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DMC

The number of attempts made in three villages X, Y, and Z are given below:

	(i)	(ii)	(iii)
X	400	300	100
Y	300	250	75
Z	500	400	150

Find the total cost incurred by the organization for the three villages separately, using matrices.

Write one value generated by the organization in the society. *4 marks*

Q.8. Solve for x : *4 marks*

$$\tan^{-1}(x + 1) + \tan^{-1}(x - 1) = \tan^{-1} \frac{8}{31}$$

OR

Prove the following:

$$\cot^{-1} \left(\frac{xy + 1}{xy - 1} \right) + \cot^{-1} \left(\frac{yz + 1}{y - z} \right) + \cot^{-1} \left(\frac{zx + 1}{z - x} \right) = 0$$

$(0 < xy, yz, zx < 1)$

Q.9. Using properties of determinants, prove the following: *4 marks*

$$\begin{vmatrix} a^2 & bc & ac + c^2 \\ a^2 + ab & b^2 & ac \\ ab & b^2 & c^2 \end{vmatrix} = 4a^2b^2c^2$$

Q.10. Find the adjoint of the matrix *4 marks*

$$A = \begin{pmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{pmatrix}$$

$$A. (\text{adj } A) = |A|I_3.$$

Q.11. Show that the function $f(x) = |x - 1| + |x + 1|$, for all $x \in \mathbb{R}$, is not differentiable at the points $x = -1$ and $x = 1$. *4 marks*

Q.12. If $y = e^{m \sin^{-1} x}$, then show that: *4 marks*

$$(1 - x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} - m^2y = 0.$$

Q.13. If $f(x) = \sqrt{x^2 + 1}$; $g(x) = \frac{x+1}{x^2+1}$ and $h(x) = 2x - 3$, then find $f'[h\{g'(x)\}]$. *4 Marks*

Q.14. Evaluate: 4 marks

$$\int (3 - 2x) \cdot \sqrt{2 + x - x^2} dx$$

OR

Evaluate:

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

Q.15. Find: 4 marks

$$\int_0^{\pi/4} \frac{dx}{\cos^3 x \sqrt{2} \sin 2x}$$

Q.16. Find: 4 marks

$$\int \frac{\log x}{(x + 1)^2} dx$$

Q.17. If $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} + \hat{j}$ and $\vec{c} = 3\hat{i} - 4\hat{j} - 5\hat{k}$, then find a unit vector perpendicular to both of the vectors $(\vec{a} - \vec{b})$ and $(\vec{c} - \vec{b})$. 4 marks

Q.18. Find the equation of a line passing through the point (1, 2, -4) and perpendicular to two lines. 4 marks

$$\vec{r} = (8\hat{i} - 19\hat{j} + 10\hat{k}) + \lambda(3\hat{i} - 16\hat{j} + 7\hat{k}) \text{ and } \vec{r} = (15\hat{i} + 29\hat{j} + 5\hat{k}) + \mu(3\hat{i} + 8\hat{j} - 5\hat{k}).$$

OR

Find the equation of the plane passing through the points (-1, 2, 0), (2, 2, -1) and parallel to the line $\frac{x-1}{1} = \frac{2y+1}{2} = \frac{z+1}{-1}$

Q.19. Three cards are drawn successively with replacement from a well shuffled pack of 53 cards. Find the probability distribution of the number of spades. Hence find the mean of the distribution. 4 marks

OR

For 6 trials of an experiment, let X be a binomial variate which satisfies the relation $9P(X = 4) = P(X = 2)$. Find the probability of success.

SECTION – C

Question number 20 to 26 carry 6 marks each.

Q.20. Consider $f: \mathbb{R}_+^{\rightarrow}[-9\infty]$ give by $f(x)5x^2 + 6x - 9$. Prove that f is invertible with: 6 marks

$$f^{-1}(y) = \left(\frac{\sqrt{54 + 5y} - 3}{5} \right)$$

OR

A binary operation $*$ is defined on the set $X = \mathbb{R} - \{-1\}$ by $x * y = x + y + xy, \forall x, y \in X$. Check whether $*$ is commutative and associative. Find its identity element and also find the inverse of each element of X .

Q.21. Find the value of p for which the curves $x^2 = 9p(9 - y)$ and $x^2 = p(y + 1)$ cut each other at right angles. 6 marks

Q.22. Using integration, prove that the curves $y^2 = 4x$ and $x^2 = 4y$ divide the area of the square bounded by $x = 0, x = 4, y = 4$, and $y = 0$ into three equal parts. 6 marks

Q.23. Show that the differential equation

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

is homogeneous and also solve it. 6 marks

OR

Find the particular solution of the differential equation $(\tan^{-1}y - x)dy = (1 + y^2)dx$, given that $x = 1$ when $y = 0$.

Q.24. Find the distance of the point P(3, 4, 4) from the point, where the line joining the points A(3, -4, -5) and B(2, -3, 1) intersects the plane $2x + y + z = 7$. 6 marks

Q. 25. A company manufactures three kinds of calculators: A, B and C in its two factories I and II. The company has got an order for manufacturing at least 6400 calculators of kind C. The daily output of factory I is of 50 calculators of kind A, 50 calculators of kind B and 30 calculators of kind C, The daily output of factory II is of 40 calculators of kind A, 20 of kind B and 40 of kind C. The cost per day to run factory I is Rs 12,000 and of factory II is Rs 15,000. How many days do the two factory have to be in operation to produce the order with the minimum cost ? formulate this problem as an LPP and solve it graphically. 6 marks

Q. 26. In a factory which manufactures bolts, machines A, B and C manufacture respectively 30%, 50% and 20% of the bolts. Of their outputs 3, 4 and 1 percent respectively are defective bolts. A bolt is drawn at random from the product and is found to be defective. find the probability that this is not manufactured by machine B 6 marks

