OCR
RECOGNISING ACHIEVEMENT

H

Tuesday 15 January 2013 – Afternoon

GCSE APPLICATIONS OF MATHEMATICS

A382/02 Applications of Mathematics 2 (Higher Tier)

A316920113

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Scientific or graphical calculator
- Geometrical instruments
- Tracing paper (optional)

Duration: 2 hours

A382O2

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.

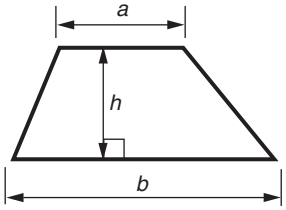
INFORMATION FOR CANDIDATES

- 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 **20** pages. Any blank pages are indicated.

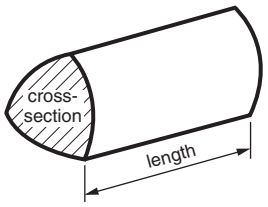
You are permitted to use a calculator for this paper

Formulae Sheet: Higher Tier

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



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

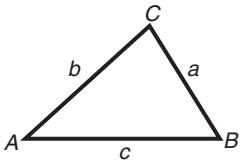


In any triangle *ABC*

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

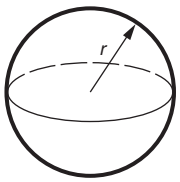
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



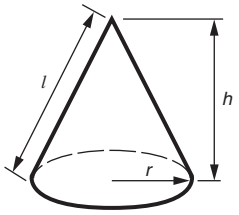
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

Curved surface area of cone $= \pi rl$



The Quadratic Equation

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

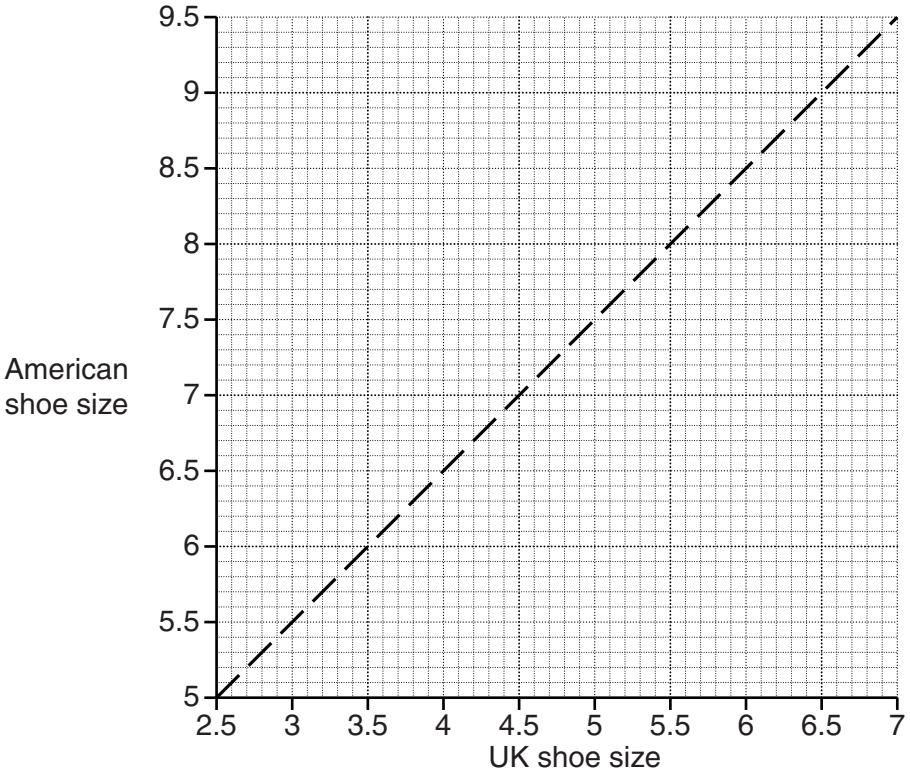
$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

PLEASE DO NOT WRITE ON THIS PAGE

1 The table shows UK, European and American equivalent sizes for women's shoes.

UK	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7
America	5	5 ½	6	6 ½	7	7 ½	8	8 ½	9	9 ½
Europe	35		36	37		38		39	40	41

(a) (i) This graph shows the conversion between UK and American shoe sizes.



The relationship between UK and American shoe sizes is linear.
Explain how you can tell this from the graph.

_____ **[1]**

(ii) Write a rule to convert UK shoe sizes to American shoe sizes.

(a)(ii) _____ **[1]**

(b) One way to convert European shoe sizes to UK shoe sizes is:

Step 1: Subtract 32 from the European size

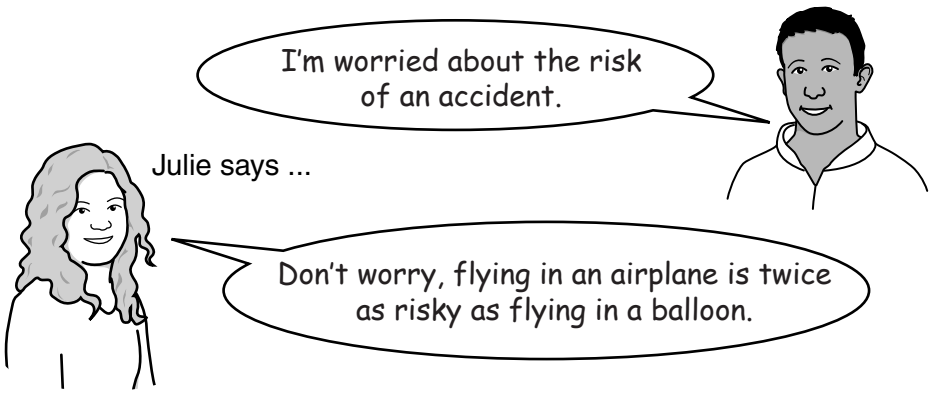
Step 2: Multiply by 0.8

Step 3: Round up to nearest half.

