Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Award

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 13 January 2021

Morning (Time: 2 hours) | Paper Reference **AST30/01**

Statistical Methods

Level 3
Calculator allowed

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 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 ▶

P 6 3 6 8 4 R A 0 1 2 4

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 A youth club has 450 members.

Each member was asked to name their favourite type of sport.

Each member could choose from badminton, snooker, squash or tennis.

The table shows the number of males and the number of females who chose each of these types of sport.

	badminton	**snooker**	**squash**	**tennis**
male	45	40	86	96
female	50	28	50	55

(a) The type of sport is an example of which type of data?

.....

(1)

Jaymini is going to take a sample of 65 of these members, stratified by gender and by the sport that they chose.

(b) Work out the number of members of the youth club that are male and chose snooker that should be in her sample.

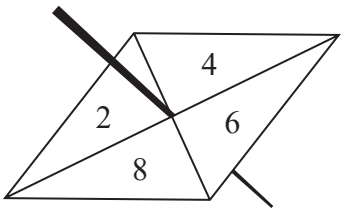
.....

(2)

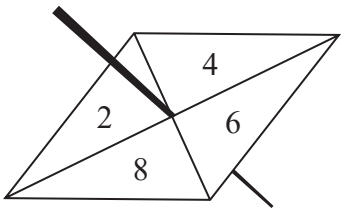
(Total for Question 1 is 3 marks)

2 Sarah has two fair 4-sided spinners.

There is a blue spinner and a red spinner.



blue spinner



red spinner

Each spinner has four sections numbered 2, 4, 6 and 8

Sarah spins each spinner once and records the number that each spinner lands on.

For each spin

total score = number that the blue spinner lands on + number that the red spinner lands on

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

		red spinner			
		2	**4**	**6**	**8**
blue spinner	**2**				
	4				
	6				
	8				

(1)

(b) Find the probability that Sarah gets a total score of 14

.....

(1)

Sarah is going to spin each spinner 200 times.

(c) Work out an estimate for the number of times the total score will be 14

.....

(2)

(Total for Question 2 is 4 marks)

3 John wants to estimate the number of grasshoppers in his garden.

On Monday he catches a sample of 35 grasshoppers from his garden, marks each grasshopper with some paint and releases them back into his garden.

On Tuesday he catches a sample of 30 grasshoppers from his garden.

Using the Peterson capture and recapture method, John estimates that there are 210 grasshoppers in his garden.

Work out how many of the grasshoppers in his sample on Tuesday were marked with paint.

.....

(Total for Question 3 is 2 marks)

4 The table gives information about the weights, in kg, of some fish caught in a river during a competition.

Mean	Standard deviation
3.6	0.6

In the competition Ken caught a fish with a weight of 4.5 kg.

The weights of the fish caught in the competition are normally distributed.

(a) Calculate the standardised score of the weight of Ken's fish.

.....

(2)

Jane caught a fish in the competition.

The standardised score of the weight of Jane's fish is −1.2

(b) Calculate the weight of the fish caught by Jane in the competition.

..... kg

(2)

(Total for Question 4 is 4 marks)

5 The weights, in kg, of goats on farm A and on farm B were measured and recorded.

The incomplete ordered back-to-back stem and leaf diagram shows the weights of the goats on farm B.

farm A		farm B
	5	0 3 4
	6	1 1 5 7
	7	3 4
	8	2
	9	0
	10	

Key:

Key: 5 | 0 represents 50 kg

Here are the weights, in kg, of the goats on farm A.

54	58	64	66	70
72	75	78	83	85
85	92	96	101	102

(a) Complete the ordered back-to-back stem and leaf diagram for the weights of the goats on farm A.

(2)

(b) Compare the distribution of the weights of the goats on farm A with the distribution of the weights of the goats on farm B.
You should write down **two** comparisons.

.....

.....

.....

.....

.....

.....

