Write your name here

Surname	Other names

Pearson Edexcel Award

Centre Number	Candidate Number

Statistical Methods

Level 3
Calculator allowed

Wednesday 10 May 2017 – 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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P 4 8 3 6 6 A 0 1 2 8

Pearson

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		

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The director of a company is planning to make changes in the staff canteen.

He wants to find out what changes the staff would like.

He decides to take a census rather than a sample.

(a) What is the population he should use for the census?

.....

(1)

(b) Give one advantage and one disadvantage of taking a census.

Advantage .....

.....

Disadvantage .....

.....

(2)

(Total for Question 1 is 3 marks)

2 The table gives information about the 120 teachers in a school.

		Age		
		Under 30	**30 to 50**	**Over 50**
Gender	**Male**	27	20	12
	Female	16	34	11

The headteacher of the school is going to take a sample of 30 of these teachers stratified by gender and by age.

Calculate the number of males aged over 50 that should be in the sample.

.....

(Total for Question 2 is 2 marks)

3 Astrid wants to estimate the number of dolphins that are known to be feeding in a region of an ocean.

She catches a sample of 30 dolphins, tags them and releases them back into the ocean.

The following week, she takes a second sample of 40 dolphins and finds 6 are tagged.

(a) Work out an estimate for the number of dolphins in this region of the ocean.

.....

(2)

(b) Write down an assumption you have made.

.....

.....

.....

.....

(1)

(Total for Question 3 is 3 marks)

4 Bill and Ben want to investigate the heights of sunflower plants.

Bill used the internet to collect information about the heights of sunflower plants.
Ben measured the heights of sunflower plants in his garden.

(a) (i) Write down one advantage of **Bill's** method of data collection.

.....

.....

(ii) Write down one advantage of **Ben's** method of data collection.

.....

.....

(2)

Here are their results.

All heights are given to the nearest cm.

Bill	206	210	218	222	227	228
	229	234	236	238	239	
Ben	194	198	203	209	212	215
	218	219	222	225	231	

(b) Draw an ordered back-to-back stem and leaf diagram for the heights of these sunflower plants.

Bill		**Ben**
	19	
	20	
	21	
	22	
	23	

Key:

(3)

(c) Compare the distribution of the heights of Bill's sunflower plants with the distribution of the heights of Ben's sunflower plants.

Write down two comparisons.

1 .....

.....

2 .....

.....

(2)

(Total for Question 4 is 7 marks)

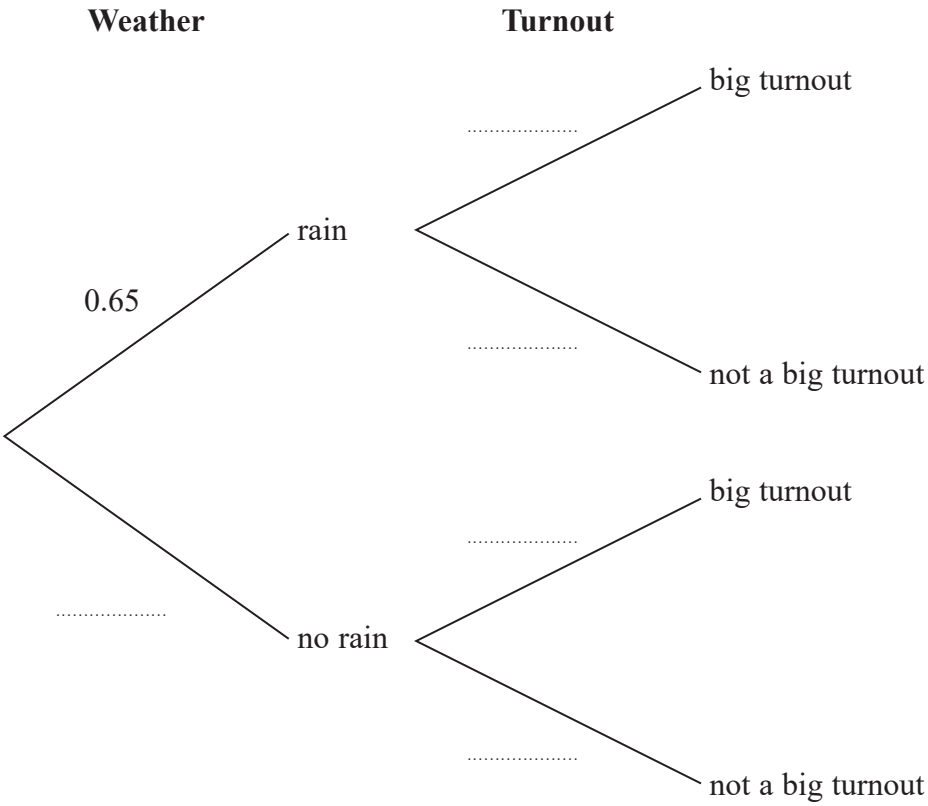
5 The number of spectators at Wimbledon depends upon the weather.

