OCR
Oxford Cambridge and RSA

Wednesday 7 June 2017 – 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 inside 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.** If additional answer space is required you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 barcodes.
- 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 three 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 A marathon is 42.195 km long.

At the start of 2016 the world record for the men's marathon was 2 hours 2 minutes and 57 seconds.

At the same time the world record for the men's 100 metres was 9.58 seconds.

(i) Find the average time that the marathon runner took over 100 m during the world record marathon run. **[4]**

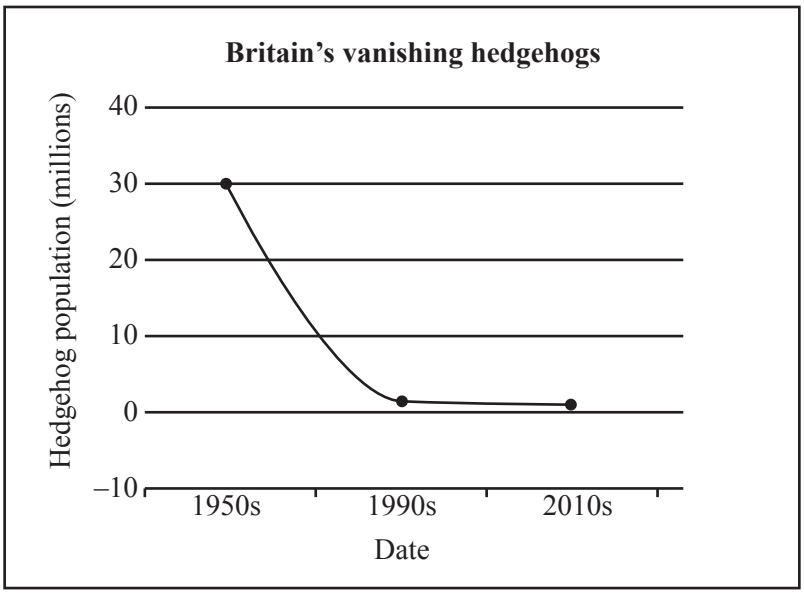
(ii) By what percentage is the answer to part **(i)** greater than the world record time for 100 m? **[3]**

1 (i)	

1 (ii)	

2 This question is based on pre-release material.

The article 'Our humble hedgehog is disappearing fast' contains this graph.



(i) Give two criticisms of the graph. **[2]**

2 (i)	

In the 1985 assessment of the badger population, it was estimated that there were 42 000 social groups of badgers in England with an average of between 2 and 3 adults per group.

(ii) **(*A*)** Estimate the number of adult badgers in England in 1985. **[1]**

(*B*) Assuming that the number 42 000 was rounded to the nearest 1000, show that a lower bound for the adult badger population that year is 83 000 and find the equivalent upper bound. **[2]**

2 (ii)	**(*A*)**

2 (ii)	(*B*)

The figures below gives the UK population in thousands of an animal over ten years.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Population	48	49	42	39	33	39	45	49	53	45

(iii) (*A*) Describe very briefly what is happening to the population. **[1]**

(*B*) '*The animal is out of control; it is increasing at 5000 per year*'.

This claim was made on the basis of two values of the population, from 4 years apart. Which years were used? **[1]**

(*C*) Explain briefly how this example is relevant to claims about badger population trends. **[1]**

2 (iii)	(*A*)
	(*B*)
	(*C*)

(iv) '*Hedgehog numbers are falling; at the same time badger numbers are rising. So badgers must be to blame for what is happening to the hedgehogs*'.

Give one criticism of this statement. **[1]**

2 (iv)	

3 Ela is planning to make money by keeping hens.

In order to estimate how the finances will work out, she prepares this spreadsheet.

If she changes any of the inputs in column C, the figures in columns F, G and I will adjust automatically.