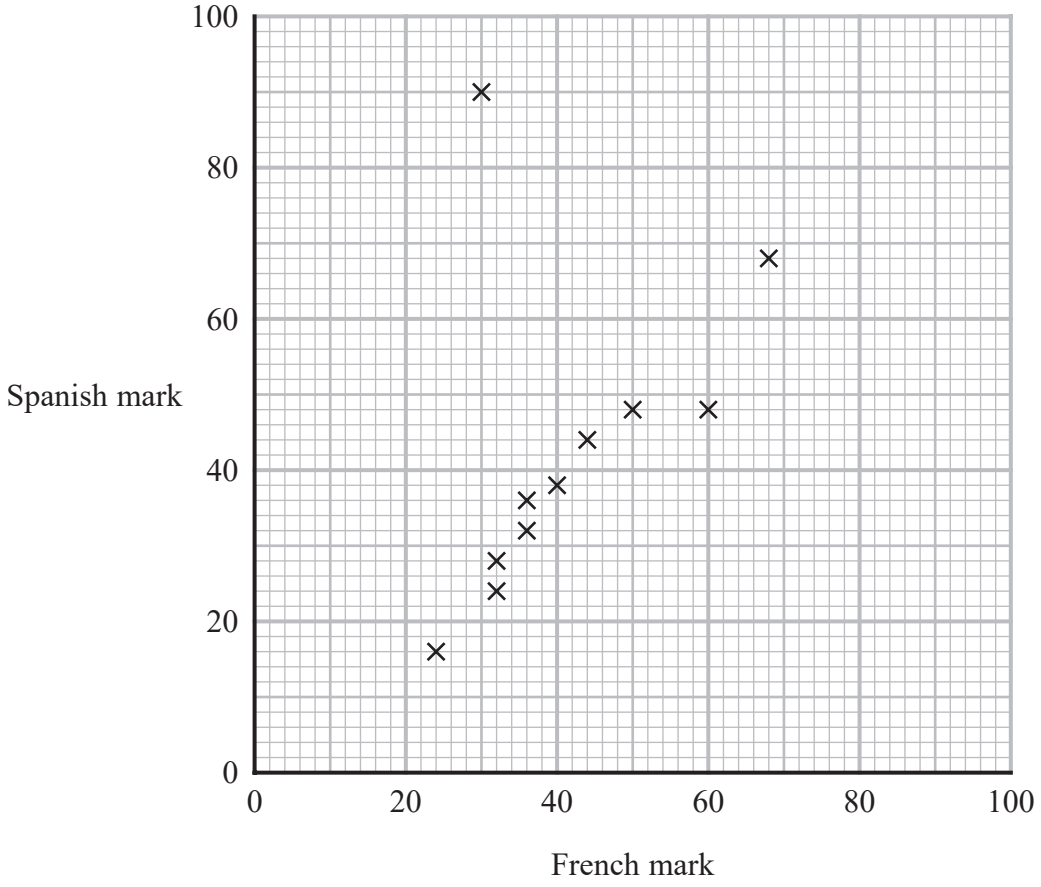
(2)

(Total for Question 5 is 4 marks)

6 Eleven students sat a French test and a Spanish test.

Each test was marked out of 100

The scatter diagram shows information about the marks scored by each of the 11 students in each of the two tests.

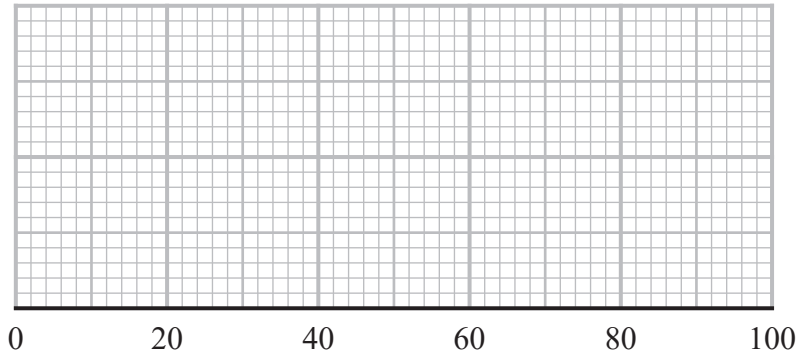


Greg says that the point (30, 90) is an outlier on the scatter diagram because 90 is an outlier for the Spanish marks.

