

NDA/NA SOLVED PAPER 2022-I

MATHEMATICS

1. If $\Delta_1 = \begin{vmatrix} 1 & p & q \\ 1 & q & r \\ 1 & r & p \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} 1 & 1 & 1 \\ q & r & p \\ r & p & q \end{vmatrix}$ where $p \neq q \neq r$, then $\Delta_1 + \Delta_2$ is

- (a) 0
 (b) always positive
 (c) always negative
 (d) positive if p, q, r are positive else negative

2. If $(a-b)(b-c)(c-a) = 2$ and $abc = 6$, then what is the

value of $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$?

- (a) 3 (b) 12
 (c) 14 (d) 15

3. Under which of the following conditions does the

determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$ vanish?

1. $a + b + c = 0$
 2. $a^3 + b^3 + c^3 = 3abc$
 3. $a^2 + b^2 + c^2 - ab - bc - ca = 0$

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

4. Consider the following in respect of the matrices:

$$A = [m \ n], B = [-n \ -m] \text{ and } C = \begin{bmatrix} m \\ -m \end{bmatrix}$$

1. $CA = CB$
 2. $AC = BC$
 3. $C(A + B) = CA + CB$

Which of the above statements is/are correct?

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

5. If $A = \begin{bmatrix} 2 \sin \theta & \cos \theta & 0 \\ -2 \cos \theta & \sin \theta & 0 \\ -1 & 1 & 1 \end{bmatrix}$, then what is $A(\text{adj } A)$ equal to?

- (a) Null matrix (b) $-I$
 (c) I (d) $2I$

where I is the identify matrix.

6. For what value of k is the matrix

$$\begin{bmatrix} 2 \cos 2\theta & 2 \cos 2\theta & 6 \\ 1 - 2 \sin^2 \theta & 2 \cos^2 \theta - 1 & 3 \\ k & 2k & 1 \end{bmatrix}$$
 singular?

- (a) 0 only (b) 1 only
 (c) 2 only (d) Any real value

7. Let A be a non-singular matrix and $B = \text{adj } A$. Which of the following statements is/are correct?

1. $AB = BA$
 2. AB is a scalar matrix
 3. AB can be a null matrix

Select the correct answer using the code given below :

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

8. Consider the following statements in respect of square matrices A and B of same order:

1. If AB is a null matrix, then at last one of A and B is a null matrix.

2. If AB is an identity matrix, then $BA = AB$.

Which of the above statements is/are correct?

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

9. If A is the identity matrix of order 3 and B is its transpose, then what is the value of the determinant of the matrix $C = A + B$?

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

10. Let A and B be non-singular matrices of the same order such that $AB = A$ and $BA = B$. Which of the following statements is/are correct?

1. $A^2 = A$
 2. $AB^2 = A^2B$

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

11. How many terms are there in the expansion of

$$\left(1 + \frac{2}{x}\right)^9 \left(1 - \frac{2}{x}\right)^9 ?$$

- (a) 9 (b) 10
 (c) 19 (d) 20

12. Consider the following statements in respect of the expansion of $(x + y)^{10}$:
- Among all the coefficients of the terms, the coefficient of the 6th term has the highest value
 - The coefficient of the 3rd term is equal to coefficient of the 9th term
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
13. If $C(3n, 2n) = C(3n, 2n - 7)$, then what is the value of $C(n, n - 5)$?
- (a) 42 (b) 35
(c) 28 (d) 21
14. What is the value of $C(51, 21) - C(51, 22) + C(51, 23) - C(51, 24) + C(51, 25) - C(51, 26) + C(51, 27) - C(51, 28) + C(51, 29) - C(51, 30)$?
- (a) $C(51, 25)$ (b) $C(51, 27)$
(c) $C(51, 51) - C(51, 0)$ (d) $C(51, 25) - C(51, 27)$
15. How many odd numbers between 300 and 400 are there in which none of the digits is repeated?
- (a) 32 (b) 36
(c) 40 (d) 45
16. How many permutations are there of the letters of the word 'TIGER' in which the vowels should not occupy the even positions?
- (a) 72 (b) 36
(c) 18 (d) 12
17. Let α and β be the roots of the equation $x^2 + px + q = 0$. If α^3 and β^3 are the roots of the equation $x^2 + mx + n = 0$, then what is the value of $m + n$?
- (a) $p^3 + q^3 + pq$ (b) $p^3 + q^3 - pq$
(c) $p^3 + q^3 + 3pq$ (d) $p^3 + q^3 - 3pq$
18. Let α and β be the roots of the equation $x^2 - ax - bx + ab - c = 0$. What is the quadratic equation whose roots are a and b ?
- (a) $x^2 - \alpha x - \beta x + \alpha\beta + c = 0$
(b) $x^2 - \alpha x - \beta x + \alpha\beta - c = 0$
(c) $x^2 + \alpha x + \beta x + \alpha\beta + c = 0$
(d) $x^2 + \alpha x + \beta x + \alpha\beta - c = 0$
19. If the roots of the equation $x^2 - ax - bx - cx + bc + ca = 0$ are equal, then which one of the following is correct?
- (a) $a + b + c = 0$ (b) $a - b + c = 0$
(c) $a + b - c = 0$ (d) $-a + b + c = 0$
20. Let α and β ($\alpha > \beta$) be the roots of the equation $x^2 - 8x + q = 0$. If $\alpha^2 - \beta^2 = 16$, then what is the value of q ?
- (a) -15 (b) -10
(c) 10 (d) 15
21. What is the maximum value of n such that 5^n divides $(30! + 35!)$, where n is a natural number?
- (a) 4 (b) 6
(c) 7 (d) 8
22. What is the value of $2(2 \times 1) + 3(3 \times 2 \times 1) + 4(4 \times 3 \times 2 \times 1) + 5(5 \times 4 \times 3 \times 2 \times 1) + \dots + 9(9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1) + 2$?
- (a) 11! (b) 10!
(c) $10 + 10!$ (d) $11 + 10!$
23. If $A = \{(1, 2, 3)\}$, then how many elements are there in the power set of A ?
- (a) 1 (b) 2
(c) 4 (d) 8
24. If a, b, c are in GP where $a > 0, b > 0, c > 0$, then which of the following are correct?
- a^2, b^2, c^2 are in GP
 - $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in GP
 - $\sqrt{a}, \sqrt{b}, \sqrt{c}$ are in GP
- 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
25. If $\frac{a+b}{2}, b, \frac{b+c}{2}$ are in HP, then which one of the following is correct?
- (a) a, b, c are in AP
(b) a, b, c are in GP
(c) $a + b, b + c, c + a$ are in GP
(d) $a + b, b + c, c + a$ are in AP
26. What is value of $\cot^2 15^\circ + \tan^2 15^\circ$?
- (a) 12 (b) 14
(c) $8\sqrt{3}$ (d) 4
27. In a triangle ABC ,
 $\sin A - \cos B - \cos C = 0$.
What is angle B equal to?
- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$
28. If $\alpha + \beta = \frac{\pi}{4}$ and $2 \tan \alpha = 1$, then what is $\tan 2\beta$ equal to?
- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
(c) $\frac{3}{4}$ (d) $\frac{3}{5}$
29. If $\tan(45^\circ + \theta) = 1 + \sin 2\theta$, where $-\frac{\pi}{4} < \theta < \frac{\pi}{4}$, then what is the value of $\cos 2\theta$?
- (a) 0 (b) $\frac{1}{2}$
(c) 1 (d) 2

30. Let $\sin 2\theta = \cos 3\theta$, where θ is acute angle. What is the value of $1 + 4\sin\theta$?
- (given that $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$)
- (a) $\sqrt{3}$ (b) 2
(c) $\sqrt{5}$ (d) 3
31. If $\tan \theta = -\frac{5}{12}$, then what can be the value of $\sin\theta$?
- (a) $\frac{5}{13}$ but cannot be $-\frac{5}{13}$
(b) $-\frac{5}{13}$ but cannot be $\frac{5}{13}$
(c) $\frac{5}{13}$ or $-\frac{5}{13}$
(d) None of the above
32. What is the value of $\cos^4 \frac{7\pi}{8} + \cos^4 \frac{5\pi}{8}$?
- (a) $\frac{3}{2}$ (b) $\frac{3}{4}$
(c) $\frac{3}{8}$ (d) $\frac{3}{16}$
33. What is $\sin^2\left(\frac{\pi}{4} + \theta\right) - \sin^2\left(\frac{\pi}{4} - \theta\right)$ equal to?
- (a) $\sin 2\theta$ (b) $\cos 2\theta$
(c) $2\sin\theta$ (d) $2\cos\theta$
34. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height h . At a point on the plane the angles of elevation of the bottom and top of the flagstaff are θ and 2θ respectively. What is the height of the tower?
- (a) $h\cos\theta$ (b) $h\sin\theta$
(c) $h\cos 2\theta$ (d) $h\sin 2\theta$
35. The shadow of a tower becomes x metre longer, when the angle of elevation of sun changes from 60° to θ . If the height of the tower is $\sqrt{3}x$ metre, then which one of the following is correct?
- (a) $0 < \theta < 30^\circ$ (b) $30^\circ < \theta < 45^\circ$
(c) $45^\circ < \theta < 60^\circ$ (d) $60^\circ < \theta < 90^\circ$
36. If $\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{x}{3}\right) = \frac{\pi}{4}$, where $0 < x < 6$, then what is x equal to?
- (a) 1 (b) 2
(c) 3 (d) 5
37. If $3\sin^{-1}x + \cos^{-1}x = \pi$, then what is x equal to?
- (a) 0 (b) $\frac{1}{2}$
(c) $\frac{1}{\sqrt{2}}$ (d) $\frac{1}{\sqrt{3}}$
38. If $\tan \alpha + \tan \beta = 1 - \tan \alpha \cdot \tan \beta$, where then which of the following is one of the values of $(\alpha + \beta)$?
- (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$
39. If $(1 + \tan\theta)(1 + \tan 9\theta) = 2$, then what is the value of $\tan(10\theta)$?
- (a) 0 (b) 1
(c) 2 (d) Infinite
40. What is the value of $\sin 0^\circ + \sin 10^\circ + \sin 20^\circ + \sin 30^\circ + \dots + \sin 360^\circ$?
- (a) -1 (b) 0
(c) 1 (d) 2
41. Consider all the subsets of the set $A = \{1, 2, 3, 4\}$. How many of them are supersets of the set $\{4\}$?
- (a) 6 (b) 7
(c) 8 (d) 9
42. Consider the following statements in respect of two non-empty sets A and B :
- $x \notin (A \cup B) \Rightarrow x \notin A$ or $x \notin B$
 - $x \notin (A \cap B) \Rightarrow x \notin A$ and $x \notin B$
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
43. Consider the following statements in respect of two non-empty sets A and B :
- $A \cup B = A \cap B$ iff $A = B$
 - $A \Delta B = \emptyset$ iff $A = B$
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
44. Consider the following statements in respect of the relation R in the set \mathbb{IN} of natural numbers defined by xRy if $x^2 - 5xy + 4y^2 = 0$:
- R is reflexive
 - R is symmetric
 - R is transitive
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3

45. Consider the following statements in respect of any relation R on a set A :
- If R is reflexive, then R^{-1} is also reflexive
 - If R is symmetric, then R^{-1} is also symmetric
 - If R is transitive, then R^{-1} is also transitive
- 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
46. What is the principal argument of $\frac{1}{1+i}$ where $i = \sqrt{-1}$?
- (a) $-\frac{3\pi}{4}$ (b) $-\frac{\pi}{4}$
(c) $\frac{\pi}{4}$ (d) $\frac{3\pi}{4}$
47. What is the modulus of $\left(\frac{\sqrt{-3}}{2} - \frac{1}{2}\right)^{200}$?
- (a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) 1 (d) 2^{200}
48. Consider the following statements :
- $\frac{n!}{3!}$ is divisible by 6, where $n > 3$
 - $\frac{n!}{3!} + 3$ is divisible by 7, where $n > 3$
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
49. In how many ways can a team of 5 players be selected out of 9 players so as to exclude two particular players?
- (a) 14 (b) 21
(c) 35 (d) 42
50. In the expansion of $\left(x + \frac{1}{x}\right)^{2n}$, what is the $(n+1)$ th term from the end (when arranged in descending powers of x)?
- (a) $C(2n, n)x$ (b) $C(2n, n-1)x$
(c) $C(2n, n)$ (d) $C(2n, n-1)$
51. If the sum of the first 9 terms of an AP is equal to sum of the first 11 terms, then what is the sum of the first 20 terms?
- (a) 20 (b) 10
(c) 2 (d) 0
52. If the 5th term of an AP is $\frac{1}{10}$ and its 10th term is $\frac{1}{5}$, then what is the sum of first 50 terms?
- (a) 25 (b) 25.5
(c) 26 (d) 26.5
53. What is $(1110011)_2 \div (10111)_2$ equal to?
- (a) $(101)_2$ (b) $(1001)_2$
(c) $(111)_2$ (d) $(1011)_2$
54. If $x^3 + y^3 = (100010111)_2$ and $x + y = (11111)_2$, then what is $(x-y)^2 + xy$ equal to?
- (a) $(1101)_2$ (b) $(1001)_2$
(c) $(1011)_2$ (d) $(1111)_2$
55. Consider the inequations $5x - 4y + 12 < 0$, $x + y < 2$, $x < 0$ and $y > 0$. Which one of the following points lies in the common region?
- (a) $(0, 0)$ (b) $(-2, 4)$
(c) $(-1, 4)$ (d) $(-1, 2)$
56. Consider the following statements in respect of the function $y = [x]$, $x \in (-1, 1)$ where $[.]$ is the greatest integer function:
- Its derivative is 0 at $x = 0.5$
 - It is continuous at $x = 0$
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
57. What is the degree of the differential equation $1 + \left(\frac{dy}{dx}\right)^2 = \left(\frac{d^2y}{dx^2}\right)^{\frac{4}{3}}$?
- (a) $\frac{4}{3}$ (b) 2
(c) 3 (d) 4
58. A radioactive substance decays at a rate proportional to the amount of substance present. If half of the substance decays in 100 years, then what is the decay constant (proportionality constant)?
- (a) $\frac{\ell n 2}{100}$ (b) $\frac{\ell n 5}{100}$
(c) $\frac{\ell n 10}{100}$ (d) $\frac{2\ell n 2}{100}$
59. What is the domain of the function $f(x) = \sqrt{1 - (x-1)^2}$?
- (a) $(0, 1)$ (b) $[-1, 1]$
(c) $(0, 2)$ (d) $[0, 2]$
60. The area of the region bounded by the parabola $y^2 = 4kx$, where $k > 0$ and its latus rectum is 24 square units. What is the value of k ?
- (a) 1 (b) 2
(c) 3 (d) 4
61. What is $\int_0^{\pi} \frac{dx}{(\sin x + \cos x)^2}$ equal to?
- (a) $-\frac{1}{2}$ (b) $\frac{1}{2}$
(c) 1 (d) $\frac{3}{2}$

