## SECTION - A $10 \times 2 = 20$

### VERY SHORT ANSWER TYPE QUESTIONS

**Answer All questions. Each question carries 2 marks.**

1. If $f: R \to R, g: R \to R$ are defined by $f(x) = 3x - 2$ and $g(x) = x^2 + 1$, then find $(g \circ f^{-1})(2)$.
2. Find domain of the function $\sqrt{4x - x^2}$.
3. Let $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ and $\mathbf{b} = 3\mathbf{i} + \mathbf{j}$. Find the unit vector in the direction of $\mathbf{a} + \mathbf{b}$.
4. Show that the vectors $\mathbf{i} + \mathbf{j}, \mathbf{j} + \mathbf{k}, -\mathbf{k} + \mathbf{i}$ are linearly dependent.
5. If $\mathbf{a} = \mathbf{i} + \mathbf{j} + \mathbf{k}$ and $\mathbf{b} = 2\mathbf{i} + 3\mathbf{j} + \mathbf{k}$, find the length of the projection of $\mathbf{b}$ on $\mathbf{a}$ and the length of the projection of $\mathbf{a}$ on $\mathbf{b}$.
6. If $\tan 20° = \lambda$, prove that $\dfrac{\tan 160° - \tan 110°}{1 + \tan 160° \cdot \tan 110°} = \dfrac{1 - \lambda^2}{2\lambda}$.
7. Find the maximum and minimum values of $\sin x \ \sin(60° + x) \ \sin(60° - x)$.
8. If $\cosh x = 5/2$, find the value of $\cosh 2x$ and $\sinh 2x$.
9. In $\Delta ABC$, express $\Sigma r_1 \cot(A/2)$ in terms of '$s$'.
10. If the amplitude of $\left(\dfrac{z-2}{z-6i}\right)$ is $\dfrac{\pi}{2}$, find the equation of locus of $z$.

## SECTION - B $5 \times 4 = 20$

### SHORT ANSWER TYPE QUESTIONS

**Attempt any 5 questions. Each question carries 4 marks.**

11. Find the vector equation of the plane passing through the points $4\mathbf{i} - 3\mathbf{j} - \mathbf{k}$, $3\mathbf{i} + 7\mathbf{j} - 10\mathbf{k}$, $2\mathbf{i} + 5\mathbf{j} - 7\mathbf{k}$. Show that the point $\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$ lies in this plane.
12. If $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$, $\mathbf{b} = \mathbf{i} + \mathbf{j} - \mathbf{k}$ and $\mathbf{c} = \mathbf{i} - \mathbf{j} + \mathbf{k}$, compute $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$ and verify that it is perpendicular to $\mathbf{a}$.
13. If $\cos\theta > 0$, $\tan\theta + \sin\theta = m$, $\tan\theta - \sin\theta = n$ then show that $m^2 - n^2 = 4\sqrt{mn}$.
14. If $\tan\left(\dfrac{\pi}{2}\sin\theta\right) = \cot\left(\dfrac{\pi}{2}\cos\theta\right)$, then show that $\sin\left(\theta + \dfrac{\pi}{4}\right) = \pm\dfrac{1}{\sqrt{2}}$.

15. Show that $Tan^{-1}\frac{1}{8}+Tan^{-1}\frac{1}{2}+Tan^{-1}\frac{1}{5}=\frac{\pi}{4}$.

16. Show that $a^3\cos(B-C)+b^3\cos(C-A)+c^3\cos(A-B)=3abc$.

17. Show that $\sin^7\theta=\frac{1}{64}[35\sin\theta-21\sin 3\theta+7\sin 5\theta-\sin 7\theta]$.

## SECTION - C

**5 × 7 = 35**

### LONG ANSWER TYPE QUESTIONS

**Attempt any 5 questions. Each question carries 7 marks.**

18. Let $f: A\to B$ and $g: B\to C$ be bijections. Prove that $gof: A\to C$ is also a bijection.

19. Using the principles of Mathematical Induction, prove that

$$2\cdot3+3\cdot4+4\cdot5+\ldots \text{ upto } n \text{ terms}=\frac{n(n^2+6n+11)}{3}, \text{ for all } n\in N.$$

20. If **a**, **b**, **c** are three unit vectors such that $\mathbf{a}\times(\mathbf{b}\times\mathbf{c})=\frac{1}{2}\mathbf{b}$ then show that $(\mathbf{a},\mathbf{b})=90^\circ$, $(\mathbf{a},\mathbf{c})=60^\circ$.

21. If $A+B+C=180^\circ$, prove that $\cos A+\cos B-\cos C=-1+4\cos\frac{A}{2}\cos\frac{B}{2}\sin\frac{C}{2}$.

22. In $\Delta ABC$, prove that $r+r_1+r_2-r_3=4R\cos C$.

23. From the top of a tree on the bank of a lake, an aeroplane in the sky makes an angle of elevation $\alpha$ and its image in the river makes an angle of depression $\beta$. If the height of the tree from the water surface is '$a$' and that of the height of the aeroplane is '$h$', show that $h=\frac{a\sin(\alpha+\beta)}{\sin(\beta-\alpha)}$.

24. Solve the equation $x^4+1=0$