

① If  $z\bar{z} = |z + \bar{z}|$ , where  $z = x + iy$ ,  $i = \sqrt{-1}$ , then the locus of  $z$  is a pair of:

- (a) straight lines
- (b) rectangular hyperbolas
- (c) parabolas
- (d) circles

(D)

② If  $1! + 3! + 5! + 7! + \dots + 199!$  is divided by 24, what is the remainder?

- (a) 3
- (b) 6
- (c) 7
- (d) 9

(C)

③ What is the value of  $\sqrt{12+5i} + \sqrt{12-5i}$ , where  $i = \sqrt{-1}$ ?

- (a) 24
- (b) 25
- (c)  $5\sqrt{2}$
- (d)  $5(\sqrt{2} - 1)$

(C)

④ If  $A = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ , then what is the value of

$\det(I + AA')$ , where  $I$  is the  $3 \times 3$  identity matrix?

- (a) 15
- (b) 6
- (c) 0
- (d) -1

(A)

⑤

If  $A$ ,  $B$  and  $C$  are square matrices of order 3 and  $\det(BC) = 2 \det(A)$ , then what is the value of  $\det(2A^{-1}BC)$ ?

- (a) 16
- (b) 8
- (c) 4
- (d) 2

(A)

⑥

If the  $n^{\text{th}}$  term of a sequence is  $\frac{2n+5}{7}$ , then what is the sum of its first 140 terms?

- (a) 2840
- (b) 2780
- (c) 2920
- (d) 5700

(C)

⑦

Let  $A$  be a skew-symmetric matrix of order 3. What is the value of  $\det(4A^4) - \det(3A^3) + \det(2A^2) - \det(A) + \det(-I)$  where  $I$  is the identity matrix of order 3?

- (a) -1
- (b) 0
- (c) 1
- (d) 2

(A)

8. If  $A = \begin{bmatrix} 0 & 3 & 4 \\ -3 & 0 & 5 \\ -4 & -5 & 0 \end{bmatrix}$ , then which one of the following statements is correct?

- (a)  $A^2$  is symmetric matrix with  $\det(A^2) = 0$ .  
 (b)  $A^2$  is symmetric matrix with  $\det(A^2) \neq 0$ .  
 (c)  $A^2$  is skew-symmetric matrix with  $\det(A^2) = 0$ .  
 (d)  $A^2$  is skew-symmetric matrix with  $\det(A^2) \neq 0$ .

9. If  $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ , then which of the following statements are correct?

1.  $A^n$  will always be singular for any positive integer  $n$ .  
 2.  $A^n$  will always be a diagonal matrix for any positive integer  $n$ .  
 3.  $A^n$  will always be a symmetric matrix for any positive integer  $n$ .

Select the correct answer using the code given below:

- (a) 1 and 2 only  
 (b) 2 and 3 only  
 (c) 1 and 3 only  
 (d) 1, 2 and 3

10. If  $(a, b)$ ,  $2b$ ,  $(b + c)$  are in HP, then which one of the following is correct?

- (a)  $a, b$  and  $c$  are in AP  
 (b)  $a - b, b - c$  and  $c - a$  are in AP  
 (c)  $a, b$  and  $c$  are in GP  
 (d)  $a - b, b - c$  and  $c - a$  are in GP

11. Let  $t_1, t_2, t_3 \dots$  be in GP. What is  $(t_1 t_3 \dots t_{21})^{\frac{1}{11}}$  equal to?

- (a)  $t_{10}$   
 (b)  $t_{10}^2$   
 (c)  $t_{11}$   
 (d)  $t_{11}^2$

12. Which one of the following is a square root of  $-\sqrt{-1}$ ?

- (a)  $1 + i$   
 (b)  $\frac{1-i}{\sqrt{2}}$   
 (c)  $\frac{1+i}{\sqrt{2}}$   
 (d)  $\frac{1}{\sqrt{2}}i$

13. What is the maximum number of points of intersection of 10 circles?

- (a) 45  
 (b) 60  
 (c) 90  
 (d) 120

14. A set  $S$  contains  $(2n+1)$  elements. There are 4096 subsets of  $S$  which contain at most  $n$  elements. What is  $n$  equal to?

- (a) 5  
 (b) 6  
 (c) 7  
 (d) 8

$$2n+1 \text{ terms } \rightarrow 2^{2n+1} \text{ total subsets}$$

$$2^{2n} = 4096 = 2^{12} \Rightarrow 2n = 12 \Rightarrow n = 6$$

5. If  $\begin{vmatrix} x^2 + 3x & x - 1 & x + 3 \\ x + 1 & -2x & x - 4 \\ x - 3 & x + 4 & 3x \end{vmatrix} = ax^4 + bx^3 + cx^2 + dx + e,$

then what is the value of  $e$ ?

- (a)  $-1$   
(b)  $0$   
(c)  $1$   
(d)  $2$

(b)

6. If all elements of a third order determinant are equal to  $1$  or  $-1$ , then the value of the determinant is:

- (a)  $0$  only  
(b) an even number but not necessarily  $0$   
(c) an odd number  
(d)  $0, 1$  or  $-1$

(a)

17. If  $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 3 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ , then what is the value of  $\det[\text{adj}(\text{adj}A)]$ ?

