



Rewarding Learning

General Certificate of Secondary Education  
2024

Centre Number

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Candidate Number

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## Further Mathematics

Unit 3 (With calculator)

Statistics



[GFM31]

\*GFM31\*

WEDNESDAY 19 JUNE, AFTERNOON

### TIME

1 hour.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.**

**Do not write outside the boxed area on each page.**

Complete in black ink only. **Do not write with a gel pen.**

All working **must** be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.

Where rounding is necessary give answers correct to **2 decimal places** unless stated otherwise.

Answer **all six** questions.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 50.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You may use a calculator.

The Formula Sheet is on page 2 and the Normal Probability Table is on page 3.

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## FORMULA SHEET

### STATISTICS

Statistical measures: Mean =  $\frac{\Sigma fx}{\Sigma f}$

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fx^2}{\Sigma f} - (\bar{x})^2}$$

where  $\bar{x}$  is the mean

Probability:  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$$P(A | B) = \frac{P(A \cap B)}{P(B)}$$

Bivariate Analysis: Spearman's coefficient of rank correlation is given by

$$r = 1 - \frac{6 \Sigma d^2}{n(n^2 - 1)}$$

Quadratic equations: If  $ax^2 + bx + c = 0$  ( $a \neq 0$ )

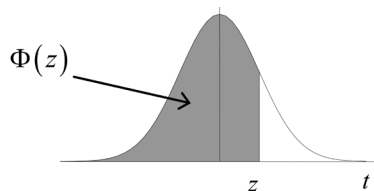
$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



# NORMAL PROBABILITY TABLE

Table of  $\Phi(z)$

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
<b>0.0</b>	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
<b>0.1</b>	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
<b>0.2</b>	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
<b>0.3</b>	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
<b>0.4</b>	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
<b>0.5</b>	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
<b>0.6</b>	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
<b>0.7</b>	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
<b>0.8</b>	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
<b>0.9</b>	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
<b>1.0</b>	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
<b>1.1</b>	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
<b>1.2</b>	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
<b>1.3</b>	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
<b>1.4</b>	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
<b>1.5</b>	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
<b>1.6</b>	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
<b>1.7</b>	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
<b>1.8</b>	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
<b>1.9</b>	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
<b>2.0</b>	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
<b>2.1</b>	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
<b>2.2</b>	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
<b>2.3</b>	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
<b>2.4</b>	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
<b>2.5</b>	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
<b>2.6</b>	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
<b>2.7</b>	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
<b>2.8</b>	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
<b>2.9</b>	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
<b>3.0</b>	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990



[Turn over



1 A midwife recorded the lengths, to the nearest centimetre, of 30 newborn babies.

The table below shows a summary of the lengths.

Length (cm)	Frequency			
45–47	3			
48–50	8			
51–53	10			
54–56	6			
57–59	2			
60–62	1			

(i) Calculate an estimate of the mean length.

You **must** show your working.

Answer \_\_\_\_\_ cm [2]



(ii) Calculate an estimate of the standard deviation of the lengths.

You **must** show your working.

Answer \_\_\_\_\_ cm [3]

It was discovered at a later date that, due to a fault in the measuring equipment, all recorded lengths were 3 cm too long.

(iii) What should the estimated values be for

(a) the mean in part (i),

Answer \_\_\_\_\_ cm [1]

(b) the standard deviation in part (ii)?

Answer \_\_\_\_\_ cm [1]

[Turn over



- 2 The marks obtained by 10 students in their Written and Practical music tests are shown in the table below.

Student	Alice	Bob	Cay	Don	Ellie	Fiona	Gail	Holly	Ivy	Jill
Written test	42	37	44	40	33	43	45	38	47	36
Practical test	45	38	41	42	35	39	41	36	43	40
Ranks (Written test)										
Ranks (Practical test)										

- (i) Write down, in the table above, the rank orders for the Written and Practical tests' marks. [2]

- (ii) Calculate Spearman's coefficient of rank correlation.

Answer \_\_\_\_\_ [4]



(iii) Interpret your answer to part (ii).

