

Please check the examination details below before entering your candidate information

Candidate surname		Other names	
Pearson Edexcel Award	Centre Number	Candidate Number	
Monday 13 January 2020			
Morning (Time: 2 hours)		Paper Reference AST30/01	
Statistical Methods Level 3 Calculator allowed			
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** Sandeep wants to find information about cars caught speeding along a particular road.

He uses a database to collect a sample of the cars caught speeding along this road.

- (a) (i) Write down one **advantage** of taking a sample rather than a census.

(1)

- (ii) Write down a suitable sampling frame he could use.

(1)

Sandeep is using secondary data.

- (b) Write down one **disadvantage** of using secondary data.

(1)

Sandeep records the number of cars caught speeding along this road for each of 50 days.

The table shows his results.

Number of cars	Frequency
1	12
2	15
3	11
4	9
5	3

One of these 50 days is picked at random.

- (c) Work out the probability that more than 2 cars were caught speeding along this road on this day.

(2)

(Total for Question 1 is 5 marks)



- 2 One morning in winter, 15 people completed an obstacle course. These 15 people also completed the same obstacle course one morning in summer.

The table gives the time taken, in minutes, by each person to complete the course in winter and in summer.

	Time taken (in minutes)														
Winter	66	85	72	59	67	86	86	63	73	67	55	79	58	68	76
Summer	45	50	64	51	46	47	51	45	55	48	62	43	52	69	68

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

Winter

Summer

	4	
	5	
	6	
	7	
	8	

Key:

(4)



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

(2)

(Total for Question 2 is 6 marks)



P 6 3 0 5 2 A 0 5 2 4

3 Last Wednesday 60 men were working in an office.

James recorded for each man whether he was wearing a white shirt (W) or a blue shirt (B) or a tie (T).

Here are his results.

17 men were wearing a white shirt

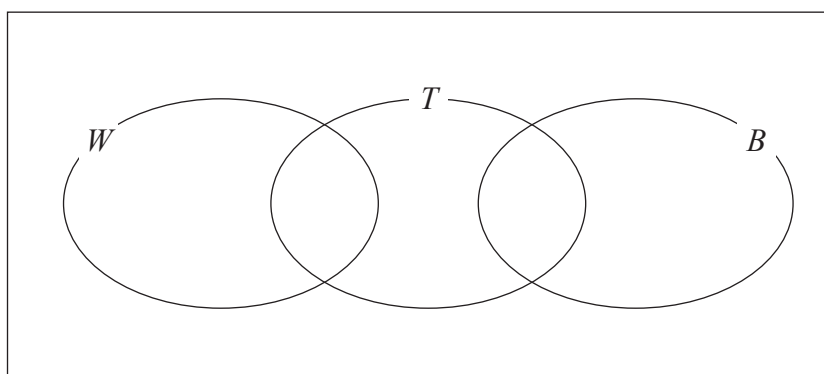
18 men were wearing a blue shirt

32 men were wearing a tie

3 men were wearing a white shirt and a tie

8 men were wearing a blue shirt and a tie

(a) Complete the Venn diagram for this information.



(3)

Two of the events shown in the Venn diagram are mutually exclusive.

(b) Which two?

..... and
(1)

One of the men working in the office last Wednesday is chosen at random.

(c) Find the probability that this man was not wearing a white shirt or a blue shirt or a tie.

.....
(1)

(d) Given that this man was wearing a tie, find the probability that he was wearing a white shirt or a blue shirt.

.....
(2)

(Total for Question 3 is 7 marks)

