CUET 2026 May 18 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. Solve:

$$\frac{dy}{dx} = y \tan x$$

(A) $y = C \sec x$

(B) $y = C \cos x$

(C) $y = C \sin x$

(D) $y = C \tan x$

Correct Answer: (A)

Solution:

Concept:

The given differential equation is a first-order separable differential equation.

A separable differential equation is of the form:

$$\frac{dy}{dx} = f(x)g(y)$$

Such equations are solved by:

- separating variables involving y and x
- integrating both sides
- simplifying the obtained expression

Step 1: Given differential equation.

We are given:

$$\frac{dy}{dx} = y \tan x$$

We separate variables:

$$\frac{dy}{y} = \tan x \, dx$$

Step 2: Integrating both sides.

Integrate both sides:

$$\int \frac{1}{y} \, dy = \int \tan x \, dx$$

We know:

$$\int \frac{1}{y} \, dy = \ln|y|$$

and

$$\int \tan x \, dx = \ln|\sec x|$$

Therefore:

$$\ln|y| = \ln|\sec x| + C$$

Step 3: Simplifying the expression.

Exponentiating both sides:

$$|y| = e^C \sec x$$

Let:

$$e^C = C_1$$

Thus:

$$y = C \sec x$$

where C is an arbitrary constant.

Step 4: Matching with options.

The obtained solution is:

$$y = C \sec x$$

which matches option (A).

Final Answer:

$$\boxed{(A)\ y = C \sec x}$$

Quick Tip: Useful standard integrals:

$$\int \tan x \, dx = \ln|\sec x| + C$$

For separable differential equations:

- first separate variables
- integrate both sides carefully
- absorb constants after exponentiation

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2. Solve:

$$\frac{dy}{dx} + y = e^x, \qquad y(0) = 2$$

(A) $y = e^x + e^{-x}$

(B) $y = \frac{1}{2}e^x + \frac{3}{2}e^{-x}$

(C) $y = e^x + 1$

(D) $y = 2e^x$

Correct Answer: (B)

Solution:

Concept:

The given equation is a first-order linear differential equation of the form:

$$\frac{dy}{dx} + Py = Q$$

where:

$$P = 1, \qquad Q = e^x$$

Such equations are solved using the integrating factor (I.F.) method.

The integrating factor is:

$$I.F. = e^{\int P\,dx}$$

Step 1: Finding the integrating factor.

Given equation:

$$\frac{dy}{dx} + y = e^x$$

Comparing with:

$$\frac{dy}{dx} + Py = Q$$

we get:

$$P = 1$$

Therefore integrating factor:

$$I.F. = e^{\int 1\,dx} = e^x$$

Step 2: Multiplying entire equation by integrating factor.

Multiply both sides by e^x:

$$e^x \frac{dy}{dx} + ye^x = e^{2x}$$

Observe that:

$$e^x \frac{dy}{dx} + ye^x = \frac{d}{dx}(ye^x)$$

Thus equation becomes:

$$\frac{d}{dx}(ye^x) = e^{2x}$$

Step 3: Integrating both sides.

Integrating:

$$\int \frac{d}{dx}(ye^x)\,dx = \int e^{2x}\,dx$$

we get:

$$ye^x = \frac{1}{2}e^{2x} + C$$

Divide throughout by e^x:

$$y = \frac{1}{2}e^x + Ce^{-x}$$

Step 4: Applying initial condition.

Given:

$$y(0) = 2$$

Substitute $x = 0$:

$$2 = \frac{1}{2} + C$$

Therefore:

$$C = \frac{3}{2}$$

Substitute back:

$$y = \frac{1}{2}e^{x} + \frac{3}{2}e^{-x}$$

Step 5: Matching with options.

The obtained solution matches option (B).

Final Answer:

$$\boxed{(B)\ y = \frac{1}{2}e^{x} + \frac{3}{2}e^{-x}}$$

Quick Tip: For linear differential equations:

$$\frac{dy}{dx} + Py = Q$$

use:

$$I.F. = e^{\int P\,dx}$$

Then:

$$y(I.F.) = \int Q(I.F.)\,dx + C$$

Always apply the initial condition at the end to determine the constant.

