Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

6788605115

STATISTICS **4040/22**

Paper 2 **October/November 2015**

2 hours 15 minutes

Candidates answer on the Question Paper.

Additional Materials: Pair of compasses
Protractor

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
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 in Section A and not more than **four** questions from Section B.
If working is needed for any question it must be shown below that question.
The use of an electronic calculator is expected in this paper.

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.

This document consists of **20** printed pages.

DC (ST/FD) 100436/2

CAMBRIDGE International Examinations

[Turn over

Section A [36 marks]

Answer **all** of the questions 1 to 6.

1 Two of the units used to measure temperature are degrees Fahrenheit (°F) and degrees Celsius (°C).
The table below shows the mean and standard deviation of the daily mid-day temperatures in the town of Weatherville for 1970 and 2010.

	Mean	*Standard deviation*
1970	62.1 °F	6.6 °F
	......................°C	......................°C
2010	18.2 °C	3.4 °C

The formula $y = \frac{5}{9}(x - 32)$ converts x °F to y °C.

(i) Find the mean and standard deviation, in °C, for the daily mid-day temperatures in the town in 1970, and complete the table above.

[2]

(ii) Explain what the figures in the table tell you about the differences between the daily mid-day temperatures in Weatherville in 1970 and 2010.

....

....

....[2]

2 **(a)** A and B are two possible outcomes of the same experiment. State, in each case below, whether the two events are definitely mutually exclusive, definitely not mutually exclusive, or whether there is insufficient information to decide.

$P(A) = 0.3$ and $P(B) = 0.3$	
$P(A) = 0.3$ and $P(B) = 0.7$	
$P(A) = 0.3$ and $P(B) = 0.8$	

[2]

(b) C and D are two independent events where

$$P(C) = 0.4 \quad \text{and} \quad P(D) = 0.3\ .$$

Find

(i) $P(C \cap D)$,

....[2]

(ii) $P(C \cup D)$.

....[2]

3 The total petrol consumption, in thousands of barrels per day, for the years 2011 and 2012 in three countries is shown in the table below.

	2011	2012
New Zealand	148.5	151.9
Chile	332.7	347.1
Austria	262.9	258.9

(i) Show that the percentage change in petrol consumption from 2011 to 2012 for New Zealand was 2.3%, correct to two significant figures.

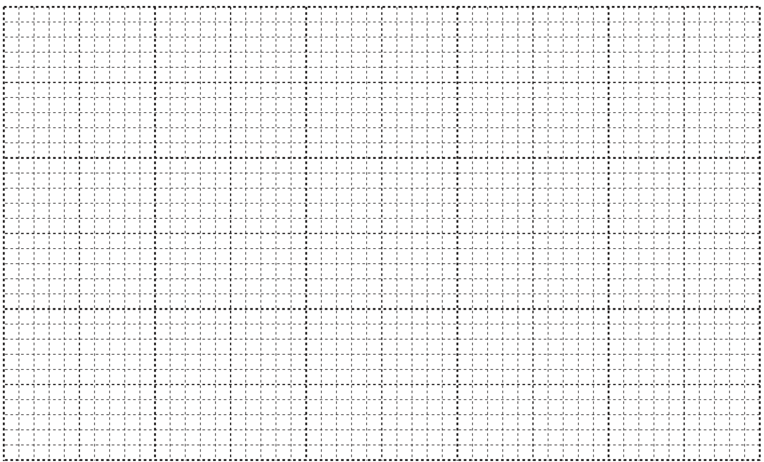
[1]

(ii) Find also the percentage change in petrol consumption from 2011 to 2012 for Chile and Austria.

Chile ....

Austria ....[2]

(iii) On the grid below draw a change chart to show the percentage changes in petrol consumption for the three countries.



[3]

4 A class of 30 pupils took a Statistics test. For the whole class, the mean mark was 58.1 and the standard deviation was 8.1 .

(i) The marks are to be scaled to a mean of 50 and a standard deviation of 10.

(a) Find, correct to one decimal place, the scaled mark for a pupil whose original mark was 48.

