Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER			CANDIDATE NUMBER	

STATISTICS **4040/12**

Paper 1 **October/November 2018**

2 hours 15 minutes

Candidates answer on the Question Paper.

Additional Materials:	Pair of compasses
	Protractor
	Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
If working is needed for any question it must be shown below that question.
Essential working must be shown for full marks to be awarded.
Electronic calculators should be used.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

This document consists of **17** printed pages and **3** blank pages.

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[Turn over

1 Six statistical terms associated with the collection of data are

survey,
census,
random,
systematic,
quota,
and stratified.

In each of the following statements one of these terms has been omitted.
Complete each statement by inserting the appropriate term.

(a) If a population is made up of different categories, and a sample is required which will be

representative of the population in terms of these categories, a ....

sample should be selected. [1]

(b) When selecting a sample from a population, in order to ensure that the sampling method is

free from bias, a .... sample should be selected. [1]

(c) Data on every element of a population is collected when a .... is

conducted. [1]

(d) When selecting a sample from a population without the use of a sampling frame,

a .... sample may be selected. [1]

2 In a particular town there are often cuts in the electrical power supply. The following data shows, for a period of 8 weeks, the number of days in each week on which there were power cuts.

<div align="center">2   5   2   0   2   0   7   4</div>

(a) For this period, find the mean number of days per week on which

    (i) there were power cuts,

        ....[2]

    (ii) there were **no** power cuts.

        ....[1]

(b) For this period, find the total number of days on which there were **no** power cuts.

    ....[1]

3 The guest rooms in a hotel are of either standard or superior quality, are either non-smoking or smoking, and have either a city view or a mountain view.
The diagram below shows the number of these rooms which are one or more of standard quality, non-smoking, and city view.
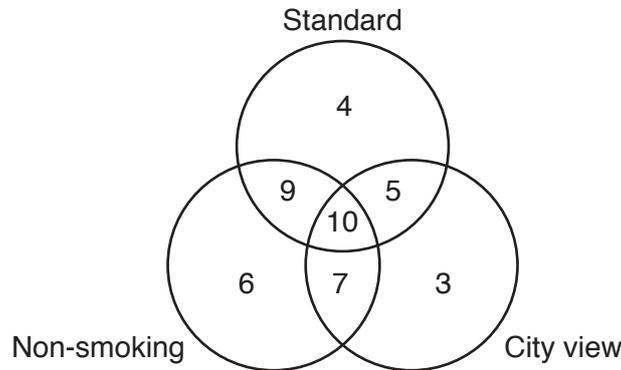
(a) Use this information to find the number of guest rooms which are

   (i) non-smoking,

   ....[1]

   (ii) standard quality and non-smoking,

   ....[1]

   (iii) standard quality, with a mountain view,

   ....[1]

   (iv) superior quality and smoking, with a city view.

   ....[1]

(b) State precisely the extra information which you would need to find the total number of guest rooms in the hotel.

   ....

   ....[1]

4 At a telephone company, statistical measures are calculated for the lengths of an equally large number of telephone calls made by each of two people. The following values, in minutes, are obtained.

Measure	Person A	Person B
Median	3.55	3.45
Lower quartile	1.90	1.83
Upper quartile	5.20	9.76
40th percentile	3.07	2.94

(a) Write down the percentage of calls whose length is

  (i) for Person A,

   (a) less than 5.20 minutes,

   ....[1]

   (b) more than 3.07 minutes,

   ....[1]

  (ii) for Person B,

   (a) between 1.83 minutes and 2.94 minutes,

   ....[1]

   (b) less than 3.45 minutes or more than 9.76 minutes.

   ....[1]

A trainee statistician at the company inspects the measures and makes the following statement to her supervisor.

'Because the median length of a call from Person A is greater than the median length of a call from Person B, the total length of all the calls from Person A must be greater than the total length of all the calls from Person B.'

(b) Explain whether or not you agree with the trainee.

  ....

  ....[1]

5 In a city there are 15 tennis clubs. The following table shows the number of indoor and outdoor courts at each of these clubs.

		Number of outdoor courts				
		2	3	4	6	8
Number of indoor courts	0	1	1	2	1	2
	2	0	0	3	1	0
	3	0	0	0	2	0
	4	0	0	0	1	1

For example, there are 3 clubs with 4 outdoor courts and 2 indoor courts.

(a) Find the number of clubs with

   (i) no indoor courts,

                                           ....[1]

   (ii) at least 4 outdoor courts.

                                           ....[1]

(b) Calculate the total number of outdoor courts at the city's tennis clubs.

