

Surname											Other Names										
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For Examiner's Use

General Certificate of Secondary Education
June 2009

STATISTICS Higher Tier

3311/H
H



Tuesday 16 June 2009 9.00 am to 11.30 am

For this paper you must have: <ul style="list-style-type: none"> a calculator mathematical instruments. 	
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Time allowed: 2 hours 30 minutes

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book.

Information

- The maximum mark for this paper is 120.
- The marks for questions are shown in brackets.
- Additional answer paper and graph paper will be issued on request and must be tagged securely to this answer book.
- You are expected to use a calculator where appropriate.

Advice

- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26–27	
TOTAL	
Examiner's Initials	



JUN093311H01

APW/Jun09/3311/H

3311/H

You may need to use the following formulae:

Mean of a frequency distribution $= \frac{\sum fx}{\sum f}$

Mean of a grouped frequency distribution $= \frac{\sum fx}{\sum f}$, where x is the mid-interval value.

Standard deviation for a set of numbers x_1, x_2, \dots, x_n having a mean value of \bar{x} is given by

$$\sqrt{\frac{\sum (x - \bar{x})^2}{n}} \text{ or } \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$$

Standard deviation for a frequency distribution

$$\sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} \text{ or } \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$$

The same formula applies to the standard deviation of a grouped frequency distribution where x is the mid-interval value.

Spearman's rank correlation coefficient $= 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$

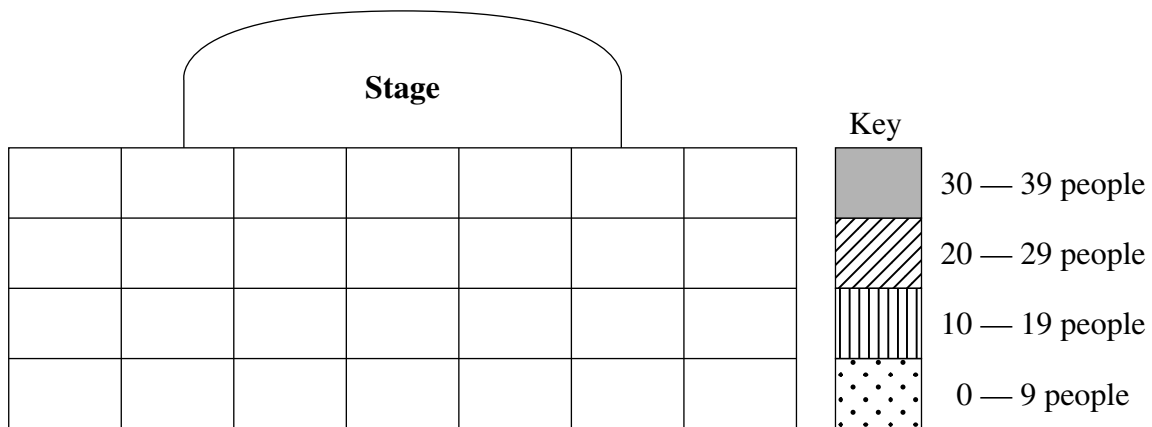


Answer **all** questions in the spaces provided.

- 1 A band is playing at a small open-air concert in a field.
The organisers monitor the number of people in different areas of the field.
They split the field into rectangles and count the number of people in each rectangle.
The diagram shows the number of people in each rectangle.

Stage						
12	23	36	38	33	20	8
10	18	34	39	32	19	5
5	11	34	37	32	11	3
3	4	16	19	12	10	2

- 1 (a) Use the Key to produce a choropleth (shading) map on the blank copy of the field below.



(3 marks)

- 1 (b) Each person at the concert has a numbered ticket.
One ticket is to be chosen at random to meet the members of the band backstage.
Write a T in the rectangle which is most likely to contain the person with the chosen ticket.

(1 mark)



- 2** Boris is investigating if the distance from a polling station affects whether people usually vote in his town.

He plans to ask a random sample of people some questions.

- 2** (a) Define the population for this survey.

.....

