1. Let $\sum_{i=1}^{9} x_i^2 = 855$. If M is the mean and σ is the standard deviation of $x_1, x_2, \cdots, x_9$, then what is the value of $M^2 + \sigma^2$?

(a) 100

(b) 95

(c) 90

(d) 85

2. The mean of the series $x_1, x_2, \cdots, x_n$ is $\bar{x}$. If x_n is replaced by k, then what is the new mean?

(a) $\bar{x} - x_n + k$

(b) $\frac{n\bar{x} - \bar{x} + k}{n}$

(c) $\frac{\bar{x} - x_n - k}{n}$

(d) $\frac{n\bar{x} - x_n + k}{n}$

3. A fair coin is tossed till two heads occur in succession. What is the probability that the number of tosses required is less than 6?

(a) 5/64

(b) 15/32

(c) 31/64

(d) 19/32

4. Urn A contains 2 white and 2 black balls while urn B contains 3 white and 2 black balls. One ball is transferred from urn A to urn B and then a ball is drawn out of urn B. What is the probability that the ball is white?

(a) 11/20

(b) 7/12

(c) 3/5

(d) 1

5. For two events A and B, $P(A) = P(A|B) = 0.25$ and $P(B|A) = 0.5$. Which of the following are correct?

I. A and B are independent.

II. $P(A^c \cup B^c) = 0.875$

III. $P(A^c \cap B^c) = 0.375$

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

6. Two perfect dice are thrown. What is the probability that the sum of the numbers on the faces is neither 9 nor 10?

(a) 1/36

(b) 5/36

(c) 7/36

(d) 29/36

7. The occurrence of a disease in an industry is such that the workers have 20% chance of suffering from it. What is the probability that out of 6 workers chosen at random, 4 or more will suffer from the disease?

(a) 53/3125

(b) 63/3125

(c) 73/3125

(d) 83/3125

8. Three perfect dice are rolled. Under the condition that no two show the same face, what is the probability that one of the faces shown is an ace (one)?

(a) 5/9

(b) 2/3

(c) 1/3

(d) 1/2

9. Three perfect dice D_1, D_2 and D_3 are rolled. Let x, y and z represent the numbers on D_1, D_2 and D_3 respectively. What is the number of possible outcomes such that $x < y < z$?

(a) 20

(b) 18

(c) 14

(d) 10

10. In a binomial distribution, if the mean is 6 and the standard deviation is $\sqrt{2}$, then what are the values of the parameters n and p respectively?

(a) 18 and 1/3

(b) 9 and 1/3

(c) 18 and 2/3

(d) 9 and 2/3

11. Let $x - 3y + 4 = 0$ and $2x - 7y + 8 = 0$ be two lines of regression computed from some bivariate data. If b_{yx} and b_{xy} are regression coefficients of lines of regression of y on x and x on y respectively, then what is the value of $b_{xy} + 7b_{yx}$?

(a) -2

(b) 1

(c) 2

(d) 5

12. The mean of n observations

$1, 4, 9, 16, \cdots, n^2$

is 130. What is the value of n?

(a) 18

(b) 19

(c) 20

(d) 21

13. Three distinct natural numbers are chosen at random from 1 to 10. What is the probability that they are consecutive?

(a) 1/12

(b) 3/40

(c) 1/15

(d) 7/120

14. A, B, C are three mutually exclusive and exhaustive events associated with a random experiment. If $3P(B) = 4P(A)$ and $3P(C) = 2P(B)$, then what is $P(A)$ equal to?

(a) 7/29

(b) 8/29

(c) 9/29

(d) 10/29

15. A die has two faces with number 4, three faces with number 5 and one face with number 6. If the die is rolled once, then what is the probability of getting 4 or 5?

(a) 1/3

(b) 2/3

(c) 5/6

(d) 1/2

16. A box contains 2 black, 4 yellow and 6 white balls. Three balls are drawn in succession with replacement. What is the probability that all three are of the same colour?

