

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**GCSE**

**A382/01**

**APPLICATIONS OF MATHEMATICS**

**Applications of Mathematics 2**  
**(Foundation Tier)**

**FRIDAY 13 JUNE 2014: Morning**

**DURATION: 1 hour 30 minutes**  
**plus your additional time allowance**

**MODIFIED ENLARGED**

<b>Candidate forename</b>		<b>Candidate surname</b>	
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<b>Centre number</b>						<b>Candidate number</b>				
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**Candidates answer on the Question Paper.**

**OCR SUPPLIED MATERIALS:**

**A3 Loose Sheet for Question 1(d)**

**A4 Loose Sheet for Question 4(e)**

**OTHER MATERIALS REQUIRED:**

**Scientific or graphical calculator**

**Geometrical instruments**

**Tracing paper (optional)**

<p><b>YOU ARE PERMITTED TO USE A CALCULATOR FOR THIS PAPER</b></p>
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**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

**Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**

**Use black ink. HB pencil may be used for graphs and diagrams only.**

**Answer ALL the questions.**

**Read each question carefully. Make sure you know what you have to do before starting your answer.**

**Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.**

**Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

## **INFORMATION FOR CANDIDATES**

**The number of marks is given in brackets [ ] at the end of each question or part question.**

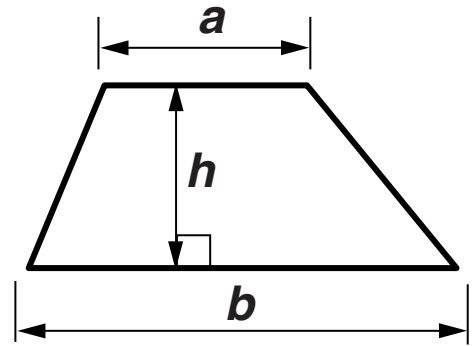
**Your quality of written communication is assessed in questions marked with an asterisk (\*).**

**The total number of marks for this paper is 90.**

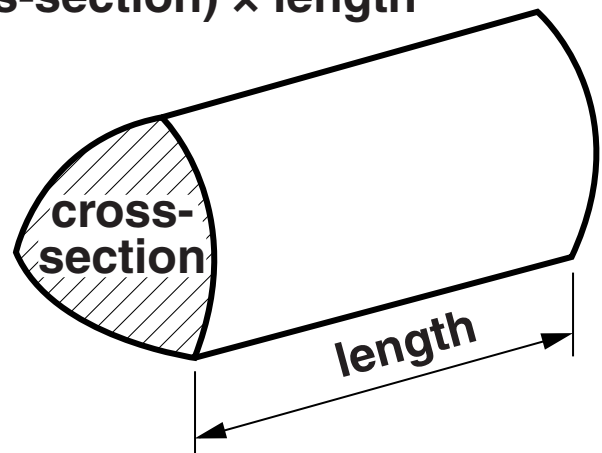
**Any blank pages are indicated.**

## FORMULAE SHEET: FOUNDATION TIER

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



Volume of prism = (area of cross-section) × length



**Answer ALL the questions.**

- 1 Water puts out fires in two ways:  
by cooling down the area round the fire  
by turning into steam which takes oxygen away from  
the fire.**

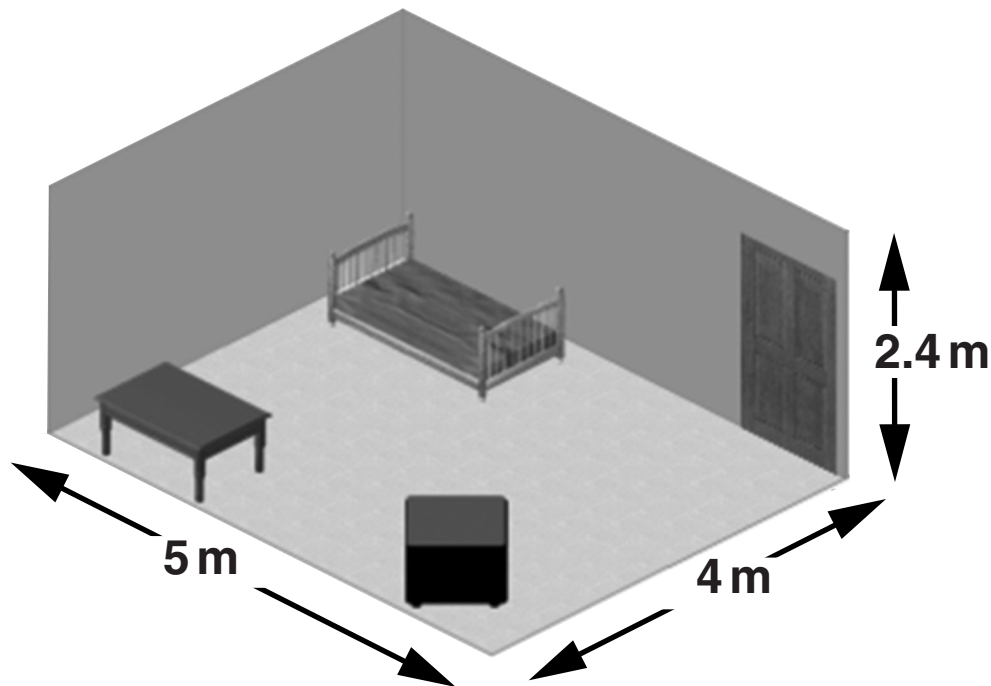
- (a) Most household fires can be put out by the fire  
brigade using a fine spray of water.**

**The following rule can be used to calculate the  
approximate amount of water needed to put out a  
fire in a room in a house.**

<b>Amount of water (litres) = volume of room (cubic metres) divided by 3</b>
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The sketch below shows a room in a house.  
The room is a cuboid.

Use the rule to calculate the amount of water  
needed to put out a fire in this room.



(a) \_\_\_\_\_ litres [3]

