OCR
Oxford Cambridge and RSA

Wednesday 3 June 2015 – Morning

AS GCE/Level 3 Certificate

QUANTITATIVE METHODS (MEI)

G244/01 Introduction to Quantitative Methods (IQM)

Question Paper

Candidates answer on the Question Paper.

OCR supplied materials:
- Insert (inserted)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the spaces provided. Please write clearly and in capital letters.
- **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).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper unless the question states otherwise.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The Insert contains a copy of the pre-release material for use with two of the questions.
- The total number of marks for this paper is **72**.
- This Question Paper consists of **20** pages. Any blank pages are indicated.

1 On 12 November 2014 a space probe named Philae landed on the comet 67P/Churyumov-Gerasimenko.

Signals from Philae, travelling at the speed of light, took just over 28 minutes to reach Earth.

The speed of light is $3.0 \times 10^8\,\text{m}\,\text{s}^{-1}$.

Find the distance of Philae from Earth at that time. Give your answer in millions of kilometres correct to 1 significant figure. **[5]**

1

2 This question is based on 'The ignorance index' shown in Fig. 2 below, and in the pre-release material. This appeared in The Times on October 30th 2014.

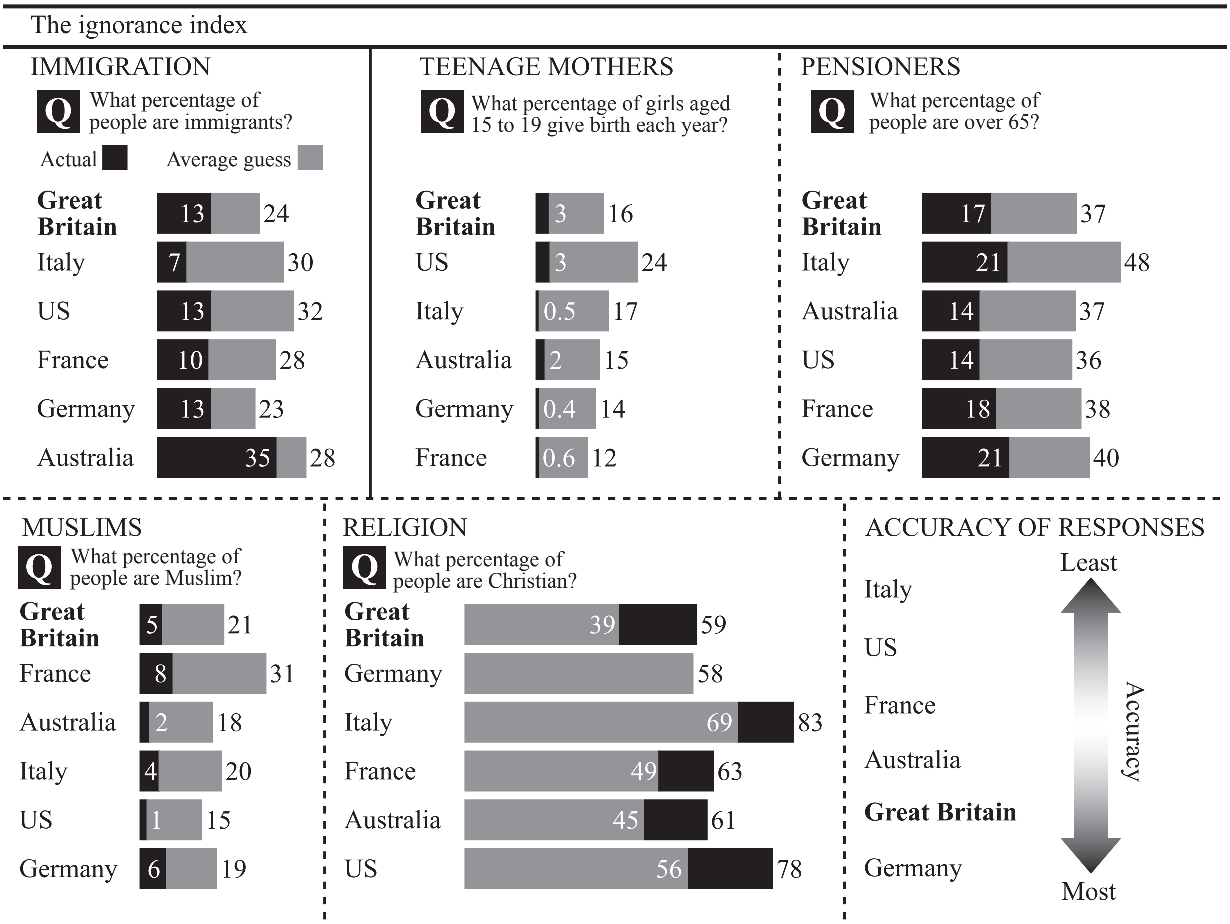

Fig. 2

(i) In which response is the ratio $\frac{\text{Average guess}}{\text{Actual}}$ highest in Great Britain?

