

Time : 2:30 Hour

Total Marks : 300

Important Instructions :

1. This test Booklet contains **120 items (questions)**. Each item is printed in **English**. Each item comprises four responses (answer's). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
2. You have to mark all your responses **ONLY** on the separate Answer Sheet provided.
3. **All items carry equal marks.**
4. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions.
5. **Penalty for wrong answers :**
THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
 - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, one-third of the marks assigned to that question will be deducted as penalty.
 - (ii) If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to be correct and there will be same penalty as above to that question.
 - (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be no penalty for that question.

1. If $x + \log_{10}(1 + 2^x) = x \log_{10} 5 + \log_{10} 6$, then x is equal to
 (a) 2, -3 (b) 2 only
 (c) 1 (d) 3
2. The remainder and the quotient of the binary division $(101110)_2 \div (110)_2$ are respectively
 (a) $(111)_2$ and $(100)_2$ (b) $(100)_2$ and $(111)_2$
 (c) $(101)_2$ and $(101)_2$ (d) $(100)_2$ and $(100)_2$
3. The matrix A has x rows and $x + 5$ columns. The matrix B has y rows and $11 - y$ columns. Both AB and BA exist. What are the values of x and y respectively?
 (a) 8 and 3 (b) 3 and 4
 (c) 3 and 8 (d) 8 and 8
4. If $S_n = nP + \frac{n(n-1)Q}{2}$, where S_n denotes the sum of the first n terms of an AP, then the common difference is
 (a) $P + Q$ (b) $2P + 3Q$
 (c) $2Q$ (d) Q
5. The roots of the equation
 $(q - r)x^2 + (r - p)x + (p - q) = 0$
 are
 (a) $(r - p)/(q - r), 1/2$ (b) $(p - q)/(q - r), 1$
 (c) $(q - r)/(p - q), 1$ (d) $(r - p)/(p - q), 1/2$
6. If E is the universal set and $A = B \cup C$, then the set $E - (E - (E - (E - (E - A))))$ is same as the set
 (a) $B' \cup C'$ (b) $B \cup C$
 (c) $B' \cap C'$ (d) $B \cap C$
7. If $A = \{x : x \text{ is a multiple of } 2\}$, $B = \{x : x \text{ is a multiple of } 5\}$ and $C = \{x : x \text{ is a multiple of } 10\}$, then $A \cap (B \cap C)$ is equal to
 (a) A
 (b) B
 (c) C
 (d) $\{x : x \text{ is a multiple of } 100\}$
8. If α and β are the roots of the equation
 $1 + x + x^2 = 0$, then the matrix product
 $\begin{bmatrix} 1 & \beta \\ \alpha & \alpha \end{bmatrix} \begin{bmatrix} \alpha & \beta \\ 1 & \beta \end{bmatrix}$ is equal to
 (a) $\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} -1 & -1 \\ -1 & 2 \end{bmatrix}$
 (c) $\begin{bmatrix} 1 & -1 \\ -1 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} -1 & -1 \\ -1 & -2 \end{bmatrix}$
9. If $|a|$ denotes the absolute value of an integer, then which of the following are correct?
 (1) $|ab| = |a| |b|$
 (2) $|a + b| \leq |a| + |b|$
 (3) $|a - b| \geq ||a| - |b||$

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. How many different permutations can be made out of the letters of the word 'PERMUTATION' ?
(a) 19958400 (b) 19954800
(c) 19952400 (d) 39916800

11. If $A = \begin{bmatrix} 4i-6 & 10i \\ 14i & 6+4i \end{bmatrix}$ and $k = \frac{1}{2i}$, where

$i = \sqrt{-1}$, then kA is equal to

(a) $\begin{bmatrix} 2+3i & 5 \\ 7 & 2-3i \end{bmatrix}$ (b) $\begin{bmatrix} 2-3i & 5 \\ 7 & 2+3i \end{bmatrix}$

(c) $\begin{bmatrix} 2-3i & 7 \\ 5 & 2+3i \end{bmatrix}$ (d) $\begin{bmatrix} 2+3i & 5 \\ 7 & 2+3i \end{bmatrix}$

12. The sum of all real roots of the equation $|x-3|^2 + |x-3| - 2 = 0$ is
(a) 2 (b) 3
(c) 4 (d) 6

13. It is given that the roots of the equation $x^2 - 4x - \log_3 P = 0$ are real. For this, the minimum value of P is

(a) $\frac{1}{27}$ (b) $\frac{1}{64}$

(c) $\frac{1}{81}$ (d) 1

14. If A is a square matrix, then the value of $\text{adj } A^T - (\text{adj } A)^T$ is equal to

- (a) A
(b) $2|A|I$, where I is the identity matrix
(c) null matrix whose order is same as that of A
(d) unit matrix whose order is same as that of A

15. The value of the product

$$\frac{1}{6^2} \times \frac{1}{6^4} \times \frac{1}{6^8} \times \frac{1}{6^{16}} \times \dots \text{ up to infinite terms is}$$

- (a) 6 (b) 36
(c) 216 (d) 512

16. The value of the determinant

$$\begin{vmatrix} \cos^2 \frac{\theta}{2} & \sin^2 \frac{\theta}{2} \\ \sin^2 \frac{\theta}{2} & \cos^2 \frac{\theta}{2} \end{vmatrix}$$

for all values of θ , is

- (a) 1 (b) $\cos \theta$
(c) $\sin \theta$ (d) $\cos 2\theta$

17. The number of terms in the expansion of $(x+a)^{100} + (x-a)^{100}$ after simplification is

- (a) 202 (b) 101
(c) 51 (d) 50

18. In the expansion of $(1+x)^{50}$, the sum of the coefficients of odd powers of x is

- (a) 2^{26} (b) 2^{49}
(c) 2^{50} (d) 2^{51}

19. If a, b, c are non-zero real numbers, then the inverse of the matrix

$$A = \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$$

is equal to

(a) $\begin{bmatrix} a^{-1} & 0 & 0 \\ 0 & b^{-1} & 0 \\ 0 & 0 & c^{-1} \end{bmatrix}$ (b) $\frac{1}{abc} \begin{bmatrix} a^{-1} & 0 & 0 \\ 0 & b^{-1} & 0 \\ 0 & 0 & c^{-1} \end{bmatrix}$