 (2 marks)

- 2** (b) Boris is undecided about whether to interview people or send a postal questionnaire.
Which method should Boris choose?

Give **two** reasons for your answer.

Method

Reason 1

.....

Reason 2

.....
 (2 marks)

- 2** (c) Boris decides to do a pilot survey first.

One question he uses is

Question: What is the distance from your house to the nearest polling station?

Response: miles

- 2** (c) (i) Give **one** criticism of the question.

.....

 (1 mark)

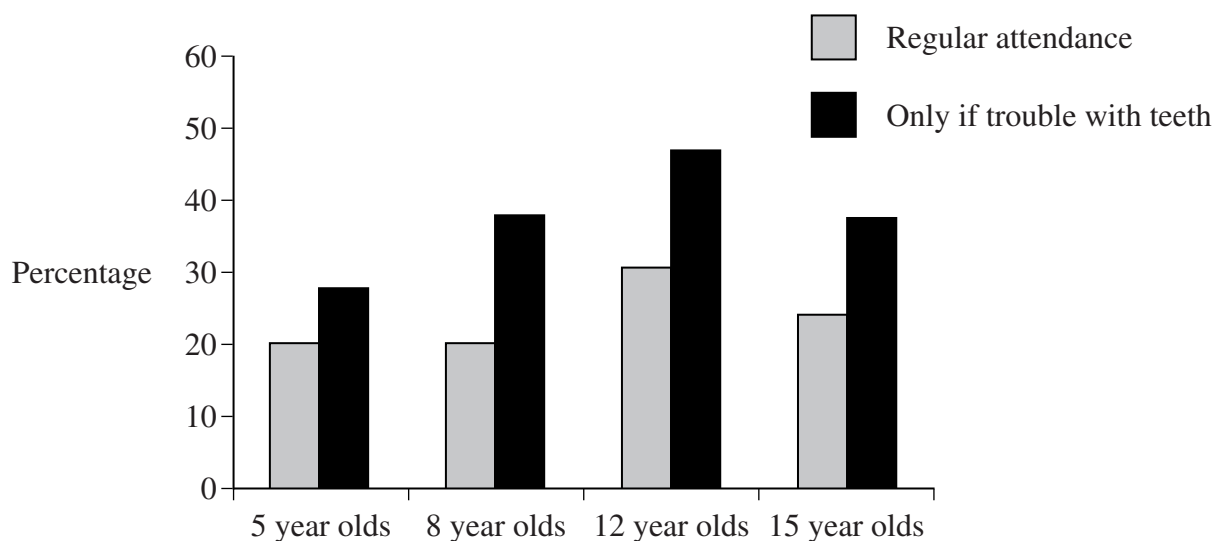
- 2** (c) (ii) Give **one** criticism of the response section.

.....

 (1 mark)



- 3 The diagram shows the percentages of children who visit the dentist at various ages, either regularly or only when they have trouble with teeth.



Source: www.statistics.gov.uk

- 3 (a) What is the name of this type of diagram?

Answer (1 mark)

- 3 (b) Using the information given, at what age do less than 50% of all children visit the dentist?

Answer (1 mark)

- 3 (c) Consider the statement, 'more 15 year olds have **regular attendance** than 5 year olds'.

Is this statement True, False or Not possible to tell?

Give a reason for your answer.

Answer

Reason

.....

(2 marks)

Turn over for the next question



4 Over a long period of time a theme park has discovered that

32% of its visitors are Adults (A) aged 20 and over

30% of its visitors are Teenagers (T) aged 13-19

38% of its visitors are Children (C) under 13

4 (a) (i) What is the probability that the next visitor is a Teenager?

.....

Answer (1 mark)

4 (a) (ii) Work out the probability that the next two visitors are both Teenagers.

.....

.....

Answer (2 marks)

4 (a) (iii) What assumption did you make in order to answer part (ii)?

.....

..... (1 mark)

4 (b) The theme park wants to run a simulation of its visitors using two-digit random numbers from 00 to 99.

Suggest a suitable allocation of these numbers.

