

## MHT CET 2023 Question Paper with Answers and Solution May 11 Shift 2 (Memory-based)

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**Question 1.** The value of  $\int (1 - \cos x) \operatorname{cosec}^2 x \, dx$  is?

**Answer.**  $\cos(x) + \sin(x) + \cot(\cos(x)) + C$

**Solution.** To evaluate the integral  $\int (1 - \cos x) \operatorname{cosec}^2(x) \, dx$ , we can simplify the integrand using trigonometric identities.

Recall that  $\operatorname{cosec}^2(x)$  is equal to  $1 + \cot^2(x)$ , where  $\cot(x)$  is the cotangent of  $x$ .

$$\int (1 - \cos x) \operatorname{cosec}^2(x) \, dx = \int (1 - \cos x) (1 + \cot^2(x)) \, dx$$

Expanding the expression:

$$= \int (1 - \cos x + \cot^2(x) - \cos x * \cot^2(x)) \, dx$$

Now, let's evaluate each term separately:

$$\int (1 - \cos x) \, dx = x - \sin(x) + C_1$$

$$\int \cot^2(x) \, dx \text{ can be integrated by using the formula } \int \cot^2(x) \, dx = -x - \cot(x) + C_2$$

$\int \cos x * \cot^2(x) \, dx$  can be integrated by substitution. Let's denote  $\cos(x)$  as  $u$ :

$$u = \cos(x) \quad du = -\sin(x) \, dx$$

Replacing  $dx$  and  $\cos(x)$  with  $du$  and  $u$ , respectively, we have:

$$\int u \cdot \cot^2(x) (-du/\sin(x)) = -\int u \cot^2(x) du = -\int \cot^2(x) du$$

Using the formula mentioned earlier, we know that  $\int \cot^2(x) dx = -x - \cot(x)$

+  $C_2$ . Hence, the integral of  $-\int \cot^2(x) du$  will be  $-(-u - \cot(u) + C_2) = u + \cot(u) - C_2$ .

Putting it all together, the integral becomes:

$$x - \sin(x) + C_1 + (-x - \cot(x) + C_2) + (\cos(x) + \cot(\cos(x)) -$$

$C_2)$  Simplifying:

$$= x - x + \cos(x) + \sin(x) + \cot(\cos(x)) + C_1 - C_2$$

The final result is  $\cos(x) + \sin(x) + \cot(\cos(x)) + C$ , where  $C = C_1 - C_2$  is the constant of integration.

**Question 2.** The function of  $f(x) = 2x^3 - 9x^2 + 12x + 29$  is monotonically increasing in the interval

- A.  $(-\infty, 1)$
- B.  $(-\infty, 1) \cup (2, \infty)$
- C.  $(-\infty, -\infty)$
- D.  $(2, \infty)$

**Answer.** B

**Solution.** To determine whether the function  $f(x) = 2x^3 - 9x^2 + 12x + 29$  is monotonically increasing in an interval, we need to analyze the first derivative of the function, which is given by:

$$f'(x) = 6x^2 - 18x + 12$$

To find the critical points of the function (where the derivative is equal to zero), we need to solve the equation  $f'(x) = 0$ :

$$6x^2 - 18x + 12 = 0$$

Dividing both sides by 6, we get:

$$x^2 - 3x + 2 = 0$$

Factoring the left-hand side, we get:

$$(x - 1)(x - 2) = 0$$

So the critical points are  $x = 1$  and  $x = 2$ .

Now we need to analyze the sign of the derivative in the different intervals: Interval  $(-\infty, 1)$ :

For  $x < 1$ , we can choose  $x = 0$  as a test point. Plugging this into the derivative, we get:

$$f'(0) = 6(0)^2 - 18(0) + 12 = 12$$

Since  $f'(0) > 0$ , the derivative is positive in the interval  $(-\infty, 1)$ . This means that the function is monotonically increasing in this interval.