	A	B	C	D	E	F	G	H	I
1	**Inputs**				**Annual debits**			**Annual credits**	
2									
3	**Shed**				Shed	£100.00		Eggs	£360.00
4	Cost (£)		500		Hens	£20.00			
5	Life (years)		5		Feed	£84.00			
6					**Total**	**£204.00**		**Total**	**£360.00**
7	**Hens**								
8	Number		6						
9	Cost each (£)		10						
10	Lifetime (years)		3						
11						**Profit**	**£156.00**		
12	**Feed**								
13	Cost/sack (£)		7						
14	Sacks/hen/year		2						
15									
16	**Eggs**								
17	Value/egg (p)		20						
18	Number/hen/year		300						

(i) Write down the formulae used for the following cells

(A) G11 ***(B)*** I3 ***(C)*** F3. **[4]**

3 (i) ***(A)*** G11

(B) I3

(C) F3

(ii) Ela considers a more expensive shed, costing £800, which she will write off over 4 years.

She also decides that it is more realistic to think each hen will lay 250 eggs per year.

Estimate her annual profit or loss in these circumstances. **[3]**

3 (ii)	

4 A river flows through a town. The height of the water above its usual level is measured on a scale attached to a bridge. If this height is greater than 2 metres, the town is flooded.

A record is kept of the greatest height, h metres, each year. The values of h from 1950 to 1999 are illustrated on the Normal probability plot in Fig. 4.1.

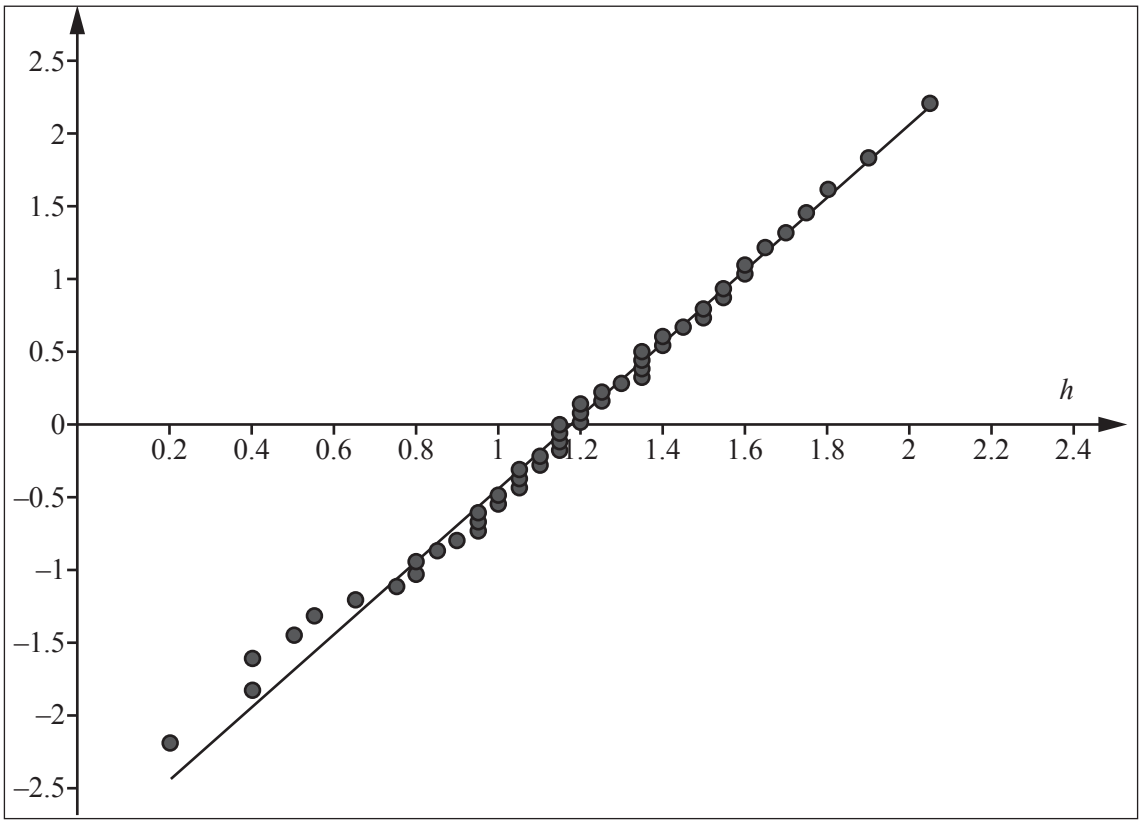


Fig. 4.1

(i) State what features of this graph indicate that

(*A*) the distribution of h was Normal,

(*B*) its mean was about 1.2,

(*C*) the standard deviation of h was about 0.4. **[3]**

4 (i)	**(*A*)**
	(*B*)
	(*C*)

(ii) Draw a sketch of a Normal distribution with mean 1.2 and standard deviation 0.4 on Fig. 4.2 below.

