CUET 2026 May 30 Shift 1 Mathematics

Question Paper (Memory-Based) With Solution

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. Find the order and degree of the differential equation:

$$\sqrt{1+\left(\frac{dy}{dx}\right)^2} = \frac{d^2y}{dx^2}$$

(A) Order 2, Degree 2

(B) Order 2, Degree 1

(C) Order 1, Degree 2

(D) Order 2, Degree $\frac{1}{2}$

Correct Answer: (A) Order 2, Degree 2

Solution:

Concept:

The **order** of a differential equation is the order of the highest derivative present in the equation.

The **degree** of a differential equation is the power of the highest-order derivative after the equation has been made free from radicals and fractional powers involving derivatives.

Before determining the degree, the equation must be converted into polynomial form with respect to derivatives.

Step 1: Write the given differential equation

The given differential equation is

$$\sqrt{1+\left(\frac{dy}{dx}\right)^2}=\frac{d^2y}{dx^2}$$

We observe that the highest derivative present is

$$\frac{d^2y}{dx^2}$$

Therefore, the order is expected to be 2.

Step 2: Remove the radical sign

To determine the degree, we must first eliminate the square root.

Squaring both sides gives

$$\left(\sqrt{1+\left(\frac{dy}{dx}\right)^2}\right)^2=\left(\frac{d^2y}{dx^2}\right)^2$$

Hence,

$$1+\left(\frac{dy}{dx}\right)^2=\left(\frac{d^2y}{dx^2}\right)^2$$

This equation is now polynomial in derivatives.

Step 3: Determine the order

The highest-order derivative appearing in the equation is

$$\frac{d^2y}{dx^2}$$

Therefore,

$$\boxed{\text{Order}=2}$$

Step 4: Determine the degree

The highest-order derivative is

$$\frac{d^2y}{dx^2}$$

and its exponent is

$$2$$

Therefore,

$$\boxed{\text{Degree} = 2}$$

Final Answer:

$$\boxed{\text{Order } 2, \text{ Degree } 2}$$

Quick Tip: Whenever radicals or fractional powers involve derivatives, first remove them before finding the degree of the differential equation.

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2. Find the angle between the vectors

$$\vec{a} = \hat{i} + \hat{j} - \hat{k}$$

and

$$\vec{b} = \hat{i} - \hat{j} + \hat{k}.$$

(A) 0°

(B) 90°

(C) $\cos^{-1}\left(-\frac{1}{3}\right)$

(D) $\cos^{-1}\left(\frac{1}{3}\right)$

Correct Answer: (C) $\cos^{-1}\left(-\frac{1}{3}\right)$

Solution:

Concept:

The angle between two vectors can be found using the dot product formula:

$$\vec{a} \cdot \vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta$$

Therefore,

$$\cos\theta = \frac{\vec{a}\cdot\vec{b}}{|\vec{a}||\vec{b}|}$$

where

$$\theta = \text{angle between the vectors.}$$

Step 1: Write the given vectors

$$\vec{a} = (1, 1, -1)$$

$$\vec{b} = (1, -1, 1)$$

Step 2: Find the dot product

Using

$$\vec{a}\cdot\vec{b} = a_1b_1 + a_2b_2 + a_3b_3$$

we get

$$= (1)(1) + (1)(-1) + (-1)(1)$$

$$= 1 - 1 - 1$$

$$= -1$$

Hence,

$$\vec{a}\cdot\vec{b} = -1$$

Step 3: Find magnitude of each vector

For vector $\vec{a}$,

$$|\vec{a}| = \sqrt{1^2 + 1^2 + (-1)^2}$$

$$= \sqrt{1+1+1}$$

$$= \sqrt{3}$$

Similarly,

$$|\vec{b}| = \sqrt{1^2 + (-1)^2 + 1^2}$$

$$= \sqrt{3}$$

Step 4: Apply the angle formula

$$\cos\theta = \frac{-1}{\sqrt{3} \times \sqrt{3}}$$

$$= -\frac{1}{3}$$

Therefore,

$$\theta = \cos^{-1}\left(-\frac{1}{3}\right)$$

Final Answer:

$$\boxed{\cos^{-1}\left(-\frac{1}{3}\right)}$$

Quick Tip: If the dot product is negative, the angle between the vectors is obtuse.