What is the UK shoe size for European size 43?

(b) _____ **[2]**

2* Julie wants to take a hot air balloon trip.
She invites Andy to come as well.



She finds this information on an American ballooning webpage on the internet.

Number of accidents for airplanes and hot air balloons and the total number of flying hours for each (for the last two years)

Airplanes

Accidents	Total number of flying hours
3760	50 345 000

Hot air balloons

Accidents	Total number of flying hours
39	116 700

Is Julie correct?
Justify your answer using Julie's information.
Show the calculations you use.

_____

_____

_____

_____

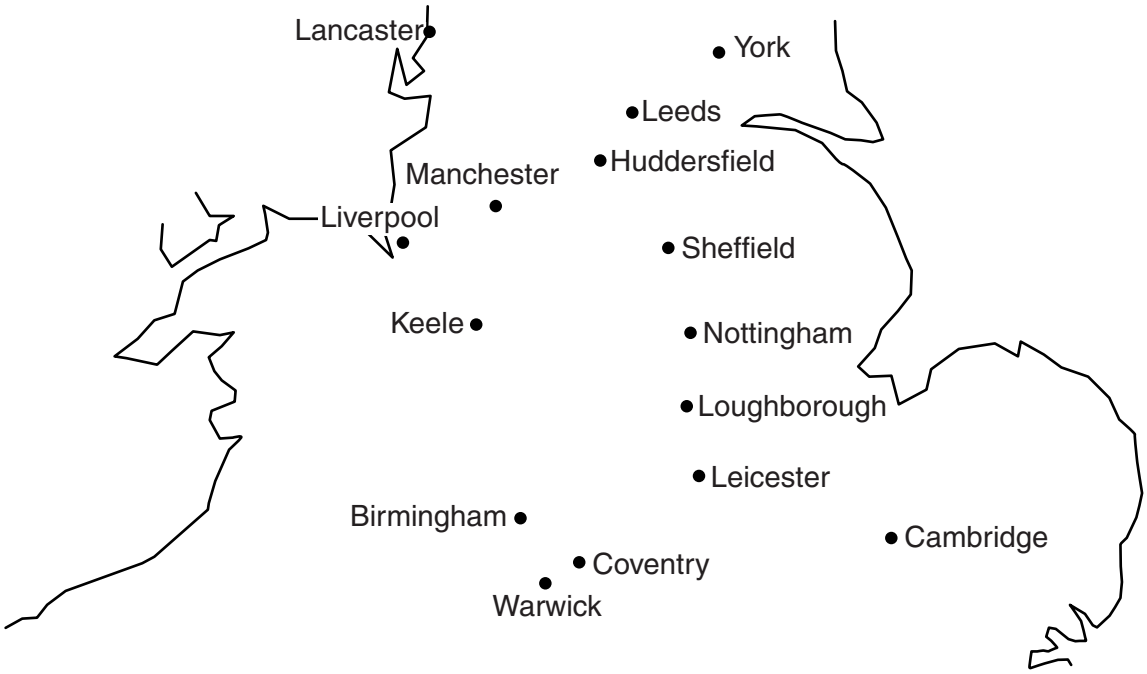
_____

_____

_____

_____ **[4]**

3 This map shows the location of some universities.



Scale: 1 cm represents 40 km

Jon's home is in Huddersfield.
He wanted to go to university.
Jon wanted a university that was more than 100 km and less than 200 km from his home.
He also wanted to be closer to Birmingham than Liverpool.

(a) On the map construct and shade the region in which Jon chose universities.
Use a ruler and a pair of compasses and show all your construction lines. **[5]**

(b) Jon needed a Maintenance Loan to help pay his living costs at university.
He found this information on the internet.

The maximum Maintenance Loan available for students starting their course in 2012/13 is:

- £4,375 if you're living in your family home
- £5,500 if you're living away from home and studying outside London
- £7,675 if you're living away from home and studying in London.

In 2012/13 you will be able to apply for 65 per cent of the maximum Maintenance Loan without your household income being taken into account.

Work out the maximum Maintenance Loan available for Jon without his household income being taken into account.

(b) £ _____ **[2]**

(c) Jon worked at a school during the summer before going to university.

July 2012

M	Tu	W	Th	F	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August 2012

M	Tu	W	Th	F	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

27th Bank Holiday

The first day he worked was 12th July and the last day was 31st August 2012.
Jon did not work on Saturdays, Sundays or Bank Holidays.

The working day started at 8:30am and finished at 4:30pm.
Jon had a total of 1 hour of break times each day.

Jon was paid £6.25 per hour, but was not paid for break times.
He got 7.3 minutes of holiday time for each hour he worked.

Jon worked every day that he could during July and August.
He chose to take his holiday time as extra pay, rather than time off.

How much in total was Jon paid?

(c) £ _____ **[5]**

(d) In total 8 students were employed by the school to work during the summer.
Not all of the students were able to work every day from 12th July to 31st August 2012.
None of the students worked Saturdays, Sundays or Bank Holidays.

