

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL AS FURTHER MATHEMATICS

(9665/FM02) Unit FPSM1 Pure Mathematics, Statistics and Mechanics

Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the Oxford International AQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphic calculator.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- There are three sections to this paper.
- The maximum mark for this paper is 80. There are 40 marks for **Section A**, 20 marks for **Section B** and 20 marks for **Section C**.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use

| Question | Mark |
|--------------|------|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
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| 6 | |
| 7 | |
| 8 | |
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| 12 | |
| TOTAL | |



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Answer **all** questions in the spaces provided.

$$\frac{dy}{dx} = \frac{\sqrt{x+2}}{y(x+1)}$$

[5 marks]

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Answer

5

2 The matrix **A** is defined by $\mathbf{A} = \begin{bmatrix} \frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & \frac{1}{2} \end{bmatrix}$

The matrix **B** is defined by $\mathbf{B} = \begin{bmatrix} 1 & 0 \\ p & 1 \end{bmatrix}$ where p is a constant and $p > 1$

2 (a) Describe fully the transformation represented by the matrix **A**

[2 marks]

2 (b) State the type of transformation represented by the matrix **B**

[1 mark]



[4 marks]

[illegible]

Find the determinant of **CAB**

[3 marks]

Answer



- 3** The variables X and Y are related by an equation of the form

$$Y = nX + b$$

where n and b are constants.

- 3 (a)** Given that $X = \log_{10} x$ and $Y = \log_{10} y$

show that $y = ax^n$ where a is a constant.

[2 marks]

- 3 (b)** An experiment gives the following values of x and y

| | | | | | |
|-----|-----|-----|-----|-----|-----|
| x | 2 | 4 | 10 | 20 | 40 |
| y | 4.6 | 3.0 | 1.8 | 1.2 | 0.8 |

Complete the table below.

| | | | | | |
|-----|------|--|--|--|--|
| X | 0.30 | | | | |
| Y | 0.66 | | | | |

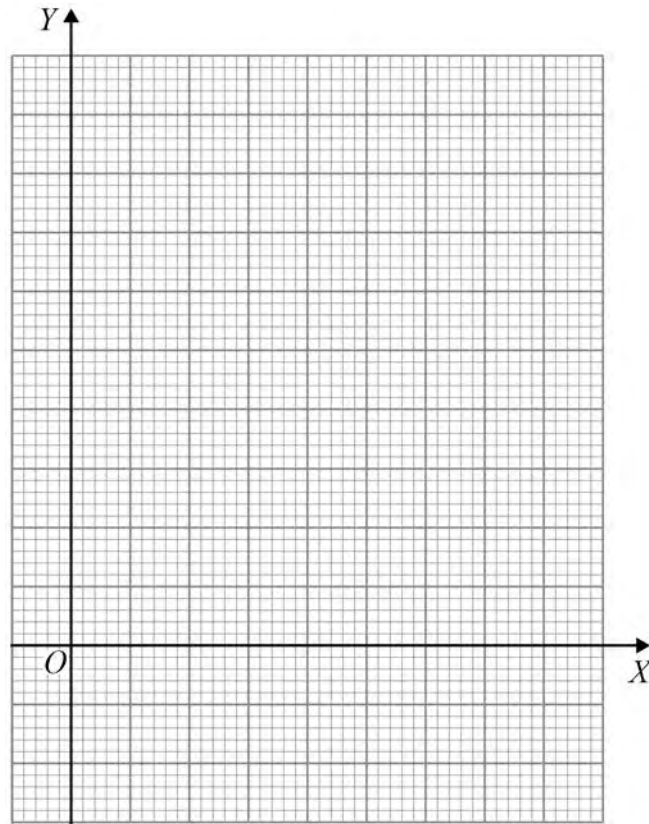
[2 marks]



3 (c) (i) On the grid, plot Y against X

Draw a line of best fit for the points you have plotted.

