1. If the regression coefficient of Y on X is 4/3, then the regression coefficient of X and Y:
   a. is 3/4
   b. is less than 3/4
   c. is less than 1
   d. can take any value

2. Which of the following is the inverse of the proposition ‘If a number is prime then it is odd’?
   a. If a number is not a prime then it is odd
   b. If a number is not a prime then it is not odd
   c. If a number is not odd then it is not a prime
   d. If number is odd then it is a prime

3. What must be the matrix X if \(2X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 8 \\ 7 & 2 \end{bmatrix}\)?
   a. \(\begin{bmatrix} 1 \\ 2 \end{bmatrix}
   b. \(\begin{bmatrix} 1 \\ 2 \end{bmatrix}
   c. \(\begin{bmatrix} 2 \\ 4 \end{bmatrix}
   d. \(\begin{bmatrix} 2 \\ 4 \end{bmatrix}

4. The value of \(\begin{vmatrix} 1 & 1 & 1 \\ bc & ca & ab \\ b + c & c + a & a + b \end{vmatrix}\) is:
   a. 1
   b. 0
   c. a -b b -c c -a
   d. a+b b+c c+a

5. The value of \(\begin{vmatrix} 441 & 442 & 443 \\ 445 & 446 & 447 \\ 449 & 450 & 451 \end{vmatrix}\) is:
   a. 441x446x4510
   b. 0
   c. -1
   d. 1
6. \( \vec{i} - \vec{j} + (\vec{i} + \vec{k}) \) is equal to:

a) \( \vec{i} \)  

b) \( 2 \vec{j} \)  

c) \( \vec{i} + \vec{k} \)  

d) \( \vec{j} \)

7. Inverse of the matrix \( \begin{bmatrix} \cos 2\theta & -\sin 2\theta \\ \sin 2\theta & \cos 2\theta \end{bmatrix} \) is:

a) \( \begin{bmatrix} \cos 2\theta & -\sin 2\theta \\ \sin 2\theta & \cos 2\theta \end{bmatrix} \)  

b) \( \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{bmatrix} \)  

c) \( \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ -\sin 2\theta & \cos 2\theta \end{bmatrix} \)  

d) \( \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & \cos 2\theta \end{bmatrix} \)  

8. If \( |\vec{i}| = 3, |\vec{j}| = 4 \), then a value of \( \lambda \) for which \( \vec{i} + \lambda \vec{j} \) is perpendicular to \( \vec{i} - \lambda \vec{j} \) is:

a) \( \frac{9}{16} \)  

b) \( \frac{3}{4} \)  

c) \( \frac{3}{2} \)  

d) \( \frac{4}{3} \)

9. The projection of \( \vec{i} = 2\vec{i} + 3\vec{j} - 2\vec{k} \) on \( \vec{i} = \vec{i} + 2\vec{j} + 3\vec{k} \) is:

a) \( \frac{1}{\sqrt{14}} \)  

b) \( \frac{2}{\sqrt{14}} \)  

c) \( \frac{14}{\sqrt{14}} \)  

d) \( -\frac{2}{\sqrt{14}} \)

10. A line passes through the points 6, -7, 1 and 2, -3, 1. The direction cosines of the line so directed that the angle made by it with the positive direction of x-axis is acute, are:

a) \( \frac{2}{3}, \frac{2}{3}, -\frac{1}{3} \)  

b) \( -\frac{2}{3}, \frac{2}{3}, \frac{1}{3} \)  

c) \( \frac{2}{3}, \frac{2}{3}, -\frac{1}{3} \)  

d) \( \frac{2}{3}, -\frac{2}{3}, \frac{1}{3} \)

11. The maximum of the function \( 3\cos x - 4\sin x \) is:

a) 2  

b) 3  

c) 4  

d) 5

12. If the distance's metres traversed by particle in t seconds is given by \( s = t^3 - 3t^2 \), then the velocity of the particle when the acceleration is zero, in m/s, is:

a) 3  

b) -2
13. For the curve \( y^n = a^{n-1} x \) if the subnormal at any point is a constant then \( n \) is equal to:
   a) 1  
   b) 2  
   c) -2  
   d) -1