**(b) Fire engines carry about 1800 litres of water in their tanks.**

**The graph opposite shows the volume of water left in a fire engine's tank after arriving at a fire.**

**(i) How soon after arriving at the fire did the fire engine start pumping water?**

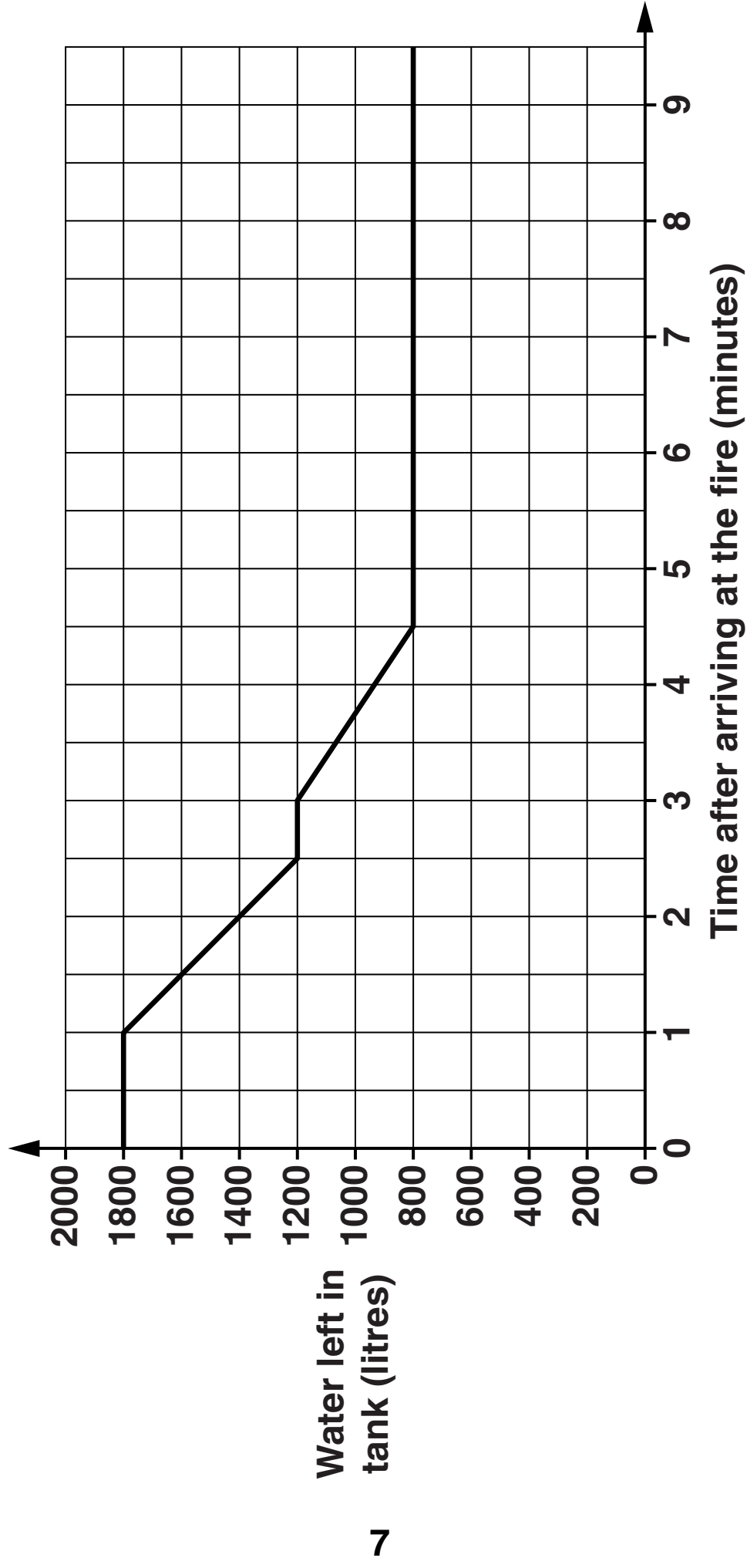
**(b)(i) \_\_\_\_\_ minutes [1]**

**(ii) How much water was left in the tank two minutes after arriving at the fire?**

**(ii) \_\_\_\_\_ litres [1]**

**(iii) After the fire engine arrived, how long did it take to put the fire out?**

**(iii) \_\_\_\_\_ minutes [1]**



- (c) Where there are fires in tall buildings the water needs to reach high up.

The following formula can be used to find the maximum height water can reach up a tall building.

$$h = \frac{8f^2}{d^4}$$

$h$  metres is the height reached,  
 $f$  litres per second is the water flow rate,  
 $d$  centimetres is the hose diameter.

A hose pipe has diameter 3.8 cm.  
Water is pumped through it at 35 litres per second.

- (i) Calculate  $3.8^4$ .

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

- (ii) What is the maximum height the water can reach?

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

- (iii) Some fire engines have a very long ladder with a platform attached.**

**These platforms can reach up to 40 m.**

**An average platform can safely carry a load of 380 kg.**

**How many adults in total could this platform safely carry?**

**State any assumptions that you make to find your answer.**

**(iii) \_\_\_\_\_ adults [2]**

**(d) The bar chart provided separately on the Loose Sheet shows information about fires in England.**

**(i) In the first quarter (Q1) of 2009 there were 8.2 thousand household fires.**

**How many household fires were there in Q1 of 2012?**

**(d)(i) \_\_\_\_\_ thousand [1]**

**(ii) Izzy says “Each year Q4 is ALWAYS the worst quarter for household fires.”**

**Is Izzy right?**

**Use evidence from the graph to support your answer.**

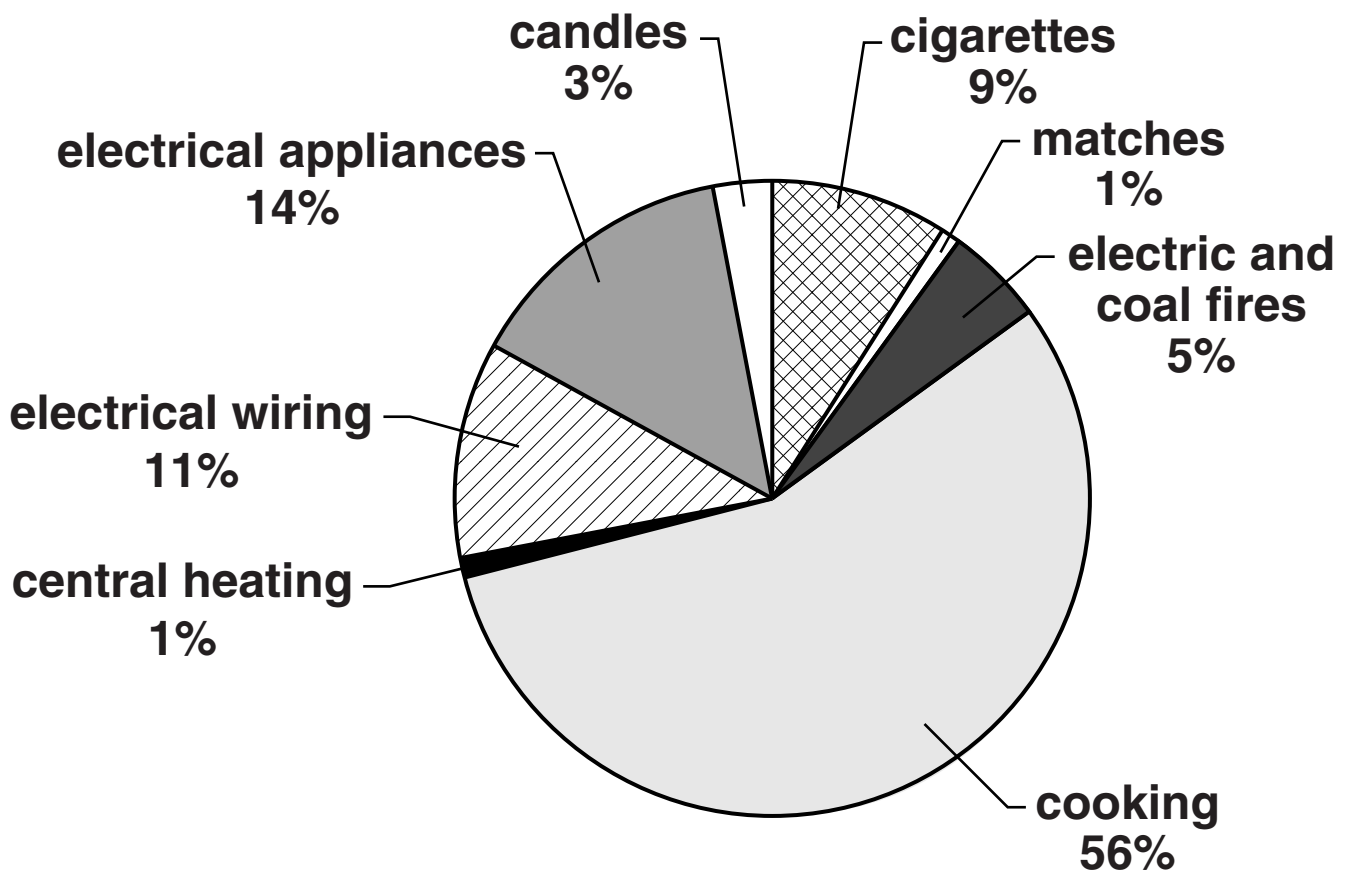
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

**(iii) How many household fires were there in England in total for the four quarters from 2011 Q2 to 2012 Q1?  
Give your answer in thousands and as an ordinary number.**

**(iii) \_\_\_\_\_ thousand which as an  
ordinary number is \_\_\_\_\_ [3]**

(e) The following pie chart shows the causes of accidental household fires.

