

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

Wednesday 13 May 2015 – Morning

Time: 2 hours

Paper Reference

**AST30/01**

**You must have:**

Pen, HB pencil, eraser, calculator, ruler, protractor.

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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**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 stages in your working.**

**1** Sam owns a garage which sells new tyres.

He wants information about the numbers of new tyres sold to customers.

(a) (i) The numbers of new tyres sold are examples of which type of data?

He is going to collect primary data.

(ii) Write down one advantage of collecting primary data.

.....  
(2)

Sam recorded the number of new tyres sold to each customer on one day in his garage.

The frequency table shows information about his results.

Number of tyres sold	Number of customers
1	3
2	6
3	8
4	10
5	3

(b) Work out the mean number of tyres sold per customer.

.....  
(2)

(c) Calculate the standard deviation of the number of tyres sold per customer.  
Give your answer correct to 3 significant figures.

.....  
(2)

**(Total for Question 1 is 6 marks)**



2 Fifteen apple trees in an orchard were treated with an experimental fertiliser.

Another fifteen apple trees were left untreated.

The yield of apples, in kg, for each tree is given in these tables.

	Yield (kg)														
<b>Untreated</b>	24	34	44	38	19	25	36	22	42	21	41	19	39	28	27

	Yield (kg)														
<b>Treated</b>	45	24	51	38	47	39	27	42	54	48	36	28	39	49	55

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

Untreated		Treated
	1	
	2	
	3	
	4	
	5	

Key

(4)



The two distributions are compared to decide if the treatment makes a difference.

(b) Write down two comparisons.

1 .....

2 .....

(2)

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



- 3 The table gives information about the numbers of adults who can play only one of the three card games – Hearts, Rummy and Bridge.

	Type of card game played			Total
	Hearts	Rummy	Bridge	
Male	42	32	39	113
Female	41	16	30	87
Total	83	48	69	200

Govind is going to take a sample of 65 of these adults stratified by gender and by game played.

- (a) Work out the number of the female adults who can play Hearts in his sample.

.....  
(2)

Govind is going to pick at random two of the male adults.

- (b) Work out the probability that both males can play Rummy.

.....  
(2)

(Total for Question 3 is 4 marks)



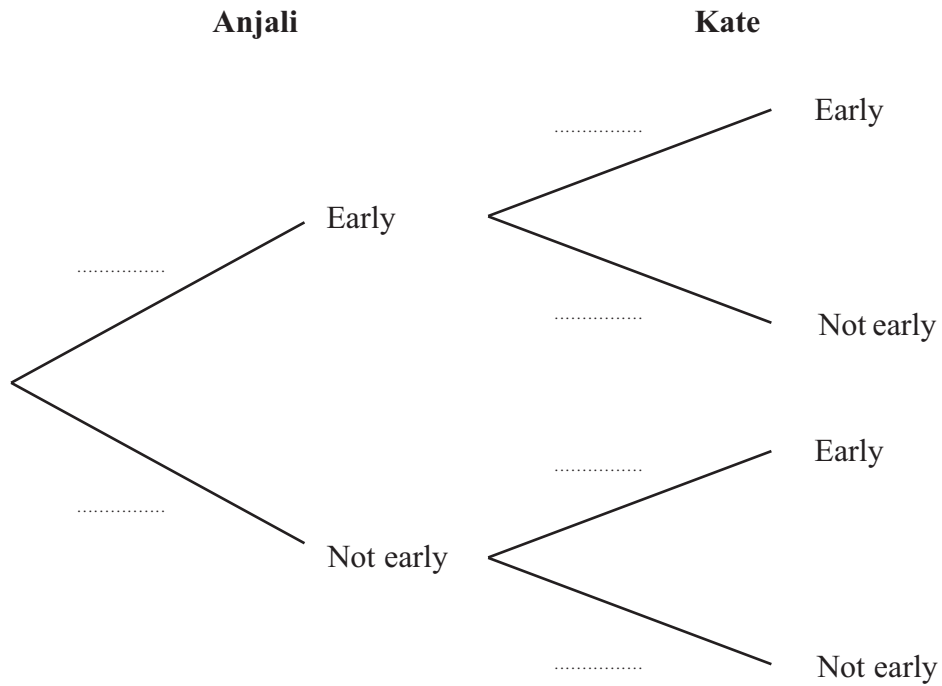
4 Anjali and Kate are going to the theatre to watch a play.

