# CBSE Maths Questions – 2016

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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 $(\mathbf{a} + \mathbf{b})$ and $(\mathbf{a} - \mathbf{b})$ if

$$\mathbf{a} = 2\hat{i} - \hat{j} + 3\hat{k}, \quad \mathbf{b} = 3\hat{i} + \hat{j} - 2\hat{k}$$

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 7 boys and 4 girls. Find the probability that the committee contains exactly 2 girls, given that at least one girl is in the committee.

20. Show that the relation $R$ defined by

$$(a, b)R(c, d) \Rightarrow a + d = b + c$$

on $A \times A$, 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 $\alpha$ is $\frac{h}{3}$. Hence find the greatest volume:

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

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 foot of the perpendicular and the perpendicular distance from $P(4, 3, 2)$ 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 gets a total of 9. Find the probability that A wins, if A starts first.

26. A company manufactures two types of cardigans. Formulate the LPP and find the maximum profit graphically.

# Task 1

## Problem 1

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

**Solution:**

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

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

## Problem 2

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

Given $y(1) = 0$.

**Solution:**

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

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

## Problem 3

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

**Solution:**

$$\cos\theta = \frac{(\mathbf{a} + \mathbf{b}) \cdot (\mathbf{a} - \mathbf{b})}{\|\mathbf{a} + \mathbf{b}\| \, \|\mathbf{a} - \mathbf{b}\|} = \frac{\|\mathbf{a}\|^2 - \|\mathbf{b}\|^2}{\|\mathbf{a} + \mathbf{b}\| \, \|\mathbf{a} - \mathbf{b}\|}$$