62. What is $\int (\sin x)^{-1/2} (\cos x)^{-3/2} dx$ equal to?
 (a) $\sqrt{\tan x} + c$ (b) $2\sqrt{\tan x} + c$
 (c) $\sqrt{\cot x} + c$ (d) $\sqrt{2 \tan x} + c$
63. If $I_1 = \int \frac{e^x dx}{e^x + e^{-x}}$ and $I_2 = \int \frac{dx}{e^{2x} + 1}$, then what is $I_1 + I_2$ equal to?
 (a) $\frac{x}{2} + c$ (b) $x + c$
 (c) $\ln(e^x + e^{-x}) + c$ (d) $\ln(e^x - e^{-x}) + c$
64. What is $\int_{-2}^{-1} \frac{x}{|x|} dx$ equal to?
 (a) -2 (b) -1
 (c) 1 (d) 2
65. How many extreme values does $\sin 4x + 2x$, where $0 < x < \frac{\pi}{2}$ have?
 (a) 1 (b) 2
 (c) 4 (d) 8
66. What is the maximum value of the function $f(x) = \frac{1}{\tan x + \cot x}$, where $0 < x < \frac{\pi}{2}$?
 (a) $\frac{1}{4}$ (b) $\frac{1}{2}$
 (c) 1 (d) 2
67. If $4f(x) - f\left(\frac{1}{x}\right) = \left(2x + \frac{1}{x}\right)\left(2x - \frac{1}{x}\right)$, then what is $f(2)$ equal to?
 (a) 0 (b) 1
 (c) 2 (d) 4
68. If $f(x) = 4x + 3$, then what is $f \circ f \circ f(-1)$ equal to?
 (a) -1 (b) 0
 (c) 1 (d) 2
69. If $x^y y^x = 1$, then what is $\frac{dy}{dx}$ at $(1, 1)$ equal to?
 (a) -1 (b) 0
 (c) 1 (d) 4
70. If $y = (x^y)^x$, then what is the value of $\frac{dy}{dx}$ at $x = 1$?
 (a) $\frac{1}{2}$ (b) 1
 (c) 2 (d) 4
71. Let $y = [x + 1]$, $-4 < x < -3$ where $[.]$ is the greatest integer function. What is the derivative of y with respect to x at $x = -3.5$?
 (a) -4 (b) -3.5
 (c) -3 (d) 0
72. If $\frac{dy}{dx} = (\ln 5)y$ with $y(0) = \ln 5$, then what is $y(1)$ equal to?
 (a) 0 (b) 5
 (c) $2 \ln 5$ (d) $5 \ln 5$
73. Consider the following in respect of the function $f(x) = 10^x$:
 1. Its domain is $(-\infty, \infty)$
 2. It is a continuous function
 3. It is differentiable at $x = 0$
 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
74. What is $\lim_{x \rightarrow 0} x^3 (\operatorname{cosec} x)^2$ equal to?
 (a) 0 (b) $\frac{1}{2}$
 (c) 1 (d) Limit does not exist
75. What is $\lim_{x \rightarrow 1} \frac{x^3 - 1}{\sqrt{x} - 1}$ equal to?
 (a) 0 (b) 3
 (c) 6 (d) Limit does not exist
76. In which one of the following intervals is the function $f(x) = \frac{x^3}{3} - \frac{7x^2}{2} + 6x + 5$ decreasing?
 (a) $(-\infty, 1)$ only (b) $(1, 6)$
 (c) $(6, \infty)$ only (d) $(-\infty, 1) \cup (6, \infty)$
77. If the derivative of the function $f(x) = \frac{m}{x} + 2nx + 1$ vanishes at $x = 2$, then what is the value of $m + 8n$?
 (a) -2
 (b) 0
 (c) 2
 (d) Cannot be determined due to insufficient data
78. What is the area included in the first quadrant between the curves $y = x$ and $y = x^3$?
 (a) $\frac{1}{8}$ square unit (b) $\frac{1}{4}$ square unit
 (c) $\frac{1}{2}$ square unit (d) 1 square unit
79. If $xy = 4225$ where x, y are natural numbers, then what is the minimum value of $x + y$?
 (a) 130 (b) 260
 (c) 2113 (d) 4226
80. What does the equation $x \frac{dy}{dx} - 2y = 0$ represent?
 (a) A family of straight lines
 (b) A family of circles
 (c) A family of parabolas
 (d) A family of ellipses

81. If the points with coordinates $(-5, 0)$, $(5p^2, 10p)$ and $(5q^2, 10q)$ are collinear, then what is the value of pq where $p \neq q$?
- (a) -2 (b) -1
(c) 1 (d) 2
82. What is the equation of the straight line which passes through the point $(1, -2)$ and cuts off equal intercepts from the axes?
- (a) $x + y - 1 = 0$ (b) $x - y - 1 = 0$
(c) $x + y + 1 = 0$ (d) $x - y - 2 = 0$
83. What is the equation of the circle which touches both the axes in the first quadrant and the line $y - 2 = 0$?
- (a) $x^2 + y^2 - 2x - 2y - 1 = 0$
(b) $x^2 + y^2 + 2x + 2y + 1 = 0$
(c) $x^2 + y^2 - 2x - 2y + 1 = 0$
(d) $x^2 + y^2 - 4x - 4y + 4 = 0$
84. What is the equation of the parabola with focus $(-3, 0)$ and directrix $x - 3 = 0$?
- (a) $y^2 = 3x$ (b) $x^2 = 12y$
(c) $y^2 = 12x$ (d) $y^2 = -12x$
85. What is the distance between the foci of the ellipse $x^2 + 2y^2 = 1$?
- (a) 1 (b) $\sqrt{2}$
(c) 2 (d) $2\sqrt{2}$
86. Let a, b, c be the lengths of sides BC, CA, AB respectively of a triangle ABC . If p is the perimeter and q is the area of the triangle, then what is $p(p - 2a) \tan\left(\frac{A}{2}\right)$ equal to?
- (a) q (b) $2q$
(c) $3q$ (d) $4q$
87. A straight line passes through the point of intersection of $x + 2y + 2 = 0$ and $2x - 3y - 3 = 0$. It cuts equal intercepts in the fourth quadrant. What is the sum of the absolute values of the intercepts?
- (a) 2 (b) 3
(c) 4 (d) 6
88. Under which one of the following conditions are the lines $ax + by + c = 0$ and $bx + ay + c = 0$ parallel ($a \neq 0, b \neq 0$)?
- (a) $a - b = 0$ only (b) $a + b = 0$ only
(c) $a^2 - b^2 = 0$ (d) $ab + 1 = 0$
89. What is the equation of the locus of the mid-point of the line segment obtained by cutting the line $x + y = p$, (where p is a real number) by the coordinate axes?
- (a) $x - y = 0$ (b) $x + y = 0$
(c) $x - y = p$ (d) $x + y = p$
90. If the point (x, y) is equidistant from the points $(2a, 0)$ and $(0, 3a)$ where $a > 0$, then which one of the following is correct?
- (a) $2x - 3y = 0$ (b) $3x - 2y = 0$
(c) $4x - 6y + 5a = 0$ (d) $4x - 6y - 5a = 0$

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

The plane $6x + ky + 3z - 12 = 0$ where meets the coordinate axes at A, B and C respectively. The equation of the sphere passing through the origin and A, B, C is $x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$.

91. What is the value of k ?
- (a) 3 (b) 4
(c) 6 (d) 12
92. If p is the perpendicular distance from the centre of the sphere to the plane, then which one of the following is correct?
- (a) $0 < p < 0.5$ (b) $0.5 < p < 1$
(c) $1 < p < 1.5$ (d) $p > 1.5$
93. What is the equation of the line through the origin and the centre of the sphere?
- (a) $x = y = z$ (b) $2x = 3y = 4z$
(c) $6x = 3y = 4z$ (d) $6x = 4y = 3z$

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

Let the plane $\frac{2x}{k} + \frac{2y}{3} + \frac{z}{3} = 2$ pass through the point $(2, 3, -6)$.

94. What are the direction ratios of a normal to the plane?
- (a) $\langle 3, 2, 1 \rangle$ (b) $\langle 2, 3, 6 \rangle$
(c) $\langle 6, 3, 2 \rangle$ (d) $\langle 1, 2, 3 \rangle$
95. If p, q and r are the intercepts made by the plane on the coordinate axes respectively, then what is $(p + q + r)$ equal to?
- (a) 10 (b) 11
(c) 12 (d) 13
96. If $4\hat{i} + \hat{j} - 3\hat{k}$ and $p\hat{i} + q\hat{j} - 2\hat{k}$ are collinear vectors, then what are the possible values of p and q respectively?
- (a) $4, 1$ (b) $1, 4$
(c) $\frac{8}{3}, \frac{2}{3}$ (d) $\frac{2}{3}, \frac{8}{3}$
97. If $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of the vertices A, B, C respectively of a triangle ABC and G is the centroid of the triangle, then what is \vec{AG} equal to?
- (a) $\frac{\vec{a} + \vec{b} + \vec{c}}{3}$ (b) $\frac{2\vec{a} - \vec{b} - \vec{c}}{3}$
(c) $\frac{\vec{b} + \vec{c} - 2\vec{a}}{3}$ (d) $\frac{\vec{a} - 2\vec{b} - 2\vec{c}}{3}$
98. Consider the following statements:
- Dot product over vector addition is distributive
 - Cross product over vector addition is distributive
 - Cross product of vectors is associative
- Which of the above statements is/are correct?
- (a) 1 only (b) 2 only
(c) 1 and 2 only (d) 1, 2 and 3

99. Let \vec{a} , \vec{b} , \vec{c} be three non-zero vectors such that $\vec{a} \times \vec{b} = \vec{c}$. Consider the following statements :

1. \vec{a} is unique if \vec{b} and \vec{c} are given
2. \vec{c} is unique if \vec{a} and \vec{b} are given

Which of the above statements is/are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2
100. Let \vec{a} and \vec{b} be two unit vectors such that $|\vec{a} - \vec{b}| < 2$. If 2θ is the angle between \vec{a} and \vec{b} , then which one of the following is correct?

- (a) $0 < \sin \theta < 1$ only (b) $-\frac{1}{2} < \sin \theta < \frac{1}{2}$ only
(c) $-1 < \sin \theta < 0$ only (d) $-1 < \sin \theta < 1$

101. Two digits out of 1, 2, 3, 4, 5 are chosen at random and multiplied together. What is the probability that the last digit in the product appears as 0?

- (a) $\frac{1}{10}$ (b) $\frac{1}{5}$
(c) $\frac{2}{5}$ (d) $\frac{4}{5}$

102. The frequency curve (assuming unimodal) corresponding to the data obtained in an experiment is skewed to the left. What conclusion can be drawn from the curve?

- (a) Mean > Median > Mode
(b) Mean > Mode > Median
(c) Median > Mean > Mode
(d) Mode > Median > Mean

103. The variance of five positive observations is 3.6. If four of the observations are 2, 2, 4, 5 then what is the remaining observation?

- (a) 4 (b) 5
(c) 7 (d) 9

104. What is the arithmetic mean of 50 terms of an AP with first term 4 and common difference 4?

- (a) 50 (b) 51
(c) 100 (d) 102

105. What is the coefficient of mean deviation of 21, 34, 23, 39, 26, 37, 40, 20, 33, 27 (taken from mean)?

- (a) 0.11 (b) 0.22
(c) 0.33 (d) 0.44

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

The algebraic sum of the deviations of a set of values $x_1, x_2, x_3, \dots, x_n$ measured from 100 is -20 and the algebraic sum of the deviations of the same set of values measured from 92 is 140.

106. What is the mean of the values?

- (a) 91 (b) 96
(c) 98 (d) 99

107. What is the algebraic sum of the deviations of the same set of values measured from 99?

- (a) 0 (b) 10
(c) 20 (d) 40

108. If the algebraic sum of the deviations of the same set of values measured from y is 180, then what is the value of y ?

- (a) 80 (b) 85
(c) 90 (d) 95

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

The marks obtained by 51 students in a class are in AP with its first term 4 and common difference 3.

109. What is the mean of the marks?

- (a) 67 (b) 71
(c) 75 (d) 79

110. What is the median of the marks?

- (a) 79.5 (b) 79
(c) 78.5 (d) 77

111. What is the sum of the deviations measured from the median?

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

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

There are 90 applicants for a job. Some of them are graduates. Some of them have less than three years experience.

	Number of graduates	Number of non-graduates
At least 3 years experience	18	9
Less than 3 years experience	36	27

Let G be the event that the first applicant interviewed is a graduate and T be the event that first applicant interviewed has at least 3 years experience.

112. What is $P(G \cap \bar{T})$ equal to?

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

113. What is $P(G | \bar{T})$ equal to?

- (a) $\frac{2}{7}$ (b) $\frac{3}{7}$
(c) $\frac{4}{7}$ (d) $\frac{5}{7}$

5. Failure is the stepping stone to success;
(a)
however, successive failures are not
(b)
successive stepping stones to success.
(c)
No error
(d)

6. India's strengths are
(a)
its diversity of culture and
(b)
the spirit of tolerance in it's people.
(c)
No error
(d)

7. Once considered ninth planet of the solar system,
(a)
Pluto is today listed as the
(b)
largest dwarf planet of the solar system.
(c)
No error
(d)

8. The greatest glory in life
(a)
is to be able to realize ones dreams and ambitions
(b)
without trampling on those of others.
(c)
No error
(d)

9. To be able to manage one's
(a)
anger is a reflection of an individual's
(b)
psychological maturity.
(c)
No error
(d)

10. A honest mistake
(a)
is no more than that;
(b)
just an honest mistake.
(c)
No error
(d)

DIRECTIONS : Given below are some idioms/phrases followed by four alternative meanings to each. Choose the most appropriate answer from among the options (a), (b), (c) and (d).

11. Counting your chickens
(a) confident of success
(b) greedily accumulating wealth
(c) being careful about spending money
(d) getting scared because of danger
12. The icing on the cake
(a) baked food that is delicate and delicious with a topping
(b) extra benefit over and above an already good deal
(c) getting what you asked for
(d) more than what is needed
13. A stitch in time
(a) tailoring one's efforts efficiently
(b) making an effort to succeed
(c) inability to take timely decision
(d) timely action that prevents a negative outcome
14. At sixes and sevens
(a) on top of the situation
(b) state of denial
(c) state of total confusion
(d) well-planned and prepared
15. Talking twenty to the dozen
(a) talking hurriedly and rapidly
(b) talking too much
(c) talking without making sense
(d) talking out of turn
16. Under the weather
(a) walking in the rain
(b) controlled by the elements
(c) browbeaten by the heat
(d) unwell
17. To sit on the fence
(a) to act promptly
(b) to be lazy
(c) to be undecided
(d) to sit without doing anything

18. Once in a blue moon
 (a) romantic moment (b) occasionally
 (c) rarely (d) often
19. Through thick and thin
 (a) in genuine freindship
 (b) through the best of everything
 (c) among people both fat and slim
 (d) through difficult times
20. Like chalk and cheese
 (a) very different from each other
 (b) without any blemish
 (c) pure white in colour
 (d) very like each other

DIRECTIONS : Each of the following items in this section consists of a sentence, the parts of which have been jumbled. These parts have been labelled P, Q, R and S. Given below each sentence are four sequences namely (a), (b), (c) and (d). You are required to rearrange the jumbled parts of the sentence and mark your response accordingly.

