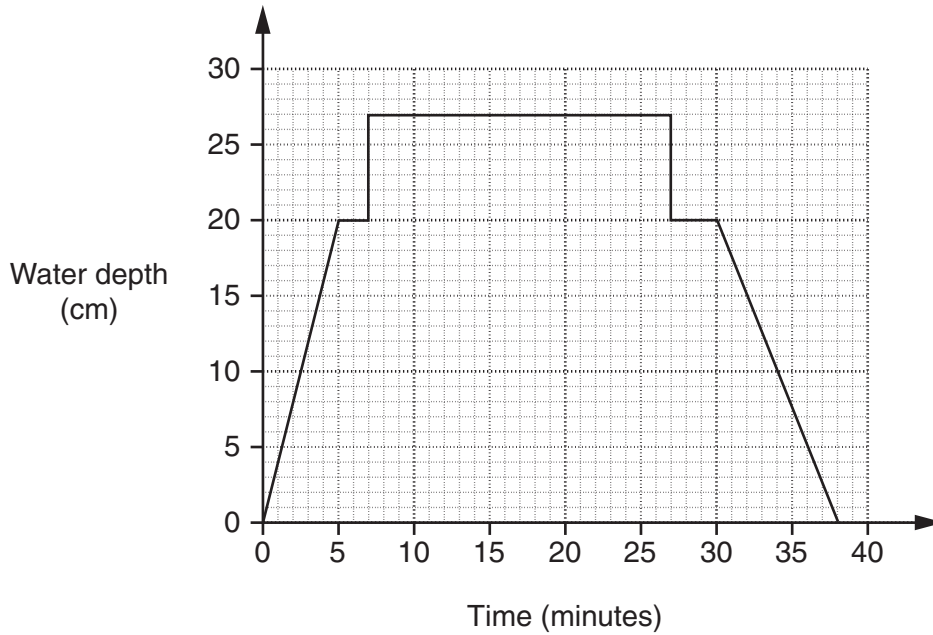
(b) \_\_\_\_\_ [2]

(c) The reciprocal of 0.16.

.....

(c) \_\_\_\_\_ [1]

- 3 Rachael decides to bath her dog, Oscar. She runs water into the bath, puts Oscar in the bath, baths Oscar, takes him out and then empties the bath. The graph shows the depth of water in the bath.



- (a) Which is quicker, running water into the bath or emptying it?  
Explain how you can tell.

\_\_\_\_\_ [1]

- (b) By how much does the depth of the water increase in one minute as water runs into the bath?

.....  
(b) \_\_\_\_\_ cm [1]

- (c) For how long was Oscar in the bath?

.....  
(c) \_\_\_\_\_ minutes [1]

- (d) The volume of the bath water was  $119600\text{cm}^3$ .

Change  $119600\text{cm}^3$  into litres.

.....  
(d) \_\_\_\_\_ litres [1]

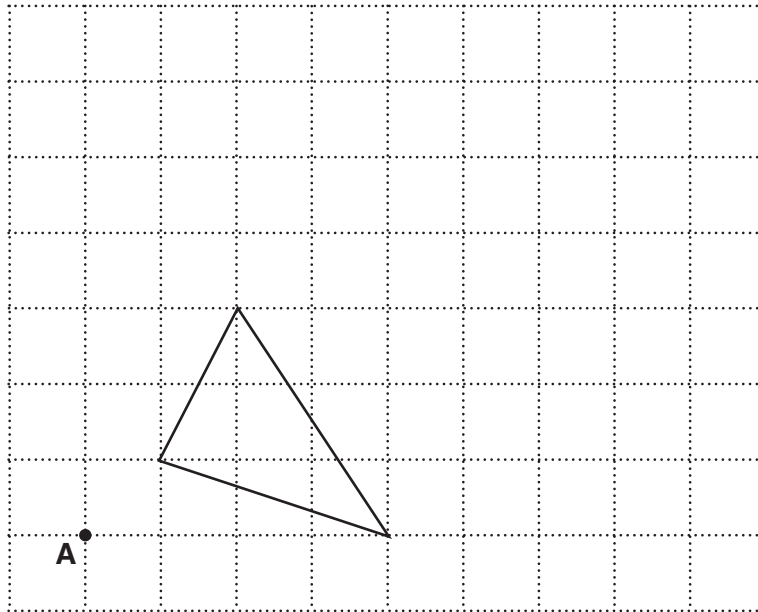
5

4 Calculate the average speed for a journey of 420 miles that takes 3 hours 30 minutes.

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\_\_\_\_\_ mph [3]