Mark the values on the horizontal scale. **[3]**

(iii) In the year 2000 a town councillor saw this distribution and said 'This shows me that our town has a low risk of being flooded. It is a 1 in 100 years event.'

Use the information given in part **(i)** to show that the councillor's statement was incorrect.

Calculate a better estimate of the risk. **[4]**

4 (ii)

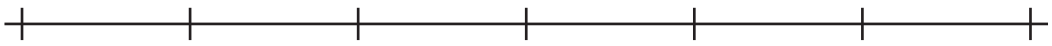


Fig. 4.2

4 (iii)

(iv) Fig. 4.3 shows the values of h for the years 2000 to 2016.

Fig. 4.4 shows the annual rainfall in mm in the catchment area of the river from 1950 to 2016.

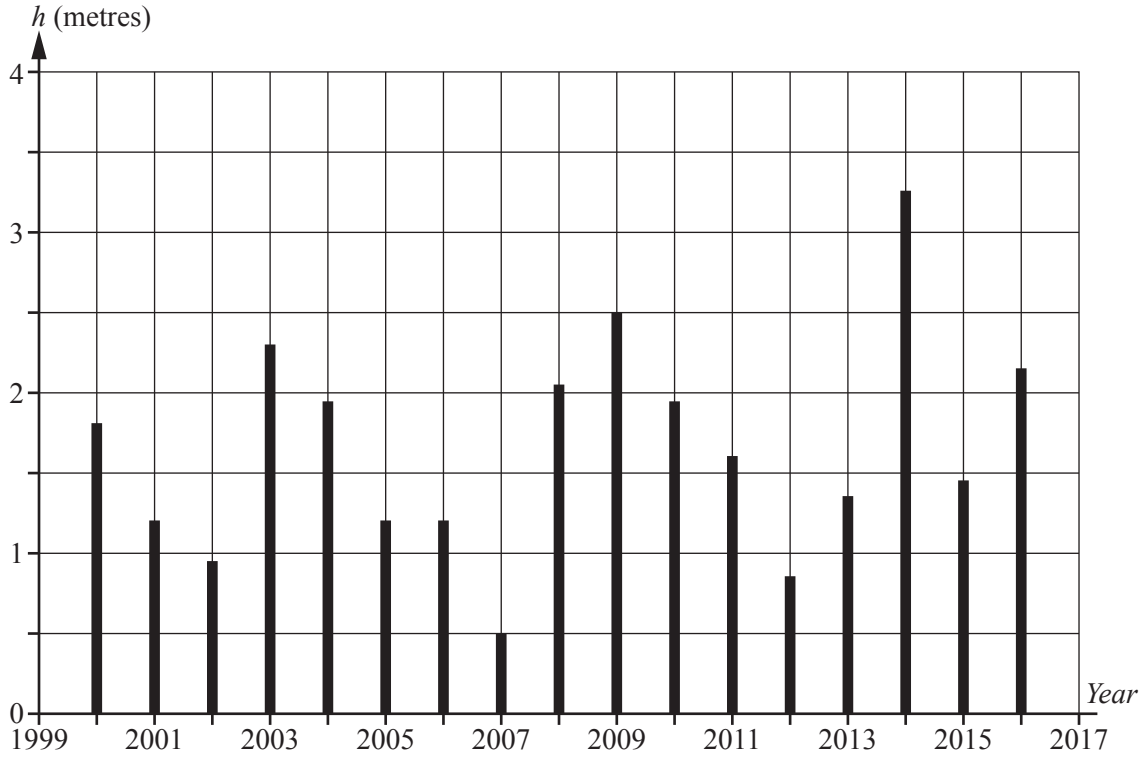


Fig. 4.3

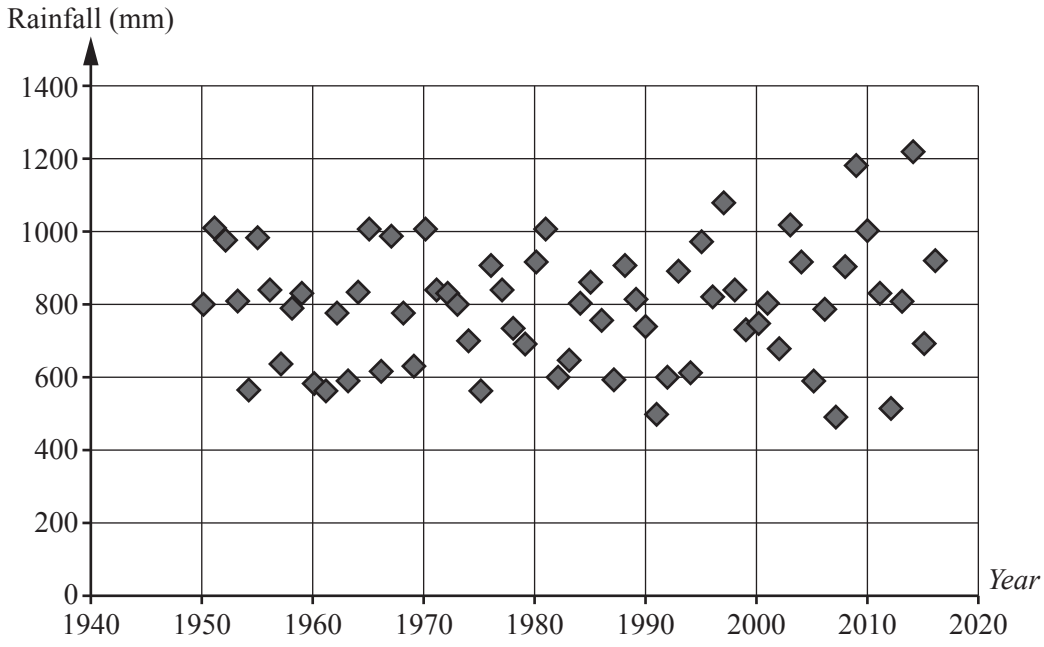


Fig. 4.4

Residents claim that the risk of flooding has increased.

They suggest two possible causes for it.

- It is a consequence of climate change caused by global warming.
- The flooding is caused by a housing estate 10 miles higher up the river which was built in 1999 on the river's flood plain.

(*A*) Give a brief argument to support the residents' claim that risk of flooding has increased. **[2]**

(*B*) Without doing any calculations, make one comment about each of the two suggested causes and say which you consider the more likely. **[3]**

4 (iv)	**(*A*)**
	(*B*)

5 Fig. 5.1 below illustrates a mathematical model for the depth of water, d metres, at the entrance to a harbour during the course of the 24 hours of one day.

(i) Estimate the times, according to this model, at which the depth of the water is 3 metres. **[1]**

(ii) Draw a suitable line on Fig. 5.1 and use it to estimate the rate at which the water is rising or falling at 1200. **[3]**

5 (i)

5 (ii)

