

Write your name here

Surname

Other names

Pearson
Edexcel Award

Centre Number

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Candidate Number

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Statistical Methods

Level 3

Calculator allowed

Monday 15 January 2018 – Morning

Time: 2 hours

Paper Reference

AST30/01

You must have:

Pen, HB pencil, eraser, calculator, ruler.

Total Marks



Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.

Information

- The total mark for this paper is 90
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- Normal distribution tables can be found on the inside of the front cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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THE NORMAL DISTRIBUTION FUNCTION

The function tabulated below is $\Phi(z)$, defined as $\Phi(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^z e^{-\frac{1}{2}t^2} dt$.

z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$	z	$\Phi(z)$
0.00	0.5000	0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.9772
0.01	0.5040	0.51	0.6950	1.01	0.8438	1.51	0.9345	2.02	0.9783
0.02	0.5080	0.52	0.6985	1.02	0.8461	1.52	0.9357	2.04	0.9793
0.03	0.5120	0.53	0.7019	1.03	0.8485	1.53	0.9370	2.06	0.9803
0.04	0.5160	0.54	0.7054	1.04	0.8508	1.54	0.9382	2.08	0.9812
0.05	0.5199	0.55	0.7088	1.05	0.8531	1.55	0.9394	2.10	0.9821
0.06	0.5239	0.56	0.7123	1.06	0.8554	1.56	0.9406	2.12	0.9830
0.07	0.5279	0.57	0.7157	1.07	0.8577	1.57	0.9418	2.14	0.9838
0.08	0.5319	0.58	0.7190	1.08	0.8599	1.58	0.9429	2.16	0.9846
0.09	0.5359	0.59	0.7224	1.09	0.8621	1.59	0.9441	2.18	0.9854
0.10	0.5398	0.60	0.7257	1.10	0.8643	1.60	0.9452	2.20	0.9861
0.11	0.5438	0.61	0.7291	1.11	0.8665	1.61	0.9463	2.22	0.9868
0.12	0.5478	0.62	0.7324	1.12	0.8686	1.62	0.9474	2.24	0.9875
0.13	0.5517	0.63	0.7357	1.13	0.8708	1.63	0.9484	2.26	0.9881
0.14	0.5557	0.64	0.7389	1.14	0.8729	1.64	0.9495	2.28	0.9887
0.15	0.5596	0.65	0.7422	1.15	0.8749	1.65	0.9505	2.30	0.9893
0.16	0.5636	0.66	0.7454	1.16	0.8770	1.66	0.9515	2.32	0.9898
0.17	0.5675	0.67	0.7486	1.17	0.8790	1.67	0.9525	2.34	0.9904
0.18	0.5714	0.68	0.7517	1.18	0.8810	1.68	0.9535	2.36	0.9909
0.19	0.5753	0.69	0.7549	1.19	0.8830	1.69	0.9545	2.38	0.9913
0.20	0.5793	0.70	0.7580	1.20	0.8849	1.70	0.9554	2.40	0.9918
0.21	0.5832	0.71	0.7611	1.21	0.8869	1.71	0.9564	2.42	0.9922
0.22	0.5871	0.72	0.7642	1.22	0.8888	1.72	0.9573	2.44	0.9927
0.23	0.5910	0.73	0.7673	1.23	0.8907	1.73	0.9582	2.46	0.9931
0.24	0.5948	0.74	0.7704	1.24	0.8925	1.74	0.9591	2.48	0.9934
0.25	0.5987	0.75	0.7734	1.25	0.8944	1.75	0.9599	2.50	0.9938
0.26	0.6026	0.76	0.7764	1.26	0.8962	1.76	0.9608	2.55	0.9946
0.27	0.6064	0.77	0.7794	1.27	0.8980	1.77	0.9616	2.60	0.9953
0.28	0.6103	0.78	0.7823	1.28	0.8997	1.78	0.9625	2.65	0.9960
0.29	0.6141	0.79	0.7852	1.29	0.9015	1.79	0.9633	2.70	0.9965
0.30	0.6179	0.80	0.7881	1.30	0.9032	1.80	0.9641	2.75	0.9970
0.31	0.6217	0.81	0.7910	1.31	0.9049	1.81	0.9649	2.80	0.9974
0.32	0.6255	0.82	0.7939	1.32	0.9066	1.82	0.9656	2.85	0.9978
0.33	0.6293	0.83	0.7967	1.33	0.9082	1.83	0.9664	2.90	0.9981
0.34	0.6331	0.84	0.7995	1.34	0.9099	1.84	0.9671	2.95	0.9984
0.35	0.6368	0.85	0.8023	1.35	0.9115	1.85	0.9678	3.00	0.9987
0.36	0.6406	0.86	0.8051	1.36	0.9131	1.86	0.9686	3.05	0.9989
0.37	0.6443	0.87	0.8078	1.37	0.9147	1.87	0.9693	3.10	0.9990
0.38	0.6480	0.88	0.8106	1.38	0.9162	1.88	0.9699	3.15	0.9992
0.39	0.6517	0.89	0.8133	1.39	0.9177	1.89	0.9706	3.20	0.9993
0.40	0.6554	0.90	0.8159	1.40	0.9192	1.90	0.9713	3.25	0.9994
0.41	0.6591	0.91	0.8186	1.41	0.9207	1.91	0.9719	3.30	0.9995
0.42	0.6628	0.92	0.8212	1.42	0.9222	1.92	0.9726	3.35	0.9996
0.43	0.6664	0.93	0.8238	1.43	0.9236	1.93	0.9732	3.40	0.9997
0.44	0.6700	0.94	0.8264	1.44	0.9251	1.94	0.9738	3.50	0.9998
0.45	0.6736	0.95	0.8289	1.45	0.9265	1.95	0.9744	3.60	0.9998
0.46	0.6772	0.96	0.8315	1.46	0.9279	1.96	0.9750	3.70	0.9999
0.47	0.6808	0.97	0.8340	1.47	0.9292	1.97	0.9756	3.80	0.9999
0.48	0.6844	0.98	0.8365	1.48	0.9306	1.98	0.9761	3.90	1.0000
0.49	0.6879	0.99	0.8389	1.49	0.9319	1.99	0.9767	4.00	1.0000
0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.9772		

