

Friday 13 June 2014 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/01 Applications of Mathematics 2 (Foundation Tier)

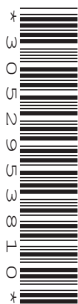
Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:

- Scientific or graphical calculator
- Geometrical instruments
- Tracing paper (optional)

Duration: 1 hour 30 minutes



Candidate forename		Candidate surname	
--------------------	--	-------------------	--

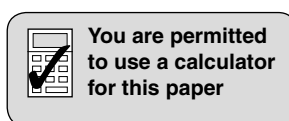
Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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).
- Do **not** write in the bar codes.

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**.
- This document consists of **28** pages. Any blank pages are indicated.

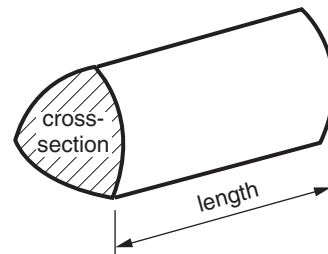


Formulae Sheet: Foundation Tier

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



Volume of prism = (area of cross-section) \times length



PLEASE DO NOT WRITE ON THIS PAGE

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.



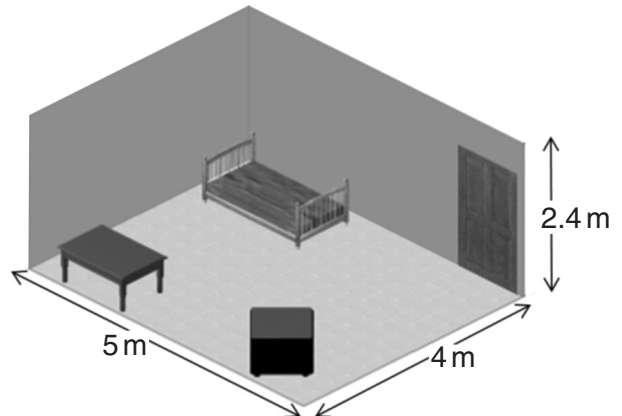
- (a) Most household fires can be put out by the fire brigade using a fine spray of water.

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

Amount of water (litres) = volume of room (cubic metres) divided by 3

This is a sketch of 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.

This graph 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.
This 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.

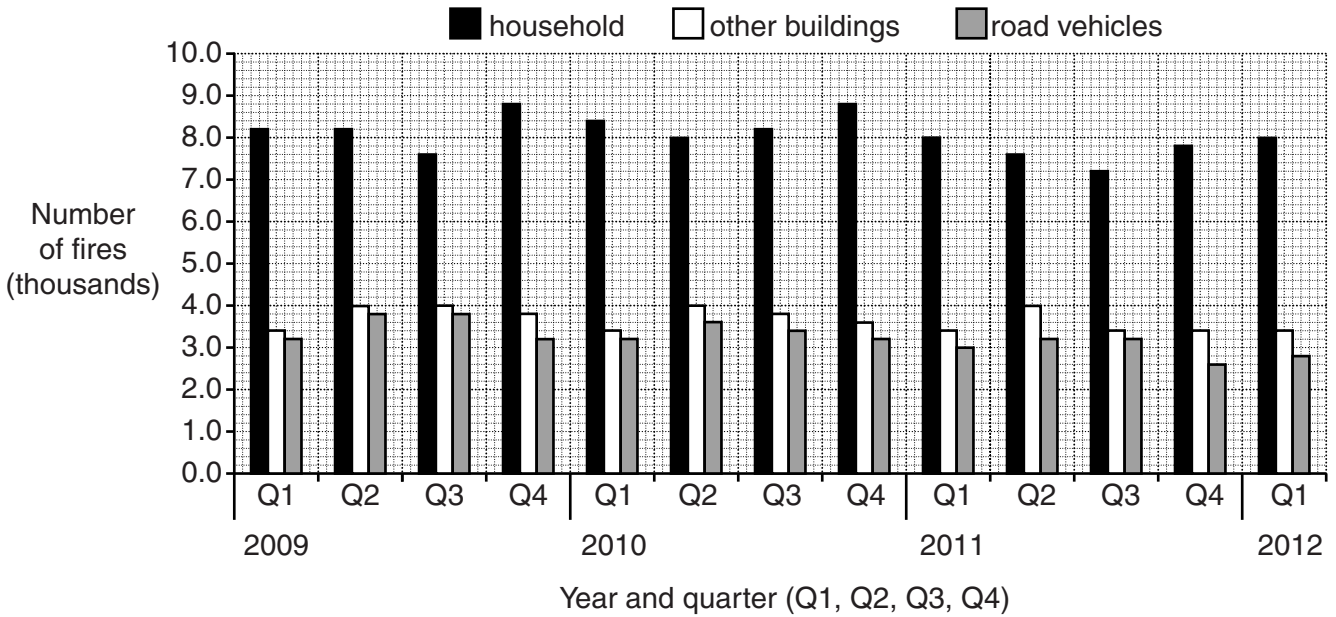
An average platform can safely carry a load of 380 kg.