A two-way table was drawn to show the number of students who were available to work each day.

Here is part of the table.

Week beginning	Monday	Tuesday	Wednesday	Thursday	Friday
9th July					
16th July					
23rd July					

(i) How many more rows are needed to complete the table?

(d)(i) _____ **[1]**

One student could not start work until 18th July.
Another student was only able to work on Tuesdays, Wednesdays and Thursdays.
Two other students were not able to work the week beginning 23rd July.

(ii) Fill in the table above for the weeks beginning 9th, 16th and 23rd July. **[4]**

4 Egg sizes are based on the weight of the eggs, given to the nearest gram.
The table shows chicken egg sizes for the UK, USA and Australia.

Size	UK	USA	Australia
Jumbo	–	71 g or more	68 g or more
Extra large	73g or more	64 g – 70 g	60 g – 67 g
Large	63 g – 72 g	57 g – 63 g	52 g – 59 g
Medium	53 g – 62 g	50 g – 56 g	43 g – 51 g
Small	52 g or under	43 g – 49 g	–
Peewee	–	35 g – 42 g	–

(a)* In an **Australian** cookery book there is a recipe for custard pie.
This recipe uses 5 extra large eggs.

Work out the number of **USA** small size eggs that should be used in this recipe.
Justify your answer.

_____

_____

_____

_____

_____

_____

_____ **[4]**

(b) Anna keeps chickens on a farm in the USA.
The table shows the number of eggs of each size that her chickens laid during three months.
The heaviest egg ever laid by one of Anna's chickens was 77 g.

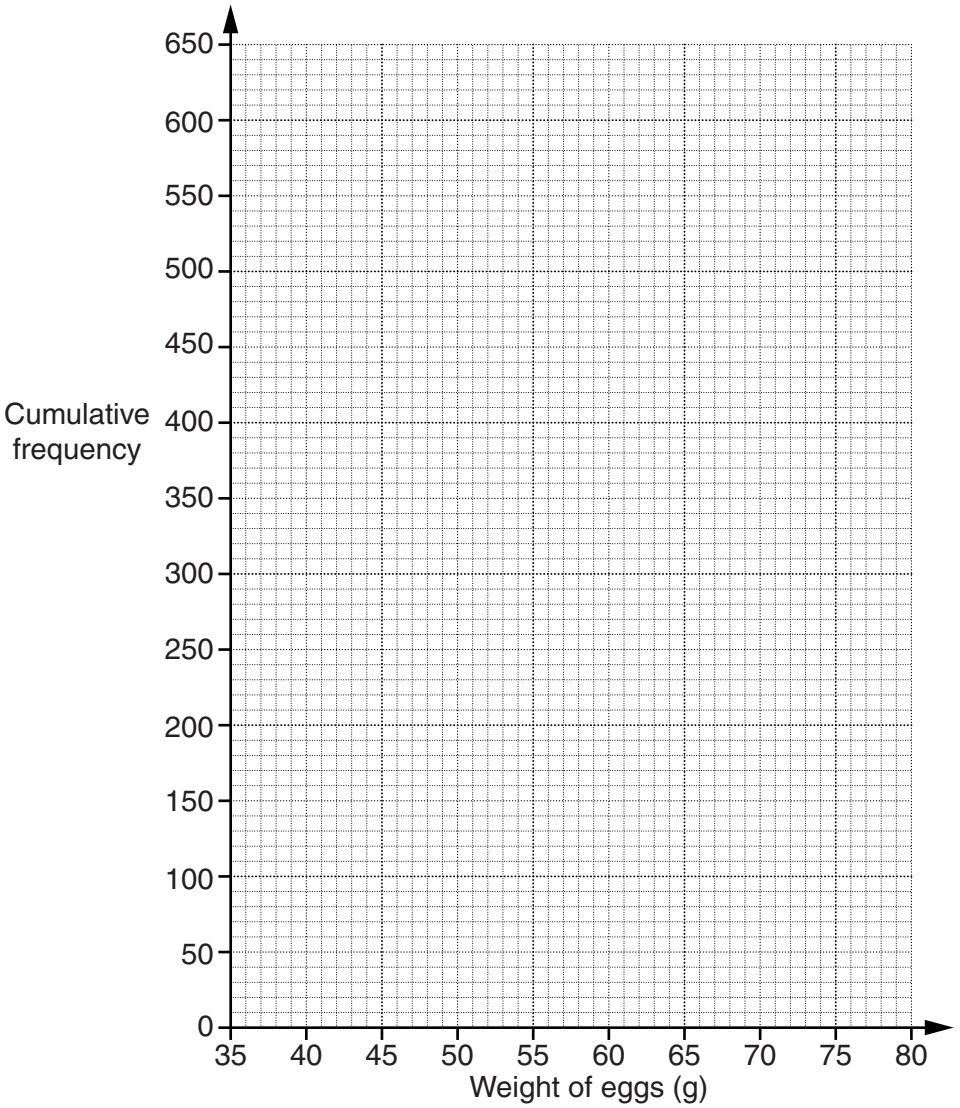
Size	Weight of eggs	Number of eggs
Jumbo	71 g or more	15
Extra large	64 g – 70 g	75
Large	57 g – 63 g	166
Medium	50 g – 56 g	234
Small	43 g – 49 g	95
Peewee	35 g – 42 g	55

(i) Complete the cumulative frequency table.

