

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 18 January 2016 – 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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**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		

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Answer ALL questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

- 1 Two fair 4-sided spinners are each spun once.

Spinner A can land on 1 or on 2 or on 3 or on 4

Spinner B can land on Red or on Green or on Yellow or on Pink.

- (a) Complete the sample space diagram to show all the possible outcomes.

		Spinner B			
		Red (R)	Green (G)	Yellow (Y)	Pink (P)
Spinner A	1	(1, R)			
	2				
	3				
	4				

(2)

- (b) Find the probability that spinner A lands on 1 **and** spinner B lands on Green.

.....  
(1)

The spinners are then spun together 320 times.

- (c) Find an estimate for the number of times that the outcome is 1 on spinner A **and** is Green on spinner B.

.....  
(2)

(Total for Question 1 is 5 marks)



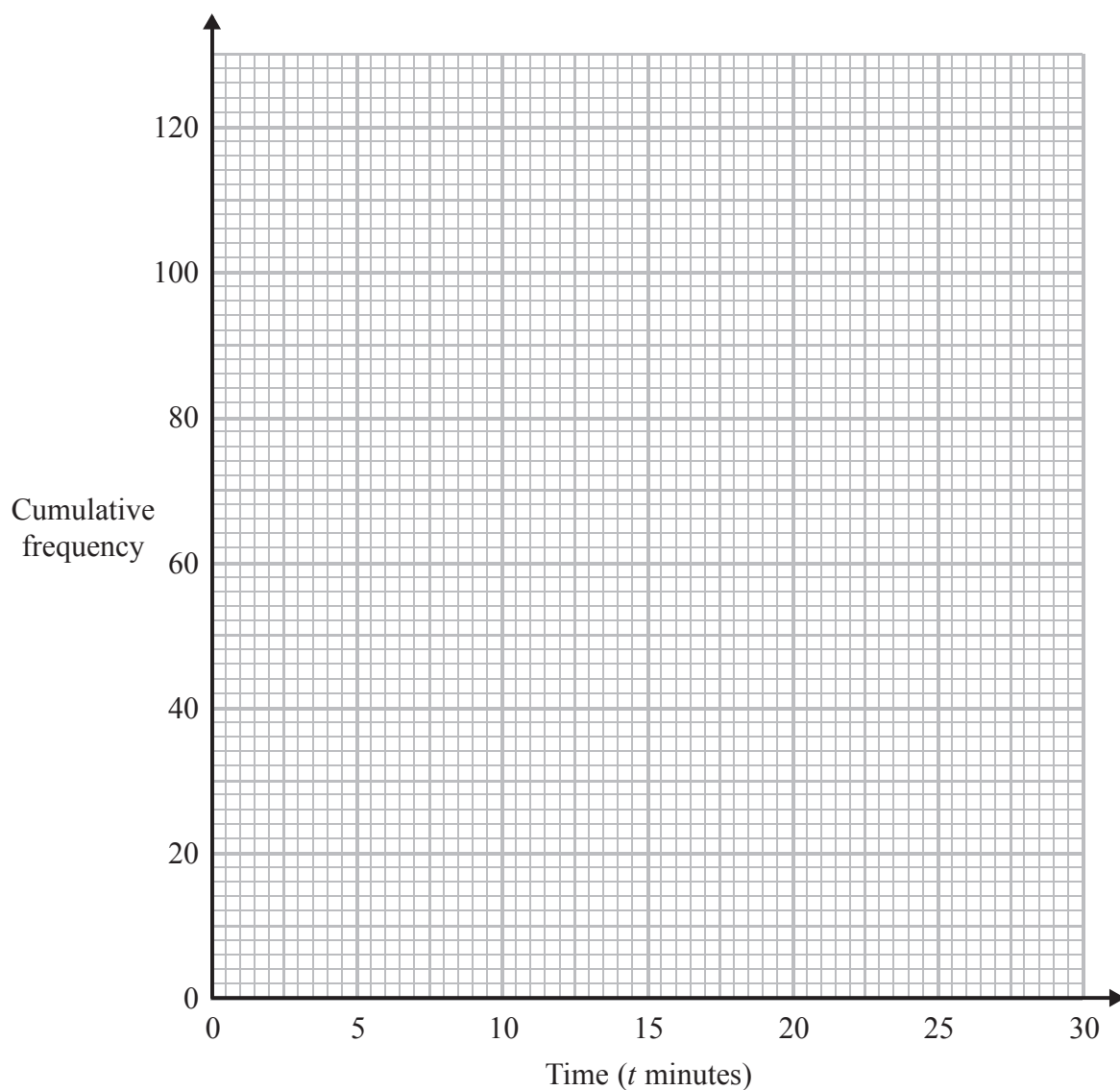
2 120 people each did a jigsaw puzzle.