- (a)  $5$   
(b)  $25$   
(c)  $125$   
(d)  $625$

(d)

18. If  $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ , then what is

$23A^3 - 19A^2 - 4A$  equal to?

- (a) Null matrix of order  $3$   
(b) Identity matrix of order  $3$

(c)  $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

(d)  $\begin{bmatrix} 7 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 7 \end{bmatrix}$

(a)

19. The value of the determinant of a matrix  $A$  of order  $3$  is  $3$ . If  $C$  is the matrix of cofactors of the matrix  $A$ , then what is the value of determinant of  $C^2$ ?

- (a)  $3$   
(b)  $9$   
(c)  $81$   
(d)  $729$

(c)

20. If  $A_k = \begin{bmatrix} k-1 & k \\ k-2 & k+1 \end{bmatrix}$ , then what is

$\det(A_1) + \det(A_2) + \det(A_3) + \dots + \det(A_{100})$  equal to?

- (a)  $100$   
(b)  $1000$   
(c)  $9900$   
(d)  $10000$

(d)

$$\begin{array}{r} 38 \\ -1 \\ \hline 37 \end{array}$$

$$\begin{array}{r} 713 \\ 198 \\ \hline 911 \end{array}$$

$$\begin{array}{r} 198 \\ 217 \\ \hline 415 \end{array}$$

$$\begin{array}{r} 97 \\ 96 \end{array}$$

$$\begin{array}{r} 98 \\ 100 \\ \hline 9700 \end{array}$$

21. The Cartesian product  $A \times A$  has 16 elements among which are  $(0, 2)$  and  $(1, 3)$ . Which of the following statements is/are correct?

1. It is possible to determine set  $A$ .
2.  $A \times A$  contains the element  $(3, 2)$ .

Select the correct answer using the code given below :

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

22. Let  $A = \{1, 2, 3, \dots, 20\}$ . Define a relation  $R$  from  $A$  to  $A$  by  $R = \{(x, y) : 4x - 3y = 1\}$ , where  $x, y \in A$ . Which of the following statements is/are correct?

1. The domain of  $R$  is  $\{1, 4, 7, 10, 13, 16\}$ .
2. The range of  $R$  is  $\{1, 5, 9, 13, 17\}$ .
3. The range of  $R$  is equal to codomain of  $R$ .

Select the correct answer using the code given below :

- (a) 1 only
- (b) 2 only
- (c) 1 and 2
- (d) 2 and 3

23. Consider the following statements :

1. The relation  $f$  defined by

$$f(x) = \begin{cases} x^3, & 0 \leq x \leq 2 \\ 4x, & 2 \leq x \leq 8 \end{cases} \text{ is a function.}$$

2. The relation  $g$  defined by

$$g(x) = \begin{cases} x^2, & 0 \leq x \leq 4 \\ 3x, & 4 \leq x \leq 8 \end{cases} \text{ is a function.}$$

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

24. Consider the following statements :

1.  $A = (A \cup B) \cup (A - B)$

2.  $A \cup (B - A) = (A \cup B)$

3.  $B = (A \cup B) - (A - B)$

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

25. A function satisfies  $f(x-y) = \frac{f(x)}{f(y)}$ , where  $f(y) \neq 0$ . If  $f(1) = 0.5$ , then what is  $f(2) + f(3) + f(4) + f(5) + f(6)$  equal to?
- (a)  $\frac{15}{32}$   
 (b)  $\frac{17}{32}$   
 (c)  $\frac{29}{64}$   
 (d)  $\frac{31}{64}$
26. What is  $2 \cot\left(\frac{1}{2} \cos^{-1} \frac{\sqrt{5}}{3}\right)$  equal to?
- (a)  $-1$   
 (b)  $1$   
 (c)  $3 + \sqrt{5}$   
 (d)  $3 - \sqrt{5}$
27. If  $\sec^{-1} p - \operatorname{cosec}^{-1} q = 0$ , where  $p > 0, q > 0$ ; then what is the value of  $p^{-2} + q^{-2}$ ?
- (a)  $1$   
 (b)  $2$   
 (c)  $\frac{1}{2}$   
 (d)  $\frac{1}{2\sqrt{2}}$
28. What is  $1 + \sin^2\left(\cos^{-1}\left(\frac{3}{\sqrt{17}}\right)\right)$  equal to?
- (a)  $\frac{25}{17}$   
 (b)  $\frac{8}{17}$   
 (c)  $\frac{9}{17}$   
 (d)  $\frac{47}{17}$
29. If  $\tan(\pi \cos \theta) = \cot(\pi \sin \theta)$ ,  $0 < \theta < \frac{\pi}{2}$ ; then what is the value of  $8 \sin^2\left(\theta + \frac{\pi}{4}\right)$ ?
- (a)  $16$   
 (b)  $2$   
 (c)  $1$   
 (d)  $\frac{1}{2}$
30. If  $\tan \alpha = \frac{1}{7}$ ,  $\sin \beta = \frac{1}{\sqrt{10}}$ ;  $0 < \alpha, \beta < \frac{\pi}{2}$ , then what is the value of  $\cos(\alpha + 2\beta)$ ?
- (a)  $-\frac{1}{2}$   
 (b)  $-\frac{1}{\sqrt{2}}$   
 (c)  $\frac{1}{\sqrt{2}}$   
 (d)  $\frac{1}{2}$



Consider the following for the next two (02) items that follow :

Consider the equation  $(1-x)^4 + (5-x)^4 = 82$ .