Adults (A) Numbers to

Teenagers (T) Numbers to

Children (C) Numbers to

(2 marks)

4 (c) Use the two-digit random numbers below to simulate the next 10 visitors to the park in terms of whether they are Adults (A), Teenagers (T) or Children (C).

Number	79	02	32	55	09	76	44	00	82	32
Adult (A)										
Teenager (T)										
Child (C)										

(2 marks)



- 4 (d) One day in the summer holidays the theme park offers free admission to Children under 13.

The theme park analysed the first 100 visitors that day according to age and gender. It was noted that

- the proportion of Children under 13 was one and a half times bigger than usual
- 27 of these Children under 13 were male
- there were 8 Teenagers
- half of the Teenagers were male
- there were 15 male Adults.

Complete this two-way table showing the type and gender of these 100 visitors.

	Male	Female	
Children under 13			
Teenagers			
Adults			
			Total 100

(4 marks)

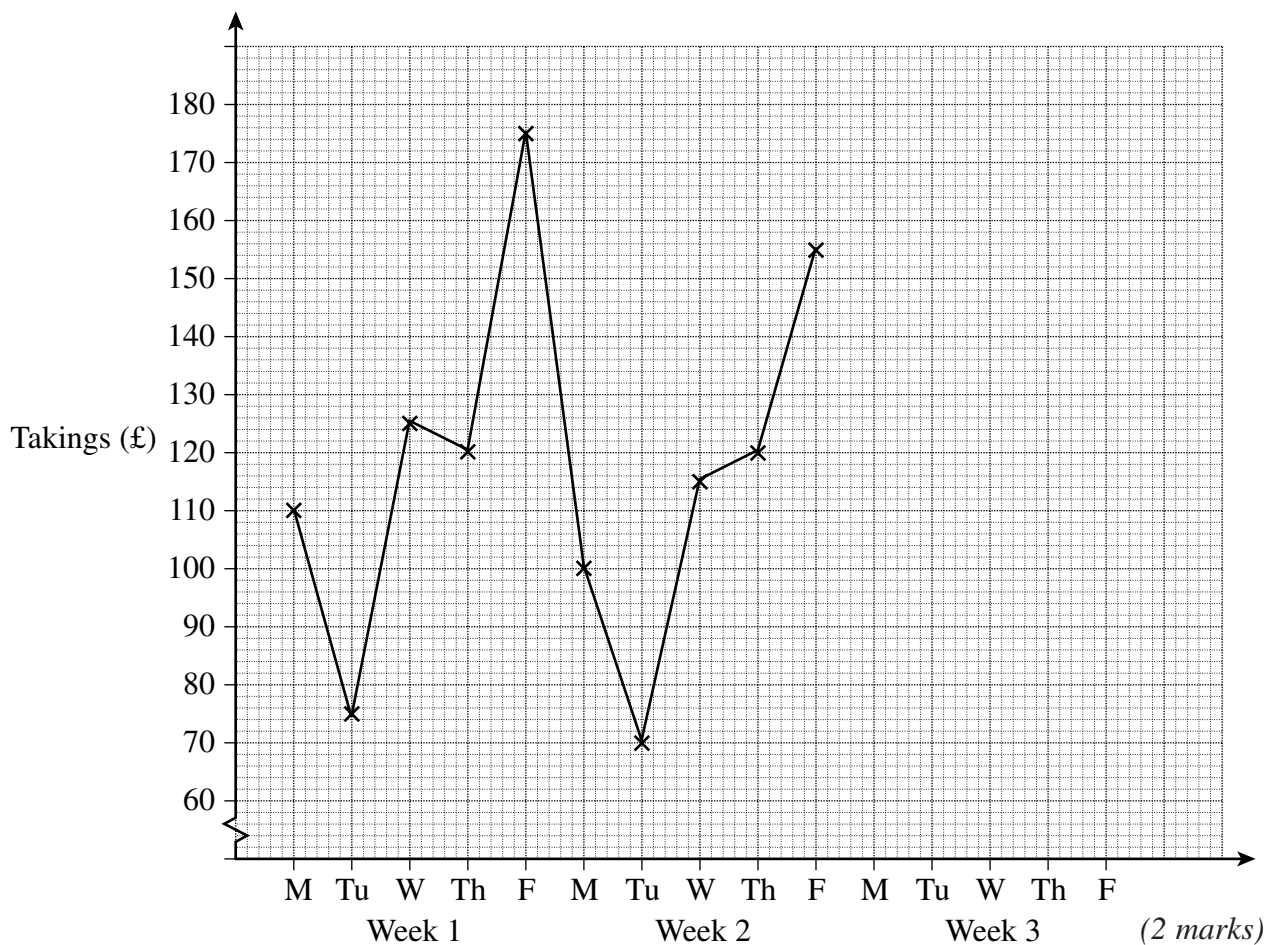
Turn over for the next question



5 The table shows the takings (£) for lunches at a work's café over a period of three weeks.

Week	Day	Takings (£)
1	Monday (M)	110
	Tuesday (Tu)	75
	Wednesday (W)	125
	Thursday (Th)	120
	Friday (F)	175
2	Monday (M)	100
	Tuesday (Tu)	70
	Wednesday (W)	115
	Thursday (Th)	120
	Friday (F)	155
3	Monday (M)	95
	Tuesday (Tu)	60
	Wednesday (W)	115
	Thursday (Th)	105
	Friday (F)	150

5 (a) Complete the time series graph below by plotting the points for week 3



- 5** (b) The takings are lowest on Tuesdays.

Give a possible reason for this.

.....

.....

(1 mark)

- 5** (c) Describe two **other** patterns in the data.

Pattern 1

.....

Pattern 2

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(2 marks)

Turn over for the next question



- 6 The table shows the number of years of life expectancy for people living in the countries of the United Kingdom for 2003 – 2005.

Life expectancy, 2003 – 2005

	At birth		At age 65 years	
	Males	Females	Males	Females
England	76.9	81.2	16.8	19.6
Wales	76.3	80.7	16.4	19.2
Scotland	74.2	79.3	15.5	18.4
Northern Ireland	76.0	80.8	16.4	19.3

Source: *www.statistics.gov.uk*

