OCR
Oxford Cambridge and RSA

Wednesday 22 May 2019 – Morning

Level 3 Certificate
Quantitative Reasoning (MEI)

H866/02 Critical Maths

Time allowed: 2 hours

You must have:
• the Insert (inserted)

You may use:
• a scientific or graphical calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
• The Insert will be found inside this document.
• Use black ink. You may use an HB pencil for graphs and diagrams.
• Answer **all** the questions.
• Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
• 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.

INFORMATION
• The total mark for this paper is **60**.
• The marks for each question are shown in brackets **[ ]**.
• This document consists of **20** pages.
• Final answers should be given to a degree of accuracy appropriate to the context.

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Turn over

Answer **all** the questions.

1 **This question refers to the article "Share Indexes". This was given out as pre-release material and is available as an insert.**

A computer programmer conducts an experiment. He has 16 000 email addresses of people he does not know. The email addresses have been collected independently so the people are unlikely to know each other.

One Sunday, he sends half of the 16 000 people version 1 of the email below. The other half get version 2 at the same time.

I have a system for predicting share prices. At 9 am tomorrow the FTSE 100 share index will be increasing.	I have a system for predicting share prices. At 9 am tomorrow the FTSE 100 share index will be decreasing.
Version 1	**Version 2**

Throughout this question, you may assume that the FTSE 100 share index is always either decreasing or increasing. It is never constant.

(i) How many people receive an email on Sunday which correctly predicts the direction of change in the FTSE 100 share index on Monday? **[1]**

(ii) On each of Monday, Tuesday, Wednesday and Thursday evenings, the programmer divides the people who got a correct prediction the day before into two equal groups.
He sends one group version 1 of the email and the other group get version 2.
Those who got an incorrect prediction the day before get no further emails.

How many people get an email with a correct prediction of the change in Friday's FTSE 100 share index? **[3]**

1(i)	

1(ii)	

**(iii)** On Friday, the programmer sends those who have had five correct predictions an invitation to sign up for investment information at a cost.
28 women and 17 men respond.

   (*A*) What percentage of those who received invitations respond? **[2]**

   (*B*) Explain whether the data tell you that women are definitely more likely than men to respond to such invitations. **[1]**

1(iii)(*A*)

1(iii)(*B*)

2 The graph below shows the annual percentage population growth rate in Zimbabwe from 1960 to 2016.

Zimbabwe population growth (annual %)
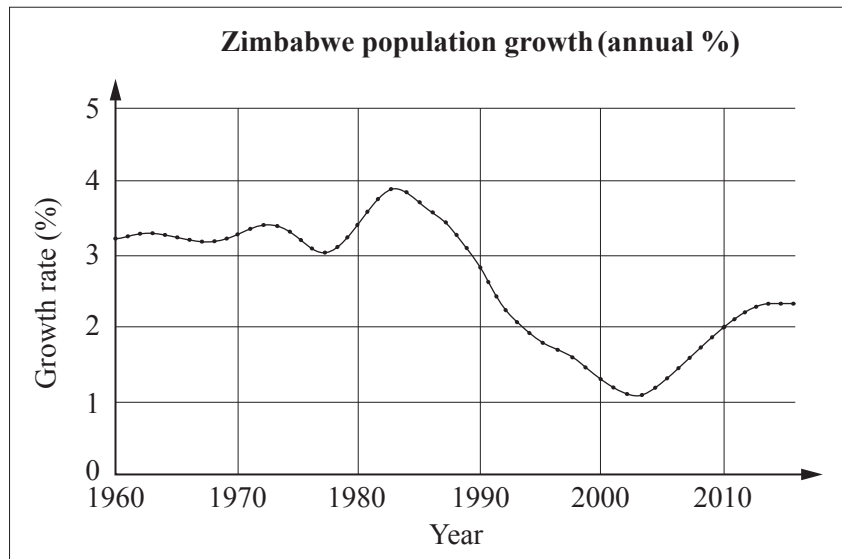
(i) A newspaper claims that the graph shows that the population of Zimbabwe decreased in the 1990s before rising again.
Does the graph show this? Justify your answer. **[2]**

(ii) (*A*) Use the graph to estimate the average population growth rate between 1960 and 2016. **[2]**