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3. Evaluate:

$$\int \frac{1}{x^2 + 4x + 5}\,dx$$

(A) $\tan^{-1}(x+2) + C$

(B) $\frac{1}{2}\tan^{-1}(x+2) + C$

(C) $\tan^{-1}(2x+4) + C$

(D) $\ln(x^2 + 4x + 5) + C$

Correct Answer: (A)

Solution:

Concept:

To evaluate integrals of quadratic expressions in denominator, first complete the square.

Recall:

$$\int \frac{1}{x^2 + a^2}\, dx = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right) + C$$

Step 1: Completing the square.

Given integral:

$$I = \int \frac{1}{x^2 + 4x + 5}\, dx$$

Rewrite denominator:

$$x^2 + 4x + 5 = (x + 2)^2 + 1$$

Thus:

$$I = \int \frac{1}{(x + 2)^2 + 1}\, dx$$

Step 2: Substitution.

Let:

$$u = x + 2$$

Then:

$$du = dx$$

Integral becomes:

$$I = \int \frac{1}{u^2 + 1}\, du$$

Using standard formula:

$$\int \frac{1}{u^2+1}\,du = \tan^{-1} u + C$$

Hence:

$$I = \tan^{-1}(x+2) + C$$

Final Answer:

$$\boxed{(A)\ \tan^{-1}(x+2) + C}$$

Quick Tip: Always complete the square in quadratic denominators:

$$x^2 + 4x + 5 = (x+2)^2 + 1$$

Then apply:

$$\int \frac{1}{x^2+a^2}\,dx = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C$$

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4. Evaluate:

$$\int_0^1 \frac{1}{1+x^2}\,dx$$

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

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

(C) 1

(D) $\ln 2$

Correct Answer: (B)

Solution:

Concept:

Recall the standard integral:

$$\int \frac{1}{1+x^2}\,dx = \tan^{-1} x + C$$

For definite integrals:

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

where $F(x)$ is antiderivative of $f(x)$.

Step 1: Integrating the function.

Given:

$$I = \int_0^1 \frac{1}{1+x^2}\,dx$$

Using standard result:

$$\int \frac{1}{1+x^2}\,dx = \tan^{-1} x$$

Thus:

$$I = \left[\tan^{-1} x\right]_0^1$$

Step 2: Applying limits.

Substitute upper and lower limits:

$$I = \tan^{-1}(1) - \tan^{-1}(0)$$

We know:

$$\tan^{-1}(1) = \frac{\pi}{4}$$

and

$$\tan^{-1}(0) = 0$$

Hence:

$$I = \frac{\pi}{4}$$

Final Answer:

$$\boxed{(B)\ \frac{\pi}{4}}$$

Quick Tip: Remember:

$$\int \frac{1}{1+x^2}\,dx = \tan^{-1}x + C$$

and:

$$\tan^{-1}(1) = \frac{\pi}{4}$$

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5. For $y = x^3 - 3x^2 + 2$, slope at $x = 2$:

(A) 0

(B) 2

(C) 4

(D) 6

Correct Answer: (A)

Solution:

Concept:

The slope of a curve at a point is given by:

$$\frac{dy}{dx}$$

Thus we differentiate the function and substitute the given value of x.

Step 1: Differentiating the function.

Given:

$$y = x^3 - 3x^2 + 2$$

Differentiate term-by-term:

$$\frac{dy}{dx} = 3x^2 - 6x$$

Step 2: Substituting $x = 2$.

$$\left.\frac{dy}{dx}\right|_{x=2} = 3(2)^2 - 6(2)$$

$$= 12 - 12$$

$$= 0$$

Final Answer:

$$\boxed{(A)\ 0}$$

Quick Tip: Slope of curve:

$$y = f(x)$$

at any point is:

$$\frac{dy}{dx}$$

Differentiate first, then substitute the given value of x.

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6. If

$$A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$$

then $A^{-1} =$

(A) $\frac{1}{5}\begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}$

(B) $\frac{1}{5}\begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix}$

(C) $\frac{1}{3}\begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}$

(D) $\begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}$

Correct Answer: (A)

Solution:

Concept:

For matrix:

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

inverse is:

$$A^{-1} = \frac{1}{ad - bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

provided determinant is non-zero.

Step 1: Finding determinant.

$$|A| = (2)(4) - (3)(1)$$

$$= 8 - 3$$

$$= 5$$

Step 2: Applying inverse formula.

$$A^{-1} = \frac{1}{5}\begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}$$

Final Answer:

$$\boxed{(A)\ \frac{1}{5}\begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}}$$

Quick Tip: For:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

inverse is:

$$\frac{1}{ad-bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

Interchange diagonal entries and change signs of off-diagonal entries.