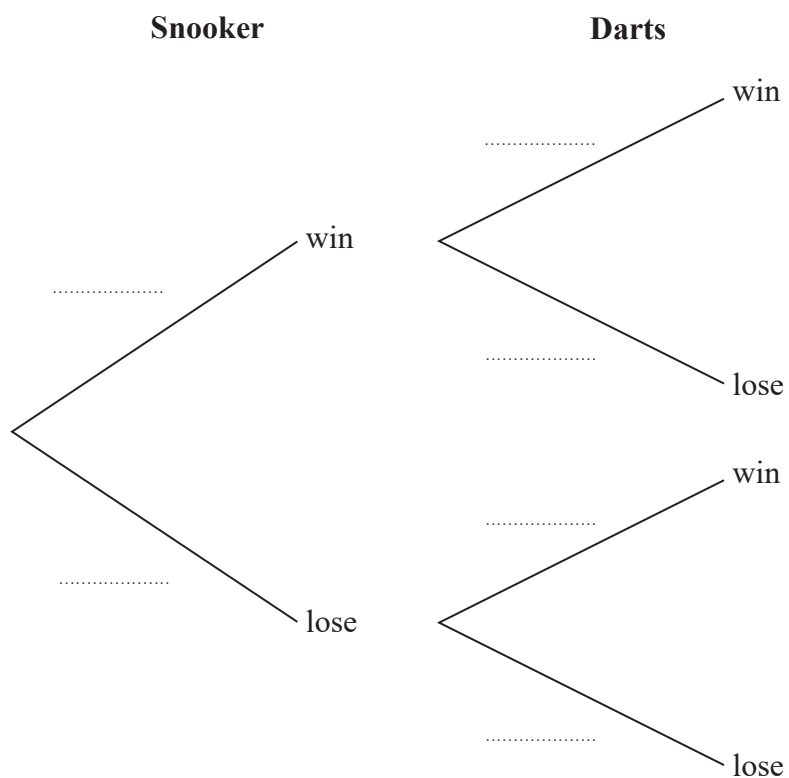


- 4 Alex is going to play a game of snooker and a game of darts.
He will win or lose either game.

The probability that Alex will win the game of snooker is 0.75

The probability that Alex will win the game of darts is 0.9

- (a) Complete the probability tree diagram.



(2)

- (b) Work out the probability that Alex will win exactly one of the two games.

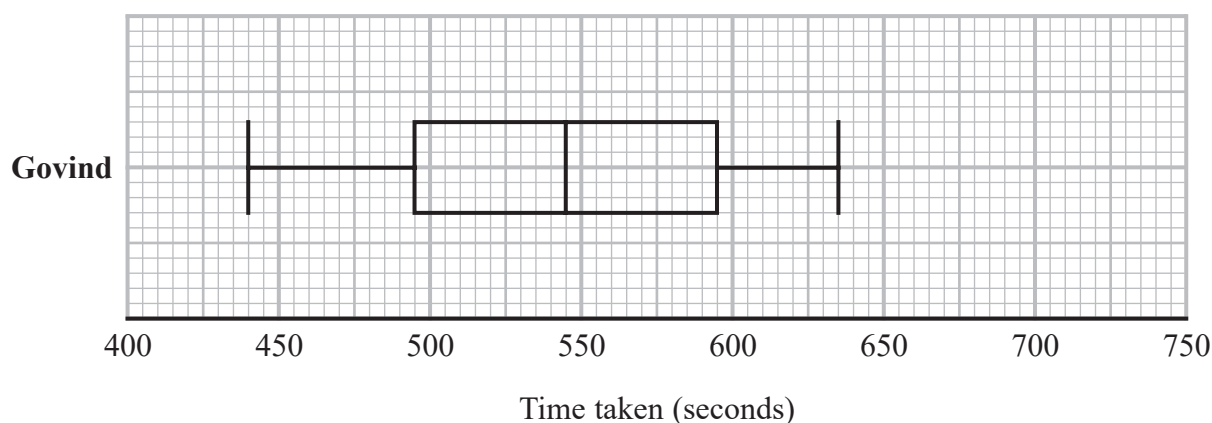
(3)

(Total for Question 4 is 5 marks)



- 5 Govind and Ben are swimmers. They both take part in some 400 m races.

The box plot shows information about the times, in seconds, taken by Govind in these races.



This table gives information about the times, in seconds, taken by Ben in these races.