When there are very many spectators this is called a big turnout.

On a day when there is rain the probability of a big turnout is 0.3
On a day when there is no rain the probability of a big turnout is 0.95

On a particular day the probability that there will be rain is 0.65

(a) Complete the probability tree diagram for this information.



(2)

(b) Work out the probability that on this particular day

(i) there is rain and there is a big turnout,

.....

(ii) there is a big turnout.

.....

(4)

(Total for Question 5 is 6 marks)

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6 Patty recorded the distances, in metres, some golfers hit a golf ball.

The distances the golfers hit the golf ball are normally distributed with mean 185 metres and standard deviation 5 metres.

Veronica and Holly are two of these golfers.

Veronica hit the golf ball a distance of 191 metres.

(a) Calculate Veronica's standardised score.

.....

(2)

Holly's standardised score is −1.4

(b) Work out the distance Holly hit the golf ball.

..... m

(2)

(Total for Question 6 is 4 marks)

7 At a talent show, 10 people entered the dance competition.

Judge X and Judge Y each put the dancers in rank order.

Rank 1 is for the best dancer.

Here are the results.

Dancer	A	B	C	D	E	F	G	H	I	J
Judge X	1	9	3	6	8	2	7	4	10	5
Judge Y	8	4	7	1	3	5	10	9	6	2

(a) Calculate Spearman's coefficient of rank correlation for this information.
You may use the blank rows in the table to help with your calculations.
Give your answer correct to 2 decimal places.

.....

(3)

(b) (i) Identify the type of correlation shown by your answer in part (a).

.....

(ii) Interpret your answer in the context of the information in the table.

.....

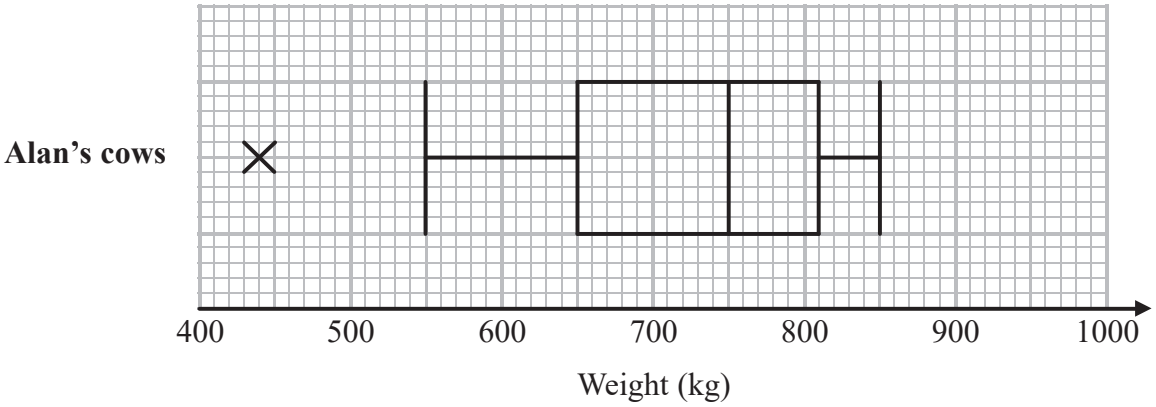
.....