Weight of eggs	< 42.5 g	< 49.5 g	< 56.5 g	< 63.5 g		
Cumulative frequency	55	150				640

[2]

(ii) Draw the cumulative frequency graph.



[3]

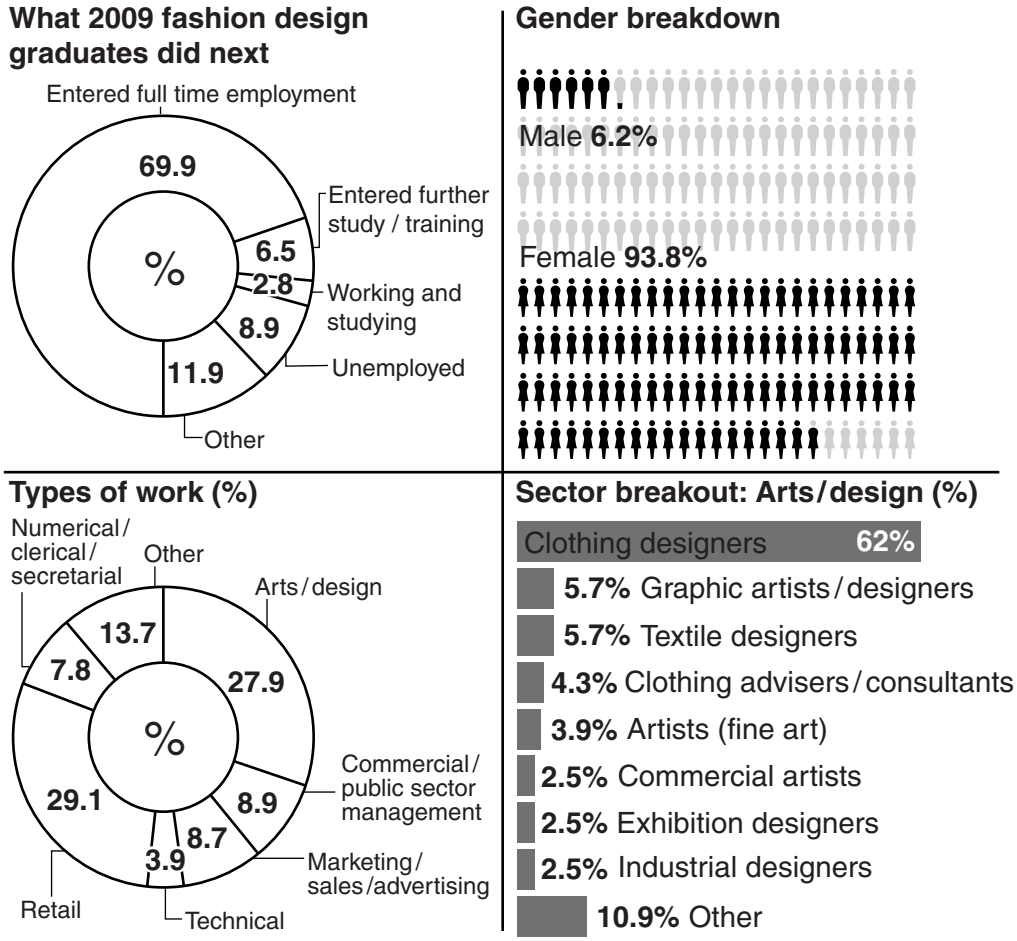
(iii) Use your cumulative frequency graph to complete this table of UK egg sizes for Anna's eggs.

Weight of eggs	Number of eggs
73 g or more	
63 g – 72 g	
53 g – 62 g	
52 g or under	

[4]

5 A newspaper reported on what fashion design graduates did next in 2009.

These four graphs were published in the report.



(a) What percentage of these graduates did not enter full time employment?

(a) _____ % **[1]**

(b) Show that about 20% of fashion design graduates found full time employment in retail.