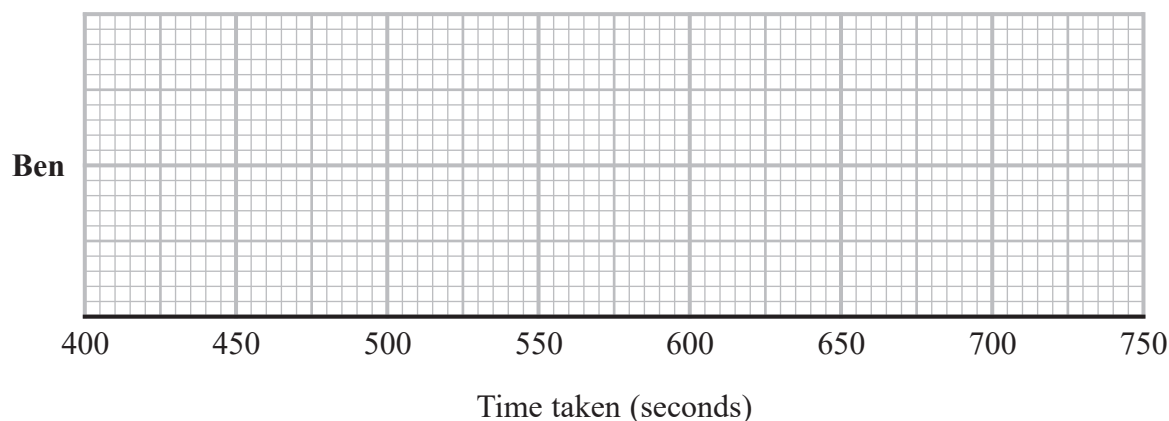
Shortest time	Lower quartile	Median	Upper quartile	Longest time
430	470	510	540	700

- (a) Show that 700 seconds is an outlier for Ben's times.

(3)

It is given that 430 seconds is not an outlier for Ben's times and that his second longest time is 625 seconds.

- (b) On the grid below, draw a box plot for the times taken by Ben in these races.



(3)



- (c) Compare the distributions of the times taken by Govind and by Ben.
Write down two comparisons.

1

.....

2

.....

(2)

(Total for Question 5 is 8 marks)

- 6 Anjali has a biased dice.

The probability that the dice will land on 4 is 0.35

Anjali is going to roll the dice 300 times.

Work out an estimate for the number of times the dice will land on 4

.....

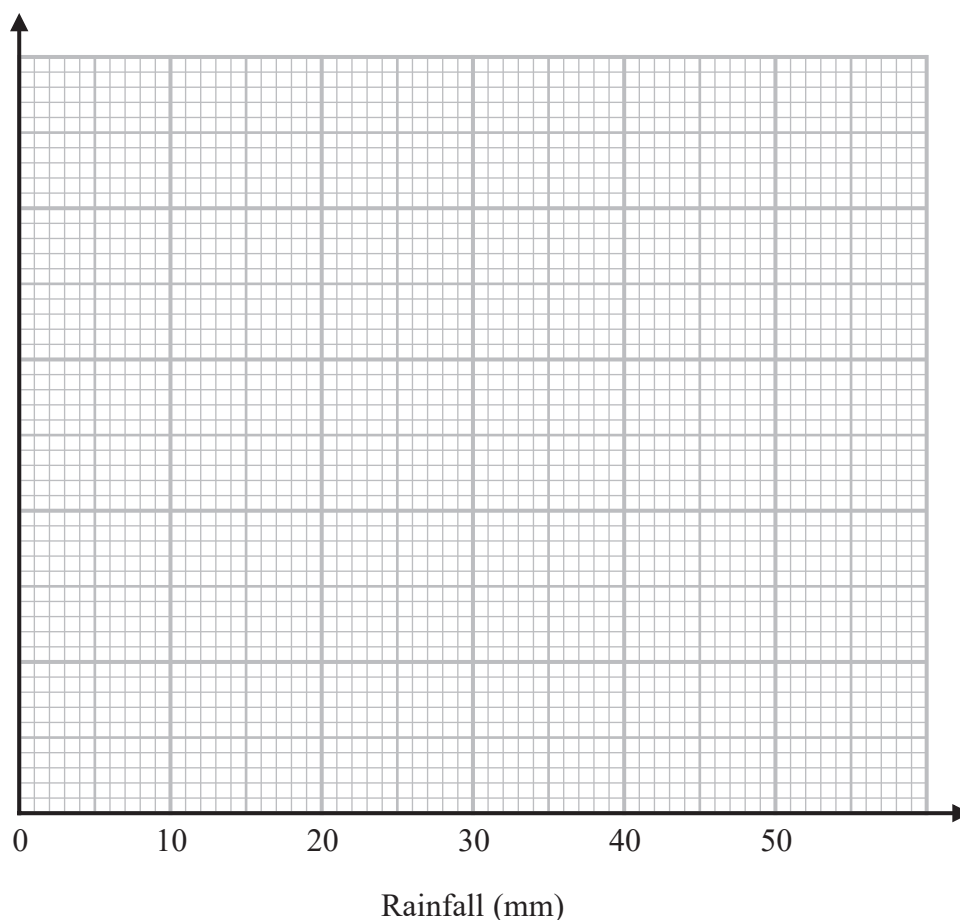
(Total for Question 6 is 2 marks)



- 7 The table gives information about the total rainfall, in millimetres, recorded at each of 135 weather stations one month.

