

1. The variance of 10 observations is 25. If 2 is multiplied to each of the observations and subsequently 7 is subtracted from each multiplied observation, then what is the new variance?

(a) 125
(b) 100
(c) 50
(d) 25

2. If the random variable X has mean 5 and standard deviation 4, then what is the standard deviation of the random variable $Y = 3X + 4$?

(a) 16
(b) 12
(c) 10
(d) 6

3. For a binomial distribution with mean 4 and standard deviation $\sqrt{3}$, what is the value of $P(X = 0)$?

(a) $\left(\frac{1}{4}\right)^{16}$
(b) $\left(\frac{3}{4}\right)^{16}$
(c) $\left(\frac{1}{4}\right)^{12}$
(d) $\left(\frac{3}{4}\right)^{12}$

4. If the correlation coefficient between the variables X and Y is zero, then the two lines of regression are

(a) $X + Y + 11 = 0$ and $2X + 3Y + 4 = 0$
(b) $X = \bar{X}$ and $Y = \bar{Y}$
(c) $X = 0.4Y + 10$ and $Y = 1.6X + 20$
(d) $\bar{X} + \bar{Y} + 11 = 0$ and $2\bar{X} + 3\bar{Y} + 4 = 0$

5. Four dice are rolled. What is the probability of getting a total of the numbers on the dice as 7?

(a) $5/1296$
(b) $7/324$
(c) $7/1296$
(d) $5/324$

6. If $P(A \cap B) = 1/2$ and $P(\bar{A} \cap \bar{B}) = 1/2$, and $2P(A) = P(B) = k$, then what is the value of k ?

(a) $1/4$
(b) $1/2$
(c) $1/3$
(d) $2/3$

7. A committee has 6 men and 4 women. One member is selected randomly which is woman only. What is the probability that she belongs to a subgroup of 2 senior women?

(a) $1/3$
(b) $1/2$
(c) $2/3$
(d) $3/4$

8. The standard deviation of X is 4 and the standard deviation of Y is 5. If the correlation coefficient r is 0.8, then what is the regression coefficient of Y on X ?

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

9. In a class, the probability of passing students in Mathematics is 0.7 and the probability of passing both Mathematics and Statistics is 0.5. What is the probability that a student passes Statistics given that the student passed Mathematics?

(a) $5/7$
(b) $4/7$
(c) $3/7$
(d) $2/7$

10. If the mean of 50 observations is 40 and the standard deviation is 8, then what is the coefficient of variation?

(a) 15%
(b) 20%
(c) 25%
(d) 30%

11. If two fair dice are tossed, then what is the probability that the sum of the numbers on the faces of the dice is neither 5 nor 7?

(a) $11/18$
(b) $2/3$
(c) $13/18$
(d) $5/6$

12. Consider the following statements for three events A , B and C :

I. $P(A \cap B \cap C) \leq P(A) + P(B) + P(C) - 2$

II. $P(A \cup B \cup C) \geq P(A) + P(B) + P(C)$

Which of the statements given above is/are correct?

(a) I only
(b) II only
(c) Both I and II
(d) Neither I nor II

13. A Mathematics problem is given to two students X and Y to solve. The odds in favour of X solving the problem are 6 to 9 and the odds against Y in solving the problem are 6 to 5. What is the probability that the problem will be solved if both X and Y try to solve the problem?

(a) $27/55$
(b) $31/55$
(c) $37/55$
(d) $39/55$

14. The events A and B are independent among three events A , B and D . If $P(A \cap B \cap D) = 0.04$, $P(D|A \cap B) = 0.25$ and $P(B) = 4P(A)$, then what is the value of $P(A \cup B)$?

