

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 16 January 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  $\pi$  button, take the value of  $\pi$  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 Adrian is going to investigate the age at which people in Wales who smoke started smoking.  
It would be difficult for Adrian to use a census.

(a) Write down a reason why.

(1)

Adrian decides to use a sample.

(b) Describe the population for his sample.

(1)

Adrian is going to obtain primary data from his sample.

(c) Explain how Adrian can do this.

(1)

(Total for Question 1 is 3 marks)



2 The speeds, in miles per hour (mph), of cars on road A and on road B were recorded.

Here are the results for 15 cars on each road.

Speed (mph)															
<b>Road A</b>	73	52	79	66	86	67	55	70	82	76	64	56	67	77	83

Speed (mph)															
<b>Road B</b>	52	62	72	66	47	53	64	50	70	49	59	47	67	56	55

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

Road A		Road B
	4	
	5	
	6	
	7	
	8	

**Key:**

**Key:**

(4)



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(b) Compare the two distributions.  
Write down two comparisons.

1 .....

2 .....

(2)

**(Total for Question 2 is 6 marks)**



- 3 The table gives information about the weights, in kg, of 90 rabbits.

Weight ( $w$ kg)	Frequency
$0 < w \leq 2$	12
$2 < w \leq 4$	21
$4 < w \leq 6$	39
$6 < w \leq 8$	18

- (a) The weights are examples of which type of data?

.....  
(1)

- (b) Calculate an estimate for the mean weight of these rabbits.

..... kg  
(3)

- (c) Calculate an estimate for the standard deviation of the distribution of these weights.  
Give your answer correct to 3 significant figures.

You may use  $\sum fx^2 = 2058$

..... kg  
(2)

**(Total for Question 3 is 6 marks)**



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4 A clinic recorded the blood group of a sample of 250 blood donors who gave blood during a six month period.

The two-way table gives information about these 250 blood donors.

	Blood group				Total
	A	B	O	AB	
Male	37	27	18	38	120
Female	33	29	25	43	130
Total	70	56	43	81	250

Sandeep is going to take a sample of 50 of these donors stratified by gender and by blood group.

(a) Work out the number of females with blood group O that should be in his sample.

.....  
(2)

During the six month period, 9000 people gave blood at this clinic.

(b) Work out an estimate for the number of males with blood group AB giving blood at the clinic during this period.

.....  
(2)

**(Total for Question 4 is 4 marks)**



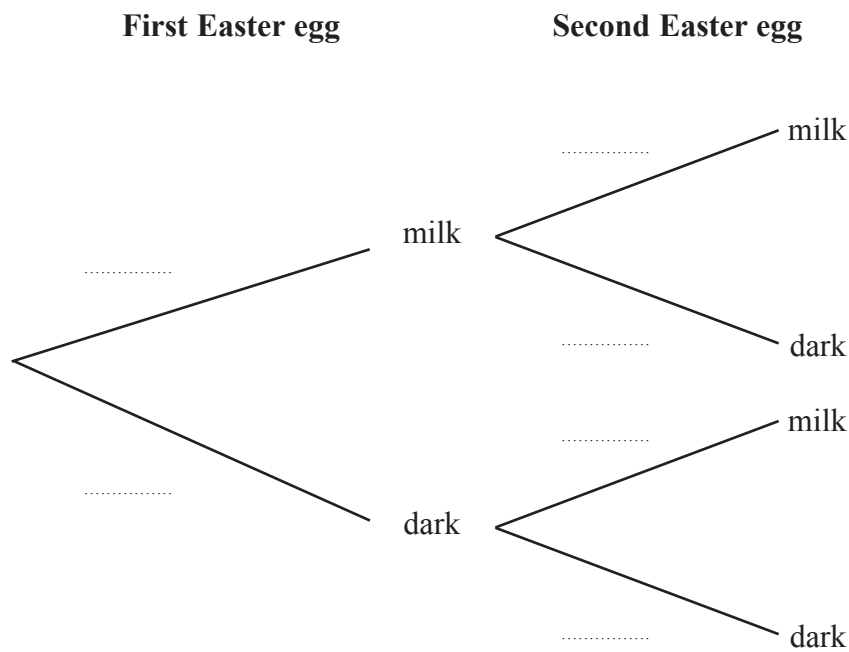
5 Ravina is given two Easter eggs.

The first Easter egg contains 7 milk chocolates and 3 dark chocolates only.

The second Easter egg contains 4 milk chocolates and 5 dark chocolates only.

Ravina takes at random one chocolate from each Easter egg.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that both chocolates are milk.

