Write your name here

Surname		Other names

**Pearson
Edexcel Award**

Centre Number

Candidate Number

Statistical Methods

Level 3
Calculator allowed

Monday 13 January 2014 – Afternoon
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

PEARSON

THE NORMAL DISTRIBUTION FUNCTION

The function tabulated below is $\Phi(z)$, defined as $\Phi(z) = \dfrac{1}{\sqrt{2\pi}} \displaystyle\int_{-\infty}^{z} e^{-\frac{1}{2}t^2} \; dt$.

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		

1   The table shows information about the ages of 40 children.

Age (years)	Number of children
1	7
2	8
3	14
4	3
5	6
6	2

(a) Calculate the mean of these ages.

.... years

(2)

(b) Calculate the standard deviation of these ages.
     Give your answer correct to 3 significant figures.

.... years

(2)

(Total for Question 1 is 4 marks)

2 Oliver recorded the heart rates, in beats per minute, for each of 15 students when they were seated.
Oliver then asked the 15 students to run along the corridor.
He recorded their heart rates again.

Here are the results.

	Beats per minute														
Seated	72	63	83	79	56	69	61	75	78	67	80	62	71	57	67
After running	89	86	98	94	75	99	64	86	98	92	88	73	78	67	68

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

Seated   **After running**

	5	
	6	
	7	
	8	
	9	

(3)

(b) Compare the heart rates of the students when they were seated with their heart rates after running along the corridor.

Write down two comparisons.

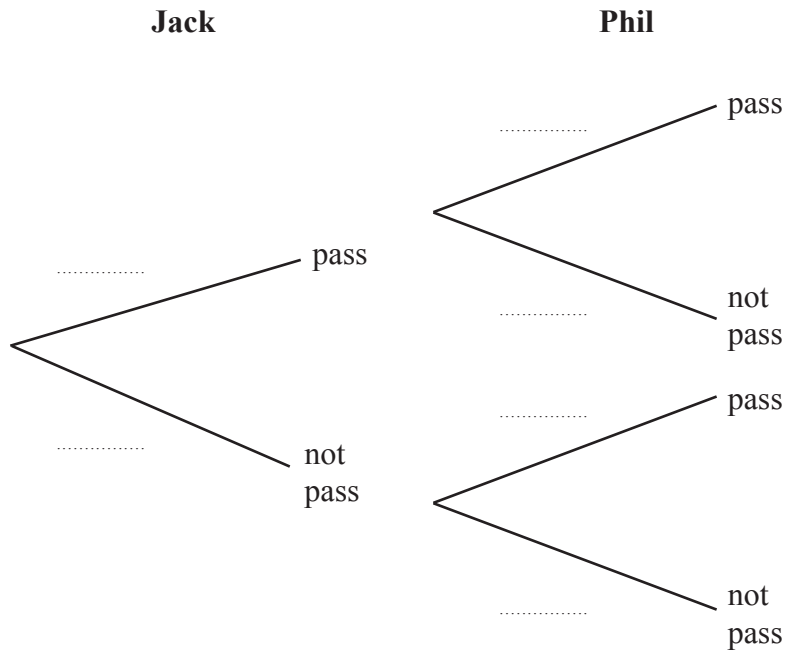1 ....

....

2 ....

....

(2)

(Total for Question 2 is 5 marks)

3 Jack and Phil each take a driving test.

The probability that Jack will pass his driving test is 0.7
The probability that Phil will pass his driving test is 0.8

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

Jack   **Phil**

                                                    pass
                    ....
                            pass
    ....
                                            ....   not
                                                               pass

                                            ....   pass
    ....   not
                       pass
                                                    ....   not
                                                                       pass

(2)

(b) Work out the probability that both Jack and Phil will **not** pass.

....

(2)

(c) Work out the probability that Jack or Phil, but not both, will pass.

....

