CUET 2026 May 30 Shift 2 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. If

$$\int_0^1 (3x^2 + 2x + 1)\,dx = k,$$

then the value of k is:

(A) 2

(B) 3

(C) 4

(D) 5

Correct Answer: (B) 3

Solution:

Concept:
A definite integral gives the exact area under a curve between the specified limits.
For evaluating a definite integral, we first find the antiderivative and then apply the limits using:

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

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

Step 1: Find the antiderivative

Given,

$$k = \int_0^1 (3x^2 + 2x + 1)\,dx$$

Integrating term by term,

$$\int (3x^2 + 2x + 1)\,dx = x^3 + x^2 + x$$

Therefore,

$$k = \left[x^3 + x^2 + x\right]_0^1$$

Step 2: Substitute the upper limit

At $x = 1$,

$$1^3 + 1^2 + 1 = 1 + 1 + 1 = 3$$

Step 3: Substitute the lower limit

At $x = 0$,

$$0^3 + 0^2 + 0 = 0$$

Step 4: Apply Fundamental Theorem of Calculus

$$k = 3 - 0$$

$$k = 3$$

Final Answer:

$$\boxed{3}$$

Quick Tip: For polynomial functions, integrate each term separately and then apply the limits carefully.

2. If

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

is equal to:

(A) $\ln(x^2+x+1)+C$

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

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

(D) $\frac{x}{x^2+x+1}+C$

Correct Answer: (A) $\ln(x^2+x+1)+C$

Solution:

Concept:

Whenever the numerator is the derivative of the denominator, use the standard formula:

$$\int \frac{f'(x)}{f(x)}\,dx = \ln|f(x)|+C$$

Step 1: Identify the denominator

$$f(x)=x^2+x+1$$

Differentiate:

$$f'(x)=2x+1$$

Step 2: Compare numerator and derivative

Numerator:

$$2x+1$$

Derivative of denominator:

$$2x+1$$

They are exactly the same.

Step 3: Apply the standard result

$$\int \frac{2x+1}{x^2+x+1}\,dx = \ln|x^2+x+1| + C$$

Since

$$x^2+x+1>0$$

for all real x,

$$= \ln(x^2+x+1) + C$$

Final Answer:

$$\boxed{\ln(x^2+x+1)+C}$$

Quick Tip: Look for the pattern $\frac{f'(x)}{f(x)}$. It immediately gives a logarithmic integral.

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3. The number of 5-digit numbers that can be formed using the digits $1,2,3,4,5,6$ without repetition and divisible by 5 is:

(A) 60

(B) 120

(C) 240

(D) 720

Correct Answer: (B) 120

Solution:

Concept:

A number is divisible by 5 if its last digit is 0 or 5.

Since only the digit 5 is available, every valid number must end with 5.

Step 1: Fix the last digit

Last digit:

$$5$$

Now we need to fill the remaining four positions.

Available digits:

$$1, 2, 3, 4, 6$$

Total digits available = 5.

Step 2: Arrange four digits in four places

Number of arrangements:

$$^{5}P_4 = \frac{5!}{(5-4)!}$$

$$= \frac{5!}{1!}$$

$$= 5 \times 4 \times 3 \times 2$$

$$= 120$$

Step 3: Write the result

Hence the total number of required numbers is

$$120$$

Final Answer:

$$\boxed{120}$$

Quick Tip: For divisibility by 5, always fix the last digit first and then arrange the remaining digits.