Justify your answer numerically. **[2]**

(ii) Identify **two** different errors in the display. **[2]**

2 (i)	
2 (ii)	

3 The world population is currently between 7 and 8 billion people.

There are different models which predict the size of the world population in the future. This question is based on the United Nations' 'medium growth' model. This predicts the following figures.

Year	2030	2050	2070	2090	2100
Population prediction ($\times 10^9$)	8.4	9.6	10.3	10.7	10.9

Table 3.1

The points already marked on the graph below show the dates when the world population is believed to have passed through whole numbers of billions of people, from 2 billion on.

(i) Plot the figures in Table 3.1 on this graph and join all the points with a smooth curve. **[2]**

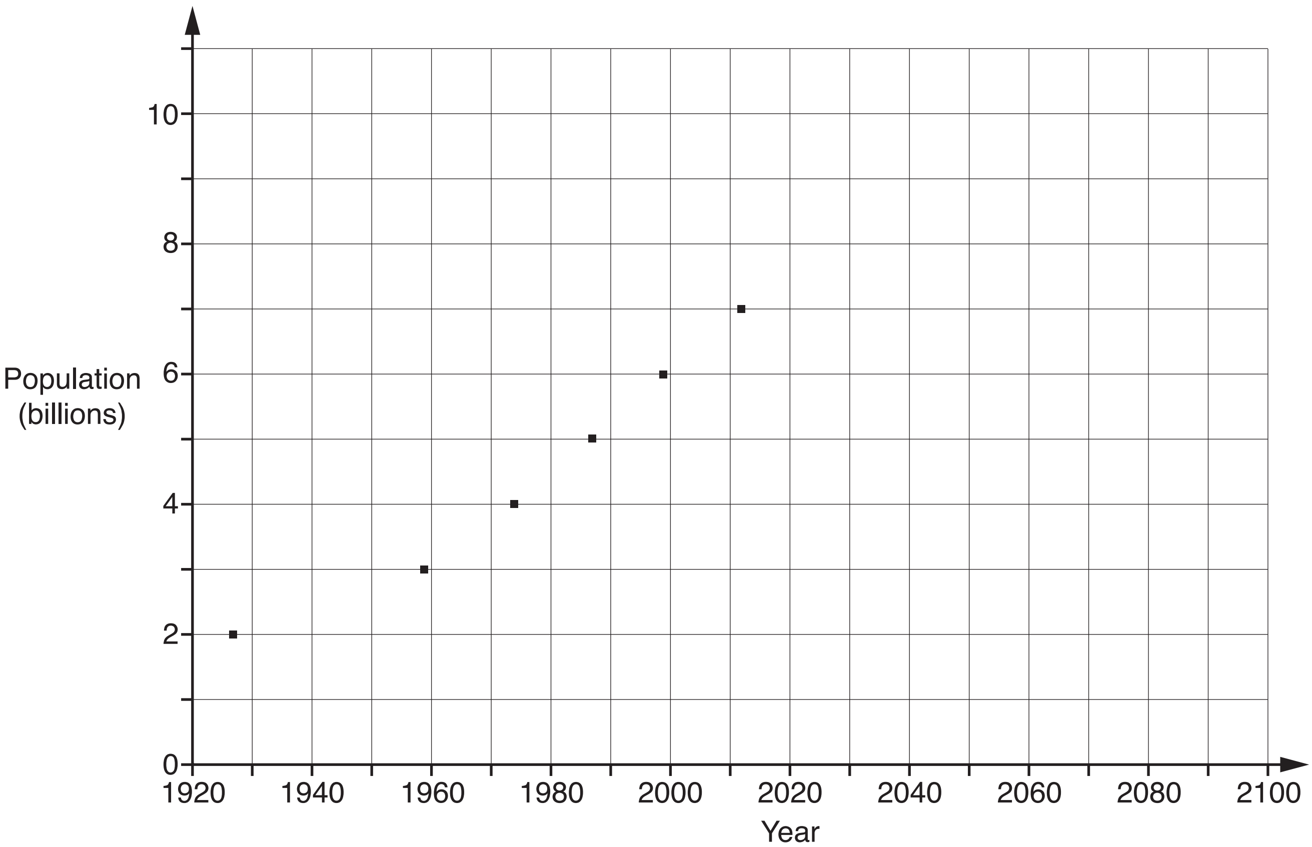

Fig. 3.2

(ii) By drawing a suitable line on your graph, estimate the year when the world population grew or will grow at the fastest rate, and what that rate is. Give your answer in people per day.