_____

_____

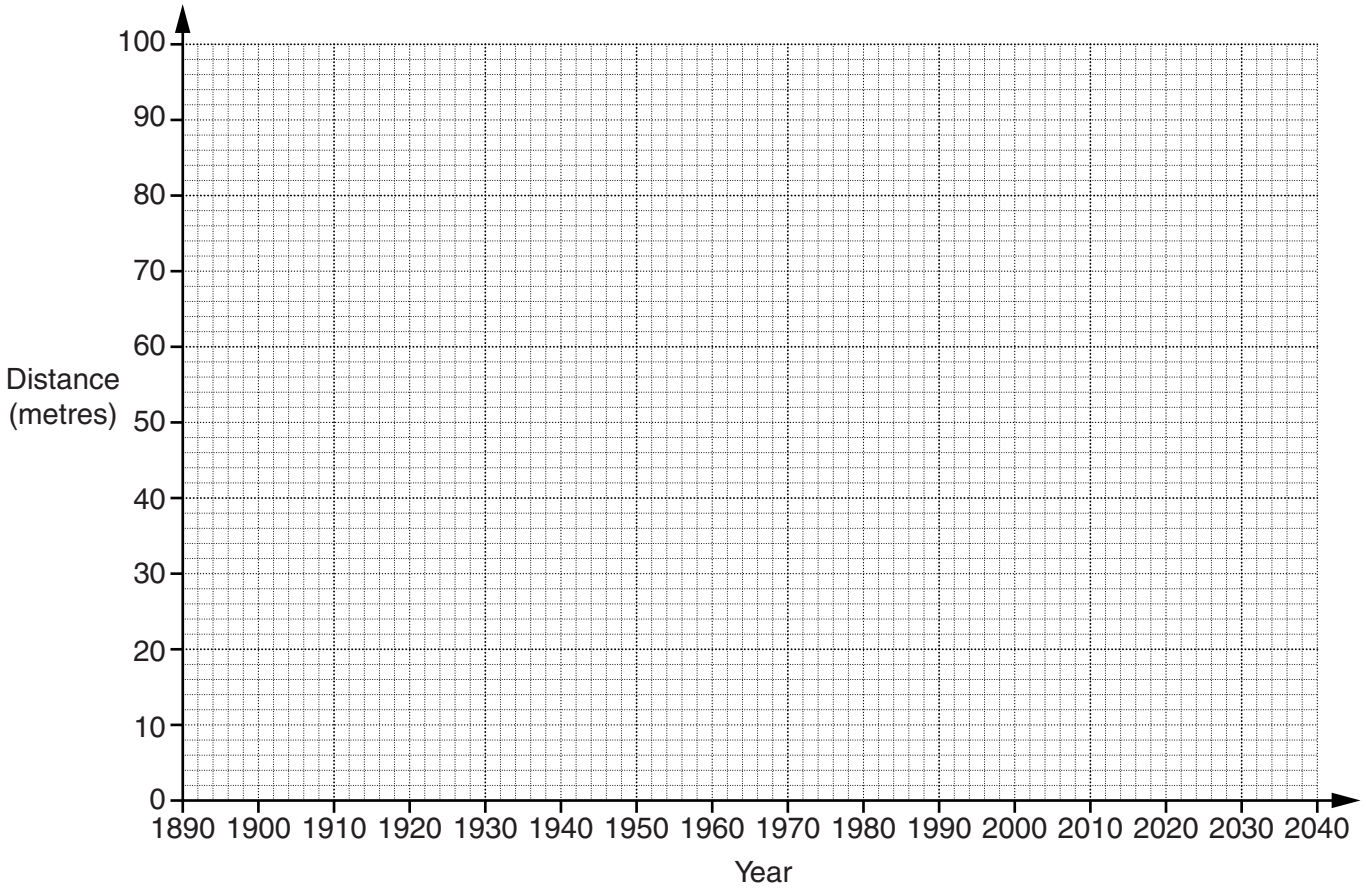
_____ **[2]**

6 Coastal erosion happens when cliffs and rocks are broken up by the sea.

(a) Josie lives in a cottage close to a cliff top. The back of the cottage faces the sea.
The distance, in metres, from the back of the cottage to the edge of the cliff top has been recorded for some years from 1892 to 2006.

Year	1892	1927	1948	1957	1981	2006
Distance (metres)	94	83	60	58	47	35

(i) Plot these points.



[2]

(ii) There is a garden at the back of Josie's cottage. In 1892 it was 40 m long.

Use your graph to estimate the year when Josie's garden began to disappear due to coastal erosion.

(a)(ii) _____ **[1]**

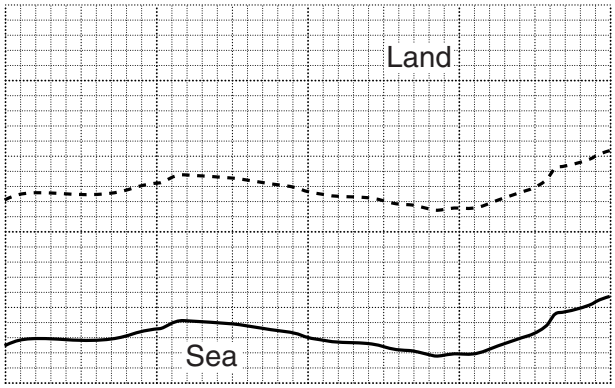
(iii) Josie will leave her cottage when the distance from the back of the cottage to the edge of the cliff is 25 m.

Use your graph to estimate the year that Josie will leave her cottage.
Show on your graph how you found your estimate.

(iii) _____ **[2]**

(b) It is estimated that the annual rate of coastal erosion in some areas is 2 m per year.

This diagram shows a plan view of part of a cliff coastline.
The dotted line shows where the coastline may be in 5 years time due to coastal erosion.

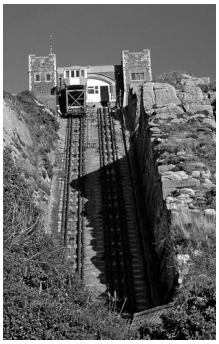


Scale: 1 cm represents 5 m

Estimate the area of land that may be lost over 5 years on this part of the coastline.
Show your working.

(b) _____ m^2 **[2]**

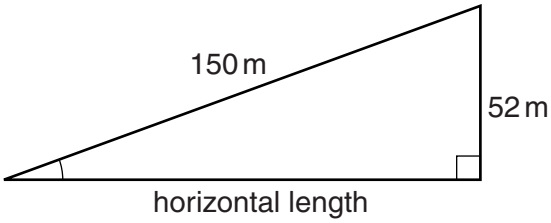
A funicular railway carries people up and down steep slopes such as cliffs.



(c) There are two funicular railways in Hastings.

(i) The West Hill Cliff railway is 150 m long.
The vertical height between the top and bottom of the track is 52 m.

Not to scale



Work out the angle that the West Hill Cliff railway is inclined to the horizontal length.