(a) 0.88

(b) 0.84

(c) 0.28 ✓

(d) 0.16

16. If G is the geometric mean of $P(A)$, $P(B)$, $P(C)$ and $P(D)$, then what is G equal to?

(a) $\frac{5}{2\sqrt{3}}$

(b) $\frac{2}{5\sqrt{3}}$

(c) $\frac{\sqrt{3}}{5}$

(d) $\frac{1}{5\sqrt{3}}$

For the next **three (03)** items that follow :

Let A , B , C and D be mutually exclusive and exhaustive events such that

$$\frac{P(A)}{6} = \frac{P(B)}{3} = \frac{P(C)}{4} = \frac{P(D)}{2}$$

15. What is $\frac{P(A) + 2P(B)}{3P(C) + P(D)}$ equal to?

(a) $5/4$

(b) $6/7$

(c) $2/5$

(d) $17/6$

17. If H is the harmonic mean of $P(A)$, $P(B)$, $P(C)$ and $P(D)$, then what is H equal to?

(a) $14/75$

(b) $15/76$

(c) $16/75$

(d) $16/15$

For the next **three (03)** items that follow :

Five numbers are randomly picked from the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and arranged them in ascending order [$x_1 < x_2 < x_3 < x_4 < x_5$; x_1 being the smallest number and x_5 being the largest number selected].

18. What is $P(x_1 = 4)$ equal to?

(a) $5/84$

(b) $1/14$ ✓

(c) $1/7$

(d) $19/84$

19. What is $P(x_3 = 6)$ equal to?

(a) $5/21$

(b) $10/21$

(c) $11/21$ ✓

(d) $17/21$

20. What is $P(x_1 = 2, x_2 = 3, x_3 = 8)$ equal to?

(a) $1/12$

(b) $1/60$

(c) $1/252$

(d) 0 ✓

21. Consider the following statements :

I. $\frac{d}{dx} \ln|x| = -\frac{1}{x}$ if $x < 0$

II. $\frac{d}{dx} \ln|x| = \frac{1}{x}$ if $x > 0$

Which of the statements given above is/are correct?

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

22. If $y = \left| \sin\left(\frac{\pi}{4} - x\right) \right|$, then what is $\frac{dy}{dx}$ at $x = \frac{\pi}{4}$ equal to?

(a) -1

(b) 0

(c) 1

(d) It does not exist

23. Let f be a differentiable function such that $f(x+y) = f(x) + f(y)$ for all $x, y \in R$. Which of the following statements is/are correct?

I. If $f(x) = xg(x)$, then the derivative of $f(x)$ with respect to x is equal to $g(0)$.

II. If $f(x) = x^2g(x)$, then the derivative of $f(x)$ with respect to x is equal to 0 .

(Here g is a continuous function)

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

24. If

$$f(x) = x^{n-1} + x^{n-2} + x^{n-3} + \dots + 1$$

then what is $f'(2)$ equal to?

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

25. ABC is a triangle right angled at B. If AC = 8 units, then what is the area of the triangle of maximum area?

- (a) 32 square units
- (b) 24 square units
- (c) 16 square units
- (d) 12 square units

26. For the curve $y = xe^{2x}$

- (a) minimum occurs at $x = -2$
- (b) minimum occurs at $x = -1$
- (c) minimum occurs at $x = -1/2$
- (d) maximum occurs at $x = -1/2$

27. Let $f(x) = \int xe^x dx$. Then $f(x)$ decreases in the interval

- (a) $(-\infty, 0)$
- (b) $(0, \infty)$
- (c) $(-\infty, -1)$
- (d) $(-1, \infty)$

28. What is the solution of the differential equation $\frac{dy}{dx} = 1 + x \cot(y-x)$?

- (a) $\sec(y-x) = ce^{\frac{x^2}{2}}$
- (b) $\cos(y-x) = ce^{\frac{x^2}{2}}$
- (c) $\operatorname{cosec}(y-x) = ce^{\frac{x^2}{2}}$
- (d) $\sin(y-x) = ce^{\frac{x^2}{2}}$

29. Consider the following statements in respect of the function

$$f: R - \left\{\frac{3}{5}\right\} \rightarrow R - \left\{\frac{3}{5}\right\}$$

$$\text{such that } f(x) = \frac{3x+2}{5x-3} :$$

I. $f(x)$ is a bijective function.

II. $f^{-1}(x) = f(x)$

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

30. Let A and B be the sets having only 2 and 3 elements respectively. What is the total number of mappings from A to B?

- (a) 4
- (b) 6
- (c) 8
- (d) 9

31. What is the domain of the function $f(x) = \log_x e$?

- (a) $(0, \infty)$
- (b) $(0, \infty) - \{1\}$
- (c) $(0, \infty) - \{e\}$
- (d) $(0, \infty) - \{10\}$

32. If $f(x)$ is the integral of

$$\frac{1 + \cos^2 x - 2 \cos x}{x \sin^2 x \tan x}$$

then what is $\lim_{x \rightarrow 0} f'(x)$ equal to?

