
PAPER II : MATHEMATICS

1. What is the value of the determinant

$$\begin{vmatrix} x+1 & x+2 & x+4 \\ x+3 & x+5 & x+8 \\ x+7 & x+10 & x+14 \end{vmatrix} ?$$

- (a) $x + 2$ (b) $x^2 + 2$
(c) 2 (d) -2

2. Consider the following statements in respect of the function

$$f(x) = x^3 - 1, x \in [-1, 1]$$

1. $f(x)$ is increasing in $[-1, 1]$
2. $f(x)$ has no root in $(-1, 1)$

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

3. The largest value of $2x^3 - 3x^2 - 12x + 5$ for $-2 \leq x \leq 2$ occurs when

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

4. What is $\int_0^p \frac{dx}{1 + 2 \sin^2 x}$ equal to ?

- (a) π (b) $\frac{p}{3}$
(c) $\frac{p}{\sqrt{3}}$ (d) $\frac{2p}{\sqrt{3}}$

5. If 5 and 7 are the roots of the equation

$$\begin{vmatrix} x & 4 & 5 \\ 7 & x & 7 \\ 5 & 8 & x \end{vmatrix} = 0 \text{ then what is the third root ?}$$

- (a) -12 (b) 9
(c) 13 (d) 14

6. In a GP of positive terms, any term is equal to one-third of the sum of next two terms. What is the common ratio of the GP ?

(a) $\frac{\sqrt{3}+1}{2}$ (b) $\frac{\sqrt{3}-1}{2}$

(c) $\frac{\sqrt{13}+1}{3}$ (d) $\sqrt{13}$

7. If $(1 + \tan \theta)(1 + \tan \phi) = 2$, then what is $(\theta + \phi)$ equal to ?

- (a) 30° (b) 45°
(c) 60° (d) 90°

8. If $f(x)$ is an even function, then what is

$$\int_0^p f(\cos x) dx \text{ equal to ?}$$

(a) 0 (b) $\int_0^{\frac{p}{2}} f(\cos x) dx$

(c) $2 \int_0^{\frac{p}{2}} f(\cos x) dx$ (d) 1

9. What is the value of k for which the system of equations $kx + 2y = 5$ and $3x + y = 1$ has no solution ?

- (a) 0 (b) 3
(c) 6 (d) 15

10. In how many ways can 6 girls be seated in 2 empty chairs ?

- (a) 10 (b) 15
(c) 24 (d) 30

11. What is the value of

$$\log_{10} \left(\frac{9}{8} \right) - \log_{10} \left(\frac{27}{32} \right) + \log_{10} \left(\frac{3}{4} \right) ?$$

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

12. Which term of the series $\frac{1}{4}, -\frac{1}{2}, 1, \dots$ is -128 ?

- (a) 9th (b) 10th
(c) 11th (d) 12th

13. What is the number of ordered pairs of non-zero positive integers (x, y) such that $x + y \leq 4$?

- (a) 4 (b) 5

- (c) 6 (d) 8
14. In the binary system of numbers let $a = 00111$ and $b = 01110$, then in decimal system what is b/a equal to ?
 (a) 1
 (b) 2
 (c) 4
 (d) 5
15. If $\frac{1}{b-a} + \frac{1}{b-c} = \frac{1}{a} + \frac{1}{c}$ then a, b, c are in
 (a) AP (b) GP
 (c) HP (d) None of the above
16. What is $\int \sin^{-1}(\cos x) dx$ equal to ?
 (a) $\frac{xp}{2} + \frac{x^2}{2} + k$ (b) $\frac{p}{2} + \frac{x^2}{2} + k$
 (c) $-\frac{xp}{2} - \frac{x^2}{2} + kx$ (d) $\frac{p}{2} - \frac{x^2}{2} + k$
17. If α and β are the roots of the equation $4x^2 + 3x + 7 = 0$, then what is the value of $(\alpha^{-2} + \beta^{-2})$?
 (a) $47/49$ (b) $49/47$
 (c) $-47/49$ (d) $-49/47$
18. What is the equation of the line passing through $(2, -3)$ and parallel to y -axis ?
 (a) $y = -3$ (b) $y = 2$
 (c) $x = 2$ (d) $x = -2$
19. What is the set of points (x, y) satisfying the equations $x^2 + y^2 = 4$ and $x + y = 2$?
 (a) $\{(2, 0), (-2, 0), (0, 2)\}$
 (b) $\{(0, 2), (0, -2)\}$
 (c) $\{(0, 2), (2, 0)\}$
 (d) $\{(2, 0), (-2, 0), (0, 2), (0, -2)\}$
20. Consider the following statements :
 1. The inverse of a square matrix, if exists, is unique.
 2. If A and B are singular matrices of order n , then AB is also a singular matrix of order n .
 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
21. What is the angle between the lines whose direction cosines are proportional to $(2, 3, 4)$ and $(1, -2, 1)$ respectively ?
 (a) 90° (b) 60°
 (c) 45° (d) 30°
22. What is the value of k for which the following function $f(x)$ is continuous for all x ?