The probability that Anjali will arrive early is 0.15

The probability that Kate will arrive early is 0.2

The two events are independent.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Anjali and Kate both arrive early.

.....  
(2)

(c) Work out the probability that either Anjali or Kate arrive early but not both.

.....  
(3)

**(Total for Question 4 is 7 marks)**



5 A group of 200 adults were asked which types of magazines they read.

Their replies showed that

82 read Sports magazines

80 read Garden magazines

84 read Fashion magazines

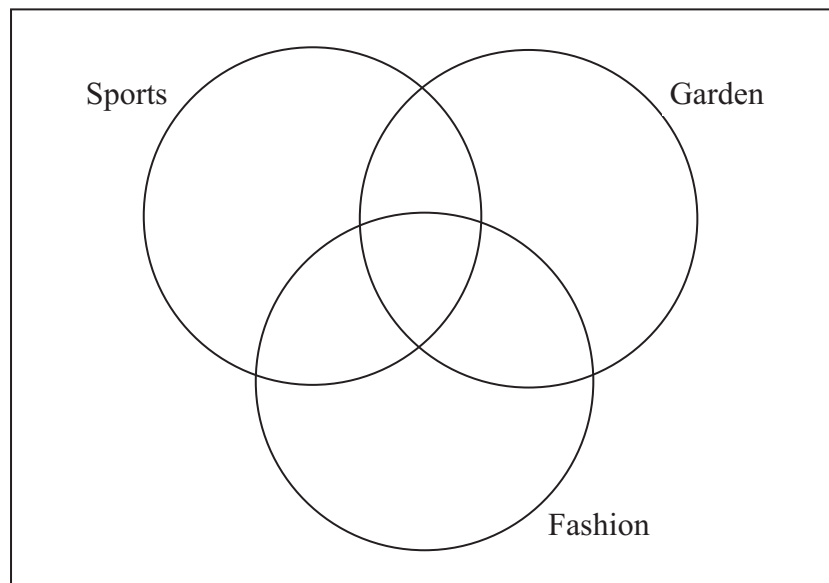
36 read Sports magazines and read Garden magazines

31 read Sports magazines and read Fashion magazines

25 read Garden magazines and read Fashion magazines

14 read Sports magazines and read Garden magazines and read Fashion magazines

(a) Complete the Venn diagram for this information.



(4)

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

(b) Find the probability that this adult

(i) reads none of these magazine types,

.....

(ii) reads exactly two of these magazine types.

.....

(3)

(Total for Question 5 is 7 marks)