How many adults in total could this platform safely carry?
State any assumptions that you make to find your answer.

(iii) _____ adults [2]

(d) This bar chart shows information about fires in England.

Number of fires in England for each quarter

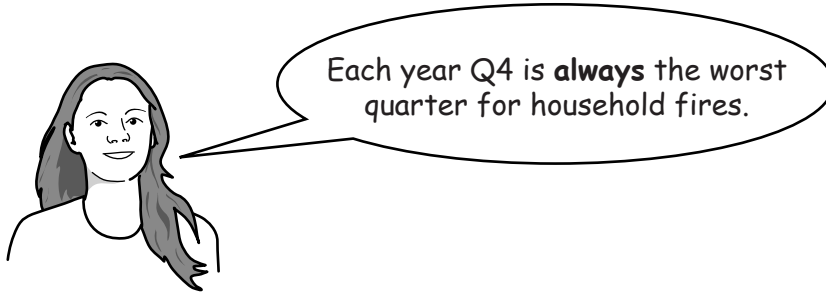


(i) In the first quarter (Q1) of 2009 there were 8.2 thousand household fires.

How many household fires were there in Q1 of 2012?

(d)(i) _____ thousand [1]

(ii) Izzy says



Is Izzy right?
Use evidence from the graph to support your answer.

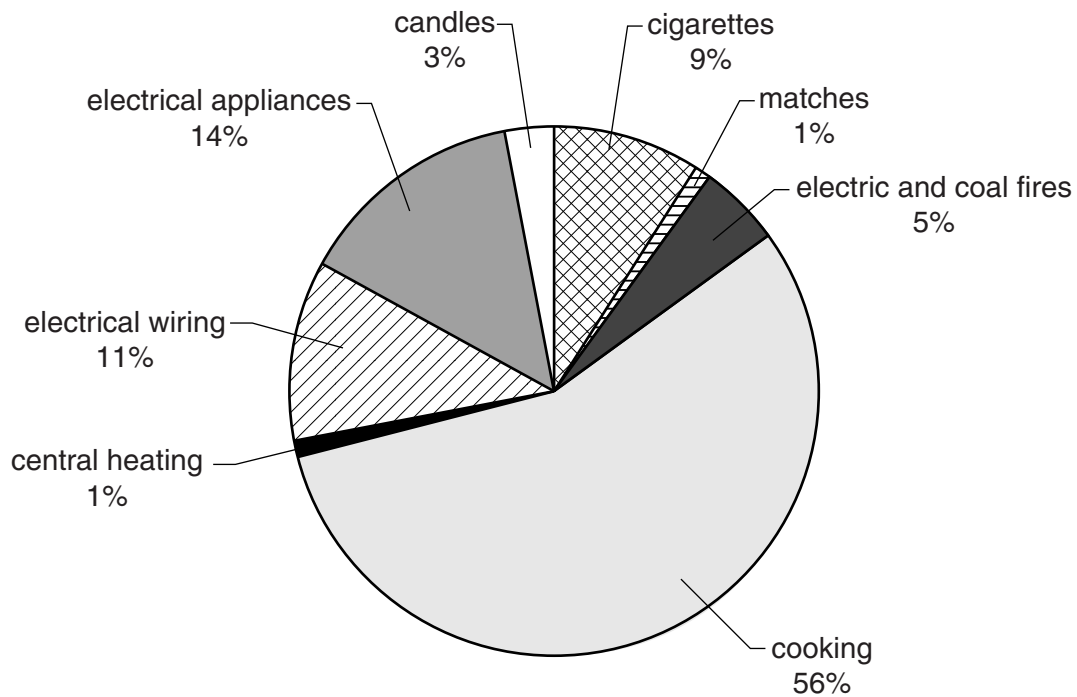
[2]

- (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) This 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.