(2)

(Total for Question 7 is 5 marks)

8 Two farmers, Alan and Brett, have cows on their farms.

This box plot shows information about the weights, in kg, of the cows on Alan's farm.



(a) (i) Write down the median weight.

..... kg

(ii) Find the interquartile range of the weights.

..... kg

(2)

Brett says that Alan should not have marked an outlier on his box plot.

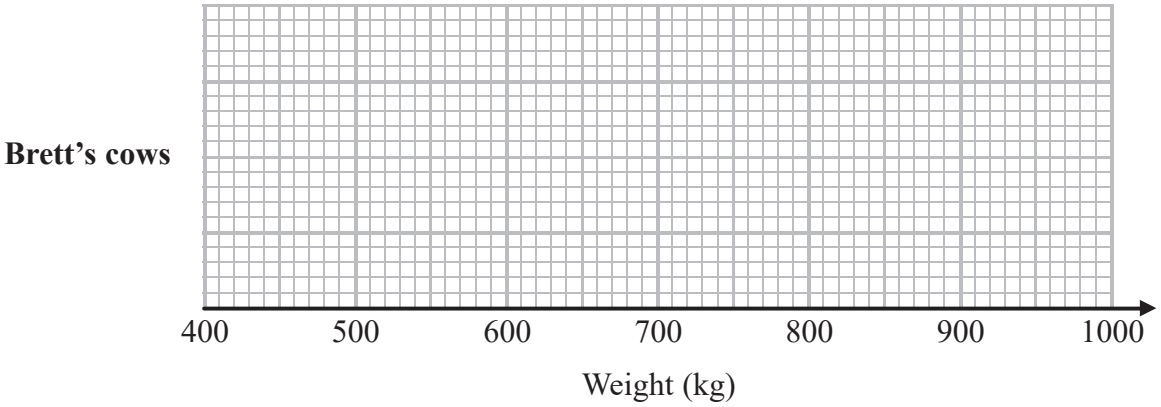
(b) Is Brett correct?
You must show your working.

(3)

This table gives information about the weights, in kg, of the cows on Brett's farm.

Least	Lower quartile	Median	Upper quartile	Greatest
510	610	720	830	930

(c) On the grid, draw a box plot for this information.



(3)

(d) Compare the distribution of the weights of Alan's cows with the distribution of the weights of Brett's cows.
Write down **two** comparisons.

.....

.....

.....

.....