31. What is the number of real roots of the equation ?

- (a) 0
- (b) 2
- (c) 4
- (d) 8

(C)

32. What is the sum of all the roots of the equation ?

- (a) 24
- (b) 12
- (c) 10
- (d) 6

(B)

Consider the following for the next three (03) items that follow :

Consider equation-I :  $z^3 + 2z^2 + 2z + 1 = 0$  and equation-II :  $z^{1985} + z^{100} + 1 = 0$ .

33. What are the roots of equation-I ?

- (a)  $1, \omega, \omega^2$
- (b)  $-1, \omega, \omega^2$
- (c)  $1, -\omega, \omega^2$
- (d)  $-1, -\omega, -\omega^2$

(B)

34. Which one of the following is a root of equation-II ?

- (a)  $-1$
- (b)  $-\omega$
- (c)  $-\omega^2$
- (d)  $\omega$

(D)

35. What is the number of common roots of equation-I and equation-II ?

- (a) 0
- (b) 1
- (c) 2
- (d) 3

(C)

Consider the following for the next two (02) items that follow :

A quadratic equation is given by  $(a+b)x^2 - (a+b+c)x + k = 0$ , where  $a, b, c$  are real.

36. If  $k = \frac{c}{2}$ , ( $c \neq 0$ ), then the roots of the equation are :

- (a) Real and equal
- (b) Real and unequal
- (c) Real iff  $a > c$
- (d) Complex but not real

(B)

17. If  $k = c$ , then the roots of the equation are :

- (a)  $\frac{a+c}{a+b}$  and  $\frac{b}{a+b}$   
(b)  $\frac{a+c}{a+b}$  and  $-\frac{b}{a+b}$   
(c) 1 and  $\frac{c}{a+b}$   
(d) -1 and  $-\frac{c}{a+b}$

C

Consider the following for the next three (03) items that follow :

$$\text{Let } (1+x)^n = 1 + T_1x + T_2x^2 + T_3x^3 + \dots + T_nx^n.$$

38. What is  $T_1 + 2T_2 + 3T_3 + \dots + nT_n$  equal to ?

- (a) 0  
(b) 1  
(c)  $2^n$   
(d)  $n2^{n-1}$

D

39. What is  $1 - T_1 + 2T_2 - 3T_3 + \dots + (-1)^n nT_n$  equal to ?

- (a) 0  
(b)  $-2^{n-1}$   
(c)  $n2^{n-1}$   
(d) 1

D

40. What is  $T_1 + T_2 + T_3 + \dots + T_n$  equal to ?

- (a)  $2^n$   
(b)  $2^n - 1$   
(c)  $2^{n-1}$   
(d)  $2^n + 1$

B

Consider the following for the next two (02) items that follow :

$$\text{Let } f(x) = x^2 - 1 \text{ and } g(f(x)) = x - \sqrt{x} + 1.$$

41. Which one of the following is a possible expression for  $g(x)$  ?

- (a)  $\sqrt{x+1} - \sqrt[4]{x+1}$   
(b)  $\sqrt{x+1} - \sqrt[4]{x+1} + 1$   
(c)  $\sqrt{x+1} + \sqrt[4]{x+1}$   
(d)  $x + 1 - \sqrt{x+1} + 1$

B

42. What is  $g(15)$  equal to ?

- (a) 1  
(b) 2  
(c) 3  
(d) 4

C

Consider the following for the next two (02) items that follow :

Let a function  $f$  be defined on  $\mathbb{R} - \{0\}$  and  $2f(x) + f\left(\frac{1}{x}\right) = x + 3$ .

43. What is  $f(0.5)$  equal to ?

- (a)  $\frac{1}{2}$   
(b)  $\frac{2}{3}$   
(c) 1  
(d) 2

B

B

44. If  $f$  is differentiable, then what is  $f'(0.5)$  equal to?

- (a)  $\frac{1}{4}$
- (b)  $\frac{2}{3}$
- (c) 2
- (d) 4

(C)

Consider the following for the next two (02) items that follow:

A function is defined by

$$f(x) = \begin{vmatrix} x+1 & 2 & 3 \\ 2 & x+4 & 6 \\ 3 & 6 & x+9 \end{vmatrix}$$

45. The function is decreasing on:

- (a)  $\left[-\frac{28}{3}, 0\right]$
- (b)  $\left[0, \frac{28}{3}\right]$
- (c)  $\left[0, \frac{50}{3}\right]$
- (d)  $\left[0, \frac{56}{3}\right]$

(A)

46. The function attains local minimum value at:

- (a)  $x = -\frac{28}{3}$
- (b)  $x = -1$
- (c)  $x = 0$
- (d)  $x = \frac{28}{3}$

(C)

Consider the following for the next two (02) items that follow:

Given that  $4x^2 + y^2 = 9$ .