### CAUSES OF ACCIDENTAL HOUSEHOLD FIRES



(i) Most accidental household fires are caused by cooking.

Which TWO causes together make up a quarter of all accidental household fires?

(e)(i) \_\_\_\_\_ and \_\_\_\_\_ [1]

**(ii) Matches are the cause of about 400 accidental household fires a year.**

**About how many accidental household fires are caused by candles each year?**

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

- (f) Foam can sometimes be better than just water to put out fires.**

**A liquid called the CONCENTRATE is added to the water.**

**This SOLUTION is then mixed by a special machine and pumped out as foam.**

- The ratio of concentrate to water in the solution is 1 : 24.**
- The ratio of volume of foam produced to volume of solution is the EXPANSION RATIO.**

- (i) Ordinary fire engines carry 50 litres of concentrate.**

**How much SOLUTION will 50 litres of concentrate make?**

**(f)(i) \_\_\_\_\_ litres of solution [2]**

**There is a fire in a disused underground car park.**

**The fire is to be put out by completely filling the car park with foam.**

**The fire brigade has plans of the underground car park.**

- **The underground car park has a volume of 5250 m<sup>3</sup>.**
- **A cubic metre is equivalent to 1000 litres.**
- **The expansion ratio for the foam is 500:1.**
- **A single fire engine carries 1800 litres of water and 50 litres of concentrate.**

**(ii)\* Will one fire engine have enough concentrate to fill the underground car park with foam?**

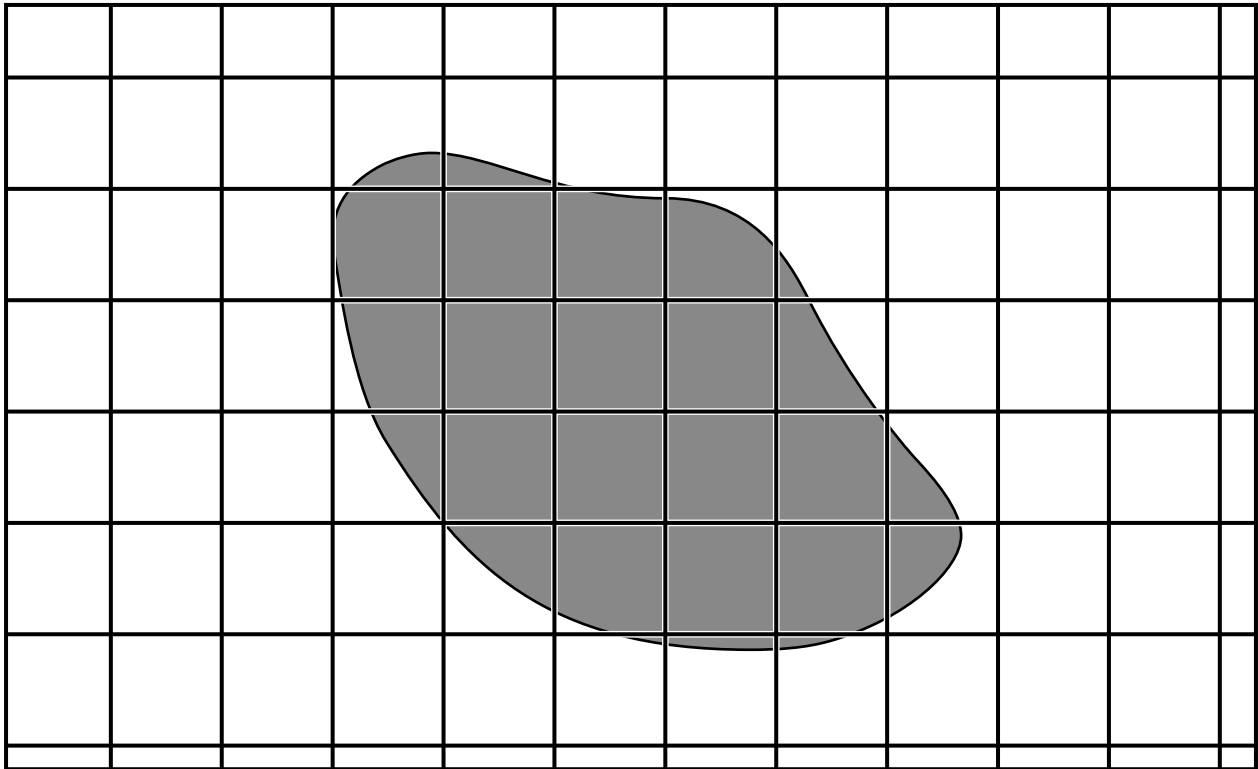
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**[4]**

- (g) Forest fires can be very bad for the environment. Every year thousands of square kilometres of forest in southern Europe are destroyed.**



**The shaded area in the diagram above shows the area burnt by a forest fire.**

- (i) Estimate the area burnt by the forest fire. Each small square represents an area of 4 square kilometres.**

