

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

Thursday 15 January 2026

07:00 UK Time

Time allowed: 1 hour 30 minutes

Materials

- For this paper you must have the OxfordAQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical 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	
5	
6	
7	
8	
9	
10	
11	
12	
TOTAL	



Section A**Pure Mathematics**

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

1 The matrix **A** is defined by $\mathbf{A} = \begin{bmatrix} 3 & q \\ 4-q & 2 \end{bmatrix}$ where q is a positive constant.

1 (a) The matrix **B** represents a reflection in the line $x + y = 0$

1 (a) (i) Write down the matrix **B**

[1 mark]

Answer _____

1 (a) (ii) The matrix **C** represents the following sequence of transformations:

- the transformation represented by **A**

followed by

- the transformation represented by **B**

Find the matrix **C** in terms of q

[3 marks]

Answer _____



1 (b) The triangle T has area 3 square units.

The image of T under the transformation represented by $\mathbf{A}$ has area 21 square units.

Find the exact value of q

[4 marks]

$q =$ _____

8

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$$\frac{dy}{dx} = 3\log_2(x^2 + y)$$

[4 marks]

[illegible]

Answer

- 3** The variables p and q are related by the equation

$$q = \frac{A}{(p+B)^2}$$

where A and B are constants.

It is given that $Y = \frac{1}{\sqrt{q}}$

- 3 (a)** Show that there is a linear relationship between p and Y

[2 marks]

- 3 (b)** Some values of p and q are obtained in an experiment.

The values are shown in the table below.

p	-0.7	0.2	0.8	1.5	2.0
q	0.91	0.26	0.15	0.11	0.087

- 3 (b) (i)** Complete the table below.

Give your values of Y to two decimal places.

[2 marks]

p	-0.7	0.2	0.8	1.5	2.0
Y	1.05			3.02	

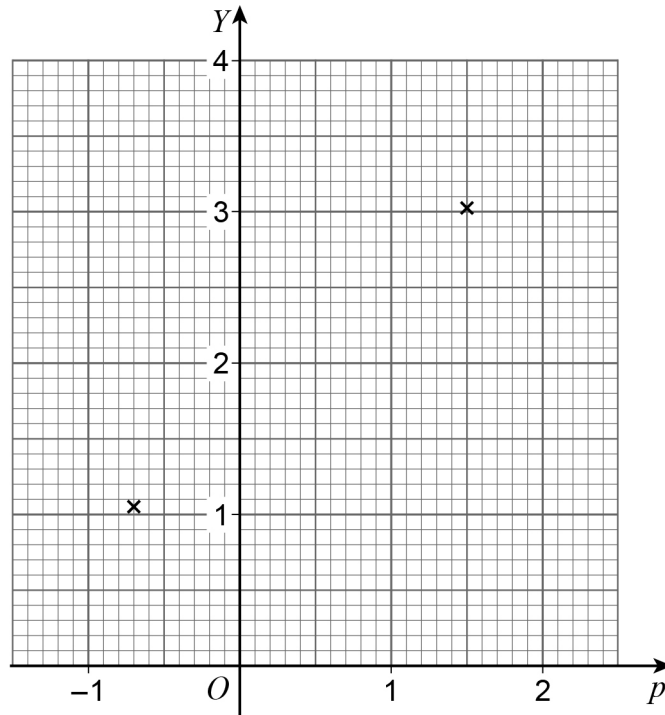


3 (b) (ii) Plot the remaining values of p and Y on **Figure 1**

Draw a line of best fit.

[2 marks]

Figure 1



3 (b) (iii) Use your line of best fit to estimate the value of A and the value of B

[3 marks]

$A =$ _____ $B =$ _____



4 A function f is defined by $f(x) = 2x^{\frac{3}{2}} - 5x + 2$

4 (a) Show that the equation $f(x) = 0$ has a root α in the interval $0 < x < 1$

[2 marks]

4 (b) The equation $f(x) = 0$ also has a root β in the interval $5 < x < 6$

Use the Newton-Raphson method **once** with an initial value of $x_1 = 5.5$ to find an improved estimate, x_2 , to β

Give your answer to three decimal places.

[4 marks]

Answer _____



[2 marks]

$$k = \underline{\hspace{10cm}}$$

[3 marks]

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Answer _____

Question 5 continues on the next page

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5 (c) (i) Find the equations of the invariant lines of the transformation represented by **M** [6 marks]

[illegible]

Answer _____



5 (c) (ii) The matrix **M** satisfies the equation $\mathbf{M} = \mathbf{R}^{-1}\mathbf{S}\mathbf{R}$ where

- the matrix **R** represents a rotation about $(0,0)$
- the matrix **S** represents a stretch parallel to the y -axis.

Find the scale factor of the stretch represented by **S**

[2 marks]

Answer _____

13

Turn over for the next section

Turn over ►



Section B**Statistics**

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

6 A game is played.

The random variable X represents the score achieved in the game.