- (a) 0
- (b) $1/2$
- (c) $1/3$
- (d) $1/4$

33. Consider the following statements in respect of the function $f(x) = [3x]$, where $[\cdot]$ is the greatest integer function :

- I. $f(x)$ is continuous at $x = 1/3$.
- II. $f(x)$ is differentiable at $x = 1/4$.

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

34. What is $\lim_{x \rightarrow 0} \frac{\sin^2 x}{x|x|}$ equal to?

- (a) -1
- (b) 0
- (c) 1
- (d) Limit does not exist

35. Let $f(x) = p|x| + q$, where p and q are real constants. If $f'(x)$ exists at $x = 0$, then what is the value of p ?

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

36. Consider the following statements in respect of the given function :

$$f(x) = \begin{cases} \frac{x^3}{|x|}, & x \neq 0 \\ 0, & x = 0 \end{cases}$$

- I. $f(x)$ is continuous everywhere.
- II. $f(x)$ is differentiable everywhere.

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

37. What is $\lim_{x \rightarrow \infty} (\sqrt{x + \sqrt{x}} - \sqrt{x})$ equal to?

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

38. If m and n are the roots of the equation $x^2 - px + q = 0$, then what is

$$\lim_{x \rightarrow m} \frac{e^{x^2 - px + q} - 1}{(x - m)(x - n)}$$

equal to?

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

39. Let $f(x) = x^n + k$, where n is a natural number and k is a positive real constant such that $f(x) + f\left(\frac{1}{x}\right) = f(x)f\left(\frac{1}{x}\right)$ and $f(2) = 9$. What is $f(-1)$ equal to?

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

40. If $f(x) = \cos\left\{\frac{\pi}{3}[x] + x\right\}$ for $1 < x < 2$, where $[\cdot]$ is the greatest integer function, then what is $f\left(\frac{\pi}{2}\right)$ equal to?

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

41. What is $\int \frac{\sqrt{x}}{\sqrt{1-x^3}} dx$ equal to?

- (a) $\frac{x^{3/2}}{3} + c$
- (b) $\frac{2x^{3/2}}{3} + c$
- (c) $\frac{1}{3} \sin^{-1}(x^{3/2}) + c$
- (d) $\frac{2}{3} \sin^{-1}(x^{3/2}) + c$

42. What is $\int_0^1 \frac{dx}{(ax + bx + c)^2}$ equal to?

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

43. What is $\int e^{x \ln 10} e^x dx$ equal to?

- (a) $\frac{(10e)^x}{1 + \ln 10} + c$
- (b) $\frac{10e^x}{1 + \ln 10} + c$
- (c) $\frac{e^{2x}}{2} + c$
- (d) $\frac{e^{2x}}{4} + c$

44. What is $\int_1^2 x^x (1 + \ln x) dx$ equal to?

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

[P.T.O.]

45. If $f(x+y) = f(x) + f(y)$, then what is

$$\int_{-1}^1 f(x) dx$$

equal to?

(a) 0

(b) $\int_0^1 f(x) dx$

(c) $2 \int_0^1 f(x) dx$

(d) $2f(1)$

46. What is the area bounded by $y = e^{|x|}$ and the lines $|x| = 1$ and $y = 0$?

(a) $(e - 1)$ square units

(b) $(2e - 2)$ square units

(c) $2e$ square units

(d) $(2e - 1)$ square units

47. The slope of the tangent to the curve $y = f(x)$ at $(x, f(x))$ is $2x$. If the curve passes through the origin, then what is the area bounded by the curve, the x -axis and the line $x = 1$?

(a) $1/3$ square unit

(b) $2/3$ square unit

(c) 1 square unit

(d) $4/3$ square units

48. What is the solution of

$$y dx - x dy - y^2 \cos x dx = 0?$$

(a) $y = \frac{x}{c + \sin x}$

(b) $y = \frac{x}{c - \sin x}$

(c) $y = \frac{x}{1 + c \sin x}$

(d) $y = \frac{x}{1 - c \sin x}$

49. What is the differential equation of the family of straight lines passing through the origin?

(a) $y \frac{dy}{dx} - x = 0$

(b) $y \frac{dy}{dx} + x = 0$

(c) $x \frac{dy}{dx} - y = 0$

(d) $x \frac{dy}{dx} + y = 0$

50. What is the degree of the differential equation representing the family of curves $y^2 = \sqrt{c} x$, where c is a positive parameter?