                                           ....[2]

(c) Complete the following table to show the frequency distribution of the total number of courts per club.

Total number of courts, x	Number of clubs, f
2	1

[2]

**(d)** A national tennis coach, investigating the facilities available in different cities, requests from each city information on the number of courts at clubs in the city, summarised in one table.

State, giving a reason, whether you would expect the coach to prefer this to be in the form of the first or second table in this question.

....

....[1]

6 The main political parties in a country are the Modern Left, the Reform Party, and the Central Union. In an opinion poll before an election, 1800 voters were questioned on which party they supported. Results are shown in the following pie chart, of radius 4 cm, which is drawn to scale.
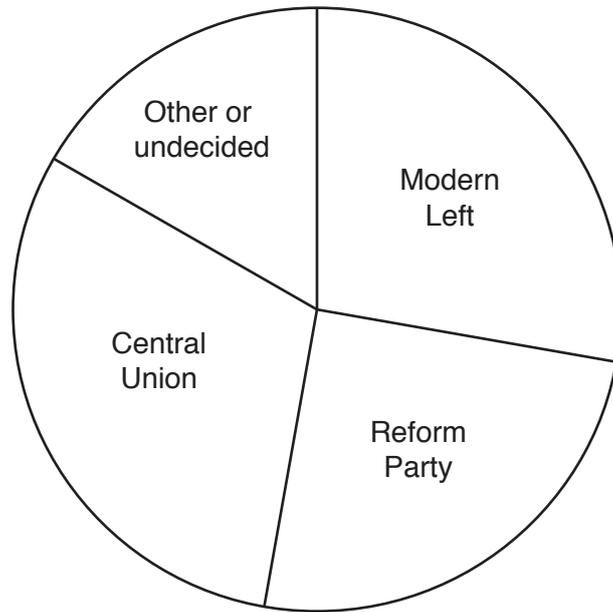
Use the chart to find the number of these voters who

(a) supported the Central Union,

....[2]

(b) did not support the Reform Party.

....[2]

In a later poll, 3000 voters were questioned.

(c) If a comparative pie chart were drawn to show the results of this later poll, find, correct to 1 decimal place, its radius.

....[3]

7 Warona buys a pack of 7 toothbrushes, of which 1 is red, 2 are green, and 4 are blue. She opens the pack, selects a toothbrush at random, and starts using it.

(a) Write down the probability that it is blue.

...[1]

Warona's dentist advises that one toothbrush should be used for 3 months, then thrown away. Warona follows the advice, selecting a new toothbrush at random from those remaining in the pack each time she throws away a used toothbrush.

(b) Given that the first toothbrush selected was blue, find the probability that the toothbrushes being used 8 months and 11 months after opening the pack are the same colour as each other.

....[7]