The time taken by each person was recorded.

The cumulative frequency table below gives information about these times.

Time ( $t$ minutes)	Cumulative frequency
$0 < t \leq 5$	8
$0 < t \leq 10$	36
$0 < t \leq 15$	75
$0 < t \leq 20$	109
$0 < t \leq 25$	120

(a) On the grid, draw a cumulative frequency graph for the information in the table.



(3)



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(b) Use your cumulative frequency graph to find an estimate for

(i) the median,

..... minutes

(ii) the interquartile range.

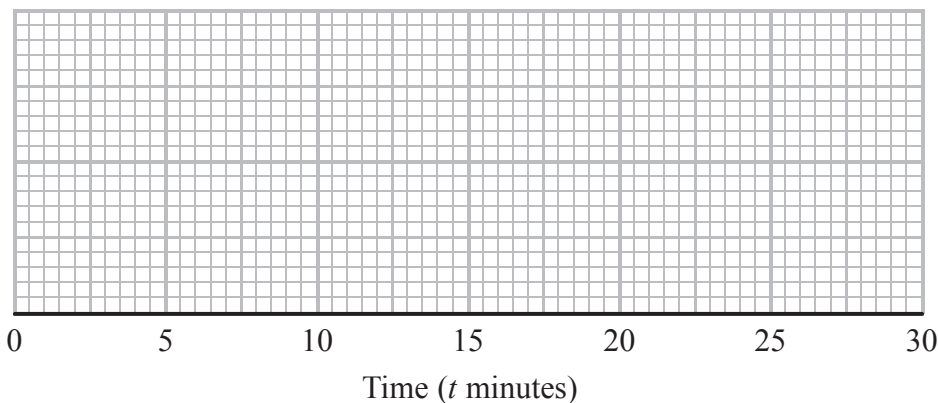
..... minutes

(3)

The shortest time taken to do the jigsaw puzzle was 2 minutes.

The longest time taken to do the jigsaw puzzle was 24 minutes.

(c) On the grid, draw a box plot for the times taken to do the jigsaw puzzle.



(3)

(Total for Question 2 is 9 marks)



3 Jas used the internet to collect information about the lengths of two types of film.

(a) Write down one advantage and one disadvantage of using the internet to collect data.

Advantage.....

.....

Disadvantage.....

.....

(2)

The back-to-back stem and leaf diagram shows information about the lengths of two types of film.

The lengths are given to the nearest minute.

Action films		Comedy films
0	9	1 2 3 5 6
	10	2 4 6 6 7 7
9 7 5 5 2	11	0 3 4 5 7 9 9 9
9 9 9 7 6 5 4 2 1 0	12	1 2 4 6 6 7 7 7 7 8 9
8 7 6 6 5 4 3 1	13	1
7 7 6 6 5 3 1	14	

Key 0 | 9 | 1 means 90 minutes for Action films and 91 minutes for Comedy films



Some of the quartiles for these two distributions are shown in the table below.

	Action films	Comedy films
Lower quartile	121	.....
Median	.....	117
Upper quartile	138	.....

(b) Complete the table.

(3)

(c) Compare the distributions of the lengths of the two types of film.

Write down **two** comparisons.

.....

.....

.....

.....

(2)

Jas thinks that 90 minutes is an outlier for these Action films.

(d) Do a suitable calculation to show that Jas is correct.