Answer \_\_\_\_\_ [1]

(iv) Calculate the mean mark for the Written test and the mean mark for the Practical test.

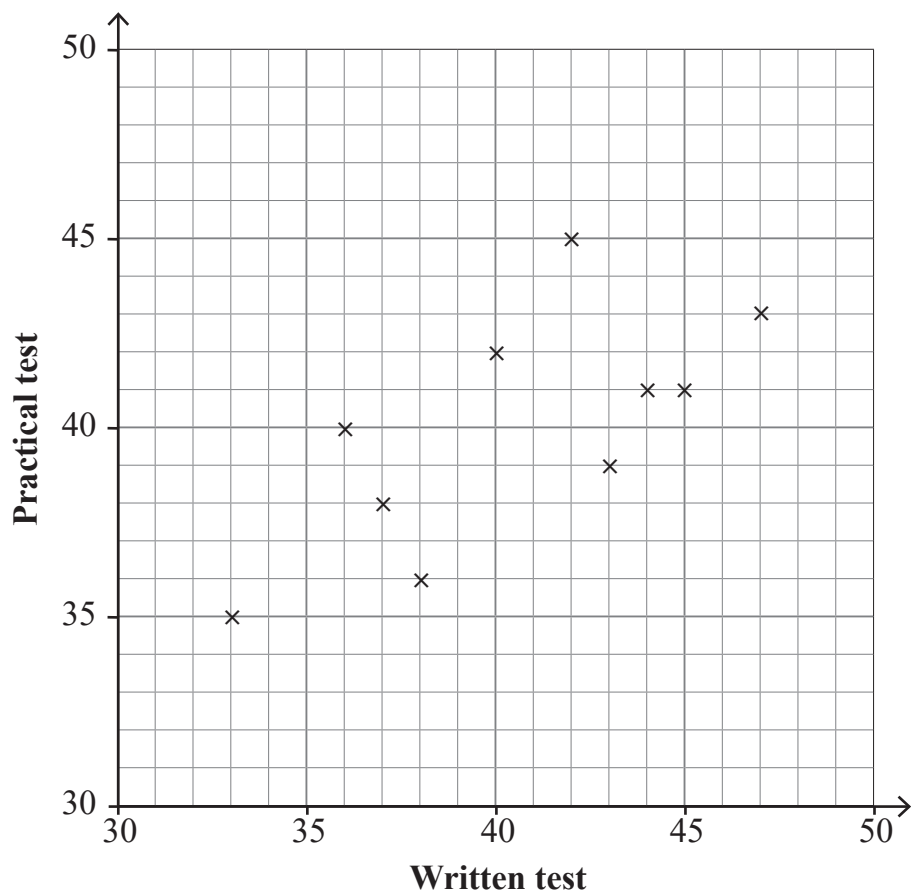
Answer Mean mark (Written test) \_\_\_\_\_

Mean mark (Practical test) \_\_\_\_\_ [1]

[Turn over



The data from the table are plotted on the graph below.



(v) Draw your line of best fit on the graph.

[2]





(vi) Determine the equation of the line of best fit which you have drawn.