$$f(x) = \begin{cases} \frac{x^3 - 3x + 2}{(x-1)^2} & \text{for } x \neq 1 \\ k & \text{for } x = 1 \end{cases}$$

 (a) 3 (b) 2
 (c) 1 (d) -1
23. If p, q, r are rational numbers, then the roots of the equation $x^2 - 2px + p^2 - q^2 + 2qr - r^2 = 0$ are
 (a) complex (b) pure imaginary
 (c) irrational (d) rational
24. If $A = \{1, 2, 5, 6\}$ and $B = \{1, 2, 3\}$, then what is $(A \times B) \cap (B \times A)$ equal to ?
 (a) $\{(1, 1), (2, 1), (6, 1), (3, 2)\}$
 (b) $\{(1, 1), (1, 2), (2, 1), (2, 2)\}$
 (c) $\{(1, 1), (2, 2)\}$
 (d) $\{(1, 1), (1, 2), (2, 5), (2, 6)\}$
25. What is the differential equation of all parabolas whose axes are parallel to y -axis?
 (a) $\frac{d^3 y}{dx^3} = 0$ (b) $\frac{d^2 x}{dy^2} = c$
 (c) $\frac{d^3 x}{dy^3} = 1$ (d) $\frac{d^3 x}{dx^3} = c$
 where c is a constant.
- For the next five (5) items that follow :
- The students of a class are offered three language (Hindi, English and French). 15 students learn all the three languages whereas 28 students do not

learn any language. The number of students learning Hindi and English but not French is twice the number of students learning Hindi and French but not English. The number of students learning English and French but not Hindi is thrice the number of students learning Hindi and French but not English. 23 students learn only Hindi and 17 students learn only English. The total number of students learning French is 46 and the total number of students learning only French is 11.

26. How many students learn precisely two languages ?

- (a) 55 (b) 40
(c) 30 (d) 13

27. How many students learn at least two languages ?

- (a) 15 (b) 30
(c) 45 (d) 55

28. What is the total strength of the class ?

- (a) 124 (b) 100
(c) 96 (d) 66

29. How many students learn English and French ?

- (a) 30 (b) 43
(c) 45 (d) 73

30. How many students learn at least one language ?

- (a) 45 (b) 51
(c) 96 (d) None of the above

For the next four (4) items that follow :

ABC is a triangle right angled at B. The hypotenuse (AC) is four times the perpendicular (BD) is four times the perpendicular (BD) drawn to its from the opposite vertex and $AD < DC$.

31. What is one of the acute angles of the triangle?

- (a) 15° (b) 30°
(c) 45° (d) None of the above

32. What is angle ABD ?

- (a) 15° (b) 30°
(c) 45° (d) None of the above

33. What is AD : DC equal to ?

- (a) $(7 - 2\sqrt{3}) : 1$ (b) $(7 - 4\sqrt{3}) : 1$
(c) 1 : 2 (d) None of these

34. What is $\tan(A - C)$ equal to ?

- (a) 0 (b) 1
(c) 2 (d) None of the above

35. What is the radius of the sphere $x^2 + y^2 + z^2 - x - y - z = 0$?

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

36. An experiment consists of flipping a coin and then flipping it a second time if head occurs. If a tail occurs on the first flip, then a six-faced die is tossed once. Assuming that the outcomes are equally likely, what is the probability of getting one head and one tail?