The probability distribution of X is given in the table.

x	0	4	8
$P(X = x)$	0.5	0.3	0.2

6 (a) Find $G_X(t)$, the probability generating function of X

[1 mark]

Answer

6 (b) A different second game is played.

The random variable Y represents the score achieved in the second game.

The random variables X and Y are independent.

The probability generating function of Y is given by

$$G_Y(t) = 1 - k + kt$$

where k is a constant.

The total score from the two games is $X + Y$

Show that the probability generating function for the total score is given by

$$G_{X+Y}(t) = 0.5(1-k) + 0.5kt + 0.3(1-k)t^4 + 0.3kt^5 + 0.2(1-k)t^8 + 0.2kt^9$$

[2 marks]



6 (c) The mean total score from the two games is equal to 3.4

Use differentiation to find the value of k

[4 marks]

$k =$ _____

$\frac{\quad}{7}$

Turn over ►



7 The random variable S has a geometric distribution with parameter p

7 (a) State the variance of S in terms of p

[1 mark]

Answer

7 (b) The random variable T has the same distribution as S

The population product moment correlation coefficient between S and T is $\frac{3}{4}$

The variance of $S - T$ is 2

Find the value of p

Give your answer to four significant figures.

[3 marks]

$p =$



7 (c) Find $E(S+T)$

Give your answer to three significant figures.

[2 marks]

Answer _____

6

Turn over for the next question

Turn over ►



- 8** Bag A contains n balls which are uniquely numbered $1, 2, 3, \dots, n$ where $n > 10$
- A ball is randomly selected from bag A
- The random variable X represents the number on the ball selected from bag A

- 8 (a)** State the standard deviation of X

Give your answer in terms of n

[1 mark]

Answer

- 8 (b)** Bag B contains $n + 2$ balls which are uniquely numbered $1, 2, 3, \dots, n + 2$

A ball is randomly selected from one of bag A or bag B

The probability that the ball is selected from bag A is 0.6

Show that the probability that the ball is selected from bag A given that the ball selected is numbered 1 is

$$\frac{0.6n + 1.2}{n + 1.2}$$

[3 marks]



- 8 (c)** The probability that the ball is selected from bag A given that the ball selected is numbered 1 is $\frac{13}{21}$

Determine the distribution of the random variable X

[3 marks]

Answer _____

7

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Section C**Mechanics**

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

- 9** A coin of mass m kg is placed so that it lies flat on a rotating horizontal disc. The coin follows a circular path of radius r metres at a speed of v m s⁻¹

A student models the magnitude of the resultant force F newtons which acts on the coin by

$$F = m^{\alpha} r^{\beta} v^{\gamma}$$

where α , β and γ are constants.

Use dimensional analysis to find the value of α , the value of β and the value of γ

[3 marks]

$\alpha =$ _____ $\beta =$ _____ $\gamma =$ _____

3

Turn over for the next question

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- 10** A ball of mass 0.3 kg falls vertically and then collides with a horizontal surface.

The magnitude of the force F newtons exerted by the surface on the ball at time t seconds after the ball makes contact with the surface is modelled by

$$F = 270t(1 - 5t)$$

- 10 (a)** The ball is in contact with the surface for 0.2 seconds.

Find the magnitude of the impulse exerted by the surface on the ball while they are in contact.

[2 marks]

Answer _____

- 10 (b)** The speed of the ball is 4 m s^{-1} when it collides with the surface.

Find the speed of the ball when it first loses contact with the surface.

[3 marks]

Answer _____



11

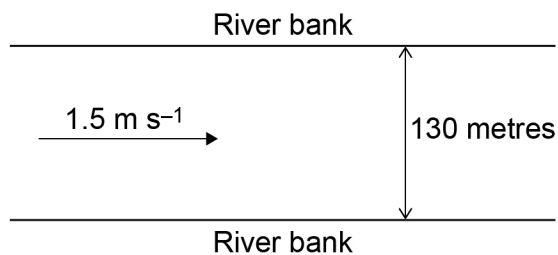
The water in a river flows at a constant speed of 1.5 m s^{-1}

The banks of the river are parallel.

The width of the river is 130 metres.

Figure 2 shows the river and the water flow.

Figure 2



A boat crosses the river and travels the shortest possible distance.

The boat moves with a speed of 2.5 m s^{-1} relative to the water.

Find the time that it takes for the boat to cross the river.

[3 marks]

Answer _____

3

Turn over for the next question

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The spheres collide directly.

The mass of A is m kg and the mass of B is 4 kg

The coefficient of restitution between the two spheres is e

Find the velocity of A after the collision.

Give your answer in terms of e and m

[4 marks]

[illegible]

Answer



12 (b) It is given that sphere A changes direction as a result of the collision.

12 (b) (i) Show that $m < \frac{4}{3}$

[2 marks]

12 (b) (ii) It is given that $m = \frac{1}{2}$

Find the range of possible values of e

[3 marks]

Answer _____

9

END OF QUESTIONS



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