21. but perhaps the best way is to agree
 P
there are many ways of dealing
 Q
with them without excessive argumentation
 R
with intransigent customers
 S
 The correct sequence should be
 (a) QPRS (b) QSPR
 (c) PSQR (d) RSQP
22. in the years following
 P
India achieved remarkable economic development
 Q
liberalization in the year 1991
 R
the landmark reforms inaugurated via
 S
 The correct sequence should be
 (a) PQRS (b) PRSQ
 (c) SPRQ (d) QPSR
23. was the victory secured by the women's hockey team
 P
in the arena of sport, perhaps
 Q
against Australia in the Tokyo Olympics
 R

the greatest moment in Indian Olympic history

S

The correct sequence should be

- (a) SPQR (b) RPQS
 (c) QSPR (d) QRPS

24. in terms of GDP and GNP,

P

for gauging the success of a nation

Q

which are the two major determinants

R

economic progress is determined

S

The correct sequence should be

- (a) SQRP (b) RPQS
 (c) SPRQ (d) QRPS

25. with the aplomb of a stage artist,

P

that they are not men of straw

Q

they can twist and shake their wobbly heads

R

mesmerizing the gullible into believing

S

The correct sequence should be

- (a) PRQS (b) RPSQ
 (c) SPQR (d) QRPS

26. of its rain-soaked verdure

P

an on the other there are

Q

on the one hand there is the immense beauty

R

th artifacts of its visible modernity

S

The correct sequence should be

- (a) PRQS (b) QRSP
 (c) SPQR (d) RPQS

27. are often rooted the causes

P

Q

of extreme poverty

R

in the inequalities of social systems

S

The correct sequence should be

- (a) QRPS (b) QRSP
 (c) SRQP (d) SRPQ

28. a person by the way he behaves and
 P Q

- you must judge not by the way he looks
 R S

The correct sequence should be

- (a) RPQS (b) QRSP
 (c) RSQP (d) QPSR

29. to the greatest number of people
 P

- that causes the least discomfort
 Q

- whenever in doubt always opt for the option
 R S

The correct sequence should be

- (a) RQPS (b) QRSP
 (c) RSQP (d) QPSR

30. brought by bad times against the despondency
 P Q

- our greatest defence faith and belief are
 R S

The correct sequence should be

- (a) RQPS (b) SRQP
 (c) RSQP (d) QPRS

DIRECTIONS : Each item in this section consists of a sentence with an underlined word followed by four words (a), (b), (c) and (d). Select the option that is opposite in meaning to the underlined word and mark your response in your Answer Sheet accordingly.

31. He is essentially a crude person.
 (a) coarse (b) refined
 (c) eager (d) balanced
32. His confidence is high.
 (a) diffidence (b) eagerness
 (c) steadfastness (d) endurance
33. His integrity is noticed.
 (a) skilfulness (b) ability
 (c) dependability (d) dishonesty
34. She is a benevolent individual.
 (a) clever (b) muddled
 (c) malevolent (d) ambivalent
35. His sartorial manner is judged.
 (a) unstylish (b) uncompromising
 (c) common (d) crude
36. This piece of art is authentic.
 (a) genuine (b) expensive
 (c) rare (d) fake

37. The deluge affected the population.
 (a) cloudburst (b) drought
 (c) deforestation (d) drizzle
38. His dedication is known to all.
 (a) clarity (b) hostility
 (c) apathy (d) anger
39. His perspicacity was remarkable.
 (a) smartness (b) dullness
 (c) dedication (d) deviousness
40. He has a penchant for spicy food.
 (a) tendency (b) affinity
 (c) fear (d) dislike

DIRECTIONS : Each item in this section consists of a sentence with an underlined word followed by four words (a), (b), (c) and (d). Select the option that is nearest in meaning to the underlined word and mark your response in your Answer Sheet accordingly.

41. After a good meal, it is important to pay a compliment to the chef.
 (a) tip (b) praise
 (c) admonish (d) revile
42. His work is laudable.
 (a) praiseworthy (b) laughable
 (c) bold (d) loud
43. Raj is a competent carpenter.
 (a) capable (b) exceptional
 (c) inadequate (d) clumsy
44. He is diligent in submitting assignments.
 (a) dilly-dallying (b) procrastinating
 (c) intelligent (d) conscientious
45. He appears to be reticent.
 (a) expansive (b) jolly
 (c) silent (d) withdrawn
46. He is always joyial.
 (a) cheerful (b) callous
 (c) garrulous (d) credulous
47. Mohan remains morose these days.
 (a) introspective (b) generous
 (c) chirpy (d) sullen
48. He was a reluctant learner.
 (a) enthusiastic (b) eager
 (c) unwilling (d) fearful
49. Amit is optimistic about the prospects of his investments.
 (a) pessimistic (b) uncaring
 (c) carefree (d) sanguine
50. Sachin is very cooperative by nature.
 (a) complaisant (b) covert
 (c) complacent (d) conniving

PART-B: GENERAL KNOWLEDGE

51. What is the mass of a material, whose specific heat capacity is $400 \text{ J/(kg}^\circ\text{C)}$ for a rise in temperature from 15°C to 25°C , when heat received is 20 kJ ?
- (a) 0.1 kg (b) 1 kg
(c) 10 kg (d) 5 kg
52. The specific latent heat of vaporization of a substance is the quantity of heat needed to change unit mass from
- (a) liquid to vapour with a change of temperature
(b) liquid to vapour without a change of temperature
(c) vapour to liquid without a change of temperature
(d) vapour to liquid with a change of temperature
53. Evaporation from the surface of a given liquid takes place more rapidly when
- (a) the temperature is high and the surface area of the liquid is large
(b) the temperature is low and the surface area of the liquid is large
(c) the temperature is low and the surface area of the liquid is small
(d) the temperature is high and the surface area of the liquid is small
54. Which of the following statements correctly explains/explain the existence of a positive force between two electric charges?
1. Both the charges are positive.
2. Both the charges are negative.
3. Both are charges are oppositely charged.
- 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
55. An electric wire of resistance 50 ohm is cut into five equal wires. These wires are then connected in parallel. What is the equivalent resistance of this combination?
- (a) 2 ohm (b) 10 ohm
(c) 0.5 ohm (d) 5 ohm
56. The electric field lines from an isolated positively charged conducting sphere are
- (a) tangential to the conducting surface
(b) at right angles to the conducting surface and towards the centre of the sphere
(c) at any angle to the conducting surface
(d) at right angles to the conducting surface and outwards from the centre of the sphere
57. Which one of the following is *not* a solution?
- (a) Alloy (b) Milk
(c) Air (d) Sugar
58. Refining of petroleum is carried out using which one of the following techniques?
- (a) Evaporation (b) Fractional distillation
(c) Separating funnel (d) Sublimation
59. Which one of the following is a chemical change?
- (a) Dissolving sugar in water
(b) Melting of ice
(c) Crystallization
(d) Milk turning sour
60. Which one of the following is the correct molecular formula of ammonium carbonate if the valency of ammonium ion is $(+1)$ and carbonate anion is (-2) ?
- (a) $(\text{NH}_4)_2\text{CO}_3$ (b) $\text{NH}_4(\text{CO}_3)_2$
(c) $(\text{NH}_3)_2\text{CO}_3$ (d) NH_4CO_3
61. Which one of the following is a covalent compound?
- (a) Calcium oxide (b) Sodium nitride
(c) Silicon carbide (d) Zinc sulphide
62. The mass number of argon is 40 . Which one of the following statements is correct?
- (a) The number of protons in argon is 22 .
(b) The number of neutrons in argon is 18 .
(c) The number of electrons in argon is 18 .
(d) The sum of numbers of protons and electrons in argon is 40 .
63. Which one of the following is the correct order of the valencies of elements Ne, Si, N and Mg?
- (a) $\text{Ne} < \text{Mg} < \text{N} < \text{Si}$ (b) $\text{Si} < \text{N} < \text{Mg} < \text{Ne}$
(c) $\text{Ne} < \text{N} < \text{Si} < \text{Mg}$ (d) $\text{Mg} < \text{Ne} < \text{N} < \text{Si}$
64. The frequency of an alternating current is 3 Hz . It implies that
- (a) there are 6 cycles/s (b) there are 3 cycles/s
(c) there are 2 cycles/s (d) there is only 1 cycle/s
65. Which one of the following correctly represents the SI unit of resistivity?
- (a) Ω (b) Ω/m
(c) $\Omega \text{ cm}$ (d) $\Omega \text{ m}$
66. What is the current required to light a 60 W incandescent bulb in a domestic supply of 240 V ?
- (a) 0.5 A (b) 0.25 A
(c) 1.0 A (d) 5.0 A
67. The magnetic field produced by a current-carrying straight wire at a point outside the wire depends
- (a) inversely on the distance from it
(b) directly on the distance from it
(c) inversely at short distances and directly at large distances from it
(d) directly on the distance (at short distances) and inversely on the distance (at long distances) from it
68. What is the dimension of gravitational constant?
- (a) ML^3T^{-2} (b) $\text{M}^{-1}\text{L}^3\text{T}^{-2}$
(c) $\text{M}^2\text{L}^{-2}\text{T}^{-2}$ (d) $\text{M}^2\text{L}^{-1}\text{T}^{-2}$
69. A ball is thrown vertically upward with a speed of 40 m/s . The time taken by the ball to reach the maximum height would be approximately
- (a) 2 s (b) 3 s
(c) 4 s (d) 5 s

70. The time period of a 1 m long pendulum approximates to
 (a) 6 s (b) 4 s
 (c) 2 s (d) 1 s
71. Which of the following statements about living and non-living being is/are correct?
 1. While living being can demonstrate growth and repair, non-living being cannot.
 2. While living being demonstrates metabolic processes, non-living being does not.
 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
72. Which one of the following plant plastids stores starch, oil and protein granules?
 (a) Chloroplast (b) Leucoplast
 (c) Chromoplast (d) Xanthoplast
73. Which one of the following statements about 'vacuoles' is **not** correct?
 (a) In plants, there is a large central vacuole that may occupy 90% of total cell volume.
 (b) In plant cells, vacuoles provide turgidity and rigidity.
 (c) In Amoeba, vacuoles have role in nutrition.
 (d) Vacuoles are absent in animal cells.
74. In aquatic plants, large air sacs give them buoyancy effects. These sacs are surrounded by which one of the following types of tissues?
 (a) Parenchyma (b) Collenchyma
 (c) Sclerenchyma (d) Complex tissue
75. Which one of the following belongs to 'Pisces'?
 (a) Dogfish (b) Jellyfish
 (c) Silverfish (d) Starfish
76. Which one of the following groups is called 'amphibians of plant kingdom'?
 (a) Bryophytes (b) Thallophytes
 (c) Pteridophytes (d) Gymnosperms
77. Which one of the following is caused by a bacterial pathogen?
 (a) AIDS (b) Dengue fever
 (c) COVID-19 (d) Typhoid fever
78. The twinkling of a star is due to the atmospheric
 (a) diffraction of starlight
 (b) reflection of starlight
 (c) refraction of starlight
 (d) dispersion of starlight
79. A mass M is dragged by a pulley on a horizontal plane by a force anti-parallel to its displacement. The work done in pulling the mass M is
 (a) zero (b) positive
 (c) infinite (d) negative
80. A 5 N force is defined when a mass of 10 kg is accelerated with
 (a) 5.0 cm/s^2 (b) 0.5 m/s^2
 (c) 0.5 cm/s^2 (d) 5.0 m/s^2
81. A boy of mass 52 kg jumps with a horizontal velocity of 2 m/s onto a stationary cart of mass 3 kg. The cart is fixed with frictionless wheels. Which one of the following would be the speed of the cart?
 (a) 2.15 m/s (b) 1.89 m/s
 (c) 1.51 m/s (d) 2.51 m/s
82. The energy possessed by a body due to its change in position or shape is called
 (a) thermal energy (b) potential energy
 (c) kinetic energy (d) electric energy
83. A sound wave has a frequency of 1 kHz and wavelength 50 cm. How long will it take to travel 1 km?
 (a) 5 s (b) 4 s
 (c) 3 s (d) 2 s
84. For an element with atomic number 35, which one of the following will be the correct number of electrons in its valence shell based on Bohr's model of an atom?
 (a) 1 (b) 3
 (c) 5 (d) 7
85. Which one of the following is **not** an example of a redox reaction?
 (a) $\text{AlCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{Al}(\text{OH})_3 + 3\text{HCl}$
 (b) $2\text{NaH} \rightarrow 2\text{Na} + \text{H}_2$
 (c) $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$
 (d) $\text{CuSO}_4 + \text{Zn} \rightarrow \text{Cu} + \text{ZnSO}_4$
86. Which one of the following allotropes of carbon is isomorphous with crystalline silicon?
 (a) Coke (b) Diamond
 (c) Graphite (d) Coal
87. Which one of the following is the colour of hydrogen gas?
 (a) Light yellow (b) Orange
 (c) Black (d) Colourless
88. Which one of the following is **not** a pigment?
 (a) Zinc oxide (b) Chalk
 (c) White lead (d) Silica
89. Which one of the following statements about fertilizers is **not** correct?
 (a) Urea is a phosphorus-containing fertilizer.
 (b) Application of fertilizer to the soil increases fertility of the soil.
 (c) Urea can be prepared by action of ammonia and carbon dioxide under high pressure and at high temperature.
 (d) Urea contains more nitrogen than other fertilizers.
90. Which one of the following statements is **not** correct?
 (a) Most carbon compounds are good conductors of electricity.
 (b) Bonding in organic compounds is covalent.
 (c) Graphite is used as a lubricant.
 (d) Diamond is an allotrope of carbon.

