CUET 2026 May 15 Shift 1 Mathematics

Question Paper (Memory-Based) with Solutions

Conducted by National Testing Agency (NTA)

General Instructions

(i) The examination will be conducted in Computer-Based Test (CBT) mode.

(ii) Each question carries +5 marks for correct answer and -1 mark for wrong answer.

(iii) The total number of questions are 50.

(iv) Duration of the exam is 1 hour (60 minutes).

1. Let $A = \{1, 2, 3\}$ and $B = \{2, 4, 6\}$. A function $f : A \to B$ is defined by $f(x) = 2x$. The function is:

(A) One-one only

(B) Onto only

(C) Both one-one and onto

(D) Neither one-one nor onto

Correct Answer: (C) Both one-one and onto

Solution:

Step 1: Understanding the Question:

The question defines a set A (domain), a set B (codomain), and a function $f(x) = 2x$ mapping from A to B. We need to determine if the function is one-one, onto, both, or neither.

Step 2: Key Formula or Approach:

1. **One-one (Injective):** A function $f : A \to B$ is one-one if every distinct element in A maps to a distinct element in B. That is, if $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$.

2. **Onto (Surjective):** A function $f : A \to B$ is onto if every element in B (codomain) has at least one corresponding element in A (domain). That is, the range of the function must be

equal to its codomain.

Step 3: Detailed Explanation:

Given:

Domain $A = \{1, 2, 3\}$

Codomain $B = \{2, 4, 6\}$

Function $f(x) = 2x$

Let's find the image of each element in the domain A:

- For $x = 1$: $f(1) = 2 \times 1 = 2$
- For $x = 2$: $f(2) = 2 \times 2 = 4$
- For $x = 3$: $f(3) = 2 \times 3 = 6$

The range of the function is $\text{Range}(f) = \{2, 4, 6\}$.

Check for One-one:

Each distinct element in A (1, 2, 3) maps to a distinct element in B (2, 4, 6).

$f(1) = 2$

$f(2) = 4$

$f(3) = 6$

Since no two distinct elements in A map to the same element in B, the function is **one-one**.

Check for Onto:

The codomain is $B = \{2, 4, 6\}$.

The range of the function is $\text{Range}(f) = \{2, 4, 6\}$.

Since the range is equal to the codomain, every element in B has a pre-image in A. Therefore, the function is **onto**.

Since the function is both one-one and onto, option (C) is the correct answer.

Step 4: Final Answer:

The function is Both one-one and onto.

Quick Tip: To verify one-one: Check if $f(x_1) = f(x_2)$ implies $x_1 = x_2$.
To verify onto: Check if the range of the function equals its codomain. If $|A| = |B|$ and the function is one-one, it must also be onto.

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2. If $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, then A^{-1} is:

(A) $\begin{pmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{pmatrix}$

(B) $\begin{pmatrix} 2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{pmatrix}$

(C) $\begin{pmatrix} 2 & 1 \\ \frac{3}{2} & \frac{1}{2} \end{pmatrix}$

(D) $\begin{pmatrix} -2 & 1 \\ -\frac{3}{2} & -\frac{1}{2} \end{pmatrix}$

Correct Answer: (A) $\begin{pmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{pmatrix}$

Solution:

Step 1: Understanding the Question:

The question asks to find the inverse of a given 2x2 matrix A.

Step 2: Key Formula or Approach:

For a 2x2 matrix $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, its inverse A^{-1} is given by the formula:

$$A^{-1} = \frac{1}{\det(A)} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$$

Where $\det(A)$ is the determinant of A, calculated as $ad - bc$.

Step 3: Detailed Explanation:

Given matrix: $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$

Here, $a = 1, b = 2, c = 3, d = 4$.