(a) 1/6

(b) 1/36

(c) 1/12

(d) 5/12

17. A can hit a target 5 times in 6 shots, B can hit 4 times in 5 shots and C can hit 3 times in 4 shots. What is the probability that A and C may hit but B may lose?

(a) 1/8
(b) 1/6
(c) 1/4
(d) 1/3

18. The letters of the word ZOOLOGY are arranged in all possible ways. What is the probability that the consonants and vowels occur alternatively?

(a) 6/35
(b) 3/35
(c) 2/35
(d) 1/35

19. A natural number x is chosen at random from the first 100 natural numbers. What is the probability that $x^2 + x > 50$?

(a) 93/100
(b) 47/50
(c) 24/25
(d) 23/25

20. What is the mean deviation of the first 10 natural numbers?

(a) 2
(b) 2·5
(c) 3
(d) 3·5

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

Let $f(x) = |x^2 - x - 2|$.

21. What is $\int_0^2 f(x)\,dx$ equal to?

(a) 0
(b) 1
(c) 5/3
(d) 10/3

22. What is $\int_1^3 f(x)\,dx$ equal to?

(a) 2
(b) 3
(c) 4
(d) 5

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

Let $f(t) = \ln(t + \sqrt{1+t^2})$ and $g(t) = \tan[f(t)]$.

23. Consider the following statements :

I. $f(t)$ is an odd function.

II. $g(t)$ is an odd function.

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

24. What is $\int_{-\pi}^{\pi} g(t)\,dt$ equal to?

(a) -1

(b) 0

(c) 1/2

(d) 1

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

Let $f : [-1, 1] \to R$ be a differentiable function with $f(0) = -1$ and $f'(0) = 1$. Let $h(x) = f(2f(x) + 2)$ and $g(x) = (h(x))^2$.

25. What is $h'(0)$ equal to?

(a) -2

(b) -1

(c) 0

(d) 2

26. What is $g'(0)$ equal to?

(a) -4

(b) -2

(c) 0

(d) 4

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

Let $I = \int_0^{\pi/2} \frac{f(x)}{g(x)}\,dx$, where $f(x) = \sin x$ and $g(x) = \sin x + \cos x + 1$.

27. What is $\int_0^{\pi/2} \frac{dx}{g(x)}$ equal to?

(a) $\frac{\ln 2}{2}$

(b) $\frac{\ln 2}{4}$

(c) $\ln 2$

(d) $2 \ln 2$

28. What is I equal to?

(a) $\frac{\pi}{4} + \ln 2$

(b) $\frac{\pi}{4} - \ln 2$

(c) $\frac{\pi}{4} - \frac{\ln 2}{2}$

(d) $\frac{\pi}{4} + \frac{\ln 2}{2}$

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

Let

$$\int \frac{x^2-1}{\sqrt{x^3+1}}\,dx = U(x)\,V(x) - 3\ln|f(x)+V(x)| + c$$

29. What is $|U^2(x) - V^2(x)|$ equal to?

(a) 0

(b) 1

(c) 2

(d) 3

30. What is $U(x)\,V(x)$ equal to?

(a) $\sqrt{x^2+x^4}$

(b) $\sqrt{x+x^3}$

(c) $\dfrac{\sqrt{x^2+x^4}}{2}$

(d) $2\sqrt{x^2+x^4}$

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

Let $f \circ g(x) = \cos^2\sqrt{x}$ and $g \circ f(x) = |\cos x|$.

31. Which one of the following is $f(x)$?

(a) $\cos x$

(b) $\cos x^2$

(c) $\cos^2 x$

(d) $\cos|x|$

32. Which one of the following is $g(x)$?

(a) $\sqrt{x}$

(b) $|x|$

(c) x^2

(d) $x|x|$

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

Let $f(x) = |x|^2 - |x^2|$.