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3. Minimize

$$Z = 2x + 3y$$

subject to

$$x + y \geq 5, \qquad x, y \geq 0.$$

(A) 10

(B) 15

(C) 0

(D) 12

Correct Answer: (A) 10

Solution:

Concept:

In Linear Programming Problems, the optimum value of the objective function occurs at one of the corner points of the feasible region.

The objective function is

$$Z = 2x + 3y$$

and the constraint is

$$x + y \geq 5$$

with

$$x \geq 0, \qquad y \geq 0.$$

Step 1: Determine the feasible region

The line

$$x + y = 5$$

cuts the coordinate axes at

$$(5, 0)$$

and

$$(0, 5).$$

Since

$$x + y \geq 5,$$

the feasible region lies on or above the line.

The corner points on the boundary are

$$(5, 0)$$

and

$$(0, 5).$$

Step 2: Evaluate the objective function at corner points

At

$$(5, 0)$$

$$Z = 2(5) + 3(0)$$

$$= 10$$

At

$$(0, 5)$$

$$Z = 2(0) + 3(5)$$

$$= 15$$

Step 3: Compare the values

$$Z(5, 0) = 10$$

$$Z(0, 5) = 15$$

The smaller value is

$$10$$

Final Answer:

$$\boxed{10}$$

Quick Tip: For minimization problems, always select the smallest value of the objective function among the feasible corner points.

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4. If

$$P(A) = 0.5, \qquad P(B) = 0.3, \qquad P(A \cap B) = 0.1,$$

find

$$P(A|B).$$

(A) 0.1

(B) 0.2

(C) $\frac{1}{3}$

(D) 0.5

Correct Answer: (C) $\frac{1}{3}$

Solution:

Concept:

Conditional probability measures the probability of occurrence of one event when another event has already occurred.

The formula is

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

provided

$$P(B) \neq 0.$$

Step 1: Write the given values

$$P(A) = 0.5$$

$$P(B) = 0.3$$

$$P(A \cap B) = 0.1$$

Step 2: Substitute into the conditional probability formula

$$P(A|B) = \frac{0.1}{0.3}$$

$$= \frac{1}{3}$$

Step 3: Verify the result

Since probability lies between 0 and 1,

$$\frac{1}{3}$$

is a valid probability value.

Final Answer:

$$\boxed{\frac{1}{3}}$$

Quick Tip: Conditional probability is always calculated as

$$\frac{\text{Intersection}}{\text{Given Event}}$$

provided the denominator is non-zero.

5. Find the rate of change of the area of a circle with respect to its radius r when

$$r = 3 \textbf{ cm}.$$

(A) 3π

(B) 6π

(C) 9π

(D) π

Correct Answer: (B) 6π

Solution:

Concept:

The area of a circle of radius r is

$$A = \pi r^2.$$

The rate of change of area with respect to radius is obtained by differentiating A with respect to r.

Step 1: Write the formula for area

$$A = \pi r^2$$

Step 2: Differentiate with respect to r

Differentiating both sides,

$$\frac{dA}{dr} = \frac{d}{dr}(\pi r^2)$$

Since π is constant,

$$\frac{dA}{dr} = \pi \frac{d}{dr}(r^2)$$

$$= \pi(2r)$$

$$= 2\pi r$$

Step 3: Substitute $r = 3$

$$\frac{dA}{dr} = 2\pi(3)$$

$$= 6\pi$$

Step 4: Interpret the result

This means that when the radius is 3 cm, the area increases at the rate of

$$6\pi$$

square units for every unit increase in radius.

