

Name: _____

Class: _____



JURONG PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination 2026

MATHEMATICS
Higher 2

9758/02

15 September 2026

Paper 2

3 hours

Additional materials: Printed Answer Booklet
List of Formulae and Results (MF27)

READ THESE INSTRUCTIONS FIRST

Answer **all** questions.

Write your answers on the Printed Answer Booklet. Follow the instructions on the front cover of the answer booklet.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

You are expected to use an approved graphing calculator.

Unsupported answers from a graphing calculator are allowed unless a question specifically states otherwise.

Where unsupported answers from a graphing calculator are **not** allowed in a question, you must present the mathematical steps using mathematical notations and not calculator commands.

You must show all necessary working clearly.

The number of marks is given by [] at the end of each question or part question.

Section A: Pure Mathematics [40 Marks]

- 1 Without using a calculator, solve $\frac{3x^2 + 4x - 10}{x^2 + 2x - 3} \geq 2$. [4]

Hence solve $\frac{3x^2 + 4|x| - 10}{x^2 + 2|x| - 3} \geq 2$. [2]

- 2 The planes p_1 and p_2 have vector equations

$$\mathbf{r} = \begin{pmatrix} 2 \\ b \\ -1 \end{pmatrix} + \lambda_1 \begin{pmatrix} a \\ 0 \\ 1 \end{pmatrix} + \mu_1 \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix},$$

$$\mathbf{r} = \begin{pmatrix} 2 \\ b \\ -1 \end{pmatrix} + \lambda_2 \begin{pmatrix} a \\ 0 \\ 1 \end{pmatrix} + \mu_2 \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix},$$

respectively, where λ_1 , λ_2 , μ_1 and μ_2 are real parameters, and a and b are constants.

- (a) Given that p_1 and p_2 intersect along a line L , write down a vector equation of L , in terms of a and b . [1]
- (b) Deduce an equation of the plane p_3 that passes through $(0, 4, 4)$ and is perpendicular to both p_1 and p_2 , in terms of a . [1]

The plane p_4 has equation $\mathbf{r} \cdot \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = 3$.

- (c) Given that L lies in p_4 , find the values of a and b . [4]
- 3 (a) Using standard series from the List of Formulae (MF27), expand $\ln(k - 2x)$ as far as the term in x^2 , where k is a positive constant. [2]
- (b) Find the range of values of x for which the expansion in part (a) is valid. [1]
- (c) It is given that the first three terms found in part (a) are equal to the first three terms in the series expansion of $(1 + mx)^n$, where m is a constant. Find the exact values of k and m . [4]

- 4 The function f is such that

$$f : x \mapsto x^2 - 4x + 7, \quad x \in \mathbb{R}, \quad x \leq k,$$

where k is a real constant.

- (i) State the greatest value of k for which the function f^{-1} exists. [1]

For the rest of the question, take the value of k as the value found in part (i).

- (ii) Find f^{-1} in similar form. [3]

The function g is such that

$$g : x \mapsto 2 + \frac{10}{x^2 + 1}, \quad x \in \mathbb{R}.$$

- (iii) Sketch the graph of $y = g(x)$, giving the equations of any asymptotes and the coordinates of any turning points. [2]
- (iv) Show that the composite function gf exists. [1]
- (v) Find the range of gf . [2]

- 5 (a) A man borrows \$5000 from a lender at the start of the first month. Interest is added immediately at a rate of 2.5% of the amount borrowed and thereafter at the start of every month at a rate of 2.5% of the outstanding loan. The man pays \$400 to the lender at the end of every month.

- (i) Find the outstanding loan at the end of the n th month. [4]

- (ii) Calculate how many complete months he will take to repay his loan. [3]

- (b) A supplier delivers steel rods to a factory weekly. In the first week, 100 steel rods are delivered and in each subsequent week, 10 more steel rods are delivered.

- (i) Find the total number of steel rods delivered to the factory in n weeks. [1]

After n weeks, where $n < 20$, the delivery plan is changed so that each subsequent week's delivery is 10 steel rods fewer than the previous week's delivery. By the 20th week, the total number of steel rods delivered is 3180.

- (ii) Find the value of n . [4]

Section B: Probability and Statistics [60 Marks]

- 6** At a carnival, Peter plays a game where two balls are drawn at random without replacement from an urn containing 4 red balls, 4 blue balls and 2 green balls. He wins \$ m if the 2 balls drawn are of the same colour, and loses \$1 if the 2 balls drawn are of different colours. In addition, he gains \$0.50 if at least one of the balls drawn is green. The random variable X denotes the amount of money Peter wins in a single game.

(i) Show that $P(X = -0.5) = \frac{16}{45}$. [1]

(ii) Determine the probability distribution of X , expressing your answers in terms of m . [3]

(iii) Find the least value of m such that it is favourable for Peter to play the game. [2]

- 7** An investigation was carried out to examine the relationship between wind speed and the electrical power generated by a wind turbine. The wind speed, $x \text{ ms}^{-1}$, and the electrical power generated $y \text{ kW}$, were recorded on 6 occasions, as shown in the table.

x	4	6	8	10	12	14
y	41	83	165	303	523	805

- (a) Draw a scatter diagram for these values. Explain which of the following equations, where a and b are positive constants, provides the most appropriate model for the relationship between x and y .