14. If \( x = A \cos 4t + B \sin 4t \) then \( \frac{d^2x}{dt^2} \) is equal to:
   a) -16x  
   b) 16x  
   c) x  
   d) -x

15. If tangent to the curve \( x = at^2, y = 2at \) is perpendicular to x-axis, then its points of contact is:
   a) a, a  
   b) 0, a  
   c) 0, 0  
   d) a, 0

16. The general solution of the differential equation
   \[ \frac{dy}{dx} + \frac{1 + \cos 2y}{1 - \cos 2x} = 0 \]
   is given by:
   a) \( \tan y \cot x = c \)  
   b) \( \tan y - \cot x = c \)  
   c) \( \tan x - \cot y = c \)  
   d) \( \tan x + \cot y = c \)

17. The degree of the differential equation
   \[ \left( 1 + \left( \frac{dy}{dx} \right)^2 \right)^{3/4} = \left( \frac{d^2y}{dx^2} \right)^{1/3} \]
   is:
   a) 2  
   b) 4  
   c) 9  
   d) 1

18. The area enclosed between the curves \( y = x^3 \) and \( y = \sqrt[3]{x} \) is, in square units:
   a) \( \frac{5}{3} \)  
   b) \( \frac{5}{4} \)  
   c) \( \frac{5}{12} \)  
   d) \( \frac{12}{5} \)

19. \[ \int_0^{\pi/8} \cos^3 4\theta \, d\theta \] is equal to:
   a) \( \frac{5}{3} \)  
   b) \( \frac{5}{4} \)
20. \[ \int_0^{\pi/2} \frac{\cos x - \sin x}{1 + \cos x \sin x} \, dx \] is equal to:
- a \( 0 \)
- b \( \frac{\pi}{2} \)
- c \( \frac{\pi}{4} \)
- d \( \frac{\pi}{6} \)

21. If \( ax^2 - y^2 + 4x - y = 0 \) represents a pair of lines, then \( a \) is equal to:
- a \(-16\)
- b \(16\)
- c \(4\)
- d \(-4\)

22. What is the equation of the locus of a point which moves such that 4 times its distance from the \( x \)-axis is the square of its distance from the origin?
- a \( x^2 + y^2 - 4y = 0 \)
- b \( x^2 + y^2 - 4|y| = 0 \)
- c \( x^2 + y^2 - 4x = 0 \)
- d \( x^2 + y^2 - 4|x| = 0 \)

23. Equation of the straight line making equal intercepts on the axes and passing through the point \( 2, 4 \) is:
- a \( 4x - y - 4 = 0 \)
- b \( 2x + y - 8 = 0 \)
- c \( x + y - 6 = 0 \)
- d \( x + 2y - 10 = 0 \)

24. If the area of the triangle with vertices \( x, 0, 1, 1 \) and \( 0, 2, 1, 4 \) sq units, then the value of \( x \) is:
- a \(-2\)
- b \(-4\)
- c \(-6\)
- d \(8\)

25. \[ \lim_{\theta \to \frac{\pi}{2}} \frac{\pi - \theta}{\sec \theta} \]
- a \(0\)
- b \(-1\)
- c \(1\)
- d \(\infty\)

26. The probability that A can solve a problem is \( \frac{2}{3} \) and B can solve it is \( \frac{3}{4} \). If both attempt the problem what is the probability that the problem gets solved?
- a \( \frac{11}{12} \)
- b \( \frac{7}{12} \)
- c \( \frac{5}{12} \)
- d \( \frac{9}{12} \)

27. The radius of the circle passing through the point \( 6, 2 \) and two whose diameters are \( x + y = 6 \) and \( x + 2y = 4 \) is:
- a \( 4 \)
- b \( 6 \)
- c \( 20 \)
- d \( \frac{20}{\sqrt{2}} \)

28. If \( 0, 6 \) and \( 0, 3 \) are respectively the vertex and focus of a parabola, then its equation is:
- a \( x^2 + 12y = 72 \)
- b \( x^2 - 12y = 72 \)
29. For the ellipse

\[ 24x^2 + 9y^2 - 150x - 90y + 225 = 0 \]

the eccentricity \( e \) is equal to:

\[ a \quad \frac{2}{5} \quad b \quad \frac{3}{5} \quad c \quad \frac{4}{5} \quad d \quad \frac{1}{5} \]