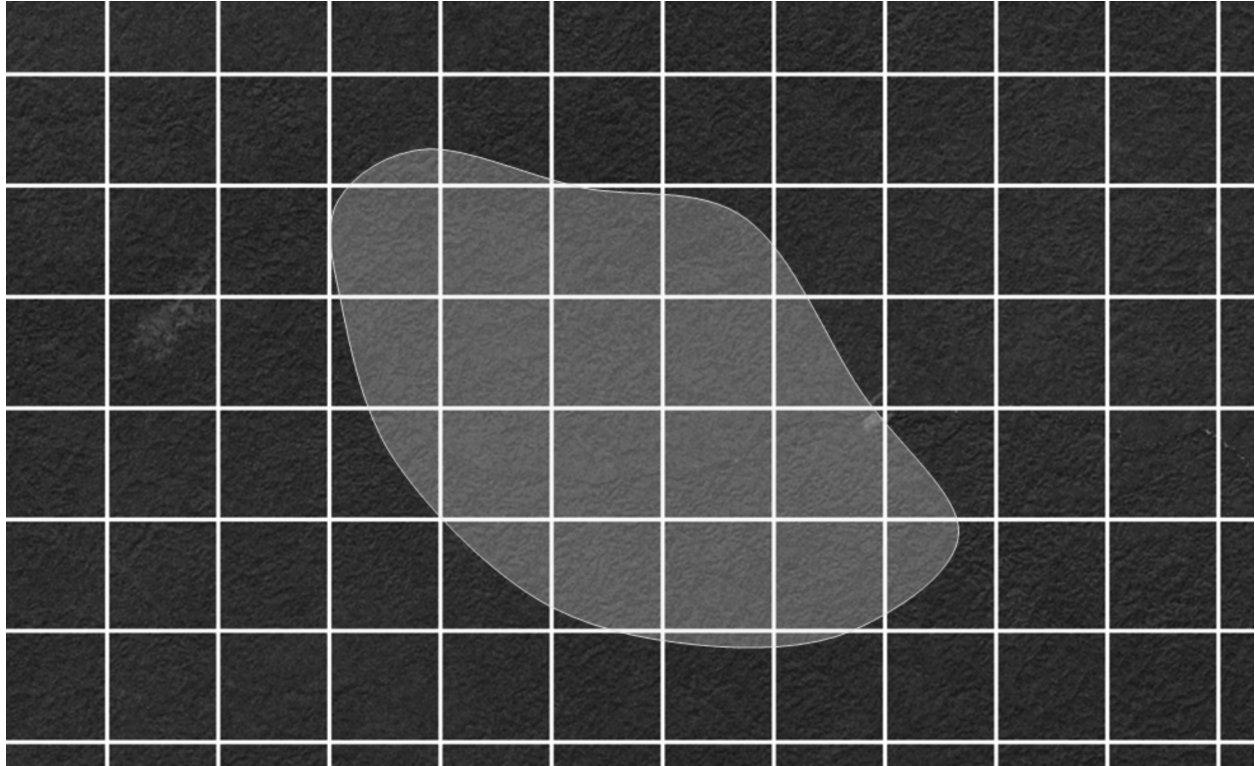
The fire is to be put out by completely filling the car park with foam.
The fire brigade has plans of the underground car park.

- The underground car park has a volume of 5250 m^3 .
- 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?

[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 light area in this satellite picture 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]

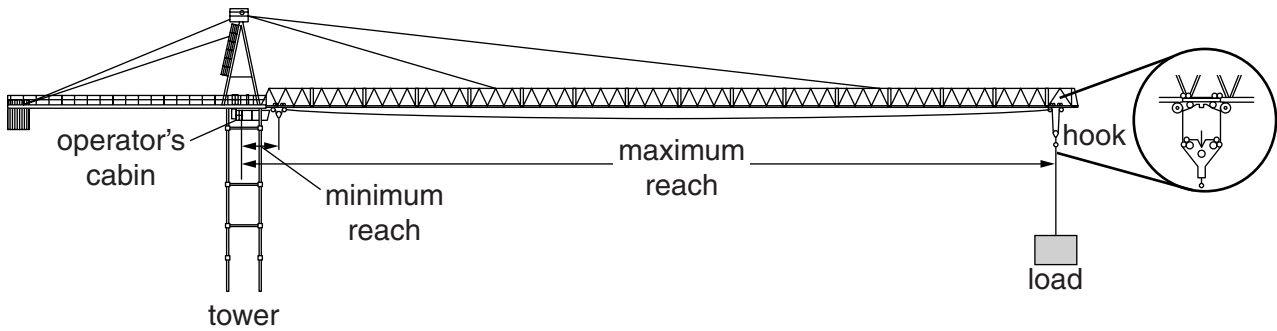
- (ii) Forest fires can travel at 10 kilometres per hour.

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

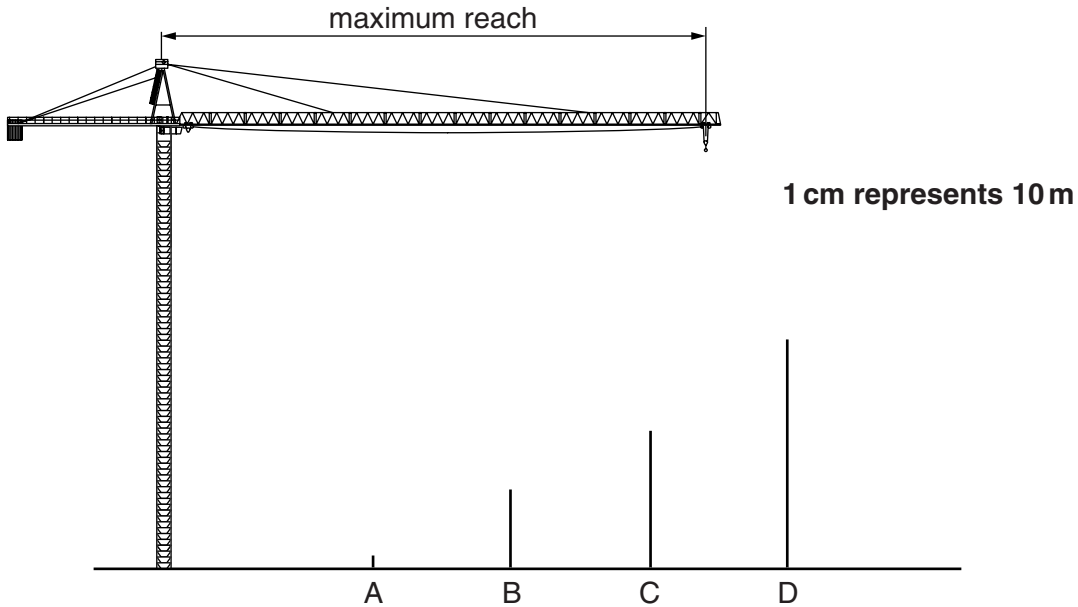
(ii) _____ hours [1]