(3)

(Total for Question 3 is 7 marks)

6

P44241A0624

4 In a school of 100 students

42 study Statistics
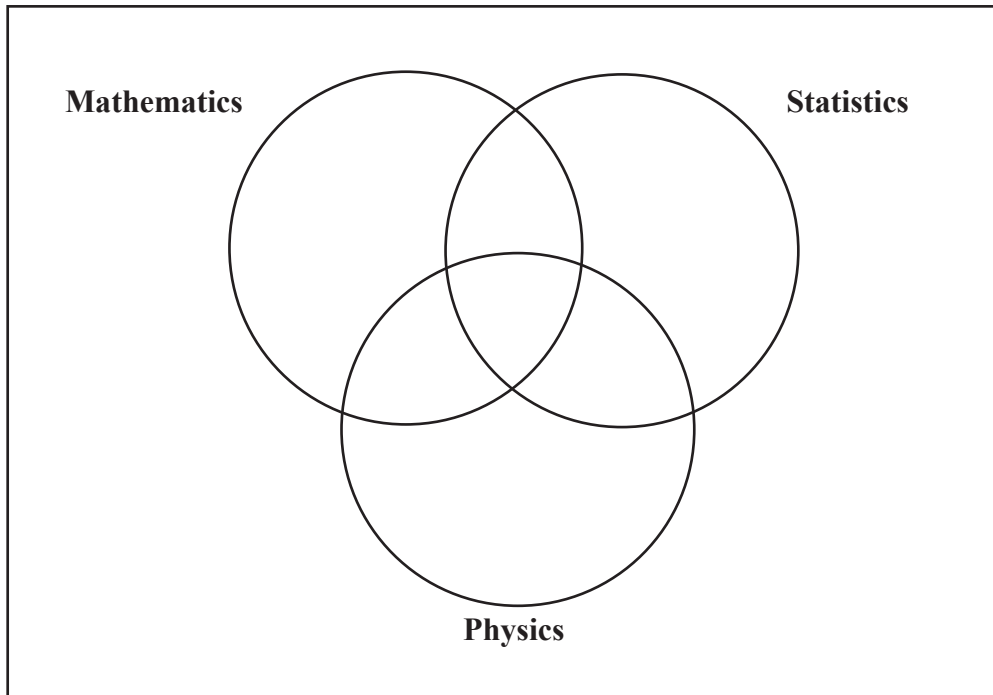40 study Mathematics
50 study Physics
21 study Mathematics and Physics
19 study Statistics and Physics
17 study Statistics and Mathematics
 5 study all three

(a) Complete the Venn Diagram.

(4)

One of the students is picked at random.

(b) Find the probability that this student studies only **one** of these subjects.

....

(2)

(Total for Question 4 is 6 marks)

5 The table gives information about the students studying Languages at a university.

	Language studied			Total
	French	**Latin**	**Spanish**	
Boys	35	63	47	145
Girls	48	29	58	135
Total	83	92	105	280

Jyoti is going to take a sample of 60 students stratified by gender and language studied.

Work out the number of boys studying Spanish in her sample.

....

(Total for Question 5 is 2 marks)

6 The table gives information about the annual cost of gas for households in the UK in 2009, 2010, 2011 and 2012.

Year	2009	2010	2011	2012
Annual Cost (£)	980	1120	1080	1260

(a) Using 2009 as the base year, complete the table by calculating the index number for the year 2012.
Give your answer correct to one decimal place.

Year	2009	2010	2011	2012
Index number	100	114.3	110.2	....

(2)

(b) Calculate the geometric mean of the index numbers for 2010, 2011 and 2012.
Give your answer correct to one decimal place.

....

(2)

(c) What does the geometric mean show about the annual cost of gas over this period?

....