33. What is $f(0{\cdot}999) + f(1{\cdot}001)$ equal to?

(a) -1

(b) 0

(c) 1

(d) 2

34. Consider the following statements :

I. $f(x)$ is continuous at $x = 0$.

II. $f(x)$ is continuous at $x = 1$.

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

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

Let $f(x) = \cos 2x + x$ on $[-\pi/2, \pi/2]$.

35. What is the greatest value of $f(x)$?

(a) $\frac{\sqrt{3}}{2} + \frac{\pi}{12}$

(b) $\frac{\sqrt{3}}{2} + \frac{\pi}{12}$

(c) $\frac{\sqrt{3}}{2} + \frac{\pi}{9}$

(d) $\frac{\sqrt{3}}{2} + \frac{\pi}{6}$

36. What is the least value of $f(x)$?

(a) $-\left(1 + \frac{\pi}{2}\right)$

(b) $-\left(\frac{1}{2} + \frac{\pi}{2}\right)$

(c) $-\left(1 + \frac{\pi}{4}\right)$

(d) $-2\left(\frac{1}{2} - \frac{\pi}{4}\right)$

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

The area bounded by the parabola $y^2 = kx$ and the line $x = k$, where $k > 0$, is $4/3$ square units.

37. What is the value of k?

(a) 1/2

(b) 1

(c) $\sqrt{2}$

(d) 2

38. What is the area of the parabola bounded by the latus rectum?

(a) 1/5 square unit

(b) 2/5 square unit

(c) 1 square unit

(d) 4/3 square units

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

Let $y\,dx + (x - y^3)\,dy = 0$ be a differential equation.

39. What are the order and degree respectively of the differential equation?

(a) 1 and 1

(b) 1 and 2

(c) 2 and 1

(d) 1 and 3

40. What is the solution of the differential equation?

(a) $y^4 + 2x = c$

(b) $y^4 + 3x = c$

(c) $2xy^4 + x = c$

(d) $4xy - y^4 = c$

41. Let $z = [y]$ and $y = \{x\} - x$, where $[\cdot]$ is the greatest integer function. If x is not an integer but positive, then what is the value of z?

(a) -1

(b) 0

(c) 1

(d) 2

42. If $f(x) = 4x + 1$ and $g(x) = kx + 2$ such that $f \circ g(x) = g \circ f(x)$, then what is the value of k?

(a) 7

(b) 5

(c) 4

(d) 3

43. What is the minimum value of the function $f(x) = \log_{10}(x^2 + 2x + 11)$?

(a) 0

(b) 1

(c) 2

(d) 10

44. Which one of the following is correct regarding $\lim_{x \to 3} \frac{|x-3|}{x-3}$?

(a) Limit exists and is equal to 1

(b) Limit exists and is equal to 0

(c) Limit exists and is equal to −1

(d) Limit does not exist

45. What is the maximum value of $a\cos x + b\sin x + c$?

(a) $\sqrt{a^2+b^2+c}$

(b) $\sqrt{a^2+b^2}+c$

(c) $\sqrt{a^2+b^2}-c$

(d) $\sqrt{a^2+b^2}$

46. If $f(2x) = 4x^2 + 1$, then for how many real values of x will $f(2x)$ be the GM of $f(x)$ and $f(4x)$?

(a) Four

(b) Two

(c) One

(d) None

47. If $f(x) = [x]^2 - 30[x] + 221 = 0$, where $[x]$ is the greatest integer function, then what is the sum of all integer solutions?