- 6 (a) Which of these countries had the highest life expectancy?

Answer (1 mark)

- 6 (b) (i) According to the table to what age is a 65-year-old Scottish female expected to live?

.....

Answer..... (2 marks)

- 6 (b) (ii) Why is the answer to part (b) (i) different to the value 79.3 years shown in the left-hand table?

.....

.....

(1 mark)

- 6 (c) The average life expectancy at birth for males in the United Kingdom is 76.6

The average of the four figures for males at birth for England, Wales, Scotland and Northern Ireland is 75.85

Explain why these two values are different.

.....

.....

(1 mark)



Turn over for the next question

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Turn over ►



- 7 The following table is an extract from the results of a survey in 2008 into people's attitudes towards secondary schooling in the UK.

Percentages

	Agree strongly	Agree	Neither agree nor disagree	Disagree	Disagree strongly	All
Formal exams are the best way to judge pupils	4	60	20	10	3	97
On the whole pupils are too young when they have to decide which subjects to specialise in	10	9	64	13	1	97
The present law allows pupils to leave school when they are too young	2	10	20	57	8	97
So much attention is given to exam results that a pupil's everyday classroom work counts for very little	7	32	20	32	6	97

Source: Adapted from *British Social Attitudes survey*, National Centre for Social Research

- 7 (a) Give a reason why the 'All' column totals are 97 rather than 100

.....

.....

(1 mark)



- 7 (b) A discrete opinion scale was used in this survey.

Describe an alternative opinion scale that could have been used to record the responses.

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(2 marks)

- 7 (c) Use the results in the table to make two recommendations about secondary schooling based on the 2008 survey.

Recommendation 1

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Recommendation 2

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(2 marks)

Turn over for the next question



- 8** A television football show organised a goal of the month competition.

Viewers were asked to rank 10 goals scored from best to worst.