(c) $\frac{1}{abc} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (d) $\frac{1}{abc} \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$

20. A person is to count 4500 notes. Let a_n denote the number of notes he counts in the n^{th} minute.

If $a_1 = a_2 = a_3 = \dots = a_{10} = 150$, and $a_{10}, a_{11}, a_{12}, \dots$ are in AP with the common difference -2 , then the time taken by him to count all the notes is

- (a) 24 minutes (b) 34 minutes
(c) 125 minutes (d) 135 minutes

21. The smallest positive integer n for which

$$\left(\frac{1+i}{1-i} \right)^n = 1, \text{ is}$$

- (a) 1 (b) 4
(c) 8 (d) 16

22. If we define a relation R on the set $N \times N$ as $(a, b) R (c, d) \Leftrightarrow a + d = b + c$

for all $(a, b), (c, d) \in N \times N$,

then the relation is

- (a) symmetric only
(b) symmetric and transitive only
(c) equivalence relation
(d) reflexive only

23. If $y = x + x^2 + x^3 + \dots$ up to infinite terms where $|x| < 1$, then which one of the following is correct?

- (a) $x = \frac{y}{1+y}$ (b) $x = \frac{y}{1-y}$
- (c) $x = \frac{1+y}{y}$ (d) $x = \frac{1-y}{y}$
24. If α and β are the roots of the equation $3x^2 + 2x + 1 = 0$, then the equation whose roots are $\alpha + \beta^{-1}$ and $\beta + \alpha^{-1}$ is
- (a) $3x^2 + 8x + 16 = 0$
 (b) $3x^2 - 8x - 16 = 0$
 (c) $3x^2 + 8x - 16 = 0$
 (d) $x^2 + 8x + 16 = 0$
25. The value of $\frac{1}{\log_3 e} + \frac{1}{\log_3 e^2} + \frac{1}{\log_3 e^4} + \dots$ up to infinite terms is
- (a) $\log_e 9$ (b) 0
 (c) 1 (d) $\log_e 3$
26. A tea party is arranged for 16 people along two sides of a long table with eight chairs on each side. Four particular men wish to sit on one particular side and two particular men on the other side. The number of ways they can be seated is
- (a) $24 \times 8! \times 8!$ (b) $(8!)^3$
 (c) $210 \times 8! \times 8!$ (d) $16!$
27. The system of equations $kx + y + z = 1$, $x + ky + z = k$ and $x + y + kz = k^2$ has no solution if k equals
- (a) 0 (b) 1
 (c) -1 (d) -2
28. If $1.3 + 2.3^2 + 3.3^3 + \dots + n.3^n = \frac{(2n-1)3^a + b}{4}$, then a and b are respectively
- (a) $n, 2$ (b) $n, 3$
 (c) $n + 1, 2$ (d) $n + 1, 3$
29. In ΔPQR , $\angle R = \frac{\pi}{2}$. If $\tan\left(\frac{P}{2}\right)$ and $\tan\left(\frac{Q}{2}\right)$ are the roots of the equation $ax^2 + bx + c = 0$, then which one of the following is correct?
- (a) $a = b + c$ (b) $b = c + a$
 (c) $c = a + b$ (d) $b = c$
30. If $\left|z - \frac{4}{z}\right| = 2$, then the maximum value of $|z|$ is equal to
- (a) $1 + \sqrt{3}$ (b) $1 + \sqrt{5}$
 (c) $1 - \sqrt{5}$ (d) $\sqrt{5} - 1$
31. The angle of elevation of a stationary cloud from a point 25 m above a lake is 15° and the angle of depression of its image in the lake is 45° . The height of the cloud above the lake level is
- (a) 25 m (b) $25\sqrt{3}$ m
 (c) 50 m (d) $50\sqrt{3}$ m
32. The value of $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ$ is equal to
- (a) -1 (b) 0
 (c) 1 (d) 4
33. The value of $\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ$ is equal to
- (a) 4 (b) 2
 (c) 1 (d) -4
34. Angle α is divided into two parts A and B such that $A - B = x$ and $\tan A : \tan B = p : q$. The value of $\sin x$ is equal to
- (a) $\frac{(p+q)\sin\alpha}{p-q}$ (b) $\frac{p\sin\alpha}{p+q}$
 (c) $\frac{p\sin\alpha}{p-q}$ (d) $\frac{(p-q)\sin\alpha}{p+q}$
35. The value of $\sin^{-1}\left(\frac{3}{5}\right) + \tan^{-1}\left(\frac{1}{7}\right)$ is equal to
- (a) 0 (b) $\frac{\pi}{4}$
 (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$
36. The angles of elevation of the top of a tower from the top and foot of a pole are respectively 30° and 45° . If h_T is the height of the tower and h_p is the height of the pole, then which of the following are correct?
- (1) $\frac{2h_p h_T}{3 + \sqrt{3}} = h_p^2$
 (2) $\frac{h_T - h_p}{\sqrt{3} + 1} = \frac{h_p}{2}$
 (3) $\frac{2(h_p + h_T)}{h_p} = 4 + \sqrt{3}$
- Select the correct answer using the code given below.
- (a) 1 and 3 only (b) 2 and 3 only
 (c) 1 and 2 only (d) 1, 2 and 3
37. In a triangle ABC, $a - 2b + c = 0$. The value of $\cot\left(\frac{A}{2}\right)\cot\left(\frac{C}{2}\right)$ is