30. If the foci of the ellipse \( \frac{x^2}{16} + \frac{y^2}{b^2} = 1 \) and the hyperbola \( \frac{x^2}{144} - \frac{y^2}{81} = \frac{1}{25} \) coincide, then the value of \( b^2 \) is:

\[ a \quad 1 \quad b \quad 7 \]
\[ c \quad 5 \quad d \quad 9 \]

31. The differential coefficient is \( f(\sin x) \) with respect to \( x \) where \( f(x) = \log x \) is:

\[ a \quad \tan x \quad b \quad \cot x \]
\[ c \quad f(\cos x) \quad d \quad \frac{1}{x} \]

32. If \( f(x) = \begin{cases} \frac{1 - \cos x}{x} & x \neq 0 \\ k & x = 0 \end{cases} \) is continuous at \( x = 0 \), then the value of \( k \) is:

\[ a \quad 0 \quad b \quad \frac{1}{2} \]
\[ c \quad \frac{1}{4} \quad d \quad -\frac{1}{2} \]

33. If \( \omega = \frac{-1 + \sqrt{5}i}{2} \), then \( 3 + (\omega + 3\omega^2)^4 \) is:

\[ a \quad 16 \quad b \quad -16 \quad c \quad 16 \quad d \quad 16 \quad \omega^2 \]

34. If \( y = \tan^{-1} \sec x - \tan x \), then \( \frac{dy}{dx} \) is equal to:

\[ a \quad 2 \quad b \quad -2 \]
\[ c \quad \frac{1}{2} \quad d \quad -\frac{1}{2} \]

35. If \( x + \frac{1}{x} = 2 \cos \alpha \) then \( x^n + \frac{1}{x^n} \) is equal to:

\[ a \quad 2^n \cos \alpha \quad b \quad 2^n \cos n\alpha \]
\[ c \quad 2^n \cos n\alpha \quad d \quad 2 \cos n\alpha \]

36. \( \int_{-1}^{1} \sqrt{1 - x^2} \, dx \) is equal to:
37. \( \int \frac{dx}{x(x^2+1)} \) is equal to:

\[
\begin{align*}
\text{a) } & \log \left( \frac{x}{x^2+1} \right) + c \\
\text{b) } & \frac{1}{7} \log \left( \frac{x}{x^2+1} \right) + c \\
\text{c) } & \log \left( \frac{x+1}{x^2} \right) + c \\
\text{d) } & \frac{1}{7} \log \left( \frac{x+1}{x^2} \right) + c
\end{align*}
\]

38. If a sphere of constant radius \( k \) passes through the origin and meets the axis in A, B, C then the centroid of the triangle ABC lies on:

\[
\begin{align*}
\text{a) } & x^2 + y^2 + z^2 = k^2 \\
\text{b) } & x^2 + y^2 + z^2 = 4k^2 \\
\text{c) } & 9x^2 + y^2 + z^2 = 4k^2 \\
\text{d) } & 9x^2 + y^2 + z^2 = k^2
\end{align*}
\]

39. \( \int \frac{dx}{x^2+2x+2} \) is equal to:

\[
\begin{align*}
\text{a) } & \sin^{-1}x + 1 + c \\
\text{b) } & \sin h^{-1}x + 1 + c \\
\text{c) } & \tan h^{-1}x + 1 + c \\
\text{d) } & \tan^{-1}x + 1 + c
\end{align*}
\]

40. If a tangent to the curve \( y = 6x - x^2 \) is parallel to the line \( 4x - 2y - 1 = 0 \), then the point of tangency on the curve is:

\[
\begin{align*}
\text{a) } & 2, 8 \\
\text{b) } & 8, 2 \\
\text{c) } & 6, 1 \\
\text{d) } & 4, 2
\end{align*}
\]

41. A four digit number is formed of the figures 1, 2, 3, 5 with no repetitions. The probability that the number is divisible by 5 is:

\[
\begin{align*}
\text{a) } & \frac{3}{4} \\
\text{b) } & \frac{1}{4} \\
\text{c) } & \frac{1}{3} \\
\text{d) } & \text{none of these}
\end{align*}
\]