....
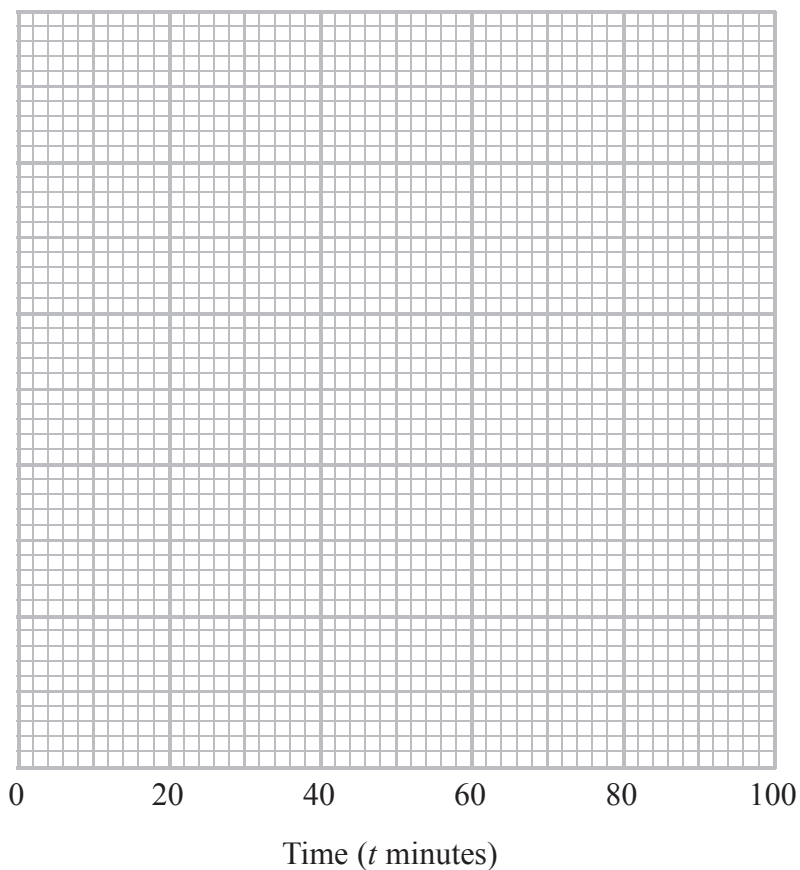
(2)

(Total for Question 6 is 6 marks)

7 The table gives information about the times, in minutes, spent by 212 adults using the internet one week.

Time spent (*t* minutes)	Frequency
$0 < t \leqslant 10$	20
$10 < t \leqslant 30$	58
$30 < t \leqslant 60$	102
$60 < t \leqslant 100$	32

(a) Draw a histogram for this information.

Time (*t* minutes)

(4)

(b) Work out an estimate for the mean time spent using the internet by these adults.
Give your answer correct to one decimal place.

....

(3)

(Total for Question 7 is 7 marks)

8 Carlos wants to find an estimate for the number of ants in a colony.

He catches 60 ants from the colony and marks each one with a dye.
He then returns the ants to the colony.

A week later, Carlos catches another 60 ants.
8 of these ants are marked with the dye.

Work out an estimate for the number of ants in the colony.
Write down an assumption you have made.

....

....

(Total for Question 8 is 3 marks)

Turn over ►

9 Alan wants to find information about the lengths of pebbles on different beaches.

(a) He is going to collect secondary data.

(i) Write down one disadvantage of collecting secondary data.

....

(1)

(ii) The lengths of pebbles are an example of which type of data?

....

(1)

(b) The lengths of each of the pebbles from beach A and from beach B were recorded.
The results are summarised in the histograms on the next page.

