Oxford Cambridge and RSA

Wednesday 8 June 2016 – 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

5958593971

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 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 three of the questions.
- The total number of marks for this paper is **72**.
- This Question Paper consists of **24** pages. Any blank pages are indicated.

1 Salim lives in the UK. One weekend he travels to Rome to watch a rugby match.
Salim goes to a money changer before he leaves the UK. The money changer's exchange rates for euros are shown below.

We buy at 1.25 We sell at 1.15

Salim changes £150 into euros. He spends €81.25 while he is in Rome.

He brings the remaining euros back to the UK in €10 and €5 notes and some coins. The total value of the coins is less than €5.

He goes to the same money changer and changes the euro notes (but not the coins) back into UK money. The exchange rates are still the same as before.

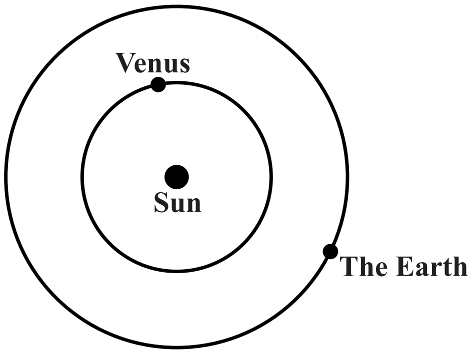
How much UK money does Salim receive? **[3]**

1	

2 The diagram illustrates the orbits of the Earth and Venus round the Sun. They are both approximately circular.

The radius of the orbit for the Earth is 150 million kilometres, and for Venus it is 1.1×10^{11} metres.

The orbits are in the same plane. The two planets take different times to complete one orbit of the Sun.



Find the distance in kilometres of Venus from the Earth when the planets are

(*A*) furthest apart,

(*B*) closest.

Give your answers in standard form, correct to 1 significant figure. **[4]**

2 (*A*)	
2 (*B*)	

3 This question is based on pre-release material.

Table 3.1 shows the changes in average speed on some of Cambridge's commuter routes from 2008 to 2014. This table was included in the pre-release material.

CHANGE IN AVERAGE SPEED FROM 2008–2014

Route	Dec 2008 avg speed	Dec 2014 avg speed	Change in speed	Route	Dec 2008 avg speed	Dec 2014 avg speed	Change in speed
A10 northbound	38.2	39.3	1.1	A1303 eastbound	23	18.9	–4.1
A10 southbound	34.9	33.4	–1.5	A1303 westbound	23.8	22.4	–1.4
A1096 northbound	31.8	29.7	–2.1	A1304 northbound	48.7	47.2	–1.5
A1096 southbound	25.8	23.4	–2.4	A1304 southbound	48.1	46.9	–1.2
A1123 eastbound	33.6	31.8	–1.8	A1307 eastbound	29.5	28.8	–0.7
A1123 westbound	31.7	32.4	0.7	A1307 westbound	30.7	28.9	–1.8
A1134 (Cambridge ring road) northbound	18.8	17.4	–1.4	A1309 northbound	12	14.6	2.6
				A1309 southbound	16.8	16.2	–0.6
A1134 (Cambridge ring road) southbound	13.1	14.3	1.2	A142 eastbound	39.4	37.9	–1.5
				A142 westbound	40.9	39.6	–1.3
A1198 northbound	43.2	42.6	–0.6	A505 eastbound	38.9	36.8	–2.1
A1198 southbound	37.3	33.3	–4	A505 westbound	42.7	38.1	–4.6
A1301 northbound	28	19.3	–8.7	A603 eastbound	25.1	20.8	–4.3
A1301 southbound	35.5	28.5	–7	A603 westbound	23.7	26.7	3

All speeds are in miles per hour

Table 3.1

(i) What percentage of the routes listed in the table show a decrease in average speed? **[2]**

3 (i)	

(ii) Which route had the greater percentage increase in average speed, the A1309 northbound or the A603 westbound? **[2]**

3 (ii)	

People driving to work in a different town use one of three routes, A, B or C. Table 3.2 gives the estimated number of cars using these routes on a typical morning and the average journey speeds for 2008 and 2014 in miles per hour.