(a) Show, by calculation, that 90 is an outlier for the Spanish marks.

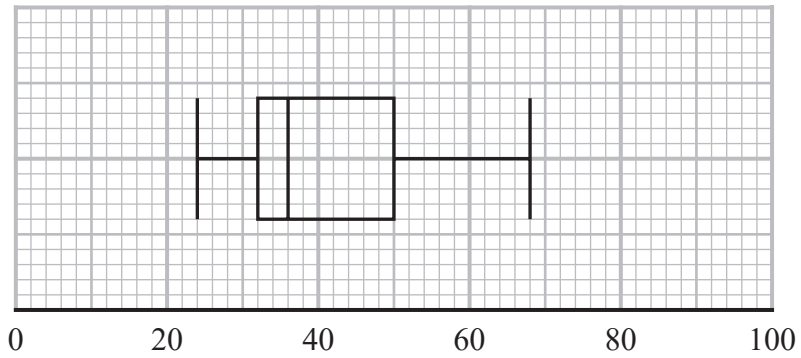
(4)

(b) On the grid, draw a box plot for the marks scored by the 11 students in the Spanish test.



(3)

The box plot below, gives information about the marks scored by the 11 students in the French test.



(c) Compare the distributions of the marks scored in the two tests.
You should write down three comparisons.

1 .....

.....

2 .....

.....

3 .....

.....

(3)

(Total for Question 6 is 10 marks)

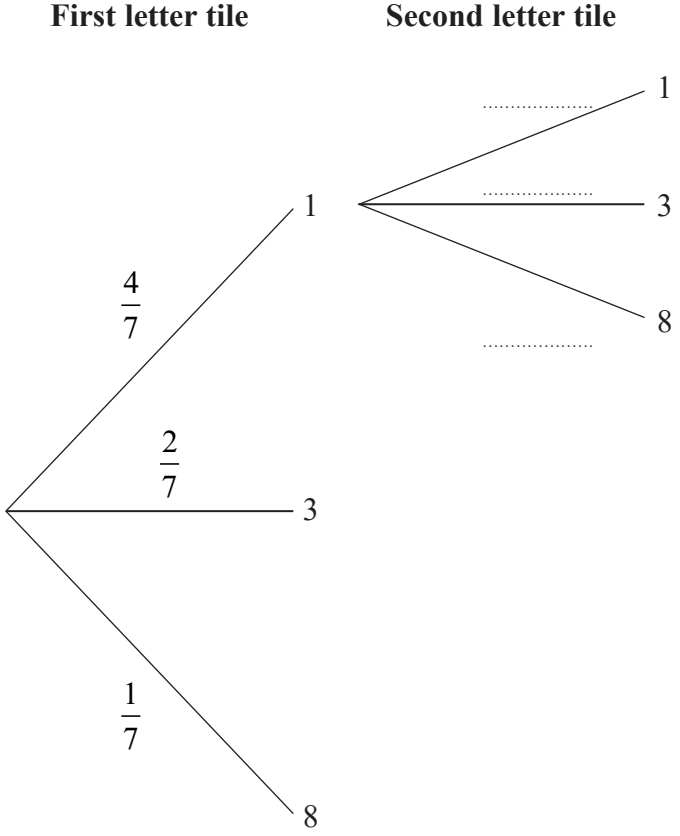
7 A bag contains the following letter tiles.

E_1	N_1	R_1	T_1	B_3	C_3	J_8

The number on each letter tile shows how many points the letter on the tile is worth.

Two letter tiles are taken at random from the bag.

(a) Complete the probability tree diagram to show all the combinations of points when two tiles are taken.