Final Answer:

$$\boxed{6\pi}$$

Quick Tip: The derivative of the area of a circle with respect to its radius is

$$\frac{dA}{dr} = 2\pi r,$$

which is numerically equal to the circumference of the circle.

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6. Find the value of

$$\cos\left(\sin^{-1}\left(\frac{1}{2}\right)\right).$$

(A) $\frac{1}{2}$

(B) $\frac{\sqrt{3}}{2}$

(C) 1

(D) 0

Correct Answer: (B) $\frac{\sqrt{3}}{2}$

Solution:

Concept:

Inverse trigonometric functions convert a trigonometric value into its corresponding angle. If

$$\theta = \sin^{-1}\left(\frac{1}{2}\right),$$

then θ is the angle whose sine is $\frac{1}{2}$.

The standard value is:

$$\sin 30^\circ = \frac{1}{2}$$

Therefore,

$$\sin^{-1}\left(\frac{1}{2}\right) = 30^\circ = \frac{\pi}{6}$$

Step 1: Find the angle represented by $\sin^{-1}\left(\frac{1}{2}\right)$

Let

$$\theta = \sin^{-1}\left(\frac{1}{2}\right)$$

Then

$$\sin\theta = \frac{1}{2}$$

The principal value satisfying this condition is

$$\theta = \frac{\pi}{6}$$

Step 2: Evaluate the cosine of the angle

Substituting $\theta = \frac{\pi}{6}$,

$$\cos\left(\sin^{-1}\left(\frac{1}{2}\right)\right) = \cos\frac{\pi}{6}$$

Using the standard trigonometric value,

$$\cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$$

Step 3: Verify using trigonometric identity

Let

$$\theta = \sin^{-1}\left(\frac{1}{2}\right)$$

Then

$$\sin\theta = \frac{1}{2}$$

Using

$$\sin^2\theta + \cos^2\theta = 1$$

we get

$$\cos\theta = \sqrt{1 - \sin^2\theta}$$

$$= \sqrt{1 - \left(\frac{1}{2}\right)^2}$$

$$= \sqrt{1 - \frac{1}{4}}$$

$$= \sqrt{\frac{3}{4}}$$

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

which confirms the answer.

Final Answer:

$$\boxed{\frac{\sqrt{3}}{2}}$$

Quick Tip: For expressions like $\cos(\sin^{-1} x)$, first find the angle represented by $\sin^{-1} x$, then apply the outer trigonometric function.

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7. Is

$$f(x) = x^2$$

continuous at $x = 0$?

(A) Yes

(B) No

(C) Only from left

(D) Only from right

Correct Answer: (A) Yes

Solution:

Concept:

A function $f(x)$ is continuous at $x = a$ if

$$\lim_{x \to a} f(x) = f(a)$$

That is,

$$\text{LHL} = \text{RHL} = f(a)$$

must hold simultaneously.

Step 1: Find the value of the function at $x = 0$

Given

$$f(x) = x^2$$

Substituting $x = 0$,

$$f(0) = 0^2 = 0$$

$$f(0) = 0$$

Step 2: Find the left-hand limit

$$\lim_{x \to 0^-} x^2$$

As x approaches 0 from the left side,

$$x^2 \to 0$$

Therefore,

$$\lim_{x \to 0^-} f(x) = 0$$

Step 3: Find the right-hand limit

$$\lim_{x \to 0^+} x^2$$

As x approaches 0 from the right side,

$$x^2 \to 0$$

Hence,

$$\lim_{x \to 0^+} f(x) = 0$$

Step 4: Compare the limits and function value

We obtain

$$\text{LHL} = 0$$

$$\text{RHL} = 0$$

and

$$f(0) = 0$$

Thus,

$$\lim_{x \to 0} f(x) = f(0)$$

Therefore, the function is continuous at $x = 0$.