(iii) Calculate the percentage change in the average speed for each of routes A, B and C from 2008 to 2014. Write your answers in the right-hand column of Table 3.2.

Use the weighted mean of these changes to estimate the overall percentage increase or decrease in the average speed of the cars bringing people in to work. **[4]**

3 (iii)

Route	Cars	Average speed (2008)	Average speed (2014)	Percentage change
A	5000	32.0	28.0	
B	3000	25.2	25.2	
C	2000	24.0	30.0	

Table 3.2

4 This question is based on pre-release material.

Sally is investigating climate change. She has been given these dates for when snowdrops were first seen to flower in the previous 3 years.

2013	February 4th
2014	January 26th
2015	January 24th

Sally says, 'This is clear evidence of global warming.'

(i) Give two different criticisms of Sally's statement. **[2]**

4 (i)	**First criticism**
	Second criticism

Sally finds a website giving the dates, over many years, when snowdrops were first seen to flower. She draws Figs 4.1 and 4.2 to illustrate the data for the last 60 years. In each case ‘Day’ is counted from the start of the year. Day 1 is January 1st and Day 32 is February 1st.

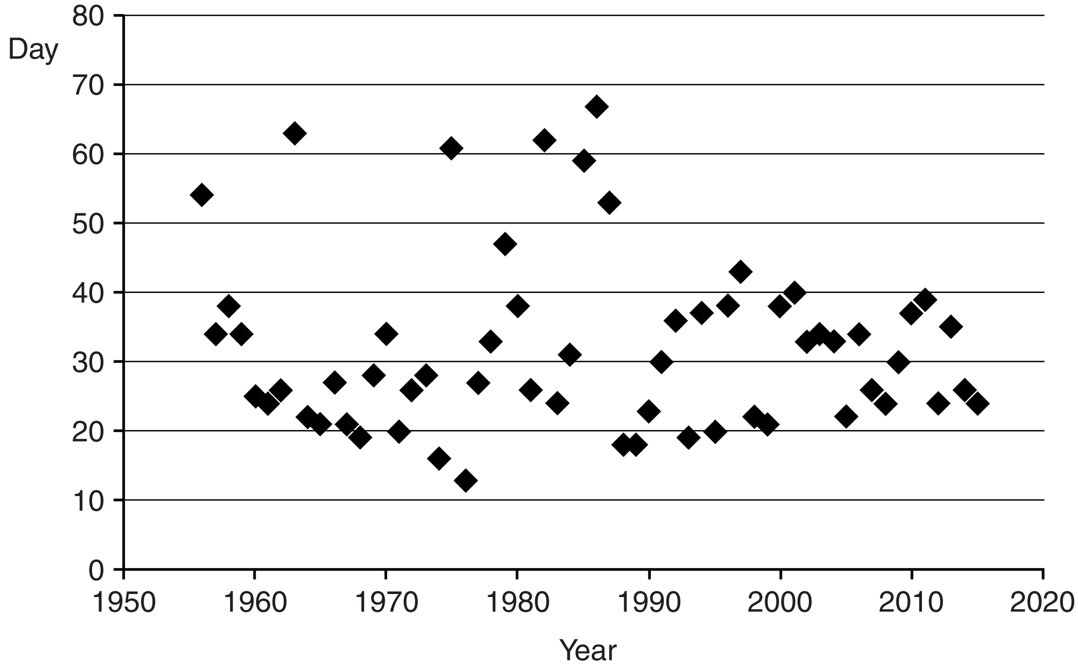


Fig. 4.1