(*B*) The population of Zimbabwe in 1960 was 3.75 million.
Use your answer to (*A*) to calculate an estimate of the population in 2016. **[3]**

(iii) The actual population of Zimbabwe in 2016 was 16.15 million.
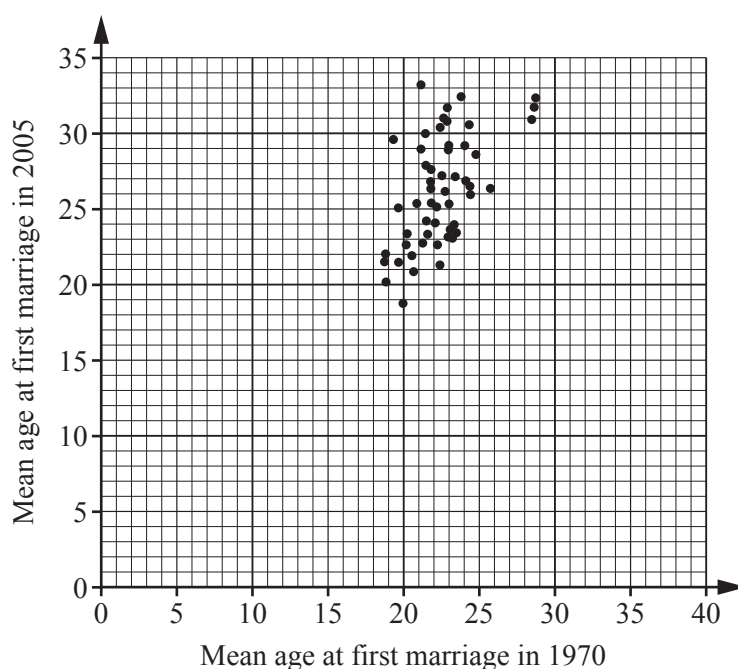What does this tell you about your answer to **(ii)**(*A*)? **[1]**

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

2(ii)(*B*)	
2(iii)	

3 The scatter diagram below shows the mean age at first marriage for women who were married in the years 1970 and 2005.

Each dot in the scatter diagram represents a different country.

The data are not available for other countries for both years.

Mean age at first marriage in 1970

(i) Circle the point which represents the country with the highest mean age of first marriage in 2005. **[1]**

(ii) Write T in the box for the statements which must be true and F for the statements which could possibly be false. **[2]**

3(ii)		
		There is positive correlation in the scatter diagram.
		The three points close together at the top right of the diagram must be due to an error in plotting.
		The graph shows that females below age 18 do not marry in any of the countries shown.
		For the countries shown in the graph, mean age at first marriage in 2005 is generally higher than in 1970.

(iii) The scatter diagram below shows 2005 data plotted against female life expectancy.
A spreadsheet has been used to draw the line of best fit.
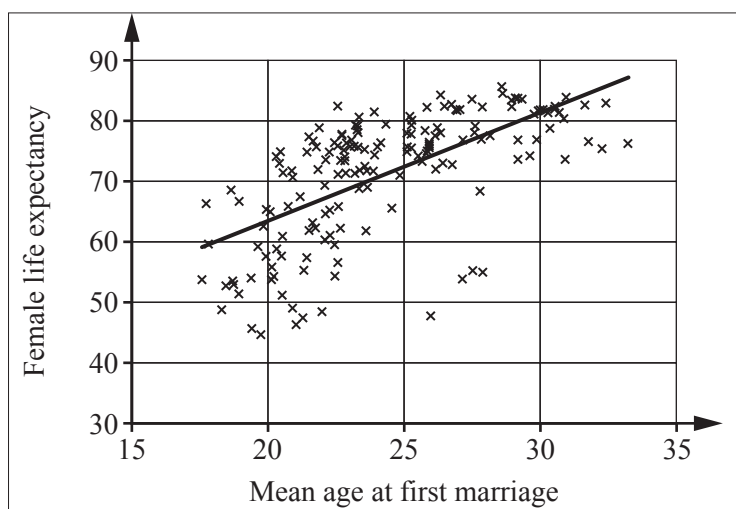
(*A*) Sam says 'The graph shows that getting married later makes you live longer'.
Is Sam correct? Justify your answer. **[1]**

(*B*) The mean age at first marriage in a country, not included on the diagram, was 27.8 in 2005.
Sam uses the line of best fit to estimate the female life expectancy in that country in 2005.
Will this give a good estimate of the female life expectancy? Justify your answer. **[1]**

3(iii)(*A*)	
3(iii)(*B*)	

4   A developer is planning a new tourist attraction.
     The initial plan has a rectangular area measuring 40 metres by 30 metres set aside for the car park.