8   Bruce is a nutritionist. He collects information on the daily energy intake from food and drink of volunteer groups of 60 men and 60 women. His results, in Calories (a continuous variable), are illustrated in the cumulative frequency curves below.
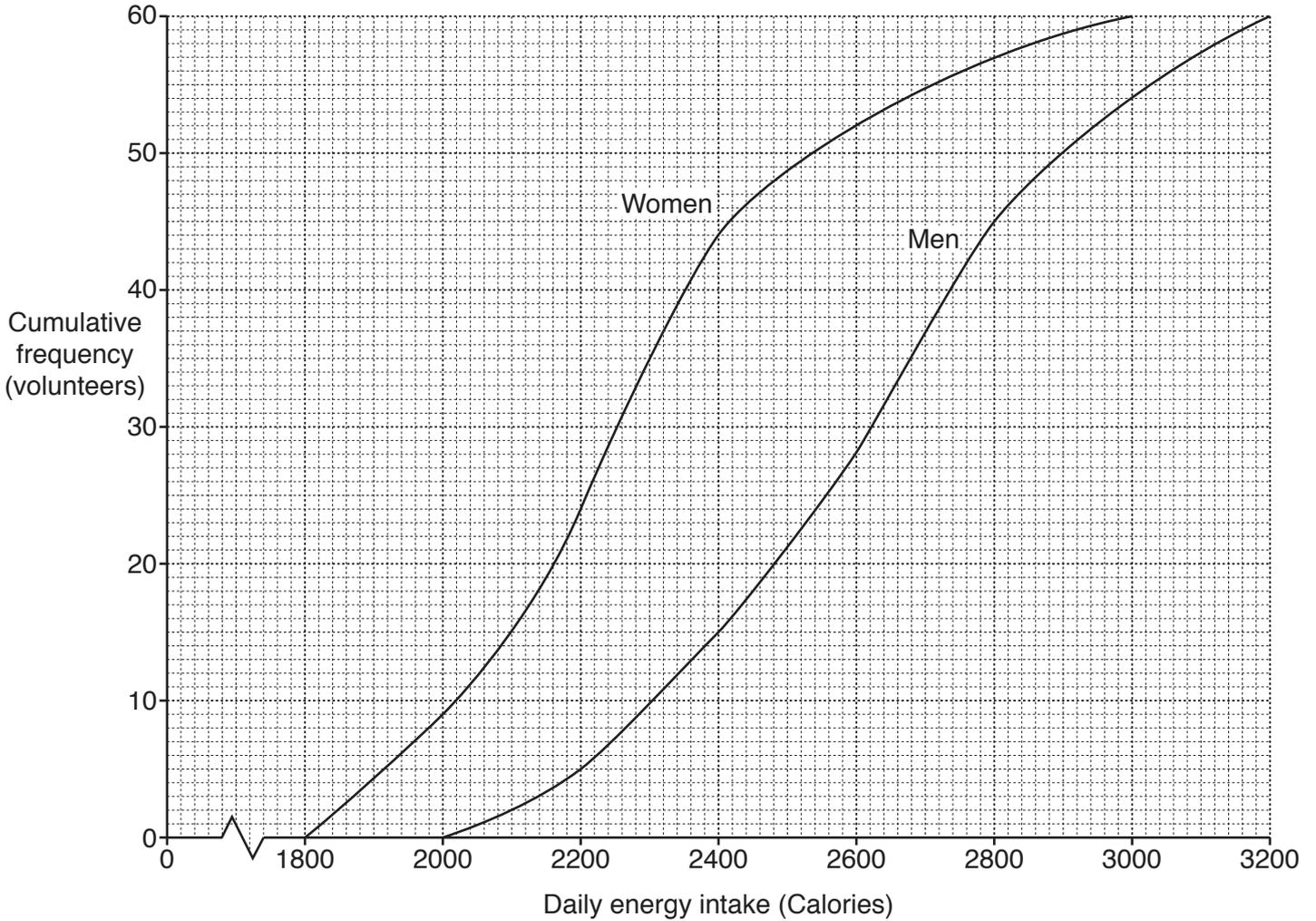
(a) Use the graph to estimate, for the daily energy intake of the men,

(i)   the median,

.... Calories [1]

(ii) the interquartile range.

.... Calories [4]

(b) Use the graph to estimate, for the daily energy intake of the women,

    (i) the 85th percentile,

.... Calories [2]

    (ii) the value of p if the pth percentile is 2340 Calories.

....[2]

Bruce observes from the graph that the interquartile range of the daily energy intake for women is smaller than that for men.

(c) Explain how he is able to make this observation without calculating the interquartile range of both groups of volunteers.

....

....[1]

Bruce's rules for a healthy diet are a maximum daily energy intake of 2500 Calories for men, and 2000 Calories for women.

(d) Estimate the number of these men and women whose diet Bruce judged to be **not** healthy.

Number of men ....

Number of women .... [2]

The volunteers themselves had recorded energy intake from their own estimates of the amounts of food and drink they had consumed.
Bruce's work colleague Sheila claims that, generally, women record values accurately, but men underestimate values by about 300 Calories.

(e) Estimate the number of these men whose diet Bruce should have judged to be **not** healthy, if Sheila's claim is correct.

....[2]

9 **In this question calculate all injury rates per thousand. Where values do not work out exactly give your answers to 1 decimal place.**

The table below gives information on the number of employees, and the number of injuries they suffered, in the Fire Service of a city in 2016. It also shows the standard population for the Fire Services of the area in which the city is situated.

Job group	Number of injuries	Number of employees	Job group injury rate	Standard population (%)
Control	0	12		3
Support	3	50		12
Full-time firefighter	91	260		55
Part-time firefighter	7	70		25
Trainee firefighter	8	25		5

(a) Calculate the crude injury rate for this Fire Service.

....[4]

(b) Calculate the injury rate for each job group and insert the values in the table above.

[2]

(c) Use your results from part **(b)** to calculate the standardised injury rate for this Fire Service.

....[4]

(d) Explain, by reference to the information given in the table and the values calculated in part **(b)**, why the standardised injury rate is smaller than the crude injury rate in this case.

....

....

....[3]

Some of the injuries suffered by employees required hospital treatment, and they all occurred in the firefighter groups. Information on these injuries is shown in the table below.