91. Which one of the following reactions is an example of decomposition reaction?
- (a) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 (b) $2\text{AgCl}(\text{s}) \xrightarrow{\text{Sunlight}} 2\text{Ag}(\text{s}) + \text{Cl}_2(\text{g})$
 (c) $\text{CuO} + \text{H}_2 \xrightarrow{\text{Heat}} \text{Cu} + \text{H}_2\text{O}$
 (d) $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$
92. Which one of the following is the mechanism of action of oral contraceptive pills?
- (a) They kill the egg.
 (b) They kill the sperm.
 (c) They kill the zygote.
 (d) They inhibit the release of egg.
93. Which one of the following plants has unisexual flowers?
- (a) Papaya (b) Hibiscus
 (c) Mustard (d) Sunflower
94. A cell is unable to synthesize lipids. Which of its cell organelles might be defective?
- (a) Smooth endoplasmic reticulum
 (b) Golgi bodies
 (c) Lysosomes
 (d) Mitochondria
95. All objects experience a buoyancy when they are immersed in a fluid. Buoyancy is
- (a) a downward force (b) a downward pressure
 (c) an upward force (d) an upward pressure
96. According to Fleming's right-hand rule, if the forefinger indicates the direction of magnetic field and thumb shows the direction of motion of conductor, then the stretched middle finger will predict the direction of
- (a) force acting on the conductor
 (b) electric field
 (c) induced current
 (d) current
97. Two resistors R_1 and R_2 arranged in parallel combination in an electrical closed circuit are made of the same material and of same thickness. If the length of R_2 is twice the length of R_1 , then the total resistance R satisfies
- (a) $3R = 2R_1$ (b) $3R = 2R_2$
 (c) $2R = 3R_1$ (d) $2R = 3R_2$
98. What is the magnification produced by a concave lens of focal length 10 cm, when an image is formed at a distance of 5 cm from the lens?
- (a) 2.0 (b) 1.0
 (c) 0.5 (d) 0.33
99. A wooden box of mass 2 kg and dimensions (30 cm \times 15 cm \times 10 cm) is placed on a table with sides 30 cm and 10 cm touching the tabletop. Which one of the following is the approximate pressure exerted on the table?
- (a) 111.1 N/m² (b) 222.2 N/m²
 (c) 333.3 N/m² (d) 666.6 N/m²
100. Why are the tyres of aircrafts made of conducting rubber?
- So that the charge accumulated on the aircraft in flight, by rubbing the air, can easily be transferred to ground on landing.
 - So that the charge accumulated due to the operation of various electronic equipments in the aircraft in flight can easily be transferred to ground on landing.
- 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
101. *Arthashastra*, the classical work of Indian political thought, focuses primarily on
- (a) economy (b) culture
 (c) statecraft (d) monarchy
102. When did *Charaka Samhita* originate?
- (a) 6th Century BCE (b) 3rd or 2nd Century BCE
 (c) 4th Century BCE (d) 5th Century BCE
103. Early Buddhist sculptors did not show Buddha in human form. Through which of the following symbols was Buddha's presence shown by the early sculptors?
- (a) Empty Seat and Stupa only
 (b) Wheel and Tree only
 (c) Wheel, Tree and Stupa only
 (d) Empty Seat, Wheel, Tree and Stupa
104. The Parliament of India is primarily based on the model of
- (a) German Parliament (b) British Parliament
 (c) American Parliament (d) French Parliament
105. Who among the following had the shortest span in office as the Prime Minister of India?
- (a) Lal Bahadur Shastri (b) Chaudhary Charan Singh
 (c) Chandra Shekhar (d) H. D. Deva Gowda
106. Which one of the following does **not** fall under the jurisdiction of the apex court of India?
- (a) Original Jurisdiction
 (b) Appellate Jurisdiction
 (c) Collegiate Jurisdiction
 (d) Advisory Jurisdiction
107. According to the Indian Meteorological Department, which of the following is/are the feature/features of cloudburst?
- Heavy precipitation in short period of time in a limited geographical area
 - It occurs generally during monsoon period and triggers flash flood and landslides
- 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
108. In a group discussion on shape and size of the Earth, three students stated the following points:
- Student 1 : The shape of the Earth is basically an oblate spheroid.
 - Student 2 : The polar diameter of the Earth is more than the equatorial diameter.

3. Student 3 : Bulge along the equatorial region is due to revolution of the Earth.
Who among the above students is/are correct?
(a) Student 1 only
(b) Student 1 and Student 2 only
(c) Student 2 and Student 3 only
(d) Student 1, Student 2 and Student 3
109. While watching news, you hear about a place, of which you had never heard earlier. You want to know more about the place and you want to locate it on the map. Which of the following is/are required for you to be able to locate the place on the map?
(a) Only latitude of the place
(b) Only longitude of the place
(c) Both longitude and latitude of the place
(d) Latitude, longitude and altitude of the place
110. Which one of the following statements with respect to Global Positioning System (GPS) is **not** correct?
(a) It is based on network of satellites orbiting above the Earth.
(b) It is based on the system of triangulation.
(c) GPS receivers provide location in terms of latitude, longitude and altitude.
(d) It provides information exclusively for military operations.
111. Which one of the following is **not** a Constitutional Commission of India?
(a) The National Commission for Scheduled Castes
(b) The National Commission for Schedule Tribes
(c) The National Commission for Backward Classes
(d) The National Commission for Women
112. Which Chinese traveller in ancient India wrote the diary called 'Records of the Travels to Middle India'?
(a) Wang Xuance (b) Xuanzang
(c) Yijing (d) Li Yibiao
113. The elections to the Lower House of the Parliament of India, held in 2019, constituted the
(a) 14th Lok Sabha (b) 15th Lok Sabha
(c) 16th Lok Sabha (d) 17th Lok Sabha
114. Panchayati Raj Institutions are primarily the institutions of
(a) Popular Government (b) Self-Government
(c) Federal Government (d) Quasi-Government
115. Which of the following is/are the right/rights mentioned in the 'American Declaration of Independence'?
1. Life
2. Liberty
3. Pursuit of Happiness
4. Fraternity
Select the correct answer using the code given below.
(a) 1 only (b) 1 and 2 only
(c) 1, 2 and 3 (d) 2, 3 and 4
116. Who among the following American Presidents described democracy as "Government of the People, for the People and by the People"?
(a) Abraham Lincoln (b) Thomas Jefferson
(c) George Washington (d) John F. Kennedy
117. Inhabitants are unaware of the speed of rotation of the planet Earth because
1. the angular velocity is constant for each place on the Earth's surface
2. the atmosphere rotates with the Earth
3. there are no nearby objects, either stationary or moving at a rate different from that of the Earth
Which of the above is/are the correct explanation(s)?
(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3
118. While travelling to a hilly region, you notice a massive boulder, which was loosened by heavy rains and moved downhill. This has resulted due to which of the following processes?
1. Mass wasting
2. Erosion
3. Weathering
Select the correct answer using the code given below.
(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 1, 2 and 3
119. Which of the following statements in respect of landslides are correct?
1. These occur only on gentle slopes during rain.
2. They generally occur in clay-rich soil.
3. Earthquakes trigger landslides.
Select the correct answer using the code given below.
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3
120. Consider the following features about a geographical phenomenon :
1. Torrents of snow and ice roaring down a steep mountain side
2. It is hazardous to skiers and mountaineers
3. It involves a mix of falling, rolling, sliding and flowing of materials
Which of the following phenomena can be identified with the above features?
(a) Slump and earthflow (b) Avalanche
(c) Landslide (d) Rockslide
121. The real beginning of western education in India can be dated from
(a) the Charter Act of 1813
(b) the Charter Act of 1793
(c) the Sarda Act of 1929
(d) the Macaulay's Minute on Indian Education, 1835
122. The term 'Industrial Revolution' was first used by
(a) J. A. Blanqui (b) T. S. Ashton
(c) Arnold Toynbee (d) R. H. Tawney

123. The Khudai Khidmatgar (Servants of the God) was organized by
 (a) Mahatma Gandhi (b) Khan Abdul Ghaffar Khan
 (c) M. A. Jinnah (d) M. M. Malaviya
124. The Mahad Satyagraha of 1927 was organized by
 (a) B. R. Ambedkar (b) Mahatma Gandhi
 (c) S. C. Bose (d) Lokmanya Tilak
125. The Satyashodhak Samaj (Truth-Seeking Society) was set up by
 (a) Vinoba Bhave (b) Jyotiba Phule
 (c) B. R. Ambedkar (d) C. Rajagopalachari
126. The 13th Century text *Lekhapaddhati* gives us information on which one of the following topics?
 (a) Art of writing (b) Essay writing
 (c) Legal document (d) Epigraphic style
127. Nkrumah was one of the five leaders, who comprised the core of the Non-aligned Movement (NAM). He was the leader of which country in Africa?
 (a) Nigeria (b) Kenya
 (c) Uganda (d) Ghana
128. The idea of Planning in Independent India was drawn from
 (a) the Bombay Plan
 (b) the demand made by peasants
 (c) the demand made by workers' unions
 (d) the Gandhian vision of India's future
129. Nisarga, Gati, Nivar, Tauktae and Yaas are names of
 (a) new fighter aircrafts (b) tourist places
 (c) weather stations (d) cyclones
130. Which one of the following States/UTs was connected with the Indian Railways network in the year 2021?
 (a) Mizoram (b) Ladakh
 (c) Manipur (d) Sikkim
131. The forests of Uttarakhand Kullu Valley in Himachal Pradesh and Dzukou Valley in Nagaland and Manipur were in the news on account of which one of the following reasons?
 (a) Deforestation
 (b) Forest fire
 (c) Poaching of wild animals
 (d) Illegal mining
132. Which one of the following is correct in respect of total number of States and Union Territories in India?
 (a) 28 States and 8 Union Territories
 (b) 27 States and 9 Union Territories
 (c) 30 States and 6 Union Territories
 (d) 29 States and 7 Union Territories
133. Snow, sleet and hail are the forms of
 (a) precipitation (b) condensation
 (c) transpiration (d) evaporation
134. Which one of the following is likely to be the most prevalent form of weathering in hot-tropical desert areas?
 (a) Mechanical (b) Chemical
 (c) Biological (d) Leaching
135. Which one of the following cities was the first to attain the status of a 'megacity'?
 (a) London (b) Paris
 (c) New York (d) Washington
136. In India, rigid and stable elevated lands, denuded rocks and series of scarps are the features of which of the following?
 (a) Northern mountains (b) Peninsular plateau
 (c) Northern plains (d) Coastal plains
137. A person has visited a region in India and found trees, such as Khair, Neem, Khejri and Palas. Which one of the following regions is she/he expected to have visited?
 (a) Malabar Coast (b) Garo Hills
 (c) Sunderban Delta (d) Desert Region
138. Consider the following statements :
 1. Rocks do not remain in their original form for long and undergo transformation.
 2. Transformation of rocks is caused by weathering, erosion and metamorphic action.
 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
139. Weathering, mass wasting, erosion and transportation are indicators of which one of the following processes?
 (a) Denudation (b) Endogenetic process
 (c) Diastrophism (d) Mountain building
140. If you want to observe moraines, eskers and outwash plains, which one of the following Union Territories you may have to visit?
 (a) Andaman and Nicobar Islands
 (b) Lakshadweep
 (c) Puducherry
 (d) Ladakh
141. Legendary Kathak dancer Pandit Birju Maharaj died recently. He was the doyen of which one of the following Gharanas of Kathak?
 (a) Jaipur (b) Raigarh
 (c) Lucknow (d) Banaras
142. In a first, India is to export BrahMos missile to
 (a) Bhutan (b) Philippines
 (c) Maldives (d) Nepal
143. Who among the following is the Head of the Committee appointed by the Supreme Court of India to enquire into the circumstances that led to the Prime Minister of India's convoy being stuck for several minutes on a flyover in Punjab recently?
 (a) Justice Indu Malhotra
 (b) Justice Ashok Bhushan
 (c) Justice Navin Sinha
 (d) Justice Rohinton Fali Nariman

144. Who among the following retired from test cricket by bagging a wicket on the last ball of his career?
 (a) AB de Villiers (b) Michael Hussey
 (c) Quinton de Kock (d) Ross Taylor
145. Who among the following is appointed as the tenth Chairman of the Indian Space Research Organization (ISRO) recently?
 (a) A. S. Kiran Kumar (b) K. Sivan
 (c) K. Radhakrishnan (d) S. Somanath
146. According to the Forest Survey Report, 2021, area-wise which one of the following States has the largest forest cover in India?
 (a) Odisha (b) Madhya Pradesh
 (c) Arunachal Pradesh (d) Chhattisgarh
147. Who among the following is the Chairperson of the Goods and Services Tax Council?
 (a) The Prime Minister of India
 (b) The Union Finance Minister
 (c) The Speaker of the Lok Sabha
 (d) The President of India
148. The International Union for Conservation of Nature (IUCN) has recently categorized the Red Sanders (Red Sandalwood) into
 (a) deficient category
 (b) endangered category
 (c) near-threatened category
 (d) critically endangered category
149. The Government of India has decided to observe 'Veer Baal Diwas' on
 (a) 6th October (b) 26th November
 (c) 26th December (d) 6th December
150. On 14th January, 2022, which one of the following ministries has organized a global Surya Namaskar Demonstration programme?
 (a) The Ministry of Culture
 (b) The Ministry of AYUSH
 (c) The Ministry of Health and Family Welfare
 (d) The Ministry of Tourism

HINTS & SOLUTIONS

MATHEMATICS

1. (c) $\therefore \Delta_1 = \begin{vmatrix} 1 & 1 & 1 \\ p & q & r \\ q & r & p \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ q & r & p \\ r & p & q \end{vmatrix} \left[\begin{array}{l} \text{Applying} \\ c_1 \leftrightarrow c_2 \\ c_2 \leftrightarrow c_3 \end{array} \right]$

$$\therefore \Delta_1 = \Delta_1 = \Delta_2$$

$$\therefore \Delta_1 + \Delta_2 = 2\Delta_2 = 2 \begin{vmatrix} 1 & 1 & 1 \\ q & r & p \\ r & p & q \end{vmatrix}$$

[Applying $c_2 \rightarrow c_2 - c_1$ and $c_3 \rightarrow c_3 - c_1$]

$$= 2 \begin{vmatrix} 1 & 0 & 0 \\ q & r-q & p-q \\ r & p-r & q-r \end{vmatrix}$$

$$= -2[p^2 + q^2 + r^2 - pq - qr - pr]$$

$$= -[(p-q)^2 + (q-r)^2 + (r-p)^2] < 0.$$

Always negative.

2. (b) Let $\Delta = \begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$

$$= abc \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix}$$

Applying $c_1 \rightarrow c_1 - c_2$ and $c_2 \rightarrow c_2 - c_3$

$$= abc \begin{vmatrix} 0 & 0 & 1 \\ a-b & b-c & c \\ (a-b)(a+b) & (b-c)(b+c) & c^2 \end{vmatrix}$$

$$= abc(a-b)(b-c) \begin{vmatrix} 0 & 0 & 1 \\ 1 & 1 & c \\ a+b & (b+c) & c^2 \end{vmatrix}$$

$$= abc(a-b)(b-c)(c-a)$$

$$= 6 \times 2 = 12$$

3. (d) Let $\Delta = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} = 0$

Applying $R_1 \rightarrow R_1 + R_2 + R_3$

$$= \begin{vmatrix} a+b+c & a+b+c & a+b+c \\ b & c & a \\ c & a & b \end{vmatrix} = 0$$

$$= (a+b+c) \begin{vmatrix} 1 & 1 & 1 \\ b & c & a \\ c & a & b \end{vmatrix} = 0$$

Applying $c_2 \rightarrow c_2 - c_1$ and $c_3 \rightarrow c_3 - c_1$

$$= (a+b+c) \begin{vmatrix} 1 & 0 & 0 \\ b & c-b & a-b \\ c & a-c & b-c \end{vmatrix} = 0$$

$$\begin{aligned} &= (a+b+c) [-a^2 - b^2 - c^2 + ab + bc + ca] = 0 \\ &= -(a+b+c) [a^2 + b^2 + c^2 - ab - bc - ca] = 0 \\ &= -(a^3 + b^3 + c^3 - 3abc) = 0 \\ &\Rightarrow a+b+c=0 \text{ or } a^2 + b^2 + c^2 - ab - bc - ca = 0 \\ &\text{or } a^3 + b^3 + c^3 = 3abc \end{aligned}$$

Hence all statement 1, 2 and 3 are correct.