1. **Calculate the determinant of A (**$\det(A)$**):**

$$\det(A) = ad - bc = (1)(4) - (2)(3) = 4 - 6 = -2$$

2. **Find the adjoint of A (adj**(A)**):**

Swap the diagonal elements (a and d) and change the signs of the off-diagonal elements (b and c).

$$\text{adj}(A) = \begin{pmatrix} 4 & -2 \\ -3 & 1 \end{pmatrix}$$

3. **Calculate the inverse of A (**A^{-1}**):**

$$A^{-1} = \frac{1}{\det(A)}\text{adj}(A) = \frac{1}{-2}\begin{pmatrix} 4 & -2 \\ -3 & 1 \end{pmatrix}$$

Multiply each element of the adjoint matrix by $-\frac{1}{2}$:

$$A^{-1} = \begin{pmatrix} 4 \times (-\frac{1}{2}) & -2 \times (-\frac{1}{2}) \\ -3 \times (-\frac{1}{2}) & 1 \times (-\frac{1}{2}) \end{pmatrix}$$

$$A^{-1} = \begin{pmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{pmatrix}$$

Comparing this result with the given options, option (A) matches the calculated inverse.

Step 4: Final Answer:

The inverse matrix A^{-1} is $\begin{pmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{pmatrix}$.

Quick Tip: Remember the inverse formula for a 2x2 matrix. It's a fundamental operation. Pay close attention to signs when changing off-diagonal elements and when multiplying by the inverse of the determinant.

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3. Evaluate: $\begin{vmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{vmatrix}$

(A) 1

(B) -1

(C) 5

(D) 10

Correct Answer: (A) 1

Solution:

Step 1: Understanding the Question:

The question asks to evaluate the determinant of a given 3x3 matrix.

Step 2: Key Formula or Approach:

For a 3x3 matrix $M = \begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}$, its determinant is calculated as:

$$\det(M) = a(ei - fh) - b(di - fg) + c(dh - eg)$$

Alternatively, expand along any row or column. It's often easiest to expand along a row or column that contains zeros.

Step 3: Detailed Explanation:

Given matrix: $M = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{pmatrix}$

Let's expand the determinant along the first row:

$$\det(M) = 1 \times \begin{vmatrix} 1 & 4 \\ 6 & 0 \end{vmatrix} - 2 \times \begin{vmatrix} 0 & 4 \\ 5 & 0 \end{vmatrix} + 3 \times \begin{vmatrix} 0 & 1 \\ 5 & 6 \end{vmatrix}$$

Calculate each 2x2 determinant:

- $\begin{vmatrix} 1 & 4 \\ 6 & 0 \end{vmatrix} = (1)(0) - (4)(6) = 0 - 24 = -24$
- $\begin{vmatrix} 0 & 4 \\ 5 & 0 \end{vmatrix} = (0)(0) - (4)(5) = 0 - 20 = -20$
- $\begin{vmatrix} 0 & 1 \\ 5 & 6 \end{vmatrix} = (0)(6) - (1)(5) = 0 - 5 = -5$

Substitute these values back:

$$\det(M) = 1 \times (-24) - 2 \times (-20) + 3 \times (-5)$$

$$\det(M) = -24 + 40 - 15$$

$$\det(M) = 16 - 15 = 1$$

Step 4: Final Answer:

The value of the determinant is 1.

Quick Tip: When calculating determinants, choose to expand along the row or column that has the most zeros. This minimizes the number of 2x2 determinants you need to calculate, reducing potential errors. Always remember the alternating signs for the cofactors (+ - +).

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4. A bag contains 5 red balls and 3 blue balls. Two balls are drawn at random without replacement. The probability that both are red is:

(A) $(\frac{5}{14})$

(B) $(\frac{8}{56})$

(C) $(\frac{5}{28})$

(D) $(\frac{15}{56})$

Correct Answer: (A) $(\frac{5}{14})$

Solution:

Step 1: Understanding the Question:

The problem asks for the probability of drawing two red balls consecutively from a bag without replacement.

Step 2: Key Formula or Approach:

The probability of multiple events occurring in sequence without replacement is calculated by multiplying the probabilities of each individual event, where the sample space decreases after each draw.

Alternatively, using combinations: The probability of selecting a specific combination of items is $\frac{\text{Number of ways to choose desired items}}{\text{Total number of ways to choose items}}$.

Step 3: Detailed Explanation:

Given:

- Number of red balls $= 5$.

- Number of blue balls $= 3$.

- Total number of balls $= 5 + 3 = 8$.