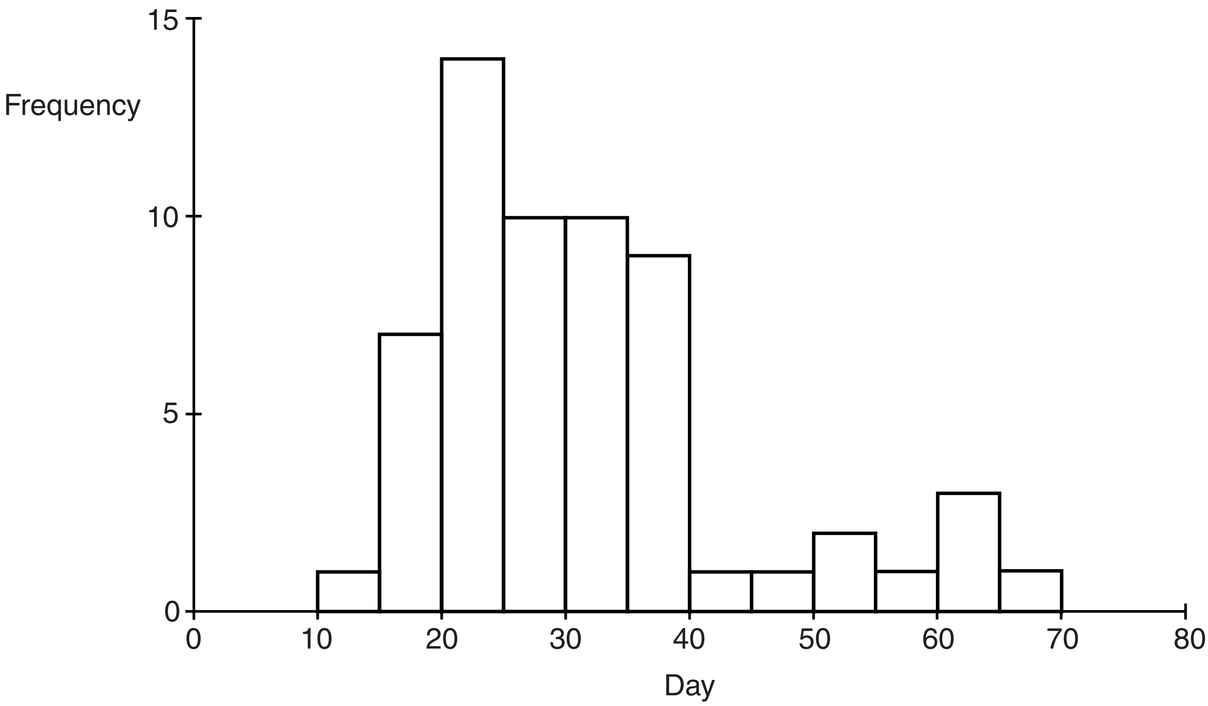


Fig. 4.2

(ii) What is the independent variable and what is the dependent variable in Fig. 4.1? **[1]**

4 (ii)	

(iii) Use the information in Figs 4.1 and 4.2 to say whether the following statements are true or false. In each case give a reason.

[An answer **without** a reason will be given no marks.]

(*A*) The distribution of the dates when snowdrops were first seen to flower is approximately Normal. **[1]**

(*B*) The latest date when snowdrops were first seen to flower was March 12th. **[2]**

(*C*) In recent years, there has been an increase in the variability in the date when snowdrops were first seen to flower. **[1]**

4 (iii)(*A*)	
4 (iii)(*B*)	
4 (iii)(*C*)	

5 Dawn wants to go on a holiday costing £600.

She does not have the money and so she visits a moneylender at the end of her road.

He tells her, 'You can borrow the money and pay it back in 16 monthly instalments of £75 each.'

(i) How much would Dawn pay the moneylender in total?

What percentage of this would be interest? **[2]**

5 (i)	

(ii) What is the equivalent rate of simple interest per annum? **[2]**

5 (ii)	

The moneylender tells Dawn that each month he charges interest of 10% of her debt at the start of that month.