Total rainfall (r mm)	Frequency (f)
$0 < r \leq 20$	18
$20 < r \leq 30$	46
$30 < r \leq 45$	63
$45 < r \leq 50$	8

- (a) Draw a histogram for this information.



(4)

- (b) Calculate an estimate for the mean rainfall.
Give your answer correct to one decimal place.

..... mm

(3)



- (c) Calculate an estimate for the standard deviation of the rainfall.
Give your answer correct to 2 decimal places.

You may use $\sum fr^2 = 137\,193.75$

..... mm

(2)

(Total for Question 7 is 9 marks)

- 8 Simran wants to estimate the number of squirrels in a forest.
She catches a sample of 40 squirrels from the forest and tags each squirrel.

Simran then returns the squirrels to the forest.

The next day Simran catches a sample of 45 squirrels.
She finds that 14 of these squirrels are tagged.

- (a) Work out an estimate for the number of squirrels in the forest.

(2)

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

(1)

(Total for Question 8 is 3 marks)



9 A shop sells bottles of drink.

The table gives information about the different types of drink and the sizes of the bottles that the shop sells.

		Type of drink			Total
		Fizzy	Juice	Water	
Size	Small	32	17	29	78
	Large	12	33	27	72
Total		44	50	56	150

Charles is going to take a sample of 45 of these bottles of drink stratified by type of drink and by size of bottle.

Work out the number of large bottles of water that should be in his sample.

(Total for Question 9 is 2 marks)



- 10 The table gives the average selling price of the cars in Lewis's car showroom for the first five months of 2018.

The table also gives some of the chain base index numbers, correct to one decimal place, for these prices.

Month	January	February	March	April	May
Average selling price (£)	18 450	17 945	17 785	17 575	17 145
Chain base index number		97.3	99.1	98.8	

- (a) Calculate the chain base index number for May.
Give your answer correct to one decimal place.

.....
(2)

- (b) Calculate the geometric mean of the four chain base index numbers.
Give your answer correct to one decimal place.
You must show your working.

.....
(2)

- (c) Interpret your answer in part (b) in the context of the question.

.....
(2)

(Total for Question 10 is 6 marks)



- 11 The times taken to complete a race by all the competitors in the race are normally distributed with a mean of 50 minutes and a standard deviation of 4 minutes.

Neville completed the race in 57 minutes.

- (a) Calculate Neville's standardised score for the race.

.....
(2)

Mark's standardised score for the race was -1.5

- (b) Calculate how long it took Mark to complete the race.

..... minutes
(2)

Oliver's standardised score for the race was -0.5

- (c) Who completed the race in the shorter time, Mark or Oliver?
Give a reason for your answer.

.....
(1)

(Total for Question 11 is 5 marks)



12 At a hospital, 10 adults each had their weight and their blood pressure recorded.

The table shows the ranks of the weights and the ranks of the blood pressures.

Rank 1 means the lowest weight and the lowest blood pressure.

Adult	A	B	C	D	E	F	G	H	I	J
Rank of weight	3	4	1	2	7	6	5	9	10	8
Rank of blood pressure	1	2	3	4	5	6	7	8	9	10

- (a) Calculate Spearman's coefficient of rank correlation for the information in the table.
You may use the blank rows in the table to help with your calculations.

.....
(3)

- (b) (i) Describe the correlation shown by your answer in part (a).

.....
(1)

- (ii) Interpret this correlation in the context of the information in the table.

.....
(1)

(Total for Question 12 is 5 marks)



13 Ravina works in a car showroom.

Every time she serves a customer, the probability that she sells a car to the customer is 0.2

On Monday afternoon Ravina serves 10 customers.

Find the probability that on Monday afternoon,

(a) Ravina sells no cars,

.....
(2)

(b) Ravina sells at most 1 car.

