1) Find the area of the region by the curve $y = \frac{1}{x}$, x-axis and between x = 1, x = 4.

2) The Cartesian equation of a line AB is $\frac{2x-1}{\sqrt{3}} = \frac{y+2}{2} \frac{z-3}{3}$. Find the direction cosines of a line parallel to AB.

3) Write the vector equation of the following line: $\frac{x-5}{3} = \frac{y+4}{7} = \frac{6-z}{2}$

4) Find the value of x, y, z if
$\begin{bmatrix} 2x+y & x-y \\ x-z & x+y+z \end{bmatrix} = \begin{bmatrix} 10 & -1 \\ 2 & 8 \end{bmatrix}$

5) If $A = \begin{bmatrix} 1 & 4 \\ 3 & 2 \\ 2 & 1 \end{bmatrix} B = \begin{bmatrix} 5 & 2 \\ -1 & 0 \\ 1 & 1 \end{bmatrix}$, then find the matrix X for which A + B - X = 0.

6) Find the value of X and Y if
$X+Y = \begin{bmatrix} 2 & 3 \\ 5 & 1 \end{bmatrix}, X-Y = \begin{bmatrix} 6 & 5 \\ 7 & 3 \end{bmatrix}$

7) If $A = \begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} -1 & 4 \\ 0 & 2 \end{bmatrix}$, show that $AB \neq BA$.

8) Define Reflexive.Give one example.

9) Define symmetric Relation.Give one example

10) Define Transitive Relation. Give one example.

11) How many equivalence relations on the set {1,2, 3} containing (I, 2) and (2, 1) are there in all ? Justify your answer.

12) If is $A = \begin{bmatrix} 0 & b & -2 \\ 3 & 1 & 3 \\ 2a & 3 & -1 \end{bmatrix}$ skew symmetric matrix, find the values of a and b.

13) If $A = \begin{bmatrix} 0 & x & -4 \\ -2 & 0 & -1 \\ y & -1 & 0 \end{bmatrix}$ is skew symmetric matrix, find the values of x and y.

14) Find $\frac{1}{2}(A+A')$ and $\frac{1}{2}(A-A')$. If $A = \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$

15) $\int sin2xcos3xdx$

16) $\int \frac{dx}{1+sinx}$

17) $\int sin^2xdx$

18) $\int \frac{dx}{1+e^x}$

19) $\int \frac{dx}{e^x+e^{-x}}$

20) $\int \frac{sec^2(logx)}{x}dx$

21) Prove the following by the principle of mathematical induction :
if $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, then $A^n = \begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$ for every positive integer n.

22) $\int \frac{cosx}{cos(x+\alpha)}dx$

23) $\int \frac{sin2x}{sin5xsin3x}dx$

24) $\int e^x \left(\frac{1}{x} - \frac{1}{x^2}\right)dx$

25) $\int e^x \left[cotx + logsinx\right] dx$

26) Find: $\int \left(\frac{1-x}{1+x^2}\right)^2 e^x dx$

27) From the differential equation of equation y = a cos2x + b sin2x, where a and b are constant.

28) Solve the differential equation $\frac{dy}{dx} = xy + x + y + 1$

29) Solve the differential equations
$\frac{dy}{dx} = \frac{1+\cos 2y}{1+\cos 2x}$

30) Find the general solution of differential equation $\frac{dy}{dx} = e^{3x-4y}$

31) Find the general solution of differential equation $\log\left(\frac{dy}{dx}\right) = x+1$

32) Find the unit vector in the direction of $\vec{a}+\vec{b}$ if $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$, and $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$

33) Find the position vector of c which divides the line segment joining A & B whose position vectors are $3\vec{a}+\vec{b}$ and $\vec{a}-3\vec{b}$ internally in the ratio 2:3.

34) One card is drawn is drawn from a pack of 52 cards. Find the probability of getting :
(a) a red card
(b) a jack of hearts
(c) a black face card
(d) a king.

35) If E and F are two events such that $P(E)=\frac{1}{4}$, $P(E)=\frac{1}{2}$ and $P(E\cap F)=\frac{1}{8}$, find
(a) P(E or F)
(b) P(not E and not F).