(a) 13

(b) 17

(c) 27

(d) 30

48. If $f(x) = 9x - 8\sqrt{x}$ such that $g(x) = f(x) - 1$, then which one of the following is correct?

(a) $g(x) = 0$ has no real roots

(b) $g(x) = 0$ has only one real root which is an integer

(c) $g(x) = 0$ has two real roots which are integers

(d) $g(x) = 0$ has only one real root which is not an integer

49. What is $\lim_{x \to \frac{\pi}{2}} (\sec\theta - \tan\theta)$ equal to?

(a) −1

(b) 0

(c) 1/2

(d) 1

50. Let $f(x)\,f(y) = f(xy)$ for all real x, y. If $f(2) = 4$, then what is the value of $f(1/2)$?

(a) 1/4

(b) 1/2

(c) 1

(d) 4

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

A triangle ABC is inscribed in the circle $x^2 + y^2 = 100$. B and C have coordinates $(6, 8)$ and $(-8, 6)$ respectively.

51. What is $\angle BAC$ equal to?

(a) $\pi/2$

(b) $\pi/3$ or $2\pi/3$

(c) $\pi/4$ or $3\pi/4$

(d) $\pi/6$ or $5\pi/6$

52. What are the coordinates of A?

(a) $(-6, 8)$

(b) $(-6, -8)$

(c) $(5\sqrt{2}, 5\sqrt{2})$

(d) Cannot be determined due to insufficient data

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

$ABCD$ is an isosceles trapezium and AB is parallel to DC. Let $A(2, 3)$, $B(4, 3)$, $C(5, 1)$ be the vertices.

53. What are the coordinates of vertex D?

(a) $(2, 1)$ (b) $(1, 2)$

(c) $(1, 1)$ (d) $(3, 1)$

54. What is the point of intersection of the diagonals of the trapezium?

(a) $(3, 7/2)$ (b) $(3, 7/3)$

(c) $(7/2, 2)$ (d) $(5/2, 2)$

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

Let $2x^2 + 2y^2 + 2z^2 + 3x + 3y + 3z - 6 = 0$ be a sphere.

55. What is the diameter of the sphere?

(a) $\frac{5\sqrt{3}}{4}$

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

(c) $\frac{3\sqrt{5}}{4}$

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

56. The centre of the sphere lies on the plane

(a) $2x + 2y + 2z - 3 = 0$

(b) $4x + 4y + 4z - 3 = 0$

(c) $4x + 8y + 8z - 15 = 0$

(d) $4x + 8y + 8z + 15 = 0$

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

Let S be the line of intersection of two planes $x + y + z = 1$ and $2x + 3y - 4z = 8$.

57. Which of the following are the direction ratios of S?

(a) $\langle -7, -6, 1 \rangle$

(b) $\langle -7, 6, 1 \rangle$

(c) $\langle -6, 5, 1 \rangle$

(d) $\langle 6, 5, 1 \rangle$

58. If (l, m, n) are direction cosines of S, then what is the value of $4(l^2 - m^2 - n^2)$?

(a) 6

(b) 5

(c) 4

(d) 1

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

Let $L: x + y + z + 4 = 0 = 2x - y - z + 8$ be a line and $P: x + 2y + 3z + 1 = 0$ be a plane.

59. What are the direction ratios of the line?

(a) $\langle 2, 1, -1 \rangle$

(b) $\langle 0, -1, 2 \rangle$

(c) $\langle 0, 1, -1 \rangle$

(d) $\langle 2, 3, -3 \rangle$

60. What is the point of intersection of L and P?

(a) $(4, 3, -3)$

(b) $(4, -3, 3)$

(c) $(-4, -3, -3)$

(d) $(-4, -3, 3)$

61. What is $3\alpha + 2\beta$ equal to if

$(2\hat{i} + 6\hat{j} + 27\hat{k}) \times (\hat{i} + \alpha\hat{j} + \beta\hat{k})$

is a null vector?

(a) 36

(b) 33

(c) 30

(d) 27

62. For what value of the angle between the vectors $\vec{a}$ and $\vec{b}$ is the quantity $|\vec{a} \times \vec{b}| + \sqrt{3}|\vec{a} \cdot \vec{b}|$ maximum?