**(g)(i) \_\_\_\_\_ square kilometres [2]**

**(ii) Forest fires can travel at 10 kilometres per hour.**

**At this rate how long would it take a forest fire to travel 15 kilometres?**

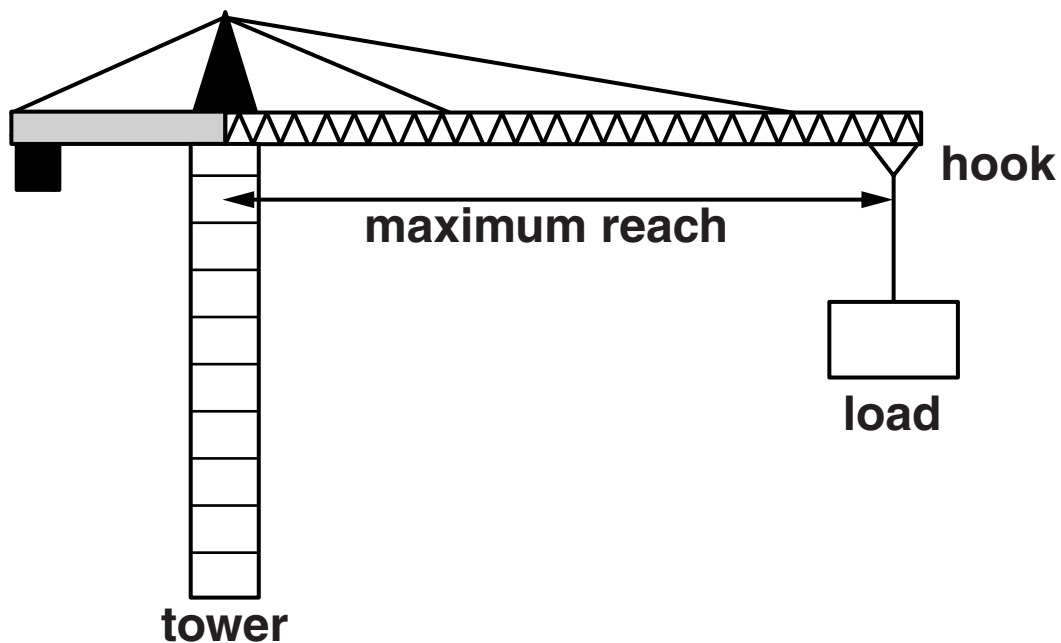
**(ii) \_\_\_\_\_ hours [1]**

- 2 Tower cranes are used to move materials around large building sites.**

**An important dimension of a tower crane is its REACH.**

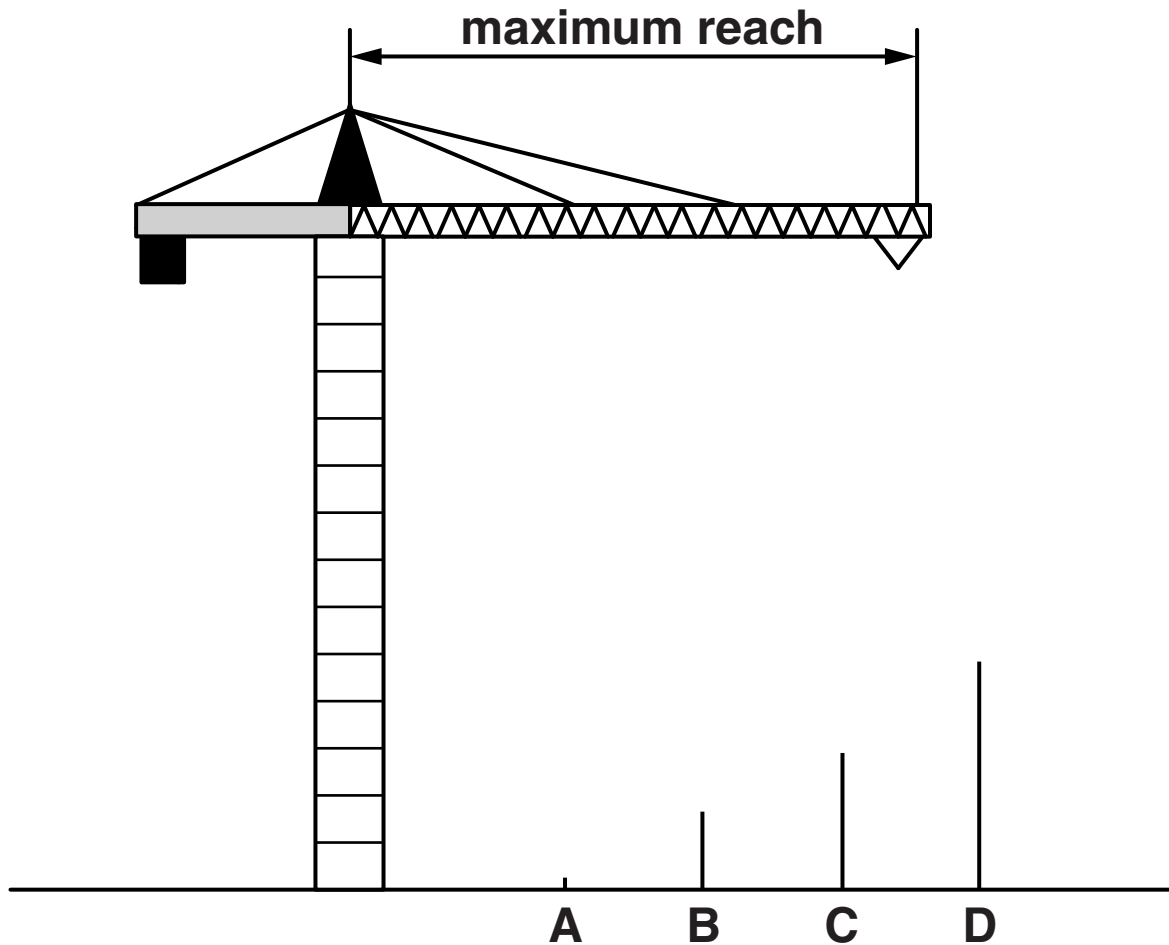
**This is the distance from the centre of the tower to the hook.**

**The following diagram shows a side view of part of a crane.**



**(a) Here is a scale drawing of a large tower crane.**

**Scale: 1 cm represents 10 m**



**(i) What is the maximum reach of the tower crane?**

**(a)(i) \_\_\_\_\_ m [2]**

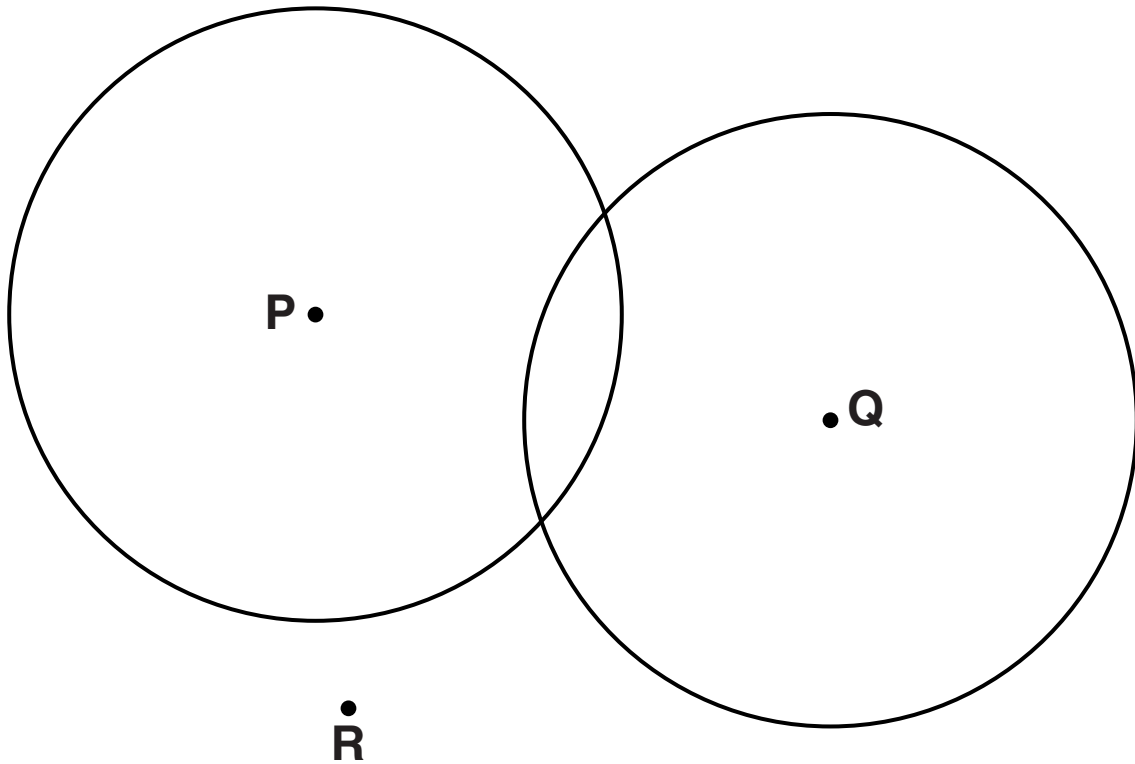
**(ii) Which line, A, B, C or D, would represent the height of an average man?**