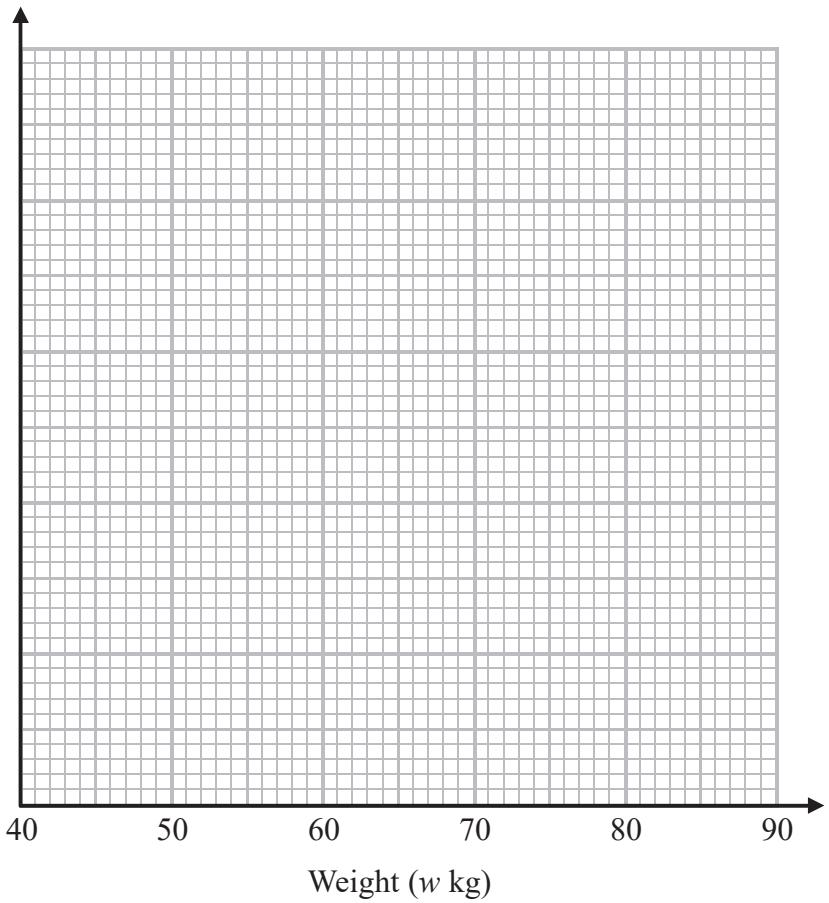
(2)

(Total for Question 8 is 10 marks)

9 The table gives information about the weights, w kg, of 120 Great Dane dogs.

Weight (w kg)	Frequency (f)
$45 < w \leqslant 50$	10
$50 < w \leqslant 55$	22
$55 < w \leqslant 65$	35
$65 < w \leqslant 75$	33
$75 < w \leqslant 80$	15
$80 < w \leqslant 85$	5

(a) Draw a histogram for the information in the table.



(4)

(b) Calculate an estimate for the mean weight.
Give your answer correct to 2 decimal places.

..... kg

(3)

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

You may use $\sum fw^2 = 495\,025$

..... kg

(2)

(Total for Question 9 is 9 marks)

10 Barack has two fair 6-sided dice.

He rolls both dice together and he adds the two numbers on the tops of the two dice to get his total score.

(a) Complete the sample space diagram to show all the possible total scores.

		Dice 1					
		1	**2**	**3**	**4**	**5**	**6**
Dice 2	**1**						
	2						
	3						
	4						
	5						
	6						

(1)

(b) Find the probability that Barack gets a total score of 8

.....

(1)

Barack rolls both dice together 200 times.

(c) Find an estimate for the number of times he gets a total score of 8

.....

(2)

(Total for Question 10 is 4 marks)

11 The table gives the average selling price of the bicycles in Bradley's Cycle shop over a period of 5 years.

The table also gives some of the chain base index numbers, correct to 1 decimal place, for these prices.

Year	2010	2011	2012	2013	2014
Average selling price (£)	439	450	523	594	655
Chain base index number		102.5	116.2		

(a) Interpret the value 116.2 in the table.

.....

.....

(1)

(b) Calculate, to 1 decimal place, the chain base index numbers for 2013 and 2014.

....

(2)

(c) Calculate the geometric mean of the four chain base index numbers.

.....

(2)

(d) What does your answer to part (c) tell you?

.....