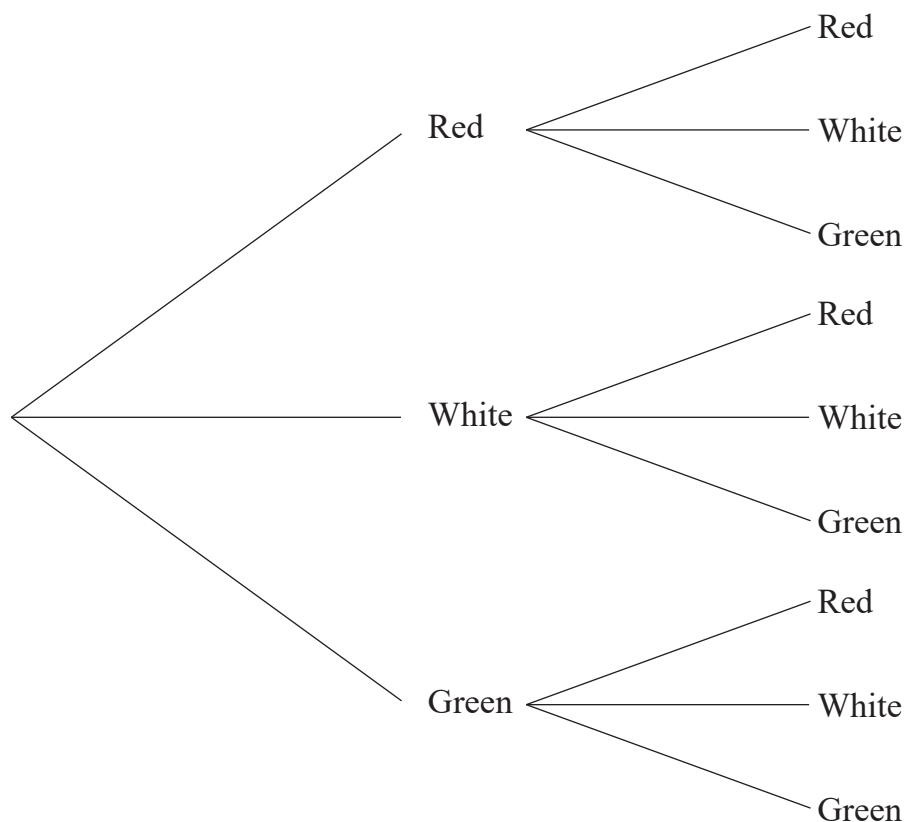
Answer \_\_\_\_\_ [3]



3 There are 5 red scarves, 3 white scarves and 4 green scarves in a box.

Jane selects two scarves at random, without replacement.

By completing the tree diagram below, or otherwise, answer the following questions.



(i) If the first scarf which Jane selects is white, what is the probability that the second scarf will be red?

Answer \_\_\_\_\_ [1]



(ii) Calculate the probability that the two scarves which Jane selects are

(a) the same colour,

Answer \_\_\_\_\_ [2]

(b) different colours.

Answer \_\_\_\_\_ [2]

**Q3 continues on page 13**

**[Turn over**



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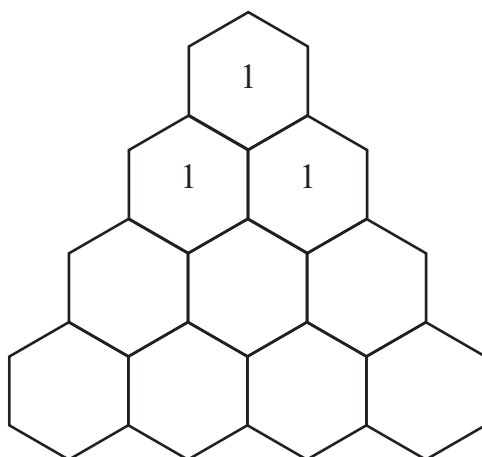


(iii) Given that both scarves which Jane selects are the same colour, what is the probability that they are both green?

Answer \_\_\_\_\_ [3]



- 4 (i) Complete Pascal's triangle in the grid below.

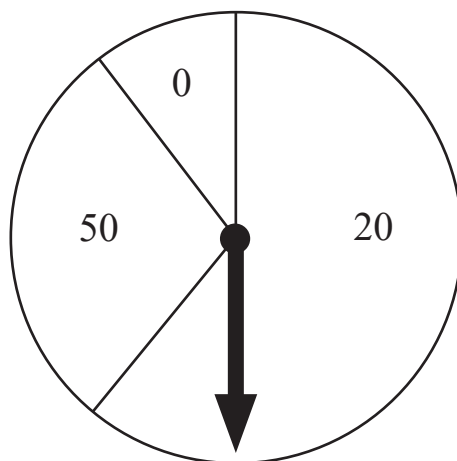


[1]

- (ii) Hence write down the expansion of  $(p + q)^3$

Answer \_\_\_\_\_ [1]

Jason is spinning a spinner with three sections, marked 0, 20 and 50, as shown in the diagram below.