- (a) $1/4$ (b) $1/36$
(c) $1/6$ (d) $1/8$

37. If, in general, the value of $\sin A$ is known, but the value of A is not known, then how many values of $\tan(A/2)$ can be calculated ?

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

38. Consider the following :

$$1. \operatorname{cosec}^{-1}\left(-\frac{2}{\sqrt{3}}\right) = -\frac{p}{3}$$

$$2. \sec^{-1}\left(\frac{2}{\sqrt{3}}\right) = \frac{p}{6}$$

Which of the above is/are correct ?

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

39. Consider the following statement with regard to correlation coefficient r between random variables x and y :

1. $r = +1$ or -1 means there is a linear

- relation between x and y .
2. $-1 \leq r \leq 1$ and r^2 is a measure of the linear relationship between the variables.
- 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
40. If the values of a set are measured in cm, what will be the unit of variance ?
- (a) cm (b) cm^2
(c) cm^3 (d) No unit
41. A box contains 6 distinct dolls. From this box, three dolls are randomly selected one by one with replacement. What is the probability of selecting 3 distinct dolls ?
- (a) $5/54$ (b) $12/25$
(c) $1/20$ (d) $5/9$
42. For the equation $ax^2 + by^2 + 2hxy + 2gx + 2fy + c = 0$ where $a \neq 0$, to represent a circle, the condition will be
- (a) $a = b$ and $c = 0$
(b) $f = g$ and $h = 0$
(c) $a = b$ and $h = 0$
(d) $f = g$ and $c = 0$
43. If A and B are events such that $P(A \cup B) = 0.5$, $P(\bar{B}) = 0.8$ and $P(A | B) = 0.4$, then what is $P(A \cap B)$ equal to ?
- (a) 0.08 (b) 0.02
(c) 0.8 (d) 0.2
44. Consider the following relations among the angles α , β , γ made by a vectors with the coordinate axes :
- $\cos 2\alpha + \cos 2\beta + \cos 2\gamma = -1$
 - $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 1$
- Which of the above is/are correct ?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
45. Which one of the following points lies on the plane $2x + 3y - 6z = 21$?
- (a) (3, 2, 2) (b) (3, 7, 1)
(c) (1, 2, 3) (d) (2, 1, -1)
46. If 3 is the root of the equation $x^2 - 8x + k = 0$, then what is the value of k ?
- (a) -15 (b) 9
(c) 15 (d) 24
47. Two straight lines $x - 3y - 2 = 0$ and $2x - 6y - 6 = 0$
- (a) never intersect
(b) intersect at a single point
(c) intersect at infinite number of points
(d) intersect at more than one point (but finite number of points)
48. If (a, 0), (0, b) (1, 1) are collinear, what is $(a + b - ab)$ equal to ?
- (a) 2 (b) 1
(c) 0 (d) -1
49. If $A = \begin{bmatrix} 3 & 1 \\ 0 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix}$ then which of the following is/are correct ?
- AB is defined
 - BA is defined
 - $AB = BA$
- Select the correct answer using the code given below :
- (a) 1 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3
50. Using the digits 1, 2, 3, 4 and 5 only once how many numbers greater than 41000 can be formed ?
- (a) 41 (b) 48
(c) 50 (d) 55
51. If an angle α is divided into two parts A and B such that $A - B = x$ and $\tan A : \tan B = 2 : 1$, then what is $\sin x$ equal to ?
- (a) $3 \sin \alpha$ (b) $(2 \sin \alpha)/3$
(c) $(\sin \alpha)/3$ (d) $2 \sin \alpha$
52. A man standing on the bank of river observes that the angle of elevation of the top of a tree just on the opposite bank is 60° . The angle of elevation is 30° from a point at a distance y metres from the bank. What is the height of the tree ?
- (a) y metres (b) $2y$ metres

- (c) $\frac{\sqrt{3y}}{2}$ metres (d) $\frac{y}{2}$ metres

53. If P, Q, R are three non-collinear points, then what is $PQ \cap PR$ equal to ?

- (a) Null set (b) {P}
(c) {P, Q, R} (d) {Q, R}

54. A, B, C, D and E are coplanar points and three of them lie in a straight line. What is the maximum number of triangles that can be drawn with these points as their vertices?