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Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 Nicola has 3 pairs of trousers and 4 t-shirts in her wardrobe.

One pair of trousers is blue, one pair is grey and one pair is orange.

One t-shirt is red, one t-shirt is blue, one t-shirt is grey and one t-shirt is white.

The sample space diagram shows all the possible outcomes that Nicola can get from selecting a pair of trousers and a t-shirt.

		trousers		
		blue (B)	grey (G)	orange (O)
t-shirts	red (R)	(B, R)	(G, R)	(O, R)
	blue (B)	(B, B)	(G, B)	(O, B)
	grey (G)	(B, G)	(G, G)	(O, G)
	white (W)	(B, W)	(G, W)	(O, W)

Each day Nicola picks at random a pair of trousers and a t-shirt.

- (a) Write down the probability that Nicola picks a pair of trousers and a t-shirt of the same colour.

.....
(1)

The t-shirts and trousers are returned to the wardrobe each day after use.
Nicola does this for 60 days.

- (b) Work out an estimate for the number of days Nicola picks the orange pair of trousers and the white t-shirt.

.....
(2)

(Total for Question 1 is 3 marks)



2 Joe is going to collect data about new cars that have been sold in the UK in the last 12 months. He decides to collect both categorical and quantitative data.

(a) Explain what is meant by

(i) categorical data,

.....
.....

(ii) quantitative data.

.....
.....

(2)

Joe is not sure whether to collect the data himself or to collect information from the internet.

(b) Give **one** advantage for each method.

Collect the data himself:

.....
.....

Collect the information from the internet:

.....
.....

(2)

Joe decides to take a sample rather than a census.

(c) (i) Give **one** reason why Joe would take a sample.

.....
.....

(ii) Describe the population for his sample.

.....
.....

(2)

(Total for Question 2 is 6 marks)



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3 Adrian wants to estimate the number of snails in his garden.

He catches a sample of 30 snails from his garden, marks each snail with some paint and puts them back into the garden.

The next day he catches a sample of 60 snails from the garden.

He finds that 9 of these snails are marked with the paint.

(a) Work out an estimate for the number of snails in his garden.

.....
(2)

(b) Write down **one** assumption you have made.