- (a) $\frac{9}{2}$ (b) 3
 (c) $\frac{3}{2}$ (d) 1
38. $\sqrt{1+\sin A} = -\left(\sin \frac{A}{2} + \cos \frac{A}{2}\right)$ is true if
 (a) $\frac{3\pi}{2} < A < \frac{5\pi}{2}$ only (b) $\frac{\pi}{2} < A < \frac{3\pi}{2}$ only
 (c) $\frac{3\pi}{2} < A < \frac{7\pi}{2}$ (d) $0 < A < \frac{3\pi}{2}$
39. In triangle ABC, if $\frac{\sin^2 A + \sin^2 B + \sin^2 C}{\cos^2 A + \cos^2 B + \cos^2 C} = 2$, then the triangle is
 (a) right-angled (b) equilateral
 (c) isosceles (d) obtuse-angled
40. The principal value of $\sin^{-1} x$ lies in the interval
 (a) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ (b) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$
 (c) $\left[0, \frac{\pi}{2}\right]$ (d) $[0, \pi]$
41. The points (a, b) , $(0, 0)$, $(-a, -b)$ and (ab, b^2) are, where $|b| < 1$
 (a) the vertices of a parallelogram
 (b) the vertices of a rectangle
 (c) the vertices of a square
 (d) collinear
42. The length of the normal from origin to the plane $x + 2y - 2z = 9$ is equal to
 (a) 2 units (b) 3 units
 (c) 4 units (d) 5 units
43. If α , β and γ are the angles which the vector \vec{OP} (O being the origin) makes with positive direction of the coordinate axes, then which of the following are correct?
 (1) $\cos^2 \alpha + \cos^2 \beta = \sin^2 \gamma$
 (2) $\sin^2 \alpha + \sin^2 \beta = \cos^2 \gamma$
 (3) $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2$
 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
44. The angle between the lines $x + y - 3 = 0$ and $x - y + 3 = 0$ is α and the acute angle between the lines $x - \sqrt{3}y + 2\sqrt{3} = 0$ and $\sqrt{3}x - y + 1 = 0$ is β . Which one of the following is correct?
 (a) $\alpha = \beta$ (b) $\alpha > \beta$
 (c) $\alpha < \beta$ (d) $\alpha = 2\beta$
45. Let $\vec{\alpha} = \hat{i} + 2\hat{j} - \hat{k}$, $\vec{\beta} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{\gamma} = 2\hat{i} + \hat{j} + 6\hat{k}$ be three vectors. If $\vec{\alpha}$ and $\vec{\beta}$ are both perpendicular to the vector $\vec{\delta}$ and $\vec{\delta} \cdot \vec{\gamma} = 10$, then what is the magnitude of $\vec{\delta}$?
 (a) $\sqrt{3}$ units (b) $2\sqrt{3}$ units
 (c) $\frac{\sqrt{3}}{2}$ units (d) $\frac{1}{\sqrt{3}}$ units
46. If \hat{a} and \hat{b} are two unit vectors, then the vector $(\hat{a} + \hat{b}) \times (\hat{a} \times \hat{b})$ is parallel to
 (a) $(\hat{a} - \hat{b})$ (b) $(\hat{a} + \hat{b})$
 (c) $(2\hat{a} - \hat{b})$ (d) $(2\hat{a} + \hat{b})$
47. A force $\vec{F} = \hat{i} + 3\hat{j} + 2\hat{k}$ acts on a particle to displace it from the point A $(\hat{i} + 2\hat{j} - 3\hat{k})$ to the point B $(3\hat{i} - \hat{j} + 5\hat{k})$. The work done by the force will be
 (a) 5 units (b) 7 units
 (c) 9 units (d) 10 units
48. For any vector \vec{a}
 $|\vec{a} \times \hat{i}|^2 + |\vec{a} \times \hat{j}|^2 + |\vec{a} \times \hat{k}|^2$
 is equal to
 (a) $|\vec{a}|^2$ (b) $2|\vec{a}|^2$
 (c) $3|\vec{a}|^2$ (d) $4|\vec{a}|^2$
49. A man running round a racecourse notes that the sum of the distances of two flag-posts from him is always 10 m and the distance between the flag-posts is 8 m. The area of the path he encloses is
 (a) 18π square metres
 (b) 15π square metres
 (c) 12π square metres
 (d) 8π square metres