....[2]

(b) Find the mark which would remain unchanged by the scaling process.

....[2]

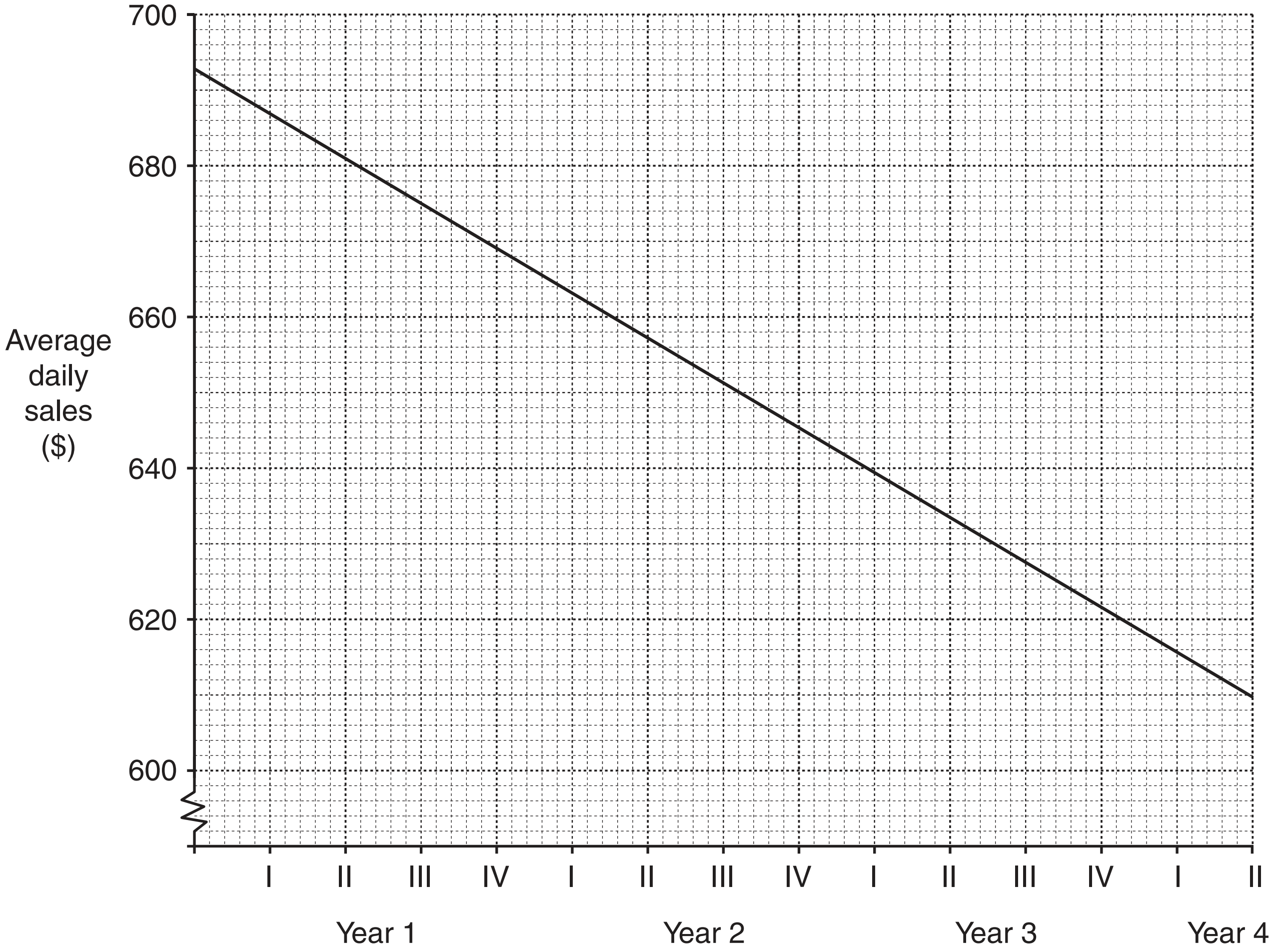
(ii) The 23 boys in the class had an original mean mark of 56.