Ahmed entered the competition giving the order as

H F D B I C J G A and E

His friend Peter gave the order as

C I F D H B A E G and J

- 8** (a) Complete the following table and hence calculate Spearman's rank correlation coefficient between the two sets of rankings.

Goal	A	B	C	D	E	F	G	H	I	J
Ahmed's rankings										
Peter's rankings										
d										
d ²										

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Answer..... (6 marks)

- 8** (b) What does the answer suggest about the level of agreement between the two friends?

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.....

(1 mark)



- 8** (c) Neither Ahmed nor Peter won the competition.

The value of the correlation coefficient between Ahmed and the winner was -0.92 and between Peter and the winner was 0.03

Give a reason why each of the entrants was not successful.

Ahmed

.....

.....

Peter

.....

.....

(2 marks)

Turn over for the next question



- 9 A teacher believes that adding a vitamin supplement to a child's diet will improve their performance in a Statistics exam.

She plans an experiment to test this theory on a class of 36 girls.

Half of the girls will be given the vitamin supplement and the other half nothing extra in their diet.

The exam results for the two groups will then be compared.

- 9 (a) State the explanatory and response variables in this experiment.

Explanatory variable

.....

Response variable

.....

(2 marks)

- 9 (b) Give an example of **one** extraneous variable that might affect the results and suggest how this might be controlled.

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(2 marks)

- 9 (c) Suggest a hypothesis the teacher might use in this case.

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(1 mark)

- 9 (d) To conduct the experiment the teacher will match up the girls in pairs, giving the vitamin supplement to one girl in each pair.

- 9 (d) (i) State two factors she should take into account when forming the pairs.

Factor 1

.....

Factor 2

.....

(2 marks)



- 9** (d) (ii) Describe a method for the teacher to use when deciding which one of each pair of girls will form the experimental group and which the control group.

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(2 marks)

Turn over for the next question



- 10** Sliddon ceramics use three materials in the manufacture of a product.

The ratio by weight of the three materials X, Y and Z to manufacture one of these products is 3:5:12

Three kilograms of material X are used in the manufacture of each one of these products.

The costs per kilo of these materials in the years 2004 – 2006 were as follows:

	Costs per kilo (£)		
Raw materials	2004	2005	2006
X	3.50	3.50	5.20
Y	1.50	1.70	2.10
Z	6.00	6.80	7.40

- 10 (a)** The total cost of materials used to manufacture one of these products in 2004 was £90.00

Calculate the total cost of materials used to manufacture the same product in 2006.

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Answer (2 marks)

- 10 (b)** Use the answer from part (a) to calculate, to 1 d.p, a materials cost index for 2006 with 2004 as base year.

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Answer (2 marks)

- 10 (c)** From 2004 to 2006 the company increased the selling price of each one of these products by 38%.

Compare this increase with the change in the cost of materials over the same period.

.....

.....

(1 mark)



- 11** The total number of days spent in a UK hospital by a random sample of 50 patients during 2007 was recorded as

$$\sum fx = 300$$

$$\text{also } \sum fx^2 = 1962$$

- 11 (a)** Calculate the mean and standard deviation for the sample.

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.....

Mean days

Standard deviation days

(4 marks)

- 11 (b)** Assuming the sample results are normally distributed, find the limits within which approximately 95% of the sample times will fall.

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Answer to days

(3 marks)

- 11 (c)** Using the sample mean calculated in part (a), give an estimate of the mean time spent in hospital by all patients in 2007.

Answer days

(1 mark)

- 11 (d)** If the size of the original sample had been increased to 200 patients what effect would this have had on the variability in the estimate made in part (c)?

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(2 marks)



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- 12** Applicants wishing to work for an IT company in Wales have to complete two tests, each marked out of 100, one in numeracy (x) and the other ICT (y).

A group of 25 applicants sat the tests.

The results were plotted on a scatter diagram and a line of best fit drawn.