4. (c) $CA = \begin{bmatrix} m \\ -m \end{bmatrix} [m \ n] = \begin{bmatrix} m^2 & mn \\ -m^2 & -mn \end{bmatrix}$

$$CB = \begin{bmatrix} m \\ -m \end{bmatrix} [-n \ -m] = \begin{bmatrix} -mn & -m^2 \\ mn & m^2 \end{bmatrix}$$

$$\therefore CA \neq CB$$

So, statement 1 is not correct.

$$AC = [m \ n] \begin{bmatrix} m \\ -m \end{bmatrix} = [m^2 - mn]$$

$$BC = [-n \ -m] \begin{bmatrix} m \\ -m \end{bmatrix} = [-mn + m^2]$$

$$\therefore AC = BC$$

So, statement 2 is correct.

$$C(A+B) = \begin{bmatrix} m \\ -m \end{bmatrix} [m-n \ n-m]$$

$$= \begin{bmatrix} m^2 - mn & mn - m^2 \\ -m^2 + mn & -mn + m^2 \end{bmatrix}$$

$$CA + CB = \begin{bmatrix} m^2 - mn & mn - m^2 \\ -m^2 + mn & -mn + m^2 \end{bmatrix} = C(A+B)$$

So, statement 3 is correct.

5. (d) $|A| = \begin{vmatrix} 2 \sin \theta & \cos \theta & 0 \\ -2 \cos \theta & \sin \theta & 0 \\ -1 & 1 & 1 \end{vmatrix} = 2$

We know that

$$A(\text{adj } A) = |A| I = 2I$$

6. (d) $\begin{vmatrix} 2 \cos 2\theta & 2 \cos 2\theta & 6 \\ 1 - 2 \sin^2 \theta & 2 \cos^2 \theta - 1 & 3 \\ k & 2k & 1 \end{vmatrix}$

$$= \begin{vmatrix} 2 \cos^2 \theta & 2 \cos^2 \theta & 6 \\ \cos^2 \theta & \cos^2 \theta & 3 \\ k & 2k & 1 \end{vmatrix} = 0$$

($\because R_1$ and R_2 are identical)

Hence, for any real value of k the given matrix is singular.

7. (b) Given that $|A| \neq 0$ and $B = \text{adj } A$
 $AB = A(\text{adj } A) = |A| I$... (i)
 $BA = [\text{adj } (A)] A = |A| I$

$$\therefore AB = BA$$

So, statement 1 is correct

It is clear from (i) AB is a scalar matrix not null matrix

So statement 2 is correct and 3 is not correct.

8. (b) Let $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

$$AB = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

But $A \neq 0$ and $B \neq 0$

So, statement 1 is not correct

$$\therefore AB = I \Rightarrow B = A^{-1}$$

We know that $AA^{-1} = A^{-1}A = I$

$$\therefore BA = I$$

So, statement 2 is correct.

9. (d) Given that $A = I$
and $B = A^T = I^T = I$

$$\text{Now } C = A + B = I + I = 2I$$

$$\therefore |C| = (2)^3 |I| = 8 \cdot 1 = 8$$

10. (b) Given that $|A| \neq 0$, $|B| \neq 0$
 $AB = A \Rightarrow A^{-1}AB = A^{-1}A \Rightarrow B = I$
and $BA = B \Rightarrow B^{-1}BA = B^{-1}B$
 $A = I$

$$\therefore A^2 = I^2 = I = A$$

So, statement 1 is correct

$$\text{Now, } AB^2 = I^2 = I$$

$$A^2B = I^2 = I$$

$$\therefore AB^2 = A^2B$$

So, statement 2 is correct

11. (b) $\left(1 + \frac{2}{x}\right)^9 \left(1 - \frac{2}{x}\right)^9 = \left(1 - \frac{4}{x^2}\right)^9$

$$\text{Number of terms} = 9 + 1 = 10$$

12. (c) Middle term of $(x+y)^{10}$ is $\left(\frac{10+2}{2}\right)^{\text{th}}$ term = 6th term

We know that coefficient of middle term is highest value.

So, statement 1 is correct

$$\text{Since total number of term} = 10 + 1 = 11$$

$$\text{Coefficient of 3rd term} = \text{coefficient of } (11 - 3 + 1)^{\text{th}} \text{ term}$$

$$= \text{Coefficient of 9th term}$$

So, statement 2 is also correct.

13. (d) Given that

$${}^{3n}C_{2n} = {}^{3n}C_{2n-7}$$

$$\Rightarrow 2An + 2n - 7 = 3n$$

$$\Rightarrow n = 7$$

$$\therefore {}^nC_{n-5} = {}^7C_2 = \frac{7 \cdot 6}{2 \cdot 1} = 21$$

14. (c) ${}^{51}C_{21} - {}^{51}C_{22} + {}^{51}C_{23} - {}^{51}C_{24} + {}^{51}C_{25} - {}^{51}C_{26} + {}^{51}C_{27} - {}^{51}C_{28}$
 $+ {}^{51}C_{29} - {}^{51}C_{30}$
 $= {}^{51}C_{51-21} - {}^{51}C_{51-22} + {}^{51}C_{51-23} - {}^{51}C_{51-24} + {}^{51}C_{51-25} -$
 ${}^{51}C_{26} + {}^{51}C_{27} - {}^{51}C_{28} + {}^{51}C_{29} - {}^{51}C_{30}$ [$\because {}^nC_r = {}^nC_{n-r}$]
 $= {}^{51}C_{30} - {}^{51}C_{29} - {}^{51}C_{28} - {}^{51}C_{27} + {}^{51}C_{26} - {}^{51}C_{26} + {}^{51}C_{27} - {}^{51}C_{28}$
 $+ {}^{51}C_{29} - {}^{51}C_{30}$
 $= 0$

Now, ${}^{51}C_{51} - {}^{51}C_0 = 1 - 1 = 0$

15. (a)

3	.	.
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1 8 4

3 is fixed in hundred place, so no. of choice = 1
 Number of choice for unit place {1, 5, 7, 9} = 4
 Number of choice for tens place = 8

\therefore Number of odd number between 300 and 400
 $= 1 \times 4 \times 8 = 32$

16. (b) Vowels = {I, E}

1	2	3	4	5
v		v		v

\therefore Number of words in which vowels not occupy the even positions = ${}^3C_2 \cdot 2! \cdot 3! = 36$

17. (d) Given that α, β are roots of equation $x^2 + px + q = 0$

$\therefore \alpha + \beta = -p$ and $\alpha \cdot \beta = q$
 and α^3 and β^3 are roots of equation $x^2 + mx + n = 0$

$\therefore \alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta) = -m$
 $\Rightarrow -p^3 + 3pq = -m \Rightarrow m = p^3 - 3pq$... (i)
 $\alpha^3 \cdot \beta^3 = (\alpha\beta)^3 = q^3 = n$... (ii)
 $\therefore m + n = p^3 + q^3 - 3pq$ [from (i) and (ii)]

18. (a) Given that α and β are roots of the equation
 $x^2 - ax - bx + ab - c = 0$

i.e. $x^2 - (a+b)x + ab - c = 0$
 $\therefore \alpha + \beta = a + b$ $\alpha \cdot \beta = ab - c$
 $\Rightarrow ab = \alpha\beta + c$

The quadratic equation whose roots are a and b is
 $x^2 - (a+b)x + ab = 0$
 $x^2 - (\alpha + \beta)x + \alpha\beta + c = 0$
 $x^2 - \alpha x - \beta x + \alpha\beta + c = 0$

19. (c) Since $x^2 - (a+b+c)x + bc + ca = 0$ has equal roots

$\therefore [(a+b+c)]^2 - 4 \cdot 1 \cdot (bc+ca) = 0$
 $\Rightarrow [(a+b)+c]^2 - 4c(a+b) = 0$
 $\Rightarrow (a+b)^2 + c^2 + 2c(a+b) - 4c(a+b) = 0$
 $\Rightarrow (a+b-c)^2 = 0$
 $\Rightarrow a+b-c = 0$

20. (d) Given that α and β ($\alpha > \beta$) are roots of the equation
 $x^2 - 8x + q = 0$

$\therefore \alpha + \beta = 8$ and $\alpha \cdot \beta = q$
 $\therefore (\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta = 64 - 4q$
 $(\alpha - \beta) = \sqrt{64 - 4q}$ ($\because \alpha > \beta$)

Now $\alpha^2 - \beta^2 = 16$

$\Rightarrow (\alpha + \beta) - (\alpha - \beta) = 16$

$\Rightarrow 8\sqrt{64 - 4q} = 16 \Rightarrow \sqrt{64 - 4q} = 2$

$\Rightarrow 64 - 4q = 4 \Rightarrow q = 15$

21. (c) $30! + 35! = 30! + 35 \cdot 34 \cdot 33 \cdot 32 \cdot 31 \cdot 30!$

$30!(1 + 35 \cdot 34 \cdot 33 \cdot 32 \cdot 31)$

$\therefore 1 + 35! \cdot 34 \cdot 33 \cdot 32 \cdot 31$ is not divisible by 5

So, maximum value of n such that 5^n divides $30!$

$$= \left[\frac{30}{5} \right] + \left[\frac{30}{5^2} \right] + \left[\frac{30}{5^3} \right] + \dots$$

$= 6 + 1 + 0 + 0 \dots = 7.$

22. (b) $2(2 \times 1) + 3(3 \times 2 \times 1) + 4(4 \times 3 \times 2 \times 1) + 5$

$(5 \times 4 \times 3 \times 2 \times 1) + \dots + 9(9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1) + 2$

$= 2 + 2 \cdot 2! + 3 \cdot 3! + 4 \cdot 4! + 5 \cdot 5! + \dots + 9 \cdot 9!$

$= 2! + (2+1) \cdot 3 \cdot 3! + 4 \cdot 4! + 5 \cdot 5! + \dots + 9 \cdot 9!$

$= 3! + 3 \cdot 3! + 4 \cdot 4! + 5 \cdot 5! + \dots + 9 \cdot 9!$

Proceed further we get

$= 9! + 9 \cdot 9! = 10!$

23. (b) $\therefore A = \{(1, 2, 3)\}$

$\therefore n(A) = 1$

Number of element in $P(A) = 2^1 = 2$

24. (d) $\therefore a, b, c$ are in GP

$\therefore b^2 = ac$... (i)

Squaring both sides

$(b^2)^2 = a^2 c^2$

$\therefore a^2, b^2, c^2$ are in GP

From (i)

$$\left(\frac{1}{b} \right)^2 = \frac{1}{a} \times \frac{1}{c}$$

$\therefore \frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in GP

From (i)

$b = \sqrt{ac} \Rightarrow (\sqrt{b})^2 = \sqrt{a} \sqrt{b}$

[$\because a > 0, b > 0$ and $c > 0$]

$\therefore \sqrt{a}, \sqrt{b}, \sqrt{c}$ are in GP.

25. (b) $\therefore \frac{a+b}{2}, b, \frac{b+c}{2}$ are in H.P.

$$\therefore \frac{2}{b} = \frac{2}{a+b} + \frac{2}{b+c} = \frac{2(a+2b+c)}{(a+b)(b+c)}$$

$\Rightarrow (a+b)(b+c) = b(a+2b+c)$

$\Rightarrow ab + ca + b^2 + bc = ab + 2b^2 + bc$

$\Rightarrow b^2 = ca$

$\therefore a, b, c$ are in GP.

26. (b) $\cot^2 15^\circ + \tan^2 15^\circ$
 $= \operatorname{cosec}^2 15^\circ - 1 + \sec^2 15^\circ - 1$
 $= \operatorname{cosec}^2 15^\circ + \sec^2 15^\circ - 2$

$$\begin{aligned}
&= \frac{1}{\sin^2 15^\circ} + \frac{1}{\cos^2 15^\circ} - 2 \\
&= \frac{\sin^2 15^\circ + \cos^2 15^\circ}{\frac{1}{4}(4\sin^2 15^\circ \cdot \cos^2 15^\circ)} - 2 \\
&= \frac{4}{\sin^2 30^\circ} - 2 = \frac{4}{\frac{1}{4}} - 2 = 16 - 2 = 14
\end{aligned}$$

27. (d) In $\triangle ABC$
 $A + B + C = \pi$

$$\begin{aligned}
\sin A &= \cos B + \cos C = 2 \cos \frac{B+C}{2} \cdot \cos \frac{B-C}{2} \\
\Rightarrow \sin A &= 2 \cos \left(\frac{\pi}{2} - \frac{A}{2} \right) \cdot \cos \left(\frac{B-C}{2} \right) \\
& \quad [\because B + C = \pi - A]
\end{aligned}$$

$$\Rightarrow 2 \sin \frac{A}{2} \cdot \cos \frac{A}{2} = 2 \sin \frac{A}{2} \cdot \cos \left(\frac{B-C}{2} \right)$$

$$\Rightarrow \cos \frac{A}{2} = \cos \left(\frac{B-C}{2} \right)$$

$$\Rightarrow \frac{A}{2} = \frac{B-C}{2} \Rightarrow A = B - C$$

$$\Rightarrow A + C = B \Rightarrow \pi - B = B$$

$$\Rightarrow B = \frac{\pi}{2}$$

28. (c) $\because 2 \tan \alpha = 1 \Rightarrow 2 \tan \alpha = \frac{1}{2}$

$$\alpha + \beta = \frac{\pi}{4} \Rightarrow \tan(\alpha + \beta) = \tan \frac{\pi}{4}$$

$$\Rightarrow \frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \cdot \tan \beta} = 1.$$

$$\Rightarrow \tan \alpha + \tan \beta = 1 - \tan \alpha \cdot \tan \beta$$

$$\Rightarrow \frac{1}{2} + \tan \beta = 1 - \frac{1}{2} \cdot \tan \beta$$

$$\Rightarrow 1 + 2 \tan \beta = 2 - \tan \beta$$

$$\tan \beta = \frac{1}{3}$$

$$\text{Now, } \tan 2\beta = \frac{2 \tan \beta}{1 - \tan^2 \beta} = \frac{2 \times \frac{1}{3}}{1 - \frac{1}{9}} = \frac{2}{3} \times \frac{9}{8} = \frac{3}{4}$$