He also says, 'There will be a small over-payment at the end of the last month. That is my administration fee and I keep it.'

Dawn enters this information into the spreadsheet in Table 5.1.

	A	B	C	D	E
1	Month	Debt	Interest	Payment	Balance
2	0	£ 600.00	£ 60.00	£ 75.00	£ 585.00
3	1	£ 585.00	£ 58.50	£ 75.00	£ 568.50
4	2	£ 568.50	£ 56.85	£ 75.00	£ 550.35
5	3	£ 550.35	£ 55.04	£ 75.00	£ 530.39
6	4	£ 530.39	£ 53.04	£ 75.00	£ 508.42
7	5	£ 508.42	£ 50.84	£ 75.00	£ 484.27
8	6	£ 484.27	£ 48.43	£ 75.00	£ 457.69
9	7	£ 457.69	£ 45.77	£ 75.00	£ 428.46
10	8	£ 428.46	£ 42.85	£ 75.00	£ 396.31
11	9	£ 396.31	£ 39.63	£ 75.00	£ 360.94
12	10	£ 360.94	£ 36.09	£ 75.00	£ 322.03
13	11	£ 322.03	£ 32.20	£ 75.00	£ 279.24
14	12	£ 279.24	£ 27.92	£ 75.00	£ 232.16
15	13	£ 232.16	£ 23.22	£ 75.00	£ 180.38
16	14	£ 180.38	£ 18.04	£ 75.00	£ 123.41
17	15	£ 123.41	£ 12.34	£ 75.00	£ 60.75
18	16	£ 60.75	£ 6.08	£ 75.00	–£ 8.17

Table 5.1

(iii) Write down the spreadsheet formulae used for the following cells **(*A*)** C2 **(*B*)** E2 **(*C*)** B12. **[3]**

5(iii)(*A*)	
5(iii)(*B*)	
5(iii)(*C*)	

(iv) Dawn's mother tells her, 'You shouldn't take out this loan. Think what would happen if you were ill and missed some payments.' The spreadsheet in Table 5.2 models the situation that would arise if Dawn did not make any repayments for 3 months.

Complete the blank cells in rows 5, 6 and 7 of this spreadsheet. **[3]**

5 (iv)

	A	B	C	D	E
1	Month	Debt	Interest	Payment	Balance
2	0	£ 600.00	£ 60.00	£ 75.00	£ 585.00
3	1	£ 585.00	£ 58.50	£ 0.00	£ 643.50
4	2	£ 643.50	£ 64.35	£ 0.00	£ 707.85
5	3	£ 707.85	£	£ 0.00	£
6	4	£	£	£ 75.00	£
7	5	£	£	£ 75.00	£ 784.65
8	6	£ 784.65	£ 78.46	£ 75.00	£ 788.11
...	...	...	...	...	...

Table 5.2

(v) In the model in Table 5.2, Dawn continues to pay £75 per month after month 6.

(*A*) When will Dawn repay the loan?

(*B*) Comment on her mother's advice. **[2]**

5(v)(*A*)

5(v)(*B*)

6 In a certain country a particular parasite is common.

Many primary school children are infected and some of them suffer permanent disability as a result.

A new inoculation against the parasite is being tested.

500 primary school children are given the inoculation and a control group of 500 are not given it.

Table 6.1 shows the results but with some entries left out.

(i) Fill in the missing figures in Table 6.1. **[3]**

6 (i)

	Treatment group	**Control group**	
	Inoculated	**Not inoculated**	**Total**
Get parasite	40	320	
Do not get parasite	460		
Total	500	500	1000

Table 6.1

(ii) Use the figures in Table 6.1 to estimate the probability that a primary school child gets the parasite when

(*A*) the child has been inoculated (*B*) the child has not been inoculated. **[2]**

6 (ii)(*A*)

6 (ii)(*B*)

Both groups are monitored for disability as a result of the parasite.