(c)(i) _____ ° **[3]**

(ii) The East Hill Cliff railway has a gradient of 78%.
This means that its vertical height is 78% of its horizontal length.

Show that the East Hill Cliff railway line is inclined to the horizontal length at an angle of 38° correct to the nearest degree.

_____

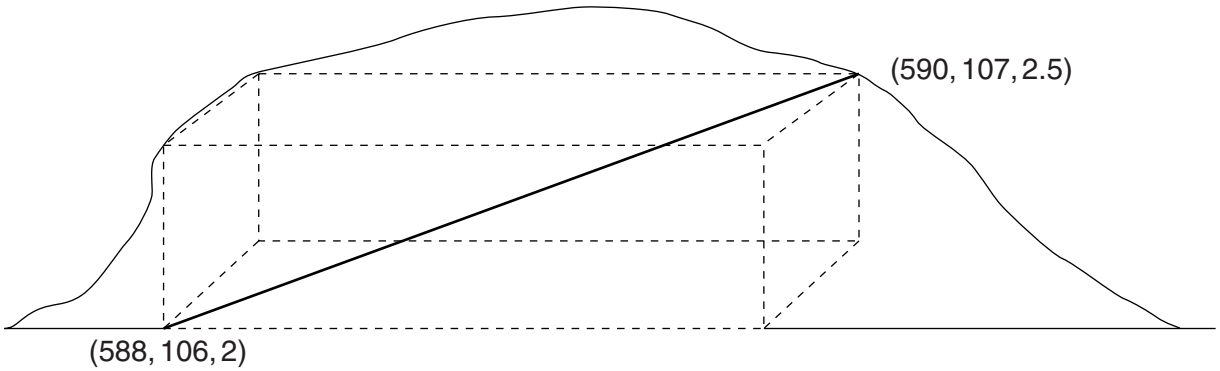
_____ **[1]**

(d) The diagram shows the top and bottom of a funicular railway.

The 3D coordinates, in kilometres, for this railway are:

Bottom of railway (588, 106, 2)

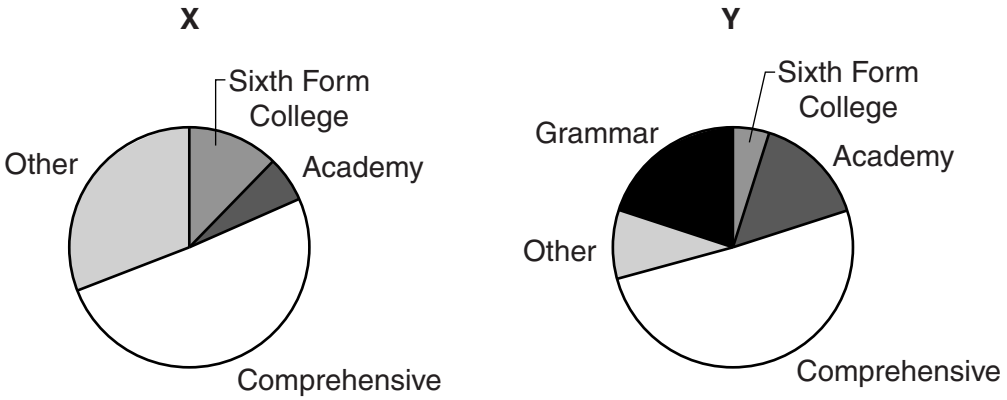
Top of railway (590, 107, 2.5)



Calculate the length of this funicular railway.

(d) _____ km **[3]**

7 Jenna drew these pie charts to show the types of secondary schools in two local authorities, X and Y.



(a) (i) In both pie charts the sectors representing comprehensive schools are semicircles.

Explain why the same size sector does not mean there is the same number of comprehensive schools in X and in Y.

_____

_____ **[1]**

(ii) There are 8 comprehensive schools in X and 10 comprehensive schools in Y.

Work out how many more schools there are in Y than in X.

(a)(ii) _____ **[1]**

(b) Holly says;

'It is better if you draw the pie charts so that their areas are in proportion to the total number of schools they represent'.

Holly draws a pie chart for X with a radius of 4 cm.

Work out the radius Holly needs to use for the pie chart for Y.

(b) _____ cm **[3]**

8 Josh is dyeing vests to sell. He can only dye one vest at a time.
The table shows the time and cost, using two different methods, to dye vests.

Method	Time per vest	Cost per vest
Tie dye	60 minutes	£1.00
Batik	90 minutes	£2.50

T is the number of tie dye vests and B is the number of batik vests.

(a) Josh has a maximum of 8 hours to dye vests.

Show that $2T + 3B \leqslant 16$.