29. (c) $\tan(45^\circ + \theta) = 1 + \sin 2\theta$

$$\Rightarrow \frac{\tan 45^\circ + \tan \theta}{1 - \tan 45^\circ \cdot \tan \theta} - 1 = \frac{2 \tan \theta}{1 + \tan^2 \theta}$$

$$\Rightarrow \frac{1 + \tan \theta}{1 - \tan \theta} - 1 = \frac{2 \tan \theta}{1 + \tan^2 \theta}$$

$$\Rightarrow \frac{2 \tan \theta}{1 - \tan \theta} = \frac{2 \tan \theta}{1 + \tan^2 \theta}$$

$$\Rightarrow 2 \tan \theta (1 + \tan^2 \theta) = 2 \tan \theta (1 - \tan \theta)$$

$$\Rightarrow \tan \theta [1 + \tan^2 \theta - 1 + \tan \theta] = 0$$

$$\Rightarrow \tan^2 \theta (\tan \theta + 1) = 0$$

$$\therefore \tan \theta = 0 \text{ or } \tan \theta = -1 \quad (\text{Not possible})$$

$$\Rightarrow \theta = 0 \quad \left[\because \frac{-\pi}{4} < \theta < \frac{\pi}{4} \right]$$

$$\text{Now, } \cos 2\theta = \cos \theta = 1$$

30. (a) $\sin 2\theta = \cos 3\theta = \sin(90^\circ - 3\theta)$

$$\Rightarrow 2\theta = 90^\circ - 3\theta \Rightarrow \theta = 18^\circ$$

$$\text{Now, } 1 + 4 \sin \theta = 1 + 4 \sin 18^\circ$$

$$= 1 + 4 \cdot \left(\frac{\sqrt{3}-1}{4} \right) = \sqrt{3}$$

31. (c) $\tan \theta = \frac{-5}{12} = \frac{p}{b}$; Let $p = 5k$ $b = 12k$

$$\therefore h = \sqrt{p^2 + b^2} = \sqrt{25k^2 + 144k^2} = 13k$$

Since value of $\tan \theta$ is -ve therefore θ lies in 2nd and 3rd quadrant.

$$\therefore \sin \theta = \frac{p}{h} = \pm \frac{5}{13}$$

32. (b) $\cos^4 \frac{7\pi}{8} + \cos^4 \frac{5\pi}{8} = \left(\cos^2 \frac{7\pi}{8} \right)^2 + \left(\cos^2 \frac{5\pi}{8} \right)^2$

$$= \left(\cos^2 \frac{7\pi}{8} - \cos^2 \frac{5\pi}{8} \right)^2 + 2 \cos^2 \frac{7\pi}{8} \cdot \cos^2 \frac{5\pi}{8}$$

$$= \left[(-1) \sin \left(\frac{7\pi}{8} + \frac{5\pi}{8} \right) \sin \left(\frac{7\pi}{8} - \frac{5\pi}{8} \right) \right]^2 + \frac{1}{2} \left[2 \cos \frac{7\pi}{8} \cdot \cos \frac{5\pi}{8} \right]^2$$

$$= \left[\sin \frac{3\pi}{2} \cdot \sin \frac{\pi}{4} \right]^2 + \frac{1}{2} \left[\cos \frac{3\pi}{2} + \cos \frac{\pi}{4} \right]^2$$

$$= \left[(-1) \cdot \frac{1}{\sqrt{2}} \right]^2 + \frac{1}{2} \left[0 + \frac{1}{\sqrt{2}} \right]^2 = \frac{1}{2} + \frac{1}{4} = \frac{3}{4}$$

33. (a) $\sin^2 \left(\frac{\pi}{4} + \theta \right) - \sin^2 \left(\frac{\pi}{4} - \theta \right)$

$$= \sin \left[\frac{\pi}{4} + \theta + \frac{\pi}{4} - \theta \right] \sin \left[\frac{\pi}{4} + \theta - \frac{\pi}{4} + \theta \right]$$

$$[\because \sin^2 x - \sin^2 y = \sin(x+y) \cdot \sin(x-y)]$$

$$= \sin \frac{\pi}{2} \cdot \sin 2\theta = \sin 2\theta$$

34. (c) In ΔPBC

$$\tan \theta = \frac{BC}{PC}$$

$$\Rightarrow PC = BC \cot \theta \quad \dots(i)$$

In ΔPAC

$$\tan 2\theta = \frac{h+BC}{PC}$$

$$\Rightarrow PC \tan 2\theta = h + BC$$

$$\Rightarrow BC \cdot \cot \theta \cdot \frac{2 \tan \theta}{1 - \tan^2 \theta} = h + BC$$

$$\Rightarrow \frac{2BC}{1 - \tan^2 \theta} - BC = h$$

$$\Rightarrow \frac{1 + \tan^2 \theta}{1 - \tan^2 \theta} BC = h$$

$$\Rightarrow BC = \frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} h = \cos 2\theta \cdot h$$

35. (b) In ΔAPB

$$\tan 60^\circ = \frac{\sqrt{3}x}{BP}$$

$$\Rightarrow \sqrt{3} = \frac{\sqrt{3}x}{BP}$$

$$\Rightarrow BP = x \quad \dots(ii)$$

In ΔAQB

$$\tan \theta = \frac{\sqrt{3}x}{x+PB} \Rightarrow \frac{\sqrt{3}x}{x+x} = \frac{\sqrt{3}}{2}$$

$$\because \frac{1}{\sqrt{3}} < \frac{\sqrt{3}}{2} < 1$$

$$\therefore 30^\circ < \theta < 45^\circ$$

36. (a) $\because \tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{x}{3}\right) = \frac{\pi}{4}$

$$\Rightarrow \tan^{-1}\left(\frac{x}{3}\right) = \tan^{-1}1 - \tan^{-1}\left(\frac{1}{2}\right)$$

$$\Rightarrow \tan^{-1}\frac{x}{3} = \tan^{-1}\left(\frac{1 - \frac{1}{2}}{1 + \frac{1}{2}}\right)$$

$$\Rightarrow \tan^{-1}\frac{x}{3} = \tan^{-1}\left(\frac{1}{3}\right)$$

$$\Rightarrow \frac{x}{3} = \frac{1}{3} \Rightarrow x = 1$$

37. (c) $3 \sin^{-1} x + \cos^{-1} x = \pi$

$$\Rightarrow 2 \sin^{-1} x + \sin^{-1} x + \cos^{-1} x = \pi$$

$$\Rightarrow 2 \sin^{-1} x + \frac{\pi}{2} = \pi$$

$$\Rightarrow 2 \sin^{-1} x = \frac{\pi}{2} \Rightarrow \sin^{-1} x = \frac{\pi}{4}$$

$$\Rightarrow x = \sin \frac{\pi}{4} = \frac{1}{\sqrt{2}}$$

38. (b) $\tan \alpha + \tan \beta = 1 - \tan \alpha \cdot \tan \beta$

$$\frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \cdot \tan \beta} = 1$$

$$\Rightarrow \tan(\alpha + \beta) = \tan \frac{\pi}{4}$$

$$\Rightarrow \alpha + \beta = \frac{\pi}{4}$$

39. (b) $\because (1 + \tan \theta)(1 + \tan 9\theta) = 2$

$$\Rightarrow 1 + \tan 9\theta + \tan \theta + \tan \theta \cdot \tan 9\theta = 2$$

$$\Rightarrow \tan \theta + \tan 9\theta = 1 - \tan \theta \cdot \tan 9\theta$$

$$\Rightarrow \frac{\tan \theta + \tan 9\theta}{1 - \tan \theta \cdot \tan 9\theta} = 1$$

$$\Rightarrow \tan(\theta + 9\theta) = 1$$

$$\Rightarrow \tan 10\theta = 1$$

40. (b) $\sin 0^\circ + \sin 10^\circ + \sin 20^\circ + \sin 30^\circ + \dots + \sin 360^\circ$
 $= (\sin 0^\circ + \sin 360^\circ) + (\sin 10^\circ + \sin 350^\circ) + (\sin 20^\circ + \sin 340^\circ) + \dots + \sin 180^\circ$
 $= 2 \sin 180^\circ \cdot \cos 180^\circ + 2 \sin 180^\circ \cdot \cos 170^\circ + 2 \sin 180^\circ \cdot \cos 160^\circ + \dots + \sin 180^\circ$
 $= 0 + 0 + 0 \dots + 0 \quad [\because \sin 180^\circ = 0]$
 $= 0$

41. (c) The subsets of the set $\{4\}$

$$= \{4\}, \{1, 4\}, \{2, 4\}, \{3, 4\}, \{2, 3, 4\}, \{1, 2, 4\}$$

$$\{1, 3, 4\}, \{1, 2, 3, 4\}$$

$$\text{number of subsets of the set } \{4\} = 8$$

42. (d) $\because x \in CA \cup B \Rightarrow n \notin A$ and $n \in B$

So, statement 1 is not correct

$$\text{Let } A = \{1, 2\}, B = \{2, 3\} \Rightarrow A \cap B = \{2\}$$

$$\because 1 \notin A \cap B \text{ But } 1 \in A$$

So, Statement 2 is not correct

43. (c) Given that A and B are non empty set statement-1

$$\text{Let } x \in A \cup B = x \in A \text{ or } x \in B \quad \dots(i)$$

$$x \in A \cap B = x \in A \text{ and } x \in B \quad \dots(ii)$$

from (i) and (ii)

$$A = B$$

$$\text{Let } A = B \text{ then } A \cup B = A \cap B$$

So, statement 1 is correct

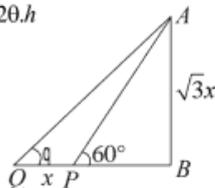
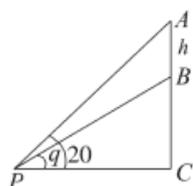
Statement 2

$$\text{Given that } A \Delta B = Q$$

$$\therefore A \Delta B = (A \cup B) - (B \cap A) = Q$$

$$\Rightarrow A \cup B = B \cap A \Rightarrow A = B$$

So, statement 2 is correct



44. (a) Given that
 $R = \{(x, y) : x^2 - 5xy + 4y^2 = 0, x, y \in \mathbb{N}\}$
 $x^2 - 5xy + 4y^2 = 0$
 $\Rightarrow x^2 - 4xy - xy + 4y^2 = 0$
 $\Rightarrow x(x-4y) - y(x-4y) = 0$
 $\Rightarrow (x-y)(x-4y) = 0$
 For reflexive.
 $(x-x)(x-4x) = 0$
 $\therefore (x, x) \in R$
 So it is reflexive
 For symmetric
 Let $(x, y) \in R$
 $x^2 - 5xy + 4y^2 = 0$
 but
 $y^2 - 5xy + 4x^2$
 may be equal to zero
 So it is not symmetric
 For transitive
 Let $(x, y) \in R$
 $x^2 - 5xy + 4y^2 = 0$ (i)
 and $(y, z) \in R$
 $y^2 - 5yz + 4z^2 = 0$ (ii)
 from (i) and (ii)
 $x^2 - 5xy + 4y^2 = y^2 - 5yz + 4z^2$
 $x^2 + 3y^2 - 4z^2 - 5xy + 5yz = 0$
 $(x^2 - 5xz + 4z^2) + (3y^2 - 4z^2 + 5xz - 5xy + 5yz) = 0$
 $\therefore 3y^2 - 4z^2 + 5xz - 5xy + 5yz \neq 0$
 $\therefore x^2 - 5xz + 4z^2 \neq 0$
 $\therefore (x, z) \notin R$
 So, it is not transitive
45. (d) We know that
 If $R \{x, y\} : x \in A$ and $y \in B$ then
 $R^{-1} = \{(y, x) : y \in B \text{ and } x \in A\}$
 Statement-1
 Let R is reflexive
 $\therefore (x, x) \in R \Rightarrow (x, x) \in R^{-1}$
 So R^{-1} is also reflexive
 Statement 2
 Let R is symmetric
 and $(x, y) \in R \Rightarrow (y, x) \in R$ (i)
 Let $(y, x) \in R^{-1} \Rightarrow (x, y) \in R^{-1}$
 So R^{-1} is also symmetric
 Statement 3
 Let R is transitive
 So, $(x, y) \in R$ and $(y, z) \in R \Rightarrow (x, z) \in R$
 $\therefore (x, y) \in R \Rightarrow (y, x) \in R$
 $(y, z) \in R \Rightarrow (z, y) \in R$
 and $(x, z) \in R \Rightarrow (z, x) \in R$
 $\therefore (z, y) \in R$ and $(z, y) \in R \Rightarrow (z, x) \in R$
 So R^{-1} is also transitive

46. (b) Let $Z = \frac{1}{1+i} \times \frac{1-i}{1-i} = \frac{1-i}{1+1} = \frac{1-i}{2} = \frac{1}{2} - \frac{1}{2}i$

$$\tan \theta = \left| \frac{-\frac{1}{2}}{\frac{1}{2}} \right| = 1 = \tan \frac{\pi}{4}$$

$\therefore \theta = \frac{\pi}{4}$ But z lies in 4th quadrant

\therefore Principal argument $= \frac{-\pi}{4}$

47. (c) $\left| \left(\frac{\sqrt{-3}}{2} - \frac{1}{2} \right)^{200} \right| = \left| \left(-\frac{1}{2} + \frac{\sqrt{3}}{2}i \right)^{200} \right|$

$$= \left| -\frac{1}{2} + \frac{\sqrt{3}}{2}i \right|^{200} \quad [\because |Z^n| = |Z|^n]$$

$$= \left| \sqrt{\frac{1}{4} + \frac{3}{4}} \right|^{200} = 1$$

48. (d) Statement 1

Let $n = 4$

$\therefore \frac{n!}{3!} = \frac{4!}{3!} = 4$ is not divisible by 6

Statement 2.

Let $n = 5$

$\therefore \frac{n!}{3!} + 3 = \frac{5!}{3!} + 3 = 5.4 + 3$

$= 23$ is not divisible by 7.