(a) 0°

(b) 30°

(c) 45°

(d) 60°

63. Let θ be the angle between two unit vectors $\vec{a}$ and $\vec{b}$. If $\vec{a} + 2\vec{b}$ is perpendicular to $5\vec{a} - 4\vec{b}$, then what is $\cos\theta + \cos 2\theta$ equal to?

(a) 0

(b) 1/2

(c) 1

(d) $\frac{\sqrt{3}+1}{2}$

64. Let $ABCDEF$ be a regular hexagon. If $\overrightarrow{AD} = m\overrightarrow{BC}$ and $\overrightarrow{CF} = n\overrightarrow{AB}$, then what is mn equal to?

(a) −4

(b) −2

(c) 2

(d) 4

65. The vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are of the same length. If taken pairwise, they form equal angles. If $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{j} + \hat{k}$, then what can $\vec{c}$ be equal to?

I. $\hat{i} + \hat{k}$

II. $\frac{-\hat{i} + 4\hat{j} - \hat{k}}{3}$

Select the correct answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

66. The diagonals of a quadrilateral $ABCD$ are along the lines $x - 2y = 1$ and $4x + 2y = 3$. The quadrilateral $ABCD$ may be a

(a) rectangle

(b) cyclic quadrilateral

(c) parallelogram

(d) rhombus

67. The foci of the ellipse $4x^2 + 9y^2 = 1$ are at Q and R. If $P(x, y)$ is any point on the ellipse, then what is $PQ + PR$ equal to?

(a) 2

(b) 1

(c) 2/3

(d) 1/3

68. If $P(2, 4)$, $Q(8, 12)$, $R(10, 14)$ and $S(x, y)$ are vertices of a parallelogram, then what is $(x + y)$ equal to?

(a) 8

(b) 10

(c) 12

(d) 14

69. The equation of a circle is

$$(x^2 - 4x + 3) + (y^2 - 6y + 8) = 0$$

Which of the following statements are correct?

I. The end points of a diameter of the circle are at (1, 2) and (3, 4).

II. The end points of a diameter of the circle are at (1, 4) and (3, 2).

III. The end points of a diameter of the circle are at (2, 4) and (4, 2).

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

70. Consider the points $P(4k, 4k)$ and $Q(4k, -4k)$ lying on the parabola $y^2 = 4kx$. If the vertex is A, then what is $\angle PAQ$ equal to?

(a) 60°

(b) 90°

(c) 120°

(d) 135°

[P.T.O.

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

Let Z_1 and Z_2 be any two complex numbers such that $Z_1^2 + Z_2^2 + Z_1 Z_2 = 0$

71. What is the value of $\left|\frac{Z_1}{Z_2}\right|$?

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

72. What is the value of

$$\frac{1}{2} + \text{Re}\left(\frac{Z_1}{Z_2}\right)?$$

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

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

The product of 5 consecutive terms of an AP is 229635. The first, second and fifth terms are in GP.

73. What is the common difference?

(a) 3
(b) 4
(c) 5
(d) 6

74. What is the sum of all five terms?

(a) 60
(b) 65
(c) 75
(d) 80

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

Let $(8 + 3\sqrt{7})^{20} = U + V$ and $(8 - 3\sqrt{7})^{20} = W$, where U is an integer and $0 < V < 1$.

75. What is $V + W$ equal to?

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

76. What is the value of $(U + V)W$?

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

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

The roots of the quadratic equation

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

are equal $(a^2 \neq b^2 \neq c^2)$.

77. Which one of the following statements is correct?

(a) a^2, b^2, c^2 are in AP.

(b) a^2, b^2, c^2 are in GP.

(c) a^2, b^2, c^2 are in HP.

(d) a^2, b^2, c^2 are neither in AP nor in GP nor in HP.