(2)

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



4 Each week the amount of pocket money Bethan gets is decided by chance.

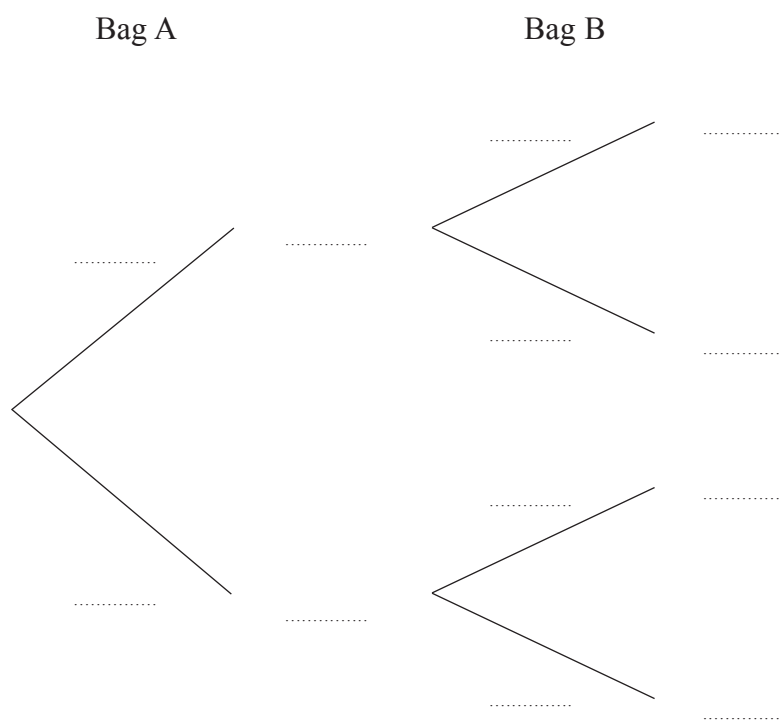
Her father puts 4 pieces of paper into Bag A **and** 3 pieces of paper into Bag B. Each piece of paper has an amount of money written on it.

In Bag A, there are 3 pieces of paper with £2 written on each of them and 1 piece of paper with £1 written on it.

In Bag B, there are 2 pieces of paper with £1 written on each of them and 1 piece of paper with £5 written on it.

Bethan takes at random one piece of paper from Bag A **and** one piece of paper from Bag B.

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



(3)





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The amount of pocket money Bethan gets is the total of the amount of money written on each of the two pieces of paper.

- (b) Work out the probability that Bethan gets £7 pocket money.  
You must show your working.

.....  
(2)

**(Total for Question 4 is 5 marks)**



5 A breakdown recovery service offers drivers two types of membership.

The table gives information about the numbers of drivers and the type of membership they have.

		Type of membership	
		Silver	Gold
Gender	Male	625	350
	Female	635	490

John is going to survey these drivers.

He will take a sample rather than a census.

(a) Write down one advantage of taking a sample.

(1)

(b) Suggest a suitable sampling frame for John to use.

(1)

John is going to take a sample of 60 of these drivers stratified by gender and by type of membership.

(c) Calculate the number of male drivers with gold membership in this sample.

(2)

**(Total for Question 5 is 4 marks)**



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6 Safur wants to estimate the number of deer in a forest.

He catches a sample of 40 deer, tags them and releases them back into the forest.

The following week, he takes a second sample of 40 deer.

5 of these deer have been tagged.

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

.....  
(2)