.....  
(2)

(c) Work out the probability that one of the chocolates is milk and the other chocolate is dark.

.....  
(3)

**(Total for Question 5 is 7 marks)**





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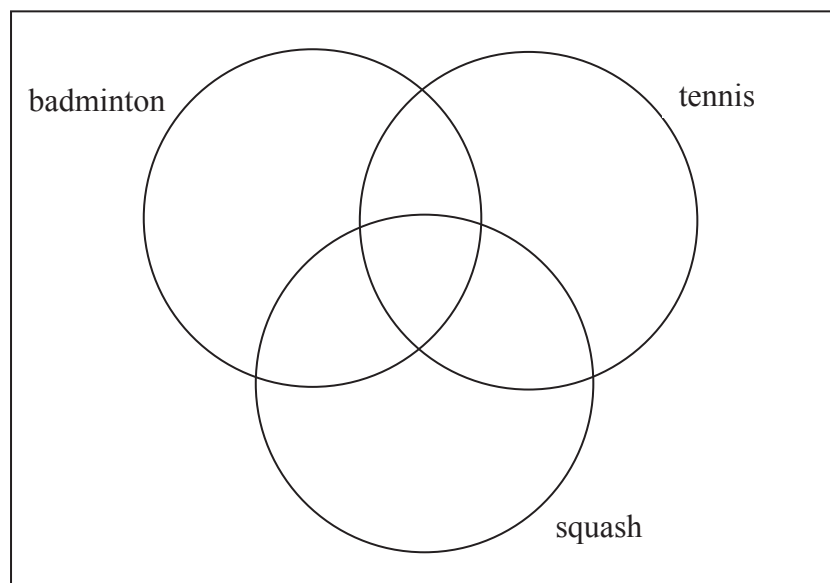
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6 90 people were asked which racket sport they play.

Their replies show that

- 33 play badminton
- 35 play tennis
- 38 play squash
- 13 play badminton and play squash
- 11 play badminton and play tennis
- 12 play tennis and play squash
- 5 play badminton and play tennis and play squash

(a) Complete the Venn diagram for this information.



(4)

One of the 90 people is chosen at random.

(b) Find the probability that this person plays exactly one of these racket sports.

(2)

(Total for Question 6 is 6 marks)



- 7 The table gives information about the average fees per year, in £, for private schools for each year from 2011 to 2015.

The table also gives the chain base index numbers, correct to one decimal place, for 2012, for 2013 and for 2014.

Year	2011	2012	2013	2014	2015
Average fee per year (£)	11 545	11 975	12 185	12 345	12 850
Chain base index number		103.7	101.8	101.3	.....

- (a) Calculate the chain base index number for 2015.  
Give your answer correct to one decimal place.

.....  
(2)

- (b) Calculate the geometric mean of the chain base index numbers for 2012, 2013, 2014 and 2015.  
Give your answer correct to one decimal place.  
You must show your working.

.....  
(2)

- (c) Describe what the geometric mean shows about the average fees per year for private schools during this period.

.....  
(2)

(Total for Question 7 is 6 marks)



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8 David wants to estimate the number of turtles in a lake.

He catches a sample of 60 turtles, marks each turtle with some paint and puts them back into the lake.

A week later he catches a sample of 70 turtles from the lake.

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

(a) Work out an estimate for the number of turtles in the lake.

.....  
(2)