The results for those who were inoculated are shown in Table 6.2.

Treatment group	Disability	No disability	Total
Got parasite	4	36	40
Did not get parasite	0	460	460
Total	4	496	500

Table 6.2

Of the 500 primary school children in the control group, 320 got the parasite and 16 of these suffered disability.

(iii) Complete Table 6.3 for the control group. **[2]**

6 (iii)

Control group	Disability	No disability	Total
Got parasite			
Did not get parasite	0		
Total			500

Table 6.3

(iv) Two local newspapers carried these headlines when the figures were published.

New treatment reduces risk of disability by 75%	**New treatment increases risk of disability by 100%**
(*A*)	**(*B*)**

Explain how these headlines were obtained from Tables 6.2 and 6.3. **[4]**

6 (iv)(*A*)	
6 (iv)(*B*)	

7 Tom was born in the year 2000. He is interested in his family tree.

Tom says, 'I have 2 parents, 4 grandparents and 8 great-grandparents. Every generation I go back the number doubles.'

This question involves modelling the numbers of ancestors Tom had in different previous generations.

The modelling requires some notation and some initial assumptions.

Notation	**Initial assumptions**
Generation 0: Tom Generation 1: Tom's parents Generation 2: Tom's grandparents … and so on.	The time from one generation to the next is 30 years. All Tom's ancestors in any generation were different people.

Table 7.1

(i) Show that Tom had just over 1000 ancestors in Generation 10. **[2]**

7 (i)	

For the rest of this question assume that the number of ancestors in Generation 10 is exactly 1000. Assume also that throughout history every person had 1000 ancestors ten generations earlier.

(ii) Use this model to estimate how many ancestors Tom had in the generation corresponding to the following years: **(*A*)** 1700 **(*B*)** 1400 **(*C*)** 1100. **[3]**

7 (ii)(*A*)	
7 (ii)(*B*)	
7 (ii)(*C*)	

(iii) **(*A*)** Draw a rough sketch graph on Fig. 7.2, showing the numbers of Tom's ancestors in the generations corresponding to the years from 1100 onwards.

(*B*) Now draw a graph illustrating the same data on Fig. 7.3, using the logarithmic scale shown on the vertical axis. **[3]**

7 (iii)(*A*)