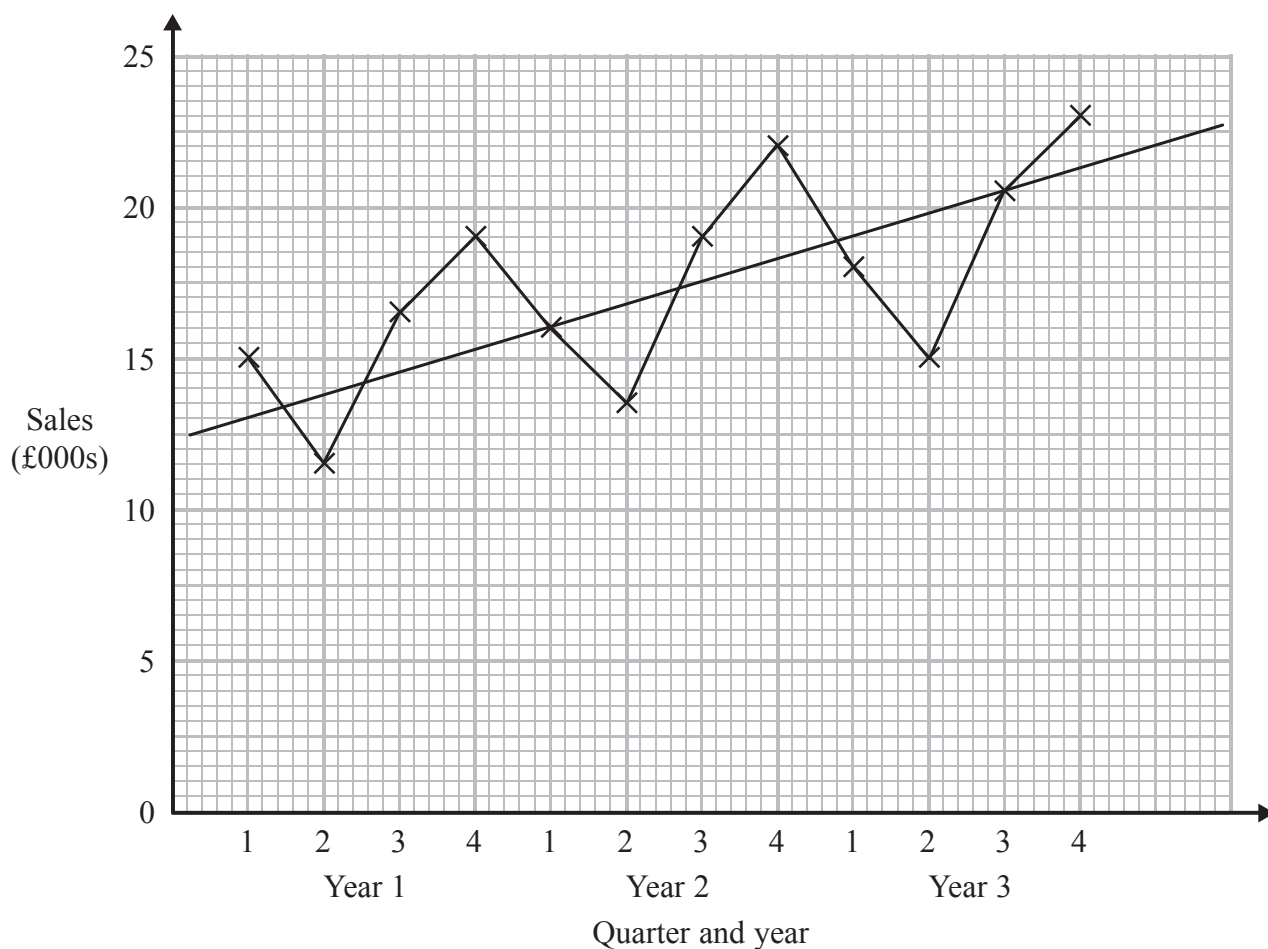
(b) Write down an assumption you have made.

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

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



7 The time-series graph gives information about the quarterly sales, in thousands of pounds, from a factory over a three year period.



A trend line has been drawn on the graph.

(a) Describe the trend.

(1)

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

£ .....  
(3)

(Total for Question 7 is 4 marks)



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8 The value of jewellery changes every year.

The table shows the value, in pounds, of a ring for the years 2009 to 2012.

Year	2009	2010	2011	2012
Value	£105	£120	£125	£140

- (a) Calculate the chain base index numbers for 2010, 2011 and 2012.  
Give each value correct to 3 significant figures.

..... (2)

- (b) Calculate the geometric mean of the three chain base index numbers.  
Give your answer correct to 3 significant figures.

..... (2)