- (a) 5 (b) 9
(c) 10 (d) 12

55. The vector $\frac{1}{a}$ lies in the plane of vectors $\frac{1}{b}$ and $\frac{1}{c}$. Which one of the following is correct?

- (a) $\frac{\mathbf{r}}{a} \cdot \left(\frac{\mathbf{r}}{b} \times \frac{\mathbf{r}}{c} \right) = 0$
(b) $\frac{\mathbf{r}}{a} \cdot \left(\frac{\mathbf{r}}{b} \times \frac{\mathbf{r}}{c} \right) = 1$
(c) $\frac{\mathbf{r}}{a} \cdot \left(\frac{\mathbf{r}}{b} \times \frac{\mathbf{r}}{c} \right) = -1$ (d) $\frac{\mathbf{r}}{a} \cdot \left(\frac{\mathbf{r}}{b} \times \frac{\mathbf{r}}{c} \right) = 3$

56. What is the projection of the vector $\hat{i} - 2\hat{j} + \hat{k}$ on the vector $4\hat{i} - 4\hat{j} + 7\hat{k}$?

- (a) $\frac{\sqrt{5}}{2}$ (b) $\frac{19}{9}$
(c) $\frac{\sqrt{5}}{4}$ (d) $\frac{11}{3}$

57. Which one of the following statement is correct ?

- (a) $\sin^2 30^\circ, \sin^2 45^\circ, \sin^2 60^\circ$ are in GP
(b) $\cos^2 30^\circ, \cos^2 45^\circ, \cos^2 60^\circ$ are in GP
(c) $\cot^2 30^\circ, \cot^2 45^\circ, \cot^2 60^\circ$ are in AP
(d) $\tan^2 30^\circ, \tan^2 45^\circ, \tan^2 60^\circ$ are in GP

58. If sum of squares of the roots of the equation $x^2 + kx - b = 0$ is $2b$, what is k equal to ?

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

59. If one root of the equation $ax^2 + bx + c = 0$, $a \neq 0$ is reciprocal of the other root, then

which one of the following is correct ?

- (a) $a = c$ (b) $b = c$
(c) $a = -c$ (d) $b = 0$

60. If ω is the imaginary cube root of unity, then what is $(2 - \omega + 2\omega^2)^{27}$ equal to ?

- (a) $3^{27} \omega$ (b) $-3^{27} \omega^2$
(c) 3^{27} (d) -3^{27}

61. What is the acute angle between the planes $x + y + 2z = 3$ and $-2x + y - z = 11$?

- (a) $\pi/5$ (b) $\pi/4$
(c) $\pi/6$ (d) $\pi/3$

62. What is the area bounded by the curves $y = e^x, y = e^{-x}$ and the straight line $x = 1$?

- (a) $\left(e + \frac{1}{e} \right)$ sq. units
(b) $\left(e - \frac{1}{e} \right)$ sq. units
(c) $\left(e + \frac{1}{e} - 2 \right)$ sq. units
(d) $\left(e - \frac{1}{e} - 2 \right)$ sq. units

63. What are the points of intersection of the curve $4x^2 - 9y^2 = 1$ with its conjugate axis ?

- (a) $(1/2, 0)$ and $(-1/2, 0)$
(b) $(0, 2)$ and $(0, -2)$
(c) $(0, 3)$ and $(0, -3)$
(d) No such points exist

64. What is the locus of a point which moves equidistant from the coordinate axes ?

- (a) $x \pm y = 0$ (b) $x + 2y = 0$
(c) $2x + y = 0$ (d) None of the above

65. What is $\int e^x \left(\sqrt{x} + \frac{1}{2\sqrt{x}} \right) dx$ equal to ?

- (a) $xe^x + c$ (b) $e^x(\sqrt{x}) + c$
(c) $2e^x(\sqrt{x}) + c$ (d) $2xe^x + c$

66. Let p, q, r, s be respectively the magnitudes of

the vectors $3\hat{i} - 2\hat{j}$, $2\hat{i} + 2\hat{j} + \hat{k}$, $4\hat{i} - \hat{j} + \hat{k}$,

$2\hat{i} + 2\hat{j} + 3\hat{k}$. Which one of the following is correct?