5 Enlarge the triangle by scale factor 2 from centre **A**.



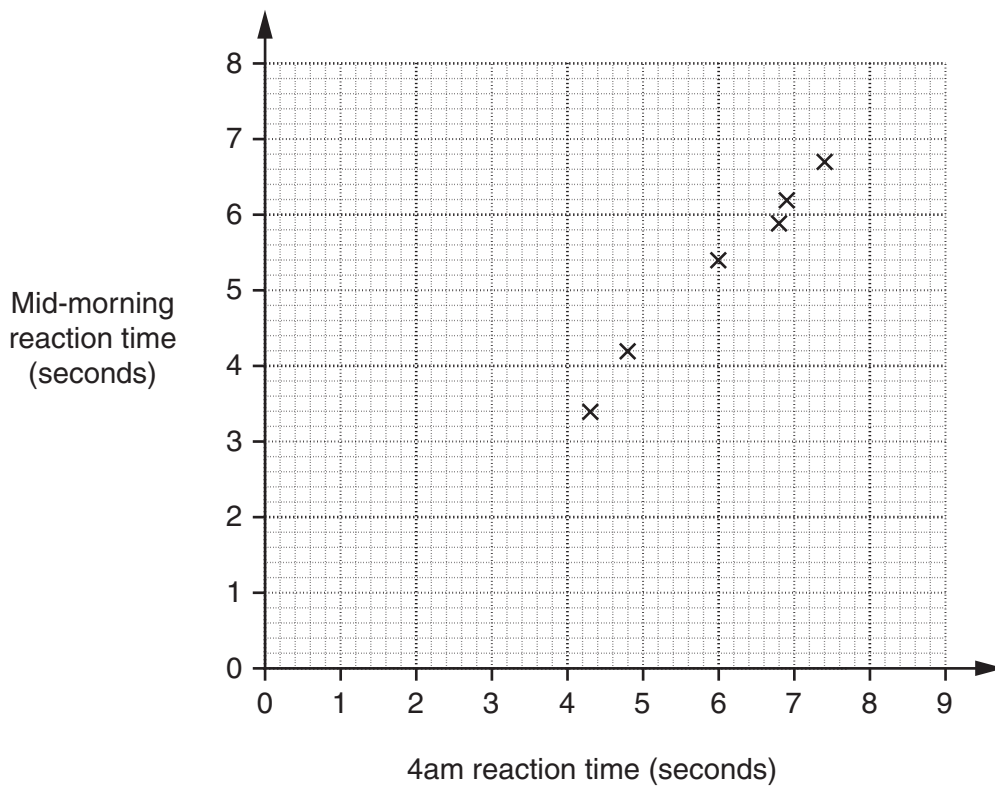
[3]

- 6 Sally conducted an experiment on reaction times. One day ten students were woken at 4 am and their reaction times were measured. Another day their reaction times were measured mid-morning after a full night's sleep.

The reaction times, in seconds, are shown in the table.

Student	A	B	C	D	E	F	G	H	I	J
4 am reaction time	4.3	6.8	6.9	7.4	6.0	4.8	5.6	4.0	8.5	3.6
Mid-morning reaction time	3.4	5.9	6.2	6.7	5.4	4.2	4.4	3.0	7.5	2.8

The scatter graph shows the reaction times for students A to F.



- (a) Complete the scatter graph. [2]
- (b) Describe the correlation shown. [1]
- 
- (c) Draw a line of best fit on your graph. [1]

- (d) Another student, John, has a mid-morning reaction time of 5.0 seconds.