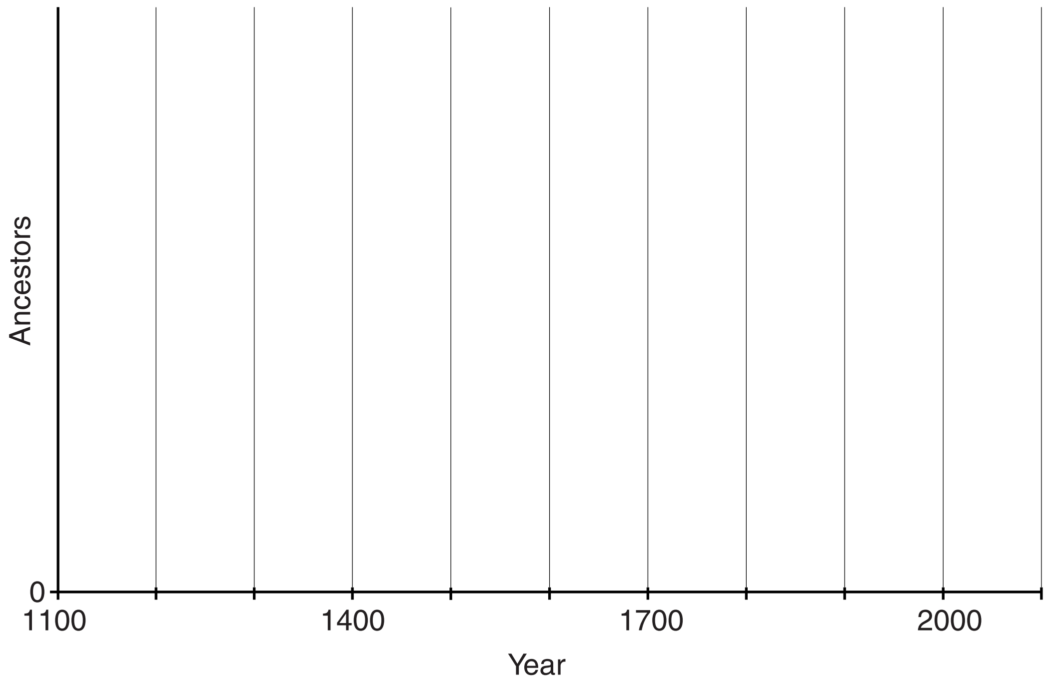


Fig. 7.2

7 (iii)(*B*)

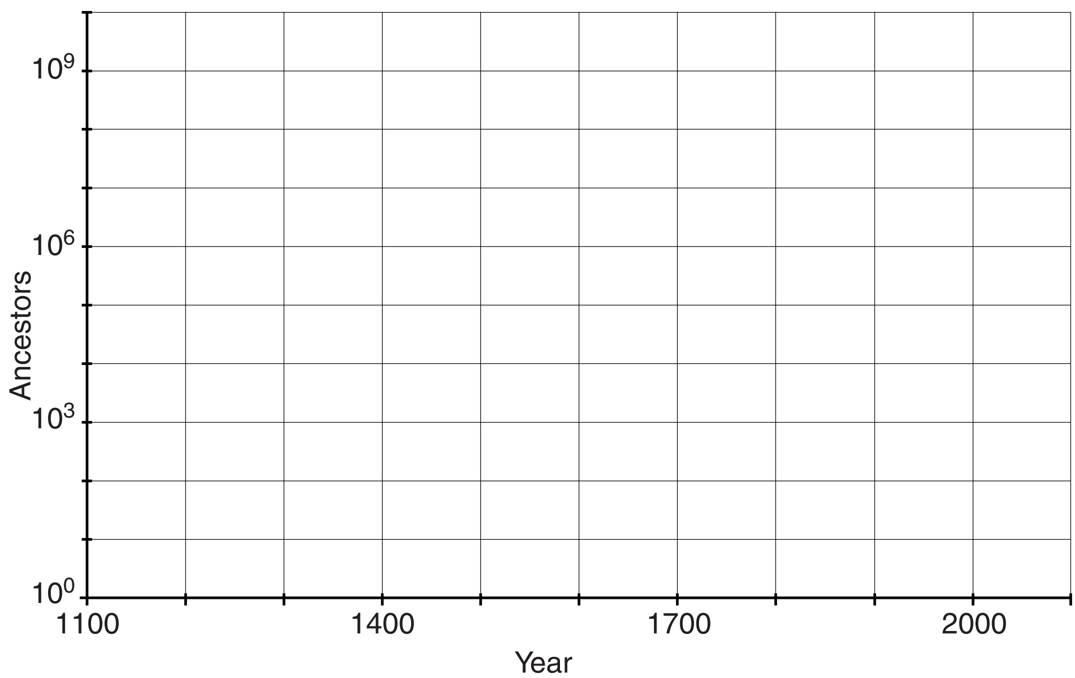


Fig. 7.3

(iv) State one advantage of using the logarithmic scale in part **(iii)**(***B***). **[1]**

7 (iv)	

(v) There are several estimates for the early world population. One of these is given in Table 7.4.

Year (AD)	200	500	800	1100	1400	1700
World population (millions)	190	190	220	320	350	610

Table 7.4

Complete Table 7.5 showing the number of Tom's ancestors, in millions, according to his model for some of these years.

Explain why the figures in Tables 7.4 and 7.5 show that Tom's model cannot be right.

