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Model Practice Paper — Mathematics-I

BTEUP Diploma • 1st Semester (First Year — Common Curriculum, All 41 Branches)
Session 2026-27

Practice Questions / Model Paper — NOT a BTEUP board paper

Time: 2.30 Hours

Max. Marks: 60

General Instructions:

- All questions are compulsory. Each question has three parts (a), (b) and (c) — **answer any two** of the three parts in every question.
- Each part carries 6 marks; each question carries 12 marks.
- Draw neat, labelled diagrams wherever they are asked or wherever they support your answer.
- Write your answers in your own words, in the same order as the questions.

About this paper: This is an original practice (model) paper prepared by KAMALDNP Academy from the official BTEUP 2026-27 syllabus topics for this subject. It is NOT a BTEUP board paper, and no question in it is promised to appear in your examination. Its structure follows the board's last published paper pattern (5 questions, each with three parts of which any two are to be answered), scaled to this subject's theory maximum of 60 marks (external) in the verified 2026-27 scheme; the printed time follows the same last published pattern. The 2026-27 scheme's own paper format has not been published yet — when your board paper is in your hand, its printed instructions govern.

Q1. (From: Algebra & Trigonometry) — Answer any two of the following:

- (a) Solve the quadratic equation $x^2 - 7x + 12 = 0$ by the method of factorisation, and verify your answer by substituting each root back into the equation. **(6)**
- (b) Prove the identity: $\sin \theta / (1 + \cos \theta) + (1 + \cos \theta) / \sin \theta = 2 \operatorname{cosec} \theta$. **(6)**

(c) From a point on level ground 30 m away from the foot of a tower, the angle of elevation of the top of the tower is 60° . Find the height of the tower. (Take $\sqrt{3} = 1.732$.) (6)

Q2. (From: Calculus) — Answer any two of the following:

(a) Evaluate the limit: $\lim_{x \rightarrow 3} (x^2 - 9) / (x - 3)$. Explain why the expression cannot be evaluated by direct substitution at $x = 3$. (6)

(b) Find the slope of the tangent to the curve $y = x^3 - 3x$ at the point where $x = 2$. Also write the derivative rule you have used. (6)

(c) Evaluate the definite integral from $x = 1$ to $x = 2$ of $(3x^2 + 2) dx$, showing each step of the integration. (6)

Q3. (From: Matrices & Determinants) — Answer any two of the following:

(a) If $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 \\ 5 & 0 \end{bmatrix}$, find $A + B$ and $2A - B$. Also state the order of each matrix and name one type of matrix (such as square, row, column or identity) to which A belongs. (6)

(b) Evaluate the determinant $\begin{vmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 1 & 0 & 6 \end{vmatrix}$ by expanding along the first row. (6)

(c) Solve the following system of linear equations: $x + y + z = 6$, $x - y + z = 2$, $2x + y - z = 1$. Verify your solution in any one equation. (6)

Q4. (From: Differential Equations) — Answer any two of the following:

(a) Solve the differential equation $dy/dx = y/x$ by the method of separation of variables, and write its general solution. (6)

(b) Solve the linear differential equation $dy/dx + 2y = e^x$, stating the integrating factor used. (6)

(c) A quantity grows at a rate proportional to its own size, so that $dy/dx = 2y$. If $y = 3$ when $x = 0$, find the particular solution giving y in terms of x . (6)

Q5. (From: Matrices & Determinants + Differential Equations (mixed)) — Answer any two of the following:

(a) If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 0 \\ 1 & 3 \end{bmatrix}$, find the product AB . Is AB equal to BA in general? Give a reason in one line. (6)

(b) Solve the system of equations $2x + 3y = 11$ and $x + y = 4$ by Cramer's rule or the matrix method. (6)

(c) Form the differential equation whose general solution is $y = A e^{(3x)}$, where A is an arbitrary constant, by eliminating A . (6)

Model Answer Outline — Mathematics-I

The key points a full-marks answer contains, question by question.

Practice Questions / Model Paper — NOT a BTEUP board paper

Q1(a)

- Factorise: $x^2 - 7x + 12 = (x - 3)(x - 4)$
- Set each factor to zero: $x - 3 = 0$ or $x - 4 = 0$
- Roots: $x = 3$ and $x = 4$
- Verification at $x = 3$: $9 - 21 + 12 = 0$
- Verification at $x = 4$: $16 - 28 + 12 = 0$

Q1(b)

- Take LCM $\sin \theta (1 + \cos \theta)$ on the left-hand side
- Numerator becomes $\sin^2 \theta + (1 + \cos \theta)^2 = \sin^2 \theta + 1 + 2 \cos \theta + \cos^2 \theta$
- Use $\sin^2 \theta + \cos^2 \theta = 1$, so numerator = $2 + 2 \cos \theta = 2(1 + \cos \theta)$
- Cancel $(1 + \cos \theta)$: result = $2 / \sin \theta$
- $2 / \sin \theta = 2 \operatorname{cosec} \theta$, which is the right-hand side

Q1(c)

- Draw the right-angled triangle: distance from foot = adjacent side = 30 m, height = opposite side
- Formula: $\tan 60^\circ = \text{height} / 30$
- Substitution: height = $30 \times \tan 60^\circ = 30 \times \sqrt{3}$
- Height = $30 \times 1.732 = 51.96$ m
- Final answer: height of the tower ≈ 51.96 m