State, with a reason, whether your answer is the same as the number of babies born per day at that time. **[6]**

3 (ii)	

4 This question uses the metric prefixes table shown in the pre-release material.

A model that is often quoted for the development of computing is called Moore's Law. It is:

'Computer processing power doubles every two years.'

The memory of a typical PC follows essentially the same pattern.

(i) Show that Moore's law is very close to an increase by a factor of 10^3 every 20 years. **[3]**

4 (i)	

(ii) In 1970, the memory of a typical PC was 1 kilobyte. Complete this graph showing the model from 1970 to 2010. **[2]**

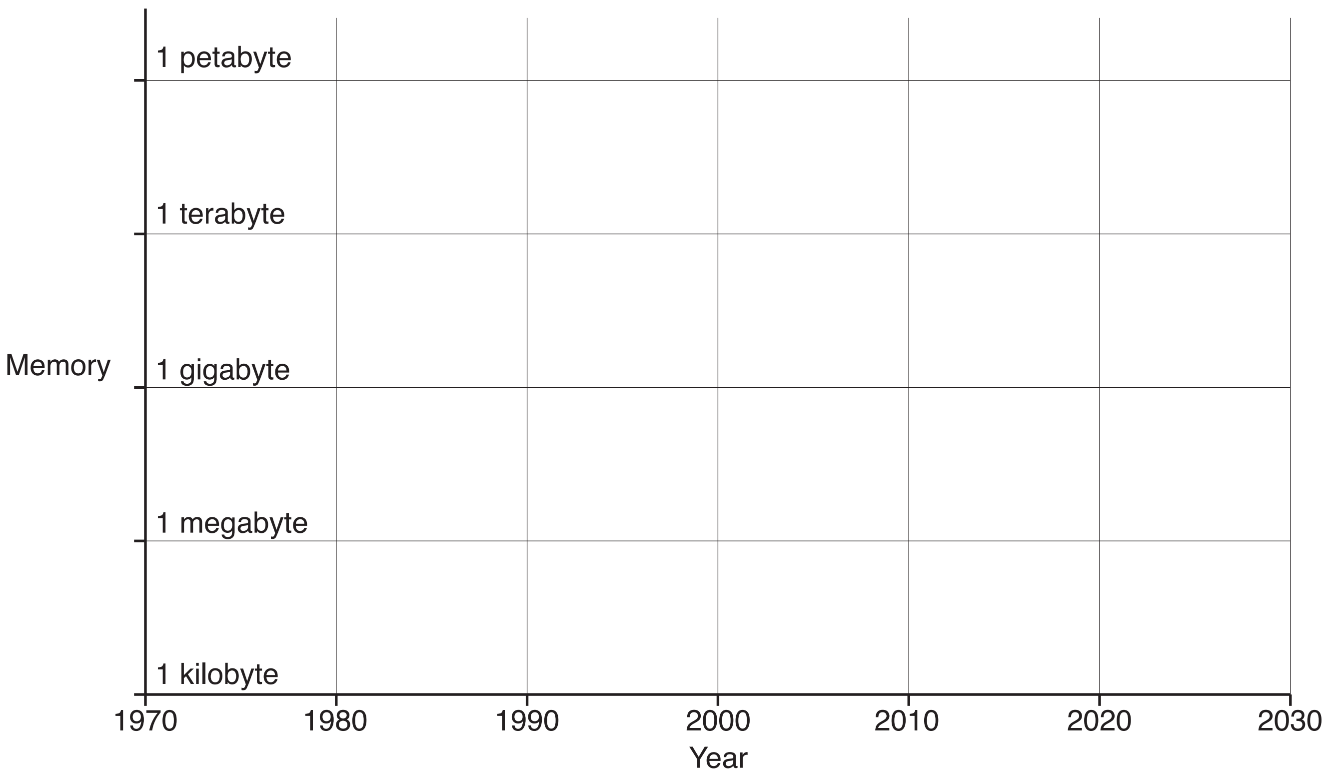

Fig. 4

(iii) Comment briefly on the scale used for the vertical axis. **[1]**

4 (iii)	

(iv) Show that doubling every 2 years is not the same as a 50% increase each year.

Find the correct annual percentage increase. **[3]**

(v) According to the model, 1 gigabyte of memory should have become available in 2010. In practice it happened in about 2005.