The line passed through two points (6, 3.9) and (20, 24.2)

- 12 (a)** Use this information to show that the equation of the line of best fit is:

$$y = 1.45x - 4.8$$

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(4 marks)

- 12 (b)** Petra scored 68% in the **numeracy** test.

Use the equation in part (a) to estimate her score in the ICT test.

.....

.....

Answer.....% (2 marks)

- 12 (c)** Explain why the equation given in part (a) is unsuitable for estimating the ICT results for **numeracy** scores of

- 12 (c) (i)** 3%

.....

.....

- 12 (c) (ii)** 82%

.....

.....

(2 marks)



- 13** The manager of a car finance company records how long it takes for her staff to process each of 50 loan applications.

The time is recorded to the nearest minute.

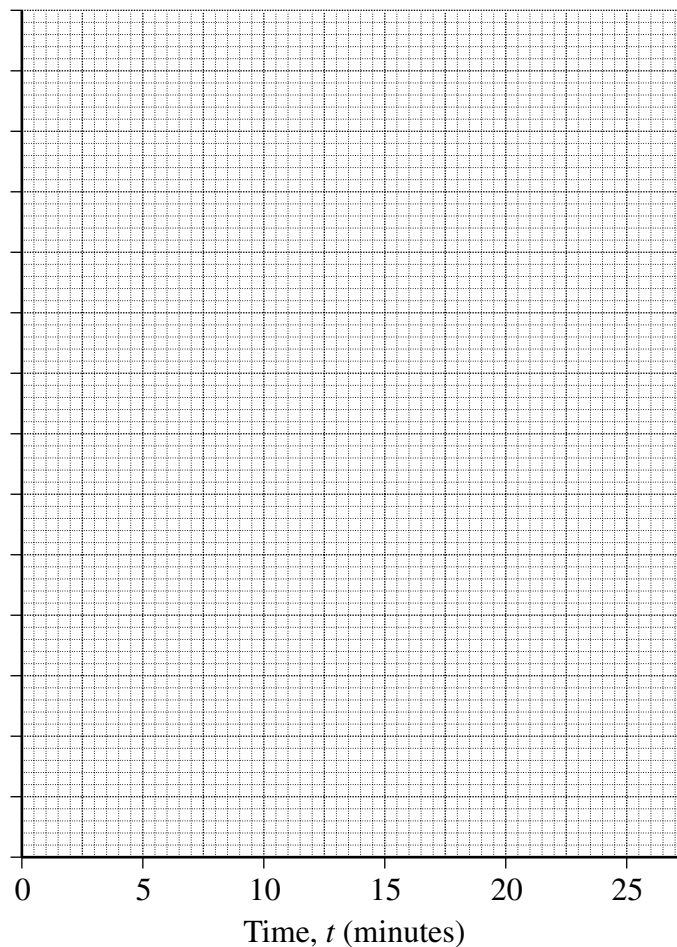
Time, t (minutes)	Number of loan applications processed
1 – 2	2
3 – 6	5
7 – 9	6
10 – 12	10
13 – 14	13
15 – 16	8
17 – 22	6

- 13** (a) Draw a histogram to represent these data on the grid below.

.....

.....

.....



(6 marks)



- 13 (b)** State, with a reason, whether the shape of the distribution is positively skewed, negatively skewed or symmetrical.

Shape

Reason

.....
(2 marks)

- 13 (c)** The manager claims that the processing time equal to the 9th decile is 16 minutes. Explain why this cannot be correct.

.....

.....
(2 marks)

- 13 (d)** Estimate the percentage of loan applications that took more than 16 minutes to process.

