IIITB COMET FOUNDATION

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Date: 21 Jan 2026

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CBSE Maths Questions 2016

14. Evaluate: $\int (3x+5)\sqrt{5+4x-2x^2}\,dx$

15. Solve the differential equation:

$$x\frac{dy}{dx} + y - x + xy\cot x = 0,\ x \neq 0.$$

16. Solve the differential equation:

$$(x^2 + 3xy + y^2)\,dx - x^2\,dy = 0$$

given that $y = 0$ when $x = 1$.

17. Find the angle between the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ if $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + \hat{j} - 2\hat{k}$. Also find a vector perpendicular to both.

18. Show that the lines

$$\frac{x-1}{3} = \frac{y-1}{-1} = \frac{z+1}{0} \quad \text{and} \quad \frac{x-4}{2} = \frac{y}{0} = \frac{z}{-3}$$

intersect. Find their point of intersection.

19. A committee of 4 students is selected from a group of 7 boys and 4 girls. Find the probability that the committee contains exactly 2 girls, given that at least one girl must be in the committee.

20. Show that the relation R defined by $(a,b)R(c,d) \Rightarrow a+d = b+c$ on the set $A \times A$, where $A = \{1, 2, 3, \ldots, 10\}$, is an equivalence relation. Hence write the equivalence class of (3,4).

21. Solve for x:

$$\begin{vmatrix} a+x & a-x & a \\ a-x & a+x & a-x \\ a & a-x & a+x \end{vmatrix} = 0$$

22. Show that the height of the cylinder of greatest volume inscribed in a right circular cone of height h and semi-vertical angle α is one-third of the height of the cone, and the greatest volume is

$$\frac{4}{27}\pi h^3 \tan^2 \alpha.$$

23. Using integration, find the area of the triangle formed by the negative x-axis and the tangent and normal to the circle $x^2+y^2 = 9$ at the point $(-1, 2\sqrt{2})$.

24. Find the coordinates of the foot of the perpendicular and the perpendicular distance from the point $P(4,3,2)$ to the plane $x + 2y + 3z = 2$. Also find the image of P in the plane.

25. A, B, and C throw a pair of dice alternately until one of them gets a total of 9 and wins the game. Find the probability that A wins, if A starts first.

26. A company manufactures two types of cardigans: type A and type B. Type A costs Rs.360 to make and sells for Rs.100 profit. Type B costs

Rs.120 to make and sells for Rs.50 profit. The company can produce at most 300 cardigans and spend at most Rs.72,000 a day. The number of B-type cardigans cannot exceed the number of A-type by more than 200. Formulate as a linear programming problem and find the maximum profit graphically.

Task 1

Problem 1

Solve:

$$x\frac{dy}{dx} + y - x + xy\cot x = 0$$

$$x\frac{dy}{dx} + y = x - xy\cot x \tag{1}$$

$$\frac{dy}{dx} + \frac{y}{x} = 1 - y\cot x \tag{2}$$

This is a linear differential equation.

Problem 2

Solve:

$$(x^2 + 3xy + y^2)\,dx - x^2\,dy = 0$$

Given $y(1) = 0$.

$$\frac{dy}{dx} = \frac{x^2 + 3xy + y^2}{x^2} \tag{3}$$

This equation is homogeneous. Using substitution $y = vx$ and applying the given condition gives the solution.

Problem 3

Find the angle between $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$.

$$\cos\theta = \frac{(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b})}{|\vec{a} + \vec{b}||\vec{a} - \vec{b}|} \tag{4}$$

$$= \frac{|\vec{a}|^2 - |\vec{b}|^2}{|\vec{a} + \vec{b}||\vec{a} - \vec{b}|} \tag{5}$$