Calculate the average annual percentage increase in memory from 1970 to 2005 that this suggests. **[3]**

4 (iv)	
4 (v)	

5 This question is based on a study into the treatment of a particular form of mental illness.

The usual treatment is to give patients particular medicines.

In a proposed new treatment they are still given the same medicines, but are also given a course of psychological therapy. This involves a series of structured discussions but no extra medicine.

The study involved 137 patients.

- Of these, 66 were assigned to a control group and received the usual treatment.
  - 28 of these patients improved.
  - The other patients in the control group did not improve.
- The remaining 71 patients were given the new treatment.
  - 40 of these patients improved.
  - The other patients receiving the new treatment did not improve.

(i) Complete Table 5.1 below to show this information. **[2]**

Patients	**Control group Treatment as usual**	**New treatment group**	
Improved	28	40	
Not improved			
Total	**66**		**137**

Table 5.1

(ii) Now complete Table 5.2 to show the probabilities that patients have improved or not improved in each of the two groups. **[2]**

Probability	**Control group Treatment as usual**	**New treatment group**
Improved	0.424	
Not improved		
Total	**1**	**1**

Table 5.2

(iii) Comment briefly on the apparent effect of the new treatment. **[1]**

5 (iii)	

(iv) One of the researchers looked at the data more closely. She divided the patients into those who were more or less severely affected by the illness. This produced 4 groups of patients. The numbers of patients in each group are shown in Table 5.3 below.

Patients	**Control group Treatment as usual**		**New treatment group**	
	Less severe	**More severe**	**Less severe**	**More severe**
Improved	11	17	7	33
Not improved	5	33	9	22
Total	**16**	**50**	**16**	**55**

Table 5.3

Use the figures in Table 5.3 to estimate the probability that a less severely affected patient improves **(*A*)** in the control group and **(*B*)** in the group receiving the new treatment. **[2]**

(v) What do your answers to part **(iv)** suggest?

Why should you treat this possible finding with caution? What should be done next? **[3]**

5 (iv) (*A*)	**Control group**
5 (iv) (*B*)	**New treatment group**
5 (v)	

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Question 6 begins on page 11

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6 A company makes T-shirts.

Its sales depend on how much they charge. The table below gives estimated figures from the company's marketing department.

Price	£8	£10	£12
Daily demand	120	100	70

Table 6.1

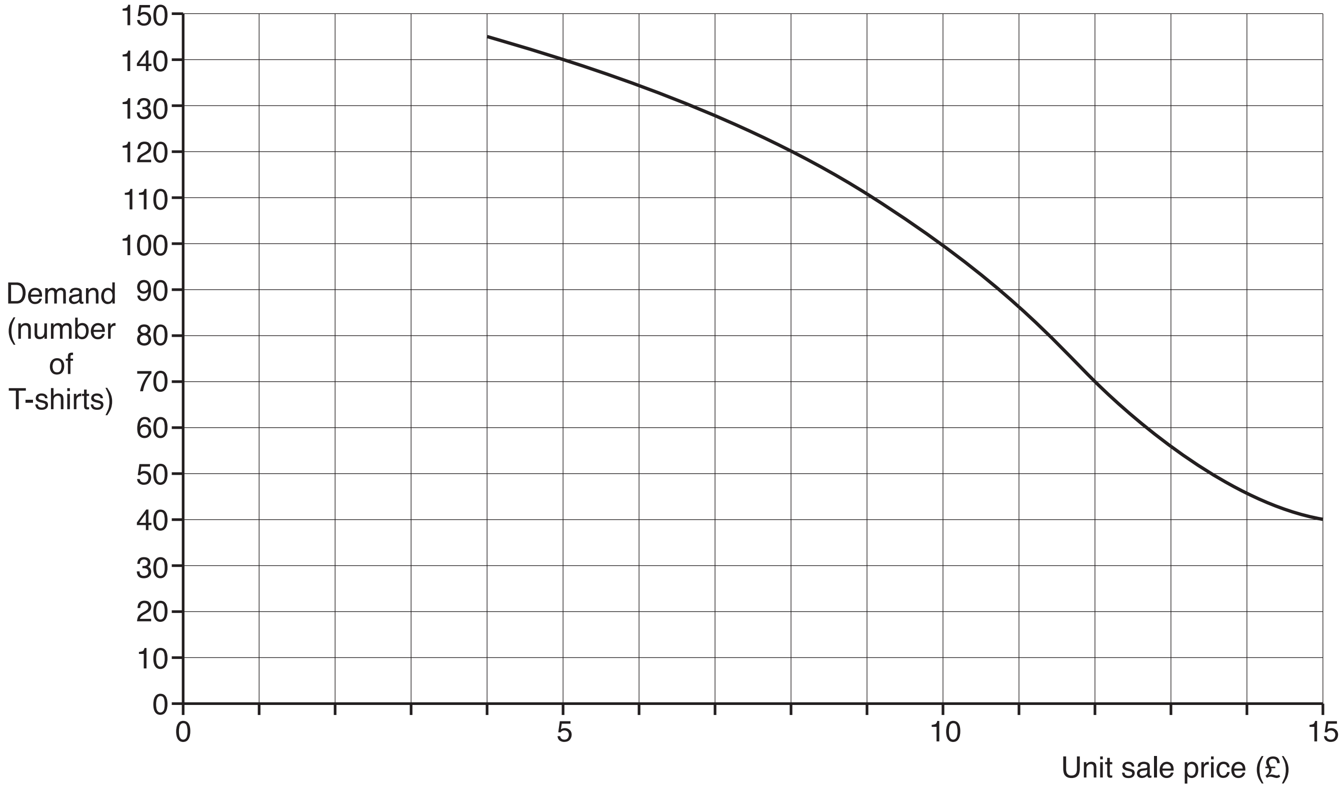
(i) For what price is the income greatest? **[2]**