47. What is the maximum value of  $y$ ?

- (a)  $\frac{3}{2}$
- (b) 3
- (c) 4
- (d) 6

(B)

48. What is the maximum value of  $xy$ ?

- (a)  $\frac{9}{4}$
- (b)  $\frac{3}{2}$
- (c)  $\frac{4}{9}$
- (d)  $\frac{2}{3}$

(A)

Consider the following for the next two (02) items that follow:

A function is defined by  $f(x) = \pi + \sin^2 x$ .

49. What is the range of the function?

- (a)  $[0, 1]$
- (b)  $[\pi, \pi + 1]$
- (c)  $[\pi - 1, \pi + 1]$
- (d)  $[\pi - 1, \pi - 1]$

(B)

50. What is the period of the function?

- (a)  $2\pi$
- (b)  $\pi$
- (c)  $\frac{\pi}{2}$
- (d) The function is non-periodic

(B)



Consider the following for the next two (02) items that follow :

A parabola passes through (1, 2) and satisfies the differential equation  $\frac{dy}{dx} = \frac{2y}{x}$ ,  $x > 0$ ,  $y > 0$ .

51. What is the directrix of the parabola ?

(a)  $y = -\frac{1}{8}$

(b)  $y = \frac{1}{8}$

(c)  $x = -\frac{1}{8}$

(d)  $x = \frac{1}{8}$

52. What is the length of latus rectum of the parabola ?

(a) 1

(b)  $\frac{1}{2}$

(c)  $\frac{1}{4}$

(d)  $\frac{1}{8}$

Consider the following for the next two (02) items that follow :

Let  $f(x) = \frac{a^{x-1} + b^{x-1}}{2}$  and  $g(x) = x - 1$ .

53. What is  $\lim_{x \rightarrow 1} \frac{f(x) - 1}{g(x)}$  equal to ?

(a)  $\frac{\ln(ab)}{4}$

(b)  $\frac{\ln(ab)}{2}$

(c)  $\ln(ab)$

(d)  $2 \ln(ab)$

54. What is  $\lim_{x \rightarrow 1} f(x)^{\frac{1}{g(x)}}$  equal to ?

(a)  $\sqrt{ab}$

(b)  $ab$

(c)  $2ab$

(d)  $\frac{\sqrt{ab}}{2}$

Consider the following for the next two (02) items that follow :

Let  $f(x) = \sqrt{2-x} + \sqrt{2+x}$ .

55. What is the domain of the function ?

(a)  $(-2, 2)$

(b)  $[-2, 2]$

(c)  $\mathbb{R} - (-2, 2)$

(d)  $\mathbb{R} - [-2, 2]$

56. What is the greatest value of the function ?

(a)  $\sqrt{3}$

(b)  $\sqrt{6}$

(c)  $\sqrt{8}$

(d) 4

Consider the following for the next two (02) items that follow :

Let  $f(x) = |x|$  and  $g(x) = [x] - 1$ , where  $[.]$  is the greatest integer function.

Let  $h(x) = \frac{f(g(x))}{g(f(x))}$ .

57. What is  $\lim_{x \rightarrow 0^+} h(x)$  equal to ?

(a) -2

(b) -1

(c) 0

(d) 1

58. What is  $\lim_{x \rightarrow 0^-} h(x)$  equal to?

- (a) -2
- (b) -1
- (c) 0
- (d) 2

A

Consider the following for the next two (02) items that follow:

$$\text{Let } f(x) = \begin{cases} \frac{x-3}{|x-3|} + a; & x < 3 \\ a - b; & x = 3 \text{ and} \\ \frac{x-3}{|x-3|} + b; & x > 3 \end{cases}$$

$f(x)$  be continuous at  $x = 3$ .

59. What is the value of  $a$ ?

- (a) -1
- (b) 1
- (c) 2
- (d) 3

D

60. What is the value of  $b$ ?

- (a) -1
- (b) 1
- (c) 2
- (d) 3

B

Consider the following for the next two (02) items that follow:

$$\text{Let } I = \int_{-2\pi}^{2\pi} \frac{\sin^4 x + \cos^4 x}{1 + 3^x} dx$$

61. What is  $\int_0^{\pi} (\sin^4 x + \cos^4 x) dx$  equal to?

- (a)  $\frac{3\pi}{8}$
- (b)  $\frac{3\pi}{4}$
- (c)  $\frac{3\pi}{2}$
- (d)  $3\pi$

B

62. What is  $I$  equal to?

- (a) 0
- (b)  $\frac{3\pi}{4}$
- (c)  $\frac{3\pi}{2}$
- (d)  $3\pi$

C

Consider the following for the next two (02) items that follow:

$$\text{Let } f(x) = \begin{cases} ax(x+1) + b, & x < 1 \\ x - 1, & 1 \leq x \leq 2 \end{cases}$$