(2)

The number of points on each of the two tiles that are taken are added together to get the score.

(b) Work out the probability that the score for the two tiles is less than 5

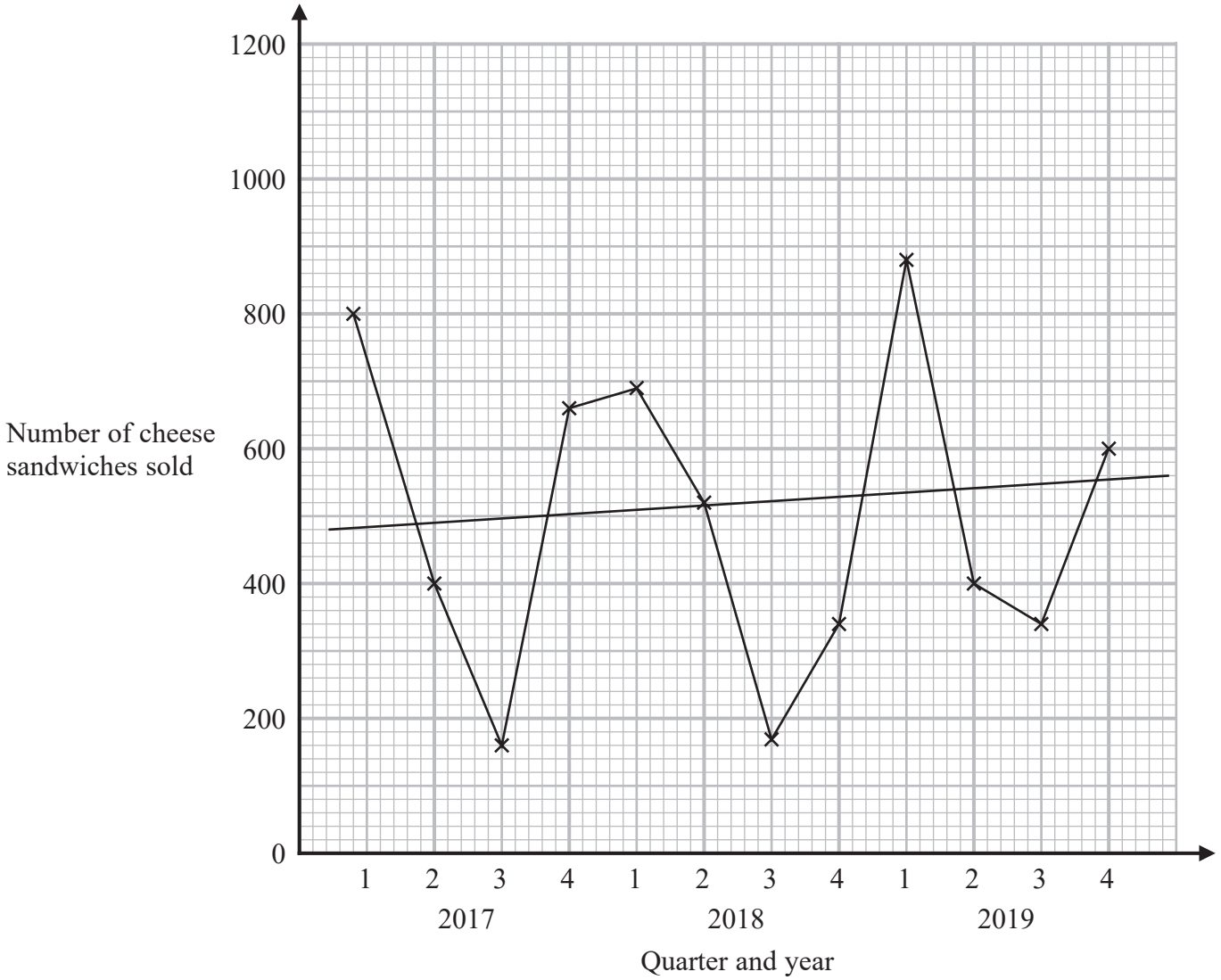
.....