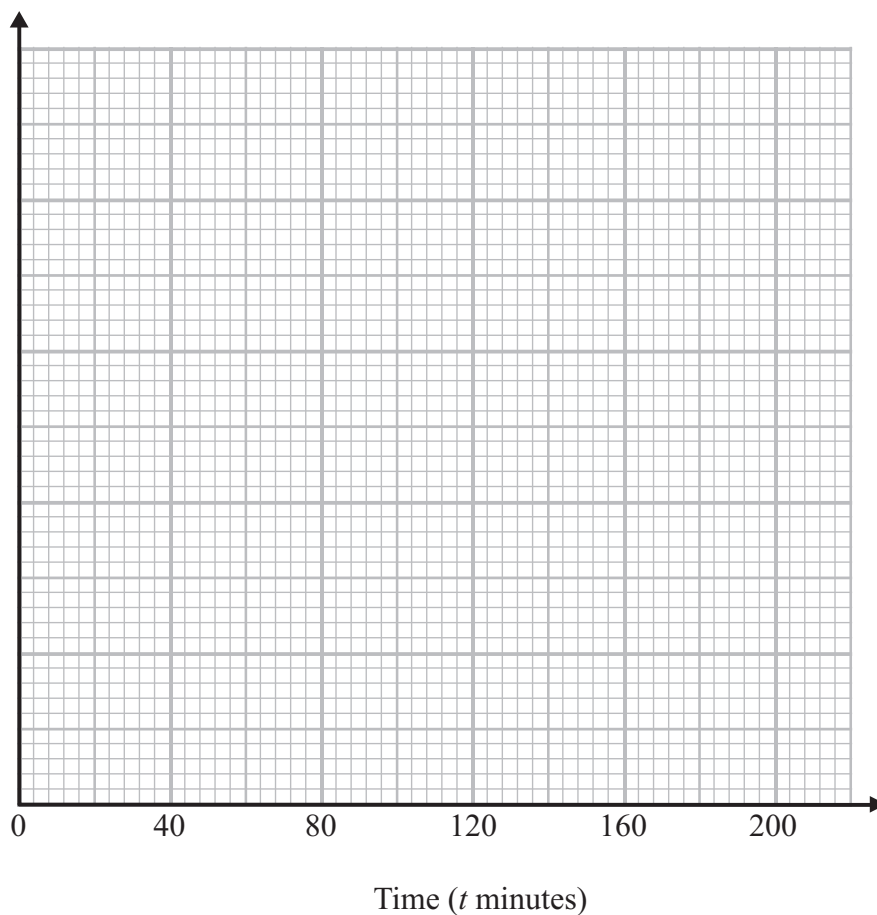




- 6 The table gives information about the times, in minutes, 346 children spent playing online games in one week.

Time ( $t$ minutes)	Frequency
$0 < t \leq 20$	42
$20 < t \leq 60$	156
$60 < t \leq 120$	84
$120 < t \leq 200$	64

Draw a histogram for this information.



(Total for Question 6 is 4 marks)



7 The table gives information about the cost per ounce, in £, of gold in January 2012, in January 2013, in January 2014 and in January 2015.

Year	2012	2013	2014	2015
Cost per ounce (£)	910	1020	1170	1540
Chain base index number		.....	.....	.....

(a) Calculate the chain base index numbers for the years 2013, 2014 and 2015 and write them in the table.  
Give each value correct to one decimal place.

(3)

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

.....  
(2)

(c) Give an interpretation of your answer to part (b).

.....  
(2)

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



8 Ravina wants to find an estimate for the number of birds in a sanctuary.

She catches a sample of 70 birds in the sanctuary and tags each of these birds.  
These birds are then released back into the sanctuary.

Next day she catches a sample of 60 birds in the sanctuary.

Ravina had tagged 12 of these birds.

Work out an estimate for the number of birds in the sanctuary.

Write down an assumption you have made.