.....
.....
(1)

(Total for Question 3 is 3 marks)



4 Eight identical cards are numbered from 1 to 8

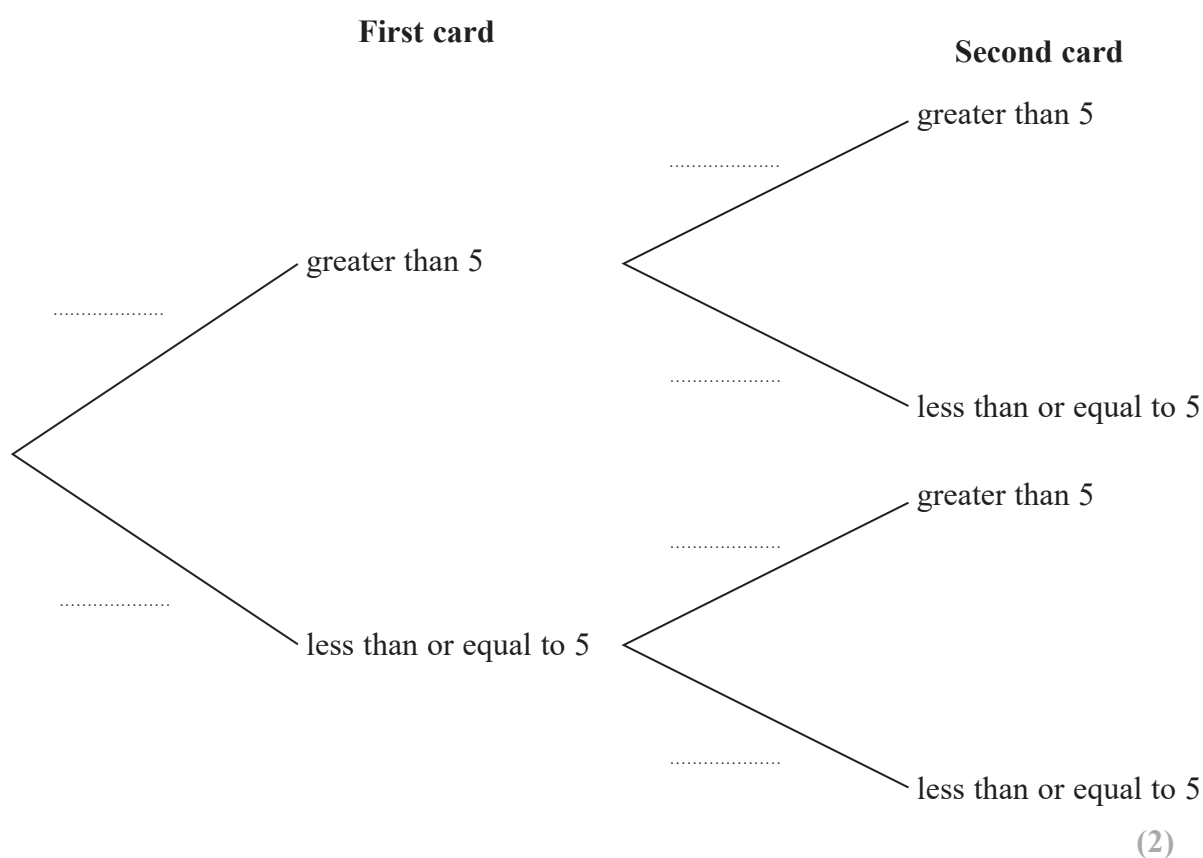


A card is selected at random and its number is recorded.

The card is replaced.

A second card is then selected at random and its number is recorded.

(a) Complete the probability tree diagram.



(b) Work out the probability that the numbers on both cards are greater than 5

.....
(2)

(Total for Question 4 is 4 marks)



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5 There are two age groups in a competition.

The table shows the number of male competitors and the number of female competitors in each age group.

Age (x years)	Males	Females
$20 < x \leq 30$	108	136
$30 < x \leq 40$	62	94

Leyla is going to survey these competitors.

She is going to take a sample of 100 of these competitors, stratified by age and by gender.

Work out the number of males in the $20 < x \leq 30$ age group that should be in her sample.

.....
(Total for Question 5 is 2 marks)



6 Here is the number of text messages received by each of 15 people during one day.

3	17	18	20	22
23	25	26	27	27
29	32	34	36	48

Heidi says that there are no outliers for these numbers of text messages.

Is Heidi correct?

You must show your working.

(Total for Question 6 is 4 marks)



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7 Jai bought a house in 2012.

The table shows the value of Jai's house for the years 2012 to 2016.

The table also gives the chain base index numbers, correct to one decimal place, for 2013, for 2014 and for 2015.

Year	2012	2013	2014	2015	2016
Value (£)	178 000	180 000	184 000	200 000	210 000
Chain base index number		101.1	102.2	108.7

(a) Calculate the chain base index number for 2016 and write it in the table.

(2)

(b) Calculate the geometric mean of the chain base index numbers for 2013, 2014, 2015 and 2016.