Method 1: Sequential Probability

1. **Probability of drawing the first red ball:**

There are 5 red balls out of 8 total.

$P(\text{1st red}) = \frac{5}{8}$.

2. **Probability of drawing the second red ball (without replacement):**

After drawing one red ball, there are now 4 red balls left and a total of 7 balls.

$P(\text{2nd red} \mid \text{1st red}) = \frac{4}{7}$.

3. **Probability that both are red:**

$P(\text{both red}) = P(\text{1st red}) \times P(\text{2nd red} \mid \text{1st red})$

$P(\text{both red}) = \frac{5}{8} \times \frac{4}{7} = \frac{20}{56}$.
Simplify the fraction: $\frac{20}{56} = \frac{5\times4}{14\times4} = \frac{5}{14}$.

Method 2: Using Combinations

1. **Total number of ways to draw 2 balls from 8:**

$$\binom{8}{2} = \frac{8 \times 7}{2 \times 1} = 28$$

2. **Number of ways to draw 2 red balls from 5 red balls:**

$$\binom{5}{2} = \frac{5 \times 4}{2 \times 1} = 10$$

3. **Probability that both are red:**

$P(\text{both red}) = \frac{\text{Number of ways to draw 2 red balls}}{\text{Total number of ways to draw 2 balls}} = \frac{10}{28}$.
Simplify the fraction: $\frac{10}{28} = \frac{5\times2}{14\times2} = \frac{5}{14}$.

Step 4: Final Answer:

The probability that both balls drawn are red is $\frac{5}{14}$. This corresponds to option (A).

Quick Tip: For probability problems involving "without replacement," remember that the denominator (total items) and sometimes the numerator (desired items) decrease after each selection. Combinations provide a reliable way to solve such problems. Simplify fractions to their lowest terms for comparison with options.

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5. If $f(x) = \begin{cases} x^2 + k, & x \leq 1 \\ 2x + 1, & x > 1 \end{cases}$ is continuous at $x = 1$, then the value of k is:

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (B) 2

Solution:

Step 1: Understanding the Question:

The question asks to find the value of a constant k that makes a piecewise function continuous at a specific point $x = 1$.

Step 2: Key Formula or Approach:

For a function $f(x)$ to be continuous at a point $x = a$, three conditions must be met:

1. $f(a)$ must be defined.
2. $\lim_{x\to a^-} f(x)$ (left-hand limit) must exist.
3. $\lim_{x\to a^+} f(x)$ (right-hand limit) must exist.
4. All three must be equal: $f(a) = \lim_{x\to a^-} f(x) = \lim_{x\to a^+} f(x)$.

Step 3: Detailed Explanation:

Given function: $f(x) = \begin{cases} x^2 + k, & x \le 1 \\ 2x + 1, & x > 1 \end{cases}$

We need to ensure continuity at $x = 1$.

1. **Value of the function at $x = 1$:**

When $x = 1$, we use the first part of the function definition ($x \le 1$):

$f(1) = (1)^2 + k = 1 + k.$

2. **Left-hand limit at $x = 1$:**

$\lim_{x\to 1^-} f(x) = \lim_{x\to 1^-}(x^2 + k)$

As x approaches 1 from the left (values less than 1), we use the first part of the function:

$\lim_{x\to 1^-}(x^2 + k) = (1)^2 + k = 1 + k.$

3. **Right-hand limit at $x = 1$:**

$\lim_{x\to 1^+} f(x) = \lim_{x\to 1^+}(2x + 1)$

As x approaches 1 from the right (values greater than 1), we use the second part of the function:

$\lim_{x\to 1^+}(2x + 1) = 2(1) + 1 = 2 + 1 = 3.$

For the function to be continuous at $x = 1$, these three values must be equal:

$f(1) = \lim_{x \to 1^-} f(x) = \lim_{x \to 1^+} f(x)$

So, $1 + k = 3$.

Solve for k:

$k = 3 - 1$

$k = 2$.

Step 4: Final Answer:

The value of k is 2.

Quick Tip: For piecewise functions, continuity at the "break point" means the function's value, left-hand limit, and right-hand limit at that point must all be equal. This usually boils down to setting the two function expressions equal at the break point.