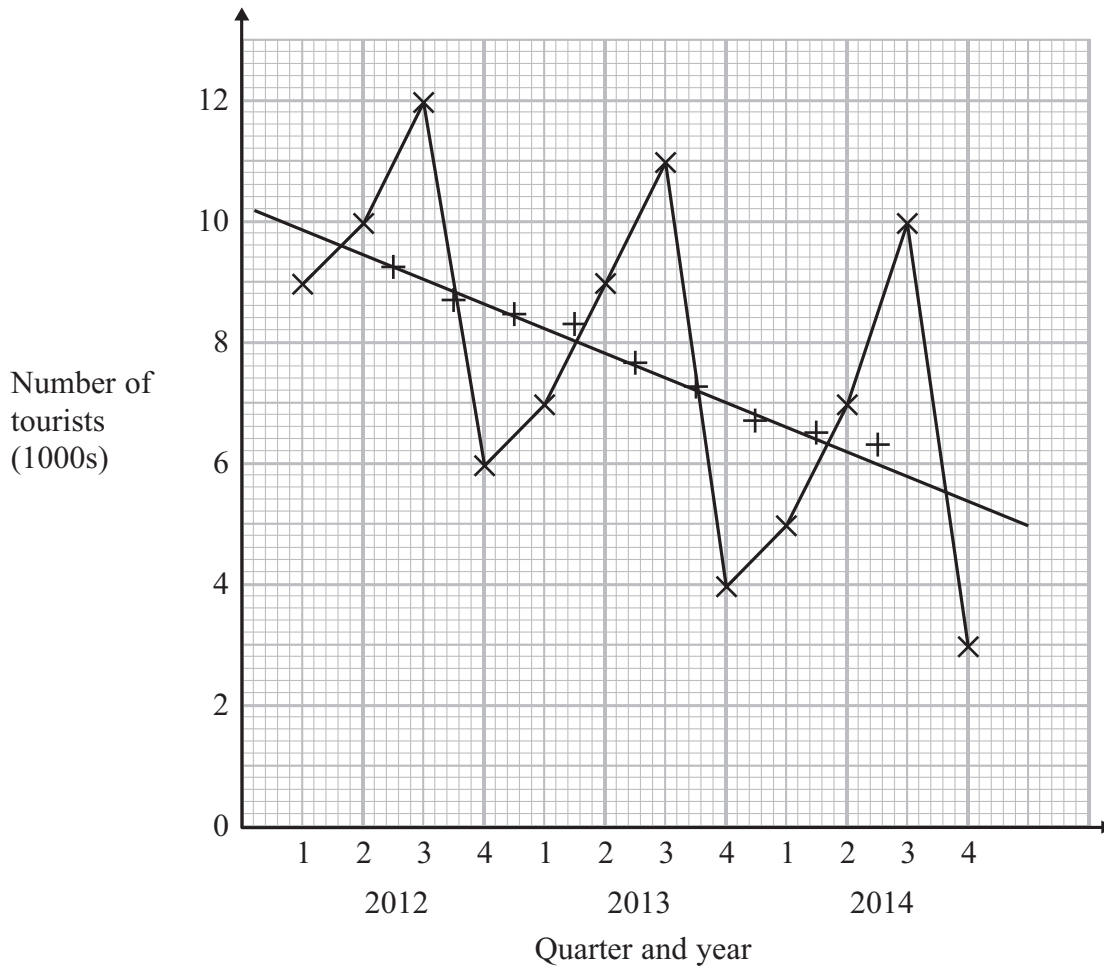
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.....  
**(Total for Question 8 is 3 marks)**



- 9 The time-series graph shows information about the number of tourists who visited a museum each quarter for the years 2012, 2013 and 2014.

The graph also shows the 4-point moving averages for this information.

A trend line for the moving averages has been drawn.



- (a) Describe the trend.

.....  
(1)

- (b) Calculate the mean seasonal variation for quarter 1

.....  
(2)

**(Total for Question 9 is 3 marks)**



10 A scientist measured the resistance, in ohms, of 15 resistors.

The table summarises his results.

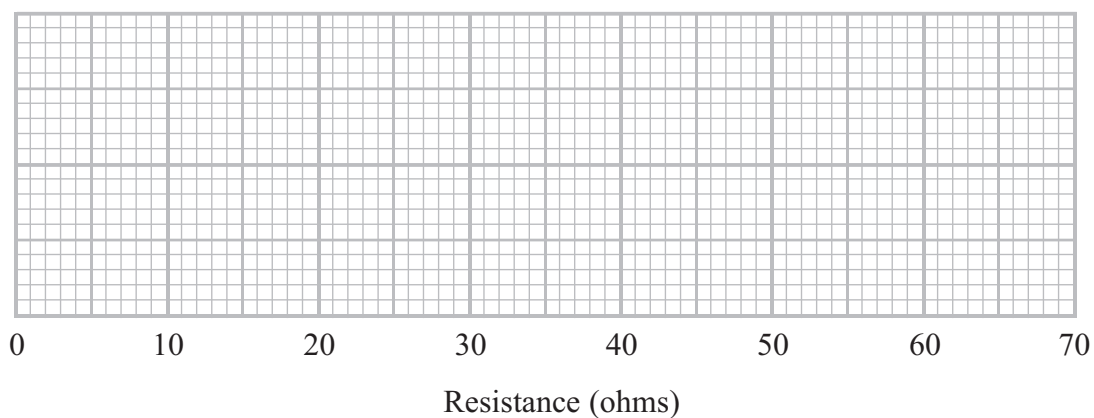
	Resistance (ohms)
Least resistance	3
Lower quartile	16
Median	24
Upper quartile	34
Greatest resistance	66