     Estimate the number of cars which could be parked in the car park. Show all your reasoning.   **[6]**

5 A journalist writes the headline below.

<div style="border:1px solid black; display:inline-block; padding:5px;">

No public toilets by 2050

</div>

The journalist used the following data about the number of public toilets in England and Wales.

Year	Number of toilets
2000	6087
2008	5084

Show that the headline is consistent with a constant rate of change in the number of toilets. **[3]**

5	

6   The chart below shows the percentages of people who smoke and who have quit smoking in different age groups in Great Britain in 2014.

Proportion who smoke and proportion who have quit smoking, Great Britain, 2014

Source: Adult smoking habits in Great Britain 2014
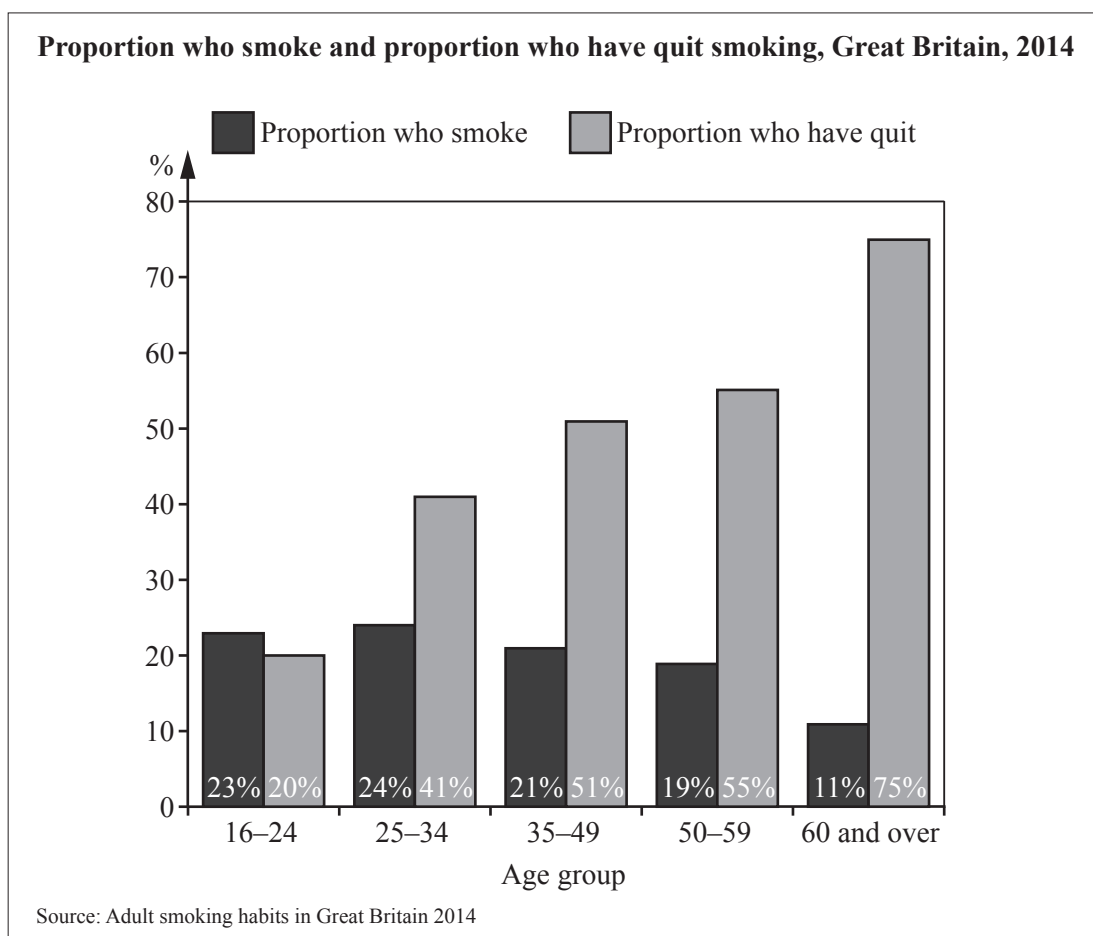
Use the chart to answer the following questions about Great Britain in 2014.