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4. If a random variable X has probability distribution

$$P(X = x) = kx,$$

$$x = 1, 2, 3, 4,$$

then the value of k is:

(A) $\frac{1}{5}$

(B) $\frac{1}{10}$

(C) $\frac{1}{20}$

(D) $\frac{1}{15}$

Correct Answer: (B) $\frac{1}{10}$

Solution:

Concept:

The sum of all probabilities in a probability distribution must be equal to 1.

$$\sum P(X = x) = 1$$

Step 1: Write all probabilities

$$P(1) = k$$

$$P(2) = 2k$$

$$P(3) = 3k$$

$$P(4) = 4k$$

Step 2: Use total probability equals one

$$k + 2k + 3k + 4k = 1$$

$$10k = 1$$

Step 3: Solve for k

$$k = \frac{1}{10}$$

Final Answer:

$$\boxed{\frac{1}{10}}$$

Quick Tip: Whenever an unknown constant appears in a probability distribution, use the fact that total probability equals 1.

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5. If

$$z = \frac{1+i}{1-i},$$

then z^8 equals:

(A) 1

(B) -1

(C) i

(D) $-i$

Correct Answer: (A) 1

Solution:

Concept:

To simplify a complex fraction, multiply the numerator and denominator by the conjugate of the denominator.

Step 1: Rationalize the denominator

$$z = \frac{1+i}{1-i}$$

Multiply by

$$\frac{1+i}{1+i}$$

$$z = \frac{(1+i)^2}{(1-i)(1+i)}$$

$$= \frac{1+2i+i^2}{1-i^2}$$

$$= \frac{1+2i-1}{1+1}$$

$$= \frac{2i}{2}$$

$$= i$$

Step 2: Find z^8

Since

$$z = i$$

$$z^8 = i^8$$

Using

$$i^4 = 1$$

$$i^8 = (i^4)^2$$

$$= 1^2$$

$$= 1$$

Final Answer:

$$\boxed{1}$$

Quick Tip: Remember the cycle:

$$i,\ -1,\ -i,\ 1$$

repeats every four powers.

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6. The differential equation of the family of curves

$$y = ce^{2x}$$

is:

(A) $\frac{dy}{dx} = 2y$
(B) $\frac{dy}{dx} = y$
(C) $\frac{d^2y}{dx^2} = 2y$
(D) $\frac{dy}{dx} = 2x$

Correct Answer: (A) $\frac{dy}{dx} = 2y$

Solution:

Concept:
The differential equation corresponding to a family of curves is obtained by eliminating the arbitrary constant from the given equation.
Given family:

$$y = ce^{2x}$$

where c is an arbitrary constant.
Step 1: Differentiate the given equation
Differentiating both sides with respect to x,

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

Using chain rule,

$$\frac{dy}{dx} = c(2e^{2x})$$

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

Step 2: Eliminate the arbitrary constant

From the original equation,

$$y = ce^{2x}$$

Substituting into the differentiated equation,

$$\frac{dy}{dx} = 2y$$

Step 3: Write the required differential equation

Hence the differential equation representing the family is

$$\boxed{\frac{dy}{dx} = 2y}$$

Final Answer:

$$\boxed{\frac{dy}{dx} = 2y}$$

Quick Tip: To form a differential equation, differentiate the given family and eliminate all arbitrary constants.

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

(A) $\frac{5}{33}$

(B) $\frac{10}{33}$

(C) $\frac{20}{33}$

(D) $\frac{5}{12}$

Correct Answer: (A) $\frac{5}{33}$

Solution:

Concept:

When objects are drawn without replacement, the probability of successive events is found using multiplication of conditional probabilities.

Step 1: Find the probability that the first ball is red

Total balls:

$$5 + 4 + 3 = 12$$

Therefore,

$$P(\text{First red}) = \frac{5}{12}$$

Step 2: Find the probability that the second ball is red

After drawing one red ball, remaining red balls $= 4$.

Remaining total balls $= 11$.

Hence,

$$P(\text{Second red} \mid \text{First red}) = \frac{4}{11}$$

Step 3: Apply multiplication rule

$$P(\text{Both red}) = \frac{5}{12} \times \frac{4}{11}$$

$$= \frac{20}{132}$$

$$= \frac{5}{33}$$

Final Answer:

$$\boxed{\frac{5}{33}}$$

Quick Tip: For "without replacement" questions, both the numerator and denominator change after each draw.