(a) Show that 66 is an outlier for his results.

(3)

The second greatest resistance measured by the scientist was 41 ohms.

(b) Using this information, draw a box plot for these resistances.



(3)

(Total for Question 10 is 6 marks)



**11** Ian wants to train as a translator.

He sits language tests to help him decide in which language he should specialise.

He sits a Spanish test, a Mandarin test and a Russian test.

The table gives the mean mark and the standard deviation of the marks for all the candidates in each of the three tests.

Test	Mean mark	Standard deviation
Spanish	65	2
Mandarin	72	5
Russian	79	4

Ian scored 68 marks in the Spanish test and 78 marks in the Mandarin test.

(a) Calculate Ian's standardised score for the Spanish test and for the Mandarin test.

Standardised Spanish score .....

Standardised Mandarin score .....

(3)

In the Russian test, Ian had a standardised score of  $-1.5$

(b) Calculate Ian's mark in the Russian test.

.....  
(2)

**(Total for Question 11 is 5 marks)**



12 Dr Farah collected some information about the Body Mass Index (BMI) and the finishing position in a marathon for each of ten male adults.

The table shows this information.

Adult	BMI	Finishing position	Rank of BMI	$d$	$d^2$
A	18.4	3			
B	19.5	2			
C	19.8	1			
D	20.5	6			
E	21.2	4			
F	22.5	5			
G	23.7	9			
H	25.3	10			
I	26.7	7			
J	29.3	8			

(a) Calculate Spearman's coefficient of rank correlation for this information.

You may use the columns in the table to help with your calculations.

.....  
(3)

(b) (i) Describe the correlation.

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

.....  
.....  
(2)

(Total for Question 12 is 5 marks)



13  $X$  and  $Y$  are two events such that  $P(X) = x$  and  $P(Y) = y$

(a) (i) When  $X$  and  $Y$  are mutually exclusive,  
write down an expression, in terms of  $x$  and  $y$ , for  $P(X \text{ or } Y)$ .

.....

(ii) When  $X$  and  $Y$  are independent,  
write down an expression, in terms of  $x$  and  $y$ , for  $P(X \text{ and } Y)$ .

.....

(2)

$A$  and  $B$  are two events such that  $P(A) = 0.45$ ,  $P(B) = 0.4$  and  $P(A|B) = 0.5$

(b) (i) Find  $P(A \cap B)$ .

.....

(ii) Find  $P(A \cup B)$ .

.....

(3)

**(Total for Question 13 is 5 marks)**





14 The lifetimes of batteries used in TV remote controls have a mean of 340 hours and a standard deviation of 8 hours.

The lifetimes of these batteries are assumed to be normally distributed.

A battery used in a TV remote control is chosen at random.

(a) Find the probability that the lifetime of the battery is less than 352 hours.

.....  
(2)

(b) Find the probability that the lifetime of the battery is more than 348 hours.

.....  
(3)

**(Total for Question 14 is 5 marks)**

---



**15** Pens are packed in boxes.  
There are 12 pens in each box.

The probability that any pen in a box is defective is 0.1

A box of pens is picked at random.

- (a) Find the probability that the box contains exactly one defective pen.  
Give your answer correct to 3 significant figures.

.....  
(2)

- (b) Find the probability that the box contains at most one defective pen.  
Give your answer correct to 3 significant figures.

.....  
(2)

Suki buys 125 boxes of pens.