Use your line of best fit to estimate John's reaction time if he was woken at 4 am.

(d) \_\_\_\_\_ s [1]

- (e) Explain why it may not be appropriate to use your line of best fit to estimate the mid-morning reaction time of a student whose 4 am reaction time is 2.0 seconds.

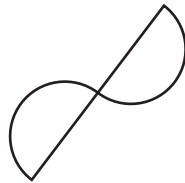
\_\_\_\_\_  
 \_\_\_\_\_ [1]

- 7 (a) Calculate the area of a circle of radius 6 cm.

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(a) \_\_\_\_\_ cm<sup>2</sup> [2]

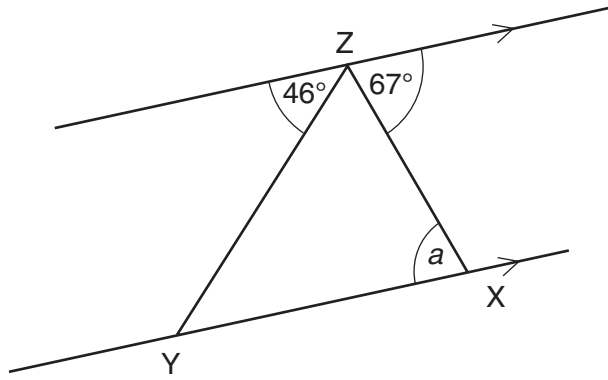
- (b) This logo is made using two semicircles, each with a radius of 6 cm.



Work out the **perimeter** of the logo.  
 Give the units of your answer.

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(b) \_\_\_\_\_ [4]



NOT TO SCALE

- (a) Find the size of angle  $a$ .  
Give a reason for your answer.

.....  
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$a =$  \_\_\_\_\_  $^{\circ}$  because \_\_\_\_\_

\_\_\_\_\_ [2]

- (b) Find the sizes of the other angles in triangle XYZ.  
What type of triangle is XYZ?

.....  
 .....

Angles are \_\_\_\_\_  $^{\circ}$  and \_\_\_\_\_  $^{\circ}$ .

Triangle XYZ is \_\_\_\_\_ [3]



- 9 Eight identical squares have a total area of  $2312 \text{ mm}^2$ .  
The length of the side of each square is  $x \text{ mm}$ .

Write an equation in  $x$  and work out the value of  $x$ .

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\_\_\_\_\_ [3]

- 10 The capacity of a tank is 8 gallons.  
The empty tank was filled with petrol.  
The petrol cost 123.9 pence per litre.  
1 litre is approximately equal to 0.22 gallons.

Calculate how much it cost to fill the tank with petrol.  
Give your answer to an appropriate degree of accuracy.

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£ \_\_\_\_\_ [4]

11 Use trial and improvement to solve this equation.

$$x^3 - x = 10$$

Give your answer to one decimal place.  
Show all your trials and their outcomes.

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\_\_\_\_\_ [4]

12 A fair spinner is numbered from 1 to 5.  
The spinner is spun twice.

By listing the possible outcomes, or otherwise, work out the probability that the number obtained on the second spin is less than the number obtained on the first spin.

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\_\_\_\_\_ [3]

13 A bouncy ball is dropped from a height of 4 m.  
After each bounce it rises to 90% of its previous height.

(a) To what height does it rise after one bounce?

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 .....  
 (a) \_\_\_\_\_ m [2]

(b) How many times does it bounce altogether before the height it rises to is less than 2.5 m?

.....  
 .....  
 .....  
 (b) \_\_\_\_\_ [2]

14 In this question the letters  $f$ ,  $g$ , and  $h$  represent lengths.

(a) Here are some expressions.

$f^2gh$        $f^2(g + h)$        $2(f + g)$        $2h(f - g)$

Write down the expression that represents

(i) a length,

.....  
 (a)(i) \_\_\_\_\_ [1]

(ii) a volume.