50. The distance of the point (1, 3) from the line $2x + 3y = 6$, measured parallel to the line $4x + y = 4$, is
- (a) $\frac{5}{\sqrt{13}}$ units (b) $\frac{5}{\sqrt{17}}$ units
 (c) $\sqrt{17}$ units (d) $\frac{\sqrt{17}}{2}$ units
51. If the vectors $a\hat{i} + \hat{j} + \hat{k}$, $\hat{i} + b\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + c\hat{k}$ ($a, b, c \neq 1$) are coplanar, then the value of $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$ is equal to
- (a) 0 (b) 1
 (c) $a + b + c$ (d) abc
52. The point of intersection of the line joining the points $(-3, 4, -8)$ and $(5, -6, 4)$ with the XY-plane is
- (a) $\left(\frac{7}{3}, -\frac{8}{3}, 0\right)$ (b) $\left(-\frac{7}{3}, -\frac{8}{3}, 0\right)$
 (c) $\left(-\frac{7}{3}, \frac{8}{3}, 0\right)$ (d) $\left(\frac{7}{3}, \frac{8}{3}, 0\right)$
53. If the angle between the lines whose direction ratios are $(2, -1, 2)$ and $(x, 3, 5)$ is $\frac{\pi}{4}$, then the smaller value of x is
- (a) 52 (b) 4
 (c) 2 (d) 1
54. The position of the point (1, 2) relative to the ellipse $2x^2 + 7y^2 = 20$ is
- (a) outside the ellipse
 (b) inside the ellipse but not at the focus
 (c) on the ellipse
 (d) at the focus
55. The equation of a straight line which cuts off an intercept of 5 units on negative direction of y -axis and makes an angle 120° with positive direction of x -axis is
- (a) $y + \sqrt{3}x + 5 = 0$
 (b) $y - \sqrt{3}x + 5 = 0$
 (c) $y + \sqrt{3}x - 5 = 0$
 (d) $y - \sqrt{3}x - 5 = 0$
56. The equation of the line passing through the point (2, 3) and the point of intersection of lines $2x - 3y + 7 = 0$ and $7x + 4y + 2 = 0$ is
- (a) $21x + 46y - 180 = 0$ (b) $21x - 46y + 96 = 0$
 (c) $46x + 21y - 155 = 0$ (d) $46x - 21y - 29 = 0$
57. The equation of the ellipse whose centre is at origin, major axis is along x -axis with eccentricity $\frac{3}{4}$ and latus rectum 4 units is
- (a) $\frac{x^2}{1024} + \frac{7y^2}{64} = 1$ (b) $\frac{49x^2}{1024} + \frac{7y^2}{64} = 1$
 (c) $\frac{7x^2}{1024} + \frac{49y^2}{64} = 1$ (d) $\frac{x^2}{1024} + \frac{4y^2}{64} = 1$
58. The equation of the circle which passes through the points (1, 0), (0, -6) and (3, 4) is
- (a) $4x^2 + 4y^2 + 142x + 47y + 140 = 0$
 (b) $4x^2 + 4y^2 - 142x - 47y + 138 = 0$
 (c) $4x^2 + 4y^2 - 142x + 47y + 138 = 0$
 (d) $4x^2 + 4y^2 + 150x - 49y + 138 = 0$
59. A variable plane passes through a fixed point (a, b, c) and cuts the axes in A, B and C respectively. The locus of the centre of the sphere OABC, O being the origin, is
- (a) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ (b) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 1$
 (c) $\frac{a}{x} + \frac{b}{y} + \frac{c}{z} = 2$ (d) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 2$
60. The equation of the plane passing through the line of intersection of the planes $x + y + z = 1$, $2x + 3y + 4z = 7$, and perpendicular to the plane $x - 5y + 3z = 5$ is given by
- (a) $x + 2y + 3z - 6 = 0$
 (b) $x + 2y + 3z + 6 = 0$
 (c) $3x + 4y + 5z - 8 = 0$
 (d) $3x + 4y + 5z + 8 = 0$
61. The inverse of the function $y = 5^{\ln x}$ is
- (a) $x = y^{\frac{1}{\ln 5}}$, $y > 0$
 (b) $x = y^{\ln 5}$, $y > 0$
 (c) $x = y^{\frac{1}{\ln 5}}$, $y < 0$
 (d) $x = 5 \ln y$, $y > 0$
62. A function is defined as follows:
- $$f(x) = \begin{cases} -\frac{x}{\sqrt{x^2}}, & x \neq 0 \\ 0, & x = 0 \end{cases}$$
- Which one of the following is correct in respect of the above function?
- (a) $f(x)$ is continuous at $x = 0$ but not differentiable at $x = 0$
 (b) $f(x)$ is continuous as well as differentiable at $x = 0$
 (c) $f(x)$ is discontinuous at $x = 0$
 (d) None of the above

63. If $y = (\cos x)^{(\cos x)^{(\cos x)^{\dots}}}$, then $\frac{dy}{dx}$ is equal to

- (a) $-\frac{y^2 \tan x}{1 - y \ln(\cos x)}$ (b) $-\frac{y^2 \tan x}{1 + y \ln(\cos x)}$
 (c) $-\frac{y^2 \tan x}{1 - y \ln(\sin x)}$ (d) $-\frac{y^2 \sin x}{1 + y \ln(\sin x)}$

64. Consider the following:

- (1) $x + x^2$ is continuous at $x = 0$
 (2) $x + \cos \frac{1}{x}$ is discontinuous at $x = 0$
 (3) $x^2 + \cos \frac{1}{x}$ is continuous at $x = 0$

Which of the above are correct?

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

65. Consider the following statements:

- (1) $\frac{dy}{dx}$ at a point on the curve gives slope of the tangent at that point.
 (2) If $a(t)$ denotes acceleration of a particle, then $\int a(t) dt + c$ gives velocity of the particle.
 (3) If $s(t)$ gives displacement of a particle at time t , then $\frac{ds}{dt}$ gives its acceleration at that instant.

Which of the above statements is/are correct?

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

66. If $y = \sec^{-1}\left(\frac{x+1}{x-1}\right) + \sin^{-1}\left(\frac{x-1}{x+1}\right)$, then $\frac{dy}{dx}$ is equal to

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

67. What is $\int \tan^{-1}(\sec x + \tan x) dx$ equal to?

- (a) $\frac{\pi x}{4} + \frac{x^2}{4} + c$ (b) $\frac{\pi x}{2} + \frac{x^2}{4} + c$
 (c) $\frac{\pi x}{4} + \frac{\pi x^2}{4} + c$ (d) $\frac{\pi x}{4} - \frac{x^2}{4} + c$

68. A function is defined in $(0, \infty)$ by

$$f(x) = \begin{cases} 1 - x^2 & \text{for } 0 < x \leq 1 \\ \ln x & \text{for } 1 < x \leq 2 \\ \ln 2 - 1 + 0.5x & \text{for } 2 < x < \infty \end{cases}$$

Which one of the following is correct in respect of the derivative of the function, i.e., $f'(x)$?