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

**(b) Tower cranes are able to turn through  $360^\circ$ .**

**The diagram below shows a scale plan of a building site showing the positions of three tower cranes, P, Q and R.**

**The three cranes have the same maximum reach. The areas reached by cranes P and Q are shown.**

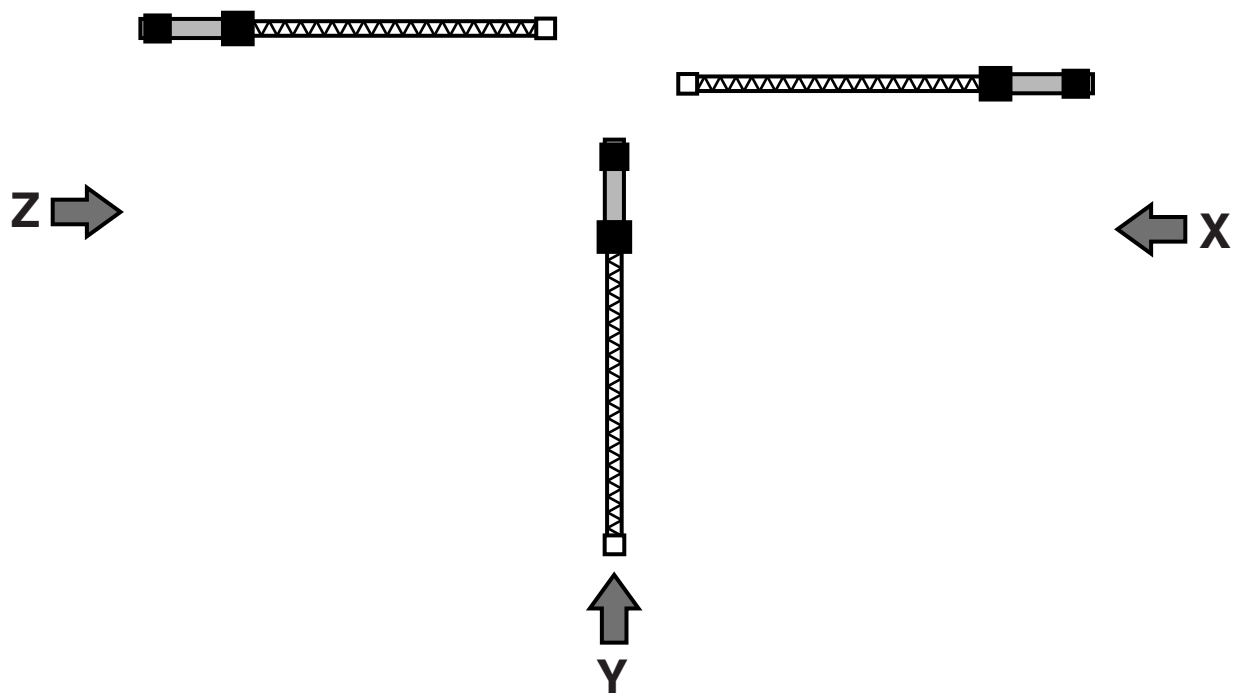


- (i) Use a pair of compasses to show the area reached by crane R. [1]**
- (ii) Shade the area that is reached by ALL THREE cranes. [1]**
- (iii) A pipe needs to be laid so that it is an equal distance from crane P and crane Q.**

**Draw where the pipe needs to be placed on the plan above. [1]**

- (c) Below is a plan view showing three tower cranes on a building site.  
On the next page are views of the cranes from different directions.

Complete the sentences below, choosing the correct view for each direction.

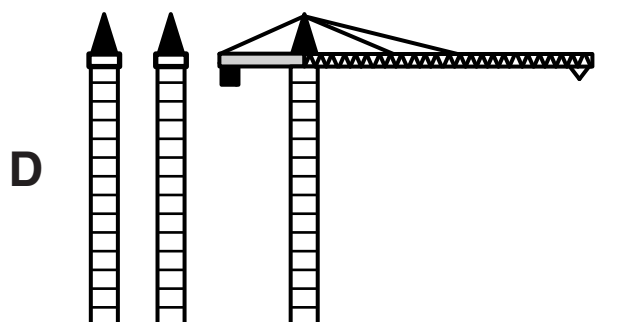
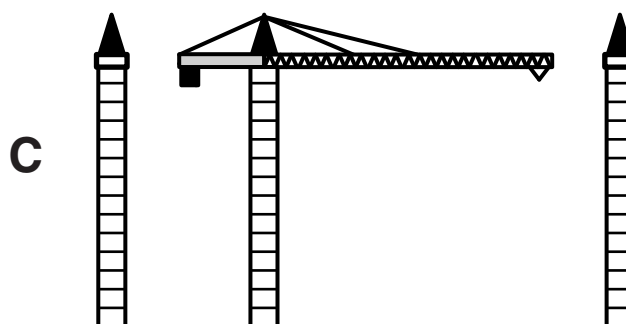
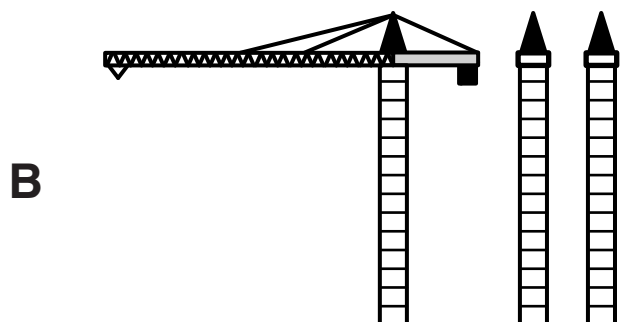
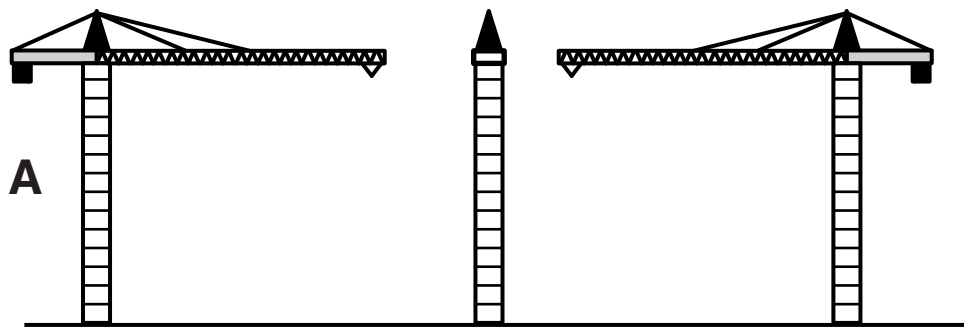


\_\_\_\_\_ is the view looking along direction X.