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

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

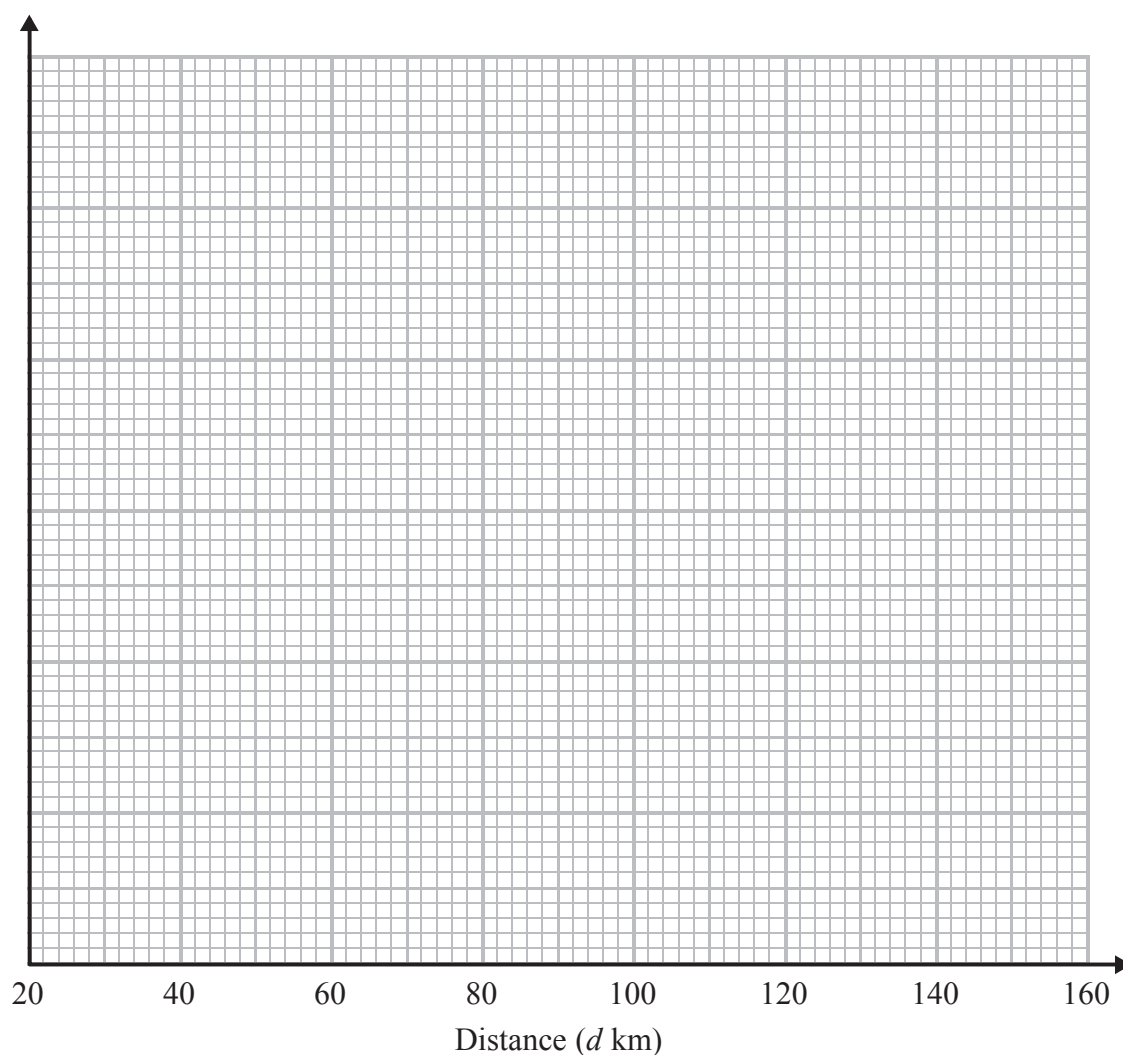
**(Total for Question 8 is 5 marks)**



- 9 This table gives information about the distance,  $d$  km, travelled by each of 136 people to go to a music concert.

Distance ( $d$ km)	Number of people ( $f$ )
$40 < d \leq 45$	6
$45 < d \leq 50$	19
$50 < d \leq 60$	53
$60 < d \leq 70$	37
$70 < d \leq 90$	15
$90 < d \leq 150$	6

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



(4)



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(b) Calculate an estimate for the mean distance.

..... km  
(3)

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

You may use  $\sum fd^2 = 552\,756.25$

..... km  
(2)

(Total for Question 9 is 9 marks)



10 The distances, in metres, some athletes threw a javelin were recorded.

The mean distance was 45.4 metres and the standard deviation was 3.6 metres.

Taylor threw the javelin 52 metres.

- (a) Calculate Taylor's standardised score.  
Give your answer correct to 2 decimal places.

.....  
(2)

For the javelin, Daisy's standardised score was 1.7

- (b) Who threw the javelin the further, Taylor or Daisy?  
Give a reason for your answer.

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

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





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11 8 people were in a cake baking competition.

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

Rank 1 is for the best cake.

Here are the results.

Cake	Judge X	Judge Y		
A	1	5		
B	6	8		
C	2	4		
D	5	2		
E	4	1		
F	3	7		
G	7	6		
H	8	3		

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

.....  
(3)

(b) Interpret your answer to part (a).