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.



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



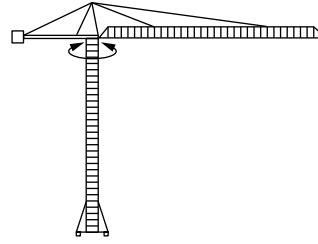
(i) What is the maximum reach of the tower crane?

(a)(i) _____ m [2]

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

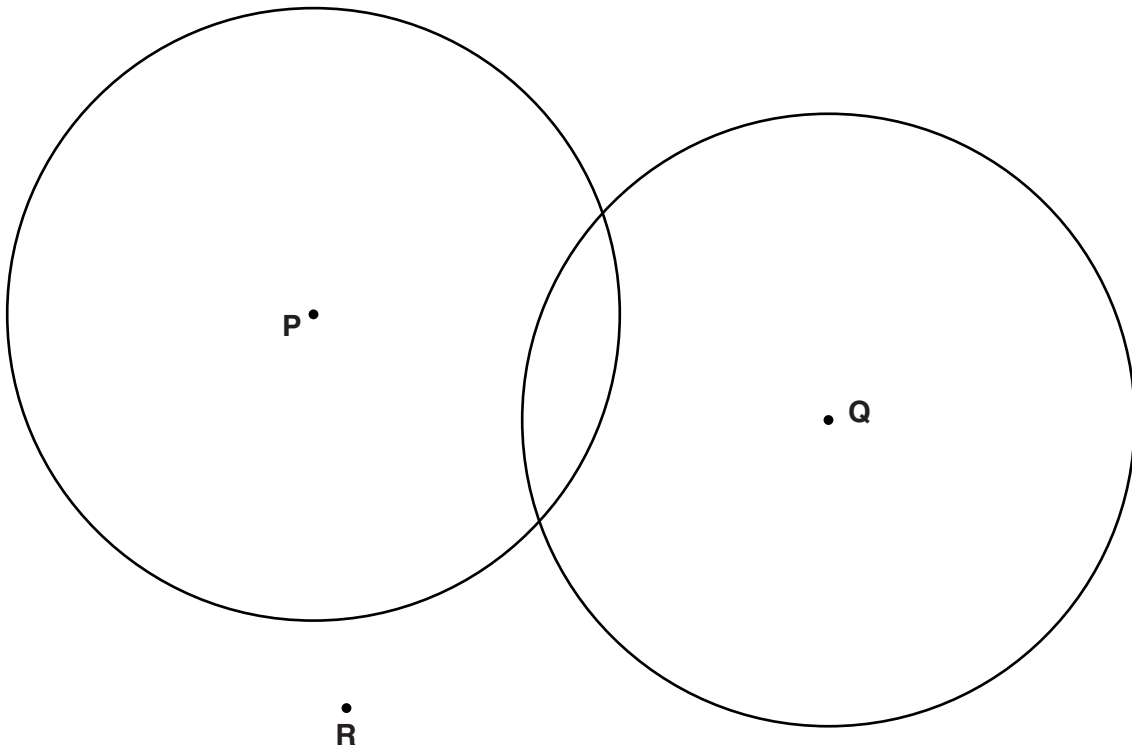
(ii) _____ [1]

- (b) Tower cranes are able to turn through 360° .