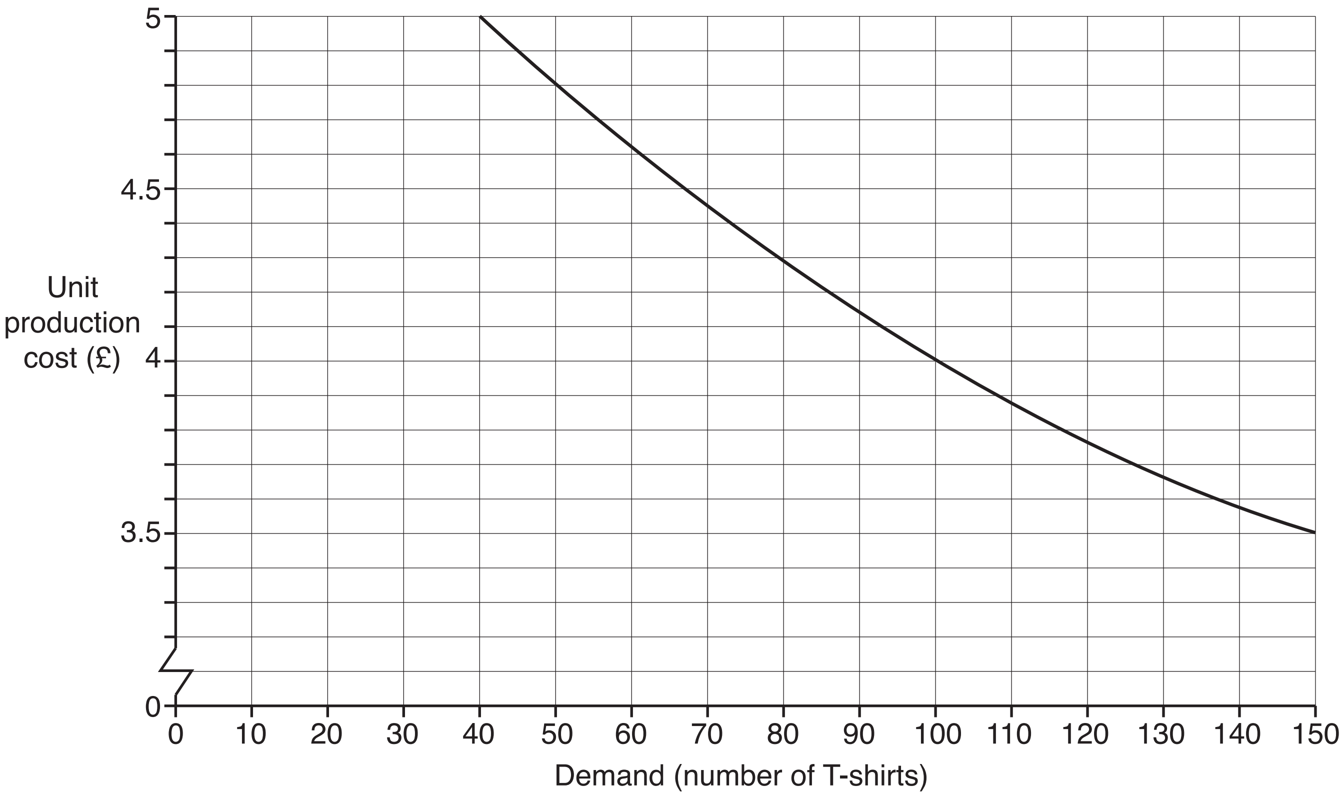
(ii) The cost of making a T-shirt is estimated to be £6.