(a) 1

(b) 2

(c) 3

(d) 4

51. The vertices of a triangle are $A(2, 0, 0)$, $B(0, 6, 0)$ and $C(0, 0, 4)$. If AD , BE and CF are the medians of the triangle, then what is $AD^2 + BE^2 + CF^2$ equal to?

- (a) 81
- (b) 84
- (c) 87
- (d) 90

52. A line makes angles α , β and γ with the positive directions of x -axis, y -axis and z -axis respectively such that $\alpha + \beta = 90^\circ$. Which of the following statements is/are correct?

- I. The maximum value of $\cos\alpha + \cos\beta$ is $\sqrt{2}$.
- II. The minimum value of $\cos\alpha + \cos\beta + \cos\gamma$ is 1.

Select the answer using the code given below.

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

53. What is the area of the triangle whose vertices are $(0, 7, 10)$, $(-1, 6, 6)$ and $(-4, 9, 6)$?

- (a) 9 square units
- (b) 12 square units
- (c) 15 square units
- (d) 18 square units

54. If O is the origin and P is the point $(2, -4, 6)$, then what is the equation of the plane through P and perpendicular to OP ?

- (a) $x + 2y + 3z - 28 = 0$
- (b) $x - 2y + 3z - 28 = 0$
- (c) $x - 2y + 3z + 28 = 0$
- (d) $2x - 4y + 6z - 55 = 0$

55. The image of the point $P(1, 3, 4)$ with respect to the plane $Ax + By + Cz + D = 0$ is $(-3, 5, 2)$. If $A + B + C = 2$, then what is D equal to?

- (a) -3
- (b) 3
- (c) 6
- (d) D cannot be determined due to insufficient data

56. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ and $\vec{d}$ be the vectors. Consider the following :

I. $(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d})$

II. $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d})$

III. $(\vec{a} \cdot \vec{b}) \cdot (\vec{c} \cdot \vec{d})$

IV. $(\vec{a} \cdot \vec{b}) \times (\vec{c} \cdot \vec{d})$

V. $\{(\vec{a} \times \vec{b}) \cdot \vec{c}\} \times \vec{d}$

where $\cdot$ represents dot product and $\times$ represents cross product of vectors. How many of the above are **not** well-defined?

(a) One

(b) Two

(c) Three

(d) Four

57. The scalar projection of $\vec{a} = \lambda\hat{i} + \hat{j} - 2\hat{k}$ on $\vec{b} = 2\hat{i} - \hat{j} - \lambda\hat{k}$ is $7/3$. What is the value of λ ?

(a) 1

(b) 2

(c) 3

(d) 4

58. How much angle does

$$\vec{r} = (\cos\theta)\hat{i} + (\sin\theta)\hat{j} + \hat{k}$$

make with the positive direction of z-axis?

(a) $\pi/2$

(b) $\pi/3$

(c) $\pi/4$

(d) $\pi/6$

59. Let $\vec{a}$ and $\vec{b}$ be unit vectors inclined at 30° . What is the area of the parallelogram whose sides are represented by the vectors $\vec{a} + 3\vec{b}$ and $3\vec{a} + \vec{b}$?

(a) $8\sqrt{3}$ square units

(b) 8 square units

(c) $4\sqrt{3}$ square units

(d) 4 square units

60. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be unit vectors such that $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c} = 0$. If the angle between $\vec{b}$ and $\vec{c}$ is $\pi/6$, then what is $\vec{a}$ equal to?