Find the original mean mark for the 7 girls in the class.

....[3]

5 The average daily sales, in dollars, for a shop were recorded for each of the quarters of three consecutive years. Using these figures, values of an appropriate moving average were calculated. These were then used to estimate quarterly components, and to draw the trend line from which the quarterly components had been removed.

Quarter	I	II	III	IV
Quarterly component	–27	41	–38	*q*



(i) Use the above information to estimate the sales figures for quarter I and quarter II of year 4.

Quarter I ....

Quarter II ....[3]

(ii) Explain what the value of the quarterly component for quarter III tells you about the original data for that quarter.

....

....[1]

(iii) Explain what this trend line tells you.

....

....[1]

(iv) Find the value of q.

....[1]

6 The table below gives information about the masses, measured to the nearest gram, of the 180 apples in a crop.

Mass (g)	*Number of apples*	*Cumulative frequency*
90 – 109	24	24
110 – 129	31	55
130 – 139	49	104
140 – 149	43	147
150 – 169	27	174
170 – 189	6	180

(i) The largest 25% of the apples from this crop are to be classed as extra-large.

Use linear interpolation to calculate an estimate of the minimum mass of an extra-large apple, correct to one decimal place.

....[4]

(ii) Apples under 116 g are to be classed as small.

Use linear interpolation to calculate an estimate of the number of apples from this crop which will be classed as small.

....[3]

Section B [64 marks]

Answer not more than **four** of the questions 7 to 11.

Each question in this section carries 16 marks.

7 **(a)** There are 600 employees at a company. A sample of the employees is to be given a questionnaire.

(i) Give one advantage and one disadvantage of taking a sample rather than asking all 600 employees.

Advantage ....

....

Disadvantage ....

....[2]

(ii) The 600 employees are numbered 001 to 600.

Use the random number table below, starting at the beginning of the table, to help you select a systematic sample of size six.

10 04 56 78 12 39 64 51 87 62 91 05 15 43

....[3]

(iii) Explain what is meant by an unbiased sampling method.

....

....[1]

(b) At another company there are 60 employees numbered 00 to 59. Table 1 shows the number of employees of each job type and gender. Table 2 shows the numbers they have been assigned.

Table 1

	Clerical	Technical	Executive
Male	12	21	7
Female	8	9	3

Table 2

	Clerical	Technical	Executive
Male	00 – 11	20 – 40	50 – 56
Female	12 – 19	41 – 49	57 – 59

(i) Use the random number table below, starting at the beginning of the table, to select a sample of size 6, stratified by job type, showing your working clearly.

24 72 19 50 43 19 38 57 13 04 66 91 27 45

....[5]

(ii) Explain, with a reason, how well the sample you have found in part **(b)(i)** represents the genders.

....

....

....[3]

(iii) A sample of the employees is to be given a questionnaire about how much they enjoy their work. Explain, with a reason, whether it would be more appropriate to take a sample stratified by job type or a sample stratified by gender for this questionnaire.

....

....

....[2]