Give your answer correct to one decimal place.

.....
(2)

(c) Describe what the geometric mean shows about the value of the house during this period.

.....
(2)

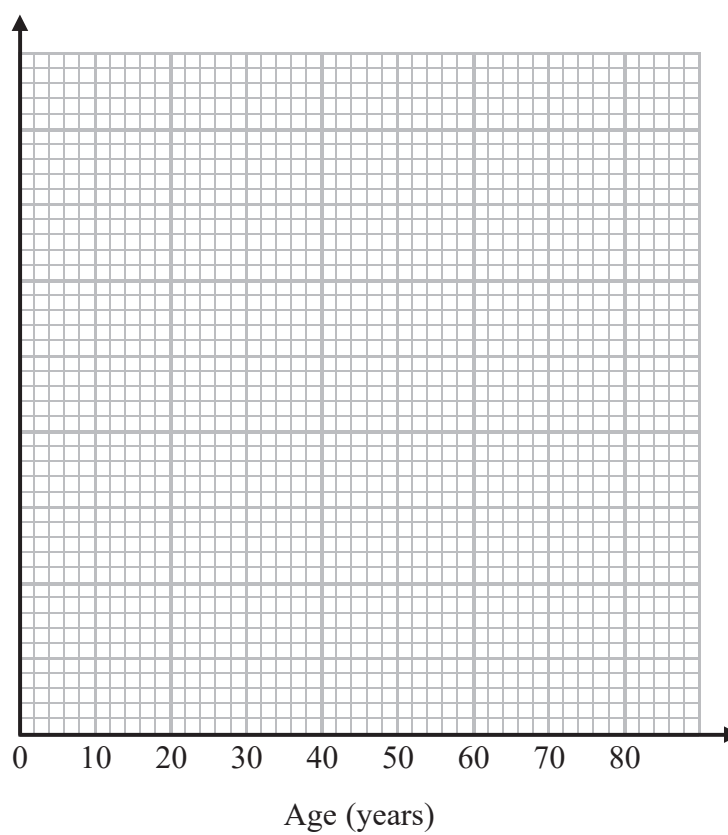
(Total for Question 7 is 6 marks)



8 The table gives information about the ages of the 480 people who live in a village.

Age (x years)	Frequency
$0 < x \leq 10$	160
$10 < x \leq 25$	60
$25 < x \leq 30$	40
$30 < x \leq 40$	100
$40 < x \leq 80$	120

(a) On the grid below, draw a histogram for this information.



(3)



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- (b) Calculate an estimate for the mean age of these people.
Give your answer correct to one decimal place.

..... years
(3)

- (c) Calculate an estimate for the standard deviation of these ages.
Give your answer correct to one decimal place.

You may use $\sum fx^2 = 607\,125$

..... years
(2)

(Total for Question 8 is 8 marks)



9 Here are the times taken, in seconds, for 11 boys and 11 girls to complete a Maths problem.

Boys	12	14	20	27	6	12	20	8	30	18	24
Girls	9	14	20	22	29	10	7	33	24	18	20

(a) Draw an ordered back-to-back stem and leaf diagram for this information.

Boys		Girls
	0	
	1	
	2	
	3	

Key:

(4)



(b) Compare the two distributions of the times taken.
You should write down **two** comparisons.

(2)

(Total for Question 9 is 6 marks)