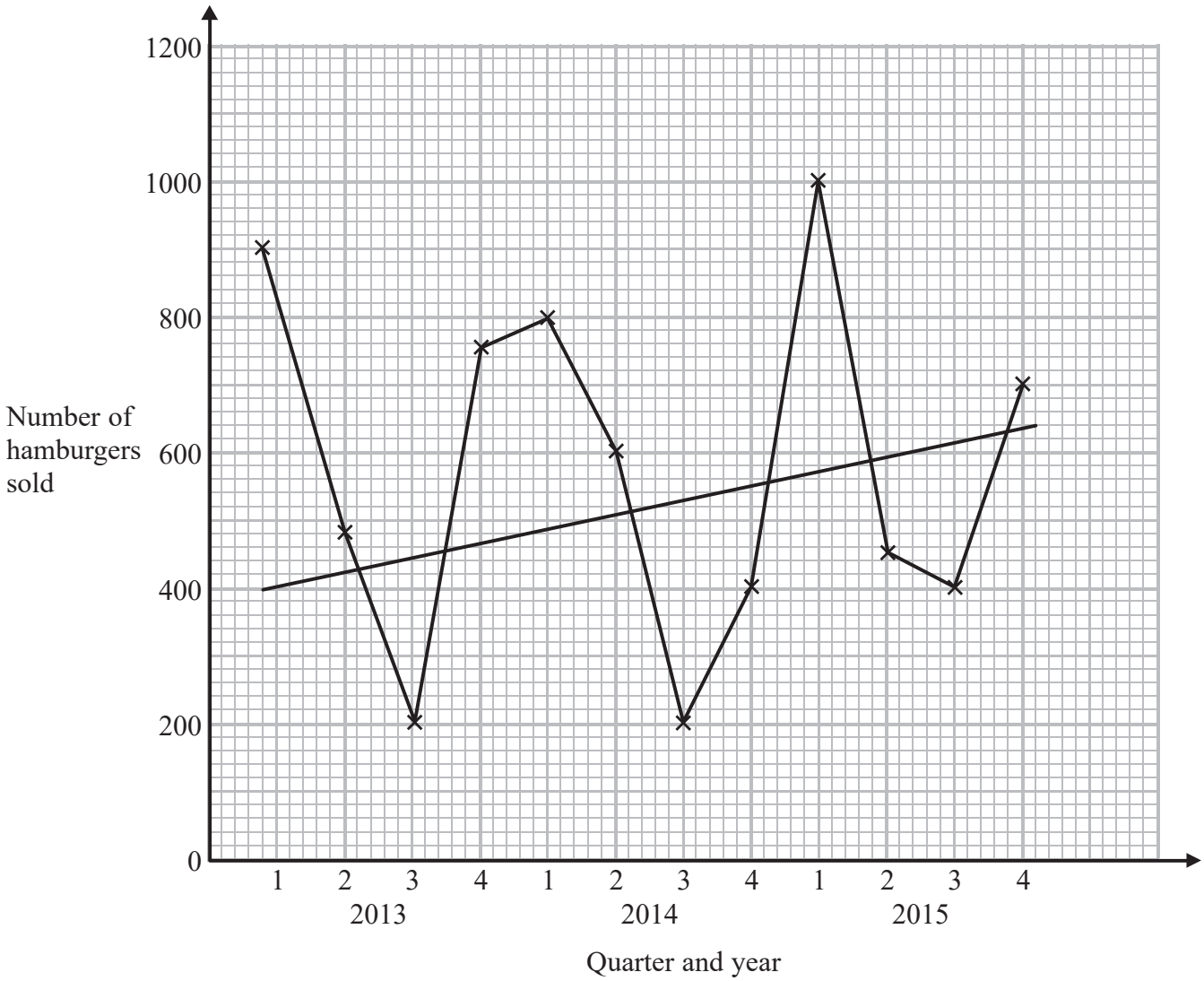
.....

(2)

(Total for Question 11 is 7 marks)

12 The time-series graph gives information about the total number of hamburgers sold each quarter from a market stall from 2013 to 2015.

A trend line has also been drawn on the graph.



(a) Describe the trend.

.....

(1)

(b) Work out the seasonal variation for quarter 2 of 2015.