78. Which one of the following is a root of the equation?

(a) $\dfrac{b^2(c^2-a^2)}{a^2(c^2-b^2)}$

(b) $\dfrac{b^2(c^2-a^2)}{a^2(b^2-c^2)}$

(c) $\dfrac{b^2(c^2-a^2)}{2a^2(c^2-b^2)}$

(d) $\dfrac{b^2(c^2-a^2)}{2a^2(b^2-c^2)}$

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

Let

$$A=\begin{bmatrix}3 & -3 & 4\\ 2 & -3 & 4\\ 0 & -1 & 1\end{bmatrix}$$

79. What is $A(\text{adj } A)$ equal to?

(a) $\begin{bmatrix}5 & 0 & 0\\ 0 & 5 & 0\\ 0 & 0 & 5\end{bmatrix}$

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

(c) $\begin{bmatrix}1/2 & 0 & 0\\ 0 & 1/2 & 0\\ 0 & 0 & 1/2\end{bmatrix}$

(d) $\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}$

80. What is A^{-1} equal to?

(a) $\begin{bmatrix}1 & -1 & 0\\ -2 & 3 & -4\\ -2 & 3 & -3\end{bmatrix}$

(b) $\begin{bmatrix}1/2 & -1/2 & 0\\ -1 & 3/2 & -2\\ -1 & 3/2 & -3/2\end{bmatrix}$

(c) $\begin{bmatrix}2 & -2 & 0\\ -4 & 6 & -8\\ -4 & 6 & -6\end{bmatrix}$

(d) $\begin{bmatrix}1/5 & -1/5 & 0\\ -2/5 & 3/5 & -4/5\\ -2/5 & 3/5 & -3/5\end{bmatrix}$

81. Consider the following numbers :

I. $\tan 22.5^\circ$

II. $\cot 22.5^\circ$

III. $\tan 22.5^\circ - \cot 22.5^\circ$

How many of the above are irrational numbers?

(a) None

(b) Only one

(c) Only two

(d) All three

82. If

$$\frac{x}{\cos\theta} = \frac{y}{\cos\left(\frac{2\pi}{3}-\theta\right)} = \frac{z}{\cos\left(\frac{2\pi}{3}+\theta\right)}$$

then what is $x+y+z$ equal to?

(a) -1

(b) 0

(c) 1

(d) 3

83. If $p\tan(\theta-30^\circ) = q\tan(\theta+120^\circ)$, then what is $(p+q)/(p-q)$ equal to?

(a) $\sin 2\theta$

(b) $\cos 2\theta$

(c) $2\sin 2\theta$

(d) $2\cos 2\theta$

84. Let P and Q be two non-void relations on a set A. Which of the following statements are correct?

I. P and Q are reflexive $\Rightarrow P \cap Q$ is reflexive.

II. P and Q are symmetric $\Rightarrow P \cup Q$ is symmetric.

III. P and Q are transitive $\Rightarrow P \cap Q$ is transitive.

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

85. If A and B are two non-empty sets having 10 elements in common, then how many elements do $A \times B$ and $B \times A$ have in common?

(a) 10

(b) 20

(c) 40

(d) 100

86. What is the remainder when $7^n - 6n$ is divided by 36 for $n = 100$?

(a) 0

(b) 1

(c) 2

(d) 6

87. What is the maximum number of possible points of intersection of four straight lines and a circle (intersection is between lines as well as circle and lines)?

(a) 6

(b) 10

(c) 14

(d) 16

88. In an AP, the ratio of the sum of the first p terms to the sum of the first q terms is $p^2 : q^2$. Which one of the following is correct?

(a) The first term is equal to the common difference

(b) The first term is equal to twice the common difference

(c) The common difference is equal to twice the first term

(d) The first term is equal to square of the common difference

89. What is the number of real roots of the equation $(x-1)^2 + (x-3)^2 + (x-5)^2 = 0$?

(a) None

(b) Only one

(c) Only two

(d) Three

90. In a class of 240 students, 180 passed in English, 130 passed in Hindi and 150 passed in Sanskrit. Further, 60 passed in only one subject, 110 passed in only two subjects and 10 passed in none of the subjects. How many passed in all three subjects?