- (a) $r > s > q > p$
 (b) $s > r > p > q$
 (c) $r > s > p > q$
 (d) $s > r > q > p$

67. In a triangle ABC, if $c = 2$, $A = 120^\circ$, $a = \sqrt{6}$, then what is C equal to?

- (a) 30° (b) 45°
 (c) 60° (d) 75°

68. Class interval	1-5	6-10	11-5	16-20
Frequency	3	7	6	5

Consider the following statements in respect of the above frequency distribution:

- The median is contained in the modal class.
- The distribution is bell-shaped.

Which of the above statements is/are correct?

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

For the next two (2) items that follow :

The following table gives the continuous frequency distribution of a continuous variable X :

Class interval	1-10	10-20	20-30	30-40	40-50
Frequency	5	10	20	5	10

69. What is the median of the above frequency distribution?

- (a) 23 (b) 24
 (c) 25 (d) 26

70. What is the mean of the above frequency distribution?

- (a) 25 (b) 26
 (c) 27 (d) 28

71. If the matrix $A = \begin{pmatrix} 2-x & 1 & 1 \\ 1 & 3-x & 0 \\ -1 & -3 & -x \end{pmatrix}$ is

singular, then what is the solution set S?

- (a) $S = \{0, 2, 3\}$ (b) $S = \{-1, 2, 3\}$
 (c) $S = \{1, 2, 3\}$ (d) $S = \{2, 3\}$

72. What is the range of $f(x) = \cos 2x - \sin 2x$?

- (a) $[2, 4]$ (b) $[-1, 1]$
 (c) $[-\sqrt{2}, \sqrt{2}]$ (d) $(-\sqrt{2}, \sqrt{2})$

73. What is the solution of the differential

equation $\frac{dy}{dx} + \sqrt{\frac{1-y^2}{1-x^2}} = 0$?

- (a) $\sin^{-1} y + \sin^{-1} x = c$
 (b) $\sin^{-1} y - \sin^{-1} x = c$
 (c) $2\sin^{-1} y + \sin^{-1} x = c$
 (d) $2\sin^{-1} y - \sin^{-1} x = c$

where c is a constant.

74. If $z = 1 + \cos \frac{p}{5} + i \sin \frac{p}{5}$ then what is $|z|$ equal to?

- (a) $2\cos \frac{p}{5}$ (b) $2\sin \frac{p}{5}$
 (c) $2\cos \frac{p}{10}$ (d) $2\sin \frac{p}{10}$

75. If $x\hat{i} + y\hat{j} + z\hat{k}$ is a unit vector and $x : y : z = \sqrt{3} : 2 : 3$, then what is the value of z?