49. (b) Selecting 5 players out of 5 players (exclude two particular players).

$$= {}^7C_5 = \frac{7.6}{2.1} = 21$$

50. (c) $(x + 1)^{th}$ term from the end of expression

$$\left(x + \frac{1}{x} \right)^{2n} = (n+1)^{th} \text{ term}$$

from begining of expression $\left(\frac{1}{x} + x \right)^{2n}$

$\therefore (n+1)^{th}$ term of $\left(\frac{1}{x} + x \right)^{2n}$ is

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

$$\begin{aligned}
 61. \quad (b) \quad & \int_0^{\frac{\pi}{4}} \frac{dx}{(\sin x + \cos x)^2} = \frac{1}{\sqrt{2}} \int_0^{\frac{\pi}{4}} \frac{dx}{\left(\frac{1}{\sqrt{2}} \sin x + \frac{1}{\sqrt{2}} \cos\right)^2} \\
 & = \frac{1}{\sqrt{2}} \int_0^{\frac{\pi}{4}} \frac{dx}{\left(\cos\left(\frac{\pi}{4} - x\right)\right)^2} = \frac{1}{\sqrt{2}} \int_0^{\frac{\pi}{4}} \sec^2\left(\frac{\pi}{4} - x\right) dx \\
 & = \frac{1}{\sqrt{2}} \left[-\tan\left(\frac{\pi}{4} - x\right) \right]_0^{\frac{\pi}{4}} = \frac{-1}{\sqrt{2}} \left[\tan 0 - \tan \frac{\pi}{4} \right] \\
 & = \frac{-1}{\sqrt{2}} \left[0 - \frac{1}{\sqrt{2}} \right] = \frac{1}{2}
 \end{aligned}$$

$$\begin{aligned}
 62. \quad (b) \quad & \text{Let } I = \int (\sin x)^{-\frac{1}{2}} (\cos x)^{-\frac{3}{2}} dx \\
 & = \int \frac{1}{(\sin x)^{\frac{1}{2}} (\cos x)^{\frac{3}{2}}} dx = \int \frac{dx}{\cos^2 x (\tan x)^{\frac{1}{2}}} \\
 & = \int \frac{\sec^2 x}{\sqrt{\tan x}} dx \\
 & \text{Let } \tan x = t^2 \Rightarrow \sec^2 x dx = 2t dt \\
 & = \int \frac{1}{t} \times 2t dt = 2 \int 1 dt = 2t + c \\
 & = 2\sqrt{\tan x} + c
 \end{aligned}$$

$$\begin{aligned}
 63. \quad (b) \quad & I_1 = \int \frac{e^x}{e^x + e^{-x}} dx = \int \frac{e^x}{e^x + \frac{1}{e^x}} dx \\
 & = \int \frac{e^{2x}}{e^{2x} + 1} dx \\
 \therefore I_1 + I_2 & = \int \frac{e^{2x} + 1}{e^{2x} + 1} dx = \int 1 dx \\
 & = x + C
 \end{aligned}$$

$$\begin{aligned}
 64. \quad (b) \quad & \int_{-2}^{-1} \frac{x}{|x|} dx \\
 & = \int_{-2}^{-1} \frac{x}{-x} dx \quad [\because |x| = -x, x < 0] \\
 & = - \int_{-2}^{-1} 1 dx = -[x]_{-2}^{-1} \\
 & = -\{(-1) - (-2)\} = -1.
 \end{aligned}$$

$$\begin{aligned}
 65. \quad (b) \quad & \text{Let } f(x) = \sin 4x + 2x \\
 & f'(x) = 4 \cos 4x + 2 = 0 \\
 \Rightarrow \cos 4x & = -\frac{1}{2} = \cos\left(\pi - \frac{\pi}{3}\right) \\
 \Rightarrow 4x & = 2n\pi \pm \frac{2\pi}{3} \\
 \Rightarrow x & = n\frac{\pi}{2} \pm \frac{\pi}{6} \\
 x & = \frac{\pi}{6}, \frac{\pi}{3} \quad [\because 0 < x < \frac{\pi}{2}]
 \end{aligned}$$

$$\begin{aligned}
 66. \quad (b) \quad & f(x) = \frac{1}{\tan x + \cot x} = \frac{\sin x - \cos x}{\sin^2 x + \cos^2 x} \\
 & = \frac{1}{2} \sin 2x \\
 f'(x) & = \cos 2x = 0 \\
 \therefore x & = \frac{\pi}{4}
 \end{aligned}$$

$$f'(x) = -2 \sin 2x = -2 \sin \frac{\pi}{4} = -2 < 0$$

$$\therefore f(x) \text{ is maximum at } x = \frac{\pi}{4}$$

\therefore Maximum value is

$$f\left(\frac{\pi}{4}\right) = \frac{1}{2} \sin\left(\frac{\pi}{2}\right) = \frac{1}{2}$$

$$\begin{aligned}
 67. \quad (d) \quad & 4f(x) - f\left(\frac{1}{x}\right) = \left(2x + \frac{1}{x}\right)\left(2x - \frac{1}{x}\right) \\
 4f(x) - f\left(\frac{1}{x}\right) & = 4x^2 - \frac{1}{x^2} \quad \dots(i)
 \end{aligned}$$

Replace x by $\frac{1}{x}$ we get

$$4f\left(\frac{1}{x}\right) - f(x) = \frac{4}{x^2} - x \quad \dots(ii)$$

from $4 \times (i) + (ii)$

$$16f(x) - 4f\left(\frac{1}{x}\right) = 16x^2 - \frac{4}{x^2}$$

$$4f\left(\frac{1}{x}\right) - f(x) = \frac{4}{x^2} - x$$

$$15f(x) = 15x^2$$

$$\therefore f(x) = x^2$$

$$\text{Now, } f(2) = 2^2 = 4.$$

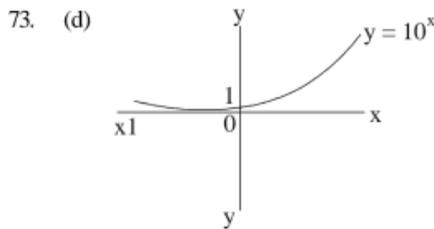
$$\begin{aligned}
 68. \quad (a) \quad & \text{Given that } f(x) = 4x + 3 \\
 \therefore \text{fofo } f(-1) & = f(f(f(-1))) \\
 & = f(f(4(-1)+3)) = f(f(-1)) \\
 & = f(4(-1)+3) = f(-1) = 4(-1) + 3 = -1
 \end{aligned}$$

69. (a) $x^y y^x = 1$
 Taking log both sides
 $y \log x + x \log y = 0$
 $y' \log x + \frac{y}{x} + \log y + \frac{x}{y} y' = 0$
 put $x = 1, y = 1$
 $y' \log(1) + 1 + \log(1) + y' = 0$
 $0 + 1 + 0 + y' = 0 \Rightarrow y' = -1$.

70. (b) $y = (x^x)^x = (x^x)^{x^2}$
 Taking log both side
 $\log y = x^2 \log x$
 $\frac{1}{y} \frac{dy}{dx} = 2x \log x + x^2 \cdot \frac{1}{x}$
 $\frac{1}{y} \frac{dy}{dx} = 2x \log x + x$
 put $x = 1, y = 1$
 $\frac{dy}{dx} = 2 \log(1) + 1 = 1$

71. (d) $\because -4 < x < -3$
 $-3 < x + 1 < -2$
 $\Rightarrow [x + 1] = -3$
 $\therefore y = -3$
 $\frac{dy}{dx} = 0$

72. (d) $\frac{dy}{dx} = (\ln 5)y \Rightarrow \int \frac{1}{y} dy = (\ln 5) \int dx$
 $\ln y = (\ln 5)x + c$
 put $x = 0, y = \ln 5$
 $\ln(\ln 5) = 0 + c \Rightarrow c = \ln(\ln 5)$
 $\therefore \ln y = (\ln 5)x + \ln(\ln 5)$
 put $x = 1$
 $\ln y = \ln 5 + \ln(\ln 5) = \ln(5 \ln 5)$
 $y = 5 \ln 5$



It is clear from function that domain $= (-\infty, \infty)$ and it is continuous function unique tangent can be drawn at $x = 0$ so, it is differentiable at $x = 0$

74. (a) $\lim_{x \rightarrow 0} x^3 (\operatorname{cosec} x)^2$
 $= \lim_{x \rightarrow 0} \frac{x^3}{\sin^2 x} = \lim_{x \rightarrow 0} \left(\frac{x}{\sin x} \right)^2 \cdot x$
 $= 1 \cdot 0 = 0$

75. (c) $\lim_{x \rightarrow 1} \frac{x^3 - 1}{\sqrt{x} - 1} = \lim_{x \rightarrow 1} \frac{(x^3 - 1)(\sqrt{x} + 1)}{x - 1}$
 $= \lim_{x \rightarrow 1} \frac{(x - 1)(x^2 + x + 1)(\sqrt{x} + 1)}{x - 1}$
 $= (1 + 1 + 1)(1 + 1) = 6$

76. (b) $f(x) = \frac{x^3}{3} - \frac{7x^2}{2} + 6x + 5$
 $f'(x) = x^2 - 7x + 6 = 0$
 $\therefore x = 1, 6$
 $\frac{+}{-\infty} \quad \frac{-}{1} \quad \frac{+}{6} \quad \frac{-}{\infty}$
 $\therefore f(x)$ is decreasing in $(1, 6)$.

77. (d) $F(x) = \frac{m}{x} + 2nx + 1$
 $\therefore f'(x) = \frac{-m}{x^2} + 2n$
 given that $f'(2) = 0$
 $\therefore \frac{-m}{(2)^2} + 2n = 0$
 $-m + 8n = 0$
 $\Rightarrow 8n - m = 0 \dots (i)$
 from equation we can't find value of $m + 8n$.

78. (b) $y = x \dots (i)$
 $y = x^3 \dots (ii)$
 Solving equations (i) and (ii) we get
 \therefore Required area
 $= \int_0^1 x dx - \int_0^1 x^3 dx$
 $= \left[\frac{x^2}{2} \right]_0^1 - \left[\frac{x^4}{4} \right]_0^1 = \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$

79. (a) $xy = 4225 \Rightarrow y = \frac{4225}{x}$
 Let $S = x + y = x + \frac{4225}{x}$
 $\frac{ds}{dx} = 1 - \frac{4225}{x^2} = 0$
 $\Rightarrow x = 65$

$$\frac{d^2s}{dx^2} = \frac{2.4225}{x^3}$$

$$\left(\frac{d^2s}{dx^2}\right)_{(x=65)} = \frac{2.4225}{(65)^3} > 0$$

∴ x + y is minimum at x = 65 and y = 65

∴ Minimum value of x + y = 65 + 65 = 130

80. (c) $x \frac{dy}{dx} - 2y = 0$

$$x \frac{dy}{dx} = 2y$$

$$\int \frac{1}{y} dy = 2 \int \frac{1}{x} dx$$

$$\ell ny = 2 \ell nx + \ell nc$$

$$\ell ny = \ell nx^2 + \ell nc$$

$$\ell ny = \ell n(cx^2)$$

$$y = cx^2$$

It represent the equation of parabolas.

81. (c) Since (-5, 0), (5p², 10p) and (5q², 10q) are collinear.

$$\therefore \begin{vmatrix} -5 & 0 & 1 \\ 5p^2 & 10p & 1 \\ 5q^2 & 10q & 1 \end{vmatrix} = 0$$

$$\Rightarrow 5 \times 10 \begin{vmatrix} -1 & 0 & 1 \\ p^2 & p & 1 \\ q^2 & q & 1 \end{vmatrix} = 0$$

Applying $c_1 \rightarrow c_1 + c_3$

$$\Rightarrow 50 \begin{vmatrix} 0 & 0 & 1 \\ p^2 + 1 & p & 1 \\ q^2 + 1 & q & 1 \end{vmatrix} = 0$$

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

$$\Rightarrow p^2q + q - pq^2 - p = 0$$

$$\Rightarrow p^2q - pq^2 + q - p = 0$$

$$\Rightarrow pq(p - q) - 1(p - q) = 0$$

$$\Rightarrow (p - q)(pq - 1) = 0$$

$$\Rightarrow pq - 1 = 0 \Rightarrow pq = 1 \quad (\because p \neq q)$$

82. (c) Let line cuts off equal intercepts 'a' from axes

∴ Equation of line

$$\frac{x}{a} + \frac{y}{a} = 1 \Rightarrow x + y = a$$

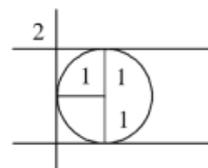
Since it passes through (1, -2)

$$\therefore 1 - 2 = a \Rightarrow a = -1$$

∴ Required equation is

$$x + y + 1 = 0$$

83. (c) Since circle touches both the axes in the first quadrant and the line $y - 2 = 0$



∴ centre (1, 1)
radius = 1

∴ Equation of circle is

$$(x - 1)^2 + (y - 1)^2 = 1$$

$$\Rightarrow x^2 + y^2 - 2x - 2y + 1 = 0$$

84. (d) Focus of parabola = (-3, 0) = (9, 0)

$$\Rightarrow a = -3$$

Equation of direction $x - 3 = 0$

∴ axis is x-axis

So, equation of parabola

$$y^2 = 4ax \Rightarrow y^2 = 4(-3)x$$

$$\Rightarrow y^2 = -12x.$$

85. (b) Given equation of ellipse

$$x^2 + 2y^2 = 1 \Rightarrow \frac{x^2}{1} + \frac{y^2}{\frac{1}{2}} = 1$$

$$\Rightarrow a^2 = 1 \text{ and } b^2 = \frac{1}{2}$$

$$\therefore b^2 = a^2 - c^2$$

$$c^2 = a^2 - b^2 = 1 - \frac{1}{2} = \frac{1}{2}$$

$$c = \frac{1}{\sqrt{2}}$$

The distance between foci of ellipse

$$= 2C = \frac{2}{\sqrt{2}} = \sqrt{2}$$

86. (d) Given that sides of triangle be a, b, c,
perimeter = P = a + b + c

$$\therefore S = \frac{P}{2}$$

Area of triangle $\Delta = q$

we know that

$$\tan \frac{A}{2} = \frac{\Delta}{S(S-a)}$$

$$\Rightarrow S(S-a) \tan \frac{A}{2} = \Delta$$

$$\Rightarrow \frac{P}{2} \left(\frac{P}{2} - a \right) \tan \frac{A}{2} = q$$

$$P(P-2a) \tan \frac{A}{2} = 42q$$

87. (a) Equation of line passing through intersection of two given lines is:

$$x + 2y + 2 + \lambda(2x - 3y - 3) = 0$$

$$(1 + 2\lambda)x + (2 - 3\lambda)y + (2 - 3\lambda) = 0$$

$$\text{x-intercept (a)} = -\frac{(2-3\lambda)}{1+2\lambda}$$

$$\text{y-intercept (b)} = -\frac{(2-3\lambda)}{2+3\lambda} = -1$$

since line cuts equal intercepts in the fourth quadrant

\therefore If y-intercept is -1 then x-intercept is 1

Now $|a| + |b| = |1| + |-1| = 2$

88. (c) Since $ax + by + c = 0$ and $bx + ay + c = 0$ are parallel

$$\therefore \frac{a}{b} = \frac{b}{a} \Rightarrow a^2 - b^2 = 0$$

89. (a) Given equation of line is $x + y = p$

$$\therefore \frac{x}{p} + \frac{y}{p} = 1$$

\therefore line has equal intercept P with coordinate axes.