63. If the function  $f(x)$  is differentiable at  $x = 1$ , then what is the value of  $(a + b)$ ?

- (a)  $-\frac{1}{3}$
- (b) -1
- (c) 0
- (d) 1

A

64. What is  $\lim_{x \rightarrow 0} f(x)$  equal to?

- (a)  $-\frac{1}{3}$
- (b)  $-\frac{2}{3}$
- (c) 0
- (d) 1

B

65. If  $f(x) = |\ln|x||$  where  $0 < x < 1$ , then what is  $f'(0.5)$  equal to?

- (a) -2
- (b) -1
- (c) 0
- (d) 2

A

66. If  $f'(x) = \cos(\ln x)$  and  $y = f\left(\frac{2x-3}{x}\right)$ , then what is  $\frac{dy}{dx}$  equal to?

- (a)  $\cos\left(\ln\left(\frac{2x-3}{x}\right)\right)$
- (b)  $-\frac{3}{x^2} \sin\left(\ln\left(\frac{2x-3}{x}\right)\right)$
- (c)  $\frac{3}{x^2} \cos\left(\ln\left(\frac{2x-3}{x}\right)\right)$
- (d)  $-\frac{3}{x^2} \cos\left(\ln\left(\frac{2x-3}{x}\right)\right)$

C

67. What is  $\int_0^{8\pi} |\sin x| dx$  equal to?

- (a) 2
- (b) 4
- (c) 8
- (d) 16

D

68. What is the area between the curve  $f(x) = x|x|$  and x-axis for  $x \in [-1, 1]$ ?

- (a)  $\frac{2}{3}$
- (b)  $\frac{1}{2}$
- (c)  $\frac{1}{4}$
- (d)  $\frac{1}{3}$

A

69. What are the order and the degree respectively of the differential equation

$$x^2 \left( \frac{d^3 y}{dx^3} \right)^2 + \left( \frac{dy}{dx} \right)^4 + \sin x = 0?$$

- (a) 3, 4
- (b) 1, 4
- (c) 2, 2
- (d) 3, 2

D

70. What is the differential equation of all parabolas of the type  $y^2 = 4a(x-b)$ ?

- (a)  $\frac{d^2 y}{dx^2} + \left( \frac{dy}{dx} \right)^2 = 0$
- (b)  $\frac{d^2 y}{dx^2} + x^2 \left( \frac{dy}{dx} \right)^2 = 0$
- (c)  $y^2 \frac{d^2 y}{dx^2} + \left( \frac{dy}{dx} \right)^2 = 0$
- (d)  $y \frac{d^2 y}{dx^2} + \left( \frac{dy}{dx} \right)^2 = 0$

D

B

Consider the following for the next two (02) items that follow :

Let  $a_1, a_2, a_3 \dots$  be in AP such that

$$a_1 + a_5 + a_{10} + a_{15} + a_{20} + a_{25} + a_{30} + a_{34} = 300.$$

71. What is

$$a_1 + a_5 - a_{10} - a_{15} - a_{20} - a_{25} + a_{30} + a_{34}$$

equal to ?

- (a) 0
- (b) 25
- (c) 125
- (d) 250

A

72. What is  $\sum_{n=1}^{34} a_n$  equal to ?

- (a) 900
- (b) 1025
- (c) 1200
- (d) 1275

D

Consider the following for the next two (02) items that follow :

$$\text{Let } p = \cos\left(\frac{\pi}{5}\right)\cos\left(\frac{2\pi}{5}\right) \text{ and } q = \cos\left(\frac{4\pi}{5}\right)\cos\left(\frac{8\pi}{5}\right).$$

73. What is the value of  $p + q$  ?

- (a)  $-\frac{1}{2}$
- (b)  $-\frac{1}{4}$
- (c) 0
- (d)  $\frac{1}{2}$

C

74. What is the value of  $pq$  ?

- (a)  $-\frac{1}{16}$
- (b)  $-\frac{1}{4}$
- (c)  $\frac{1}{4}$
- (d)  $\frac{1}{16}$

A

Consider the following for the next two (02) items that follow :

$$\text{Let } p = \frac{1}{3} - \frac{\tan 3x}{\tan x} \text{ and}$$

$$q = 1 - 3 \tan^2 x, 0 < x < \pi, x \neq \frac{\pi}{2}.$$

75. What is  $pq$  equal to ?

- (a) 1
- (b) 2
- (c)  $\frac{8}{3}$
- (d)  $-\frac{8}{3}$

D

76. For how many values of  $x$  does  $\frac{1}{p}$  become zero ?

- (a) No value
- (b) Only one value
- (c) Only two values
- (d) Only three values

C

Consider the following for the next two (02) items that follow :

$$\text{Let } \sin x + \sin y = \sqrt{3} (\cos y - \cos x); x + y = \frac{\pi}{2},$$

$$0 < x, y < \frac{\pi}{2}.$$

77. What is a value of  $\sin 3x + \sin 3y$ ?

- (a) -1
- (b) 0
- (c) 1
- (d) 3

(B)

78. What is a value of  $\cos^3 x + \cos^3 y$ ?

- (a)  $\frac{3\sqrt{3}}{8}$
- (b)  $\frac{3\sqrt{6}}{8}$
- (c)  $\frac{3\sqrt{6}}{4}$
- (d) 1

(B)

Consider the following for the next two (02) items that follow :

The angles A, B and C of a triangle ABC are in the ratio 3 : 5 : 4.

