



Rewarding Learning

General Certificate of Secondary Education  
2023

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--	--

## Further Mathematics

Unit 3 (With calculator)

Statistics



[GFM31]

\*GFM31\*

FRIDAY 23 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.

13360



\*24GFM3101\*

## 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  $ax^2 + bx + c = 0$  ( $a \neq 0$ )

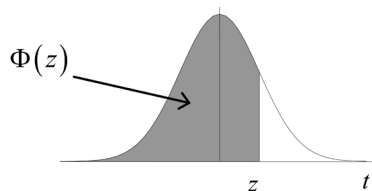
$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



# 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 At a singing contest eight competitors were scored on each of two songs.

The table below shows their scores for each song.

Competitor	Ann	Brian	Carol	David	Eve	Fred	Gail	Harry
First song	71	78	64	65	73	76	66	75
Second song	68	75	66	69	70	69	71	72
Ranks (First song)								
Ranks (Second song)								

(i) Write down, in the table above, the rank orders for the first and second songs. [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 first song and the mean mark for the second song.

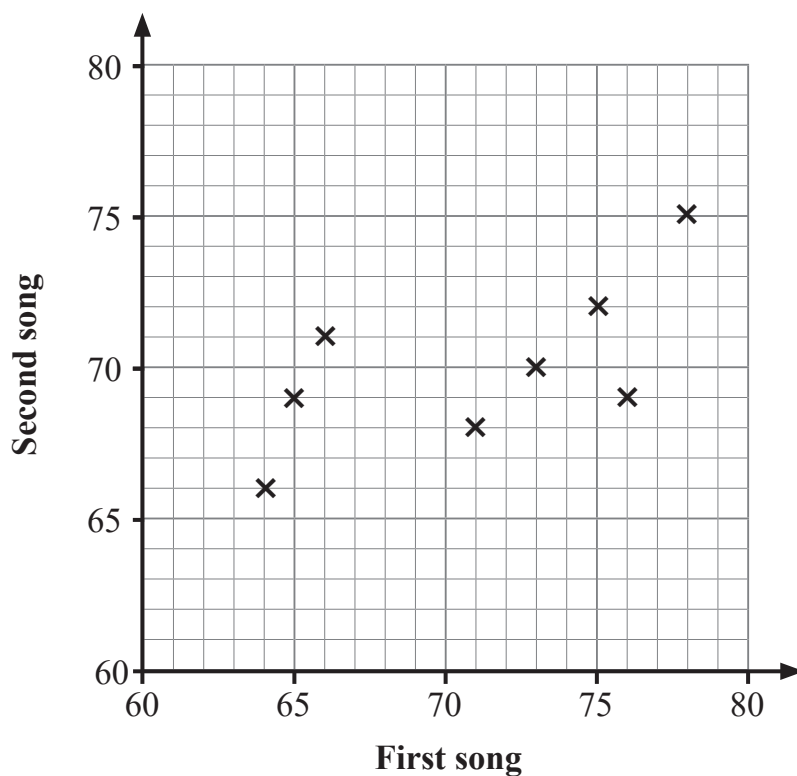
Answer Mean first song \_\_\_\_\_

Mean second song \_\_\_\_\_ [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]

[Turn over



- 2 The speeds of 10 cars and 4 lorries were recorded in a 30 mph zone on a road.
- For all 14 vehicles, the mean speed was 32 mph and the standard deviation was 4 mph.
- The speeds of the lorries were 28 mph, 30 mph, 33 mph and 40 mph.

Calculate

- (i) the mean speed of the cars,

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



(ii) the standard deviation of the speeds of the cars.