36) If P(E) = $\frac{6}{11}$, P(F) = $\frac{5}{11}$ and P(E∪ F)= $\frac{7}{11}$ then find (a) P(E/F), (b) P(F/E)

37) If P(E) = $\frac{7}{13}$,P(F)= $\frac{9}{13}$ and P(E∩ F)= $\frac{4}{13}$,then evaluate :
(a) $P(\overline{E}/F)$
(b) $P(\overline{E}/F)$

38) A coin is tossed three times. Find P(F/E), where
E: at most two tails and F: atleast one tail.

39) A couple has 2 children. Find the probability that both are boys, if it is known that (a) one of them is a boy (b) the older child is boys.

40) If P(A)= $\frac{2}{5}$, $P(B)=\frac{1}{3}$, $P(A\cap B)=\frac{1}{5}$, then find $P(\bar{A}/\bar{B})$.

41) Find the projection of $\vec{a}+\vec{b}$ on $\vec{a}-\vec{b}$,
$\vec{a}=i+2j+k, \vec{b}=3\hat{i}+\hat{j}-\hat{k}$.

42) If two vectors $\vec{a}$ and $\vec{b}$ are such that $|\vec{a}|=3, |\vec{b}|=1$ and $\vec{a}.\vec{b}=2$.
Find $(2\vec{a}-3\vec{b}).(3\vec{a}+\vec{b})$.

43) If y = log(sin x), find $\frac{d^2y}{dx^2}$

44) Find the angle between the lines
$\vec{r}=(2i-5j+k)+l(i+j+3k)$ and
$\vec{r}=(i-j-k)+\mu(2i-3j+k)$

45) Find the cartesian and vector equation of the line which passes through the point (- 2, 4, - 5) and parallel to the line given by $\frac{x+3}{3}=\frac{y-4}{5}=\frac{x-z}{-6}$

46) If x = $\frac{at}{1+t^2}, y=\frac{at^2}{1+t^2}, find \frac{dy}{dx} at$ t = 2

47) If y = $log\left(tanx\frac{x}{2}\right) find \frac{dy}{dx}$

48) Find $\left|\vec{a}\times\vec{b}\right|$, if $\vec{a}=\hat{i}+2\hat{j}-\hat{k}, \vec{b}=3\hat{i}+\hat{j}-\hat{k}$

49) Find the angle between line $\frac{x-1}{6}=\frac{y+3}{2}=\frac{z-2}{3}$ and the plane 2x - Y + 2z - 13 = 0.

50) Find $\left|\vec{a}\times\vec{b}\right|$ if $|\vec{a}|=10, \left|\vec{b}\right|=2$ and $\vec{a}.\vec{b}=12$.

51) Evaluate : $\int_0^{\frac{\pi}{2}} cos^2x dx$

52) Evaluate : $\int_2^8 |x-5| dx$

53) Evaluate : $\int_0^1 xe^x dx$

54) Evaluate : $\int_a^b \frac{logx}{x} dx$

55) Evaluate : $\int_0^{\frac{\pi}{2}} \frac{dx}{1+\sqrt{tanx}}$

56) Give an example of a relation, which is symmetric but neither reflexive nor transitive.

57) Give an example of a relation, which is reflexive and symmetric but not transitive.

58) Give an example of a relation, which is reflexive and transitive but not symmetric.

59) Give an example of a relation, which is symmetric and transitive but not reflexive.

60) Let A= {0, 1,2, 3} and define a relation R on A as R ={(0,0), (0,1), (0, 3), (1,0), (1,1),(2,2),(3,0),(3, 3)}. is R reflexive, symmetric and transitive?

61) Find the value of $\tan^{-1}(\sqrt{3}) - \sec^{-1}(-2)$

62) Find the value of $\cot\left(\frac{\pi}{2} - 2\cot^{-1}\sqrt{3}\right)$.

63) Find the value of $\sin^{-1}\left[\cos\left(\frac{33\pi}{5}\right)\right]$

64) Find the value of $2\sec^{-1}2 + \sin^{-1}\left(\frac{1}{2}\right)$

65) Find the values of a, b, c and d, if $\begin{bmatrix} a+b+c+d \\ a+c-d \\ b-c+d \\ a+d \end{bmatrix} = \begin{bmatrix} 4 \\ 1 \\ 1 \\ 2 \end{bmatrix}$

66) Find X and Y, if $2x+3y = \begin{bmatrix} 2 & 3 \\ 4 & 0 \end{bmatrix}$ $and\ 3x+2y = \begin{bmatrix} 2 & -2 \\ -1 & 5 \end{bmatrix}$

67) If $\begin{bmatrix} 2x & 3 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ -3 & 0 \end{bmatrix} \begin{bmatrix} x \\ 8 \end{bmatrix} = 0$ then find the value of x.