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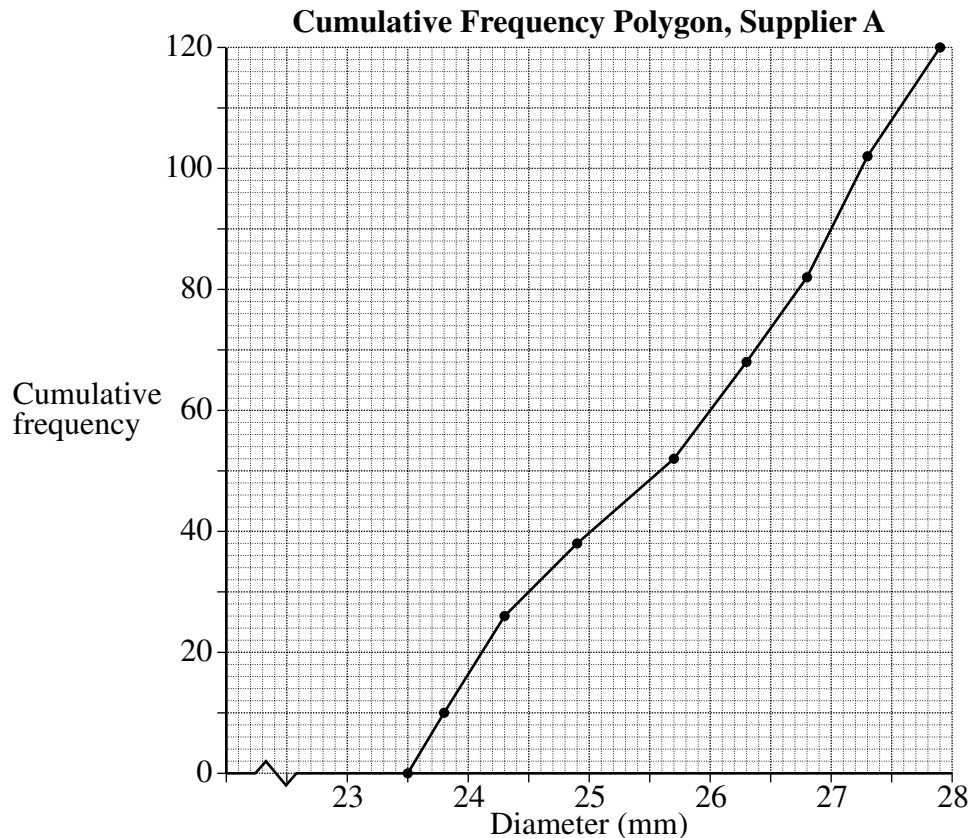
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Answer% (2 marks)

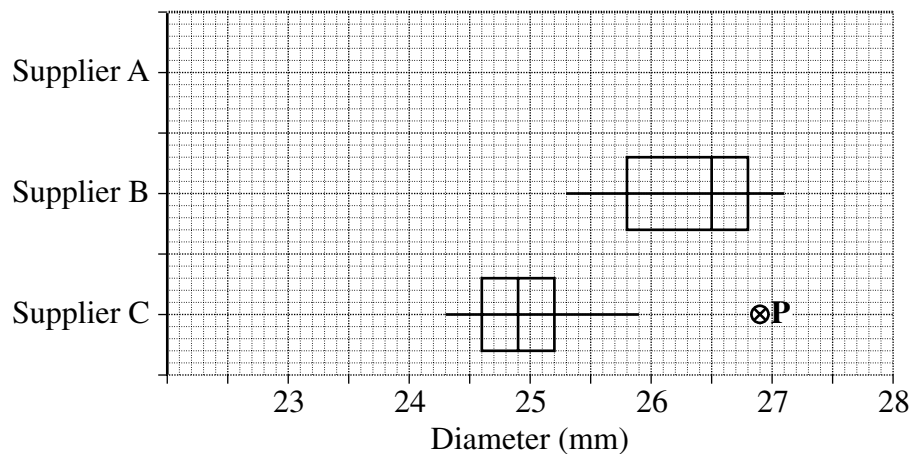
Turn over for the next question



- 14** An engineering company needs to place regular orders with a supplier for components. To test the quality of the components from three different suppliers, the manager measures the diameter of a sample of 120 components taken from each of the suppliers A, B and C. Measurements based on the sample of components from **supplier A** are shown in the cumulative frequency polygon.
- The smallest component diameter in the sample from **supplier A** was 23.5mm and the largest 27.9mm. There are no outliers.