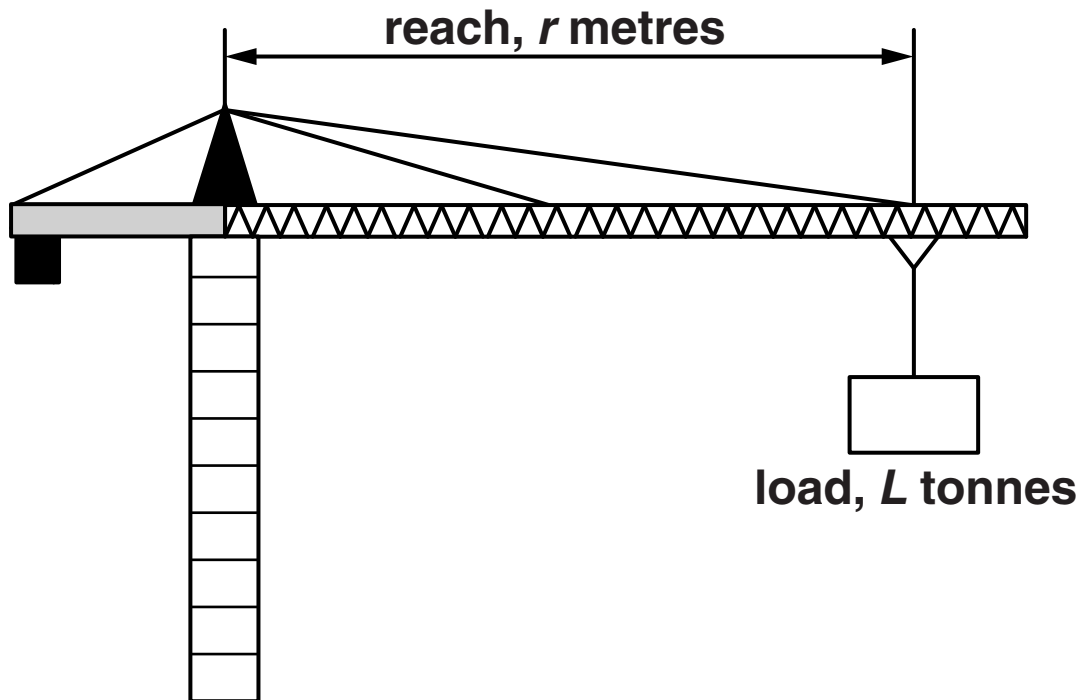
\_\_\_\_\_ is the view looking along direction Y.

\_\_\_\_\_ is the view looking along direction Z.

[3]



- (d) The **TONNE METRE** is used to measure the lifting power of tower cranes.  
A tower crane lifting a load of  $L$  tonnes, at a reach of  $r$  metres, has a **TONNE METRE MEASURE** of  $Lr$ . The reach and load are shown on the following diagram.



A **TONNE METRE MEASURE** bigger than a certain value means the crane is unsafe.  
It may fall over.

The world's biggest tower crane is the Kroll K10000.  
They cost about ten million dollars each!

The K10000 has a safe maximum **TONNE METRE MEASURE** of 10000.  
The maximum load it can safely lift at maximum reach is 100 tonnes.

Which of the four inequalities below are true for the maximum reach,  $r$ , of a K10 000?  
Tick (✓) the correct inequalities.

$$100r \leq 10\,000 \quad \underline{\hspace{2cm}}$$

$$100r \geq 10\,000 \quad \underline{\hspace{2cm}}$$

$$10\,000 \leq 100r \quad \underline{\hspace{2cm}}$$

$$r \leq 100 \quad \underline{\hspace{2cm}}$$

[2]

**(e) Amy manages large building projects.**

- (i) For the last 60 projects that her firm completed, three were late finishing. This was because of crane problems.**

**Use this information to estimate the probability that her new project will be late finishing because of crane problems. Give your answer as a fraction and as a decimal.**

**(e)(i) \_\_\_\_\_ and \_\_\_\_\_ [2]**

**(ii)\* When a project is late, the firm has to pay a penalty.  
For Amy's next project, the penalty for being late is £100 000!  
Amy says "I could hire an extra crane. It will cost £20 000. Is it worth it? The £100 000 penalty is a lot of money but ..."**

**Use probability to help Amy decide what to do – to hire a crane or not to hire a crane.  
Make your working clear enough for Amy to understand.**

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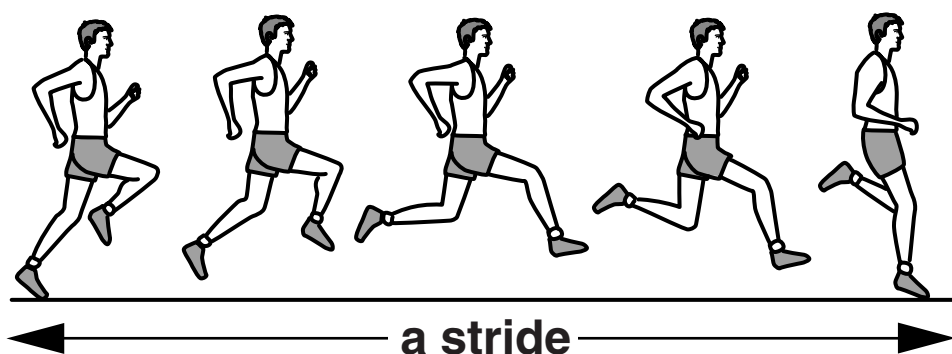
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**[4]**

- 3 The distance travelled by the athlete shown below is called a stride.**



- (a) Usain Bolt took 41 strides to gain the world 100 metres record in Berlin in 2009.**

**What was Usain Bolt's average stride length for this race?**

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

**(b) Sports scientists use the formula  $s = 1.35h$  to connect an athlete's height,  $h$ , in metres, and their stride length,  $s$ , in metres.**

**(i) Using your answer to part (a), decide if the formula  $s = 1.35h$  matches Usain Bolt who is 1.95 m tall.**

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**[3]**

**(ii) Re-write the formula so that  $h$  is the subject.**

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

**(c) Bradley is training at his local running track.**

**Tests show that during a stride, Bradley's feet are in the air for 160 milliseconds and are on the ground for 80 milliseconds.**

**What fraction of the TOTAL TIME for a stride are his feet on the ground?**

**Give your answer as a fraction in its simplest form.**

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

**(d) Marvin trains at the same track as Bradley.**

**Marvin takes 45 strides to run 100 metres in a time of 9.90 seconds.**

**He aims to reduce the time his feet are on the ground for each stride by 10% of his normal time of 80 milliseconds. A millisecond is 0.001 seconds.**

**The world record for the 100 metres in 2012 was 9.58 seconds.**

**Would this world record be broken if Marvin is successful in reducing the time his feet are on the ground by 10%? Assume that his time in the air and stride length do not change.**

**Support your answer with clear calculations.**

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**[3]**

- (e) The table below compares the average speeds of the eight finalists at the Barcelona Olympics in 1992 with those at the Berlin World Championships in 2009.

The speeds, in metres per second (m/s), are given for each 20 metre section of the race.

	BARCELONA (1992)	BERLIN (2009)
Distance, $d$ (metres)	Speed (m/s)	Speed (m/s)
$0 < d \leq 20$	6.78	6.85
$20 < d \leq 40$	10.93	11.05
$40 < d \leq 60$	11.35	11.54
$60 < d \leq 80$	11.32	11.82
$80 < d \leq 100$	11.17	11.40

- (i) In the last 20 metres of the Berlin race, what was the speed?

(e)(i) \_\_\_\_\_ m/s [1]

- (ii) In which 20 metre section was there the greatest improvement in speed from Barcelona to Berlin?

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

- (iii) Write down one overall difference between the speeds at Barcelona and the speeds at Berlin, apart from the Berlin speeds being faster.**

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**[1]**

- 4 Opinion polls sometimes ask how happy people feel. Here are two questions that might be asked:

[A]

How happy are you? \_\_\_\_\_

[B]

How happy are you? Choose one of these.