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7. Solve:

$$\begin{vmatrix} x & 1 \\ 2 & x \end{vmatrix} = 0$$

(A) $x = \pm\sqrt{2}$

(B) $x = \pm 1$

(C) $x = \pm 2$

(D) $x = 0$

Correct Answer: (A)

Solution:

Concept:

For a 2×2 determinant:

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

Step 1: Expanding determinant.

$$\begin{vmatrix} x & 1 \\ 2 & x \end{vmatrix} = x(x) - (1)(2)$$

$$= x^2 - 2$$

Given determinant equals zero:

$$x^2 - 2 = 0$$

Step 2: Solving equation.

$$x^2 = 2$$

$$x = \pm\sqrt{2}$$

Final Answer:

$$\boxed{(A)\ x = \pm\sqrt{2}}$$

Quick Tip: For determinant:

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix}$$

always use:

$$ad - bc$$

8. If $\vec{a} = 2\hat{i} + \hat{j}$, $\vec{b} = \hat{i} + 3\hat{j}$, then $\vec{a} \cdot \vec{b} =$

(A) 5

(B) 7

(C) 8

(D) 6

Correct Answer: (A)

Solution:

Concept:

Dot product formula:

$$(a_1\hat{i} + a_2\hat{j}) \cdot (b_1\hat{i} + b_2\hat{j}) = a_1b_1 + a_2b_2$$

Step 1: Identifying components.

$$\vec{a} = 2\hat{i} + \hat{j}$$

$$\vec{b} = \hat{i} + 3\hat{j}$$

Thus:

$$a_1 = 2, \quad a_2 = 1$$

$$b_1 = 1, \quad b_2 = 3$$

Step 2: Calculating dot product.

$$\vec{a} \cdot \vec{b} = (2)(1) + (1)(3)$$

$$= 2 + 3$$

$$= 5$$

Final Answer:

$$\boxed{(A)\ 5}$$

Quick Tip: Dot product:

$$\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z$$

Multiply corresponding components and add.

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9. Distance between $A(1,2,3)$ and $B(4,6,3)$:

(A) 4

(B) 5

(C) 6

(D) 7

Correct Answer: (B)

Solution:

Concept:

Distance between two points in 3D geometry:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Step 1: Substituting coordinates.

Points are:

$$A(1,2,3)$$

and

$$B(4,6,3)$$

Thus:

$$d = \sqrt{(4-1)^2 + (6-2)^2 + (3-3)^2}$$

Step 2: Simplifying.

$$= \sqrt{3^2 + 4^2 + 0^2}$$

$$= \sqrt{9+16}$$

$$= \sqrt{25}$$

$$= 5$$

Final Answer:

$$\boxed{(B)\ 5}$$

Quick Tip: Distance formula in 3D:

$$d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$$

It is the extension of Pythagoras theorem to space geometry.

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10. Line through $(1,2,3)$ **parallel to** $\hat{i} + 2\hat{j} + 3\hat{k}$**:**

(A) $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$
(B) $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$
(C) $\frac{x+1}{1} = \frac{y+2}{2} = \frac{z+3}{3}$
(D) $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{1}$

Correct Answer: (A)

Solution:

Concept:

Equation of a line passing through point:

$$(x_1, y_1, z_1)$$

and parallel to vector:

$$a\hat{i} + b\hat{j} + c\hat{k}$$

is:

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c}$$

Step 1: Identifying point and direction ratios.

Given point:

$$(1, 2, 3)$$

Direction vector:

$$\hat{i} + 2\hat{j} + 3\hat{k}$$

Hence direction ratios are:

$$1,\ 2,\ 3$$

Step 2: Writing line equation.

Using standard symmetric form:

$$\frac{x - 1}{1} = \frac{y - 2}{2} = \frac{z - 3}{3}$$

Final Answer:

$$\boxed{(A)\ \frac{x - 1}{1} = \frac{y - 2}{2} = \frac{z - 3}{3}}$$

Quick Tip: Line through point:

$$(x_1, y_1, z_1)$$

parallel to vector:

$$a\hat{i} + b\hat{j} + c\hat{k}$$

has equation:

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c}$$