.....  
 (ii) \_\_\_\_\_ [1]

(b) Explain why  $f + g^2$  cannot represent a length, an area or a volume.

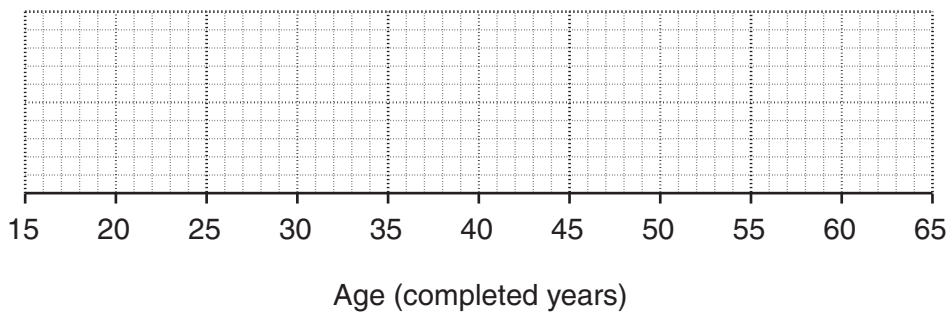
.....  
 ..... [1]

15 Ajay carried out a survey to find the age, in completed years, at which people marry.

The table summarises the results for the women in the survey.

	Age (completed years)
Youngest	18
Lower quartile	23
Median	26
Upper quartile	34
Oldest	55

(a) Draw a box plot to summarise the results for the women in the survey.



[2]

The box plot below summarises the results for the men in the survey.



(b) Give one similarity and one difference between the ages at which the men and the women in the survey marry.

Similarity \_\_\_\_\_

\_\_\_\_\_

Difference \_\_\_\_\_

\_\_\_\_\_

[2]

- (c) Ajay decides to interview two people from his survey. He chooses one woman and one man at random.

What is the probability that both the woman and the man were aged 34 or more when they married?

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(c) \_\_\_\_\_ [2]

- 16 (a) Solve, algebraically, these simultaneous equations.

$$\begin{aligned} 3x - 5y &= 111 \\ 4x + 3y &= -26 \end{aligned}$$

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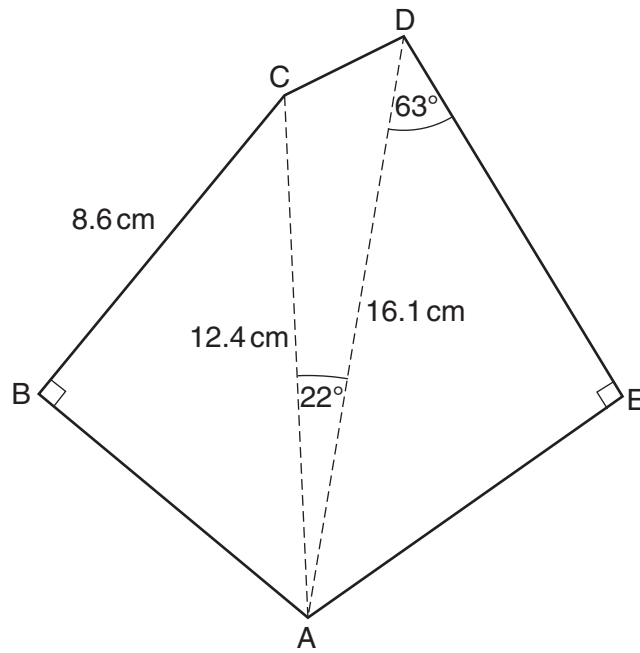
(a)  $x =$  \_\_\_\_\_  $y =$  \_\_\_\_\_ [4]

- (b) Rearrange  $t = \sqrt{\frac{2V}{r}}$  to make  $V$  the subject of the formula.

.....  
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(b) \_\_\_\_\_ [3]

17 ABCDE is an irregular pentagon with lengths and angles as shown in the diagram.



NOT TO SCALE

(a) Work out the size of angle CAB.

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(a) \_\_\_\_\_ ° [3]

(b) Work out the length DE.