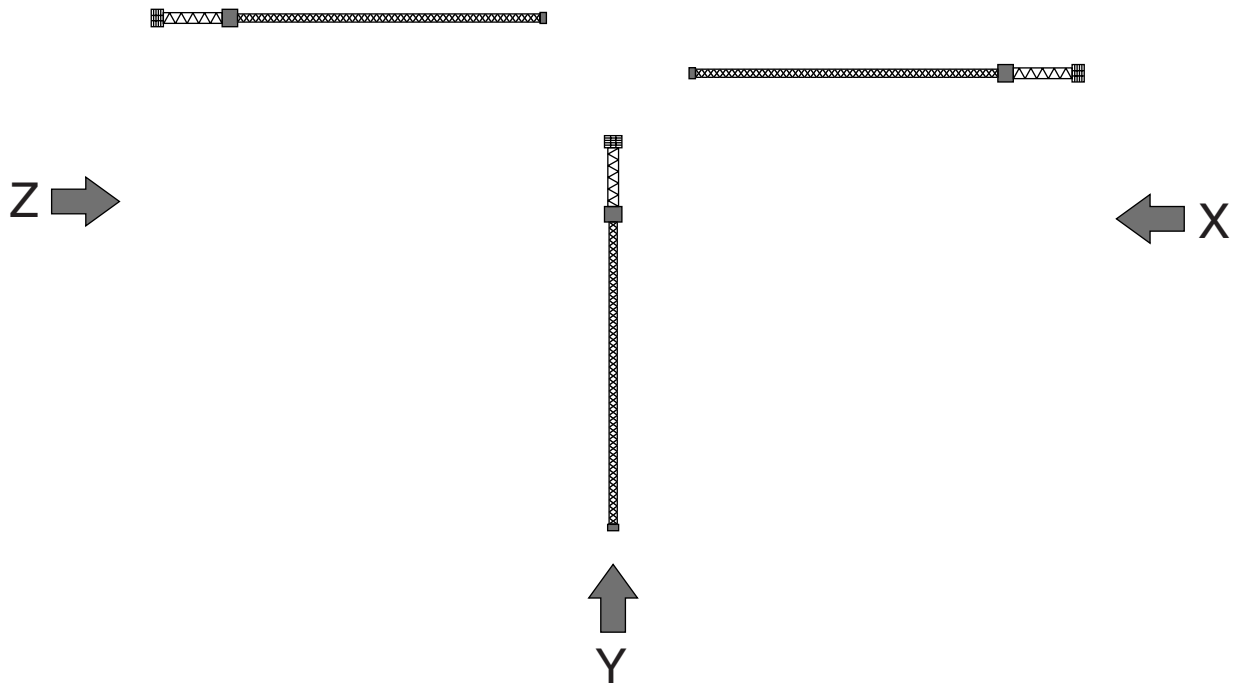
Here is a scale plan of a building site showing the positions of three tower cranes, **P**, **Q** and **R**.

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]

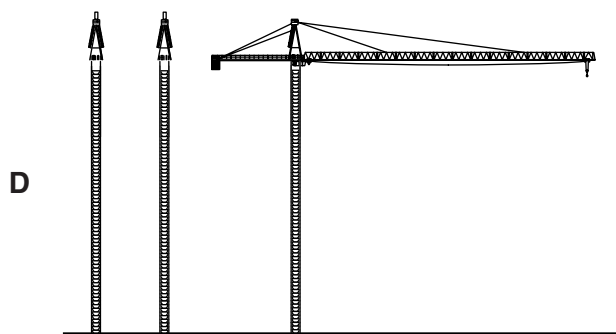
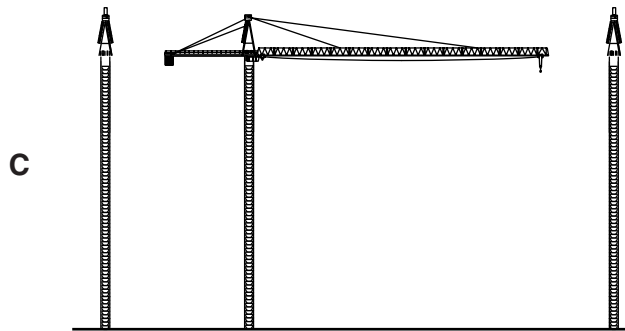
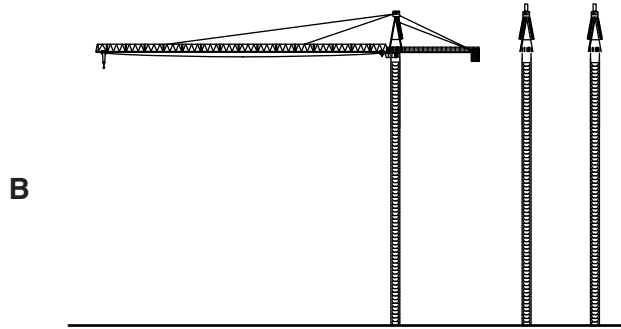
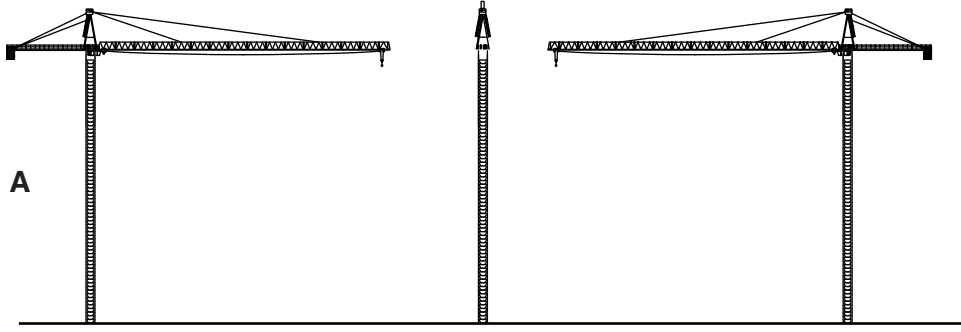
(c) Below is a plan view showing three tower cranes on a building site. On the next page are views of the cranes from different directions.