- (a) $f'(x) = 2x$ for $0 < x \leq 1$
 (b) $f'(x) = -2x$ for $0 < x \leq 1$
 (c) $f'(x) = -2x$ for $0 < x < 1$
 (d) $f'(x) = 0$ for $0 < x < \infty$

69. Which one of the following is correct in respect of the function $f(x) = x(x-1)(x+1)$?

- (a) The local maximum value is larger than local minimum value
 (b) The local maximum value is smaller than local minimum value
 (c) The function has no local maximum
 (d) The function has no local minimum

70. Consider the following statements:

- (1) Derivative of $f(x)$ may not exist at some point.
 (2) Derivative of $f(x)$ may exist finitely at some point.
 (3) Derivative of $f(x)$ may be infinite (geometrically) at some point.

Which of the above statements are correct?

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

71. The maximum value of $\frac{\ln x}{x}$ is

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

72. The function $f(x) = |x| - x^3$ is

- (a) odd
 (b) even
 (c) both even and odd
 (d) neither even nor odd

73. If

$$l_1 = \frac{d}{dx}(e^{\sin x})$$

$$l_2 = \lim_{h \rightarrow 0} \frac{e^{\sin(x+h)} - e^{\sin x}}{h}$$

$$l_3 = \int e^{\sin x} \cos x dx$$

then which one of the following is correct?

- (a) $l_1 \neq l_2$ (b) $\frac{d}{dx}(l_3) = l_2$
 (c) $\int l_3 dx = l_2$ (d) $l_2 = l_3$

74. The general solution of

$$\frac{dy}{dx} = \frac{ax+h}{by+k}$$

represents a circle only when

- (a) $a = b = 0$ (b) $a = -b \neq 0$
 (c) $a = b \neq 0, h = k$ (d) $a = b \neq 0$

75. If $\lim_{x \rightarrow \frac{\pi}{2}} \frac{\sin x}{x} = l$ and $\lim_{x \rightarrow \infty} \frac{\cos x}{x} = m$, then which

one of the following is correct?

- (a) $l = 1, m = 1$ (b) $l = \frac{2}{\pi}, m = \infty$
 (c) $l = \frac{2}{\pi}, m = 0$ (d) $l = 1, m = \infty$

76. What is $\int_0^{2\pi} \sqrt{1 + \sin \frac{x}{2}} dx$ equal to?

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

77. The area bounded by the curve $|x| + |y| = 1$ is

- (a) 1 square unit (b) $2\sqrt{2}$ square units
 (c) 2 square units (d) $2\sqrt{3}$ square units

78. If x is any real number, then $\frac{x^2}{1+x^4}$ belongs to which one of the following intervals?

- (a) $(0, 1)$ (b) $\left(0, \frac{1}{2}\right]$
 (c) $\left(0, \frac{1}{2}\right)$ (d) $[0, 1]$

79. The left-hand derivative of

$$f(x) = [x] \sin(\pi x) \text{ at } x = k$$

where k is an integer and $[x]$ is the greatest integer function, is

- (a) $(-1)^k (k-1)\pi$ (b) $(-1)^{k-1} (k-1)\pi$
 (c) $(-1)^k k\pi$ (d) $(-1)^{k-1} k\pi$

80. If $f(x) = \frac{x}{2} - 1$, then on the interval $[0, \pi]$ which one of the following is correct?

- (a) $\tan [f(x)]$, where $[\cdot]$ is the greatest integer function, and $\frac{1}{f(x)}$ are both continuous
 (b) $\tan [f(x)]$, where $[\cdot]$ is the greatest integer function, and $f^{-1}(x)$ are both continuous
 (c) $\tan [f(x)]$, where $[\cdot]$ is the greatest integer function, and $\frac{1}{f(x)}$ are both discontinuous

(d) $\tan [f(x)]$, where $[\cdot]$ is the greatest integer function, is discontinuous but $\frac{1}{f(x)}$ is continuous

81. The order and degree of the differential equation

$$\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = \rho^2 \left[\frac{d^2y}{dx^2}\right]^2$$

are respectively

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

82. If $y = \cos^{-1}\left(\frac{2x}{1+x^2}\right)$, then $\frac{dy}{dx}$ is equal to

- (a) $-\frac{2}{1+x^2}$ for all $|x| < 1$
 (b) $-\frac{2}{1+x^2}$ for all $|x| > 1$
 (c) $\frac{2}{1+x^2}$ for all $|x| < 1$
 (d) None of the above

83. The set of all points, where the function $f(x) = \sqrt{1 - e^{-x^2}}$ is differentiable, is

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

84. Match List-I with List-II and select the correct answer using the code given below the lists:

List-I (Function)	List-II (Maximum value)
(A) $\sin x + \cos x$	(1) $\sqrt{10}$
(B) $3\sin x + 4\cos x$	(2) $\sqrt{2}$
(C) $2\sin x + \cos x$	(3) 5
(D) $\sin x + 3\cos x$	(4) $\sqrt{5}$

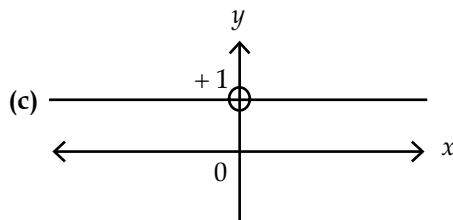
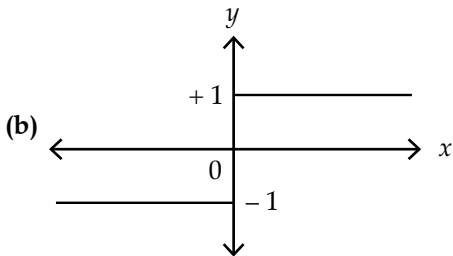
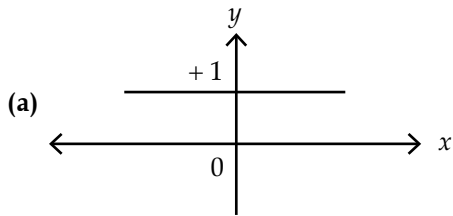
Code:

	A	B	C	D
(a)	2	3	1	4
(b)	2	3	4	1
(c)	3	2	1	4
(d)	3	2	4	1

85. If $f(x) = x(\sqrt{x} - \sqrt{x+1})$, then $f(x)$ is

- (a) continuous but not differentiable at $x = 0$
 (b) differentiable at $x = 0$
 (c) not continuous at $x = 0$
 (d) None of the above

86. Which one of the following graph represents the function $f(x) = \frac{x}{x}, x \neq 0$?



- (d) None of the above
87. Let $f(n) = \left[\frac{1}{4} + \frac{n}{1000} \right]$, where $[x]$ denotes the integral part of x . Then the value of $\sum_{n=1}^{1000} f(n)$ is

- (a) 251 (b) 250
(c) 1 (d) 0

88. $\int (\ln x)^{-1} dx - \int (\ln x)^{-2} dx$ is equal to

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

89. A cylindrical jar without a lid has to be constructed using a given surface area of a metal sheet. If the capacity of the jar is to be maximum, then the diameter of the jar must be k times the height of the jar. The value of k is

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

90. The value of $\int_0^{\frac{\pi}{4}} \sqrt{\tan x} dx + \int_0^{\frac{\pi}{4}} \sqrt{\cot x} dx$ is equal to

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

91. Let g be the greatest integer function. Then the function $f(x) = (g(x))^2 - g(x)$ is discontinuous at

- (a) all integers
(b) all integers except 0 and 1
(c) all integers except 0
(d) all integers except 1

92. The differential equation of minimum order by eliminating the arbitrary constants A and C in the equation $y = A[\sin(x+C) + \cos(x+C)]$ is

- (a) $y'' + (\sin x + \cos x)y' = 1$
(b) $y'' = (\sin x + \cos x)y'$
(c) $y'' = (y')^2 + \sin x \cos x$
(d) $y'' + y = 0$

93. Consider the following statements:

Statement I:

$$x > \sin x \text{ for all } x > 0$$

Statement II:

$f(x) = x - \sin x$ is an increasing function for all $x > 0$

Which one of the following is correct in respect of the above statements?

- (a) Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I
(b) Both Statement I and Statement II are true and Statement II is not the correct explanation of Statement I
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true
94. The solution of the differential equation

$$\frac{dy}{dx} = \frac{y\phi'(x) - y^2}{\phi(x)}$$
 is

- (a) $y = \frac{x}{\phi(x) + c}$ (b) $y = \frac{\phi(x)}{x} + c$
(c) $y = \frac{\phi(x) + c}{x}$ (d) $y = \frac{\phi(x)}{x + c}$

95. If $f(x) = \frac{4x + x^4}{1 + 4x^3}$ and $g(x) = \ln\left(\frac{1+x}{1-x}\right)$, then

what is the value of $f \circ g\left(\frac{e-1}{e+1}\right)$ equal to?

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

96. The value of the determinant $\begin{vmatrix} 1-\alpha & \alpha-\alpha^2 & \alpha^2 \\ 1-\beta & \beta-\beta^2 & \beta^2 \\ 1-\gamma & \gamma-\gamma^2 & \gamma^2 \end{vmatrix}$

is equal to

- (a) $(\alpha - \beta)(\beta - \gamma)(\alpha - \gamma)$
 (b) $(\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$
 (c) $(\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)(\alpha + \beta + \gamma)$
 (d) 0

97. The adjoint of the matrix $A = \begin{bmatrix} 1 & 0 & 2 \\ 2 & 1 & 0 \\ 0 & 3 & 1 \end{bmatrix}$ is

- (a) $\begin{bmatrix} -1 & 6 & 2 \\ -2 & 1 & -4 \\ 6 & 3 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 6 & -2 \\ -2 & 1 & 4 \\ 6 & -3 & 1 \end{bmatrix}$
 (c) $\begin{bmatrix} 6 & 1 & 2 \\ 4 & -1 & 2 \\ 6 & 3 & -1 \end{bmatrix}$ (d) $\begin{bmatrix} -6 & 2 & 1 \\ 4 & -2 & 1 \\ 3 & 1 & -6 \end{bmatrix}$

98. If $A = \begin{pmatrix} -2 & 2 \\ 2 & -2 \end{pmatrix}$, then which one of the

following is correct?

- (a) $A^2 = -2A$ (b) $A^2 = -4A$
 (c) $A^2 = -3A$ (d) $A^2 = 4A$

99. Geometrically $\text{Re}(z^2 - i) = 2$, where $i = \sqrt{-1}$ and Re is the real part, represents

- (a) circle
 (b) ellipse
 (c) rectangular hyperbola
 (d) parabola

100. If $p + q + r = a + b + c = 0$, then the determinant

$$\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix} \text{ equals}$$

- (a) 0
 (b) 1
 (c) $pa + qb + rc$
 (d) $pa + qb + rc + a + b + c$

101. A committee of two persons is selected from two men and two women. The probability that the committee will have exactly one woman is

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

102. Let a die be loaded in such a way that even faces are twice likely to occur as the odd faces. What is the probability that a prime number will show up when the die is tossed?

- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
 (c) $\frac{4}{9}$ (d) $\frac{5}{9}$

103. Let the sample space consist of non-negative integers up to 50, X denote the numbers which are multiples of 3 and Y denote the odd numbers. Which of the following is/are correct?