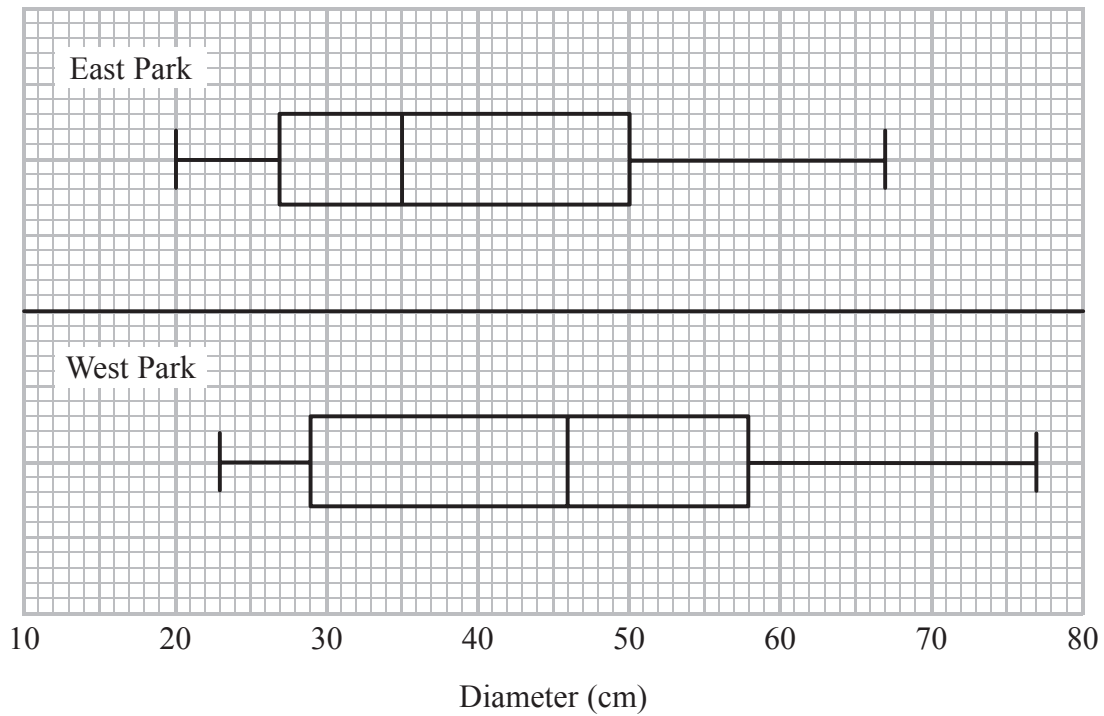
(b) Write down an assumption you have made.

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

**(Total for Question 8 is 3 marks)**



9 The box plots show information about the diameters, in cm, of some trees in two parks.



Compare the distributions of the diameters.

Write down three comparisons.

1 .....

2 .....

3 .....

(Total for Question 9 is 3 marks)



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10 There are 15 beads in a jar.

9 of the beads are blue and the remaining beads are red.

Dieter takes at random two beads from the jar.

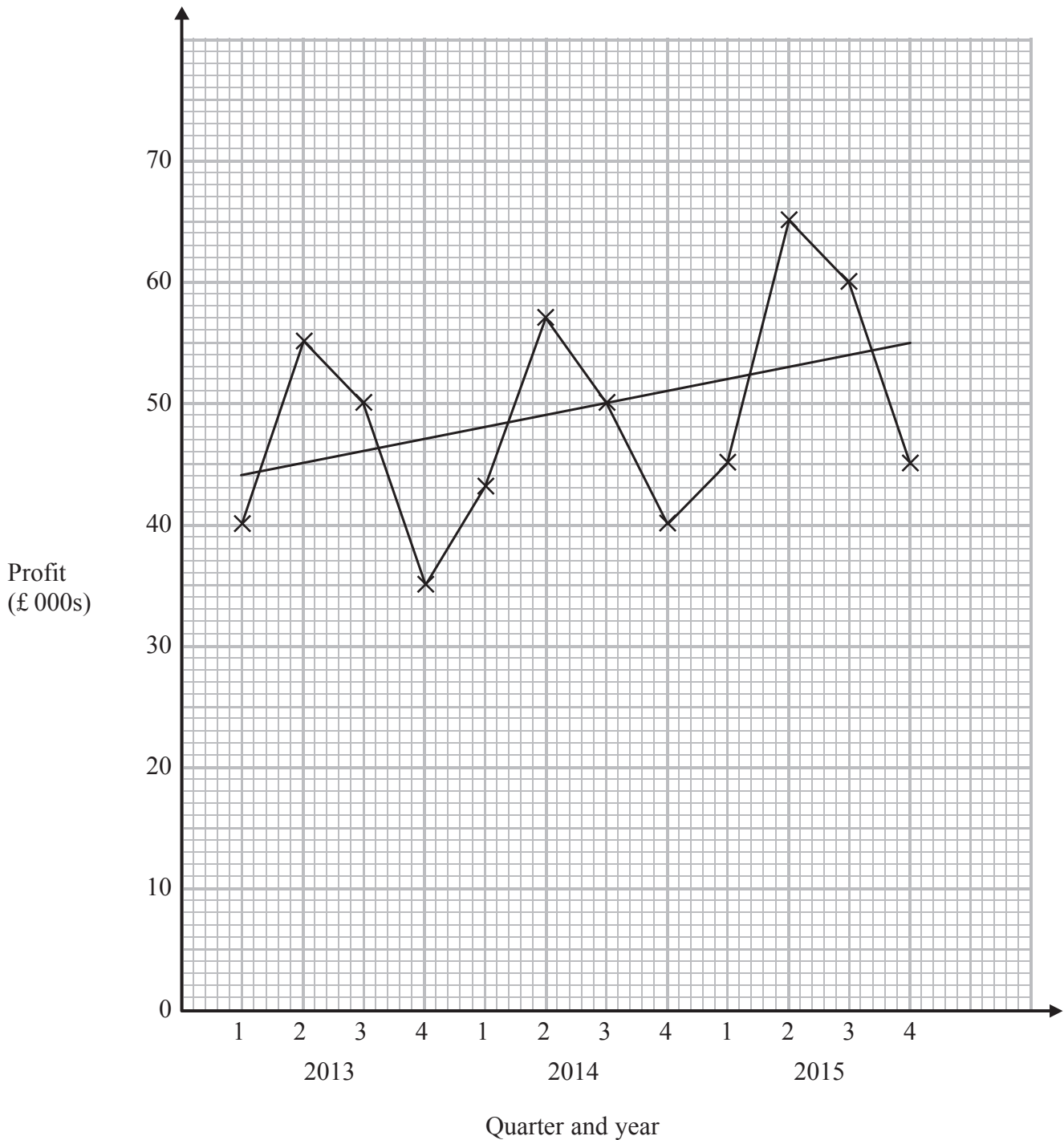
Work out the probability that both beads are the same colour.