- (c) Find an estimate for the number of boxes that contain less than two defective pens.

.....  
(2)

**(Total for Question 15 is 6 marks)**



16 A polishing company stores drums of chemical waste.

A sample of 10 drums was taken.

The table gives information about the time,  $x$  weeks, that the drum has been in storage and the amount of leakage,  $y$  ml, from each drum.

<b>Time in storage (<math>x</math> weeks)</b>	2	4	5	7	11	13	14	16	17	19
<b>Amount of leakage (<math>y</math> ml)</b>	25	40	43	50	59	67	73	81	78	85

(a) Calculate the value of  $S_{xy}$ .

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

.....  
(2)

Given that  $S_{xx} = 319.6$  and that  $S_{yy} = 3622.9$

(b) calculate the product-moment correlation coefficient for the data in the table.

.....  
(2)

(c) Interpret your answer.

.....  
(1)

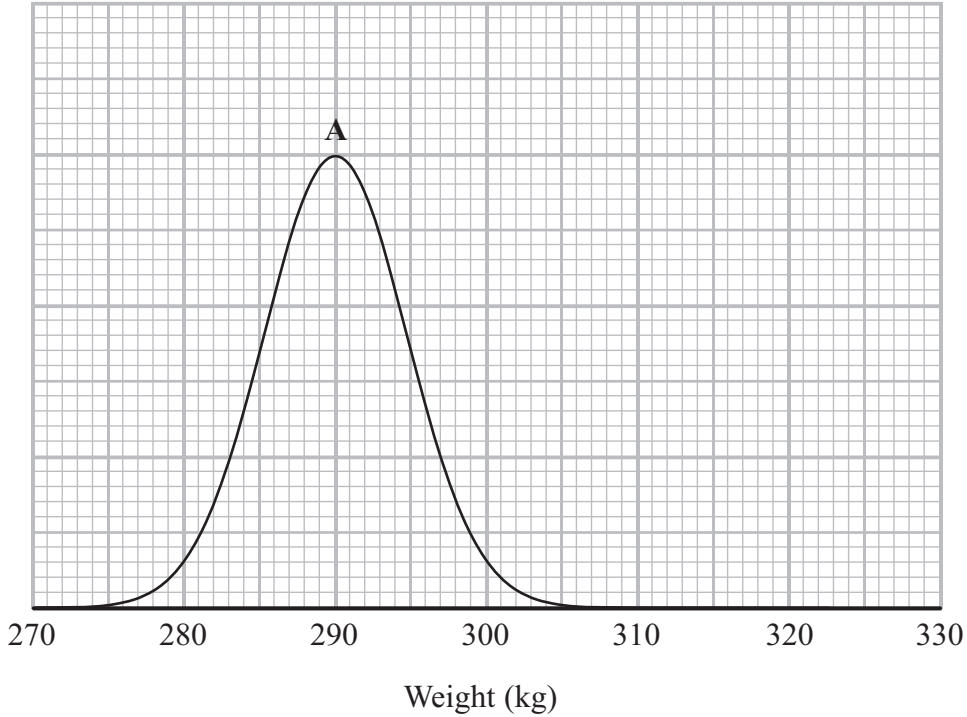
**(Total for Question 16 is 5 marks)**



17 Coal is put into bags in Factory A.

The weights, in kg, of the bags of coal are normally distributed.

The diagram shows the distribution of the weights of these bags of coal.



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

	Mean	Standard deviation
<b>A</b>	.....	.....

(2)

Coal is also put into bags in Factory B.

The weights, in kg, of the bags of coal are normally distributed with mean and standard deviation as shown in the following table.

	Mean	Standard deviation
<b>B</b>	300	3

(b) On the grid above, sketch the normal distribution of the weights of the bags of coal for Factory B.

(2)



(c) Compare the two distributions.

You should write down two comparisons.

1 .....

.....

2 .....

.....

(2)

**(Total for Question 17 is 6 marks)**

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**TOTAL FOR PAPER IS 90 MARKS**



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