Compare the information shown in the histograms.
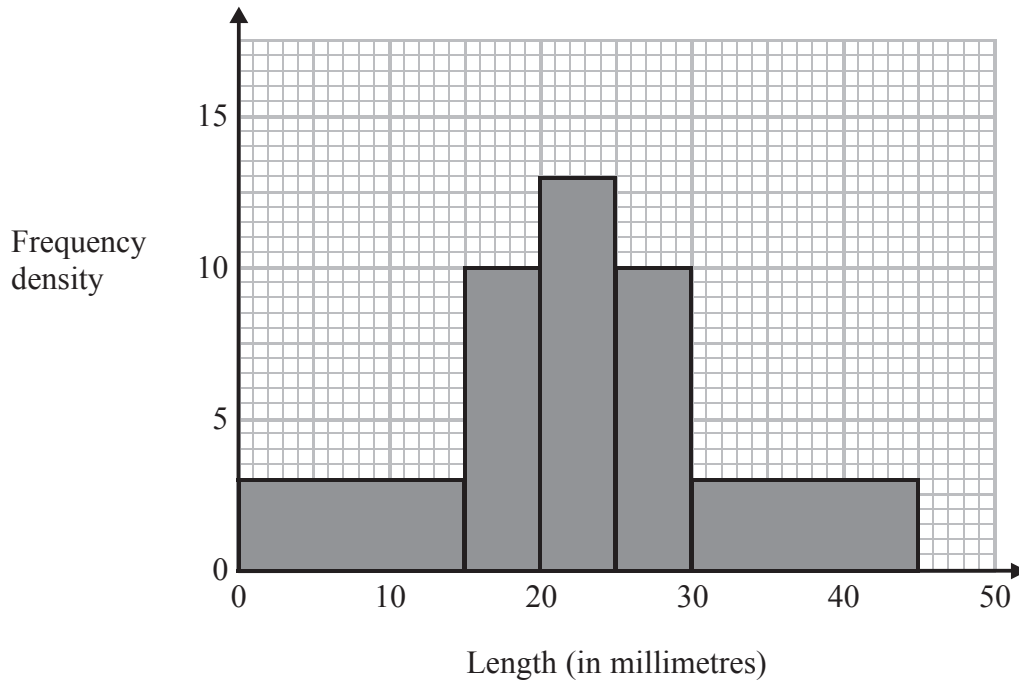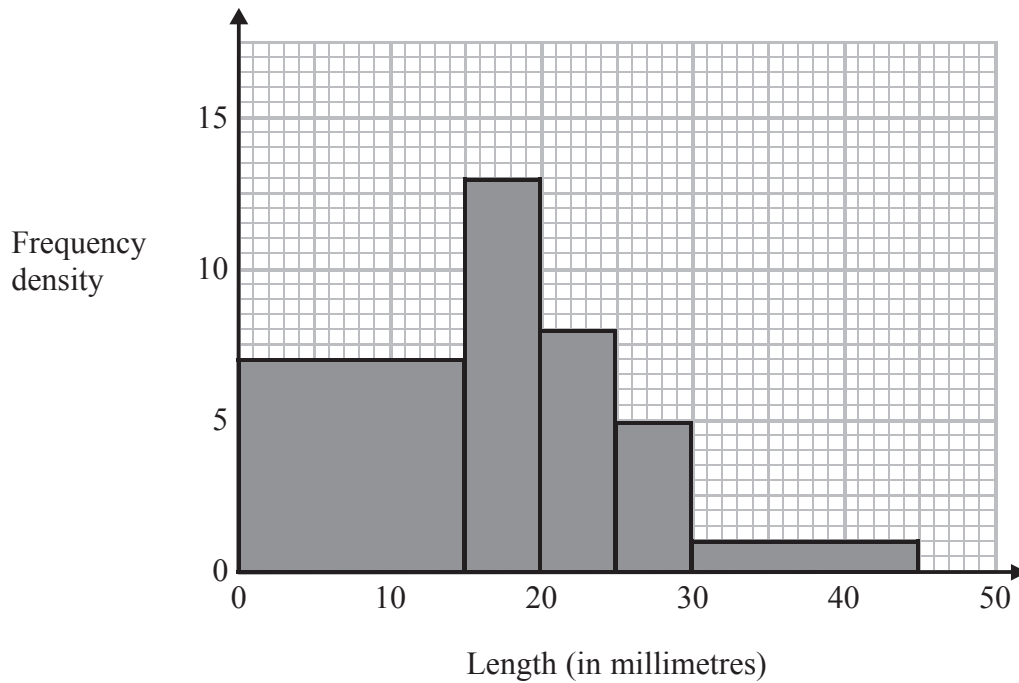Write down two comparisons.

1 ....

....

2 ....

....

(2)

Beach A

Frequency density vs Length (in millimetres)

Beach B

Frequency density vs Length (in millimetres)

(Total for Question 9 is 4 marks)

Turn over ▶

10 There are 10 marbles in a bag.

6 of the marbles are green.
4 of the marbles are yellow.

Davina takes at random two marbles from the bag.

