OCR
Oxford Cambridge and RSA

Wednesday 14 October 2020 – Afternoon

Level 3 Certificate Core Maths A (MEI)

H868/02 Critical Maths

Time allowed: 2 hours

You must have:
• the Insert (inside this document)

You can 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
• Use black ink. You can use an HB pencil, but only for graphs and diagrams.
• Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
• Answer **all** the questions.
• Where appropriate, your answer should be supported with working.
• Give your final answers to a degree of accuracy that is appropriate to the context.

INFORMATION
• The total mark for this paper is **60**.
• The marks for each question are shown in brackets **[ ]**.
• This document has **20** pages.

ADVICE
• Read each question carefully before you start your answer.

Turn over

Answer **all** the questions.

1. A group of students take a short course with a number of assignments, and a final test.
   The scatter diagram in Fig. 1 shows the percentage of assignments students handed in and their final test marks.
   The line of best fit has been drawn using software.
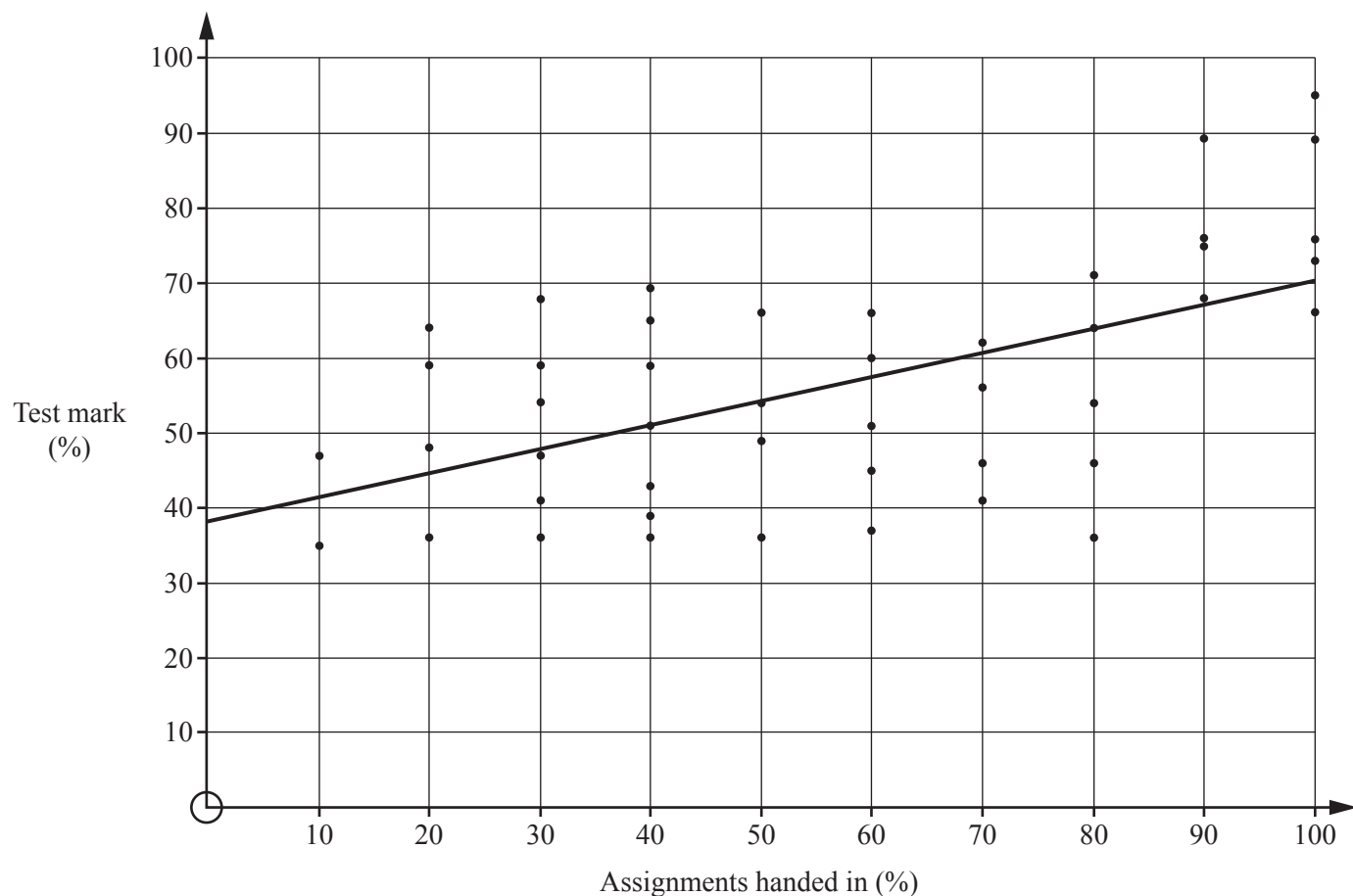
Fig. 1