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6. Solve: $\frac{dy}{dx} = 3x^2$

(A) $y = x^3 + C$

(B) $y = 3x + C$

(C) $y = x^2 + C$

(D) $y = 9x + C$

Correct Answer: (A) $y = x^3 + C$

Solution:

Step 1: Understanding the Question:

The question asks to solve a simple differential equation, which means finding the function y whose derivative with respect to x is $3x^2$.

Step 2: Key Formula or Approach:

To find y from $\frac{dy}{dx}$, we need to perform indefinite integration.

The formula for integrating power functions is:

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C \quad (\text{for } n \neq -1)$$

Where C is the constant of integration.

Step 3: Detailed Explanation:

Given differential equation:

$$\frac{dy}{dx} = 3x^2$$

To find y, integrate both sides with respect to x:

$$\int dy = \int 3x^2 dx$$

$$y = 3\int x^2 dx$$

Apply the power rule for integration ($n = 2$):

$$y = 3\left(\frac{x^{2+1}}{2+1}\right) + C$$

$$y = 3\left(\frac{x^3}{3}\right) + C$$

$$y = x^3 + C$$

This matches option (A).

Step 4: Final Answer:

The solution to the differential equation is $y = x^3 + C$.

Quick Tip: Remember that differentiation and integration are inverse operations. If you're unsure of your integration, you can always differentiate the proposed solution to see if it matches the original derivative.

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7. The feasible region of a linear programming problem is always:

(A) Circular

(B) Open

(C) Convex

(D) Irregular

Correct Answer: (C) Convex

Solution:

Step 1: Understanding the Question:

The question asks about a fundamental property of the feasible region in a linear programming problem (LPP).

Step 3: Detailed Explanation:

Feasible Region: In a linear programming problem, the feasible region is the set of all points that satisfy all the given constraints (linear inequalities). These constraints typically define a polygon or a polyhedral set in 2D or 3D space, respectively.

Convexity: A region is said to be **convex** if, for any two points within the region, the entire line segment connecting these two points also lies entirely within the region.

The intersection of a set of half-planes (which is what linear inequalities define) always results in a convex set. Therefore, the feasible region of a linear programming problem is always convex. This property is crucial because it ensures that if an optimal solution exists, it will occur at one of the vertices (corner points) of the feasible region.

Other options:

- (A) Circular: The feasible region is generally a polygon, not necessarily circular.
- (B) Open: It can be bounded (closed) or unbounded (open in one direction), but "open" itself is not a defining characteristic.
- (D) Irregular: While it can have many sides, it's always a well-defined convex polygon/polyhedron, not simply "irregular."

Therefore, the feasible region of an LPP is always convex.

Step 4: Final Answer:

The feasible region of a linear programming problem is always Convex.

Quick Tip: Remember the fundamental property of feasible regions in LPPs: they are always convex polygons (or polyhedra). This convexity is what allows the "corner point method" for finding optimal solutions.

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8. The principal value of $\tan^{-1}(1)$ is:

(A) (0)

(B) $(\frac{\pi}{6})$

(C) $(\frac{\pi}{4})$

(D) $(\frac{\pi}{2})$

Correct Answer: (C) $(\frac{\pi}{4})$

Solution:

Step 1: Understanding the Question:

The question asks for the principal value of the inverse tangent function for the input 1. The principal value refers to the unique value within the restricted range of the inverse trigonometric function.

Step 2: Key Formula or Approach:

The principal value branch for $\tan^{-1}(x)$ is $(-\frac{\pi}{2}, \frac{\pi}{2})$ (exclusive of endpoints).

We need to find the angle θ such that $\tan(\theta) = 1$ and θ lies within this range.

Step 3: Detailed Explanation:

We are looking for an angle θ such that $\tan(\theta) = 1$.

We know that $\tan(45^\circ) = 1$.

Converting 45° to radians:

$45^\circ = 45 \times \frac{\pi}{180}$ radians $= \frac{\pi}{4}$ radians.

The value $\frac{\pi}{4}$ lies within the principal value branch of $\tan^{-1}(x)$, which is $(-\frac{\pi}{2}, \frac{\pi}{2})$.