Interval  $(1, 2)$ :

For  $1 < x < 2$ , we can choose  $x = 1.5$  as a test point. Plugging this into the derivative, we get:

$$f'(1.5) = 6(1.5)^2 - 18(1.5) + 12 = -3$$

Since  $f'(1.5) < 0$ , the derivative is negative in the interval  $(1, 2)$ . This means that the function is not monotonically increasing in this interval.

Interval  $(2, \infty)$ :

For  $x > 2$ , we can choose  $x = 3$  as a test point. Plugging this into the derivative, we get:

$$f'(3) = 6(3)^2 - 18(3) + 12 = 30$$

Since  $f'(3) > 0$ , the derivative is positive in the interval  $(2, \infty)$ . This means that the function is monotonically increasing in this interval.

Therefore, the function  $f(x) = 2x^3 - 9x^2 + 12x + 29$  is monotonically increasing in the interval  $(-\infty, 1) \cup (2, \infty)$ , which corresponds to option B.

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**Question 3.** The equation of the tangent to the curve  $y = \sqrt{9-2x^2}$ , at the point where the ordinates and abscissa are equal, is?

**Answer.**  $y > 0$

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**Question 4.** For all real  $x$ , the minimum value of function  $f(x) = 1 - x + \frac{x^2}{1 - x + x}$

A.  $\frac{1}{3}$

B. 0

C. 3

D. 1

**Answer.**  $\frac{1}{3}$

**Question 5.** The minimum value of function  $(1 - x + x^2) / (1 + x + x^2)$

- A.  $\frac{1}{3}$
- B. 0
- C. 3
- D. 1

**Answer.** A

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**Question 6.**  $\int \sin(\log x) dx$

- A.  $(x/2)[\sin(\log x) - \cos(\log x)]$
- B.  $\cos(\log x) - x$
- C.  $\int (x-1)e^x / (x+1)^3$
- D.  $-\cos \log x$

**Answer.** A

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**Question 7.** If the line  $(x - 1)/2 = (y+1)/3 = (z-2)/4 = \lambda$  meets the plane,  $x+2y+3z = 15$  at a point P, then the distance of P from the origin is?

- A.  $7/2$
- B.  $9/2$
- C.  $\sqrt{5}/2$
- D.  $2\sqrt{5}$

**Answer.** B

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**Question 8.** If  $\cos x + \cos y - \cos(x+y) = 3/2$  then,

**A.**  $x+y = 0$

**B.**  $x = 2y$

**C.**  $x = y$

**D.**  $2x = y$

**Answer.**

C

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**Question 9.** If the vertices of a triangle are  $(-2,3)$  ,  $(6,-1)$  and  $(4,3)$ , then the co-ordinates of the circumcentre of the triangle are?

**A.**  $(1,1)$

**B.**  $(-1,-1)$

**C.**  $(-1,1)$

**D.**  $(1,-1)$

**Answer.** D

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**Question 10.** If  $\cos^{-1}\sqrt{p} + \cos^{-1}\sqrt{(1-p)} + \cos^{-1}\sqrt{(1-a)} = 3\pi/4$ , then q is?

**A.**  $1/2$

**B.**  $1/\sqrt{2}$

**C.** 1

**D.**  $1/3$

**Answer. A**

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**Question 11. In  $\triangle ABC$   $b=\sqrt{3}$ ,  $c=1$  angle  $A = 30$ , then largest angle?**

**Answer. 120**

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**Question 12. If the area of the parallelogram with  $a$  and  $b$  as two adjacent sides 16 sq. units, then the area of the Parallelogram having  $3a+2b$  and  $a+3b$  as two adjacent sides in sq.units is**

**A. 96**

**B. 112**

**C. 144**

**D. 128**

**Answer. B**

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**Question 13.  $\frac{dy}{dx} + \frac{y}{x} = \sin x$**

**Answer.  $xy + \cos y - \sin x = c$**

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**Question 14.  $x=5/1-2i$ , value of  $x^3+x^2-x+2$**

**Answer.  $x^2-2x+1 = -4$**

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**Question 15. Equation of tangent to the curve  $y = \sqrt{9-2x^2}$  where  $x=y$ .**