    (i) What was the highest mark obtained by a student on this test? **[1]**

1(i)	

    (ii) What feature of the scatter diagram shows that all students handed in at least one assignment? **[1]**

    (iii) All the points in the scatter diagram lie on the vertical grid lines. Give a possible explanation for this. **[1]**

1(ii)	

1(iii)	

(iv) Alicia says, "The scatter diagram shows that for any course, handing in more assignments will result in you getting a better score in the final test."
Give one criticism of Alicia's statement. **[1]**

1(iv)	

2   Two shapes will be made from wire. Shape A is shown in Fig. 2.1 and Shape B is shown in Fig. 2.2.

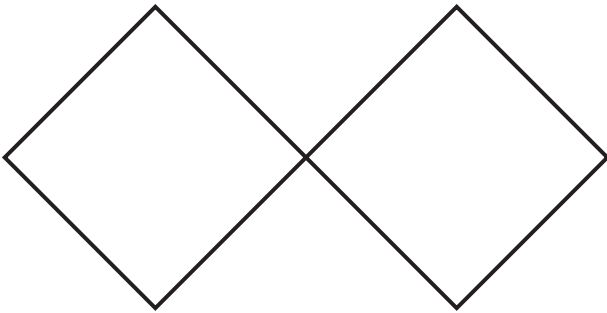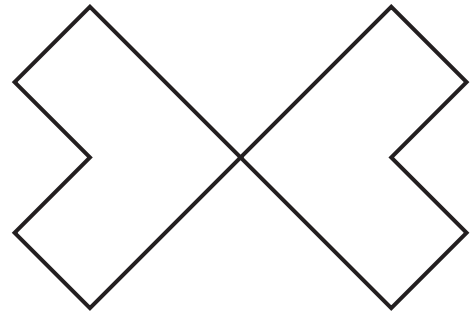Shape A   Shape B

Not to scale

Fig. 2.1   **Fig. 2.2**

Shape A consists of two identical squares. The total area enclosed by Shape A is $18\,\text{cm}^2$.

Shape B consists of two squares the same size as in Shape A but with a quarter of each square removed from one corner.
The edge of each shape will be bent from a single piece of wire.

(i) Calculate the area enclosed by Shape B.   **[3]**

(ii) Calculate the total length of wire needed for Shape A.   **[3]**

(iii) Jack says, "The total length of wire needed for Shape B is the same as for Shape A."

Either show that Jack is right **or** show that Jack is wrong.   **[2]**

2(i)	
2(ii)	
	(answer space continued on next page)

2(ii)	**(continued)**

2(iii)	

3 **This question refers to the article "A: Estimating the weight of a donkey". This was given out as pre-release material and is available as an insert.**

Molly is a donkey with height 100 cm and heart girth 105 cm.

  (i) Use the diagram below to estimate Molly's weight. **[2]**

 (ii) Another way to estimate the weight of a donkey is to use the formula

$$W = \frac{G^{2.65}}{2188}$$

W is the weight in kg and G is the heart girth in cm.

Use the formula to estimate Molly's weight.
Give your answer to a suitable degree of accuracy. **[2]**

3(i)

Heart Girth
(cm)

100   110   120   130   140   150   160

Weight (kg)

100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 260 280 300 320 340 360 380 400

Height (cm)

90   100   110   120   130   140   150

3(ii)

 (iii) The estimate of weight in part **(i)** is accurate to within 10 kg.
What can you conclude about the accuracy of the estimate in part **(ii)**?
Explain your reasoning. **[2]**

3(iii)

The town council in a tourist resort is concerned about the wellbeing of donkeys used to give rides to tourists.
They introduce the following rule.

The maximum load a donkey can carry is either one fifth of its weight or 100 kg, whichever is the lower.

(iv) (A) The world's largest donkey weighs 590 kg. What load would this donkey be allowed to carry? Explain your reasoning. **[2]**

(B) A member of the town council suggests changing the rule to the following.

The maximum load which a donkey can carry is one fifth of its weight.