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8. Find the equation of the tangent to

$$y = x^3 - 3x + 1$$

at the point where $x = 2$.

(A) $y = 9x - 13$

(B) $y = 9x - 15$

(C) $y = 6x - 7$

(D) $y = 12x - 19$

Correct Answer: (A)

$$y = 9x - 13$$

Solution:

Concept:

The equation of tangent at a point is

$$y - y_1 = m(x - x_1)$$

where m is the slope obtained from the derivative.

Step 1: Find coordinates of the point

Given

$$y = x^3 - 3x + 1$$

At $x = 2$,

$$y = 2^3 - 3(2) + 1$$

$$= 8 - 6 + 1$$

$$= 3$$

Point is

$$(2, 3)$$

Step 2: Find derivative

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

At $x = 2$,

$$m = 3(2)^2 - 3$$

$$= 12 - 3$$

$$= 9$$

Step 3: Apply point-slope form

$$y - 3 = 9(x - 2)$$

$$y - 3 = 9x - 18$$

$$y = 9x - 15$$

The correct tangent equation is

$$\boxed{y = 9x - 15}$$

Hence the given answer key appears incorrect.

Quick Tip: First find the point on the curve, then compute slope using differentiation.

9. If

$$\sin^{-1} x + \cos^{-1} x = \theta$$

find θ.

(A) 0

(B) π

(C) $\pi/2$

(D) 2π

Correct Answer: (C) $\pi/2$

Solution:

Concept:

One of the most important inverse trigonometric identities is

$$\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$$

for every $x \in [-1, 1]$.

Step 1: Apply the standard identity

Given

$$\sin^{-1} x + \cos^{-1} x = \theta$$

Using the identity,

$$\theta = \frac{\pi}{2}$$

Step 2: Verify with an example

Take

$$x = \frac{1}{2}$$

Then

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

and

$$\cos^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{3}$$

Therefore,

$$\frac{\pi}{6} + \frac{\pi}{3} = \frac{\pi}{2}$$

which confirms the identity.

Final Answer:

$$\boxed{\frac{\pi}{2}}$$

Quick Tip: Memorize the identity $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$; it is frequently asked in CUET examinations.

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10. Find the shortest distance between the skew lines

$$\vec{r} = (1,0,0) + \lambda(1,1,0)$$

and

$$\vec{r} = (0,1,1) + \mu(0,1,1)$$

(A) 1

(B) $\sqrt{2}$

(C) $\frac{1}{\sqrt{2}}$

(D) $\sqrt{3}$

Correct Answer: (C) $\frac{1}{\sqrt{2}}$

Solution:

Concept:

Shortest distance between skew lines is

$$d = \frac{|(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2)|}{|\vec{b}_1 \times \vec{b}_2|}$$

Step 1: Identify vectors

$$\vec{a}_1 = (1,0,0)$$

$$\vec{a}_2 = (0,1,1)$$

Direction vectors:

$$\vec{b}_1 = (1,1,0)$$

$$\vec{b}_2 = (0,1,1)$$

Step 2: Find cross product

$$\vec{b}_1 \times \vec{b}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{vmatrix}$$

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

Magnitude:

$$|\vec{b}_1 \times \vec{b}_2| = \sqrt{1^2 + (-1)^2 + 1^2} = \sqrt{3}$$

Step 3: Find joining vector

$$\vec{a}_2 - \vec{a}_1 = (-1,1,1)$$

Step 4: Apply formula

$$d = \frac{|(-1,1,1)\cdot(1,-1,1)|}{\sqrt{3}}$$

$$= \frac{|-1-1+1|}{\sqrt{3}}$$

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

Thus

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

Hence the answer key provided in the question appears incorrect.

Quick Tip: For shortest-distance problems, always verify the answer numerically because answer keys occasionally contain mistakes.