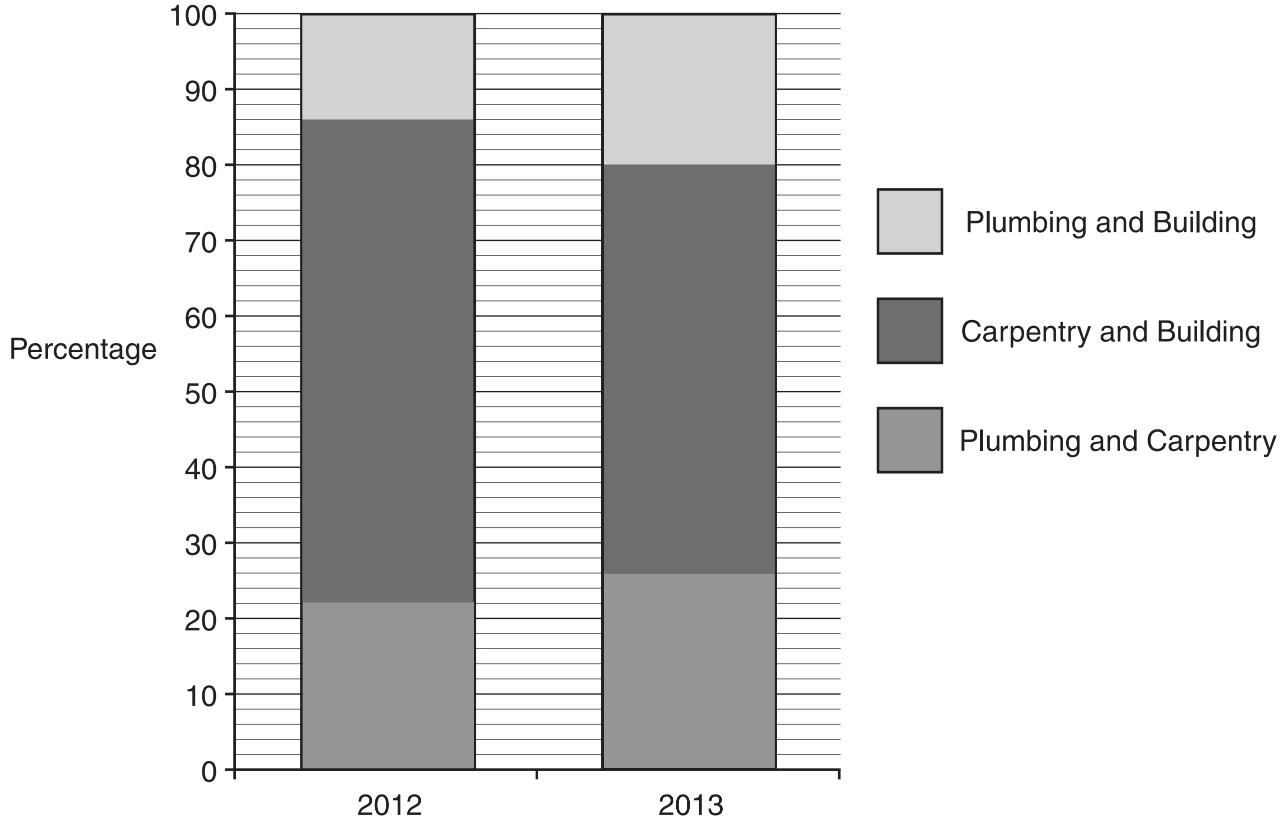
8 **(a)** Students at a Technical College must choose to specialise in two out of the three options Plumbing, Carpentry and Building.

(i) State whether the variable 'the options chosen by the students' is quantitative or qualitative. Give a reason for your answer.

....

....[2]

The chart below shows the percentage of students taking each combination in both 2012 and 2013.



It is known that 33 students studied both Plumbing and Carpentry in 2012.

(ii) Find the total number of students studying each of the three subjects Plumbing, Carpentry and Building at the college in 2012.

Plumbing ....

Carpentry ....

Building ....[5]

(iii) For each of the following statements, state whether it is definitely true, definitely false or whether there is insufficient information to decide. Give a reason for each of your answers.

(a) In 2013 more students at the college were studying Plumbing than Carpentry.

....

....[2]

(b) More students at the college were studying the combination Plumbing and Building in 2013 than in 2012.

....

....[2]

(b) The members of two cycling clubs, Pedal Powers and Speedy Wheelers, measured the distances they could cycle in one hour.

(i) State whether the variable 'the distance travelled by each cyclist' is discrete or continuous. Give a reason for your answer.

....

....[2]

They decided to record the distances by counting the number of whole laps of a particular track they had completed in one hour. (For example, a cyclist who had completed $24\frac{3}{4}$ laps would record their distance as 24 laps.)

The data were grouped with classes stated as 20 – 22, 23 – 25, 26 – 28 etc.