(3)

(Total for Question 7 is 5 marks)

8 The time-series graph gives information about the total number of cheese sandwiches sold each quarter from a cafe from 2017 to 2019.

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 2019.

.....

(2)

(Total for Question 8 is 3 marks)

9 Ojas asked 100 people which of the following curries they like.

They could choose from Korma (K), Madras (M) and Bhuna (B).

Their replies showed that

all 100 people like at least one of the three curries

2 people like only Bhuna

80 people like Madras

48 people like Korma and Bhuna

42 people like Madras and Bhuna

32 people like Korma and Madras but do not like Bhuna

38 people like all 3 curries

(a) Represent all this information in a Venn diagram.

(4)

Ojas is going to select at random one of the 100 people.

(b) Given that this person likes Korma, find the probability that this person also likes exactly one of the other two curries.

.....

(2)

(Total for Question 9 is 6 marks)

10 At a dog show, 10 Great Dane dogs were ranked by two judges.

The table gives their rankings.

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

(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 3 decimal places.

.....

(3)

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

.....

(1)

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

.....

.....

(1)

(Total for Question 10 is 5 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

11 Rita is investigating the price of petrol at her local garage.

The table gives the price, in pence, of a litre of petrol at Rita's garage on the 1st April for each year from 2014 to 2018.

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

Year	**2014**	**2015**	**2016**	**2017**	**2018**
Price (pence)	130	111	102	117	121
Chain base index number		85.4	91.9		

(a) Interpret the value 85.4 in the table.

.....

.....

(1)

(b) Calculate, to one decimal place, the chain base index numbers for 2017 and for 2018.

2017 .....

2018 .....

(2)

On the 2nd April 2018, Rita said

"The price of petrol at my local garage has shown an average annual increase since 2014."

(c) Is Rita correct?
You must show all your working and give a reason for your answer.

(4)

(Total for Question 11 is 7 marks)

12 x and y are statistical variables with the following summary statistics.

$$\sum x = 176.9 \quad \sum x^2 = 2576.47 \quad S_{xy} = 1907.63 \quad S_{yy} = 9034.93 \quad n = 15$$

(a) Show that, correct to one decimal place, $S_{xx} = 490.2$

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.

.....

(2)

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

.....

(1)

(Total for Question 12 is 4 marks)

13 50 males and 50 females sat an IQ test.

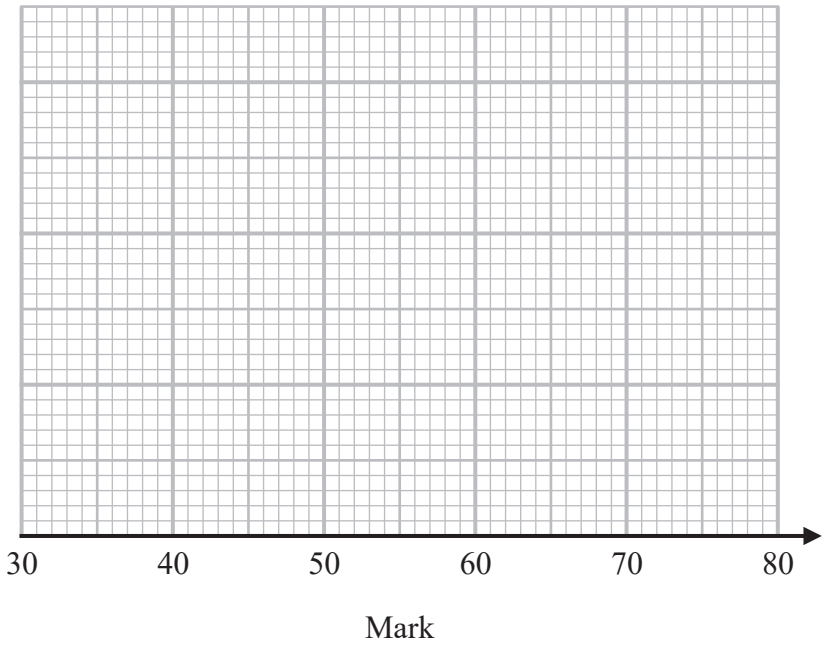
The IQ test was marked out of 100

The marks for males are normally distributed and the marks for females are normally distributed.