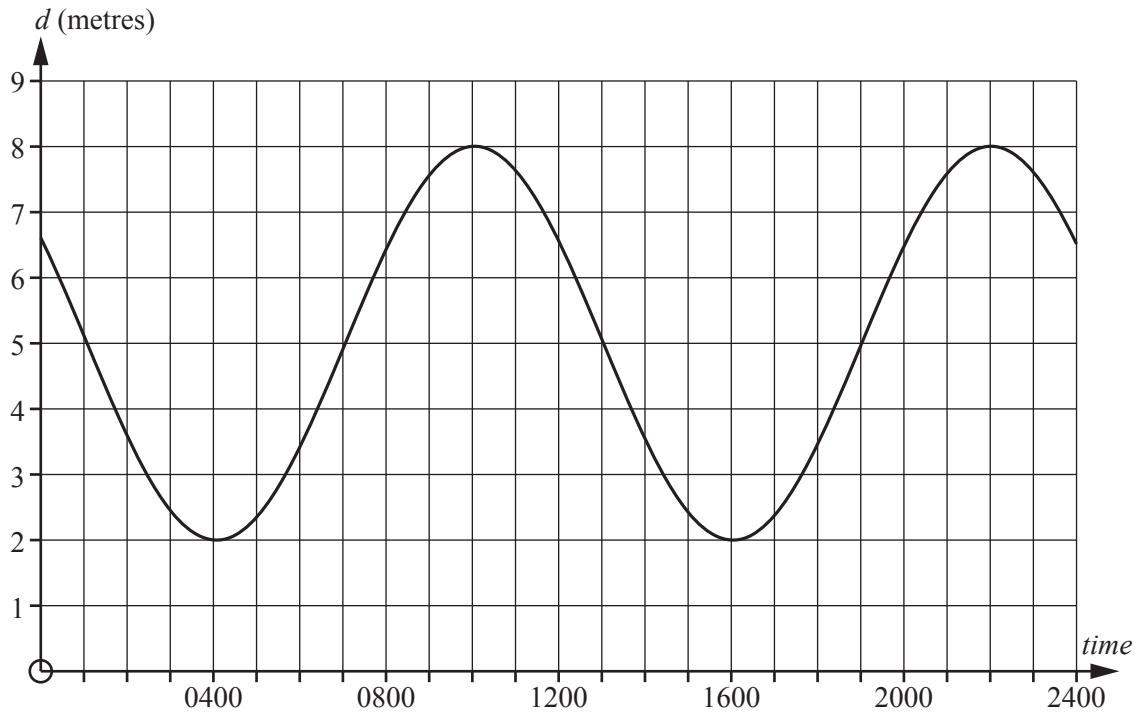


Fig. 5.1

Another model is given by a so called rule-of-thumb used by sailors. According to this rule the tide comes in for 6 hours. During those 6 hours the heights that the water rises are in the ratio 1 : 2 : 3 : 3 : 2 : 1. This is known as the 'Rule of twelfths'.

The water then falls by the same amounts during the next 6 hours.

(iii) Complete the table below to give the depth of water between 0400 and 1600 according to this rule. **[2]**

Plot the figures on Fig. 5.2 below. (This shows part of Fig. 5.1). **[1]**

Comment on how well the 'Rule of twelfths' model matches the mathematical model. **[1]**

5 (iii)

Time	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600
Rise		0.5	1	1.5					–1	–1.5	–1.5	–1	–0.5
Depth (d metres)	2	2.5	3.5	5					6.5	5	3.5	2.5	2