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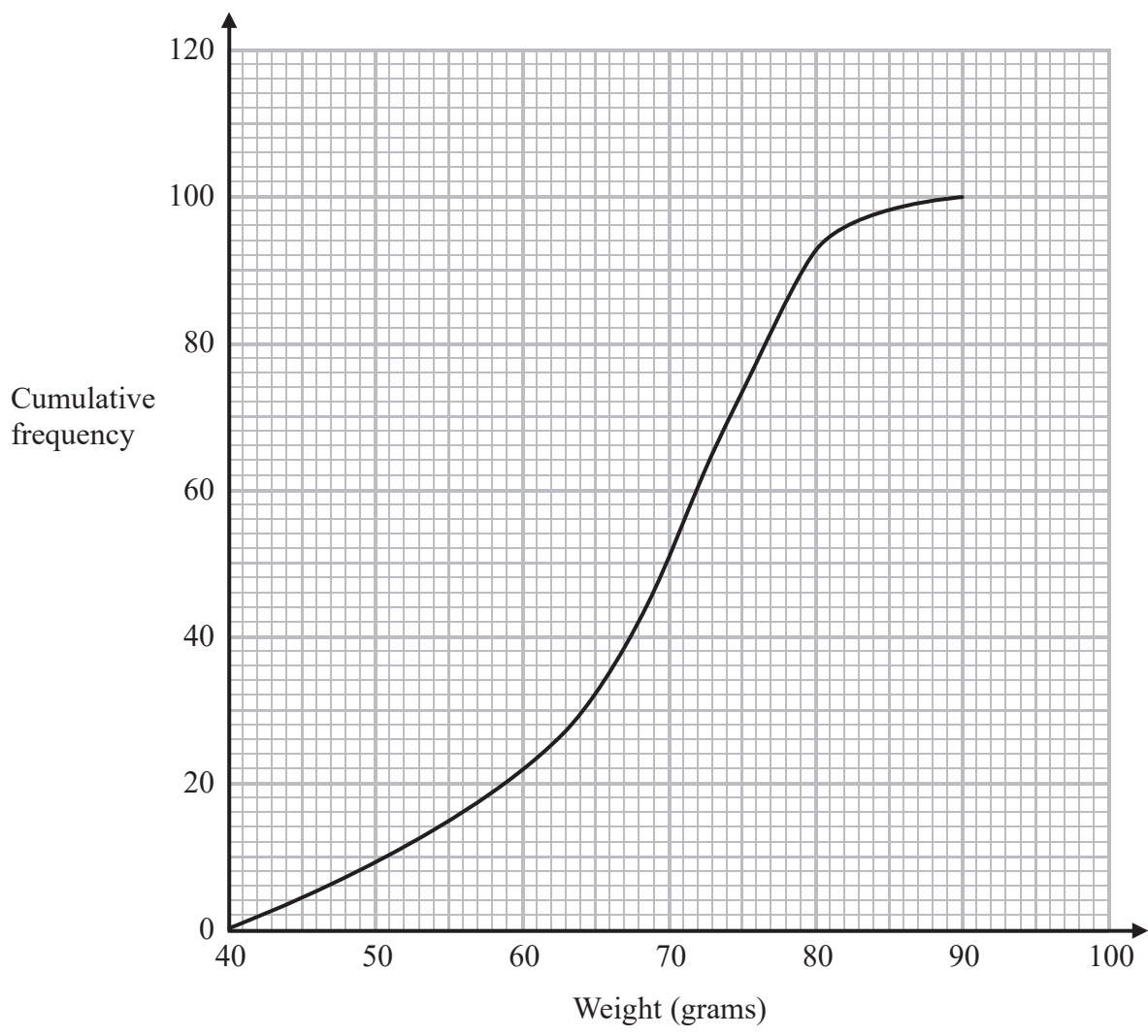
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P 5 6 1 8 2 A 0 1 3 2 4

10 The weights, in grams, of 100 letters sent by first class post on a Monday were recorded.
The cumulative frequency graph gives information about these letters.



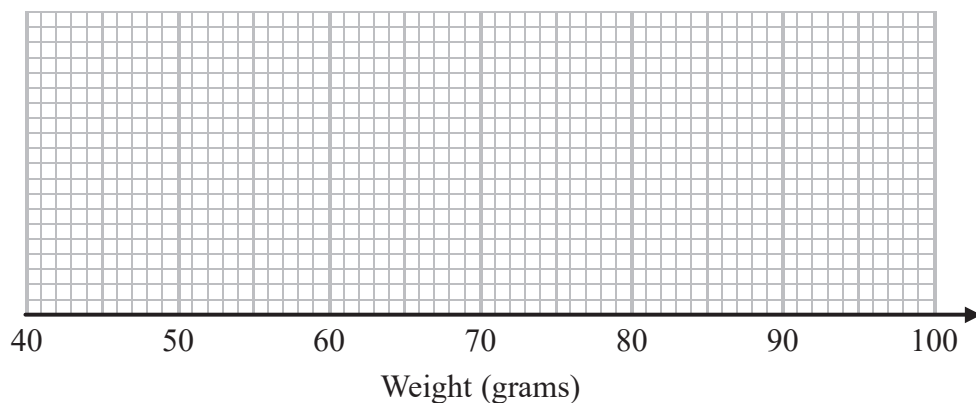
The least recorded weight was 45 grams.

The greatest recorded weight was 86 grams.