Q2(a)

- Direct substitution gives $0/0$, which is indeterminate, so factorise first
- Factorise the numerator: $x^2 - 9 = (x - 3)(x + 3)$
- Cancel the common factor $(x - 3)$, valid because x is not equal to 3 while taking the limit
- Reduced expression: $x + 3$
- Substitute $x = 3$: limit = $3 + 3 = 6$

Q2(b)

- Slope of the tangent at a point is the value of dy/dx at that point
- Rule used: $d/dx (x^n) = n x^{(n-1)}$, applied term by term
- Differentiate: $dy/dx = 3x^2 - 3$
- Substitute $x = 2$: slope = $3(2)^2 - 3 = 12 - 3$
- Final answer: slope of the tangent = 9

Q2(c)

- Integrate term by term: $\int(3x^2 + 2) dx = x^3 + 2x + C$
- For a definite integral apply the limits: $[x^3 + 2x]$ from 1 to 2
- Upper limit value: $2^3 + 2(2) = 8 + 4 = 12$
- Lower limit value: $1^3 + 2(1) = 1 + 2 = 3$
- Final answer: $12 - 3 = 9$

Q3(a)

- Matrices of the same order are added element by element: $A + B = [[3, 1], [6, 4]]$
- First find $2A = [[4, 6], [2, 8]]$ by multiplying every element by 2
- Subtract element by element: $2A - B = [[3, 8], [-3, 8]]$
- Order of A, B and both results is 2×2
- A is a square matrix (number of rows equals number of columns)

Q3(b)

- Expand along the first row with signs +, -, +
- First term: $1 \times (4 \times 6 - 5 \times 0) = 1 \times 24 = 24$
- Second term: $-2 \times (0 \times 6 - 5 \times 1) = -2 \times (-5) = +10$
- Third term: $3 \times (0 \times 0 - 4 \times 1) = 3 \times (-4) = -12$
- Final answer: $24 + 10 - 12 = 22$

Q3(c)

- Subtract the second equation from the first: $2y = 4$, so $y = 2$
- Add the first and third equations after using $y = 2$, or reduce to $x + z = 4$ from the first equation
- Use the third equation as $2x - z = -1$ (after putting $y = 2$)
- Add $x + z = 4$ and $2x - z = -1$: $3x = 3$, so $x = 1$, and then $z = 3$
- Solution: $x = 1, y = 2, z = 3$; verification in the third equation: $2(1) + 2 - 3 = 1 \checkmark$

Q4(a)

- Separate the variables: $dy / y = dx / x$
- Integrate both sides: $\log |y| = \log |x| + \log C$ (constant written in log form)
- Combine the logarithms: $\log |y| = \log |Cx|$
- Remove the logarithms to get the general solution
- Final answer: $y = Cx$, where C is an arbitrary constant

Q4(b)

- Compare with $dy/dx + Py = Q$: here $P = 2, Q = e^x$
- Integrating factor: $IF = e^{\int 2 dx} = e^{2x}$
- Multiply through and write the left side as $d/dx (y \cdot e^{2x}) = e^{3x}$
- Integrate: $y \cdot e^{2x} = e^{3x} / 3 + C$
- Final answer: $y = (1/3) e^x + C e^{-2x}$

Q4(c)

- Separate the variables: $dy / y = 2 dx$
- Integrate: $\log y = 2x + C$, so $y = A e^{(2x)}$ where $A = e^C$
- Apply the given condition $y = 3$ when $x = 0$: $3 = A e^0 = A$
- So the constant $A = 3$
- Final answer (particular solution): $y = 3 e^{(2x)}$

Q5(a)

- Multiply rows of A by columns of B, element by element
- First row: $(1 \times 2 + 2 \times 1, 1 \times 0 + 2 \times 3) = (4, 6)$
- Second row: $(3 \times 2 + 4 \times 1, 3 \times 0 + 4 \times 3) = (10, 12)$
- Final answer: $AB = \begin{bmatrix} 4 & 6 \\ 10 & 12 \end{bmatrix}$, which is a 2×2 matrix
- No, AB is not in general equal to BA: matrix multiplication is not commutative

Q5(b)

- Write the coefficient determinant $D = (2)(1) - (3)(1) = -1$, which is not zero, so a unique solution exists
- $Dx = (11)(1) - (3)(4) = 11 - 12 = -1$, so $x = Dx / D = (-1)/(-1) = 1$
- $Dy = (2)(4) - (11)(1) = 8 - 11 = -3$, so $y = Dy / D = (-3)/(-1) = 3$
- Final answer: $x = 1, y = 3$
- Check: $2(1) + 3(3) = 11$ ✓ and $1 + 3 = 4$ ✓

Q5(c)

- Given solution: $y = A e^{(3x)}$, containing one arbitrary constant A, so one differentiation is needed
- Differentiate with respect to x: $dy/dx = 3A e^{(3x)}$
- Divide or compare the two equations: $dy/dx = 3 \times (A e^{(3x)}) = 3y$
- The constant A is eliminated
- Final answer (required differential equation): $dy/dx = 3y$, i.e. $dy/dx - 3y = 0$