[2 marks]



3 (c) (ii) Use your line of best fit to find estimates for a and n

[4 marks]

$a =$ _____

$n =$ _____



4 The function f is defined by $f(x) = x^3 - 4x^2 + 6$

4 (a) Show that the equation $f(x) = 0$ has a root, α , in the interval $3 < \alpha < 4$

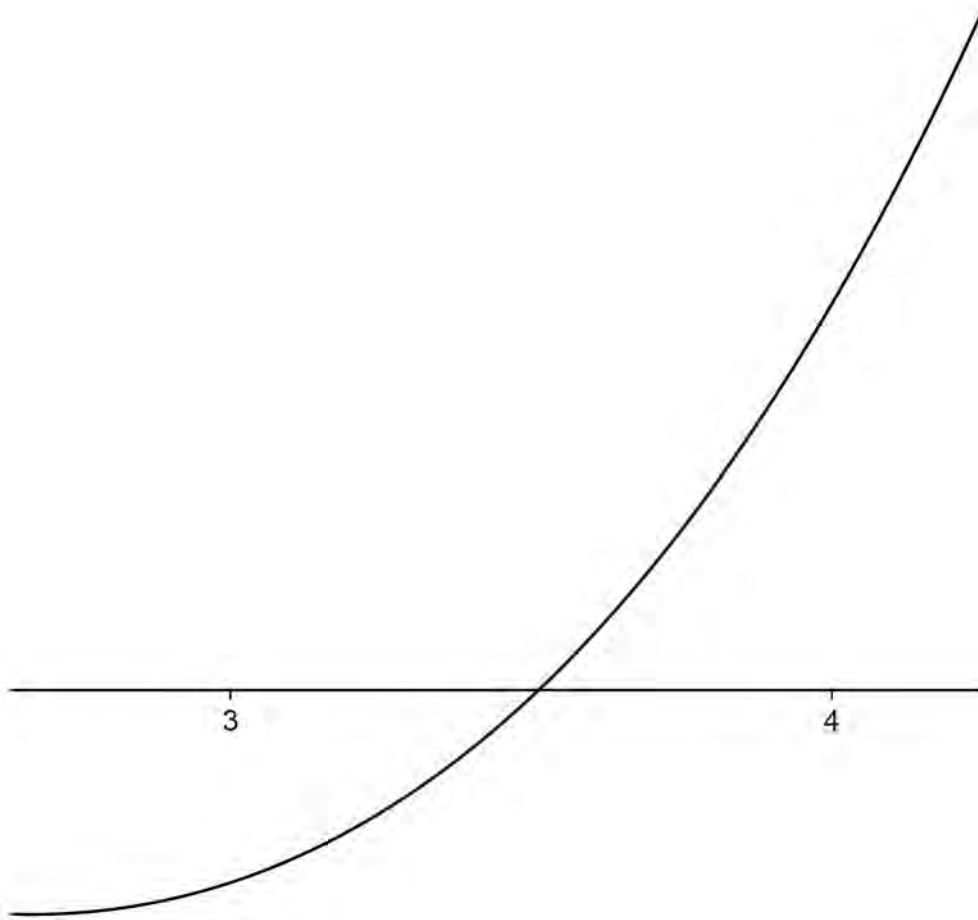
[2 marks]

4 (b) The diagram below shows part of the graph of $y = f(x)$

Draw suitable lines on the diagram to show how linear interpolation can be used to find the first two approximations, x_1 and x_2 , to α

Mark the positions of x_1 and x_2 on the x -axis.

[4 marks]



Give your answer to two decimal places.

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Answer _____

10

Turn over for the next question

Turn over ►



[5 marks]

[illegible]

Answer

Turn over for the next section

Section B**Statistics**

Answer **all** questions in the spaces provided.

- 6** Customers at a tennis club may rent a racket or use their own racket.
- The probability that a randomly selected customer rents a racket is 0.18
- The random variable R represents the number of customers on a particular day up to and including the first customer who rents a racket.

- 6 (a)** Find the exact probability that the third customer is the first to rent a racket. **[1 mark]**

Answer _____

- 6 (b)** Find the probability that the first six customers do not rent a racket, giving your answer to three significant figures. **[2 marks]**

Answer _____



- 6 (c) Find $E(R)$ giving your answer to three significant figures.

[1 mark]

Answer _____

- 6 (d) Find $\text{Var}(R)$ giving your answer to three significant figures.

[1 mark]

Answer _____

- 6 (e) The random variable S represents the number of customers on a particular day up to and including the first customer who rents a pair of shorts.

The variance of S is 3

R and S are independent.

Find $\text{Var}(R - S)$ giving your answer to three significant figures.

[1 mark]

Answer _____

Turn over ►



7

$$G_{X_i}(t) = 0.22 + 0.78t$$

X_1 and X_2 are independent.