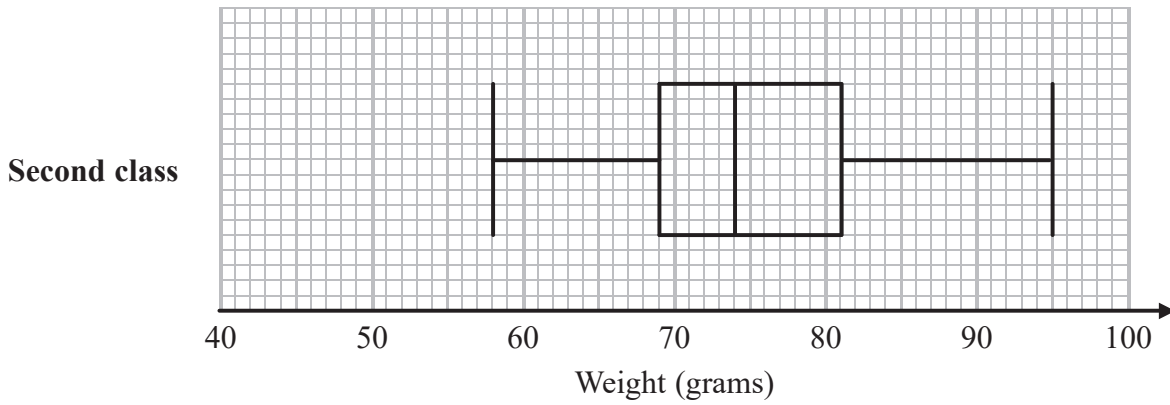
(a) On the grid, draw a box plot for the weights of the 100 letters.

(3)

First class



The box plot below gives information about the weights, in grams, of 100 letters sent by second class post on the same Monday.



(b) Compare the distributions of the weights.
You should write down three comparisons.

1.
.....

2.
.....

3.
.....

(3)

(Total for Question 10 is 6 marks)



11 Tony and Gary each ranked the performance of 10 hairdressers in a competition.

Here are their ranks.

Hairdresser	Tony's rank	Gary's rank
A	1	4
B	2	1
C	3	5
D	4	3
E	5	7
F	6	9
G	7	2
H	8	6
I	9	10
J	10	8

- (a) Calculate Spearman's coefficient of rank correlation for this information.
Give your answer correct to 3 decimal places.

.....
(3)

- (b) Interpret your answer to part (a) in the context of the information in the table.

.....
(1)

(Total for Question 11 is 4 marks)



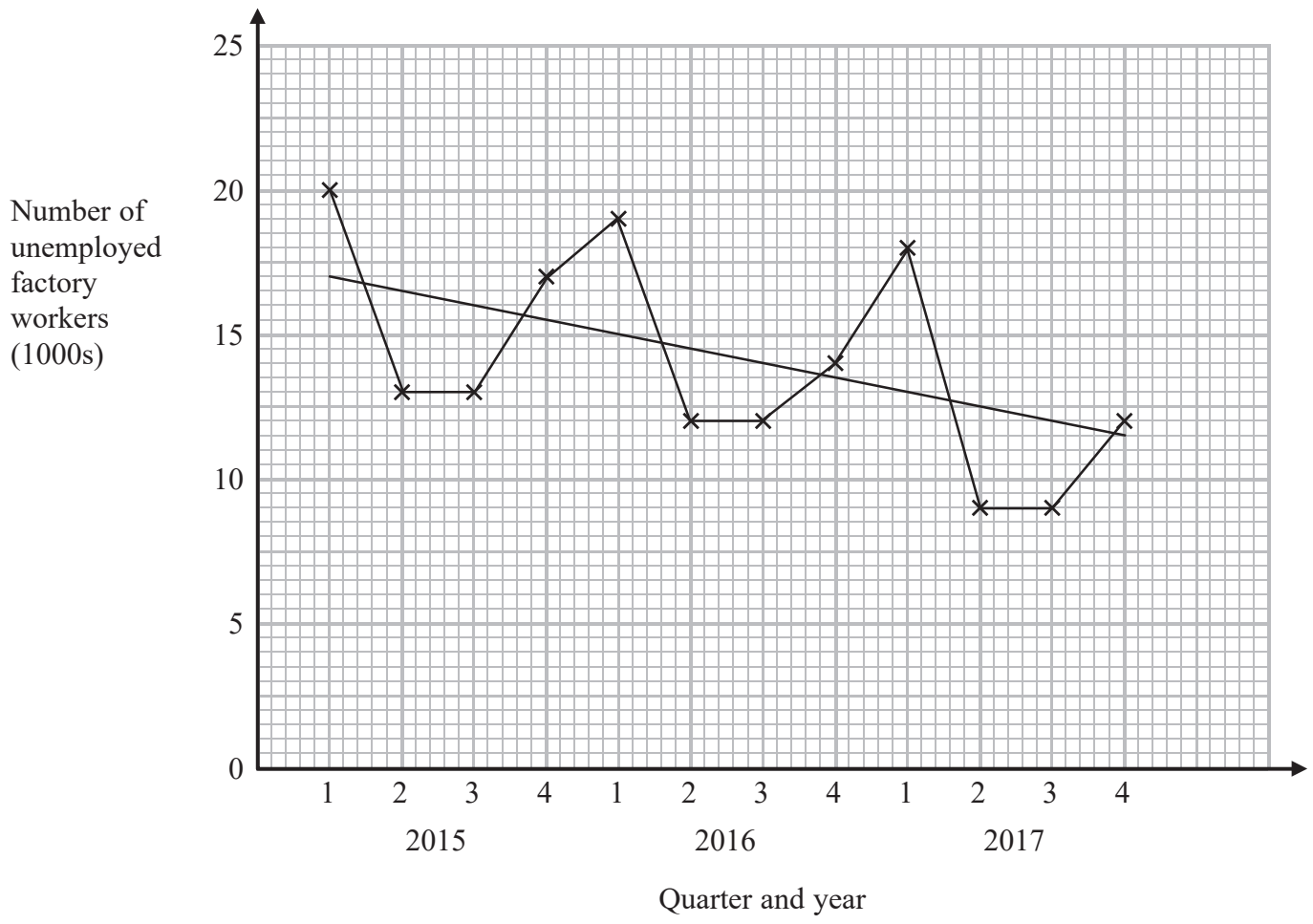
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12 The time-series graph gives information about the number of unemployed factory workers, in 1000s, for each quarter for the years 2015, 2016 and 2017.