_____

_____ **[1]**

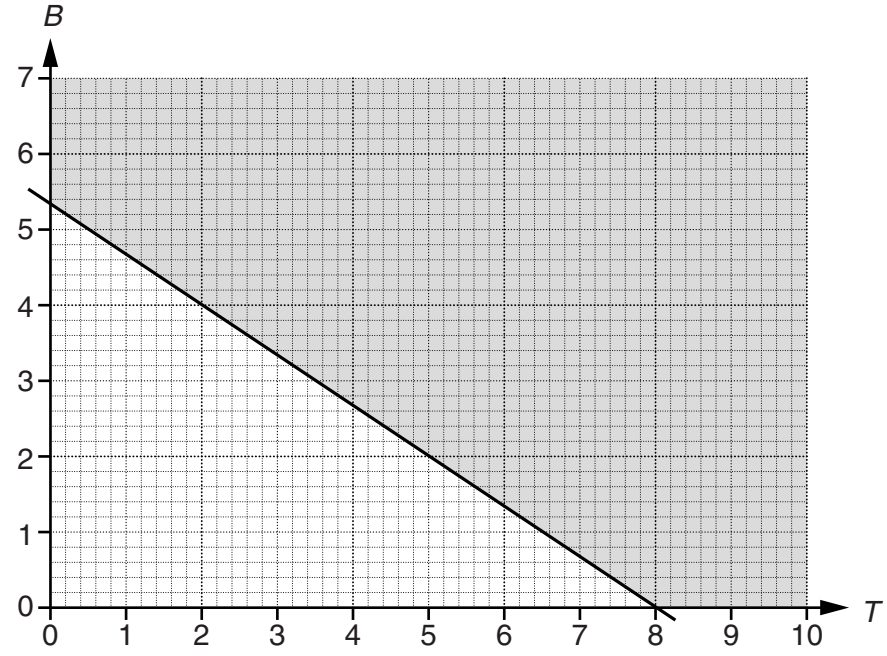
(b) Josh has at most £10 to spend.

Write down an inequality for the cost.

(b) _____ **[1]**

(c) The **unshaded** part of the grid shows $2T + 3B \leqslant 16$.

On the grid represent the inequality from part **(b)**.



[3]

(d) Josh can sell all the vests he dyes.
His profit is £3 for each tie dye vest and £7 for each batik vest.

How many of each vest should Josh make to maximise his profit?
How much is his total profit?

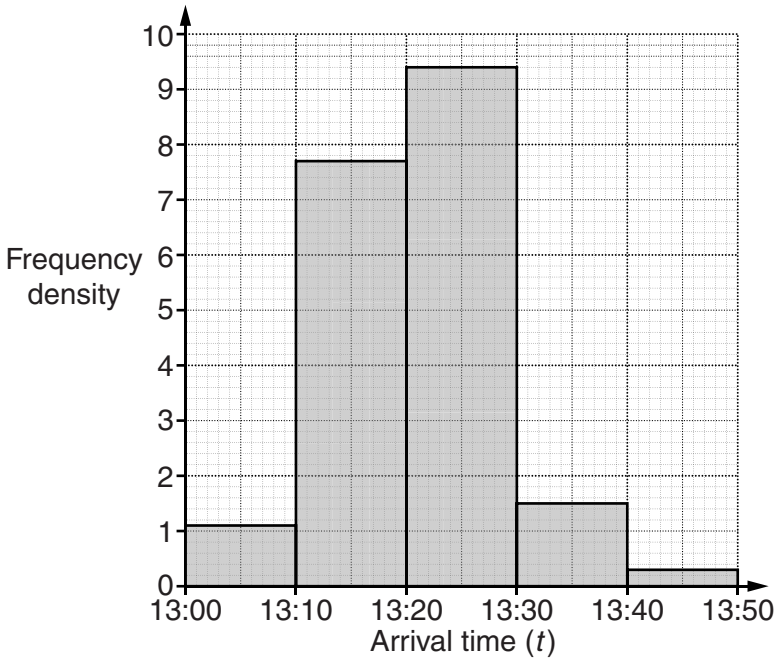
(d) T =_____, B =_____, Profit £_____ **[3]**

9 Tom and Wanda carried out a survey on the time students in year 10 arrived for a lesson.
The students were supposed to arrive by 13:30.

Tom recorded the arrival time of each student.
He collated his results in this table using equal class intervals for the arrival time.

Arrival time (t)	Frequency	Frequency density
13:00 $\leqslant t <$ 13:10	11	1.1
13:10 $\leqslant t <$ 13:20	77	7.7
13:20 $\leqslant t <$ 13:30	94	9.4
13:30 $\leqslant t <$ 13:40	15	1.5
13:40 $\leqslant t <$ 13:50	3	0.3

Tom drew this histogram to represent his data.