The mean and the standard deviation of the marks for the males and for the females are given in the table.

	mean	**standard deviation**
males	60	4
females	55	5

On the grid, sketch the two normal distributions.



(Total for Question 13 is 4 marks)

14 A, B and C are three events such that

$$P(A) = \frac{2}{5} \qquad P(C) = \frac{1}{3} \qquad P(A \cup B) = \frac{5}{8}$$

The events A and C are mutually exclusive.

The events A and B are independent.

(a) Find $P(A \cup C)$

.....

(2)

(b) Find $P(B)$

.....

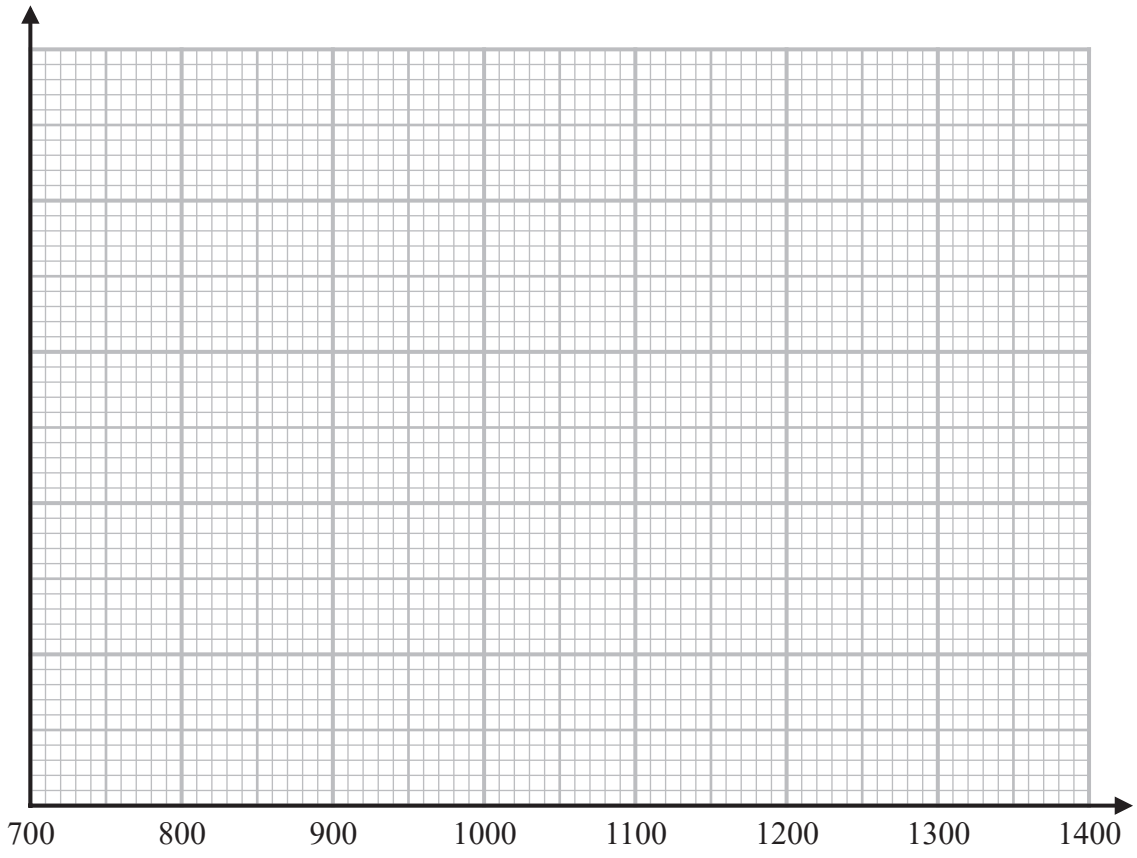
(3)