According to this estimate, for what price is the overall profit greatest? **[2]**

6 (i)	
6 (ii)	

(iii) The manager decides that proper research is needed into the effect of price on demand and the effect of demand on the cost of production. The company's marketing department summarised the results on these two graphs.





Figs. 6.2 and 6.3

The manager enters figures from these graphs onto this spreadsheet.

	A	B	C	D	E	F
1	Unit sale price	Number of T-shirts	Unit production cost	Unit profit	Total income	Total profit
2	£5	140	£3.58	£1.42	£700	£199
3	£6	134	£3.63	£2.37	£804	£318
4	£7	128	£3.68	£3.32	£896	£425
5	£8		£3.76			
6	£9	111	£3.86	£5.14	£999	£571
7	£10					
8	£11	87	£4.18	£6.82	£957	£593
9	£12	70	£4.46	£7.54	£840	£528
10	£13	56	£4.69	£8.31	£728	£465
11	£14	46	£4.88	£9.12	£644	£420
12	£15	40	£5.00	£10.00	£600	£400

Table 6.4

(*A*) State the accuracy that has been used for the figures in columns C and F. **[1]**

(*B*) Using figures from the two graphs, complete rows 5 and 7 in the spreadsheet above. **[3]**

(*C*) Write down the formulae that have been entered into the spreadsheet to work out the content of cells D2 and F2. **[2]**

(iv) What advice would you give the company about the sale price for a T-shirt? **[1]**

6(iii)(*A*)	**C Unit production cost**
	F Total profit
6(iii)(*C*)	**D2**
	F2
6 (iv)	

7 Sandra lives near Exeter Airport. She is trying to decide whether to install a small wind turbine on the roof of her house. She wants to estimate how much electricity it will generate. To do this she needs to know the wind speed distribution at her house.

Sandra is told that the mean value of the wind speed is $4\,\mathrm{m\,s^{-1}}$ and that the standard deviation is $2.5\,\mathrm{m\,s^{-1}}$.

(i) Draw a sketch of a Normal distribution with this mean and standard deviation on Fig. 7.1. **[3]**