- (a) $\frac{3}{16}$ (b) 3
 (c) $\frac{3}{4}$ (d) 2

76. What is the modulus of $\frac{1}{1+3i} - \frac{1}{1-3i}$?

- (a) $\frac{3}{5}$ (b) $\frac{9}{25}$
 (c) $\frac{3}{25}$ (d) $\frac{5}{3}$

77. Let M be the set of men and R is a relation 'is

- son of defined on M. Then R is
- an equivalence relation
 - a symmetric relation only
 - a transitive relation only
 - None of the above
78. What is the locus of the point which is at a distance 8 units to the left of y-axis?
- $x = 8$
 - $y = 8$
 - $x = -8$
 - $y = -8$
79. The number 10101111 in binary system is represented in decimal system by which one of the following numbers?
- 157
 - 175
 - 571
 - 751
80. There are 4 letters and 4 directed envelopes. These 4 letters are randomly inserted into the 4 envelopes. What is the probability that the letters are inserted into the corresponding envelopes?
- 11/12
 - 23/24
 - 1/24
 - None of above
81. The average daily income of workers of a factory including that of the owner is Rs. 110. However, if the income of the owner is excluded, the average daily income of the remaining 9 the average daily income of the remaining 9 workers is Rs. 76. What is the daily income of the owner?
- Rs. 300
 - Rs. 316
 - Rs. 322
 - Rs. 416
82. If A, B, C are non-empty sets such that $A \cap C = \Phi$, then what is $(A \times B) \cap (C \times B)$ equal to?
- $A \times C$
 - $A \times B$
 - $B \times C$
 - Φ
83. If $A = \{4n + 2 \mid n \text{ is a natural number}\}$ and $B = \{3n \mid n \text{ is a natural number}\}$, then what is $(A \cap B)$ equal to?
- $\{12n^2 + 6n \mid n \text{ is a natural number}\}$
 - $\{24n - 12 \mid n \text{ is a natural number}\}$
 - $\{60n + 30 \mid n \text{ is a normal number}\}$
 - $\{12n - 6 \mid n \text{ is a natural number}\}$
84. If the matrix $A = \begin{bmatrix} a & b \\ b & a \end{bmatrix}$ is such that $A^2 = I$, then which one of the following is correct?
- $\alpha = 0, \beta = 1$ or $\alpha = 1, \beta = 0$
 - $\alpha = 0, \beta \neq 1$ or $\alpha \neq 0, \beta = 1$
 - $\alpha = 1, \beta \neq 0$ or $\alpha \neq 1, \beta = 0$
 - $\alpha \neq 0, \beta \neq 0$
85. What is the sum of the focal distances of a point of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$?
- a
 - b
 - 2a
 - 2b
86. What is the degree of the following differential equation?
- $$\left(\frac{d^3 y}{dx^3}\right)^{\frac{2}{3}} + 4 - 3\frac{d^2 y}{dx^2} + 5\frac{dy}{dx} = 0$$
- 1
 - 2
 - 3
 - 4
87. What is the sum of $\sqrt{3} + \frac{1}{\sqrt{3}} + \frac{1}{3\sqrt{3}} + \dots$?
- $\frac{\sqrt{3}}{2}$
 - $\frac{3\sqrt{3}}{2}$
 - $\frac{2\sqrt{3}}{2}$
 - $\sqrt{3}$
88. What does the differential equation $y \frac{dy}{dx} + x = a$ (where a is a constant) represent?
- A set of circles having centre on the y-axis
 - A set of circles having centre on the x-axis
 - A set of ellipses
 - A pair of straight lines

89. If $A = \begin{bmatrix} a & 0 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$ such that $A^2 = B$, then what is the value of a ?
 (a) -1 (b) 1
 (c) 2 (d) 4
90. What is the value of n , if $P(15, n-1) : P(16, n-2) = 3 : 4$?
 (a) 10
 (b) 12
 (c) 14
 (d) 15
91. What is the middle term in the expansion of $\left(1 - \frac{x}{2}\right)^8$?
 (a) $\frac{35x^4}{8}$ (b) $\frac{17x^5}{8}$
 (c) $\frac{35x^5}{8}$ (d) None of the above
92. What is the sum of the roots of the equations $(2 - \sqrt{3})x^2 - (7 - 4\sqrt{3})x + (2 + \sqrt{3}) = 0$?
 (a) $2 - \sqrt{3}$ (b) $2 + \sqrt{3}$
 (c) $7 - 4\sqrt{3}$ (d) 4
93. What is the total number of combinations of n different things taken 1, 2, 3, ..., n at a time?
 (a) 2^{n+1} (b) 2^{2n+1}
 (c) 2^{n-1} (d) $2^n - 1$
94. One of the roots of the quadratic equation $ax^2 + bx + c = 0$, $a \neq 0$ is positive and the other root is negative. The condition for this to happen is
 (a) $a > 0, b > 0, c > 0$
 (b) $a > 0, b > 0, c < 0$
 (c) $a < 0, b > 0, c < 0$
 (d) $a < 0, c > 0$
95. If the solution of the differential equation $\frac{dy}{dx} = \frac{ax+3}{2y+f}$ represents a circle, then what is the value of a ?
 (a) 2 (b) 1
 (c) -2 (d) -1
96. If A, B, C are in AP and $b : c = \sqrt{3} : \sqrt{2}$, then what is the value of $\sin C$?
 (a) 1 (b) $\frac{1}{\sqrt{3}}$
 (c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{2}}$
97. The points with position vectors $10\hat{i} + 3\hat{j}$, $12\hat{i} - 5\hat{j}$, at $a\hat{i} + 11\hat{j}$ are collinear, if the value of a is
 (a) -8 (b) 4
 (c) 8 (d) 12
98. What is the sine of angle between the vectors $\hat{i} + 2\hat{j} + 3\hat{k}$ and $-\hat{i} + 2\hat{j} + 3\hat{k}$?
 (a) $\sqrt{\frac{13}{7}}$ (b) $\sqrt{\frac{13}{17}}$
 (c) $\frac{13}{\sqrt{7}}$ (d) None of the above
99. If $\sin\left(\sin^{-1}\frac{1}{5} + \cos^{-1}x\right) = 1$ then what is x equal to ?
 (a) 0 (b) 1
 (c) $\frac{4}{5}$ (d) $\frac{1}{5}$
100. What is $\log(a + \sqrt{a^2 + 1}) + \log\left(\frac{1}{a + \sqrt{a^2 + 1}}\right)$ equal to ?
 (a) 1 (b) 0