(a) $(\vec{b} \times \vec{c})$

(b) $\sqrt{2}(\vec{b} \times \vec{c})$

(c) $2(\vec{b} \times \vec{c})$

(d) $\sqrt{3}(\vec{b} \times \vec{c})$

61. A circle touches each of the lines $x - y = 0$ and $x + y = 0$ at unit distance from the origin. The centre of the circle may be at
- (a) $(\sqrt{2}, 0)$
- (b) $(\sqrt{3}, 0)$
- (c) $(1, 0)$
- (d) $(1, 1)$
62. A line $(\sin \theta)x + (\cos \theta)y = \sin 2\theta$ cuts the coordinate axes at points P and Q . Let M be the midpoint of the line segment PQ . What is the distance of M from the origin?
- (a) 2
- (b) 1
- (c) $\cos \theta + \sin \theta$
- (d) $\cos \theta - \sin \theta$
63. The centre and one of the foci (F) of an ellipse are at $(0, 0)$ and $(-c, 0)$ respectively. If $P(x, y)$ is any point on the ellipse and $2a$ is the length of major axis, then what is PF equal to?
- (a) $a - (cx/a)$
- (b) $a - (ax/c)$
- (c) $a + (ax/c)$
- (d) $a + (cx/a)$
64. What is the equation of the line which is equidistant from the lines $2x - 4y - 7 = 0$ and $6x - 12y + 1 = 0$?
- (a) $12x - 24y - 21 = 0$
- (b) $12x - 24y - 19 = 0$
- (c) $3x - 6y - 5 = 0$
- (d) $4x - 8y - 3 = 0$
65. A ray of light passing through the point $P(1, 2)$ reflects on the x -axis at point N and the reflected ray passes through the point $Q(5, 3)$. What is the distance of the point N from the origin?
- (a) 3 units
- (b) $14/5$ units
- (c) $13/5$ units
- (d) 2 units

66. A line cuts off intercept p on the x -axis and intercept q on the y -axis, where $p > q$. The sum of the intercepts is 2 and the product of the intercepts is -15. What is the equation of the line?

(a) $3x - 5y - 15 = 0$

(b) $3x - 5y + 15 = 0$

(c) $5x - 3y - 15 = 0$

(d) $5x + 3y - 15 = 0$

67. Let P and Q be the points on the positive x -axis and positive y -axis respectively. A point $N(2, 1)$ divides the line segment PQ in the ratio 1 : 2. What is the equation of the line?

(a) $2x + y - 5 = 0$

(b) $x + y - 3 = 0$

(c) $x + 2y - 4 = 0$

(d) $x - y - 1 = 0$

68. $ABCD$ is a square. The equations of AB , AD and BD are $y = 0$, $x = 0$ and $x + y - 4 = 0$ respectively. What is the equation of AC ?

(a) $x + y = 0$

(b) $x - y = 0$

(c) $x - y - 4 = 0$

(d) $x - y + 4 = 0$

69. ABC is a triangle, where the vertices A and B are fixed points both lying on the x -axis. Let $AB = 10$ cm. The vertex C moves such that $\frac{1}{\tan A} + \frac{1}{\tan B} = \frac{1}{k}$, where $k \neq 0$. What is the equation of the locus of the point C ?

(a) $y = 10k$

(b) $x = 10k$

(c) $ky = 10$

(d) $kx = 10$

70. What is the eccentricity (e) of the parabola $4x^2 + y = 0$?

(a) $e < 0$

(b) $0 < e < 1$

(c) $e = 1$

(d) $e > 1$

71. What is the LCM of $(11110)_2$, $(10100)_2$ and $(11011)_2$?

- (a) $(1000001100)_2$
- (b) $(1000011100)_2$
- (c) $(1000111100)_2$
- (d) $(1000011101)_2$

72. What is the coefficient of x^{2n} in the expansion of the following?

$$(1+x)^{2n} \left(1 + \frac{1}{x}\right)^{2n}$$

- (a) 1
- (b) $2n(2n-1)(2n-2) \dots (n+1)n$
- (c) $4n(4n-1)(4n-2) \dots (2n+1)(2n)$
- (d) Such term does not exist

73. Consider the following statements in respect of the expansion of $(x^2 + x^{-2} + 2)^4$:

- I. The number of terms in the expansion is 5.
- II. One of the coefficients in the expansion has a maximum value equal to 70.

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

74. Consider the following relations from A to B, where $A = \{1, 3, 5\}$ and $B = \{2, 4, 6, 8\}$:

- I. $\{(1, 2), (3, 2), (3, 6), (5, 8)\}$
- II. $\{(3, 4), (5, 8), (1, 6), (3, 2)\}$
- III. $\{(1, 2), (3, 6)\}$
- IV. $\{(1, 6), (3, 2), (5, 2)\}$

Which of the above is/are function(s) from A to B?