.....
(2)

(Total for Question 13 is 4 marks)



14 The pressure, p , of a gas is measured for 10 different volumes, v .

The data was summarised and it was found that

$$\sum p = 157.6 \quad \sum v = 170 \quad \sum pv = 1961 \quad S_{pp} = 1021.6 \quad S_{vv} = 660$$

(a) Calculate S_{pv}

You may use $S_{pv} = \sum pv - \frac{\sum p \sum v}{n}$

.....
(1)

(b) Calculate the product-moment correlation coefficient.
Give your answer correct to 2 significant figures.

.....
(3)

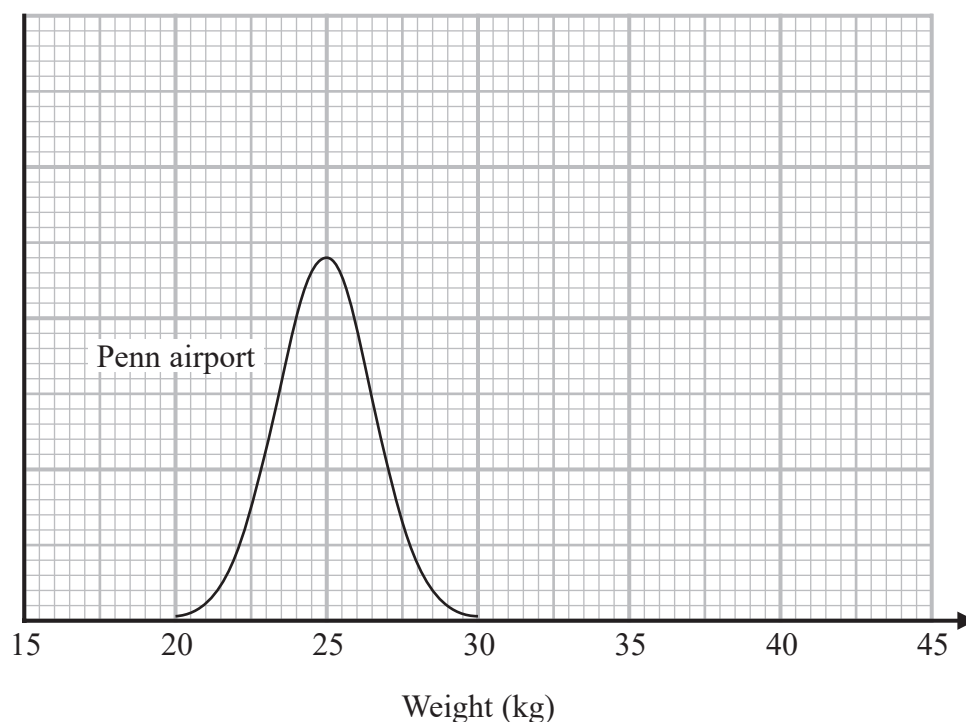
(c) Interpret, in the context of this question, your answer to part (b).

.....
(1)

(Total for Question 14 is 5 marks)



- 15 The weight, in kg, of each piece of luggage was recorded at Penn airport and at Himley airport. At each of these airports, these weights are normally distributed.
- The diagram shows the normal distribution of the weights at Penn airport.



The weights of the luggage at Himley airport have a mean of 35 kg and a standard deviation of 1 kg.

- (a) On the grid above, sketch the normal distribution of the weights of the luggage at Himley airport. (3)
- (b) Compare the two distributions of the weights of luggage. You should give two comparisons.

1.....

.....

2.....

.....

(2)

(Total for Question 15 is 5 marks)



16 X , Y and Z are three events such that $P(X) = 0.25$, $P(Y) = 0.4$ and $P(Z) = 0.2$

X and Y are mutually exclusive events.

Y and Z are independent events.

(a) Find

(i) $P(X \text{ or } Y)$

.....
(1)

(ii) $P(Y \text{ and } Z)$

.....
(1)