Very happy ☐ Fairly happy ☐

Fairly unhappy ☐ Very unhappy ☐

Don't know ☐

- (a) Which is the better survey question, [A] or [B]?

Give one reason for your choice.

\_\_\_\_\_ because \_\_\_\_\_

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

**(b) Question [B] was given to a number of people in the UK in 2005.**

**The people were asked the question in a survey carried out by telephone.**

**Give one advantage and one disadvantage of a survey carried out by telephone.**

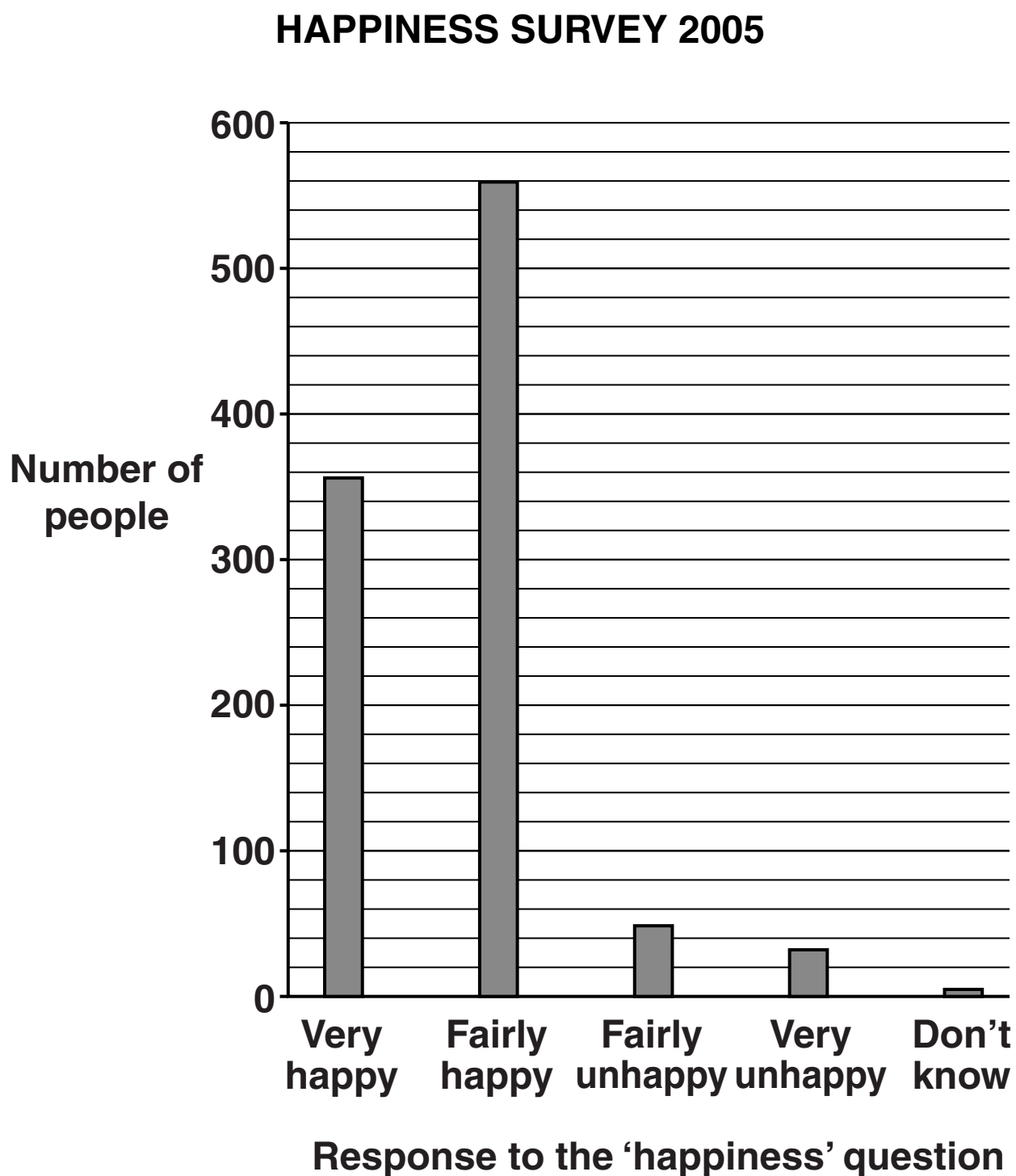
**(i) Advantage:**

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

**(ii) Disadvantage:**

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

(c) The diagram below shows the results of the survey.



- (i) What was the most common response and how many people chose it?

(c)(i) \_\_\_\_\_ chosen by  
 \_\_\_\_\_ people [2]

The table below shows the percentage of each gender choosing each response.

	VERY HAPPY	FAIRLY HAPPY	FAIRLY UNHAPPY	VERY UNHAPPY	DON'T KNOW
MALE	35	57	5	3	0
FEMALE	36	55	5	3	1

- (ii) What percentage of females said they were fairly happy?

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

- (iii) Write down one observation comparing the happiness of males with the happiness of females.

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

**In recent happiness surveys a 0 to 10 scale was used.**

**Overall, how happy did you feel yesterday?**

**Put your answer on this 0 to 10 scale,**

**where 0 is ‘not at all’ and 10 is ‘completely’.**

0	1	2	3	4	5	6	7	8	9	10
not at all										completely

**(d) What is the advantage of using a numerical scale for a response?**

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**[1]**

- (e) Amber works in advertising.  
She needs to have some idea whether young or old people are happier.**

**Amber uses the 0 to 10 happiness scale to survey the people in her office.**

**Everyone under 40 she counts as young, and everyone 40 and over she counts as old.**

**She constructs a spreadsheet to process her results.**

**Her spreadsheet is shown separately on the loose sheet.**

- (i) What number did Amber enter in cell F3?**

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

**Amber checks the results before drawing any conclusions – in case she made any errors.  
The ‘Under 40’ figures and results are correct.**

**She finds an error in the ‘40 and over’ figures and crosses it out.**

**The figure in cell L9 should have been 7, not 17.**

- (ii) Find the correct values for the mean, mode, median and range for the '40 and over' group. Remember to use 7 not 17 in L9.

Mean = \_\_\_\_\_ Mode = \_\_\_\_\_

Median = \_\_\_\_\_ Range = \_\_\_\_\_ [5]

**(iii) Is the 'Under 40' group happier than the '40 and over' group?  
Explain how you decided.**

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**[2]**

- (f) The following table shows the average happiness and the average income per household for some countries.

COUNTRY	AVERAGE INCOME PER HOUSEHOLD (THOUSANDS OF DOLLARS)	AVERAGE HAPPINESS
Austria	28	7.5
Brazil	8	6.8
Canada	28	7.4
Chile	9	6.6
Ireland	24	6.9
UK	27	6.9
Slovenia	20	6.0
Belgium	27	7.0
Germany	28	6.7
US	38	7.1
Turkey	11	5.3
Russia	14	5.3

The first eight results are plotted on the scatter graph on the opposite page.

- (i) Complete the scatter graph by plotting the last four points. [2]
- (ii) Describe fully the correlation between household income and happiness.