A trend line for this information has been drawn on the grid.



(a) Describe the trend.

.....
(1)

(b) Calculate an estimate for the mean seasonal variation for quarter 1

.....
(2)

(Total for Question 12 is 3 marks)



13 Some people took an IQ test.

The table below gives some information about these people and their results in the IQ test.

	Mean score	Standard deviation
Female	102	4
Male	98	3

Jane's score was 106

Her brother Greg's score was 104

Calculate the standardised score for Jane and for Greg.

Jane

Greg

(Total for Question 13 is 3 marks)



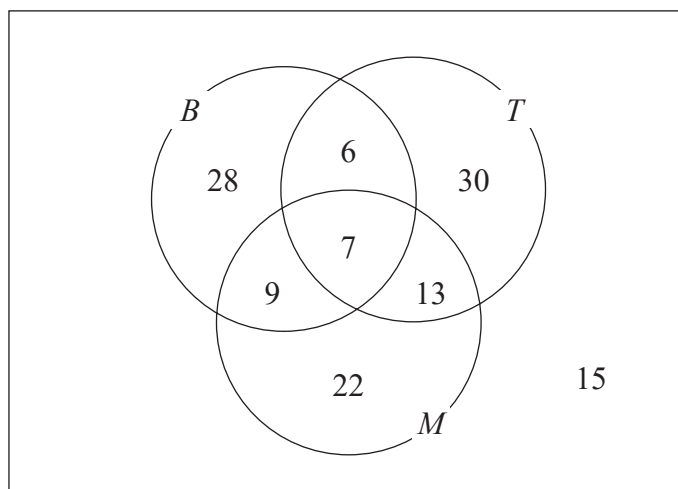
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14 The Venn diagram below gives information about the numbers of students studying 3 types of dances at a dance school.

Some students at the dance school study ballet dancing (B), tap dancing (T) and modern dancing (M).



(a) Find the total number of students at the dance school.

.....
(1)

One of the students at the dance school is chosen at random.

(b) Find the probability that this student

(i) studies all 3 types of dances,

.....

(ii) studies ballet dancing and tap dancing.

.....
(3)

Given that the student chosen studies ballet dancing,

(c) find the probability that this student also studies modern dancing.

.....
(2)

(Total for Question 14 is 6 marks)



15 A random variable X is normally distributed with mean 300 and standard deviation 5

(a) Find $P(X < 312)$

.....
(2)

(b) Find $P(305 < X < 312)$

.....
(3)

(Total for Question 15 is 5 marks)

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16 In a study of the distances students travel in order to get to college, a random sample of 20 students was taken.