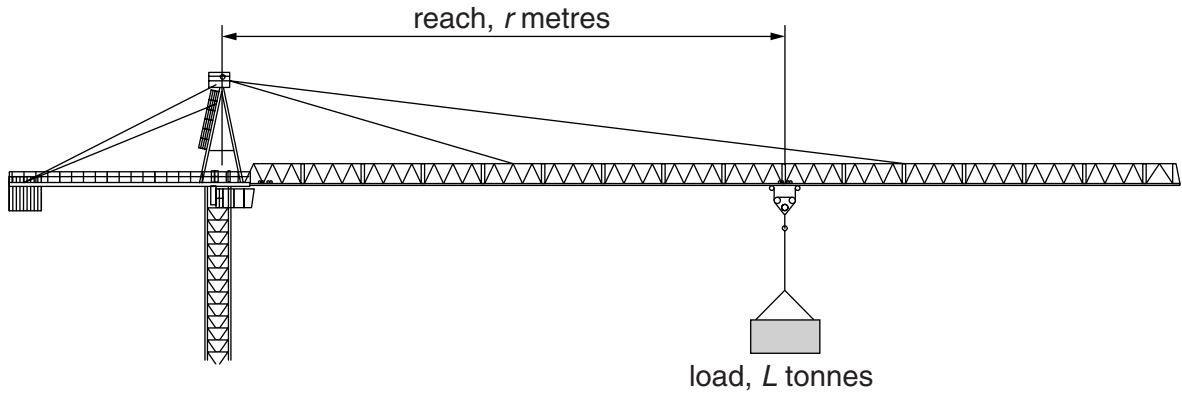
- _____ is the view looking along direction X.
- _____ is the view looking along direction Y.
- _____ is the view looking along direction Z.

[3]

13



- (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 .



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 10 000.
The maximum load it can safely lift at maximum reach is 100 tonnes.

Which of these inequalities are true for the maximum reach, r , of a K10000?
Tick (✓) the correct inequalities.

$100r \leq 10\,000$ _____

$100r \geq 10\,000$ _____

$10\,000 \leq 100r$ _____

$r \leq 100$ _____

[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!

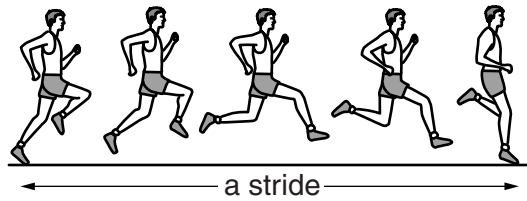


I could hire an extra crane. It will cost £20 000.
Is it worth it?
The £100 000 penalty is a lot of money but ...

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.

[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.

[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.

[3]

- (e) This table 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]

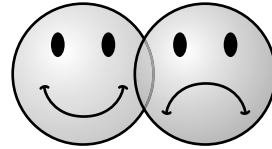
- (ii) In which 20 metre section was there the greatest improvement in speed from Barcelona to Berlin?

(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.

 _____ [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:

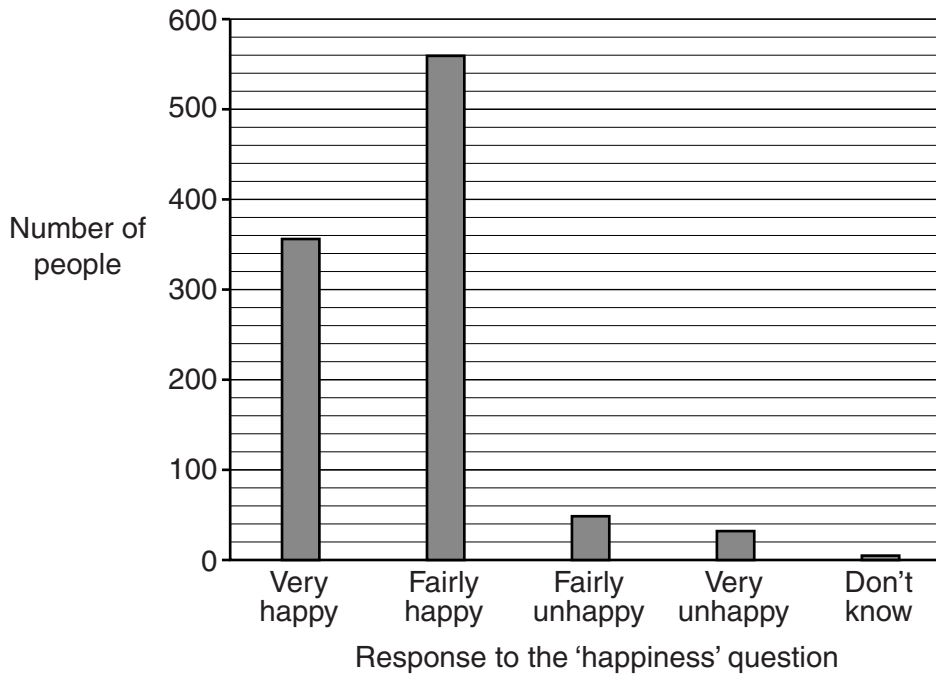
 _____ [1]

(ii) Disadvantage:

 _____ [1]

(c) Here are the results of the survey.