- (c) 2 (d) $\frac{1}{2}$
101. 5 books are to be chosen from a lot of 10 books. If m is the number of ways of choice when one specified book is always included and n is the number of ways of choice when a specified book is always excluded, then which one of the following is correct ?
 (a) $m > n$
 (b) $m = n$
 (c) $m = n - 1$
 (d) $m = n - 2$
102. Which one of the following is correct in respect of the function $f(x) = |x| + x^2$?
 (a) $f(x)$ is not continuous at $x = 0$
 (b) $f(x)$ is differentiable at $x = 0$
 (c) $f(x)$ is continuous but not differentiable at $x = 0$
 (d) None of the above
103. What is the condition that one root of the equation $ax^2 + bx + c = 0$, $a \neq 0$ should be double the other ?
 (a) $2a^2 = 9bc$ (b) $2b^2 = 9ac$
 (c) $2c^2 = 9ab$ (d) None of the above
104. Consider the following with regard to a relation R on a set of real numbers defined by xRy if and only if $3x + 4y = 5$:
1. $0 R 1$ 2. $1R\frac{1}{2}$
3. $\frac{2}{3}R\frac{3}{4}$
- Which of the above are correct ?
 (a) 1 and 2 only (b) 1 and 3 only
 (c) 2 and 3 only (d) All of the above
105. The function $f(x) = k \sin x + \frac{1}{3} \sin 3x$ has maximum value at $x = \frac{p}{3}$. What is the value of k ?
- (a) 3 (b) $\frac{1}{3}$
 (c) 2 (d) $\frac{1}{2}$
106. If $I_n = \int_0^{\frac{\pi}{4}} \tan^n x \, dx$ then what is $I_n + I_{n-2}$ equal to ?
 (a) $1/n$ (b) $1/(n-1)$
 (c) $n/(n-1)$ (d) $1/(n-2)$
107. What is the equation of the line joining the origin with the point of intersection of the lines $4x + 3y = 12$ and $3x + 4y = 12$?
 (a) $x + y = 1$
 (b) $x - y = 1$
 (c) $3y = 4x$ (d) $x = y$
108. If the sum of the squares of the distances of the point (x, y) from the points $(a, 0)$ and $(-a, 0)$ is $2b^2$, then which one of the following is correct ?
 (a) $x^2 + a^2 = b^2 + y^2$
 (b) $x^2 + a^2 = 2b^2 - y^2$
 (c) $x^2 - a^2 = b^2 + y^2$
 (d) $x^2 + a^2 = b^2 - y^2$
109. If $f(x) = 2^x$, then what is $f''(x)$ equal to ?
 (a) $2^x (1 \ln 2)^2$ (b) $x(x-1)2^{x-2}$
 (c) $2^{x+1} (1 \ln 2)$ (d) $2^x (\log_{10} 2)^2$
110. In an examination, there are 3 multiple choice questions and each question has 4 choices. If a student randomly selects an answer for all the three questions, what is the probability that the student will not answer all the three questions correctly ?
 (a) $1/64$ (b) $63/64$
 (c) $1/12$ (d) $11/12$
111. What is the geometric mean of the data 2, 4, 8, 16, 32 ?
 (a) 2 (b) 4
 (c) 8 (d) 16
112. What is the cumulative frequency curve of statistical data commonly called ?
 (a) Cartogram (b) Histogram