- (a) I, III and IV
- (b) IV only
- (c) II and IV
- (d) III only

75. If $x^2 - 2x \cos \theta + 1 = 0$, then what is the magnitude of x ?

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

76. Consider the following statements in respect of sets A and B :

- I. If $x \in A$ and $A \in B$, then $x \in B$.
- II. If $A \subset B$ and $x \notin B$, then $x \notin A$.

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

77. A research group conducted a survey of 500 consumers and reported that 370 consumers preferred product X and 240 consumers preferred product Y . What is the least number that must have preferred both the products?

(a) 90

(b) 100

(c) 110

(d) Cannot be determined due to insufficient data

78. The Cartesian product $A \times A$ has 25 elements among which are found $(3, 1)$, $(6, 2)$, $(5, 3)$. Which of the following statements is/are correct?

I. It is possible to determine other elements of $A \times A$.

II. $(5, 5) \in A \times A$ and $(1, 3) \notin A \times A$

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

79. Consider the following statements in respect of a relation R from a set A to a set B :

I. The set B is called codomain of the relation R .

II. The range of the relation is always equal to codomain of the relation R .

III. The domain of the relation R must be equal to the set A .

Which of the statements given above is/are correct?

(a) I only

(b) III only

(c) I and II

(d) I and III

80. Consider the following system of linear inequalities :

$$x - y \leq 3 \text{ and } x + y \geq 5$$

The solution of the inequalities lies in

(a) first quadrant only

(b) second quadrant only

(c) both first quadrant and second quadrant only

(d) all the four quadrants

81. If $\frac{1}{b-a} + \frac{1}{b-c} = \frac{2}{b}$, then a , b and c are in

(a) AP

(b) GP

(c) HP ✓

(d) Neither in AP nor in GP nor in HP

82. Let P , Q , R and S be the sum of n terms, $2n$ terms, $3n$ terms and $4n$ terms respectively of an AP such that $Q = 3P$. Which one of the following is correct?

(a) $5R = 3S$

(b) $6R = 5S$

(c) $8R = 7S$

(d) $9R = 8S$

83. In a GP, the 3rd, 5th and 7th terms are x , $x^2 + 2$ and $x^3 + 10$ respectively, where $x > 1$. What is the 8th term?

(a) 18

(b) $18\sqrt{3}$

(c) 54

(d) $54\sqrt{3}$

84. If $(1+i)^n - 16 = 0$, where $i = \sqrt{-1}$ and n is a positive integer, then what is the least value of n ?

(a) 2

(b) 4

(c) 8

(d) 16

85. What is $i \times i^4 \times i^9 \times i^{16} \times \dots \times i^{576}$, where $i = \sqrt{-1}$, equal to?

(a) $-i$ ✓

(b) -1

(c) 1

(d) i

86. If $z = x + iy$ be such that $\left| \frac{z + \lambda i}{z - \lambda i} \right| = 1$,

where $i = \sqrt{-1}$ and λ is a positive real number, then which of the following statements is/are correct?

I. z lies on the line $y = x$.

II. The amplitude of z is $\frac{\pi}{4}$.

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

87. What is

$$\begin{vmatrix} \frac{1}{a} & bc & a^3 \\ \frac{1}{a} + \frac{1}{b} & c(a+b) & a^3 + b^3 \\ \frac{1}{a} + \frac{1}{b} + \frac{1}{c} & ab+bc+ca & a^3 + b^3 + c^3 \end{vmatrix}$$

equal to?

(a) 0

(b) 3

(c) $(a+b+c)(ab+bc+ca)$

(d) $a^3 + b^3 + c^3 - 3abc$

88. If

$$ae + bg = cf + dh = p, af + bh = ce + dg = q$$

then what is

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} \times \begin{vmatrix} e & f \\ g & h \end{vmatrix}$$

equal to?

(a) $p^2 q^2$

(b) pq

(c) $p^2 + q^2$

(d) $p^2 - q^2$

89. If

$$x + ay + a^2 z = 1, x + by + b^2 z = 1, x + cy + c^2 z = 1$$

where $a \neq b \neq c$, then what is $x + y + z$ equal to?