Happiness Survey 2005



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

(c)(i) _____ chosen by _____ people [2]

This table 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

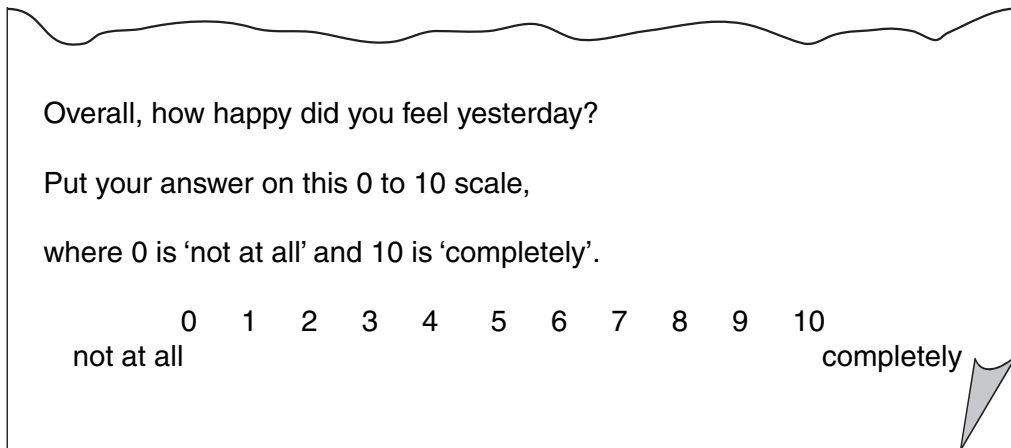
(ii) What percentage of females said they were fairly happy?

(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.



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

[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.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Under 40											
2	7	8	7	7	7	7	7	7	8	7	6	7
3	7	7	7	7	8	5	8	8	7	6	7	8
4	7	7	6	7								
5	mean= 7.036		mode= 7		median= 7		range= 3					
6												
7												
8	40 and over											
9	3	7	7	7	7	8	8	8	9	9	9	17
10	mean= 8.25		mode= 7		median= 8		range= 14					
11												

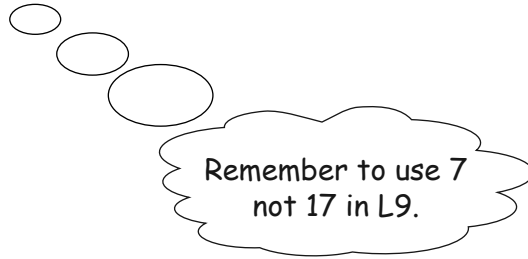
- (i) What number did Amber enter in cell F3?

(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.



Mean = _____ Mode = _____ Median = _____ Range = _____ [5]