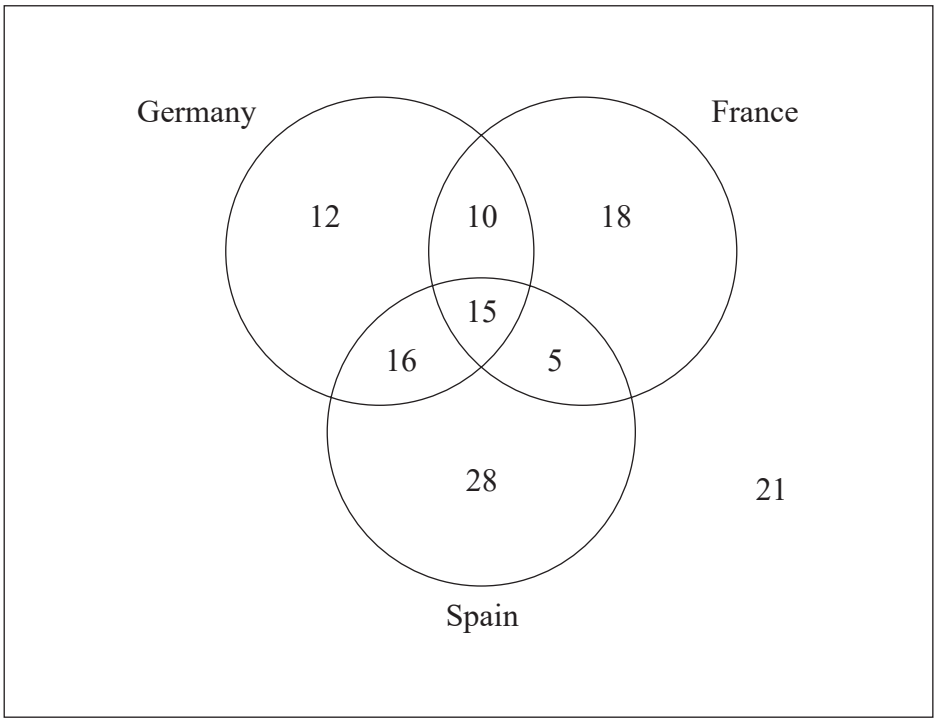
.....

(2)

(Total for Question 12 is 3 marks)

13 A group of 125 people were asked if they went to any of Germany, France or Spain last year.

The Venn diagram gives information about the numbers of these people who went to these three countries.



One of the people asked is to be chosen at random.

(a) Find the probability that this person went to both Germany and Spain.

.....

(2)

One of the people asked is to be chosen at random.

(b) Given that this person went to France, find the probability that this person also went to Germany.

.....

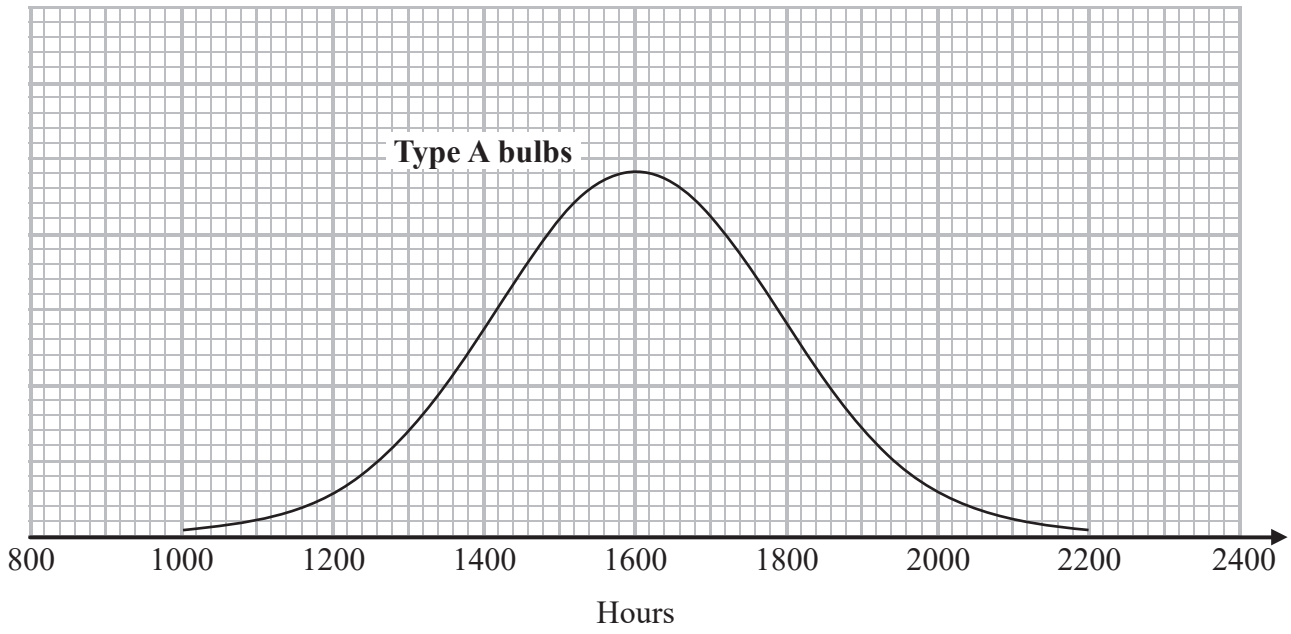
(2)