Give one reason in favour of the proposed change and one reason against it. **[2]**

3(iv)(A)	

3(iv)(B)	**Reason in favour**
	Reason against

4   Resting heart rate, in beats per minute, is sometimes used as a measure of how fit someone is.
A sports scientist wishes to test whether weight training or brisk walking is better at improving fitness.
He asks people to take part in a 6-month randomised controlled trial.
120 people volunteer and they are allocated at random to one of three groups with 40 people in each group.

Group 1: Attend a half hour weight training class three times a week.

Group 2: Take a brisk half hour walk three times a week.

Group 3: Continue with their lifestyle as before with no additional exercise.

Each participant's resting heart rate is measured at the start and end of the 6-month trial.

  (i) Which of the three groups is the control group?   **[1]**

  (ii) Explain why it is important to have a control group.   **[1]**

 (iii) Explain why it is **not** possible to conduct a double-blind trial in this situation.   **[1]**

At the end of 6 months, there are only 12 people left in group 1, 18 in group 2 and 35 in group 3.
The others have dropped out.

 (iv) Suggest one way that the trial could be improved.   **[1]**

4(i)	
4(ii)	
4(iii)	
4(iv)	

5   **(i)** (*A*)   What is the approximate population of the UK?   **[1]**

           (*B*)   Write down an estimate of the average life span of a person living in the UK.   **[1]**

A politician tweeted that 70 children are born in the UK every 5 minutes.

    (ii) Give a clearly reasoned argument which
- **either** shows that 70 children born every 5 minutes, on average, is a reasonable estimate
- **or** shows that it cannot be true.   **[4]**

5(i)(*A*)	
5(i)(*B*)	
5(ii)	

6   The chart below shows the percentages of U.S. households with a landline phone and the percentages of households who have mobile phones only.

Landline Phones Are a Dying Breed

% of U.S. households with and without a working landline telephone*

● Landline phone   ● Mobile phone only

92.7%

52.5%

43.8%

5.0%

100% | 80% | 60% | 40% | 20% | 0

2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 '17

* based on the CDC's biannual National Health Interview Survey of 15,000+ U.S. households

@StatistaCharts   Source: CDC

statista
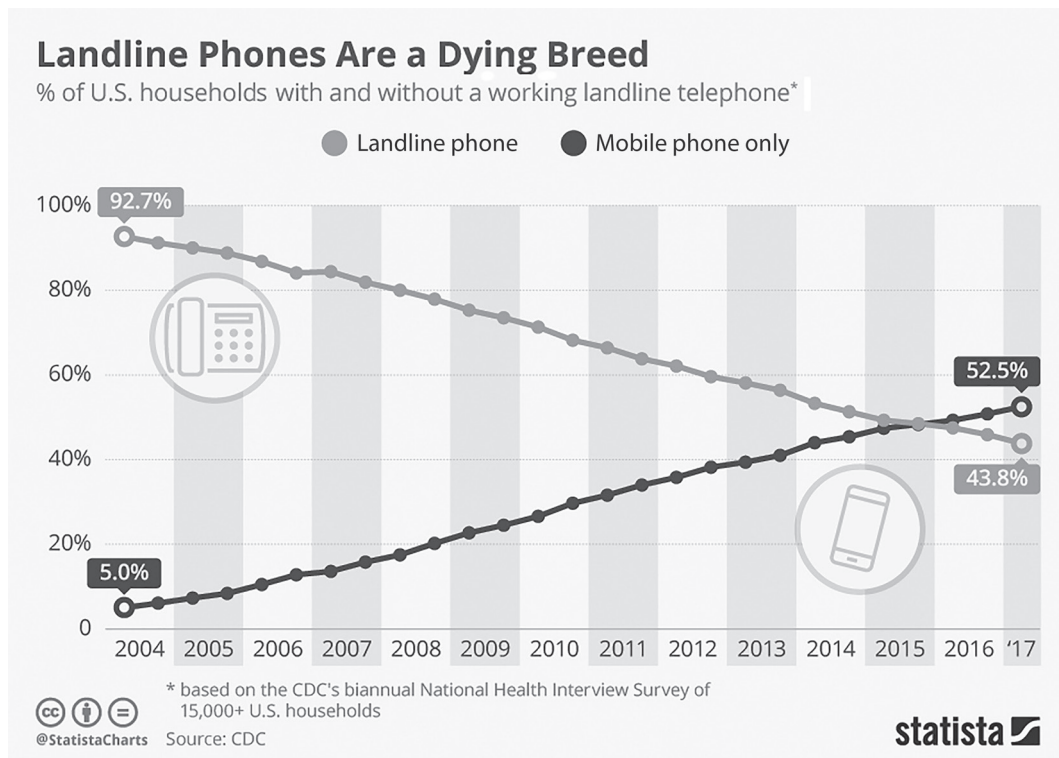
If trends continue, there will eventually be no landline phones in the U.S.
Estimate the year that this will happen.   **[3]**

6	

11

ADDITIONAL ANSWER SPACE

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

7 **This question refers to the article "B: The flu jab". This was given out as pre-release material and is available as an insert.**

Data for a typical year are given below.