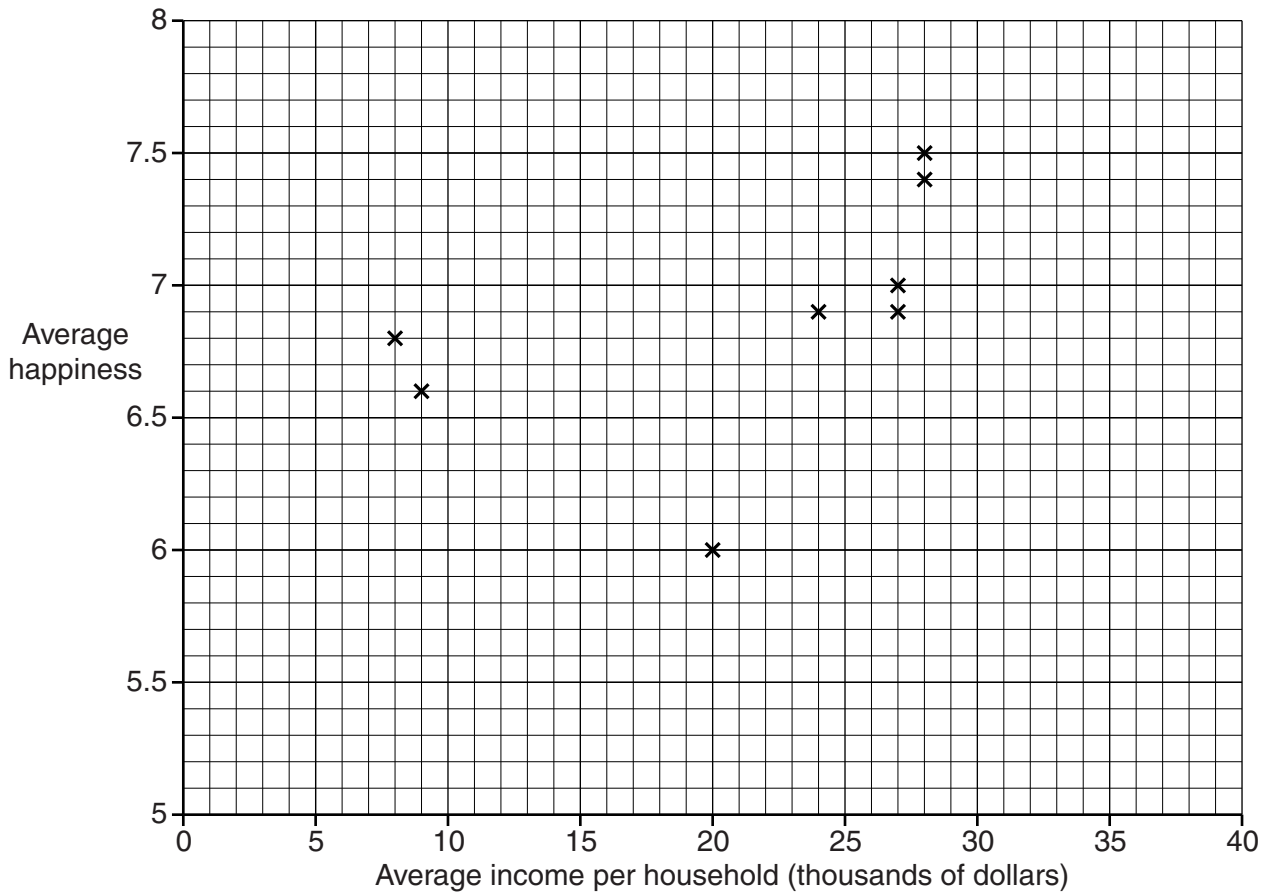
- (iii) Is the 'Under 40' group happier than the '40 and over' group?
Explain how you decided.

[2]

- (f) The 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.



(i) Complete the scatter graph. [2]

(ii) Describe fully the correlation between household income and happiness.

[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 this headline.



Is the headline correct?

Explain how you used Josh's figures to decide.

[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?

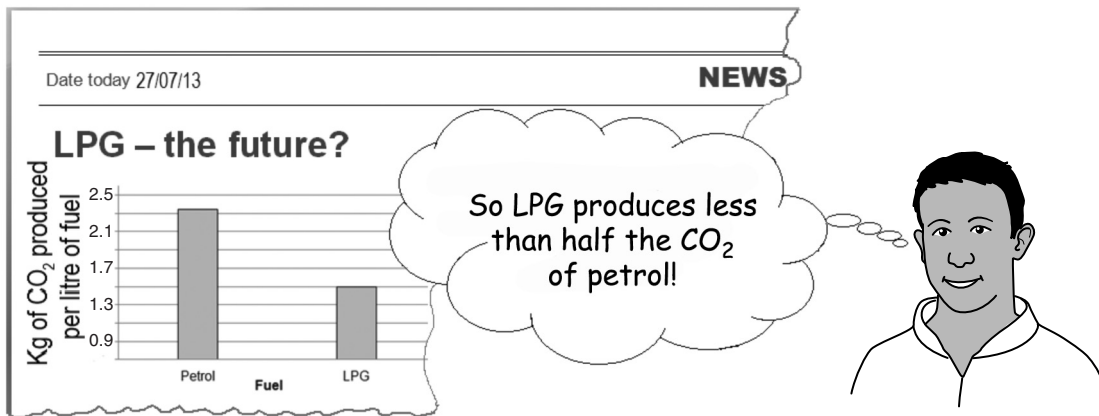
(ii) £ _____ [4]

(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]

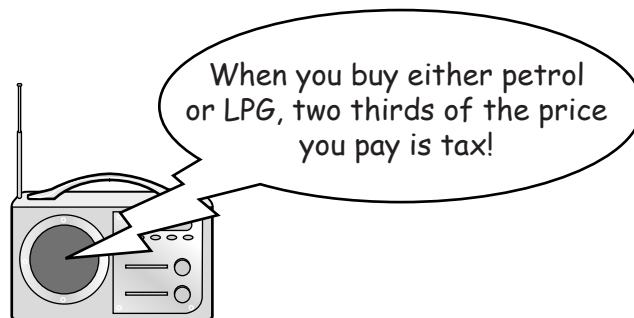
(c) Josh sees this in *Eco-Motoring*.



How is the chart misleading Josh?

 _____ [1]

(d) Josh hears this on a motoring programme on the radio.



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

(d) _____ p [2]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.