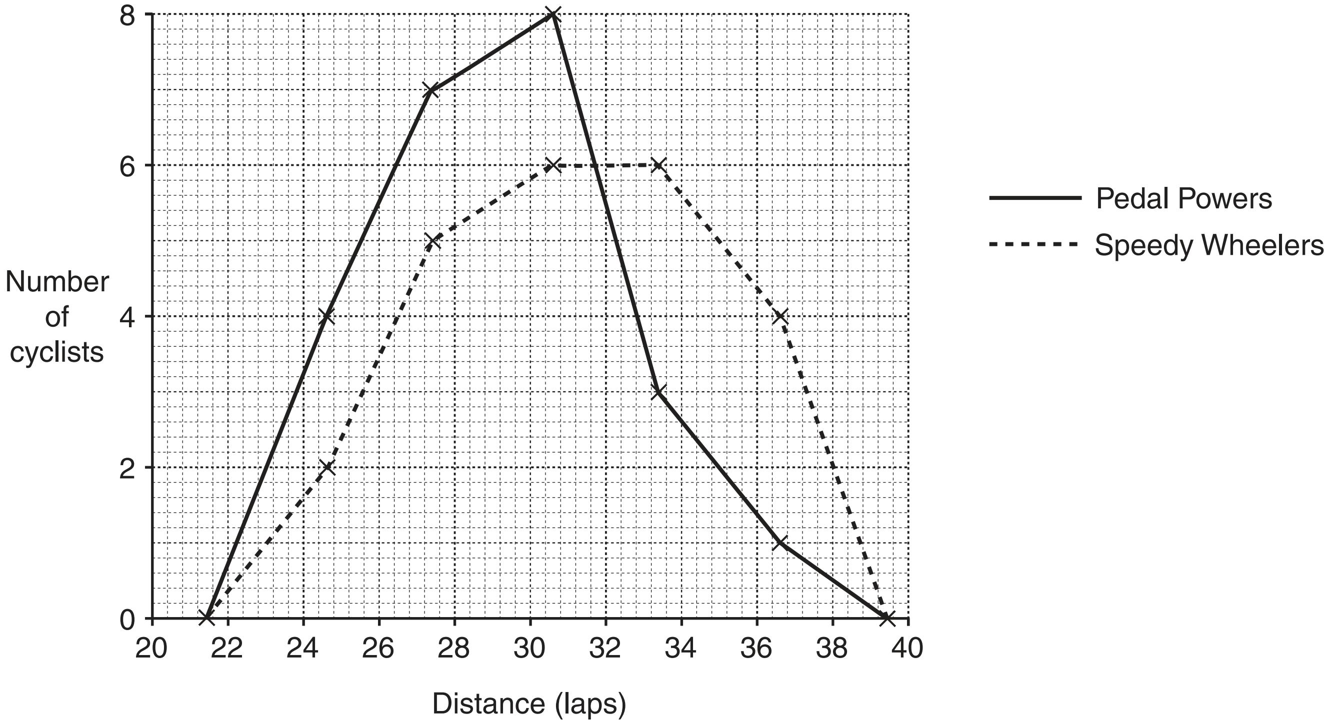
(ii) State the lower and upper class boundaries of the 23 – 25 class and find the class width.

Lower class boundary ....

Upper class boundary ....

Class width ....[2]

The frequency polygons below show the distances cycled by the members at each club.



(iii) Compare the distances cycled by the members of each club.

....

....[1]

9 The results for the candidates who took their driving test on a particular day at a driving test centre are shown in the table.

	Male	Female
Pass	4	3
Fail	6	5

(i) Find the probability that a candidate chosen at random is

(a) female,

....[1]

(b) a male who passed their test,

....[1]

(c) someone who passed, given that they are female.

....[1]

(ii) If two candidates are chosen at random, find the probability that one has passed and one has failed the test.

....[4]

(iii) If four candidates are chosen at random, one at a time, find the probability that the 4th candidate is the first to be both female and to have passed the test.

....[3]

(iv) If two males and two females are chosen at random, find the probability that the four candidates consist of one who has passed and three who have failed the test.

....[4]

Of those that failed, 1/3 of the males and 2/5 of the females retook their test within 3 months.