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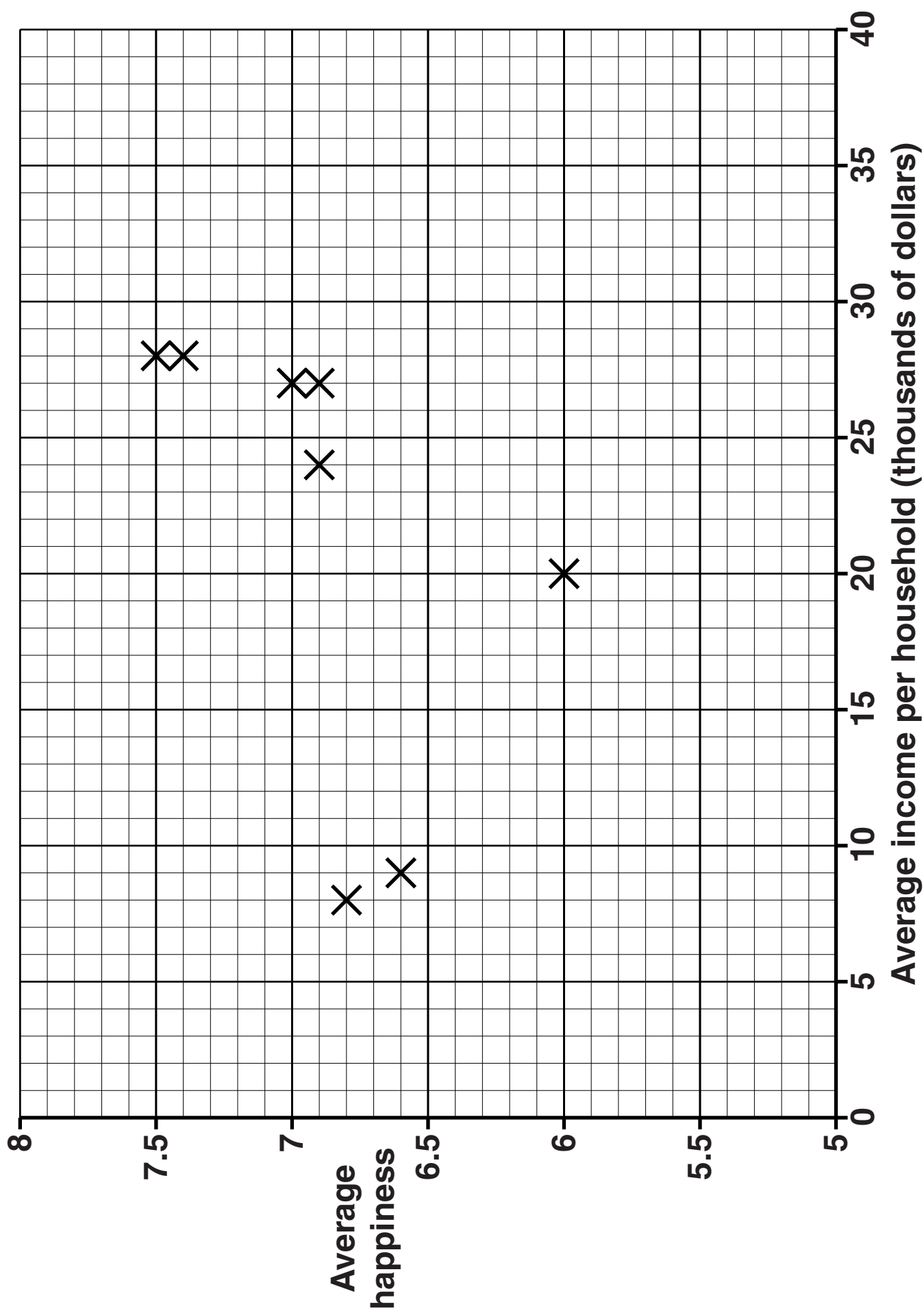


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 [2]



- 5 Josh investigates converting his car to use liquid petroleum gas (LPG).  
He uses this information.**

**A car uses 10% more LPG than petrol when driven for the same distance.**

**Petrol costs 140p per litre.**

**LPG costs 75p per litre.**

**In a typical week Josh uses 30 litres of petrol.**

**(a) Josh sees the following headline.**

**“LPG cuts fuel costs by half!!!!!!”**

**Is the headline correct?**

**Explain how you used Josh’s figures to decide.**

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**[1]**

**(b) (i) How much LPG would Josh use in a typical week?**

**(b)(i) \_\_\_\_\_ litres [2]**

**(ii) How much would Josh save each week if he converted his car to use LPG?**

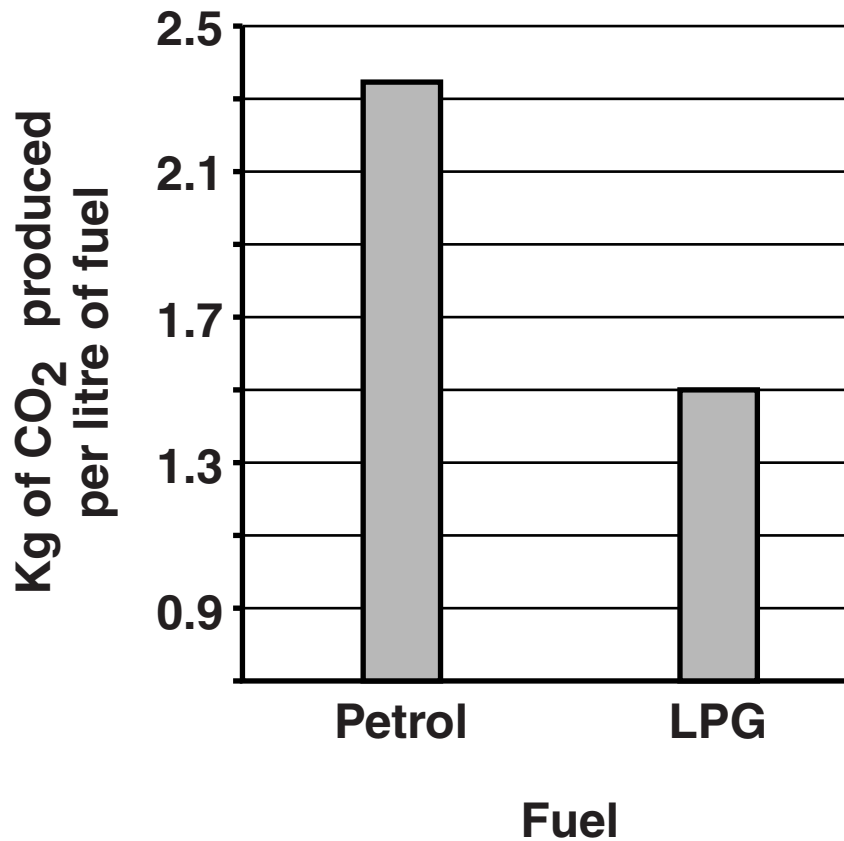
**(ii) £ \_\_\_\_\_ [4]**

**(iii) Josh is told the total cost to convert his car to use LPG is £510.**

**How many weeks would it take for Josh to get back the cost of the conversion?**

**(iii) \_\_\_\_\_ weeks [2]**

(c) Josh sees the following chart in *Eco-Motoring*.



Josh thinks “So LPG produces half the CO<sub>2</sub> of petrol!”

How is the chart misleading Josh?

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[1]

**(d) Josh listens to a motoring programme on the radio.**

**He hears “When you buy either petrol or LPG, two thirds of the price you pay is tax!”**

**If this is true, how much tax will Josh pay on a litre of LPG costing 75p?**

**(d) \_\_\_\_\_ p [2]**

**END OF QUESTION PAPER**



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