79. What is the value of  $a + b + \sqrt{2}c$  equal to?

- (a) 3a
- (b) 2b
- (c) 3b
- (d) 2c

(C)

80. What is the ratio of  $a^2 : b^2 : c^2$ ?

- (a)  $2 : 2 + \sqrt{3} : 3$
- (b)  $2 : 2 - \sqrt{3} : 2$
- (c)  $2 : 2 + \sqrt{3} : 2$
- (d)  $2 : 2 - \sqrt{3} : 3$

(A)

81. What is the equation of directrix of parabola  $y^2 = 4bx$ , where  $b < 0$  and  $b^2 + b - 2 = 0$ ?

- (a)  $x + 1 = 0$
- (b)  $x - 2 = 0$
- (c)  $x - 1 = 0$
- (d)  $x + 2 = 0$

(B)

82. The points  $(-a, -b)$ ,  $(0, 0)$ ,  $(a, b)$  and  $(a^2, ab)$  are :

- (a) lying on the same circle
- (b) vertices of a square
- (c) vertices of a parallelogram that is not a square
- (d) collinear

(D)

83. Given that  $16p^2 + 49q^2 - 4r^2 - 56pq = 0$ . Which one of the following is a point on a pair of straight lines  $(px + qy + r)(px + qy - r) = 0$ ?

- (a)  $\left(2, \frac{7}{2}\right)$
- (b)  $\left(2, -\frac{7}{2}\right)$
- (c)  $(4, -7)$
- (d)  $(4, 7)$

(B)

84. If  $3x + y - 5 = 0$  is the equation of a chord of the circle  $x^2 + y^2 - 25 = 0$ , then what are the coordinates of the mid-point of the chord?

- (a)  $\left(\frac{3}{4}, \frac{1}{4}\right)$
- (b)  $\left(\frac{3}{2}, \frac{1}{2}\right)$
- (c)  $\left(\frac{3}{4}, -\frac{1}{4}\right)$
- (d)  $\left(\frac{3}{2}, -\frac{1}{2}\right)$

(B)



85. Consider the following in respect of the equation  $\frac{x^2}{24-k} + \frac{y^2}{k-16} = 2$ .

1. The equation represents an ellipse if  $k = 19$ .
2. The equation represents a hyperbola if  $k = 12$ .
3. The equation represents a circle if  $k = 20$ .

How many of the statements given above are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

(C)

86. Consider the following statements in respect of hyperbola  $\frac{x^2}{\cos^2 \theta} - \frac{y^2}{\sin^2 \theta} = 1$ :

1. The two foci are independent of  $\theta$ .
2. The eccentricity is  $\sec \theta$ .
3. The distance between the two foci is 2 units.

How many of the statements given above are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

(C)

87. Consider the following in respect of the circle  $4x^2 + 4y^2 - 4ax - 4ay + a^2 = 0$ :

1. The circle touches both the axes.
2. The diameter of the circle is  $2a$ .
3. The centre of the circle lies on the line  $x + y = a$ .

How many of the statements given above are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

(B)

$$x^2 + y^2 - ax - ay + \frac{a^2}{4} = 0$$

$$x = \frac{a}{2}, y = \frac{a}{2}$$

88. For what values of  $k$  is the line  $(k-3)x - (5-k^2)y + k^2 - 7k + 6 = 0$  parallel to the line  $x + y = 1$ ?

- (a)  $-1, 1$
- (b)  $-1, 2$
- (c)  $1, -2$
- (d)  $2, -2$

(B)

$$\frac{a}{2}, \frac{a}{2}$$

$$\sqrt{\frac{a^2}{4} + \frac{a^2}{4}} = \frac{a}{\sqrt{2}}$$

89. The line  $x + y = 4$  cuts the line joining  $P(-1, 1)$  and  $Q(5, 7)$  at  $R$ . What is  $PR : RQ$  equal to?

- (a)  $1 : 1$
- (b)  $1 : 2$
- (c)  $2 : 1$
- (d)  $1 : 3$

(B)

90. What is the sum of the intercepts of the line whose perpendicular distance from origin is 4 units and the angle which the normal makes with positive direction of  $x$ -axis is  $15^\circ$ ?

- (a) 8
- (b)  $4\sqrt{6}$
- (c)  $8\sqrt{6}$
- (d) 16

(C)

91. What is the length of projection of the vector  $\hat{i} + 2\hat{j} + 3\hat{k}$  on the vector  $2\hat{i} + 3\hat{j} - 2\hat{k}$ ?