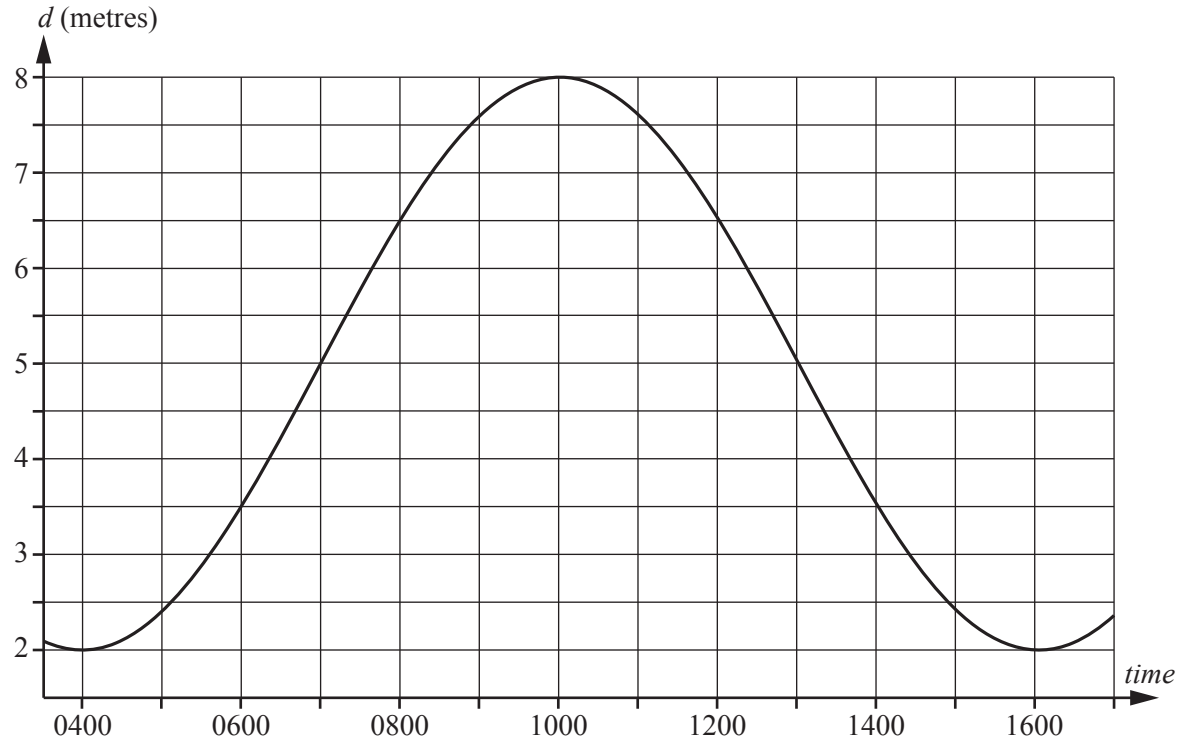


Fig. 5.2

(iv) Fig. 5.3 shows measurements, taken every 20 minutes, of the actual depth of water between 0400 and 1700.

State two ways in which it differs from either of the models. **[2]**

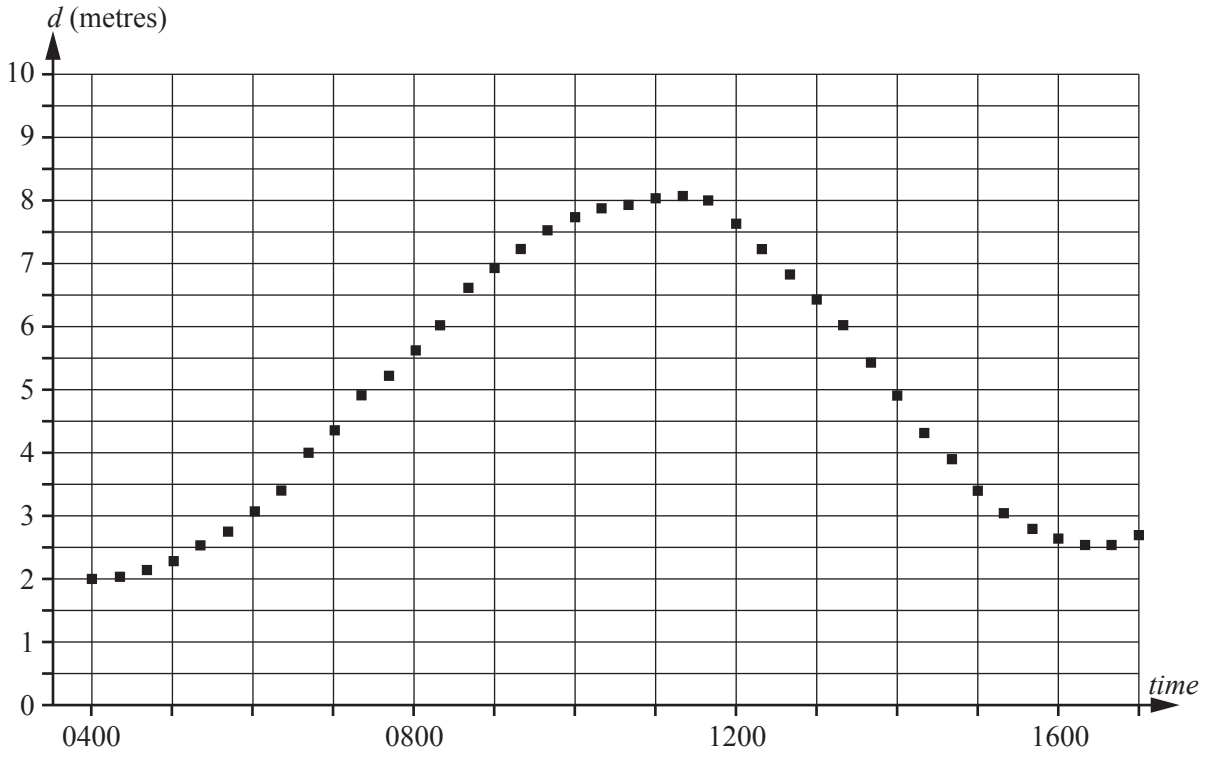


Fig. 5.3

5 (iv)

