1. If vectors $\left(\mathbf{a} = 4\hat{i} - \hat{j} + \hat{k}\right)$ and $\left(\mathbf{b} = 2\hat{i} - 2\hat{j} + \hat{k}\right)$, thenfind a unit vector parallel to the vector $(\mathbf{a} + \mathbf{b})$.

2. Find λ and μ if $\left(\hat{i} + 3\hat{j} + 9\hat{k}) \cdot (3\hat{i} - \lambda\hat{j} - \mu\hat{k}\right) = \vec{0}$

3. write the sum of intercepts cut of by the plane $\vec{r}.\left(2\hat{i} + \hat{j} - \hat{k}\right) - 5 = 0$ on the three axes

4. For what values of k the system of linear equations
   $x + y + z = 2$
   $2x + y - z = 3$
   $3x + 2y + kz = 4$
   has a unique solution

5. If A is a 3×3 matrix and $\left|3A\right| = \left|kA\right|$ then write the value of k

6. $A=\begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$,find α satisfying $0<\alpha<\frac{\pi}{2}$when $A + A^T = \sqrt{2}I_2$;where A^T is transpose of A.

7. A bag X contains 4 white balls and 2 black blls,while another bag Y contains 3 white balls and 3 black balls.Two balls are drawn(without replacement) at random from one of the bags and were found to be one white and one black.Find the probability that the balls were drawn from bag Y

8. A and B throw a pair of dice alternately,till one of them gets a total of 10 and wins the game.Find their respective probabilities of winning,if A starts first

9. Show that the four points $A(4, 5, 1)$,$(0, -1, -1)$,$C(3, 9, 4)$ and $D(-4, 4, 4)$ are coplanar

10. Find the coordinates of the foot of perpendicular drawn from the point $A(-1, 8, 4)$ to the line joining the points $B(0, -1, 3)$ and $C(2, -3, -1)$.Hence find the image of the point A in the line BC

11. Find the particular solution of the differential equation $2ye^{\frac{x}{y}}dx+\left(y - 2xe^{\frac{x}{y}}\right)dy = 0$
    given that $x = 0$ when $y = 0$

12. Find the particular solution of differential equation: $\frac{dy}{dx} = -\frac{x+y\cos x}{1+\sin x}$ given that $y = 1$ when $x = 0$

13. Find: $\int \frac{(x-5)e^{2x}}{(2x-3)^3}, dx.$

14. Find: $\int \frac{x^2+x+1}{(x^2+1)x+2} dx$

15. Find: $\int (x+3)\sqrt{3-4x-x^2} dx$

16. Find the equation of tangents to th curve $y = x^3+2x-4$, which are perpendicular to line $x + 14y + 3 = 0$.

17. If $x\cos a + y = \cos y$ then prove that $\frac{dy}{dx} = \left[\frac{\cos^2(a+y)}{sina}\right]$
hence show that $\sin a\frac{d^2y}{dx^2} + \sin 2(a+y)\frac{dy}{dx} = 0$

18. Find $\frac{dy}{dx}$ if $y = \sin^{-1}\left[\frac{6x-4\sqrt{1-4x^2}}{5}\right]$

19. Evaluate: $\int_{-2}^{2} \frac{x^2}{1+5^x} dx.$

20. If $f(x) = \begin{cases} \frac{\sin(a+1)x+2sinx}{x}, & x < 0 \\ 2, & x = 0 \\ \frac{\sqrt{1+bx}-1}{x}, & x > 0 \end{cases}$ is continuous at $x = 0$, then find the values of a and b.

21. A typist charges₹145 for typing 10 English and 3 Hindi pages, while charges for typing 3 English and 10 Hindi pages are ₹180 using matrices, find the charges of typing one English and one Hindi page separately. However typist charged only ₹2 per page from a poor student Shyam for 5 Hindi pages. How much les was charged from this poor boy? which values are reflected in this problem?

22. Slove for $x : \tan^{-1}(x-1) + \tan^{-1}x + \tan^{-1}(x+1) = \tan^{-1}3x.$

23. Prove that $\tan^{-1}\left[\frac{6x-8x^3}{1-12x^2}\right] - \tan^{-1}\left[\frac{4x}{1-4x^2}\right] = \tan^{-1}2x; |2x| < \frac{1}{\sqrt{3}}$

24. Using the method of integration, find the area of the triangular region whose vertices are $(2,-2), (4,3)$ and $(1,2)$.

25. Using properties of determinants, prove that $\begin{vmatrix} (x+y)^2 & zx & zy \\ zx & (z+y)^2 & xy \\ zy & xy & (z+x)^2 \end{vmatrix} = 2xyz\,(x+y+z)^3$

26. If $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$.and $A^3 - 6A^2 + 7A + kI_3 = 0$ find K.

27. A retired person wants to invest an amount of ₹50,000.his broker recommands investing in two type of bonds 'A' and 'B' yielding 10% and 9% return respectively on the invested amount.He decides to invest at least₹20,000. in bond $'A'$ and at least ₹10,000. in bond $'B'$.He also wants to inverst at least as much in bond $'A'$ as in bond$'B'$.Slove this linear programming problem graphically to maximise his retuns.

28. Find the equation of the plane which contains the line of intersection of the planes
$\vec{r}.\left(\hat{i} - 2\hat{j} + 3\hat{k}\right) - 4 = 0$ and
$\vec{r}.\left(-2\hat{i} = \hat{j} + \hat{k}\right) + 5 = 0$
and whose intercept on x-axis is equal to that of on y-axis.

29. Prove that $y = \frac{4\sin\theta}{2+\cos\theta} - \theta$ is an increasing function of θ on $\left[0, \frac{\pi}{2}\right]$.

30. show thatnsemi-vertical angle of cone of maximum volume and given slant height is $\cos^{-1}(\frac{1}{\sqrt{3}})$.

31. Let $A = R \times R$ and* be a binary operation on A defined by
$(a, b * c, d) = (a + c, b + d)$
Show that * is commutative and associative.Find the identity element for * on A.Also find the inverse of every element $(a, b)\, \epsilon A$.

32. Three numbers are selected at randomm (without replacement)from first six positive integers.Let X denote the largest of the three numbers obtained.Find he probability distribution of X. Also, find the mean and variance of the distribution.