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

[Turn over

13360



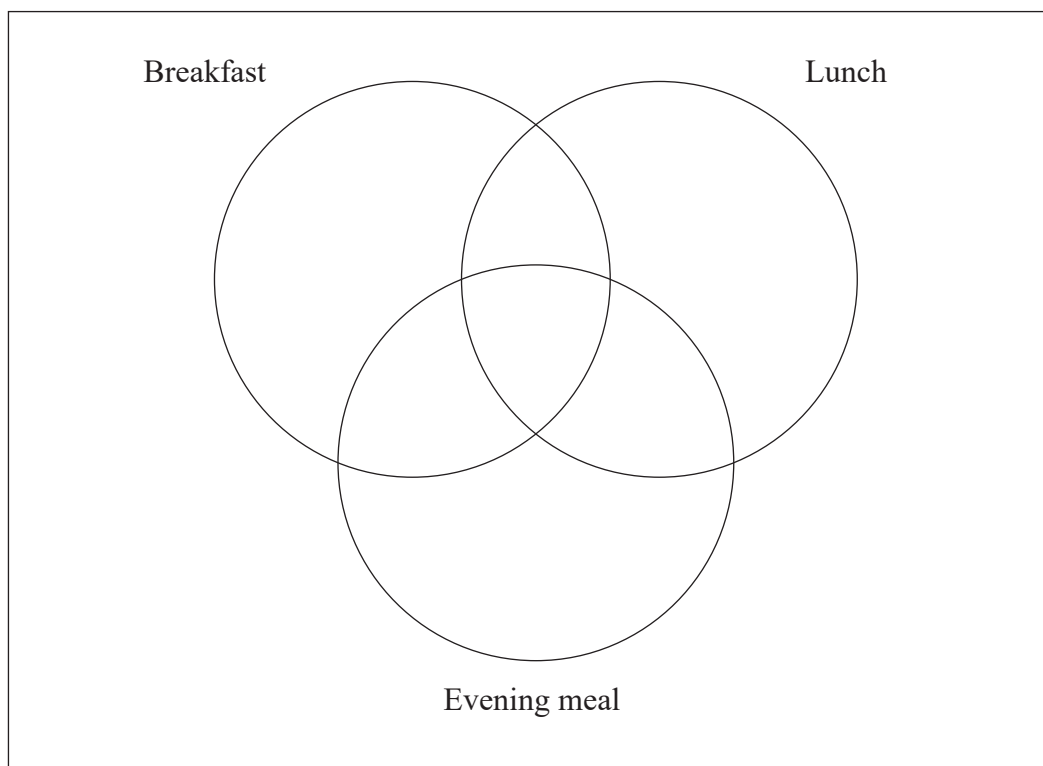
\*24GFM3109\*

3 Residents in a hotel could book a table for breakfast, lunch or evening meal.

Of the 80 residents on a given day

- 12 booked a table for all three meals
- 46 booked a table for breakfast and evening meal
- 25 booked a table for breakfast and lunch
- $x$  booked a table for lunch and evening meal **only**
- 65 booked a table for breakfast
- 34 booked a table for lunch
- 57 booked a table for evening meal
- 2 did not book a table for any meal.

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



[2]



(ii) Hence calculate the value of  $x$ .

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

(iii) What is the probability that a resident, selected at random, booked a table for **exactly** two meals?

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

Q3 continues on page 13

[Turn over



**BLANK PAGE**  
**DO NOT WRITE ON THIS PAGE**

13360



\*24GFM3112\*



A resident, selected at random, did **not** book a table for breakfast.

(iv) What is the probability that this resident booked a table for lunch?

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

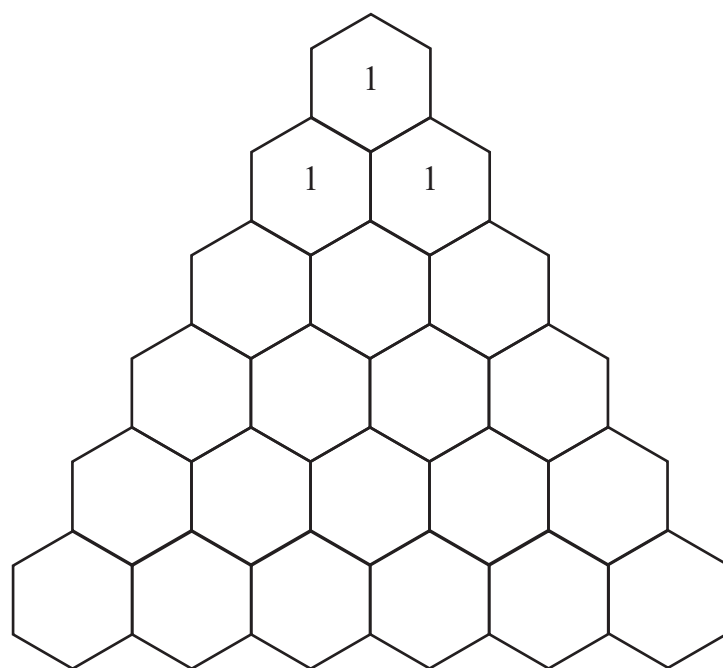
[Turn over

13360



\*24GFM3113\*

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



[1]

(ii) Hence write down the expansion of  $(p + q)^5$

Answer

---

---

[1]



A biased die is such that the probability of scoring a six with each throw is 0.2

The die is thrown five times and the scores are recorded.

(iii) Find the probability that the score is a six on **exactly** two throws.

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

(iv) Find the probability that the score is a six on **at least** two throws.

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

[Turn over



5 The heights of a large number of sunflower plants were measured.

The heights were normally distributed with mean 42 cm and standard deviation 5 cm.

- (i) Find the probability that a sunflower, chosen at random, measured less than 50 cm.

Give your answer to 4 decimal places.

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



(ii) Find the probability that a sunflower, chosen at random, measured less than 36 cm.

Give your answer to 4 decimal places.

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

Q5 continues on page 19

[Turn over



**BLANK PAGE**  
**DO NOT WRITE ON THIS PAGE**

13360



\*24GFM3118\*



(iii) Find the probability that a sunflower, chosen at random, measured less than 36 cm, **given** that it measured less than 50 cm.

Give your answer to 4 decimal places.

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

[Turn over



6 Jack received the following marks in each section of his last PE exam.

29, 23, 11, 17, 20

(i) Calculate the standard deviation of these marks.

You **must** show your working.

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



Jack needs to scale his marks so that the mean mark is 45 and the standard deviation is doubled.

He does this by

multiplying each score by a constant  $m$ ,

and then adding a constant  $n$ .

(ii) Calculate the values of  $m$  and  $n$ .

Answer  $m =$  \_\_\_\_\_ ,  $n =$  \_\_\_\_\_ [3]

---

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

---



**BLANK PAGE**  
**DO NOT WRITE ON THIS PAGE**

13360



\*24GFM3122\*





**BLANK PAGE**  
**DO NOT WRITE ON THIS PAGE**

13360



\*24GFM3123\*

**DO NOT WRITE ON THIS PAGE**

<b>For Examiner's use only</b>	
<b>Question Number</b>	<b>Marks</b>
1	
2	
3	
4	
5	
6	

<b>Total Marks</b>	
------------------------	--

--

Permission to reproduce all copyright material has been applied for.  
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA  
will be happy to rectify any omissions of acknowledgement in future if notified.

13360/2



\*24GFM3124\*