(a) 60

(b) 55

(c) 40

(d) 35

91. If $4\sin^{-1}x + \cos^{-1}x = \pi$, then what is $\sin^{-1}x + 4\cos^{-1}x$ equal to?

(a) $\pi/2$

(b) π

(c) $3\pi/2$

(d) 2π

92. What is $\cot^2(\sec^{-1}2) + \tan^2(\operatorname{cosec}^{-1}3)$ equal to?

(a) 11/12

(b) 11/24

(c) 7/24

(d) 1/24

93. In a triangle ABC

$$\frac{a}{\cos A} = \frac{b}{\cos B} = \frac{c}{\cos C}$$

What is the area of the triangle if $a = 6$ cm?

(a) $9\sqrt{3}$ square cm

(b) 12 square cm

(c) $18\sqrt{3}$ square cm

(d) 24 square cm

94. The roots of the equation $7x^2 - 6x + 1 = 0$ are $\tan\alpha$ and $\tan\beta$, where 2α and 2β are the angles of a triangle. Which one of the following is correct?

(a) The triangle is equilateral

(b) The triangle is isosceles but not right-angled

(c) The triangle is right-angled

(d) The triangle is right-angled isosceles

95. In a triangle ABC, $\angle A = 75°$ and $\angle B = 45°$. What is $2a - b$ equal to?

(a) c

(b) $\sqrt{2}c$

(c) $2c$

(d) $2\sqrt{2}c$

96. What is the number of solutions of the equation $\cot 2x \cdot \cot 3x = 1$ for $0 < x < \pi$?

(a) Only one

(b) Only two

(c) Only five

(d) More than five

97. What is the general solution of $\cos^{100} x - \sin^{100} x = 1$?

(a) $n\pi$

(b) $(2n+1)\pi$

(c) $2n\pi$

(d) $(2n+1)\pi/2$

where n is an integer.

98. In a triangle ABC

$$\tan A + \tan B + \tan C = k$$

What is the value of $\cot A \cot B \cot C$?

(a) $0 \cdot 5k$

(b) $1/k$

(c) $3/k$

(d) $1/k^3$

99. What is $\sin 12° \sin 48°$ equal to?

(a) $\frac{\sqrt{5}-1}{4}$

(b) $\frac{\sqrt{5}+1}{4}$

(c) $\frac{\sqrt{3}-1}{8}$

(d) $\frac{\sqrt{5}+1}{8}$

100. What is $\frac{\cos 17° - \sin 17°}{\cos 17° + \sin 17°}$ equal to?

(a) $\tan 34°$

(b) $\cot 34°$

(c) $\tan 62°$

(d) $\cot 62°$

101. Let $x > 1$, $y > 1$, $z > 1$ be in GP. Then

$$\frac{1}{1+\ln x}, \quad \frac{1}{1+\ln y}, \quad \frac{1}{1+\ln z}$$

are

(a) in AP

(b) in GP

(c) in HP

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

102. If

$$\omega = -\frac{1}{2} + i\frac{\sqrt{3}}{2}$$

then what is

$$\begin{vmatrix} 1+\omega & 1+\omega^2 & \omega+\omega^2 \\ 1 & \omega & \omega^2 \\ \frac{1}{\omega} & \frac{1}{\omega^2} & 1 \end{vmatrix}$$

equal to?

(a) 0

(b) ω

(c) ω^2

(d) $1-\omega^2$

103. If the sum of the first n terms of a series is $n(2n+1)$, then what is the nth term?

(a) $4n-1$

(b) $4n$

(c) $4n+1$

(d) $4n+3$

104. In how many ways can the letters of the word INDIA be permutated such that in each combination, vowels should occupy odd positions?

(a) 3

(b) 6

(c) 9

(d) 12

105. The letters of the word EQUATION are arranged in such a way that all vowels as well as consonants are together. How many such arrangements are there?