Job group	Number of injuries	Number of injuries requiring hospital treatment
Full-time firefighter	91	12
Part-time firefighter	7	1
Trainee firefighter	8	1

(e) Find the job group in which an injured employee was most likely to require hospital treatment. Justify your answer.

....

....[2]

10 The loggerhead sea turtle is an endangered species. To increase the chances of survival of baby turtles, a nursery (conservation centre) collects them from the beach when the turtle eggs hatch, and cares for them until they are older.
The following table summarises the masses, in grams, of a sample of baby turtles collected by the nursery.

Mass (g)	Number of turtles		
15 – under 17	4		
17 – under 18	7		
18 – under 19	12		
19 – under 20	15		
20 – under 22	9		
22 – under 25	3		

(a) Estimate, in grams, the mean and standard deviation of these masses. Give your answers to 3 significant figures.

Mean = ...

Standard deviation = ...[7]

Later, the nursery releases these turtles into the sea.
The following table summarises the masses of the turtles when released.

Mass (g)	Number of turtles
195 – under 215	5
215 – under 230	6
230 – under 235	7
235 – under 245	17
245 – under 265	15

(b) On the grid below draw a histogram to illustrate the data in this table. The rectangle representing the 235 – under 245 class has already been drawn for you.
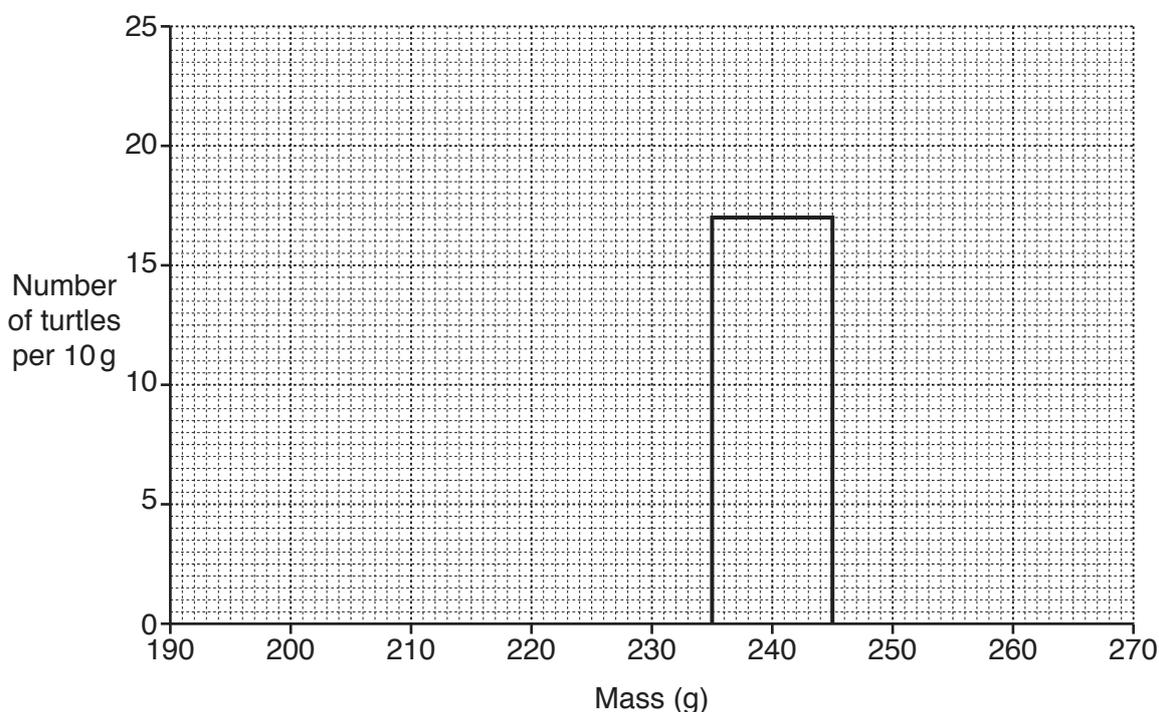
[4]

The nursery's policy is to release a turtle when its mass has become a certain multiple, *k*, of the mass when collected.

(c) Explain why *k* cannot be found accurately from the two tables of data above.

....

....[1]

(d) Use the mid-class values of the modal classes from the two tables of data above to estimate *k* to the nearest integer.

....[3]

11 An English teacher gives the 26 pupils present in her class a spelling test. She reads aloud ten words of different lengths and the pupils write them down. The following table summarises the results.