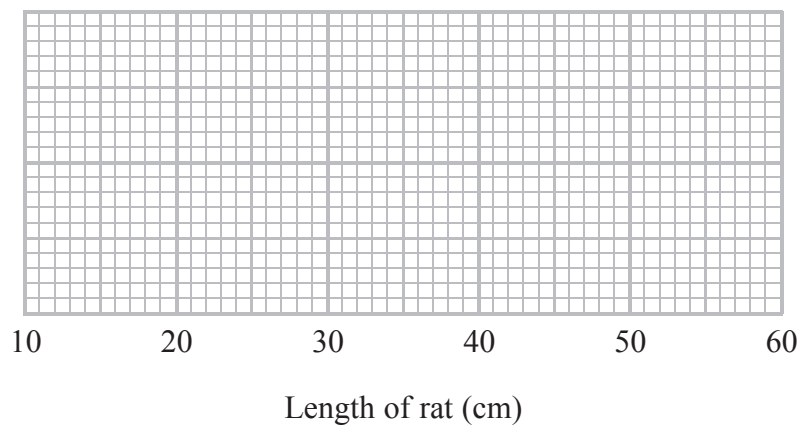Work out the probability that both marbles are the same colour.

....

(Total for Question 10 is 3 marks)

11 Here are the lengths, in centimetres, of 15 rats.

19	26	32	39	40	41	41	44
45	48	50	51	53	54	56	

(a) Show that 19 is an outlier.

....

(3)

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

Length of rat (cm)

(3)

(Total for Question 11 is 6 marks)

Turn over ▶

12 The table gives information about the number of students who enrol for a course in each term in 2011, in 2012 and in 2013.

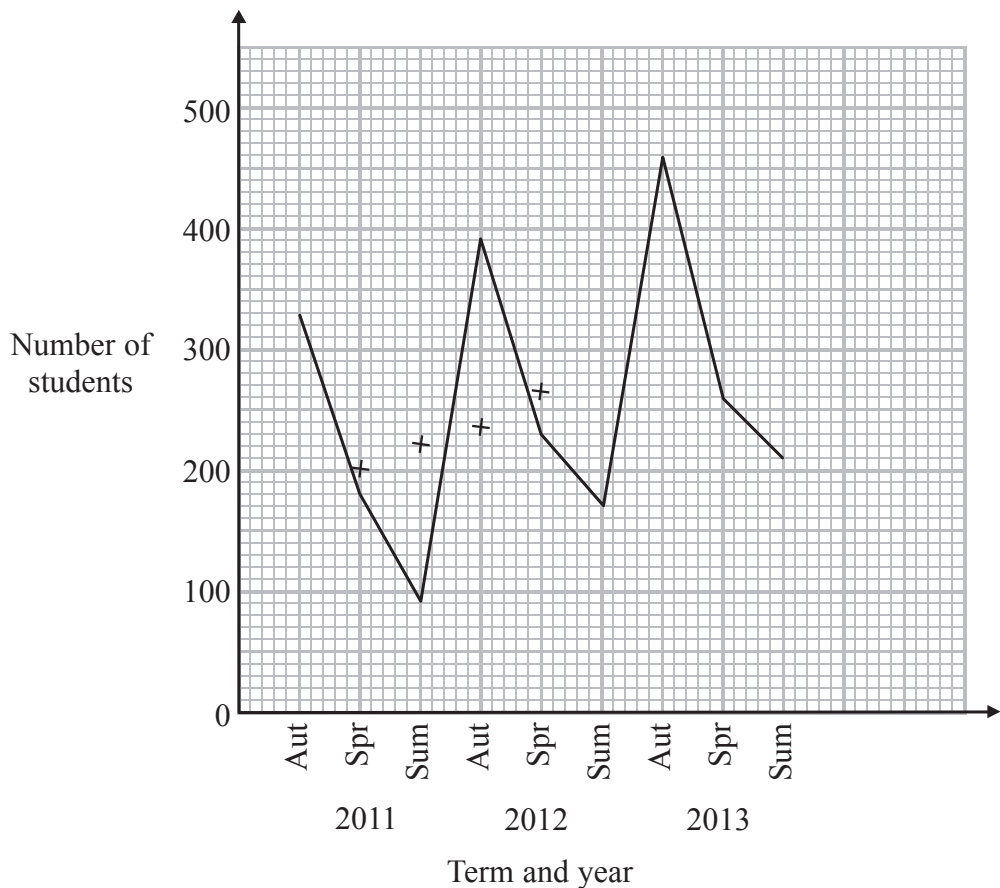The 3-point moving averages are given correct to 3 significant figures.