Comment briefly on whether a possible change to one of Tom's modelling assumptions would overcome the problem. **[4]**

7 (v)

Year (AD)	800	1100	1400	1700
Tom's ancestors (millions)				0.001

Table 7.5

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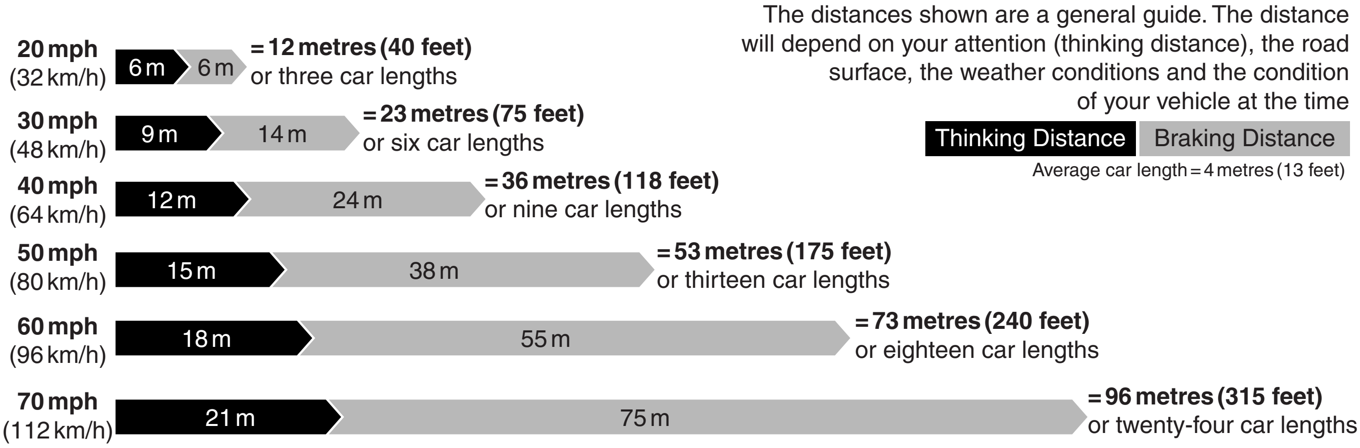
8 This question is based on pre-release material.

This diagram is reproduced from the Highway Code. It shows typical stopping distances for cars travelling at different speeds. The underlying model is that the stopping distance has two parts, the thinking distance and the braking distance.

Typical Stopping Distances



(i) Show that a speed of 48 km/h is the same as $13\frac{1}{3}$ metres per second. **[2]**

8 (i)

A driver takes a certain time to react to a danger before applying the brakes. This is called the ‘thinking time’ in this question. The distance travelled in the thinking time is the ‘thinking distance’.

(ii) Use the thinking distance for a speed of 48 km/h to show that the thinking time is 0.675 seconds.

Show that the same thinking time was used to calculate the thinking distance for a speed of 112 km/h. **[3]**

8 (ii)

The model can be written as $d + b = s$

where s is the stopping distance in metres

d is the thinking distance in metres

and b is the braking distance in metres.

The speed of the car in metres per second is denoted by v. Some values of these variables are given in the table below.

(iii) Fill in the missing values in the table. Give the missing value of v to 4 significant figures. **[2]**

8 (iii)

Speed in km/h	v **(m s^{-1})**	d **(m)**	b **(m)**	s **(m)**
32	8.89	6	6	12
48	13.33			
64	17.78	12	24	36
80	22.22	15	38	53
96		18	55	73
112	31.11	21	75	96

(iv) Write down a formula giving d in terms of v. **[1]**

8 (iv)

(v) The formula giving b in terms of v is $b = kv^2$ where k is a number.

Find the value of k using the figures for a speed of 48 km/h. **[2]**

8 (v)	

(vi) Use this model, with the value of k you obtained in part **(v)**, to estimate the stopping distance in metres for a speed of 100 mph (miles per hour). Give your answer to the nearest whole number. **[4]**

8 (vi)	

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).