Let Y be the random variable such that $Y = X_1 + X_2$

7 (a) Find $G_Y''(t)$

[4 marks]

[illegible]

Answer



[3 marks]

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Answer _____

7

Turn over ►



- 8** In a bag there are 35 balls.
Each ball has a unique whole number on it from 1 to 35

- 8 (a)** A ball is randomly selected from the bag.

Find the probability that the number on the ball is greater than 28

[1 mark]

Answer _____

- 8 (b)** In a game, a ball is randomly selected from the bag and its number is recorded.

The ball is **not** replaced in the bag.

A second ball is then randomly selected from the bag and its number is recorded.

Event A is 'the **first** ball selected from the bag has a number greater than 28'

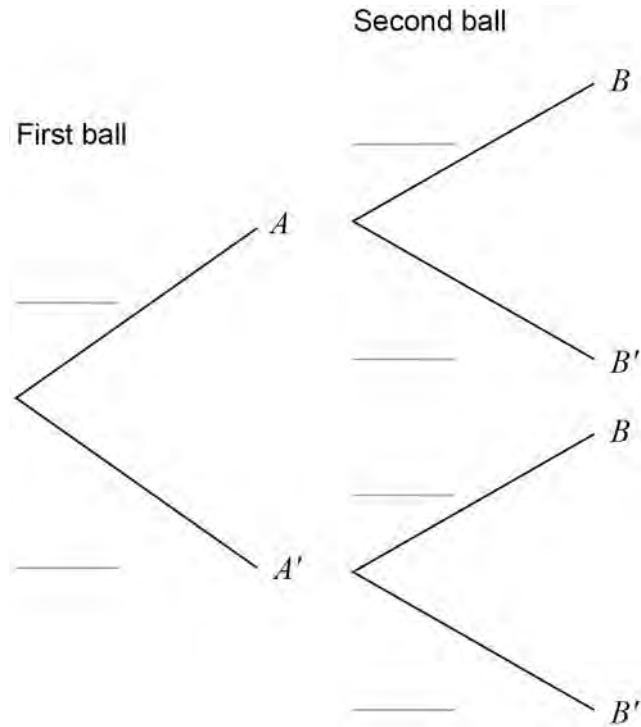
Event B is 'the **second** ball selected from the bag has a number greater than 28'

The game is won if the first ball has a number greater than 28 and the second ball has a number less than or equal to 28

- 8 (b) (i)** Complete the tree diagram by giving the probability associated with each branch.

[3 marks]





8 (b) (ii) Jamie plays the game.

Find the probability that Jamie wins the game given that the second ball has a number less than or equal to 28

[3 marks]

Answer _____

7

Turn over ►



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Section C**Mechanics**

Answer **all** questions in the spaces provided.

- 9** A ball of mass 0.3 kg is moving at a speed of 7 m s^{-1} when it collides with a vertical wall. The velocity of the ball is perpendicular to the wall when the ball collides with the wall. The ball rebounds with speed 5 m s^{-1} .
- Calculate the magnitude of the impulse exerted by the wall on the ball. **[2 marks]**

Answer _____

2

Turn over for the next question

Turn over ►



A particle is moving between two points, A and B , on a line.

$$v^2 = \omega^2 \left(\left(\frac{d}{2} \right)^2 - x^2 \right)$$

v is the speed of the particle in m s^{-1}

d is the distance between the points A and B in metres

x is the distance of the particle from the midpoint of AB in metres.

Use dimensional analysis to find the units of ω

[3 marks]

[illegible]

Answer

3



A boat is travelling at a speed of 6 m s^{-1} relative to the water.

The water is flowing towards the south west at a speed of 2 m s^{-1}

Find the resultant velocity of the boat, giving the direction as a bearing to the nearest degree.

[5 marks]

[illegible]

Answer

5

Turn over ►



Three spheres A , B and C of equal radius are at rest on a straight horizontal line.

The mass of B is 2 kg

The mass of C is 1 kg

Sphere *A* is set in motion so that it moves with speed 5 m s^{-1} towards sphere *B*

The two spheres collide directly.

The coefficient of restitution between A and B is 0.4

Find the speed of A and the speed of B after their collision.

[5 marks]

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Speed of A = _____ Speed of B = _____



The spheres A and B do not collide again.

Show that $e \leq \frac{m}{n}$ where m and n are integers.

[5 marks]

[illegible]

END OF QUESTIONS



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