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

**(Total for Question 11 is 4 marks)**

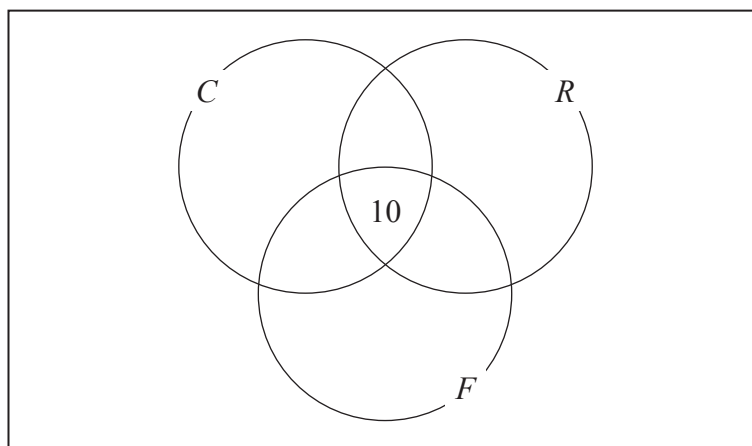


12 100 people were asked which sports they watched on television.

Here are the results.

- 36 people watched cricket ( $C$ ).
- 28 people watched rugby ( $R$ ).
- 36 people watched football ( $F$ ).
- 17 people watched both cricket and rugby.
- 19 people watched both cricket and football.
- 15 people watched both rugby and football.
- 10 people watched all three sports.

(a) Complete the Venn diagram to show this information.



(3)

One of the 100 people is selected at random.

(b) Find the probability that this person

(i) watched all three sports,

.....

(ii) did **not** watch any of the three sports,

.....

(iii) watched cricket but **not** football.

.....

(4)

(Total for Question 12 is 7 marks)

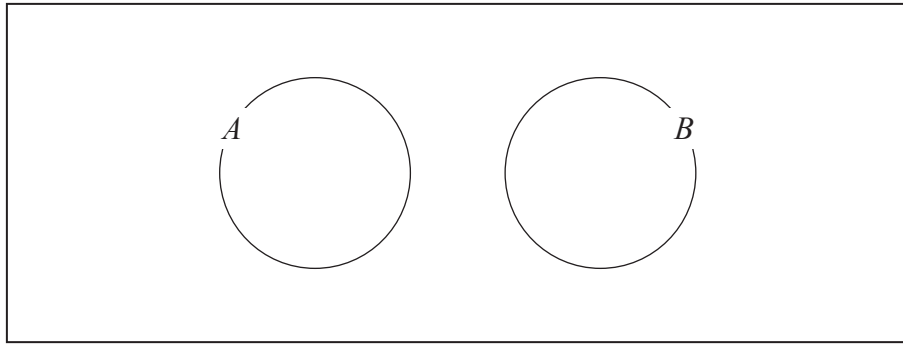


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13 The Venn diagram represents two events,  $A$  and  $B$ .



Here is a list of some terms used in probability.

independent    normal    conditional    mutually exclusive    binomial

(a) Use a term from the list to complete this sentence correctly.

The events  $A$  and  $B$  are .....

(1)

Two events,  $C$  and  $D$ , are such that  $P(C) = \frac{3}{10}$      $P(D) = \frac{2}{5}$      $P(C \cup D) = \frac{1}{2}$

(b) Find  $P(C \cap D)$

.....  
(2)