(1) $P(X) = \frac{8}{25}$

(2) $P(Y) = \frac{1}{2}$

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

104. For two events A and B, let $P(A) = \frac{1}{2}$,

$$P(A \cup B) = \frac{2}{3} \text{ and } P(A \cap B) = \frac{1}{6}. \text{ What is}$$

$P(\bar{A} \cap B)$ equal to?

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

105. Consider the following statements:

- (1) Coefficient of variation depends on the unit of measurement of the variable.
 (2) Range is a measure of dispersion.
 (3) Mean deviation is least when measured about median.

Which of the above statements are correct?

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

106. Given that the arithmetic mean and standard deviation of a sample of 15 observations are 24 and 0 respectively. Then which one of the following is the arithmetic mean of the smallest five observations in the data?

- (a) 0 (b) 8
 (c) 16 (d) 24

107. Which one of the following can be considered as appropriate pair of values of regression coefficient of y on x and regression coefficient of x on y ?

- (a) (1, 1) (b) (-1, 1)
 (c) $\left(-\frac{1}{2}, 2\right)$ (d) $\left(\frac{1}{3}, \frac{10}{3}\right)$

108. Let A and B be two events with $P(A) = \frac{1}{3}$

$$P(B) = \frac{1}{6} \text{ and } P(A \cap B) = \frac{1}{12}.$$

What is $P(B|\bar{A})$ equal to?

- (a) $\frac{1}{5}$ (b) $\frac{1}{7}$
 (c) $\frac{1}{8}$ (d) $\frac{1}{10}$

109. In a binomial distribution, the mean is $\frac{2}{3}$ and

the variance is $\frac{5}{9}$. What is the probability that

$X = 2$?

- (a) $\frac{5}{36}$ (b) $\frac{25}{36}$
 (c) $\frac{25}{216}$ (d) $\frac{25}{54}$

110. The probability that a ship safely reaches a port is $\frac{1}{3}$. The probability that out of 5 ships, at least 4 ships would arrive safely is

- (a) $\frac{1}{243}$ (b) $\frac{10}{243}$
 (c) $\frac{11}{243}$ (d) $\frac{13}{243}$

111. What is the probability that at least two persons out of a group of three persons were born in the same month (disregard year)?

- (a) $\frac{33}{144}$ (b) $\frac{17}{72}$
 (c) $\frac{1}{144}$ (d) $\frac{2}{9}$

112. It is given that $\bar{X} = 10$, $\bar{Y} = 90$, $\sigma_X = 3$, $\sigma_Y = 12$ and $r_{XY} = 0.8$. The regression equation of X on Y is

- (a) $Y = 3.2X + 58$ (b) $X = 3.2Y + 58$

- (c) $X = -8 + 0.2Y$ (d) $Y = -8 + 0.2X$

113. If $P(B) = \frac{3}{4}$, $P(A \cap B \cap \bar{C}) = \frac{1}{3}$ and

$P(\bar{A} \cap B \cap \bar{C}) = \frac{1}{3}$, then what is $P(B \cap C)$ equal to?

- (a) $\frac{1}{12}$ (b) $\frac{3}{4}$
 (c) $\frac{1}{15}$ (d) $\frac{1}{9}$

114. The following table gives the monthly expenditure of two families:

Items	Expenditure (in")	
	Family A	Family B
Food	3,500	2,700
Clothing	500	800
Rent	1,500	1,000
Education	2,000	1,800
Miscellaneous	2,500	1,800

In constructing a pie diagram to the above data, the radii of the circles are to be chosen by which one of the following ratios?

- (a) 1 : 1 (b) 10 : 9
 (c) 100 : 91 (d) 5 : 4

115. If a variable takes values 0, 1, 2, 3, ... , n with frequencies

$$1, C(n, 1), C(n, 2), C(n, 3), \dots, C(n, n)$$

respectively, then the arithmetic mean is

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

116. In a multiple-choice test, an examinee either knows the correct answer with probability p , or guesses with probability $1 - p$. The probability

of answering a question correctly is $\frac{1}{m}$, if he or

she merely guesses. If the examinee answers a question correctly, the probability that he or she really knows the answer is

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

117. If x_1 and x_2 are positive quantities, then the condition for the difference between the arithmetic mean and the geometric mean to be greater than 1 is

- (a) $x_1 + x_2 > 2\sqrt{x_1x_2}$
 (b) $\sqrt{x_1} + \sqrt{x_2} > \sqrt{2}$
 (c) $|\sqrt{x_1} - \sqrt{x_2}| > \sqrt{2}$
 (d) $x_1 + x_2 < 2(\sqrt{x_1x_2} + 1)$

118. Consider the following statements:

- (1) Variance is unaffected by change of origin and change of scale.
 (2) Coefficient of variance is independent of the unit of observations.

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

119. Five sticks of length 1, 3, 5, 7 and 9 feet are given. Three of these sticks are selected at random. What is the probability that the selected sticks can form a triangle?

- (a) 0.5 (b) 0.4
 (c) 0.3 (d) 0

120. The coefficient of correlation when coefficients of regression are 0.2 and 1.8 is

- (a) 0.36 (b) 0.2
 (c) 0.6 (d) 0.9

Finished Solving the Paper ?
Time to evaluate yourself !