(Total for Question 14 is 5 marks)

15 The table gives information about the weights, w kg, of 160 giraffes.

Weight (w kg)	Frequency (f)
$750 < w \leqslant 900$	15
$900 < w \leqslant 1000$	35
$1000 < w \leqslant 1100$	42
$1100 < w \leqslant 1200$	38
$1200 < w \leqslant 1350$	30

(a) On the grid below, draw a histogram for the information in the table.



(4)

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

..... kg
(3)

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

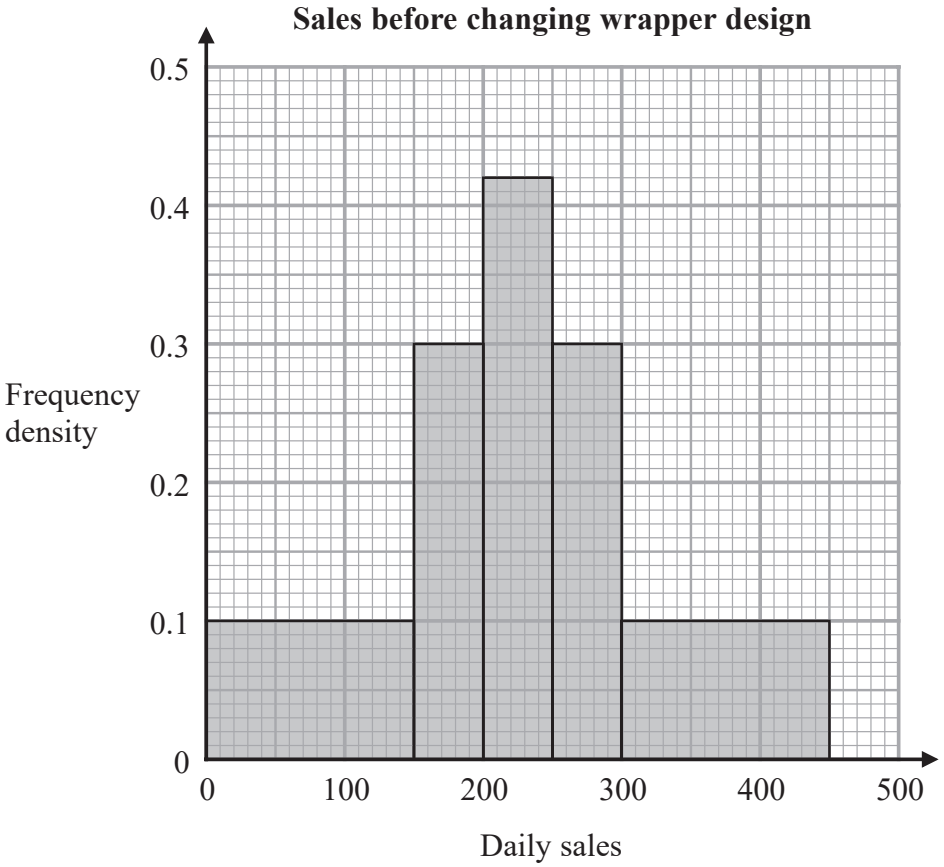
You may use $\sum fw^2 = 187\,125\,625$

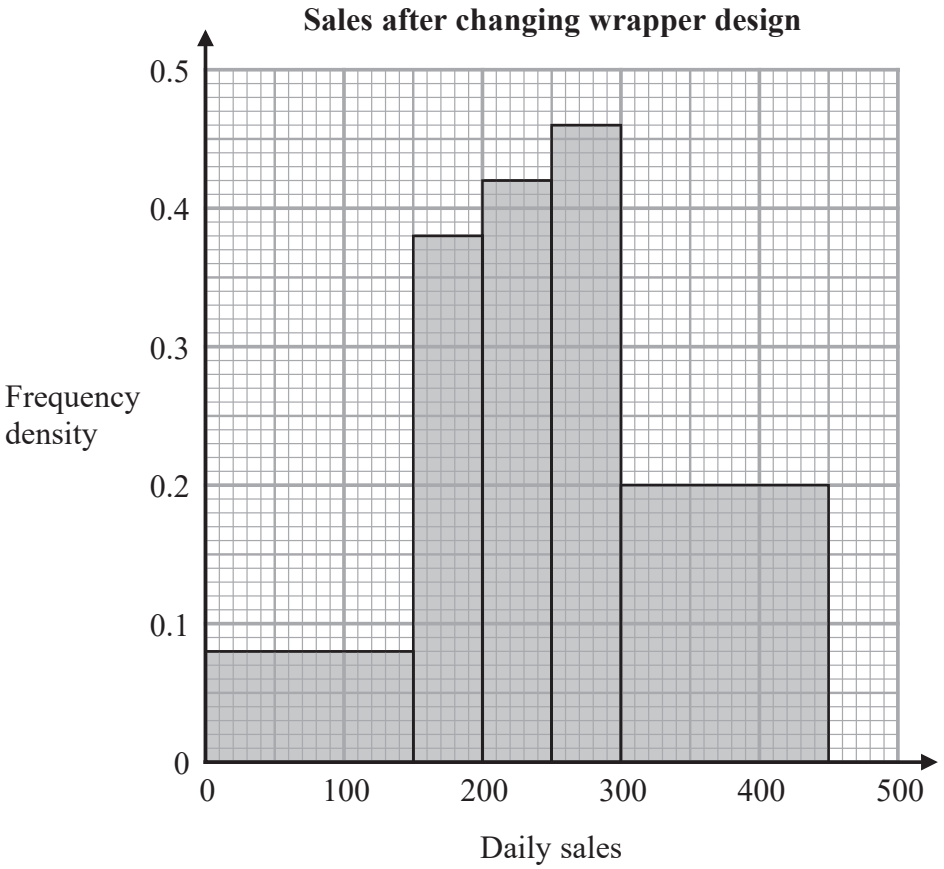
..... kg
(2)

(Total for Question 15 is 9 marks)

16 The directors of a company that makes chocolate bars decide to change the wrapper design.

The histograms show information about the daily sales of the chocolate bars, before and after changing the wrapper design.





(a) Compare the information shown in the two histograms.
Write down **two** comparisons.

.....

.....

.....

.....

(2)

The chairman of the company wants to find out what customers think about the changes made to the wrapper design.

He decides to survey a sample of the customers on one day.

The data collected in the survey is primary data.

(b) Write down one advantage **and** one disadvantage of collecting primary data.

Advantage .....

.....

Disadvantage .....

.....

(2)

(Total for Question 16 is 4 marks)

17 The breakfast cereal that Tony buys from his local supermarket is sold in boxes.

The weights of the contents of these boxes of breakfast cereal are normally distributed with mean 202 g and standard deviation 5 g.

Tony selects at random from the shelves at his local supermarket a box of his breakfast cereal.

(a) Calculate the probability that the contents of this box of breakfast cereal have a weight less than 200 g.

.....

(3)

(b) Calculate the probability that the contents of this box of breakfast cereal have a weight between 200 g and 210 g.

.....

(3)

(Total for Question 17 is 6 marks)

18 It is known that 98% of the balloons made by *Party Balloons* will not burst when blown up.

Party Balloons sells their balloons in packs of 10 balloons.

Nemy is having a birthday party for her son.
There will be 9 children, including her son, at the party.
She wants to be able to give each of the 9 children a blown up balloon.

Nemy buys one pack of 10 balloons.

Work out the probability that she can give all the children a blown up balloon.

.....

(Total for Question 18 is 5 marks)

TOTAL FOR PAPER IS 90 MARKS

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