- 75% of people aged over 64 were vaccinated against flu.
- 4% of those who had the flu jab still caught flu.
- 10% of those who did not have the flu jab caught flu.

(i) An advert, aimed at over 64s reads as follows.

Having the flu jab reduces your chance of catching flu by 60%.

Show that the figure of 60% is consistent with the data for a typical year. **[2]**

7(i)	

(ii) (*A*) Based on the data for a typical year, complete the tree diagram below to show outcomes for a representative 1000 people. **[3]**

7(ii)(*A*)	

Calculate the following.

(*B*)　The percentage of over 64s who caught flu. **[2]**

(*C*)　The probability that a person aged over 64 who caught flu was vaccinated. **[2]**

7(ii)(*B*)	

7(ii)(*C*)	

(iii) There is some discussion about whether it is worth over 64s having the flu jab.
Use the information in this question to give one argument in favour of their having it and one argument against. **[2]**

7(iii)	**In favour**
	Against

8   The charts in Fig. 8.1 and Fig. 8.2 show the average distance driven in a car or van per year per person for different age groups of males and females in 2017.

Male drivers

Female drivers

Fig. 8.1
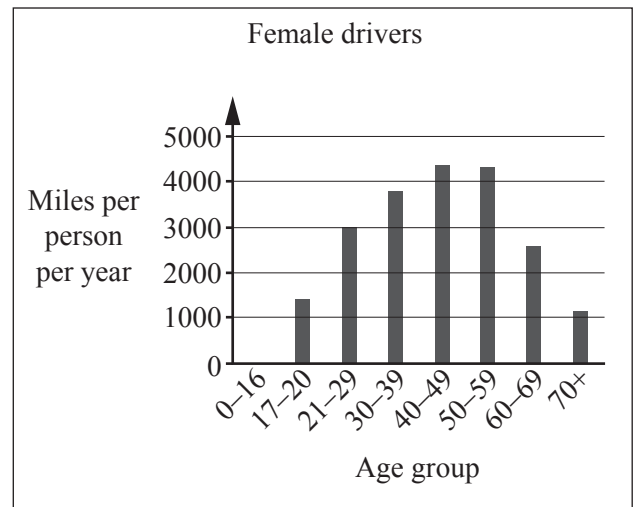
Fig. 8.2

Data: National Travel Survey 2017

(i) Write down the average number of miles driven in a car or van per year for

(A) Males aged 50–59 **[1]**

(B) Females aged 50–59. **[1]**

(ii) Suggest one change to the charts to make it easier to compare the data for males and females. **[1]**

8(i)(A)	
8(i)(B)	
8(ii)	

In 2002, on average, each male in the 50–59 age group drove 8471 miles.
Some males in this age group did not have a licence and did not drive at all, so the average distance for those with a licence was greater than 8471 miles.
Assume that all the driving is done by people with driving licences.

(iii) 89% of males aged 50–59 had driving licences.
By considering a typical 100 male drivers, or otherwise, find the average distance driven per year by males with a driving licence in this age group. **[3]**

In 2002, females aged 50–59 drove 3582 miles each on average.
74% of females aged 50–59 had driving licences.

(iv) Show that on average in 2002, females aged 50–59 with driving licences drove about half the number of miles as males aged 50–59 with driving licences. **[3]**

8(iii)	

8(iv)	

A researcher thinks that there are equal numbers of male and female drivers working at a large business park.

She wants to check whether this is the case, so she takes a random sample of 100 drivers.

(v) Imagine a large number of random samples of size 100 are taken from a population with equal numbers of male and female drivers.

    (*A*) What is the mean number of male drivers per sample? **[1]**

    (*B*) What is the standard deviation of the number of male drivers per sample? **[2]**

8(v)(*A*)	

8(v)(*B*)	

(vi) The random sample taken by the researcher has 59 male drivers.
The researcher's assistant says it would be very unusual if there were equal numbers of male and female drivers in the business park.
Is the assistant correct?
Justify your answer fully. **[2]**

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).

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