Therefore, the principal value of $\tan^{-1}(1)$ is $\frac{\pi}{4}$.

Step 4: Final Answer:

The principal value is $\frac{\pi}{4}$.

Quick Tip: Memorize the principal value ranges for inverse trigonometric functions:

- $\sin^{-1}(x)$: $[-\frac{\pi}{2}, \frac{\pi}{2}]$
- $\cos^{-1}(x)$: $[0, \pi]$
- $\tan^{-1}(x)$: $(-\frac{\pi}{2}, \frac{\pi}{2})$

These ranges ensure a unique output for each input.

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9. Differentiate: $y = x^2 \sin x$

(A) $(2x \sin x)$

(B) $(x^2 \cos x)$

(C) $(2x \sin x + x^2 \cos x)$

(D) $(2x \cos x)$

Correct Answer: (C) $(2x \sin x + x^2 \cos x)$

Solution:

Step 1: Understanding the Question:

The question asks to differentiate the given function $y = x^2 \sin x$ with respect to x.

Step 2: Key Formula or Approach:

The function is a product of two functions of x: $u(x) = x^2$ and $v(x) = \sin x$. Therefore, we need to use the product rule of differentiation.

Product Rule: If $y = u(x)v(x)$, then $\frac{dy}{dx} = u'(x)v(x) + u(x)v'(x)$.

Also, remember basic differentiation rules:

- $\frac{d}{dx}(x^n) = nx^{n-1}$

- $\frac{d}{dx}(\sin x) = \cos x$

Step 3: Detailed Explanation:

Given function: $y = x^2 \sin x$

Let $u(x) = x^2$ and $v(x) = \sin x$.

Calculate the derivatives of $u(x)$ and $v(x)$:

- $u'(x) = \frac{d}{dx}(x^2) = 2x$
- $v'(x) = \frac{d}{dx}(\sin x) = \cos x$

Now, apply the product rule:

$$\frac{dy}{dx} = u'(x)v(x) + u(x)v'(x)$$

$$\frac{dy}{dx} = (2x)(\sin x) + (x^2)(\cos x)$$

$$\frac{dy}{dx} = 2x \sin x + x^2 \cos x$$

This matches option (C).

Step 4: Final Answer:

The derivative is $2x \sin x + x^2 \cos x$.

Quick Tip: Always identify the structure of the function (e.g., product, quotient, chain rule) before differentiating. The product rule is crucial for functions formed by multiplying two variable expressions.

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10. Evaluate: $\int_0^1 (2x+1)dx$

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (B) 2

Solution:

Step 1: Understanding the Question:

The question asks to evaluate a definite integral of a polynomial function over the interval from 0 to 1.

Step 2: Key Formula or Approach:

1. Perform indefinite integration of the function.

$$\int (ax^n + b)dx = a\frac{x^{n+1}}{n+1} + bx + C$$

2. Apply the Fundamental Theorem of Calculus for definite integrals:

$$\int_a^b f(x)dx = F(b) - F(a)$$

Where $F(x)$ is the antiderivative of $f(x)$.

Step 3: Detailed Explanation:

Given integral: $I = \int_0^1 (2x+1)dx$

First, find the indefinite integral of $(2x+1)$:

$$\int (2x+1)dx = 2\int xdx + \int 1dx$$

$$= 2\left(\frac{x^{1+1}}{1+1}\right) + x + C$$

$$= 2\left(\frac{x^2}{2}\right) + x + C$$

$$= x^2 + x + C$$

So, the antiderivative $F(x) = x^2 + x$.

Now, evaluate the definite integral using the limits from 0 to 1:

$$I = [x^2 + x]_0^1$$

$$I = ((1)^2 + 1) - ((0)^2 + 0)$$

$$I = (1 + 1) - (0 + 0)$$

$$I = 2 - 0$$

$$I = 2$$

Step 4: Final Answer:

The value of the integral is 2.

Quick Tip: Remember to integrate each term of a polynomial separately. For definite integrals, always evaluate the antiderivative at the upper limit and subtract its value at the lower limit. Pay attention to constants and signs.