- (c) Ogive (d) Pictogram
113. If A and B are two mutually exclusive curve of statistical data commonly called ?
 (a) 0 (b) $P(A) + P(B)$
 (c) $P(A)P(B)$ (d) $P(A)P(B|A)$
114. If $x = \sin\theta + \cos\theta$ and $y = \sin\theta \cdot \cos\theta$, then what is the value of
 $x^4 - 4x^2y - 2x^2 + 4y^2 + 4y + 1$?
 (a) 0 (b) 1
 (c) 2 (d) None of the above
115. What is $\lim_{x \rightarrow \infty} (\sqrt{a^2x^2 + ax + 1} - \sqrt{a^2x^2 + 1})$ equal to ?
 (a) $\frac{1}{2}$ (b) 1
 (c) 2 (d) 0
116. What is $\int \frac{\sin \sqrt{x}}{\sqrt{x}} dx$ equal to ?
 (a) $\frac{\cos \sqrt{x}}{2} + c$ (b) $2 \cos \sqrt{x} + c$
 (c) $\frac{-\cos \sqrt{x}}{2} + c$ (d) $-2 \cos \sqrt{x} + c$
- where c is a constant of integration.
117. Which one of the following is the unit vector perpendicular to the vector $4\hat{i} + 2\hat{j}$ and $-3\hat{i} + 2\hat{j}$?
- (a) $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$ (b) $\frac{\hat{i} - \hat{j}}{\sqrt{2}}$
 (c) \hat{k} (d) $\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$
118. Consider the following statements in respect of the vectors
 $\vec{u}_1 = (1, 2, 3)$, $\vec{u}_2 = (2, 3, 1)$,
 $\vec{u}_3 = (1, 3, 2)$, and $\vec{u}_4 = (4, 6, 2)$,
 1. \vec{u}_1 is parallel to \vec{u}_4
 2. \vec{u}_2 is parallel to \vec{u}_4
 3. \vec{u}_3 is parallel to \vec{u}_4
 Which of the statements given above is/are correct ?
 (a) 1 only (b) 2
 (c) 3 only (d) 1 and 3
119. The line $mx + ny = 1$ passes through the points (1, 2) and (2, 1). What is the value of m ?
 (a) 1 (b) 3
 (c) $\frac{1}{2}$ (d) $\frac{1}{3}$
120. What is the solution set for the equation $x^4 - 26x^2 + 25 = 0$?
 (a) $\{-5, -1, 1, 5\}$ (b) $\{-5, -1\}$
 (c) $\{1, 5\}$ (d) $\{-5, 0, 1, 5\}$

ANSWERS**Paper II : Mathematics**

1. (d)	2. (a)	3. (b)	4. (b)	5. (a)	6. (b)	7. (b)	8. (c)	9. (c)	10. (b)
11. (d)	12. (b)	13. (c)	14. (b)	15. (c)	16. (a)	17. (c)	18. (c)	19. (c)	20. (c)
21. (a)	22. (a)	23. (d)	24. (b)	25. (a)	26. (c)	27. (c)	28. (c)	29. (a)	30. (c)
31. (a)	32. (a)	33. (d)	34. (d)	35. (a)	36. (a)	37. (b)	38. (d)	39. (c)	40. (b)
41. (a)	42. (c)	43. (a)	44. (a)	45. (b)	46. (c)	47. (a)	48. (c)	49. (d)	50. (b)
51. (c)	52. (c)	53. (b)	54. (b)	55. (a)	56. (b)	57. (d)	58. (d)	59. (a)	60. (d)
61. (d)	62. (c)	63. (d)	64. (d)	65. (b)	66. (c)	67. (b)	68. (c)	69. (c)	70. (b)
71. (a)	72. (c)	73. (a)	74. (c)	75. (c)	76. (a)	77. (d)	78. (c)	79. (b)	80. (c)
81. (d)	82. (d)	83. (d)	84. (a)	85. (c)	86. (b)	87. (b)	88. (b)	89. (b)	90. (c)
91. (a)	92. (a)	93. (d)	94. (d)	95. (c)	96. (d)	97. (c)	98. (b)	99. (d)	100. (b)
101. (b)	102. (c)	103. (b)	104. (c)	105. (c)	106. (b)	107. (d)	108. (d)	109. (a)	110. (b)
111. (c)	112. (c)	113. (b)	114. (a)	115. (a)	116. (d)	117. (c)	118. (b)	119. (d)	120. (a)