- 14 (a)** On the grid below, box plots for component diameters from **suppliers B** and **C** are shown.
- Using estimates taken from the cumulative frequency polygon, draw a box plot for component diameters from **supplier A**.



(4 marks)



- 14 (b)** Explain why the result shown as point P on the box plot for **supplier C** represents an outlier.

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.....

(3 marks)

- 14 (c)** The manager needs to choose which component supplier to use.

- All diameters must be between 23.2 mm and 27.2 mm.
- The median diameter must be below 26.3 mm.

- 14 (c) (i)** State which supplier should be chosen.

Answer
(1 mark)

- 14 (c) (ii)** Explain why each of the other two suppliers should be rejected.

Supplier

Reason

.....

Supplier

Reason

.....

(2 marks)

- 14 (d)** Suggest another factor the manager might take into account when deciding which supplier to choose.

..... (1 mark)



- 15** The Headteacher of a large school is concerned about the punctuality of pupils.

The pupils either walk to school (**W**), travel by bus (**B**) or go by car (**C**).

On 26th November the Headteacher recorded how pupils travelled to school and whether they arrived early (**E**), on time, (**T**) or late (**L**).

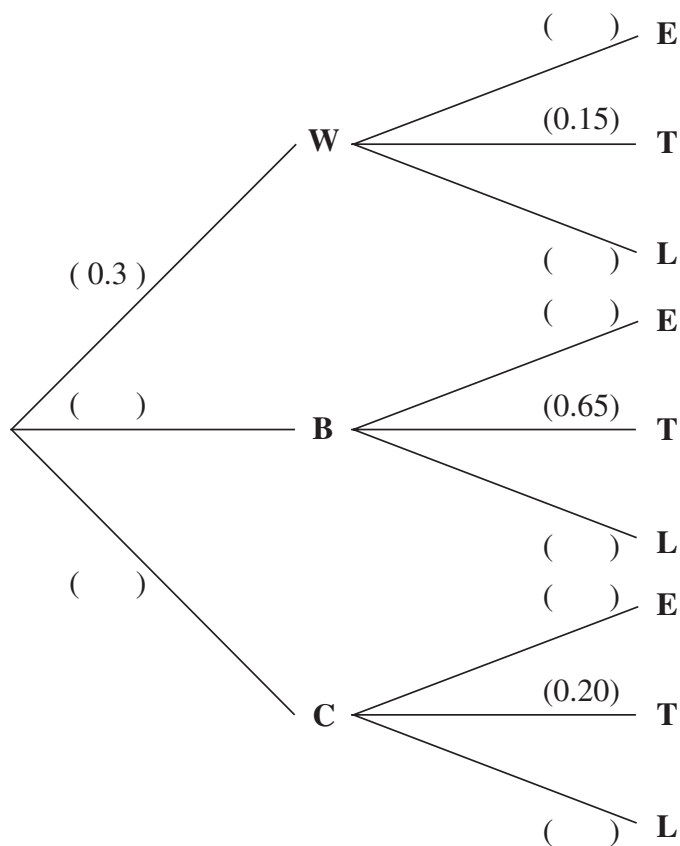
Her records showed that 30% of the pupils walked to school, 25% travelled by bus and the remainder by car.

Of those pupils walking to school, 20% arrived late, 15% on time and the remainder early.

For pupils travelling by bus, 65% arrived on time, 12% early and the remainder late.

Of those travelling by car, 75% arrived early, 20% on time with the remainder late.

- 15** (a) Use this information to complete the following tree diagram.



(4 marks)



- 15 (b)** A pupil is chosen at random.

Show that the probability the pupil arrived at school either early or on time is 0.86

.....

.....

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.....

(4 marks)

- 15 (c)** Calculate the probability that a pupil, chosen at random, arrived at school either early or on time, given that the pupil travelled by car.

.....

.....

.....

Answer (2 marks)

- 15 (d)** Three pupils are selected at random with replacement.

Calculate an estimate of the probability that two out of the three would have arrived at school late?

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.....

Answer (5 marks)

END OF QUESTIONS



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