68) If $\begin{bmatrix} x+3 & z+4 & 2y-7 \\ -6 & a-1 & 0 \\ b-3 & -21 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 6 & 3y-2 \\ -6 & -3 & 2c+2 \\ 2b+4 & -21 & 0 \end{bmatrix}$ then find the values of a, b, c and z.

69) Find the symmetric and skew-symmetric matrices of matrix matrices of matrix

$$A = \begin{bmatrix} 0 & -2 & 4 \\ 2 & 0 & -1 \\ -4 & 1 & 0 \end{bmatrix}$$

70) If area of a triangle is 35 sq units with vertices (2,- 6), (5,4) and (k, 4), then find the values of k.

71) Given $A = \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$,compute $A^{-1}$and show that $2A^{-1}$ = 91 - A

72) Find A^{-1},if $A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ and show that $A^{-1} = \frac{A^2-3I}{2}$

73) Examine the consistency of the system of equations

3x - y - 2z = 2,

2y - z = -1 and

3x - 5y = 3.

74) Is the functionfdefined by $f(x)=\begin{cases} x, & \text{if } x\le 1 \\ 5, & \text{if } x>1 \end{cases}$ continuous at x = 0, at x = 1and at x = 2?

75) Examine that sin lxI is a continuous function.

76) Find the value of k for which the function

$f(x)=\begin{cases} \dfrac{x^2+3x-10}{x-2}, x\neq 2 \\ k, x=2 \end{cases}$ is continuous at x =2 .

77) If the function $f(x)=\begin{cases} \frac{\sin x}{x}+\cos x, & \text{if } x\neq 0 \\ k, & \text{if } x=0 \end{cases}$ is continuous at x= 0, then find the value of k.

78) Find the value of a, so that the function f(x) is defined by

$f(x)=\begin{cases} \dfrac{\sin^2 ax}{x^2}, x\neq 0 \\ 1, x=0 \end{cases}$ may be continuous at

79) Find the value of p for which the function

$f(x)=\begin{cases} \frac{1-\cos 4x}{x^2}, x\neq 0 \\ p, x=0 \end{cases}$ is continuous at x = 0

80) Evaluate the left hand and right hand limits of the following function at x = 2.$f(x)=\begin{cases} 2x+3, & \text{if } x\le 2 \\ x+5, & \text{if } x>2 \end{cases}$

Does lim f(x) exist?

81) Find the value of $\lim_{x\to 3}\frac{x^2+2x-15}{x-3}$

82) Find the relationship between a and b so that the function f defined by

f $f(x)=\begin{cases} ax+1, \text{ if } x\le 3 \\ bx+3, \text{ if } x>3 \end{cases}$ is continuous at x = 3.

83) If y = x tan x + sec x, then find the value of $\frac{dy}{dx}$ at $x=\frac{\pi}{4}$.

84) Differentiate a^X w.r.t. x, where a is a positive constant.

85) Differentiate $(\sin x)^{\log x}$ w.r.t. x

86) If $x=a\sec^3\theta$ and $y=a\tan^3\theta$, then find $\frac{dy}{dx}$ $\theta=\frac{\pi}{3}$

87) If $x=t+\frac{1}{t}$ and $y=t-\frac{1}{t}$, then find $\frac{dy}{dx}$

88) Find $\frac{dy}{dy}$, if $x=a\log t$ and $y=b\sin t$.

89) Differentiate $\sin^2 x$ w.r.t. $e^{\cos x}$

90) Differentiate $(\sin x)^{\log x}$ w.r.t. sin x.

91) If y = A sin x + B cos x, then prove that $\frac{d^2y}{dx^2}+y=0$

92) For the curve y = 5x - 2x^3, if x increase at therate of 2 units/s, then find the rate of change of the slope of curve changing when x = 3.

93) Show that the functionfgiven by $f(x)=x^3-3x^2+4x, x\in R$ is strictly increasing on R.

94) Show that the function $f(x)=\tan x-x$ is always increasing in $x\in R$.

95) Show that the function f given by
$f(x)=\tan^{-1}(\sin x+\cos x), x>0$,is always an strictly increasing function in $\left(0,\frac{\pi}{4}\right)$.