(a) 0

(b) 1

(c) 3

(d) $a + b + c$

90. Let

$$A = \begin{pmatrix} 1 & -\tan \theta \\ \tan \theta & 1 \end{pmatrix} \text{ and } B = \begin{pmatrix} 1 & \tan \theta \\ -\tan \theta & 1 \end{pmatrix}$$

If $C = AB^{-1}$, then what is $\det(C)$ equal to?

(a) $\sec^2 \theta$

(b) $\sec^4 \theta$

(c) $\cos^2 \theta$

(d) 1

91. Let A and B be symmetric matrices of the same order. Which of the following statements is/are correct?

- I. $(AB - BA)$ is also a symmetric matrix.
- II. $(BA - AB)$ is a skew-symmetric matrix.

Select the answer using the code given below.

- (a) I only
- (b) II only
- (c) Both I and II ✓
- (d) Neither I nor II

92. If $A = \begin{bmatrix} -1 & 2 \\ 3 & -4 \end{bmatrix}$, then what is $|A^{-1}|$ equal to?

- (a) -2 ✓
- (b) -1
- (c) $-1/2$
- (d) 2

93. Let S be the set of all real numbers and R be a relation on S defined by $xRy \Rightarrow |x| \leq y$. Then R is

- (a) reflexive only ✓
- (b) transitive only
- (c) both reflexive and transitive
- (d) neither reflexive nor transitive

94. 4-digit numbers are formed with 1, 2, 3 and 4. What is the number of the 4-digit numbers in which at least one digit is repeated?

- (a) 256
- (b) 244
- (c) 232 ✓
- (d) 220

95. Given

$$S = \{(x, y, z) \in R^3 : xyz = 210, x < y < z, \text{ where } x, y, z \text{ are positive integers}\}$$

What is the total number of elements in S ?

- (a) 10
- (b) 12
- (c) 13
- (d) More than 13

96. If $x = 4 + i$, where $i = \sqrt{-1}$, then what is $x^3 + 2x^2 - 63x + 171$ equal to?

- (a) -1
- (b) 0 ✓
- (c) 1
- (d) 2

97. Let α and β be the roots of the equation

$$x^2 - p(x+1) - q = 0$$

What is

$$\frac{\alpha^2 + 2\alpha + 1}{\alpha^2 + 2\alpha + q} + \frac{\beta^2 + 2\beta + 1}{\beta^2 + 2\beta + q}$$

equal to?

(a) -1

(b) 0

(c) 1

(d) 2

98. If the sum of the roots of the equation

$$\frac{1}{2x+p} + \frac{1}{2x+q} = \frac{1}{r}$$

is zero, then what is r equal to?

(a) $p - q$

(b) $p + q$

(c) $(p - q)/2$

(d) $(p + q)/2$

99. Let α and β be the roots of the equation $ax^2 + bx + c = 0$ and $p_n = \alpha^n + \beta^n$, where $n > 1$. What is

$$ap_{n+1} + bp_n + cp_{n-1}$$

equal to?

(a) 0

(b) 1

(c) $a + b + c$

(d) $a - b + c$

100. If p , q and r are in AP, then what is

$$p^3 + 3pr(p+r) + r^3$$

equal to?

(a) q^3

(b) $2q^3$

(c) $3q^3$

(d) $8q^3$

101. What is $6\sin(\pi/18) - 8\sin^3(\pi/18)$ equal to?

- (a) $1/4$
- (b) $1/2$
- (c) 1
- (d) 2

102. How many values of θ satisfy the equation $\tan^2 \theta + \cot^2 \theta = 2$, where $0^\circ < \theta < 360^\circ$?

- (a) 1
- (b) 2
- (c) 4
- (d) 8

103. What is $\sin(\tan^{-1} 0.75)$ equal to?

- (a) 1
- (b) $4/5$
- (c) $3/5$
- (d) $1/2$

104. What is $\tan^2\left(\frac{1}{2}\cos^{-1}\frac{1}{3}\right)$ equal to?

- (a) $1/2$
- (b) 1
- (c) 2
- (d) 4

105. What is

$$\tan(1125^\circ)\cot(405^\circ) + \tan(765^\circ)\cot(675^\circ)$$

equal to?