The probability of Jason scoring 20 with a single spin of the spinner is 0.6

Jason spins the spinner three times and the scores are noted.



Find the probability that

(iii) he scores 20 with exactly one of his three spins,

Answer \_\_\_\_\_ [2]

(iv) he scores 20 with at least two of his three spins.

Answer \_\_\_\_\_ [3]

The probability of Jason scoring 50 with a single spin of the spinner is 0.3

(v) What is the probability of Jason scoring a total of 150 with three spins?

Answer \_\_\_\_\_ [2]

[Turn over



5 The masses of a large number of apples were measured in grams.

The masses were normally distributed with mean 200 g and standard deviation 30 g.

(i) Find the probability that an apple, chosen at random, had mass less than 245 g.

Give your answer to 4 decimal places.

Answer \_\_\_\_\_ [2]





(ii) Find the probability that an apple, chosen at random, had mass greater than 125 g.

Give your answer to 4 decimal places.

Answer \_\_\_\_\_ [3]

[Turn over



6 In a new development, 120 houses are built.

Houses may have up to three added extras, selected from a garage, a sunroom and a utility room.

Of the houses in the development

19 have a garage, a sunroom and a utility room

29 have a garage and a sunroom

26 have a garage and a utility room

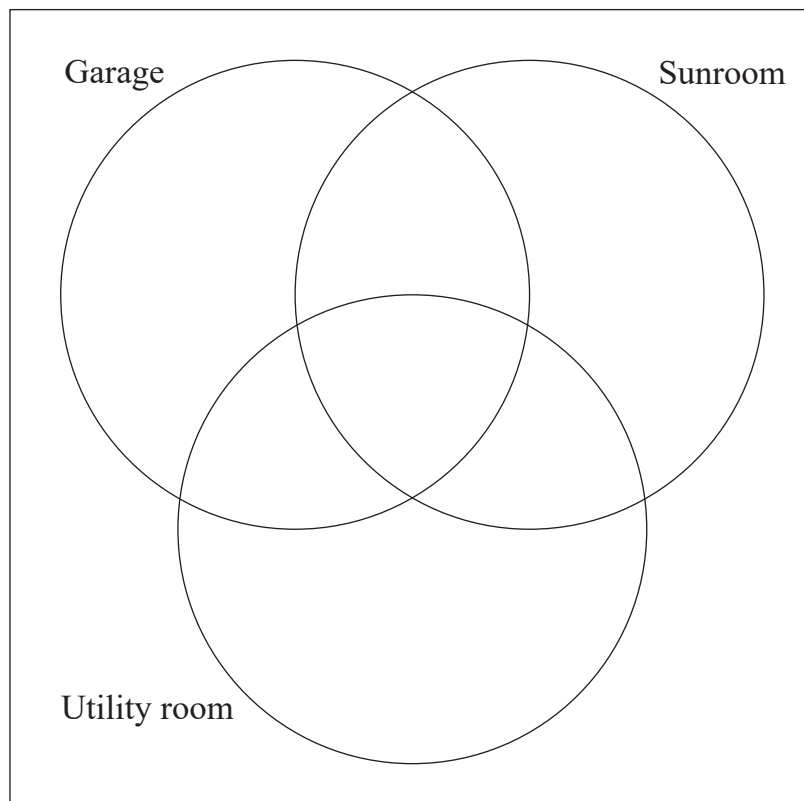
36 have a utility room and a sunroom

50 have a garage

52 have a sunroom

64 have a utility room.

(i) Illustrate this information on the Venn diagram below.



[3]



(ii) What is the probability that a house, selected at random, has **exactly** two of the added extras?

Answer \_\_\_\_\_ [2]

A house, selected at random, does not have a utility room.

(iii) What is the probability that this house has a sunroom?

Answer \_\_\_\_\_ [3]

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**THIS IS THE END OF THE QUESTION PAPER**

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Question Number	Marks
1	
2	
3	
4	
5	
6	

<b>Total Marks</b>	
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