.....  
**(Total for Question 10 is 3 marks)**



- 11 The time-series graph gives information about the profit, in £, of Alpha Computing each quarter for the years 2013, 2014 and 2015.

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



- (a) Describe the trend.

(1)



- (b) Calculate the mean seasonal variation for quarter 2  
You must show your working.

£ .....  
(2)

**(Total for Question 11 is 3 marks)**

- 12** The distances thrown in a javelin competition are normally distributed with a mean of 60 m and a standard deviation of 5 m.

Harry threw a distance of 67 m in the competition.

- (a) Calculate the standardised score of Harry's throw.

.....  
(2)

The standardised score of Jeremy's throw is  $-1.5$

- (b) Work out the distance thrown by Jeremy.

..... m  
(2)

The standardised score of Kevin's throw is  $-0.3$

- (c) Who threw further in the competition, Jeremy or Kevin?  
Give a reason for your answer.

.....  
(1)

**(Total for Question 12 is 5 marks)**



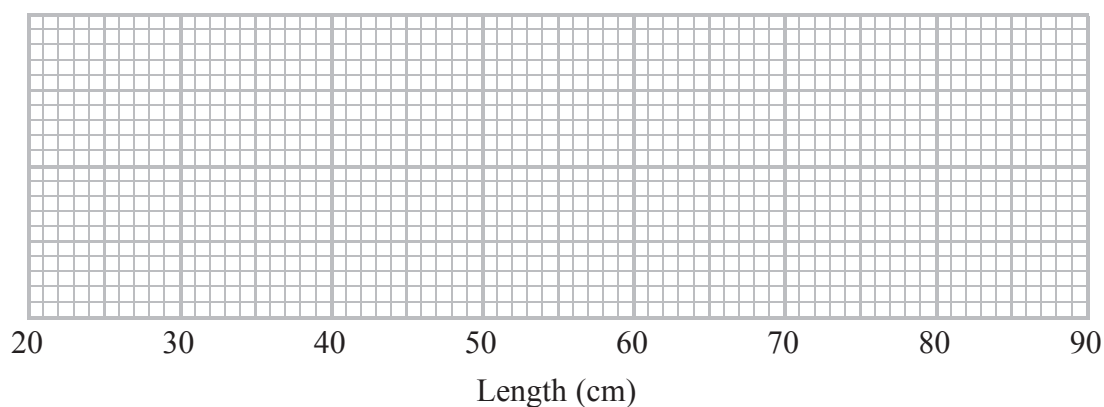
13 Here are the lengths, in centimetres, of 15 pieces of timber in a builder's yard.

22	27	33	35	42	42	46	48
49	50	52	53	63	64	85	

(a) Show that 85 is an outlier.

(3)

(b) On the grid, draw a box plot for these lengths.



(3)

(Total for Question 13 is 6 marks)





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14 Two critics watched the same 8 plays.  
They were then asked to rank the plays in order of preference.

The table gives information about their ranks.

Play	A	B	C	D	E	F	G	H
Critic 1	3	8	7	4	5	1	2	6
Critic 2	1	6	7	5	4	3	2	8

(i) Calculate Spearman's coefficient of rank correlation for this information.  
Give your answer correct to 3 significant figures.

(ii) Interpret your answer.

(Total for Question 14 is 4 marks)



15 An engineering company manufactures identical electronic components.

The electronic components are packed into boxes.

Each box contains 10 electronic components.

The probability that any electronic component in a box is faulty is 0.05

A box of electronic components is chosen at random.