A and B are two events such that $P(A) = 0.5$ $P(B) = 0.35$ $P(A|B) = 0.8$

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

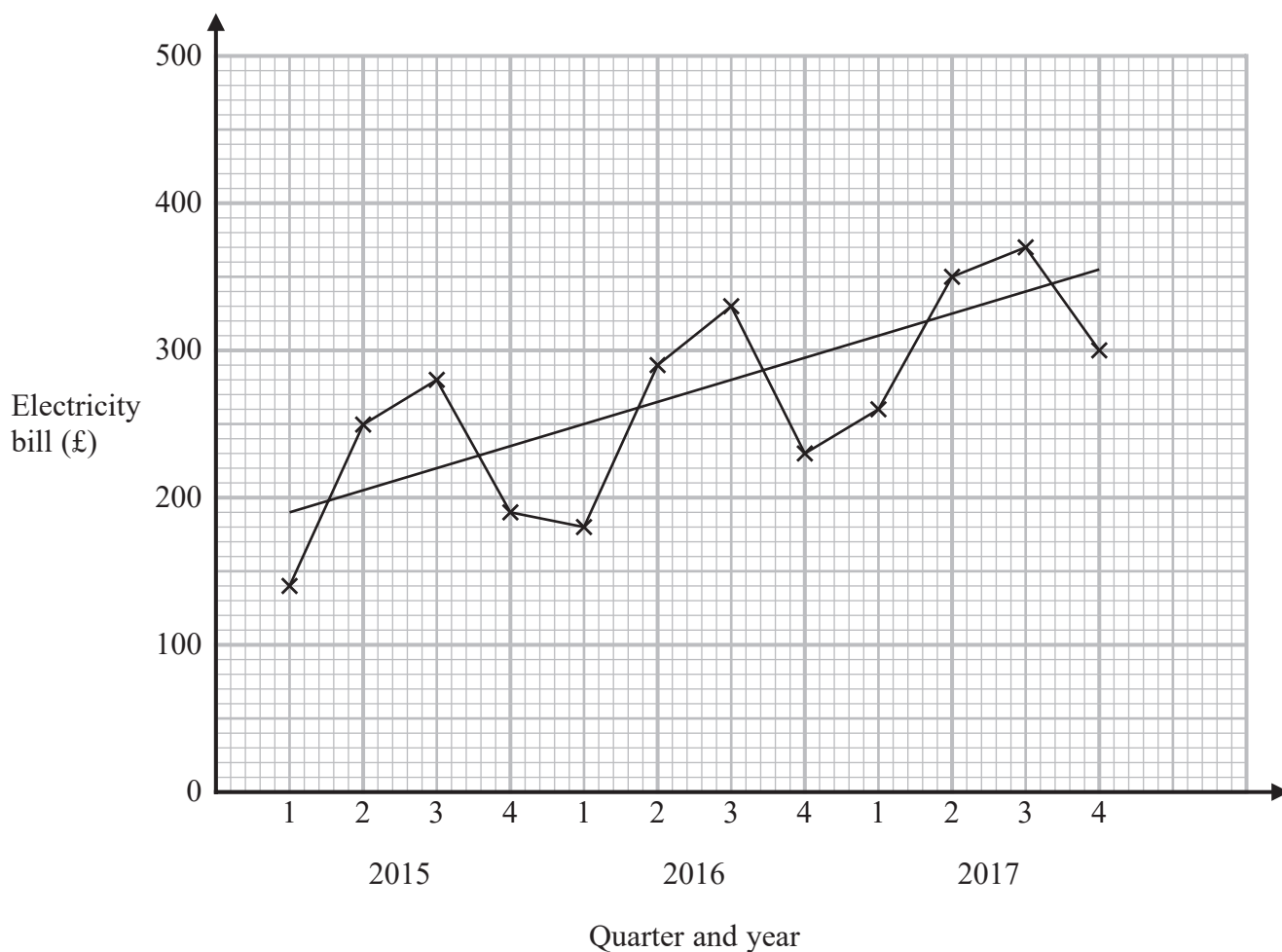
.....
(3)

(Total for Question 16 is 5 marks)



- 17 The time-series graph gives information about the electricity bill, in £, for a shop each quarter from 2015 to 2017.

The trend line for the 4-point moving averages for this information has also been drawn on the grid.



- (a) Describe the trend.

(1)

- (b) Work out an estimate for the mean seasonal variation for quarter 3

£.....

(2)

(Total for Question 17 is 3 marks)



18 Cables are made in a factory.

The breaking tensions of these cables are normally distributed with a mean of 5000 N and a standard deviation of 120 N.

One of the cables made in the factory is chosen at random.

Work out the probability that this cable will have a breaking tension of

(a) less than 5180 N,

.....
(2)

(b) more than 5210 N.

.....
(3)

(Total for Question 18 is 5 marks)

TOTAL FOR PAPER IS 90 MARKS



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