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For elaborated
Solutions

Answers

Q. No.	Answer Key	Topic Name	Chapter Name
1	(c)	Properties of Logarithm	Logarithm
2	(b)	Binary Number	Binary Number
3	(c)	Order of Matrix	Matrix
4	(d)	Sum of A.P.	Sequence and Series
5	(b)	Properties of Roots	Quadratic Equation
6	(c)	Properties of Sets	Sets
7	(c)	Intersection of Sets	Sets
8	(b)	Cube Root of Unity	Complex Number
9	(d)	Properties of Modulus	Function
10	(a)	Permutation of Alike Objects	Permutation and Combination
11	(a)	Scalar Product of Matrix	Matrix
12	(d)	Roots of Equation	Quadratic Equation
13	(c)	Nature of Roots	Quadratic Equation
14	(c)	Properties of Matrix	Matrix
15	(a)	Sum of Infinite GP	Sequence and Series
16	(b)	Value of Determinant	Determinant
17	(c)	Number of Terms	Binomial Theorem
18	(b)	Sum of Coefficients	Binomial Theorem
19	(a)	Inverse of Matrix	Matrix
20	(b)	Sum of A.P.	Sequence and Series
21	(b)	Properties of Iota	Complex Number
22	(c)	Types of Relation	Relation and Function
23	(a)	Sum of Infinite G.P.	Sequence and Series
24	(a)	Properties of Roots	Quadratic Equation
25	(a)	Sum of Infinite G.P.	Sequence and Series
26	(c)	Permutation	Permutation and Combination
27	(d)	System of Equation	Determinant
28	(d)	Sum of G.P.	Sequence and Series
29	(c)	Properties of Triangle	Properties of Triangle
30	(b)	Maximum Value	Complex Number
31	(b)	Angle of Elevation or Depression	Heights and Distance
32	(d)	Sum and Difference Formula	Trigonometric Ratios and Identities
33	(a)	Sum and Difference Formula	Trigonometric Ratios and Identities
34	(d)	Properties of Trigonometry	Trigonometric Ratios and Identities
35	(b)	Sum Formula	Inverse Trigonometric Function
36	(c)	Angle of Elevation	Heights and Distance
37	(b)	Properties of Triangle	Properties of Triangle
38	(c)	Properties of Trigonometry	Trigonometric Ratios and Identities
39	(a)	Conditional Identities	Trigonometric Ratios and Identities
40	(b)	Range	Inverse Trigonometric Functions

Q. No.	Answer Key	Topic Name	Chapter Name
41	(d)	Distance Formula	2D
42	(b)	Length of Normal	2D
43	(c)	Direction Cosine of Angles	3D
44	(b)	Angle between Two Lines	2D
45	(b)	Properties of Vector	Vector
46	(a)	Properties of Vector	Vector
47	(c)	Work Done	Vector
48	(b)	Properties of Vector	Vector
49	(b)	Ellipse	Ellipse
50	(d)	Equation of Line	2D
51	(b)	Coplanar Vectors	Vector
52	(a)	Equation of Line	3D
53	(b)	Angle between Two Lines	3D
54	(a)	Position of Point	Ellipse
55	(a)	Equation of Line	2D
56	(b)	Equation of Line	2D
57	(b)	Equation of Ellipse	Ellipse
58	(c)	Equation of Circle	Circle
59	(c)	Equation of Sphere	3D
60	(a)	Equation of Plane	3D
61	(a)	Inverse	Function
62	(c)	Continuity	Continuity and Differentiability
63	(a)	Differential Coefficient	Differentiation
64	(a)	Continuity	Continuity and Differentiability
65	(a)	Rate of Change	Application of Derivative
66	(a)	Differential Coefficient	Differentiation
67	(a)	Trigonometric Integral	Integration
68	(c)	Differential Coefficient	Differentiation
69	(a)	Maxima and Minima	Application of Derivative
70	(d)	Differentiability	Continuity and Differentiability
71	(b)	Maxima and Minima	Application of Derivative
72	(d)	Even Odd Function	Function
73	(b)	Substitution Method	Indefinite Integration
74	(b)	Variable Separable	Differential Equation
75	(c)	Standard Limit	Limits
76	(a)	Definite Integration	Integration
77	(c)	Area of Curves	Application of Integration
78	(b)	Range	Function
79	(b)	Differentiability at a Point	Continuity & Differentiability
80	(c)	Continuity	Continuity and Differentiability
81	(b)	Order and Degree	Differential Equation

Q. No.	Answer Key	Topic Name	Chapter Name
82	(a)	Differential Coefficient	Differentiation
83	(c)	Differentiability	Continuity and Differentiability
84	(b)	Maxima and Minima	Trigonometric Ratios and Identities
85	(b)	Differentiability	Continuity and Differentiability
86	(c)	Graph	Function
87	(a)	Greatest Integer Function	Function
88	(a)	Integration by Parts	Indefinite Integration
89	(b)	Maxima and Minima	Application of Derivative
90	(d)	Definite Integration	Integration
91	(b)	Continuity	Continuity and Differentiability
92	(d)	Formation of DE	Differential Equation
93	(a)	Increasing and Decreasing	Application of Derivative
94	(d)	Linear Differential Equation	Differential Equation
95	(b)	Composite Function	Function
96	(b)	Value of Determinant	Determinant
97	(b)	Adjoint of a Matrix	Matrix
98	(b)	Properties of Matrix	Matrix
99	(c)	Properties of Complex Number	Complex Number
100	(a)	Value of Determinant	Determinant
101	(b)	Classical Definition Probability	Probability
102	(c)	Classical Definition Probability	Probability
103	(d)	Classical Definition Probability	Probability
104	(a)	Addition Theorem	Probability
105	(a)	Dispersion	Statistics
106	(d)	Dispersion	Statistics
107	(a)	Regression Coefficient	Correlation and Regression
108	(c)	Conditional Probability	Probability
109	(c)	Binomial of Distribution	Probability
110	(c)	Binomial Distribution	Probability
111	(b)	Complement of a Even	Probability
112	(c)	Line of Regression	Correlation and Regression
113	(a)	Venn Diagram	Probability
114	(b)	Pie Chart	Statistics
115	(d)	Mean	Statistics
116	(b)	Baye's Theorem	Probability
117	(c)	Relation between A.P. and G.P.	Sequence and Series
118	(b)	Properties of Statistics	Statistics
119	(c)	Classical Definition Probability	Probability
120	(c)	Regression Coefficient	Correlation and Regression