(A) $y = ax + b$

(B) $y = ax^3 + b$

(C) $y = a\sqrt{x} + b$ [2]

- (b) Using the model you chose in part (a), write down the equation for the relationship between x and y , giving the numerical values of the coefficients. State the product moment correlation coefficient for this model, giving your answer to 6 decimal places.

[2]

- (c) Give two reasons why it would be reasonable to use your model to estimate the value of y when $x = 11$. [2]

A second wind turbine is tested when the wind speed is 11 ms^{-1} , and it generates 450 kW of power.

- (d) Justify if the second turbine appears to perform better than the turbine used in the original investigation. [2]

- 8 A group of 12 players is available for a street football match. The group consists of 5 attackers, 4 defenders and 3 goalkeepers. A team of 5 players is selected at random from the group.

(a) Find the

(i) number of different teams containing exactly 2 attackers, 2 defenders and 1 goalkeeper, [2]

(ii) probability that the team contains exactly 1 goalkeeper and at most 2 attackers. [3]

The coach has already decided which goalkeeper will play in a match. To help him select from the 5 attackers and 4 defenders, he conducts a passing drill involving these players. For each pass, 1 player is chosen at random to receive the ball. After each pass, the ball is returned to the coach before the next player is chosen. A player may receive the ball more than once. The coach makes 4 passes in this manner. Find the probability that

(b) exactly 3 passes are made to attackers, [2]

(c) either the first 3 passes or the last 3 passes are made to attackers (or both). [3]

- 9 (a) In this question you should state the parameters of any distribution you use.

In a grocery store, the masses (in grams) of oranges from Farm A have the distribution $N(245, 8^2)$ while those from Farm B have the distribution $N(212, 7^2)$.

(i) Find the probability that the mass of a randomly chosen Farm A orange differs from that of Farm B by more than 30 grams. [2]

(ii) Find the probability that the total mass of 3 randomly chosen oranges from Farm A and 2 randomly chosen oranges from Farm B is more than 1180 grams. [2]

(iii) State an assumption needed for your calculations in parts (i) and (ii). [1]

(b) The random variable X has distribution $N(\mu, \sigma^2)$.

(i) Given that $P(X < m) = 0.25$, find the value of $P(X > 2\mu - m)$. [2]

(ii) The mean of a random sample of n independent observations of X is denoted by $\bar{X}$. Find the greatest value of n such that the probability that $\bar{X}$ is more than μ by at least 0.01σ is more than 0.4. [3]

- 10** Josh works at a hotpot restaurant, where each serving of meat is intended to have a mass of 150 g. Recently, the manager suspects that Josh is over-portioning the meat served to customers. A random sample of 30 servings of meat is taken. The masses of the servings of meat, x g, are summarised as follows:

$$\sum (x - 150) = 104.7 \quad \sum (x - 150)^2 = 3367.5.$$

- (a)** Calculate unbiased estimates of the population mean and population variance of the mass of meat in a serving. [2]
- (b)** Test, at the 5% level of significance, whether the manager's suspicion is supported by the data. You should state your hypotheses and define any symbols that you use. [5]

Following the hypothesis test, the manager replaces manual portioning with an automatic meat dispenser machine. To investigate whether the machine is dispensing the correct amount of meat, the manager carries out a two-tailed test, at the 5% level of significance, on the mean mass dispensed by the machine. According to the manufacturer, the mass of meat dispensed by the machine follows a normal distribution with standard deviation 10 g. A new random sample of 30 servings is taken.

- (c)** Find the critical region for this test, giving your answers to 2 decimal places. [3]
- (d)** Explain why a sample of fewer than 30 servings could still be used for the hypothesis test in part **(c)**. [1]
- (e)** Explain why the manager would have less confidence in the conclusion of the hypothesis test if the sample had not been chosen randomly. [1]

11 In this question you should state the parameters of any distribution you use.

A bank employs both senior and junior managers. Their responsibilities include calling and meeting clients to persuade them to purchase investment products and services. A meeting or call that results in a product uptake is considered a successful interaction.

On average, 24% of the interactions handled by a senior manager with Elite clients are successful. A senior manager handles 6 interactions a day.

- (i) State, in context, two assumptions needed for the number of successful interactions made by a senior manager to be well-modelled by a binomial distribution. [2]

Assume now that the number of successful interactions made by a senior manager follows a binomial distribution.

- (ii) Find the probability that Sky, a senior manager, secures less than 2 successful interactions in a day. [2]
- (iii) The success of each interaction made by a senior manager in a day is independent of other interactions. Find the probability that, in a randomly chosen month of 20 working days, Sky secures at least 2 successful interactions on more than 5 days. [2]

The number of successful interactions made by a junior manager with regular clients also follows a binomial distribution. The probability that an interaction is successful for a junior manager is p . Jules is a junior manager in the bank and handles 9 interactions a day.

- (iv) It is given that the most probable number of successful interactions in a day is 2. By considering expressions in terms of p , find exactly the possible range of values of p . [3]

For the rest of the question, let $p = 0.2$.

- (v) Find the probability that the sixth customer served by Jules on a particular day is the third successful interaction of the day. [2]

Assume that the success of interactions made by Sky and Jules are independent.

- (vi) Over a period of 50 working days, find the probability that the average number of successful interactions per day for Sky exceeds that of Jules. [3]

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