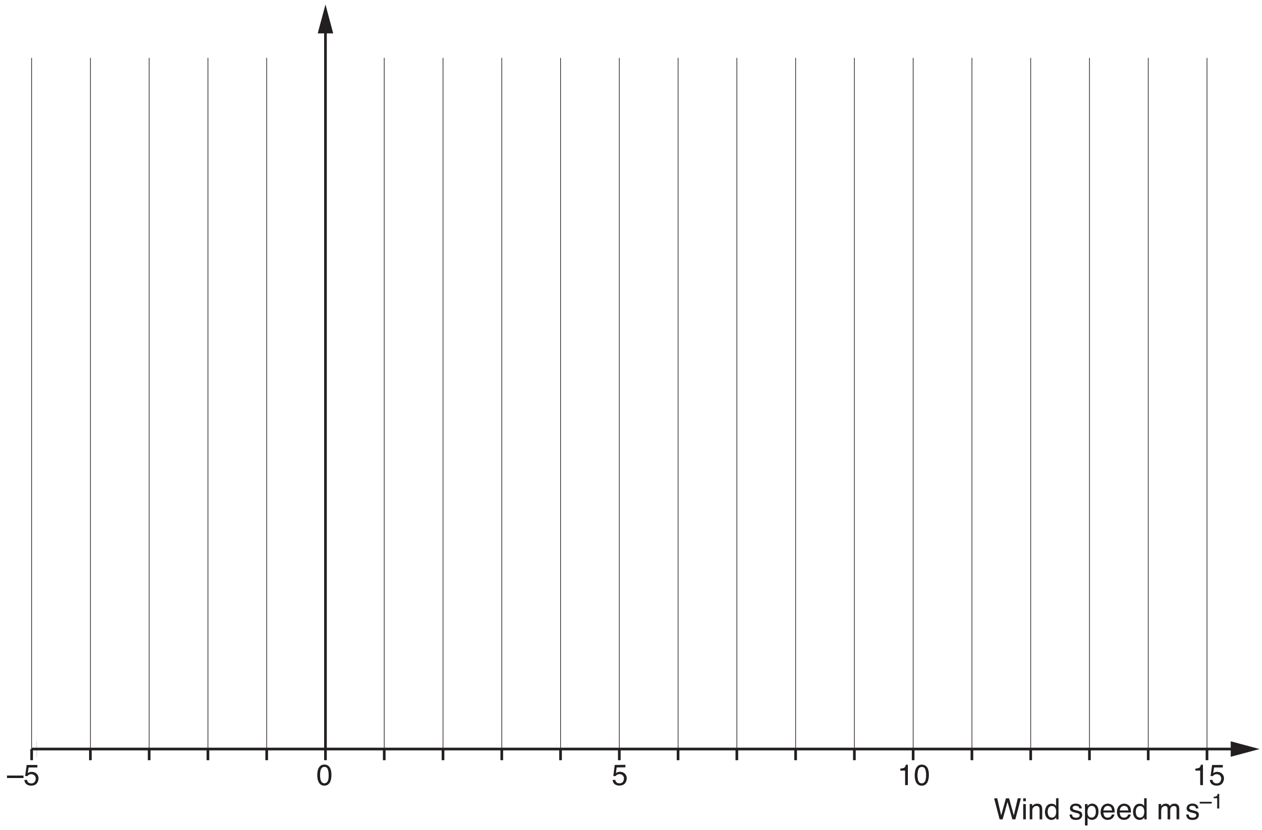


Fig 7.1

(ii) Give one reason why this Normal distribution will not be a perfect model for the wind speed distribution at Sandra's house. **[1]**

(iii) Use the Normal model, with mean $4\,\mathrm{m\,s^{-1}}$ and standard deviation $2.5\,\mathrm{m\,s^{-1}}$, to estimate the percentage of the time the wind speed is greater than $9\,\mathrm{m\,s^{-1}}$. **[3]**

7 (ii)	
7 (iii)	

(iv) Sandra obtains the following real data for the wind speed distribution at Exeter Airport from the Met Office.

The mean for these real data is 4.19 $m\,s^{-1}$ and the standard deviation is 2.47 $m\,s^{-1}$, so they are close to the figures you used in part **(iii)**.

Wind speed, $m\,s^{-1}$	≤ 1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9
%	6.47	15.38	14.56	15.22	14.17	11.78	8.95	5.81	3.64

	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	>17
	2.05	1.01	0.51	0.25	0.12	0.05	0.02	0.01	0.00

Note: 1–2 means $1 <$ wind speed ≤ 2

Table 7.2

Calculate the percentage of the time the wind speed is greater than 9 $m\,s^{-1}$ for these data. **[2]**

7 (iv)	

(v) What do your answers to parts **(ii)**, **(iii)** and **(iv)** suggest about the real distribution of wind speeds? **[1]**

7 (v)	

(vi) Sandra enters these data into a spreadsheet. The software draws this graph.

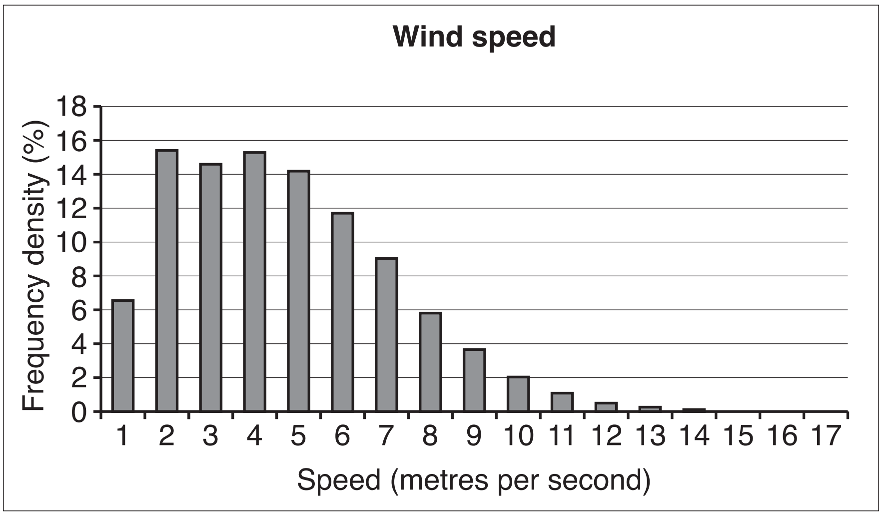


Fig. 7.3

Sandra really wants a histogram. State **two** features of this graph which need to be different. **[2]**

7 (vi)	

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Question 8 begins on page 18

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8 Women's clothes sizes vary between countries. (There is also some variation between manufacturers but this should be ignored in this question.) Table 8.1 gives typical sizes in the UK, the USA and France associated with different waist measurements. In these countries, all the sizes are even numbers.