(i)   For the age group 60 and over:

   (*A*) Write down the percentage point difference between the proportion who smoke and the proportion who have quit smoking.   **[1]**

   (*B*) For each person who smokes, roughly how many people have quit smoking?   **[2]**

(ii) (*A*) Which age group has the highest percentage of people who have **never** smoked?
          Explain how you know.   **[2]**

   (*B*) For that age group, what percentage of people have never smoked?   **[2]**

6(i)(*A*)	

6(i) *(B)*	

6(ii) *(A)*	

6(ii) *(B)*	

(iii) In order to answer this question you will need to make an assumption, which you should state, about the population.

21% of people aged 35 to 49 smoke; 24% of people aged 25 to 34 smoke.

Show that there are more smokers aged 35 to 49 than smokers aged 25 to 34. **[3]**

6(iii)	

7 A football team asks its fans to name their new mascot.
   80 people vote by putting four names in order of preference from 1 as the highest to 4 as the lowest.
   The numbers of people voting for each option are shown in the table below.

Name	Order of preference (1 highest to 4 lowest)			
	1	**2**	**3**	**4**
Endeavour	10	26	19	25
Victor	35	2	8	35
Lucky	28	12	37	
Warrior	7	40	16	17

(i) The number is missing from the shaded cell. What should it be? **[2]**

7(i)	

(ii) Someone suggests that the winning name should be Victor because that had the greatest number of highest preferences.
   Give a reason why the votes suggest that Victor should **not** be the winning name. **[1]**

(iii) Describe a **different** possible rule for finding the winning name.
   Use your rule to find the winning name. **[4]**

7(ii)	

7(iii)	

(answer space continued on next page)

7(iii)	(continued)

Turn over

8 A researcher carries out a trial to investigate whether a new medication is effective at preventing a particular illness.
Those taking part are allocated to one of two groups: those who get the medication or a control group.

(i) Megan is taking part in the trial. She does not know which group she is in, nor do those conducting the trial.

(*A*) Explain briefly why it is important for the trial to be set up in this way. **[1]**

(*B*) Which one of the following terms gives the fullest description of the trial?

   Blind,   Random,   Placebo,   Experiment,   Double blind. **[1]**

8(i)(*A*)	

8(i)(*B*)	

(ii) 500 people take part in the trial; they are randomly allocated either to the group taking medication or the control group, such that there are 250 in each group.

The makers of the medication claim that the probability of someone who does not take the medication catching the illness is 0.1 and the probability of someone who takes the medication catching the illness is 0.04.

(*A*) Assuming that the makers' claims about probability are correct, fill in the missing numbers in the table on page 15. **[3]**

(*B*) Calculate the probability that someone who catches the illness was taking the medication. **[2]**

8(ii)(*A*)	
	(answer space continued on next page)

8(ii)(*A*)	(continued)

	Expected numbers taking medication	**Expected numbers not taking medication**	**Total**
Catch illness			
Do not catch illness			465
Total	250	250	500

8(ii)(*B*)	

Turn over

9 50% of smartphone users will experience a cracked screen.
A local mobile phone shop displays this advert.

> **Smartphone protection plan**
>
> Make an additional one-off payment of £40 when you get your phone and we'll replace a cracked screen at any time

The manager of the shop thinks he will sell the protection plan to 400 smartphone users.
A Normal distribution can be used to model the number of people with the protection plan who get a cracked smartphone screen.

Assuming that each person has a 50-50 chance of getting a cracked smartphone screen and 400 users buy the protection plan, work out the following.

(i) The mean of the Normal distribution. **[1]**

(ii) The standard deviation of the Normal distribution. **[2]**

9(i)	

9(ii)	

(iii) It will cost the shop, on average, £70 to replace a cracked smartphone screen.
Work out whether the shop is certain to make a profit on the smartphone protection plan.
Explain your reasoning. **[4]**

9(iii)	

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).

19

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