96) Find the equation of normal to the curve
$y=x^3+5x^2+2$ at $(1,-1)$

97) Evaluate the following integral.
$\int\frac{x^3-x^2+x-1}{x-1}dx$

98) Evaluate the following integral.
$\int\left(e^{x\log a}+e^{a\log x}+e^{a\log a}\right)dx$

99) Evaluate the following integral
$\int\frac{(x+1)(x+\log x)^2}{x}dx$

100) Evaluate the following integral.
$\int\frac{x^3\sin(\tan^{-1}x^4)}{1+x^8}dx$

101) Evaluate the following integral
$\int\frac{\cos 2x}{(\sin x+\cos x)^2}dx$

102) Evaluate $\int_0^{\pi/2}\frac{\tan^7 x}{\cot^7 x+\tan^7 x}dx$

103) Evaluate $\int_0^{\pi/2}\frac{\sin^{3/2}x}{\sin^{3/2}x+\cos^{3/2}x}dx$

104) Prove that $\int_{-1}^{1}\log\left(\frac{2-x}{2+x}\right)dx=0$

105) Verify that the function $y=\sqrt{a^2-x^2}, x\in(-a,a)$ is a solution of differential equation $x+y\frac{dy}{dx}=0(y\neq 0)$.

106) Form the differential equation representing the family of curves $y=a\sin(x+b)$,where a, b are arbitrary constants.

107) Find the general solution of the following differential equation.
$\frac{dy}{dx}=\frac{1-\cos x}{1+\cos x}$

108) Find the general solution of the following differential equation.
$\frac{dy}{dx}=\sin^{-1}x$

109) Find the general solution of the following differential equation.
$\frac{dy}{dx}=1-x+y-xy$

110) Find the general solution of the following differential equation.
$y \log y dx - x dy = 0$

111) Find the general solution of the following differential equation.
$\sec^2 x \tan y dx + \sec^2 y \tan x dy = 0$

112) Find the general solution of the following differential equation.
$\log\left(\frac{dy}{dx}\right) = 3x + 4y$

113) Solve $\frac{dy}{dx} + y = \cos x - \sin x$

114) Solve $\frac{dy}{dx} + 2xy = y$

115) If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}, \vec{b} = \hat{i} + \hat{j} - 2\hat{k}$ and
$\vec{c} = \hat{i} + 3\hat{j} - \hat{k}$ then find λ

116) Given $|\vec{a}| = 10, |\vec{b}| = 2$ and $\vec{a} \cdot \vec{b} = 12,$ find $|\vec{a} \times \vec{b}|$

117) Find the vector equation of the line which is parallel to the vector
$3\hat{i} - 2\hat{j} + 6\hat{k}$ and which passes through the point (1, - 2, 3).

118) Find the cartesian equation of line that passing. through the points
$(1, -1, 3)$ and $(3, 4, -2)$.

119) Find the vector equation of the line passing through the point A(1, 2,-1)and parallel to the line 5x-25 = 14-7y = 35z.

120) Determine the direction cosines of the normal to the plane x + y + z = 1and the distance from the origin.

121) Find the vector and cartesian equation of the planes that passes through the point (1,0, - 2) and the normal to the plane is $\hat{i} + \hat{j} - \hat{k}$.

122) Find the equation of the line passing through the point (3, 0,1) and parallel to the plane x + 2y = 0 and 3y - z = 0.

123) Find the coordinates of the point, where the line
$\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{2}$ mtersects the plane x- y+z-5=0. Also, find the angle between the line and the plane.

124) Evaluate $P(A \cup B)$, if $2P(A) = P(B) = \frac{5}{13}$ and $P\left(\frac{A}{B}\right) = \frac{2}{5}$.

125) Three events A, Band Chave probabilities $\frac{2}{5}, \frac{1}{3}$ and $\frac{1}{2}$,respectively,If
$P(A \cap C) = \frac{1}{5}$ and $P(B \cap C) = \frac{1}{4}$ then find the values of P(C / B)
and $P(A' \cap C')$.

126) Let A be the set of all students of a boys school. Show that the relation R in A given by R = {(a, b) : a is sister of b} is the empty relation and R' = {(a, b) : the difference between heights of a and b is less than 3 meters} is the universal relation.

127) Let T be the set of all triangles in a plane with R a relation in T given by R = {(T_1, T_2) : T_1 is congruent to T_2}. Show that R is an equivalence relation.

128) Let L be the set of all lines in a plane and R be the relation in L defined as R = {(L_1, L_2) : L_1 is perpendicular to L_2}. Show that R is symmetric but neither reflexive nor transitive.