Year	Term	Number of students	3-point moving average
2011	Autumn	330	
	Spring	180	200
	Summer	90	220
2012	Autumn	390	237
	Spring	230	263
	Summer	170	287
2013	Autumn	460	297
	Spring	260	x
	Summer	210	

(a) Calculate the value of x in the table.
   Give your answer correct to 3 significant figures.

   ....
   (2)

(b) Plot the 3-point moving averages on the time-series graph.
   The first four have been done for you.

(2)

(c) On the time-series graph, draw a trend line for the 3-point moving averages.

(1)

(d) (i) Use your trend line to find an estimate for the mean seasonal variation in numbers enrolling for the Autumn Term.

....

(2)

(ii) Predict the number of students who will enrol in the Autumn Term of 2014.

....

(2)

(Total for Question 12 is 9 marks)

13 A and B are two events such that $P(A) = 0.3$ and $P(B) = 0.45$

(a) (i) Find the value of $P(A \text{ or } B)$, when A and B are mutually exclusive events.

....

(ii) Find the value of $P(A \text{ and } B)$, when A and B are independent events.

....

(2)

X and Y are two events such that $P(X) = 0.3$ and $P(Y) = 0.25$

Given that $P(X|Y) = 0.6$

(b) work out $P(Y|X)$.

....

(3)

(Total for Question 13 is 5 marks)

14 Mrs Smith and Mrs Patel ranked the work of 8 students.
The table gives information about their ranks.

Student	Rank (Mrs Smith)	Rank (Mrs Patel)		
A	4	6		
B	8	4		
C	1	3		
D	6	1		
E	2	7		
F	7	8		
G	3	2		
H	5	5		

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

....

(ii) Interpret your answer.

....

....

(Total for Question 14 is 4 marks)

Turn over ▶

15 Andrew entered a swimming race.
The times in this race are normally distributed with a mean time of 57 seconds and a standard deviation of 8 seconds.

Andrew swam the race in a time of 70 seconds.

(a) Calculate the standardised score for Andrew.

....

(2)

Ravina swam in the same race.
Her standardised score is 1.8

(b) Which of Andrew or Ravina did better in the race?
Give a reason for your answer.

....

....

....

(1)

(Total for Question 15 is 3 marks)

16 The weights of bolts are normally distributed with mean 90 g and standard deviation 12 g.

A bolt is chosen at random.

(i) Find the probability that the bolt weighs less than 105 g.

....

(ii) Find the probability that the bolt weighs more than 111 g.

....

(Total for Question 16 is 5 marks)

17 Tiles are packed in boxes of 8
The probability that any tile in a box is broken is 0.05
A box of tiles is picked at random.

(a) Find the probability that the box contains no broken tiles.
Give your answer correct to 3 decimal places.

....

(2)

(b) Find the probability that the box contains exactly one broken tile.
Give your answer correct to 3 decimal places.

....

(2)

Jim buys 150 boxes of the tiles.

(c) Find an estimate for the number of boxes that contain exactly one broken tile.

....

(2)

(Total for Question 17 is 6 marks)

18 The table shows the amount of fertiliser, x kg, given to a sample of plants.
It also shows the amount of extra growth, y kg, of the plants.

Amount of fertiliser given (x kg)	Extra growth (y kg)
1.8	7.2
1.3	8.3
2.3	9.1
4.2	9.4
3.4	8.6
4.5	9.2
5.8	10.4

(a) Calculate the value of S_{xy}

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

....
(2)

Given that $S_{xx} = 15.8$ and that $S_{yy} = 5.97$,

(b) (i) calculate the product-moment correlation coefficient for this data,

....
(2)

(ii) interpret your answer.

....
(1)

(Total for Question 18 is 5 marks)

TOTAL FOR PAPER: 90 MARKS

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