6 This question is based on the article 'Hearing sounds' in the pre-release material.

(i) Find the frequency of the note G in the octave below middle G. **[1]**

(ii) A note has frequency 3520 hertz. Which note is it and in what octave is it? **[2]**

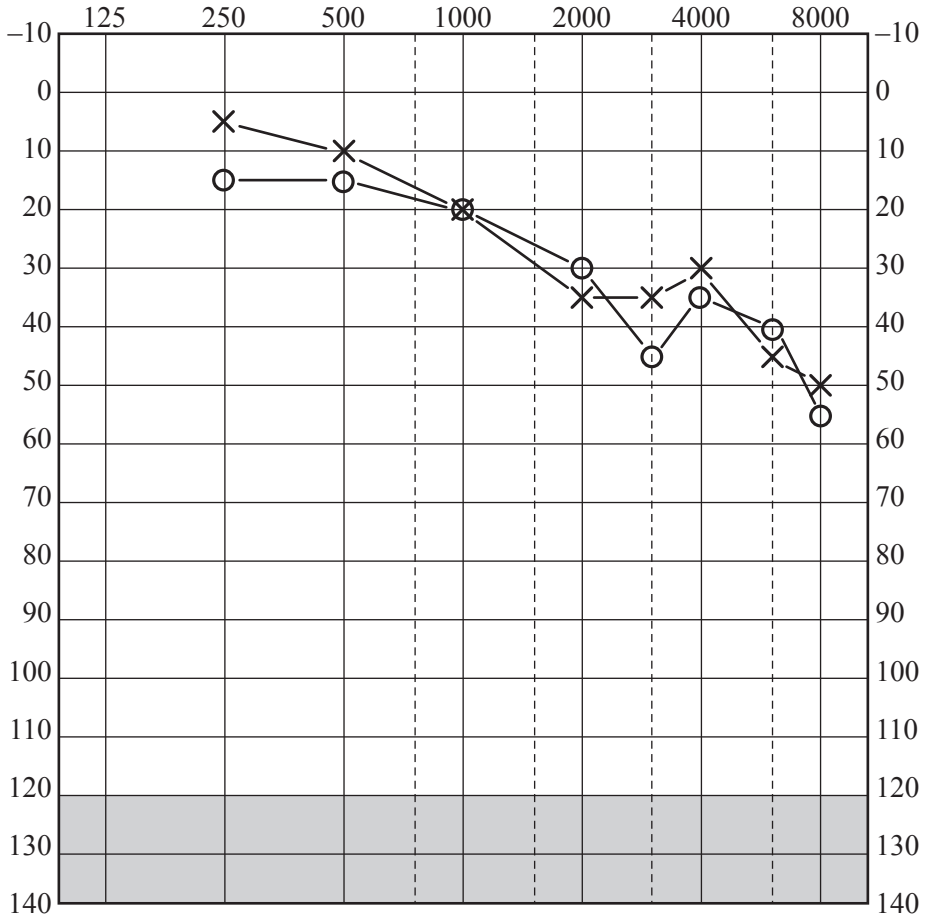
6 (i)	
6 (ii)	

(iii) When a factory whistle is on standby its loudness is 18 decibels.
When it is blown it becomes 1 000 000 000 times louder.
How many decibels is the whistle when it is blown? **[2]**

6 (iii)	

This graph shows one of the ways that the outcome of a hearing test is recorded by the National Health Service. It shows the quietest sounds that a particular patient can hear at a number of different frequencies.

- The horizontal axis gives the frequency in hertz.
- The vertical axis gives the loudness of the sound in decibels with positive downwards.
- The crosses are for the left ear.
- The circles are for the right ear.



(iv) Say whether the patient could hear the note of middle C with loudness 12 decibels. Explain your answer. **[3]**

(v) Find the greatest difference in the loudness recorded for the two ears, giving your answer

(*A*) in decibels,

(*B*) as the multiple by which the louder note exceeds the softer. **[3]**

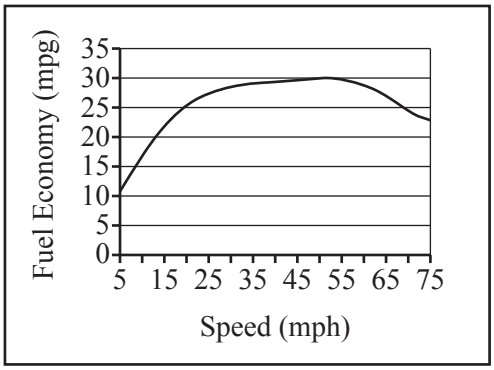
(vi) Without doing any further calculations state two conclusions you can draw from the graph. **[2]**

6 (iv)	
6 (v)	**(*A*)**
	(*B*)
6 (vi)	

7 This question is based on pre-release material.

(i) The article 'Fuel efficiency' contains this graph. It was written in the United States and so the gallons to which it refers are US gallons.