(a) 240

(b) 720

(c) 1440

(d) 1620

104. If m is a root of the equation $x^2 + px + m = 0$ and m is a root of the equation $x^2 + px + n = 0$, where $m \neq n$, then what is the value of $p + m + n$?

(a) -1

(b) 0

(c) 1

(d) 2

107. In how many ways can a student choose $(n-2)$ courses out of n courses if 2 courses are compulsory $(n > 4)$?

(a) $(n-3)(n-4)$

(b) $(n-1)(n-2)$

(c) $(n-3)(n-4)/2$

(d) $(n-2)(n-3)/2$

108. If

$$D_n = \begin{vmatrix} n & 20 & 30 \\ n^2 & 40 & 50 \\ n^3 & 60 & 70 \end{vmatrix}$$

then what is the value of $\sum_{n=1}^{4} D_n$?

(a) -10000

(b) -10

(c) 10

(d) 10000

109. Consider the following in respect of the matrices

$$P = \begin{bmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{bmatrix} \text{ and } Q = \begin{bmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{bmatrix}$$

I. PQ is a null matrix.

II. QP is an identity matrix of order 3.

III. $PQ = QP$

Which of the above is/are correct?

(a) I only

(b) II only

(c) I and III

(d) II and III

110. If P is a skew-symmetric matrix of order 3, then what is $\det(P)$ equal to?

(a) -1

(b) 0

(c) 1

(d) 3

111. Let X be a matrix of order 3×3, Y be a matrix of order 2×3 and Z be a matrix of order 3×2. Which of the following statements are correct?

1. $(ZY)X$ is defined and is a square matrix of order 3.
2. $Y(XZ)$ is defined and is a square matrix of order 2.
3. $X(YZ)$ is not defined.

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

112. Consider the following statements:

I. The set of all irrational numbers between $\sqrt{12}$ and $\sqrt{15}$ is an infinite set.

II. The set of all odd integers less than 1000 is a finite set.

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

113. How many 4-digit numbers are there having all digits as odd?

(a) 625

(b) 400

(c) 196

(d) 120

114. If $\omega \neq 1$ is a cube root of unity, then what is $(1+\omega-\omega^2)^{100} + (1-\omega+\omega^2)^{100}$ equal to?

(a) $2^{100}\omega^2$

(b) $2^{100}\omega$

(c) 2^{100}

(d) -2^{100}

115. Let A and B be two square matrices of same order. If AB is a null matrix, then which one of the following is correct?

(a) Both A and B are null matrices

(b) Either A or B is a null matrix

(c) B is a null matrix if A is a non-singular matrix

(d) Both A and B are singular matrices

114. In the expansion of $(1+x)^p(1+x)^q$, if the coefficient of x^3 is 35, then what is the value of $(p+q)$?

(a) 5

(b) 6

(c) 7

(d) 8

115. If p times the pth term of an AP is equal to q times the qth term ($p \neq q$), then what is the $(p+q)$th term equal to?

(a) 0

(b) $p+q$

(c) pq

(d) $pq(p+q)$

116. Let $p = \ln(x)$, $q = \ln(x^3)$ and $r = \ln(x^5)$, where $x > 1$. Which of the following statements is/are correct?

I. p, q and r are in AP.

II. p, q and r can never be in GP.

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

119. If

$$z = \frac{1}{3}\begin{vmatrix} i & 2i & 1 \\ 2i & 3i & 2 \\ 3 & 1 & 3 \end{vmatrix} = x + iy;\ i = \sqrt{-1}$$

then what is modulus of z equal to?

(a) 1

(b) $\sqrt{2}$

(c) 2

(d) $\sqrt{3}$

120. What is the value of the sum

$$\sum_{n=1}^{20} (i^{n-1} + i^n + i^{n+1})$$

where $i = \sqrt{-1}$?

(a) $-2i$

(b) 0

(c) 1

(d) $2i$