(c) Find  $P(D | C)$

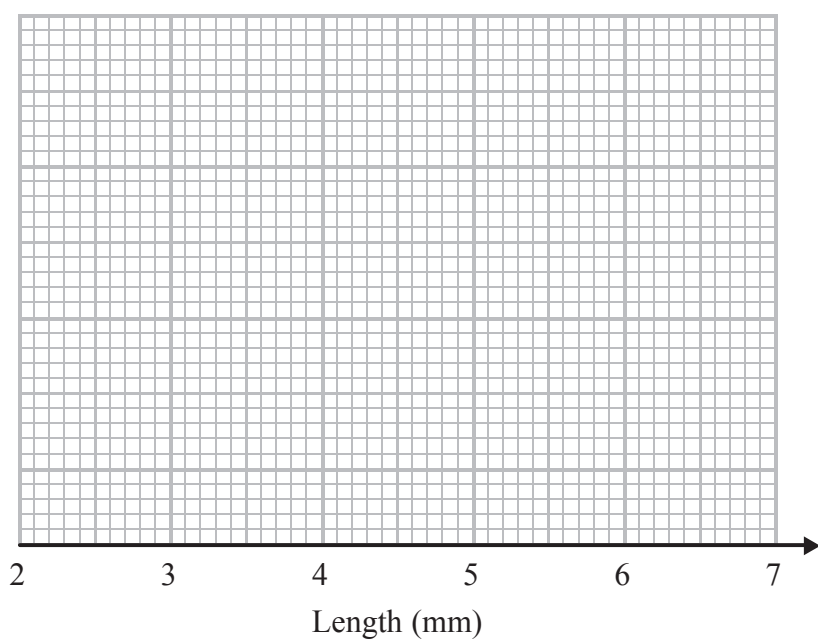
.....  
(2)

(Total for Question 13 is 5 marks)



14 The lengths of the wings of house flies are normally distributed with a mean of 4.5 mm and a standard deviation 0.4 mm.

(a) On the grid, sketch the normal distribution for the lengths of the wings of house flies.



(3)

A house fly is chosen at random.

(b) Using the standard normal distribution tables, find the probability that the length of the wings of this house fly is between 4.8 mm and 5.2 mm.

.....  
(4)



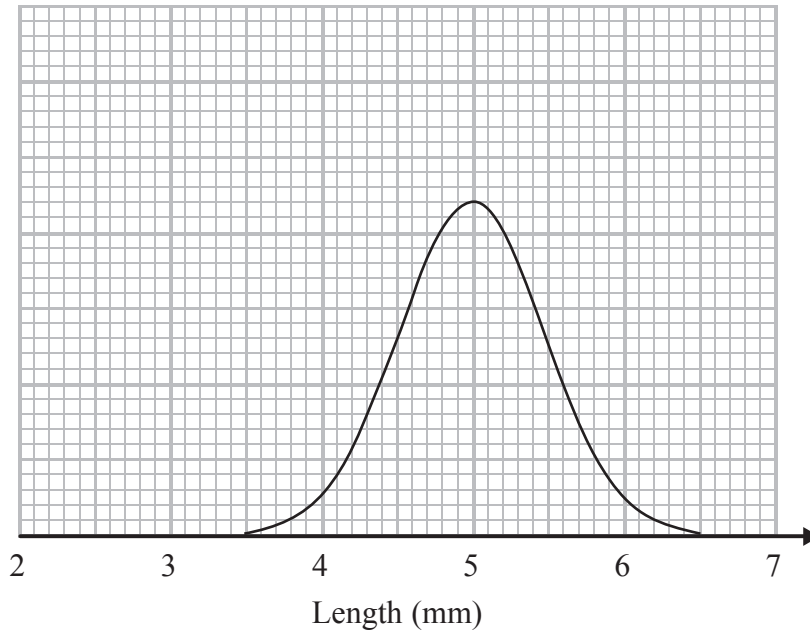
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The lengths of the wings of bottle flies are also normally distributed.

The diagram shows the normal distribution for these lengths.



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

.....

.....

.....

.....

(2)

**(Total for Question 14 is 9 marks)**



15 The probability of having blood type O is 0.4

A doctor tests the blood type of 12 patients.

Assuming a binomial distribution, calculate the probability that exactly 2 of these patients have blood type O.

.....  
(Total for Question 15 is 3 marks)

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16 The ages,  $a$  years, and heights,  $h$  cm, of seven people in a youth handball team were recorded.

The data was summarised and it was found that

$$\sum a = 115 \quad \sum a^2 = 1899 \quad S_{hh} = 571.4 \quad S_{ah} = 72.1$$

- (a) Calculate  $S_{aa}$   
Give your answer correct to one decimal place.

You may use 
$$S_{aa} = \sum a^2 - \frac{(\sum a)^2}{n}$$

.....  
(1)

- (b) Calculate the product-moment correlation coefficient.  
Give your answer correct to 3 decimal places.

.....  
(3)

- (c) (i) What type of correlation is described by your answer to part (b)?

- (ii) Describe the relationship between the age and the height of the seven people in the handball team.

.....  
(2)

(Total for Question 16 is 6 marks)

TOTAL FOR PAPER IS 90 MARKS



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