(v) Find the probability that a candidate chosen at random, from those who had failed, retook their test within 3 months.

....[2]

10 A farmer classified the expenditure on his farm into four categories: Animal food, Labour, Fuel and Veterinary services.
Taking 2011 as base year, the price relatives for each of these categories for the years 2012 and 2013 are shown in the table below.

	Price relative	
	2012	2013
Animal food	110	117
Labour	x	103
Fuel	101	98
Veterinary services	97	104

The average rate of pay for the labourers on the farm increased from \$7.96 per hour in 2011 to \$8.52 per hour in 2012.

(i) Show that x, the price relative for Labour in 2012, is 107, correct to the nearest whole number.

[2]

(ii) Find, correct to the nearest cent, the average rate of pay per hour for the labourers on the farm in 2013.

....[2]

(iii) Explain what the price relative of 97 for Veterinary services tells you.

....

....[2]

(iv) For each category find the price relative in 2013, **taking 2012 as base year**, correct to the nearest whole number.

Animal food ....

Labour ....

Fuel ....

Veterinary services ....[3]

Using his expenditure in 2012, the farmer assigned weights to each category as shown in the table below.

	Weight
Animal food	12
Labour	9
Fuel	4
Veterinary services	2

(v) Calculate, correct to one decimal place, a weighted aggregate cost index for the farmer's expenses in 2013, taking 2012 as base year.

.... [3]

(vi) If the total expenditure on these items in 2012 was \$319 000, estimate, correct to 3 significant figures, the expenditure on these items in 2013.

.... [2]

It was later discovered that, although all the price relatives used were correct, this estimate was very inaccurate.

The farmer considered four possible explanations for this:

A The price of animal food had increased

B The number of employees had changed

C More animals had become ill

D The price of fuel had changed

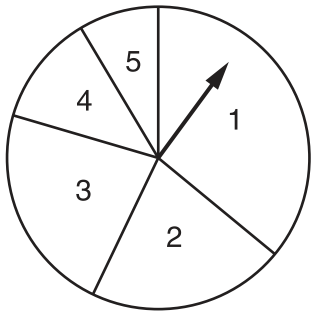
(vii) State which two of these are **not** possible explanations for the estimate being inaccurate and explain your answer.

....

....

.... [2]

11



A game consists of spinning an arrow. The arrow can point to one of the sectors marked 1, 2, 3, 4 or 5 and the probability of the arrow pointing to each is shown in the table.

x	1	2	3	4	5
P(x)	0.4	0.2	0.2	0.15	p

(i) Use the values in the table to find the value of p.

....[1]

(ii) It costs \$2.40 to play the game once and a player wins a prize of a number of dollars equal to the number in the sector where the arrow stops.

Find the expected profit or loss for someone playing the game.

....[3]

(iii) In another game the arrow is spun twice and the numbers obtained are added together. Again it costs \$2.40 to play. This time the prize is \$$y$ if they have a total of 3 or less, otherwise they get nothing.

(a) Find the probability of a total of 3 or less in this game.

....[2]

(b) Find the value of y if it is a fair game.

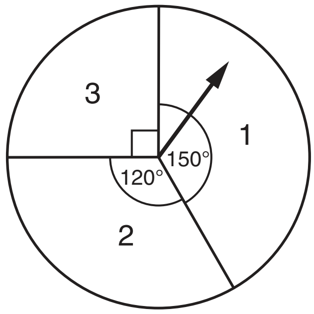
....[2]

(c) 100 people are to play this game, and the prize awarded is \$9 for a total of 3 or less. By finding the number of people expected to win, calculate the expected profit or loss for the game owner.

....[3]

[Question 11 continues on the next page]

Another spinner is as shown in the picture below. The arrow is equally likely to point in any direction when it stops. The arrow is spun once and $11 is charged to play.



(iv) If it is to be a fair game and the prizes are to be proportional to the numbers of the sectors, find how much the prizes should be.

Prize for sector 1 ....

Prize for sector 2 ....

Prize for sector 3 ....[5]