

- 1 a) i) If $x = 1 + \log_a bc$, $y = 1 + \log_b ca$ and $z = 1 + \log_c ab$. Prove that $xyz = xy + yz + zx$.
- ii) In a triangle ABC, prove that $\sin^2 A + \sin^2 B - \sin^2 C = 4 \cos A \cos B \sin C$.
- OR**
- b) i) If $\tan \alpha = \frac{1}{3}$ and $\tan \beta = \frac{1}{7}$ then show that $\tan(2\alpha + \beta) = 1$.
- ii) If $a^x = b^y = c^z$ and $y^2 = z^x$. Prove that $\log_b a = \log_c b$.
- 2 a) i) Find the derivative of $\cot x$ using first principle.
- ii) Show that the function is not differentiable at 2 where $f(x) = \begin{cases} x & 0 \leq x \leq 2 \\ 2 & x \geq 2 \end{cases}$
- OR**
- b) i) Find the maximum and minimum values of the polynomial $f(x) = x^3 - 6x^2 + 9x + 15$.
- ii) If $u = \log \frac{x^2 + y^2}{x + y}$ prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 1$
- 3 a) i) Evaluate $\int \frac{1}{3 + 5x - 2x^2} dx$
- ii) Evaluate $\int e^x \sqrt{1 + e^x} dx$
- OR**
- b) i) Evaluate $\int \frac{1}{4 + 5 \cos x} dx$
- ii) $\int \frac{3x + 7}{3x^2 + 14x - 6} dx$
- 4 a) i) Show that $\begin{vmatrix} bc & b+c & 1 \\ ca & c+a & 1 \\ ab & a+b & 1 \end{vmatrix} = (a-b)(b-c)(c-a)$
- ii) Solve the equations $3x + 4y + 5z = 18$, $2x - y + 8z = 13$ and $5x - 2y + 7z = 20$ by matrix inversion method.
- OR**
- b) i) Find the rank of the matrix $A = \begin{bmatrix} 1 & 0 & -4 \\ 2 & -1 & 3 \end{bmatrix}$

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Show that $P(Q + R) = PQ + PR$.

- 5 a) i) Find the equation of the circle passing through the points (1, 2), (3, -4) and (5, -6).
ii) Find the equation of the line having intercepts a and b on the axes such that $a + b = 5$ and $ab = 6$.

OR

- b) i) Find the equation of the line passing through the point (2, -3) and having intercepts whose ratio is 3 : 2.
ii) Find the centre and radius of the circle $3x^2 + 3y^2 + 6x - 12y - 1 = 0$.