(Total for Question 13 is 4 marks)

14 Two types of light bulb are produced in a factory, Type A and Type B.

Type A bulbs have lifespans which are normally distributed.

The diagram shows the distribution of the lifespans of Type A bulbs.



(a) Use the information in the diagram to complete the table.

	Mean (hours)	Standard deviation (hours)
Type A bulbs	.....	.....

(2)

Type B bulbs also have lifespans which are normally distributed.

The mean and standard deviation of the lifespans, in hours, of Type B bulbs are given in the following table.

	Mean (hours)	Standard deviation (hours)
Type B bulbs	1800	100

(b) On the grid above, sketch the normal distribution of the lifespans for Type B bulbs.

(2)

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(c) Compare the two distributions.
You should give **two** comparisons.

.....

.....

.....

.....

(2)

(Total for Question 14 is 6 marks)

15 A, B and C are three events.

$P(A) = 0.4$ $P(B) = 0.2$ $P(A \cap C) = 0.04$ $P(B \cup C) = 0.44$

The events A and B are mutually exclusive.

The events B and C are independent.

(a) Find $P(A \text{ or } B)$

.....

(1)

(b) Find $P(B \mid C)$

.....

(1)

(c) Find $P(C)$

.....

(3)

(Total for Question 15 is 5 marks)

16 It is known that in Fred's cafe 2 out of every 5 customers order coffee with their breakfast.

One morning 10 customers in Fred's cafe order breakfast.

Find the probability that exactly 6 of these customers ordered coffee with their breakfast.
Give your answer correct to 3 significant figures.

.....

(Total for Question 16 is 3 marks)

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17 The waist circumferences of males aged 20 to 29 years old are normally distributed with mean 92.5 cm and standard deviation 13.7 cm.

Using the standard normal distribution tables, find the probability that a male aged 20 to 29 years old chosen at random will have a waist circumference between 80 cm and 100 cm.

.....

(Total for Question 17 is 5 marks)

18 x and y are statistical variables with the following summary data.

$\sum x = 367$ $\sum x^2 = 33\,845$ $S_{xy} = 620$ $S_{yy} = 826$ $n = 6$

(a) Calculate S_{xx}

Give your answer correct to 1 decimal place.

You may use $S_{xx} = \sum x^2 - \dfrac{\left(\sum x\right)^2}{n}$

.....

(1)

(b) (i) Calculate the product-moment correlation coefficient.
Give your answer correct to 3 significant figures.

.....

(ii) Identify the type of correlation shown by your answer.

.....

(3)

(Total for Question 18 is 4 marks)

TOTAL FOR PAPER IS 90 MARKS

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