129) Show that the relation R in the set {1, 2, 3} given by R = {(1, 1), (2, 2), (3, 3), (1, 2), (2, 3)} is reflexive but neither symmetric nor transitive.

130) Determine whether the following relations are reflective, symmetric and transitive:
Relation R in the set A = {1, 2, 3...13, 14} defined as R = {(x,y):3x - y = 0}

131) Determine whether each of the following relations are reflexive, symmetric and transitive:
Relation R in the set **N** of natural numbers defined as
R = {(x, y): $y = x + 5$ and $x < 4$}

132) Determine whether each of the following relations are reflexive, symmetric and transitive:
Relation R in the set A = {1, 2, 3, 4, 5, 6} as R = {(x, y): y is divisible by x}

133) Determine whether each of the following relations are reflexive, symmetric and transitive:
Relation R in the set **Z** of all integers defined as
R = {(x, y): $x - y$ is as integer}

134) Determine order and degree (if defined) of differential equations : y' + 5y = 0

135) Determine order and degree (if defined) of differential equations :
$(y''')^2 + (y'')^3 + (y')^4 + y^5 = 0.$

136) Determine order and degree (if defined) of differential equations:
$y''' + 2y'' + y' = 0.$

137) Determine order and degree (if defined) of differential equations :
$y'' + (y')^2 + 2y = 0.$

138) Determine order and degree (if defined) of differential equations:
$y'' + (y')^2 + 2y = 0.$

139) Determine order and degree(if defined) of differential equation :
$\frac{d^4y}{dx^4} + \sin(y''') = 0$

140) Determine order and degree(if defined) of differential equation :
$\left(\frac{ds}{dt}\right)^4 + 3s\frac{d^2s}{dt^2} = 0$

141) Determine order and degree(if defined) of differential equation:
$\frac{d^2y}{(dx^2)^2} + \cos\left(\frac{dy}{dx}\right) = 0$

142) Determine order and degree(if defined) of differential equation:
$\frac{d^2y}{dx^2} = \cos 3x + \sin 3x$

143) verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation : y = ex + 1 : y'' – y' = 0

144) verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation :y = x^2 + 2x + C : y′ – 2x – 2 = 0

145) verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation : y = cos x + C : y′ + sin x = 0

146) verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation : $y=\sqrt{1+x^2} : y' = \frac{xy}{1+x^2}$

147) verify that the given functions (explicit or implicit) is a solution of the corresponding differential equation : $y = \mathrm{Ax} : xy' = y (x \neq 0)$

148) Classify the following measures as scalars and vectors.
20 m/s towards north

149) In which of the vectors are:
(i) Collinear
(ii) Equal
(iii) Coinitial

150) Find the value of a + b. if the points (2, a, 3), (3. 5, b) and (-1, 11,9) are collinear.

151) The vectors
$\vec{a} = 3\hat{i} + x\hat{j}$ and $\vec{b} = 2\hat{i} + \hat{j} + y\hat{k}$ are mutually perpendicular. If $|\vec{a}| = |\vec{b}|,$ then find the value of y .

152)
If $|\vec{a}| = a,$ then find the value of the following: $|\vec{a} \times \hat{i}|^2 + |\vec{a} \times \hat{j}|^2 + |\vec{a} \times \hat{k}|^2$

153) determine the direction cosines of the normal to the plane and the distance from the origin : z = 2

154) Determine the direction cosines of the normal to the plane and the distance from the origin : 2x + 3y – z = 5

155) Find the Cartesian equation of the following planes:
$\vec{r} \cdot (\hat{i} + \hat{j} - \hat{k}) = 2$

156) Find the Cartesian equation of the following planes:
$\vec{r} \cdot [(s-2t)\hat{i} + (3-t)\hat{j} + (2s+t)\hat{k}] = 15$

157) In the following cases, find the coordinates of the foot of the perpendicular drawn from the origin.
2x + 3y + 4z – 12 = 0

158) In the following cases, find the coordinates of the foot of the perpendicular drawn from the origin.
5y + 8 = 0

159) Find the vector and cartesian equations of the planes that passes through the point (1, 0, – 2) and the normal to the plane is
$\hat{i} + \hat{j} - \hat{k}$

160) Find the vector and cartesian equations of the planes : that passes through the point (1,4, 6) and the normal vector to the plane is $\hat{i} - 2\hat{j} + \hat{k}$