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(b) \_\_\_\_\_ cm [3]

(c) Work out the area of triangle ACD.

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(c) \_\_\_\_\_ cm<sup>2</sup> [2]

(d) Work out the length CD.

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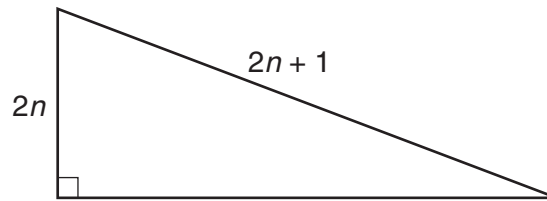
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(d) \_\_\_\_\_ cm [3]

- 18 A right-angled triangle has hypotenuse of length  $2n + 1$ , where  $n$  is an integer. Another side has length  $2n$ .



- (a) Show that the length of the third side of the triangle is  $\sqrt{4n + 1}$ .

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[3]

- (b) For some values of  $n$ , all the sides of the triangle are integer lengths.

For these values of  $n$ , is  $\sqrt{4n + 1}$  odd or even?  
Explain your answer.

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[2]



- 19** Pond weed was introduced into a pond.  
The weight of pond weed,  $p$  grams, in the pond  $t$  days later is given by

$$p = 1 + 2^t.$$

- (a)** Work out the weight of pond weed in the pond after 3 days.

.....  
.....

**(a)** \_\_\_\_\_ g [1]

- (b) (i)** Write down an equation that could be used to find the number of days it takes for the weight of pond weed to reach 129 grams.

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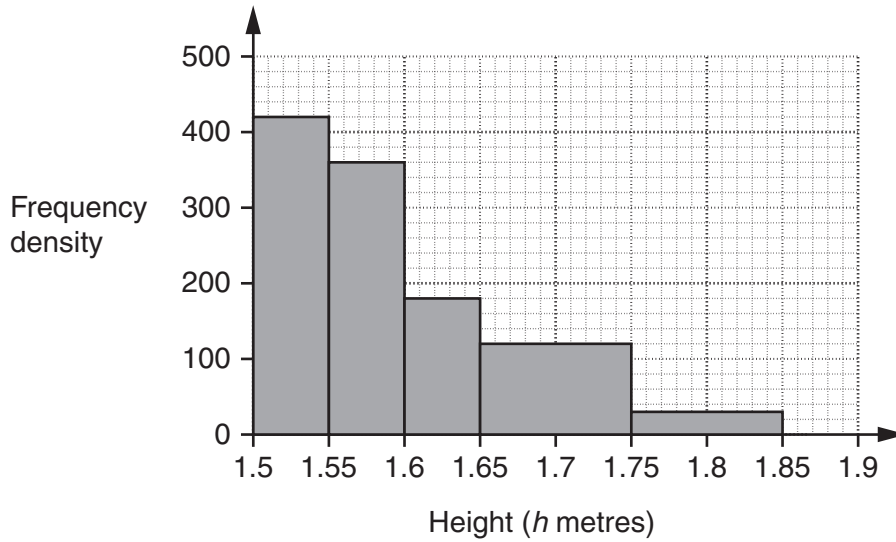
**(b)(i)** \_\_\_\_\_ [1]

- (ii)** Work out the number of days it takes for the weight of pond weed to reach 129 grams.

.....  
.....

**(ii)** \_\_\_\_\_ [2]

20 The histogram shows the distribution of the heights,  $h$  metres, of a group of nurses.



(a) Show that 12 of these nurses have height  $1.65 \leq h < 1.75$ .

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[1]

(b) Complete the frequency table.

Height ( $h$ metres)	Frequency
$1.50 \leq h < 1.55$	
$1.55 \leq h < 1.60$	
$1.60 \leq h < 1.65$	
$1.65 \leq h < 1.75$	12
$1.75 \leq h < 1.85$	

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..... [3]

21 Solve algebraically.

$$\frac{5}{x+3} + \frac{4}{2x-1} = 1$$

Give your answers correct to 2 decimal places.

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