- (a) Work out the probability that the box contains no faulty electronic components.  
Give your answer correct to 3 significant figures.

.....  
(2)

- (b) Work out the probability that the box contains at most one faulty electronic component.  
Give your answer correct to 3 significant figures.

.....  
(2)

**(Total for Question 15 is 4 marks)**

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16 The lengths of the rods produced in a workshop are normally distributed with mean 25.6 cm and standard deviation 3 cm.

A rod produced in the workshop is chosen at random.

(a) Find the probability that the length of the rod is less than 26.8 cm.

.....  
(2)

(b) Find the probability that the length of the rod is more than 27.85 cm.

.....  
(3)

**(Total for Question 16 is 5 marks)**



- 17 The table shows information about the selling price  $x$  (in pounds) and the number of sales  $y$  (in thousands) of 10 models of calculators.

$x$	$y$
3	40
6	45
15	35
20	25
8	35
18	20
12	25
6	30
25	18
30	20

It is given that

$$\sum xy = 3585 \quad S_{xx} = 718.1 \quad S_{yy} = 764.1$$

- (a) Calculate the product-moment correlation coefficient for the data.  
Give your answer correct to 3 significant figures.

You may use  $S_{xy} = \sum xy - \frac{\sum x \sum y}{n}$

.....  
(4)

- (b) (i) Describe the correlation.

- (ii) Describe the relationship between the selling price of the calculators and the number of sales.

.....  
(2)

(Total for Question 17 is 6 marks)



18 Two independent events,  $X$  and  $Y$ , are such that  $P(X) = \frac{1}{3}$  and  $P(Y) = \frac{4}{5}$

(a) Find  $P(X|Y)$

.....  
(1)

(b) Find  $P(X \cap Y)$

.....  
(1)

(c) Find  $P(X \cup Y)$

.....  
(2)

(Total for Question 18 is 4 marks)

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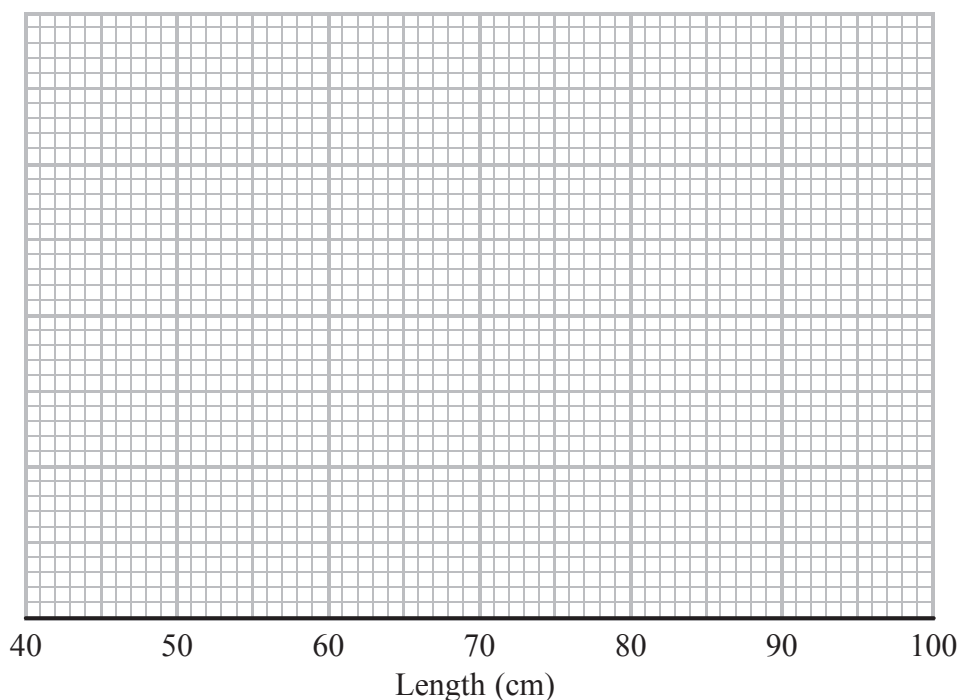


19 An angler caught two types of fish, salmon and trout.

The lengths, in cm, of each type of fish are normally distributed.  
The mean and standard deviation for each distribution is given in the table.

	Mean	Standard deviation
Salmon	72	3
Trout	60	5

(a) On the grid, sketch the two normal distributions.



(4)

(b) Compare the two distributions.  
You should write down two comparisons.

1 .....

.....

2 .....

.....

(2)

(Total for Question 19 is 6 marks)

TOTAL FOR PAPER IS 90 MARKS



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