~~(a)~~  $\frac{1}{\sqrt{17}}$

(b)  $\frac{2}{\sqrt{17}}$

(c)  $\frac{3}{\sqrt{17}}$

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

(B)

92. If  $(\vec{a} \times \vec{b})^2 + (\vec{a} \cdot \vec{b})^2 = 144$  and  $|\vec{b}| = 4$ , then what is the value of  $|\vec{a}|$ ?

~~(a)~~ 3

(b) 4

(c) 5

(d) 6

(A)

93. If  $\theta$  is the angle between vectors  $\vec{a}$  and  $\vec{b}$  such that  $\vec{a} \cdot \vec{b} \geq 0$ , then which one of the following is correct?

(a)  $0 \leq \theta \leq \pi$

(b)  $\frac{\pi}{2} \leq \theta \leq \pi$

~~(c)~~  $0 \leq \theta \leq \frac{\pi}{2}$

(d)  $0 < \theta < \frac{\pi}{2}$

(C)

94. The vectors  $60\hat{i} + 3\hat{j}$ ,  $40\hat{i} - 8\hat{j}$  and  $\beta\hat{i} - 52\hat{j}$  are collinear if:

(a)  $\beta = 20$

(b)  $\beta = 40$

~~(c)~~  $\beta = -40$

(d)  $\beta = 26$

(C)

95. Consider the following in respect of the vectors  $\vec{a} = (0, 1, 1)$  and  $\vec{b} = (1, 0, 1)$ :

1. The number of unit vectors perpendicular to both  $\vec{a}$  and  $\vec{b}$  is only one.

2. The angle between the vectors is  $\frac{\pi}{3}$ .

Which of the statements given above is/are correct?

~~(a)~~ 1 only

(b) 2 only

~~(c)~~ Both 1 and 2

(d) Neither 1 nor 2

(B)

96. If L is the line with direction ratios  $\langle 3, -2, 6 \rangle$  and passing through  $(1, -1, 1)$ , then what are the coordinates of the points on L whose distance from  $(1, -1, 1)$  is 2 units?

(a)  $\left(-\frac{11}{7}, \frac{13}{7}, \frac{19}{7}\right)$  and  $\left(\frac{1}{7}, \frac{3}{7}, \frac{5}{7}\right)$

(b)  $\left(\frac{19}{7}, -\frac{11}{7}, \frac{13}{7}\right)$  and  $\left(-\frac{1}{7}, \frac{3}{7}, -\frac{5}{7}\right)$

(c)  $\left(\frac{13}{7}, \frac{11}{7}, \frac{19}{7}\right)$  and  $\left(-\frac{1}{7}, -\frac{3}{7}, \frac{5}{7}\right)$

(d)  $\left(\frac{13}{7}, -\frac{11}{7}, \frac{19}{7}\right)$  and  $\left(\frac{1}{7}, -\frac{3}{7}, -\frac{5}{7}\right)$

(D)

97. Which one of the planes is parallel to the line  $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ ?

- (a)  $2x + 2y + z - 1 = 0$   
 (b)  $2x - y - 2z + 5 = 0$   
 (c)  $2x + 2y - 2z + 1 = 0$   
 (d)  $x - 2y + z - 1 = 0$

(D)

98. What is the angle between the lines  $2x = 3y = -z$  and  $6x = -y = -4z$ ?

- (a)  $0^\circ$   
 (b)  $30^\circ$   
 (c)  $60^\circ$   
 (d)  $90^\circ$

(D)

99. What is the equation of the sphere concentric with the sphere  $x^2 + y^2 + z^2 - 2x - 6y - 8z - 5 = 0$  and which passes through the origin?

- (a)  $x^2 + y^2 + z^2 - 2x - 8z = 0$   
 (b)  $x^2 + y^2 + z^2 - 2x - 6y = 0$   
 (c)  $x^2 + y^2 + z^2 - 6y - 8z = 0$   
 (d)  $x^2 + y^2 + z^2 - 2x - 6y - 8z = 0$

(D)

100. A point P lies on the line joining A(1, 2, 3) and B(2, 10, 1). If z-coordinate of P is 7, what is the sum of other two coordinates?

- (a) -15  
 (b) -13  
 (c) -11  
 (d) -9

(A)

101. The sum of deviations of n numbers from 10 and 20 are p and q respectively. If  $(p - q)^2 = 10000$ , then what is the value of n?

- (a) 10  
 (b) 20  
 (c) 50  
 (d) 100

(A)

102. If  $\bar{X} = 20$  is the mean of 10 observations  $x_1, x_2, \dots, x_{10}$ ; then what is the value of  $\sum_{i=1}^{10} \left( \frac{3x_i - 4}{5} \right)$ ?

- (a) 0  
 (b) 12  
 (c) 112  
 (d) 1012

(C)

103. If the mean and the sum of squares of 10 observations are 40 and 16160 respectively, then what is the standard deviation?