Word length, x (number of letters)	3	3	4	6	6	8	9	9	10	12
Number of pupils with correct spelling, y	24	23	21	19	18	17	15	13	11	9

(a) Plot these data on the grid below.
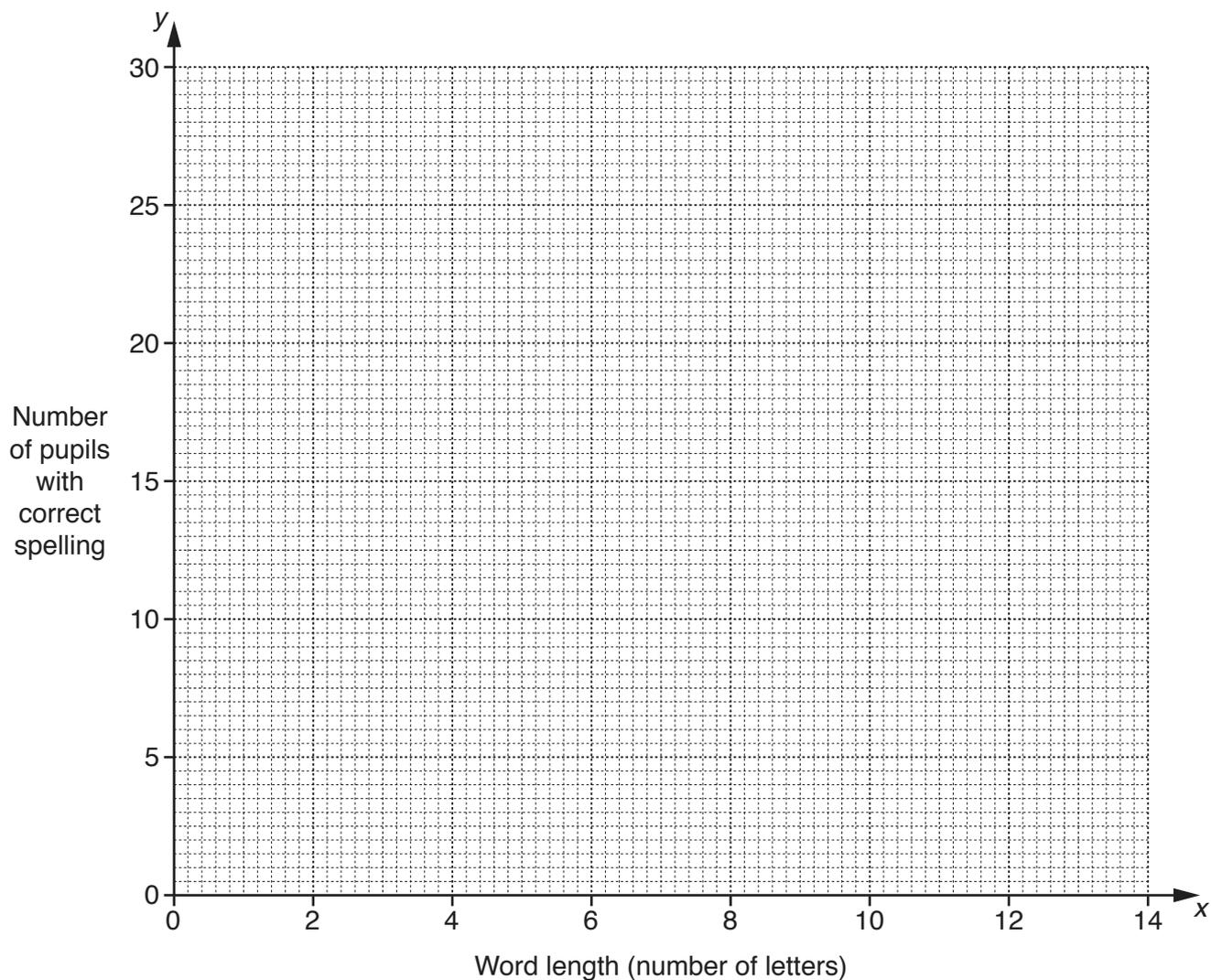
[2]

(b) Describe fully the correlation shown by the plotted points.

....[2]

The data have an overall mean of (7, 17) and a lower semi-average of (4.4, 21).

(c) Find the upper semi-average and plot this and the two given averages on your graph.

[3]

(d) Use your plotted averages to draw a line of best fit, and find its equation in the form $y = mx + c$.

....[4]

(e) Use your line to estimate the number of pupils who would spell a word with 5 letters correctly.

....[2]

The teacher also reads aloud the following three-word sentence and the 26 pupils write it down.

STUDY CREATES OPPORTUNITIES

A pupil is chosen at random.

(f) Estimate the probability that the pupil's answer contains the correct spelling of all three words.

....[3]

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