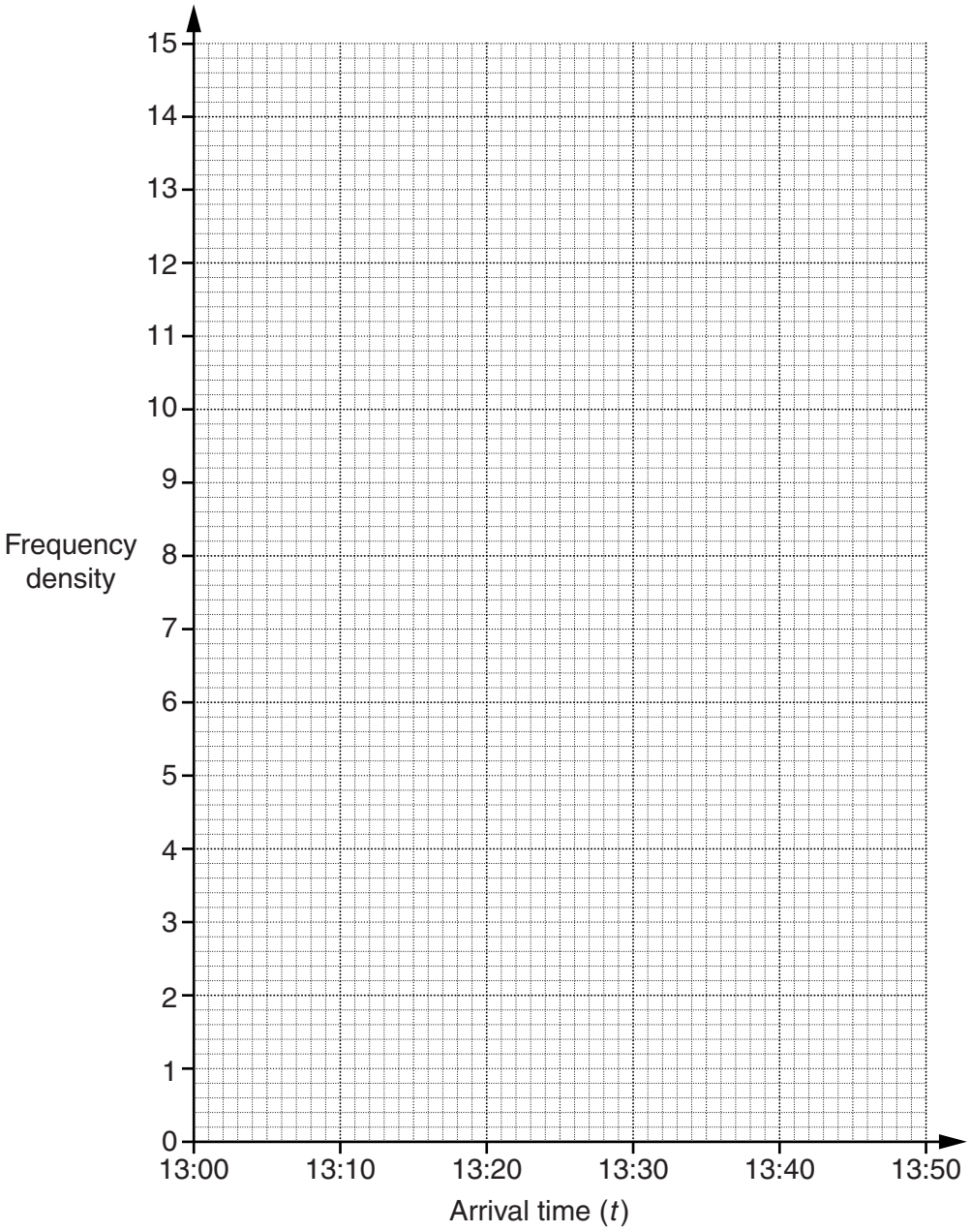
Wanda recorded the arrival times for the same students.
Wanda's table has different class intervals for arrival time.

Arrival time (t)	Frequency	Frequency density
13:00 $\leqslant t <$ 13:15	15	1
13:15 $\leqslant t <$ 13:20	73	
13:20 $\leqslant t <$ 13:25	58	
13:25 $\leqslant t <$ 13:30	36	
13:30 $\leqslant t <$ 13:45	18	

(a) Use the information from both tables to work out how many students arrived between 13:10 and 13:15.

(a) _____ **[1]**

(b) Complete the frequency density column in Wanda's table and draw a histogram for her data.



[4]

(c) State one advantage of collating the data using the time intervals in Wanda's table rather than those in Tom's table.

_____

_____ **[1]**

(d) Tom and Wanda each calculated an estimated mean arrival time from their own tables.

Whose estimate is likely to be closer to the actual mean? Explain how you know.

_____ because _____

_____ **[1]**

10 Some companies check employee absence using the Bradford Factor.

Bradford Factor = $S^2 \times D$

where S = number of times absent in any 52 week period
and D = **total** number of days absent in any 52 week period

(a) Judy and Dave work for a company.
They each had a total of 18 days of absence during a 52 week period.

Judy was absent twice, each time for 9 days.
Dave was absent nine times, each time for 2 days.

Work out the Bradford Factor for Judy and the Bradford Factor for Dave.

(a) Judy _____

Dave _____

[3]

(b) Companies find that employees who have frequent short term absence disrupt work processes more than employees who have fewer times, but longer periods off work.

Describe the effect on the Bradford Factor of frequent absence.

_____

_____ **[1]**

(c) The records of one company show only whole days and half days of absence.

(i) List all the possible ways that an employee could have a Bradford Factor of 6.

_____

_____

_____ **[2]**

(ii) Barney, an employee, has a Bradford Factor of 75.

What is the maximum number of times he could have been absent?

(c)(ii) _____ **[2]**

(d) The company uses a spreadsheet to record absence and calculate the Bradford Factor. The Bradford Factor for any date is calculated on the 52 week period up to and including that date.
Each employee has their own page.

This is the spreadsheet page for Louise.
Louise was not absent before 09/01/2011.

	I	J	K	L	M	N
1	Employee	Date of first day absent	Number of days absent	S	D	Bradford Factor
2						
3	Louise	09/01/2011	4	1	4	4
4		27/06/2011	1	2	5	20
5		05/11/2011	1	3	6	54
6		12/03/2012	2	3	4	36
7						
8						

(i) How many times was Louise absent in the 52 week period up to and including her last recorded absence?

(d)(i) _____ **[1]**

(ii) Louise's next absence was for 3 days. The first day of this absence was 06/05/2012.

Complete row 7 of the spreadsheet. **[4]**

(iii) Complete this formula to calculate the Bradford Factor in cell N7.

(iii) = L7^ _____ * _____ **[2]**

PLEASE DO NOT WRITE ON THIS PAGE