42. The number of solutions for the equation \( x^2 - 5|x| + 6 = 0 \) is:

\[
\begin{align*}
\text{a) } & 4 \\
\text{b) } & 3 \\
\text{c) } & 2 \\
\text{d) } & 1
\end{align*}
\]
43. How many numbers of 6 digits can be formed from the digits of number 112233 ?
   a  30  b  60  c  90  d  120

44. The last digit in $7^{300}$ is :
   a  7  b  9  c  1  d  3

45. If $\frac{\log x}{a-b} = \frac{\log y}{b-c} = \frac{\log z}{c-a}$, then $xyz$ is equal to :
   a  0  b  1  c  -1  d  2

46. The smallest positive integer $n$ for which $1+i^{2n} = 1-i^{2n}$ is :
   a  1  b  2  c  3  d  4

47. If $\cos^{-1} p + \cos^{-1} q + \cos^{-1} r = \pi$, then $p^2+q^2+r^2+2pqr$ is equal to :
   a  3  b  1  c  2  d  -1

48. If $\sin^{-1} \frac{x}{5} + \csc^{-1} \frac{5}{4} = \frac{\pi}{2}$, then $x$ is equal to :
   a  1  b  4  c  3  d  5

49. If $0 \leq x \leq \pi$ and $81 \sin^2 x + 81 \cos^2 x = 30$, then $x$ is equal to :
   a  $\frac{\pi}{6}$  b  $\frac{\pi}{2}$  c  $\frac{\pi}{4}$  d  $\frac{3\pi}{4}$

50. The equation of the director circle of the hyperbola $\frac{x^2}{16} - \frac{y^2}{4} = 1$ is given by :
   a  $x^2+y^2 = 16$  b  $x^2+y^2 = 4$
   c  $x^2+y^2 = 20$  d  $x^2+y^2 = 12$

51. If $Q_1$ is the set of all relations other than 1 with the binary operation $\ast$ defined by $a \ast b = a+b-ab$ for all $a,b$ in $Q_1$ with respect to $\ast$ is :
   a  1  b  0  c  -1  d  2

52. The circle $x^2+y^2-8x+4y+4 = 0$ touches :
   a  x-axis  b  y-axis  c  both axis  d  neither $x$-axis nor $y$-axis
53. The function \( f(x = \log_{1+x} - \frac{2x}{2+x} ) \) is increasing on:

a. 0, \( \infty \)  b. \( -\infty, 0 \)

c. \( -\infty, \infty \)  d. none of these

54. The minimum value of

\[
\left( 1 + \frac{1}{\sin^n \alpha} \right) \left( 1 + \frac{1}{\cos^n \alpha} \right)
\]

is:

a. 1  b. 2  

c. 1+2  d. none of these

55. The value of \( k \) so that \( x^2 + y^2 + kx + 4y + 2 = 0 \) and \( 2x^2 + y^2 - 4x - 3y + k = 0 \) cut orthogonally is:

a. \( \frac{10}{3} \)  b. \( \frac{8}{3} \)  

c. \( \frac{10}{3} \)  d. \( \frac{8}{3} \)

56. \( \lim_{x \to \infty} \left( 1 - \frac{4}{x-1} \right)^{3x-1} \) is equal to:

a. \( e^{12} \)  b. \( e^{-12} \)

c. \( e^4 \)  d. \( e^3 \)

57. If \( A+B+C = 180^0 \) then \( \sum \tan \frac{A}{2} \tan \frac{B}{2} \) is equal to:

a. 0  b. 1  c. 2  d. 3

58. In a triangle ABC if \( b=2, B=30^0 \) then the area of the circumcircle of triangle ABC in square units is:

a. \( \pi \)  b. 2  

c. 4  d. 6 \( \pi \)

59. If \( \sin x + \sin^2 x = 1 \), then

\[
\cos^{12} x + 3 \cos^{10} x + 3 \cos^8 x + \cos^6 x
\]
is equal to:

a. 1  b. 2  c. 3  d. 0

60. If \( R \) denotes the set of all real number, then the function \( f: R \rightarrow R \) defined \( f(x) = |x| \) is:

a. one -one only  

b. onto only

c. both one -one and onto

d. neither one -one nor onto