The distance travelled, x km, and the time taken, t minutes, for each student in the sample to get to college were recorded.

The mean distance travelled was 4.535 km and the mean time taken was 15.15 minutes.

For the sample data

$$\sum xt = 1433.8 \quad S_{xx} = 82.4455 \quad S_{tt} = 306.55$$

- (a) Calculate the product-moment correlation coefficient for the sample data.
Give your answer correct to 3 decimal places.

You may use $S_{xt} = \sum xt - \frac{\sum x \sum t}{n}$

.....
(4)

- (b) Describe the type of correlation shown by your answer to part (a).

.....
(1)

(Total for Question 16 is 5 marks)



17 Two events A and B are such that $P(A) = \frac{1}{4}$, $P(B) = \frac{2}{5}$ and $P(A \cup B) = \frac{3}{5}$

(a) Find $P(A \cap B)$

.....
(2)

(b) Find $P(B | A)$

.....
(2)

Two events E and F are such that $P(E) = m$ and $P(F) = n$.

(c) (i) Given that $P(E \text{ or } F) = m + n$, what does this tell you about the events E and F ?

.....
(ii) Given that $P(E \text{ and } F) = mn$, what does this tell you about the events E and F ?

.....
(2)

(Total for Question 17 is 6 marks)

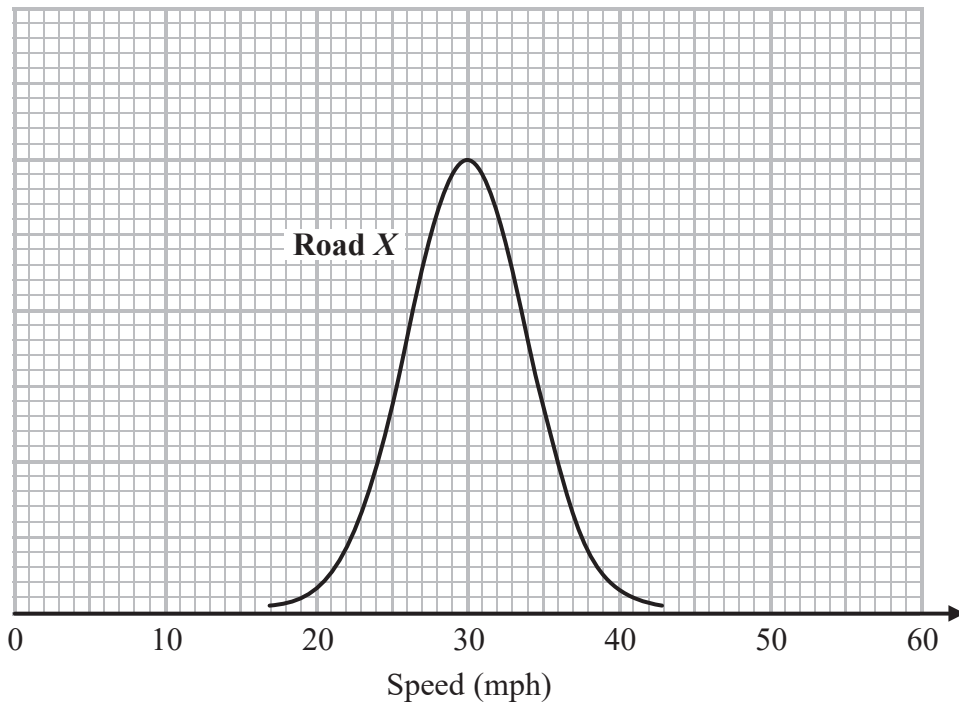


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18 The speeds, in miles per hour (mph), of cars on road X and on road Y were recorded.
 The speeds on road X and on road Y are normally distributed.
 The diagram below shows the distribution of the speeds on road X .



The mean and standard deviation of the speeds on road Y are given in the table.

	Mean	Standard deviation
Road Y	35	5

(a) On the grid above, sketch the normal distribution of the speeds on road Y .

(3)

(b) Compare the two distributions of speeds.
 You should give **two** comparisons.

(2)

(Total for Question 18 is 5 marks)



19 Items on a production line are checked for faults.

It is known that 10% of the items checked are faulty.

Ten items are selected at random from the production line.

(a) Work out the probability that exactly 2 of the items are faulty.

.....
(2)

(b) Work out the probability that 3 or more of the items are faulty.

.....
(3)

(Total for Question 19 is 5 marks)

TOTAL FOR PAPER IS 90 MARKS