The conversion rate is that 1 UK gallon is equivalent to 1.2 US gallons.



Estimate the fuel economy in miles per UK gallon when the car in question is being driven at its most economical speed. **[2]**

7 (i)

The Emerald is a new car. Its manufacturers claim that its fuel economy, c mpg, at speed v mph is given by the equation

$$c = 50 - 0.02(v - 55)^2.$$

(ii) Complete the table below. **[3]**

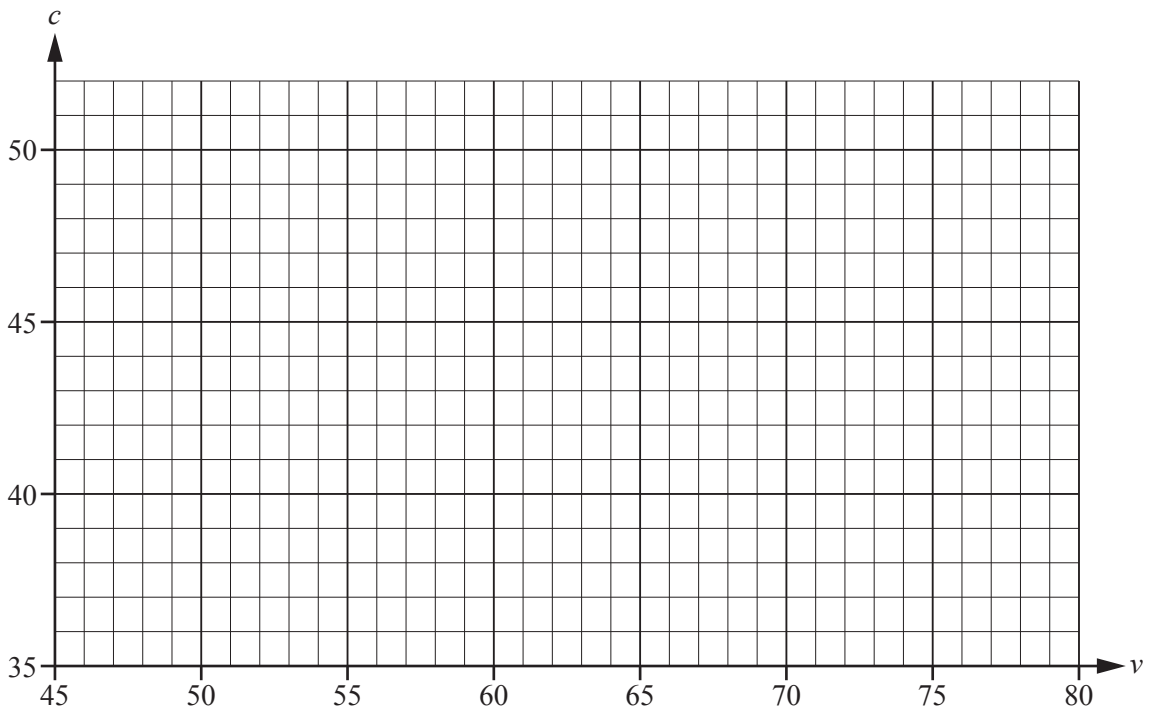
(iii) Draw the graph of c against v on the axes provided. **[1]**

(iv) State one similarity and one difference between your graph and the one (from the article) at the top of the page. **[2]**

7 (ii)

v	45	50	55	60	65	70	75	80
c			50	49.5				37.5

7 (iii)



7 (iv) **Similarity**

Difference

(v) The article in the pre-release material says that the average car is 28% less efficient at 80 mph.

Find the equivalent figure for the Emerald. **[3]**

7 (v)

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).