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

106. If A is a square matrix of order 3 and $|A|=2$, then what is $\text{adj}(\text{adj}A)$ equal to?

- (a) $8A$
- (b) $4A$
- (c) $2A$

(d) $2I$, where I is the identity matrix of order 3

107. If A is a square matrix of order 3 such that

$$A(\text{adj}A) = \begin{bmatrix} 64 & 0 & 0 \\ 0 & 64 & 0 \\ 0 & 0 & 64 \end{bmatrix}$$

then what is $|A|$ equal to?

- (a) 4
- (b) 8
- (c) 16
- (d) 64

108. Let

$$A = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$$

What is the least value of θ for which $A + A^T = I$, where I is the identity matrix of order 2?

- (a) $\pi/2$
- (b) $\pi/3$
- (c) $\pi/4$
- (d) $\pi/6$

109. Let A , B and C be the square matrices of order 2 such that $AB = AC$. Which of the statements given below is/are correct?

- I. B and C are not necessarily equal if A is a singular matrix.
- II. B and C are equal if A is a non-singular matrix.

Select the answer using the code given below.

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

110. If A is a square matrix of order 3 and $|A| = 4$, then what is $|\text{adj}A|$ equal to?

- (a) 64
- (b) 16
- (c) 8
- (d) 4

For the next **two (02)** items that follow :

From the top of a building, the angles of depression of the top and bottom of a tower of height h are α and β respectively. Let H be the height of the building and D be the horizontal distance between the building and the tower.

111. What is $H^2 + D^2$ equal to?

(a) $\frac{h^2 \cos^2 \alpha}{\sin^2(\beta - \alpha)}$

(b) $\frac{h^2 \cos^2 \beta}{\sin^2(\beta - \alpha)}$

(c) $\frac{h^2 \cos^2 \alpha}{\sin^2(\beta + \alpha)}$

(d) $\frac{h^2 \cos^2 \beta}{\sin^2(\beta + \alpha)}$

112. If $\alpha = 15^\circ$ and $\beta = 45^\circ$, then which one of the following is correct?

(a) $H = \sqrt{2}D$

(b) $D = \sqrt{2}H$

(c) $2H = \sqrt{3}D$

(d) $H = D$

For the next **two (02)** items that follow :

The angles A , B and C of a triangle ABC are in the ratio $1 : 2 : 7$.

113. What is the ratio of the side of greatest length to the side of least length?

- (a) $7 : 1$
- (b) $\sqrt{7} : 1$
- (c) $(3 + \sqrt{5}) : 2$
- (d) $(3 + \sqrt{5}) : 3$

114. What is $\sin A \cdot \cos B$ equal to?

- (a) $1/4$
- (b) $1/2$
- (c) 1
- (d) 2

For the next **two (02)** items that follow :

In a triangle ABC , $\frac{a+b}{13} = \frac{b+c}{11} = \frac{c+a}{12}$.

115. What is $\sin A : \sin B : \sin C$ equal to?

- (a) $5 : 6 : 7$
- (b) $7 : 6 : 5$
- (c) $13 : 11 : 12$
- (d) $12 : 11 : 13$

116. What is $\cos A : \cos B : \cos C$ equal to?

- (a) $7 : 19 : 25$
- (b) $11 : 12 : 13$
- (c) $7 : 11 : 13$
- (d) $12 : 11 : 13$

For the next **two (02)** items that follow :

Given that $\tan\left(\frac{A}{2} + \frac{B}{2}\right) = p$ and $\tan\left(\frac{A}{2} - \frac{B}{2}\right) = q$,

where $pq \neq \pm 1$.

117. What is $\tan A$ equal to?

- (a) $\frac{p-q}{1+pq}$
- (b) $\frac{p+q}{1-pq}$
- (c) $\frac{p+q}{1+pq}$
- (d) $\frac{p-q}{1-pq}$

118. What is $\tan B$ equal to?

- (a) $\frac{p-q}{1+pq}$
- (b) $\frac{p+q}{1-pq}$
- (c) $\frac{p+q}{1+pq}$
- (d) $\frac{p-q}{1-pq}$

For the next **two (02)** items that follow :

Let $4(A+B) = \pi$.

119. What is $(1 + \tan A)(1 + \tan B)$ equal to?

- (a) 1
- (b) 2
- (c) 4
- (d) 6

120. What is $(\cot A - 1)(\cot B - 1)$ equal to?

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