UK	8	10	12	14	16
USA	4	6	8	10	12
France	36	38	40	42	44
Waist (cm)	61	66	71	76	81

Table 8.1

(i) Describe, in words, how to convert a UK size into the equivalent size in **(*A*)** the USA and **(*B*)** France. **[2]**

8 (i) (*A*)	**USA**
8 (i) (*B*)	**France**

(ii) It is suggested that the formula

$$S = \frac{2}{5}(w - 41)$$

gives the UK size, S, for a given waist measurement, w cm.

(*A*) Verify that the formula works for a waist measurement of 76 cm. **[1]**

(*B*) Now try the formula for a waist measurement of 73 cm.

What further instruction needs to accompany the formula? **[2]**

(*C*) Find the equivalent formula for France. Write it as simply as possible.

Check your answer, using a waist measurement of 81 cm. **[3]**

8 (ii) (*A*)	
8 (ii) (*B*)	
8 (ii) (*C*)	

(iii) Fig. 8.2 shows the relationship between Japanese sizes and waist measurements.

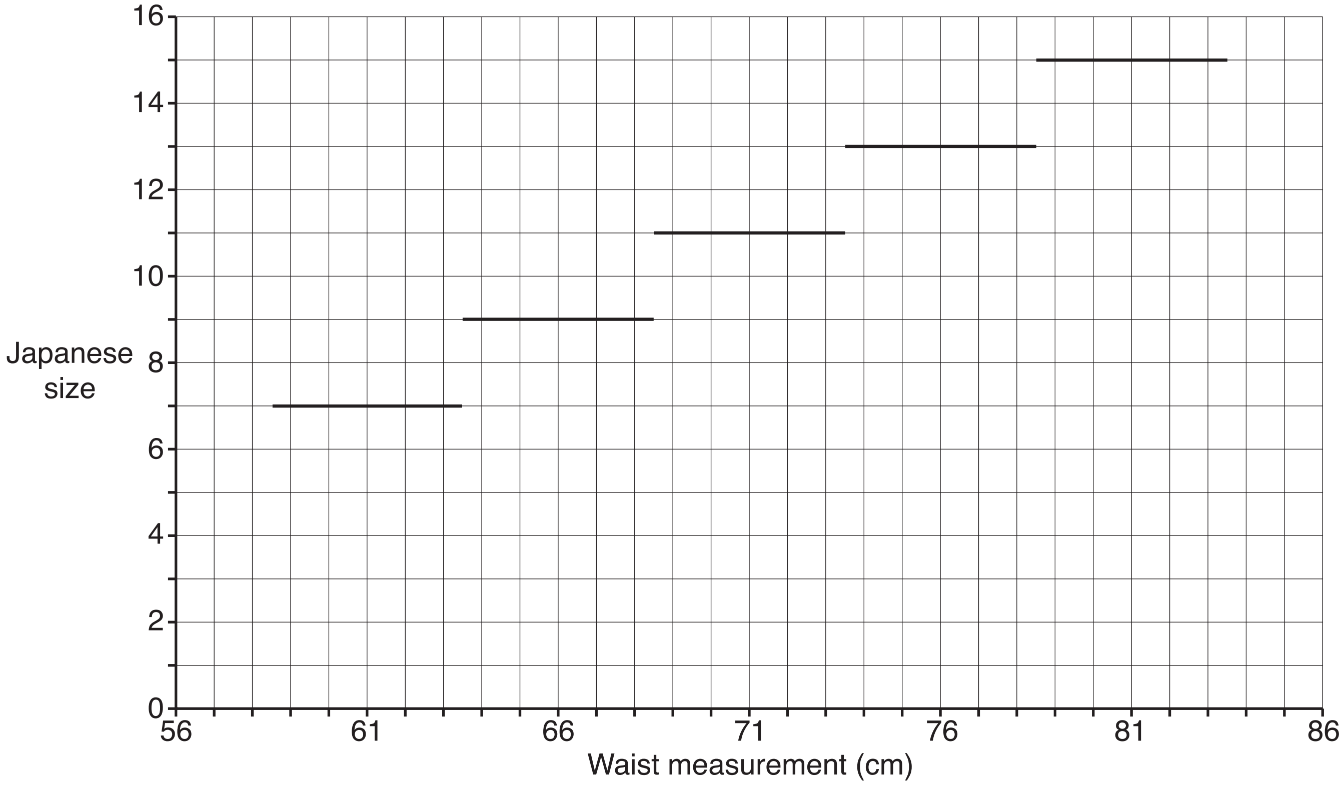

Fig 8.2

How does a Japanese woman find her equivalent size in the USA? **[2]**

8 (iii)	

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