- (a) 16  
 (b) 6  
 (c) 5  
 (d) 4

(D)

$$\bar{x} = 40$$

$$\sum x^2 = 16160$$

$$\sqrt{16160}$$

104. Three dice are thrown. What is the probability of getting a sum which is a perfect square?

- (a)  $\frac{17}{108}$   
 (b)  $\frac{5}{108}$   
 (c)  $\frac{19}{108}$   
 (d)  $\frac{23}{108}$

(A)

105. A, B, C and D are mutually exclusive and exhaustive events.

If  $2P(A) = 3P(B) = 4P(C) = 5P(D)$ ,  
then what is  $77P(A)$  equal to ?

- (a) 12  
(b) 15  
(c) 20  
(d) 30

D

106. Two distinct natural numbers from 1 to 9 are picked at random. What is the probability that their product has 1 in its unit place ?

- (a)  $\frac{1}{81}$   
(b)  $\frac{1}{72}$   
(c)  $\frac{1}{18}$   
(d)  $\frac{1}{36}$

D

107. Two dice are thrown. What is the probability that difference of numbers on them is 2 or 3 ?

- (a)  $\frac{7}{36}$   
(b)  $\frac{7}{18}$   
(c)  $\frac{5}{18}$   
(d)  $\frac{11}{36}$

B

108. What is the mean of the numbers 1, 2, 3, ..., 10 with frequencies  ${}^9C_0, {}^9C_1, {}^9C_2, \dots, {}^9C_9$ , respectively ?

- (a)  $1.1 \times 2^8$   
(b)  $1.2 \times 7^4$   
(c) 5.5  
(d) 0.55

C

109. The probability that a person recovers from a disease is 0.8. What is the probability that exactly 2 persons out of 5 will recover from the disease ?

- (a) 0.00512  
(b) 0.02048  
(c) 0.2048  
(d) 0.0512

D

110. Suppose that there is a chance for a newly constructed building to collapse, whether the design is faulty or not. The chance that the design is faulty is 10%. The chance that the building collapses is 95% if the design is faulty, otherwise it is 45%. If it is seen that the building has collapsed, then what is the probability that it is due to faulty design ?

- (a) 0.10  
(b) 0.19  
(c) 0.45  
(d) 0.95

B



111. If  $r$  is the coefficient of correlation between  $x$  and  $y$ , then what is the correlation coefficient between  $(3x + 4)$  and  $(-3y + 3)$ ?

- (a)  $-r$
- (b)  $r$
- (c)  $\sqrt{3}r$
- (d)  $-\sqrt{3}r$

B

112. A fair coin is tossed 6 times. What is the probability of getting a result in the 6<sup>th</sup> toss which is different from those obtained in the first five tosses?

- (a)  $\frac{7}{16}$
- (b)  $\frac{1}{16}$
- (c)  $\frac{1}{32}$
- (d)  $\frac{1}{64}$

C

113. If  $H$  is the Harmonic Mean of three numbers  $^{10}C_4$ ,  $^{10}C_5$ , and  $^{10}C_6$ , then what is the value of  $\frac{270}{H}$ ?

- (a) 1
- (b)  $\frac{14}{17}$
- (c)  $\frac{17}{14}$
- (d)  $\frac{1}{31}$

C

114. In a class, there are  $n$  students including the students  $P$  and  $Q$ . What is the probability that  $P$  and  $Q$  sit together if seats are assigned randomly?

- (a)  $\frac{1}{n}$
- (b)  $\frac{2}{n}$
- (c)  $\frac{4}{n}$
- (d)  $\frac{1}{2n}$

B

115. In a Binomial distribution  $B(n, p)$ ,  $n = 6$  and  $9P(X = 4) = P(X = 2)$ . What is  $p$  equal to?

- (a)  $\frac{1}{4}$
- (b)  $\frac{1}{2}$
- (c)  $\frac{3}{4}$
- (d)  $\frac{4}{5}$

A



Consider the following for the next five (05) items that follow :

Three boys P, Q, R and three girls S, T, U are to be arranged in a row for a group photograph.

116. What is the probability that all three boys sit together ?

- (a)  $\frac{1}{5}$  (A)  
(b)  $\frac{1}{4}$   
(c)  $\frac{1}{3}$   
(d)  $\frac{1}{12}$

117. What is the probability that boys and girls sit alternatively ?

- (a)  $\frac{4}{5}$   
(b)  $\frac{1}{10}$  (B)  
(c)  $\frac{5}{6}$   
(d)  $\frac{1}{7}$

118. What is the probability that no two girls sit together ?

- (a)  $\frac{2}{5}$   
(b)  $\frac{3}{5}$  (D)  
(c)  $\frac{1}{18}$   
(d)  $\frac{1}{5}$

119. What is the probability that P and Q take the two end positions ?

- (a)  $\frac{1}{15}$   
(b)  $\frac{7}{15}$  (A)  
(c)  $\frac{14}{15}$   
(d)  $\frac{11}{45}$

120. What is the probability that Q and U sit together ?

- (a)  $\frac{2}{3}$   
(b)  $\frac{1}{4}$  (D)  
(c)  $\frac{5}{6}$   
(d)  $\frac{1}{3}$