Final Answer:

$$\boxed{\text{Yes}}$$

Quick Tip: All polynomial functions are continuous for every real value of x.

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8. Find

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

if

$$y = \log(\sin x).$$

(A) $\tan x$

(B) $\cot x$

(C) $-\cot x$

(D) $\sec x$

Correct Answer: (B) $\cot x$

Solution:

Concept:

The function is a composite function because log contains another function $\sin x$ inside it. Therefore, we use the Chain Rule:

$$\frac{d}{dx}(\log u) = \frac{1}{u} \cdot \frac{du}{dx}$$

Step 1: Identify the inner function

Given

$$y = \log(\sin x)$$

Let

$$u = \sin x$$

Then

$$y = \log u$$

Step 2: Differentiate using the chain rule

Applying

$$\frac{d}{dx}(\log u) = \frac{1}{u}\frac{du}{dx}$$

we get

$$\frac{dy}{dx} = \frac{1}{\sin x} \cdot \frac{d}{dx}(\sin x)$$

$$= \frac{1}{\sin x} \cdot \cos x$$

Step 3: Simplify the expression

$$\frac{\cos x}{\sin x} = \cot x$$

Therefore,

$$\frac{dy}{dx} = \cot x$$

Final Answer:

$$\boxed{\cot x}$$

Quick Tip: Whenever a logarithm contains another function inside it, use the formula $\frac{d}{dx}(\log u) = \frac{u'}{u}$.

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9. Calculate

$$\int e^x \, dx.$$

(A) $e^x + C$

(B) $e^{x+1} + C$

(C) $\frac{e^x}{x} + C$

(D) $xe^x + C$

Correct Answer: (A) $e^x + C$

Solution:

Concept:

Integration is the reverse process of differentiation.

The exponential function e^x is unique because its derivative is equal to itself:

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

Therefore, its integral is also itself.

Step 1: Recall the standard integration formula

$$\int e^x \, dx = e^x + C$$

where C is the constant of integration.

Step 2: Verify by differentiation

Differentiate the obtained answer:

$$\frac{d}{dx}(e^x + C)$$

$$= e^x + 0$$

$$= e^x$$

which matches the original integrand.

Hence the result is correct.

Final Answer:

$$\boxed{e^x + C}$$

Quick Tip: Remember:

$$\int e^x \, dx = e^x + C$$

because e^x is its own derivative.

10. Find the distance from the point

$$(1, 1, 1)$$

to the plane

$$x + y + z = 3.$$

(A) 1

(B) 0

(C) $\sqrt{3}$

(D) 3

Correct Answer: (B) 0

Solution:

Concept:

The perpendicular distance of a point (x_1, y_1, z_1) from the plane

$$Ax + By + Cz + D = 0$$

is

$$d = \frac{|Ax_1 + By_1 + Cz_1 + D|}{\sqrt{A^2 + B^2 + C^2}}$$

Step 1: Write the plane in standard form

Given plane:

$$x + y + z = 3$$

or

$$x + y + z - 3 = 0$$

Comparing with

$$Ax + By + Cz + D = 0$$

we get

$$A = 1, \quad B = 1, \quad C = 1, \quad D = -3$$

Step 2: Substitute the coordinates of the point

Point:

$$(1, 1, 1)$$

Substituting into the formula:

$$d = \frac{|1(1) + 1(1) + 1(1) - 3|}{\sqrt{1^2 + 1^2 + 1^2}}$$

$$= \frac{|3 - 3|}{\sqrt{3}}$$

$$= \frac{0}{\sqrt{3}}$$

$$= 0$$

Step 3: Interpret the result

Since the distance is zero, the point lies exactly on the plane.

Checking:

$$1 + 1 + 1 = 3$$

which satisfies the plane equation.

Therefore, the point lies on the plane itself.

Final Answer:

$$\boxed{0}$$

Quick Tip: If a point satisfies the equation of a plane, then its perpendicular distance from the plane is zero.