\therefore Midpoint of line segment

$$= \left(\frac{P}{2}, \frac{P}{2} \right)$$

Let (h, k) be the locus of the mid-point of the line segment

$$\therefore h = \frac{P}{2} \text{ and } k = \frac{P}{2}$$

$$\therefore h = k$$

So, equation of locus is $x = y$

i.e. $x - y = 0$

90. (c) Let $p(x, y)$, $A(2a, 0)$ and $B(0, 3a)$

According to question

$$PA = PB \Rightarrow PA^2 = PB^2$$

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

$$\Rightarrow x^2 - 4ax + 4a^2 + y^2 = x^2 + y^2 - 6ay + 9a^2$$

$$\Rightarrow 4ax - 6ay + 5a^2 = 0$$

$$\Rightarrow 4x - 6y + 5a = 0$$

For questions 91 to 93

$$6x + ky + 3z - 12 = 0 \quad (k \neq 0)$$

$$\Rightarrow 6x + ky + 3z = 12$$

$$\Rightarrow \frac{x}{2} + \frac{y}{\frac{12}{k}} + \frac{z}{4} = 1$$

$$\therefore A(2, 0, 0), B\left(0, \frac{12}{k}, 0\right), C(0, 0, 4)$$

Given equation of sphere is

$$x^2 + y^2 + z^2 - 2x - 3y - 4z = 0$$

Compare with general equation of sphere

$$x^2 + y^2 + z^2 + 2gx + 2fy + 2hz + c = 0$$

$$g = -1, f = -\frac{3}{2}, h = -2, c = 0$$

\therefore centre of sphere = $(-g, -f, -h)$

$$= \left(1, \frac{3}{2}, 2 \right)$$

91. (b) Since $B\left(0, \frac{12}{k}, 0\right)$ lies on sphere

$$\therefore 0 + \left(\frac{12}{k}\right)^2 + 0 - 0 - 3\left(\frac{12}{k}\right) + 0 = 0$$

$$\Rightarrow \left(\frac{12}{k}\right)\left[\frac{12}{k} - 3\right] = 0$$

$$\Rightarrow \frac{12}{k} - 3 = 0 \quad [\because k \neq 0]$$

$$\Rightarrow k = 4$$

92. (b) Perpendicular distance from centre $\left(1, \frac{3}{2}, 2\right)$ to the plane

$$6x + 4y + 3z - 12 = 0$$

$$P = \frac{6 + 4\left(\frac{3}{2}\right) + 3(2) - 12}{\sqrt{36 + 16 + 9}}$$

$$= \frac{6 + 6 + 6 - 12}{\sqrt{61}} = \frac{6}{\sqrt{61}} = 0.74$$

93. (d) Equation of line passing through $(0, 0, 0)$

and $\left(1, \frac{3}{2}, 2\right)$ is

$$\frac{x-0}{1} = \frac{y-0}{\frac{3}{2}} = \frac{z-0}{2}$$

$$6x = 4y = 3z$$

For question 94 and 95

Since point $(2, 3, -6)$ lies plane

$$\frac{2x}{k} + \frac{2y}{3} + \frac{z}{3} = 2$$

$$\therefore \frac{4}{k} + \frac{6}{3} - \frac{6}{3} = 2$$

$$\Rightarrow \frac{4}{k} = 2 \Rightarrow k = 2$$

So, equation of plane is

$$x + \frac{2y}{3} + \frac{z}{3} = 2$$

$$\Rightarrow 3x + 2y + z = 6$$

94. (a) Direction ratios of a normal are $\langle 3, 2, 1 \rangle$

95. (b) $3x + 2y + z = 6$

$$\frac{x}{2} + \frac{y}{3} + \frac{z}{6} = 1$$

\therefore Intercept on axes are $2, 3, 6$ respectively

$$\therefore P = 2, q = 3 \text{ and } r = 6$$

$$\therefore p + q + r = 2 + 3 + 6 = 11$$

96. (c) $4\hat{i} + \hat{j} - 3\hat{k}$ and $p\hat{i} + q\hat{j} - 2\hat{k}$ are collinear vectors

$$\therefore \frac{4}{p} = \frac{1}{q} = \frac{-3}{-2} \Rightarrow P = \frac{2}{3} \times 4 = \frac{8}{3}$$

$$\text{and } \frac{1}{q} = \frac{3}{2} \Rightarrow q = \frac{2}{3}$$

97. (c) Given that \vec{a}, \vec{b} and \vec{c} are position vectors of the vertices A, B and C resp.

$$\therefore \text{position vector of centroid } G = \frac{\vec{a} + \vec{b} + \vec{c}}{3}$$

$$\text{Now, vector } \overrightarrow{AG} = \frac{\vec{a} + \vec{b} + \vec{c}}{3} - \vec{a}$$

$$= \frac{\vec{b} + \vec{c} - 2\vec{a}}{3}$$

98. (c) $\therefore \vec{a} \cdot (\vec{b} + \vec{c}) = \vec{a} \cdot \vec{b} + \vec{a} \cdot \vec{c}$

Thus, the dot-product is distributive over addition

$$\text{and } \vec{a} \times (\vec{b} + \vec{c}) = \vec{a} \times \vec{b} + \vec{a} \times \vec{c}$$

Thus the cross product is distributive over addition

$$\therefore \vec{a} \times (\vec{b} + \vec{c}) = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{a} \cdot \vec{b})\vec{c}$$

$$\text{and } (\vec{a} \times \vec{b}) \times \vec{c} = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{c} \cdot \vec{b})\vec{a}$$

$$\therefore \vec{a} \times (\vec{b} + \vec{c}) \neq (\vec{a} \times \vec{b}) \times \vec{c}$$

Thus cross product of vectors is not associative

99. (b) Given that $\vec{a} \times \vec{b} = \vec{c}$

$$\Rightarrow \vec{a} \perp \vec{c} \text{ and } \vec{b} \perp \vec{c}$$

If \vec{b} and \vec{c} are given then any vector \vec{a} coplanar with

\vec{b} is also perpendicular to \vec{c} .

So, \vec{a} is not unique

If \vec{a} and \vec{b} is given then its cross product is unique

So \vec{c} is unique.

100. (d) Given that $|\vec{a}| = |\vec{b}| = 1$

$$\text{and } |\vec{a} - \vec{b}| < 2$$

$$\Rightarrow |\vec{a} - \vec{b}|^2 < 4$$

$$\Rightarrow |\vec{a}|^2 + |\vec{b}|^2 - 2|\vec{a}||\vec{b}|\cos 2\theta < 4$$

$$\Rightarrow 1 + 1 - 2\cos 2\theta < 4$$

$$\Rightarrow \cos 2\theta > -1$$

$$\Rightarrow 1 - 2\sin^2\theta > -1$$

$$\Rightarrow \sin^2\theta < 1$$

$$\Rightarrow -1 < \sin\theta < 1$$

101. Since two digits are chosen

then $n(s) = {}^5C_2$

To get last digit 0 there are two cases = $2 \times 5 = 10$
or $4 \times 5 = 10$

$$\text{Hence, Probability} = \frac{2}{{}^5C_2} = \frac{1}{5}$$

102. (d) Since frequency curve has left skewed so, In this case mode is the greatest and mean is the lowest hence. Option (d) is correct.

103. (c) Since variance = $\frac{\sum x_i^2}{n} - (\bar{x})^2$

$$3.6 = \frac{2^2 + 2^2 + 4^2 + 5^2 + x^2}{n} - \left(\frac{2+2+4+5+x}{n}\right)^2$$

$$3.6 = \frac{4+4+16+25+x^2}{5} - \left(\frac{13+x}{5}\right)^2$$

On solving, we get

$$2x^2 - 13x - 7 = 0$$

$$\Rightarrow x = 7$$

104. (d) Given $a = 4, d = 4$ and $n = 50$

$$\text{hence } S_n = \frac{n}{2}[2a + (n-1)d]$$

$$= \frac{50}{2}[2 \times 4 + 49 \times 4]$$

$$= 50[4 + 98]$$

$$\text{Now } \bar{X} = \frac{S_n}{n} = \frac{50 \times 102}{50} = 102$$

105. (b) Here mean

$$= \frac{21+34+23+39+26+37+40+20+33+27}{10}$$

$$= \frac{300}{10} \Rightarrow 30$$

Mean deviation

$$= \frac{|-9| + |4| + |-7| + |9| + |-4| + |7| + |10| + |-10| + |3| + |-3|}{10}$$

$$= \frac{66}{10} = 6.6$$

$$\text{Coefficient of mean deviation} = \frac{\text{Mean Deviation}}{\text{Mean}}$$

$$= \frac{6.6}{30} = 0.22$$

For Q 106 to 108

Here, $(x_1 - 100) + (x_2 - 100) + \dots + (x_n - 100) = -20$

hence $(x_1 + x_2 + x_3 + \dots + x_n) - 100n = -20$

Or $x_1 + x_2 + x_3 + \dots + x_n = 100n - 20$ (i)

and according to question for same set

$x_1 + x_2 + x_3 + \dots + x_n = 92n + 140$ (ii)

from (i) and (ii)

106. (d) $8n = 160 \Rightarrow n = 20$

from (i) $x_1 + x_2 + x_3 + \dots + x_n = 1980$

$$\text{Mean} = \frac{100 \times 20 - 20}{20} = 99$$

107. (a) Acc to question
 $(x_1 + x_2 + x_3 + \dots + x_n) - 99n$
 $\Rightarrow 1980 - 99 \times 20$
 $= 0$

108. (c) Acc. to question.
 $(x_1 + x_2 + x_3 + \dots + x_n) - 20y = 180$
 $1980 - 20y = 180$
or $20y = 1800 \Rightarrow y = 90$

109. (d) $S_n = \frac{n}{2}[2a + (n-1)d]$
 $= \frac{51}{2}[8 + 50 \times 3] = \frac{51 \times 158}{2} = 51 \times 79$

Mean $= \frac{S_n}{n} = \frac{51 \times 79}{51} = 79$

110. Median = Middle term of A.P. $= \left(\frac{51+1}{2}\right)^{\text{th}}$ term $= 26^{\text{th}}$ term

$\therefore T_{26} = 4 + 25 \times (3) = 79$

111. (b) Sum of deviations measured from the median
 $= S_n - n \times \text{Median}$
 $= 51 \times 79 - 51 \times 79 = 0$

112. (b) $\therefore n(G \cap \bar{T}) = P$ (Graduates less than 3 years experience)
 $= 36$

$P(G \cap \bar{T}) = \frac{36}{90} = \frac{2}{5}$

113. (c) $\therefore P(G \cap \bar{T}) = \frac{2}{5}$

$P(\bar{T}) = \frac{63}{90} = \frac{7}{10}$

$\therefore P(G/\bar{T}) = \frac{P(G \cap \bar{T})}{P(\bar{T})} = \frac{\frac{2}{5}}{\frac{7}{10}} = \frac{4}{7}$

114. (d) $\therefore n(\bar{T} \cap \bar{G}) = 27$

$n(\bar{G}) = 9 + 27 = 36$

$\therefore P(\bar{T}/\bar{G}) = \frac{P(\bar{T} \cap \bar{G})}{P(\bar{G})}$

$\frac{27}{36} = \frac{27}{36} = \frac{3}{4}$

For questions 115 to 117

Let P = probability of workers which is suffering from disease.

$= \frac{1}{3}$

$\therefore q = 1 - \frac{1}{3} = \frac{2}{3}$

115. (d) $P(x=3) = {}^6C_3 \left(\frac{1}{3}\right)^3 \left(\frac{2}{3}\right)^3 = \frac{6.5.4}{3.2.1} \times \frac{8}{3^6} = \frac{160}{729}$

116. (b) $P(X=0) = {}^6C_0 \left(\frac{1}{3}\right)^0 \left(\frac{2}{3}\right)^6 = \frac{2^6}{3^6} = \frac{64}{729}$

117. (b) $P(x \geq 1) = 1 - P(X=0)$

$= 1 - \frac{64}{729} = \frac{665}{729}$

Sol. (118-120):

C.I	f_i	x_i	$f_i x_i$
0-20	17	10	170
20-40	P + q	30	30(P + 8)
40-60	32	50	1600
60-80	P-3q	70	70P-210q
80-100	19	90	1710

$68 + 2P - 2q$ $3480 + 100p - 180q$
 $\therefore 68 + 2P - 2q = 120$
 $\Rightarrow p - q = 26$ (i)

$50 = \frac{3480 + 100P - 180q}{120}$

$6000 = 3480 + 100P - 180q$
 $\Rightarrow 5P - 9q = 126$ (ii)

On solving equation (i) and (ii) we get
P = 27 and q = 1

118. (c)

119. (a)

120. (b) If frequency of each class is doubled

$\therefore \text{New Mean} = \frac{\sum_{i=1}^n x_i 2f_i}{\sum_{i=1}^n 2f_i} = 2 \frac{\sum_{i=1}^n x_i f_i}{2 \sum_{i=1}^n f_i}$

$= \frac{\sum_{i=1}^n x_i f_i}{\sum_{i=1}^n f_i} = 50$

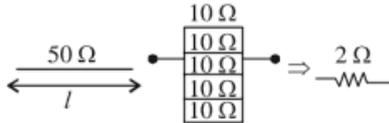
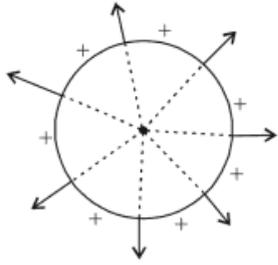
GENERAL ABILITY

PART-A: ENGLISH

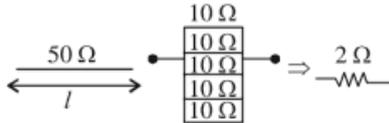
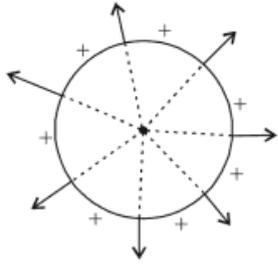
- (c) **“have”** should be replaced by **“has”** and **“their”** should be replaced by **“its”** to make the sentence grammatically correct, Because, “a company of five thousand soldiers” is a collective noun, hence singular verb and pronoun is used accordingly...i.e. “has” and “its”.
- (c) instead of pronoun **“their”**, pronoun **“his”** should be used to make the sentence grammatically correct,

“every” is always used with a singular noun form and therefore with a singular verb form and pronoun accordingly in English.

3. (a) **“reflects”** should be replaced by **“reflect”** to make the sentence grammatically correct.
4. (d) no error.
5. (d) no error.
6. (c) **“it’s”** should be replaced by **“its”** to make the sentence grammatically correct. “It’s” is a contraction and should be used where a sentence would normally read “it is.” The apostrophe indicates that part of a word has been removed. “Its” with no apostrophe, on the other hand, is the possessive word, like “his” and “her,” for nouns without gender.
7. (a) **“the”** should be added to the sentence after **“considered”**, to make the sentence grammatically correct.
8. (b) **“ones”** should be replaced by **“one’s”**, as The only times “ones” has no apostrophe are when it is being used to mean “examples” or “people” as in “ripe ones” or “loved ones,” or in the informal arithmetical expression “the ones column. “ Whereas “ one’s” is a possessive pronoun, which fits suitably in the given sentence.
9. (d) no error.
10. (a) article **“an”** should replace **“a”** to make the sentence grammatically meaningful because we use an with vowel sounds.
11. (a) this idiom is usually used in negative statements to mean that someone should not depend on something hoped for until he or she knows for certain that it will happen, however option (a) **“confident of success”** is the closest to the meaning.
12. (b) the idiom mean- an attractive but inessential addition or enhancement; hence option (b) is the closest to the meaning.
13. (d) the idiom mean- **used to say that it is better to fix a problem when it is small than to wait and let it become a bigger problem.** Hence option (d) is the closest in the meaning.
14. (c) the idiom mean- **in a state of total confusion or disarray.** Hence option (c) is the closest in the meaning.
15. (a) the idiom mean- **To talk (to someone) very rapidly, hurriedly, and/or energetically.** Hence option (a) is the closest in the meaning.
16. (d) the idiom mean- **slightly unwell or in low spirits.** Hence option (d) is the closest in the meaning.
17. (c) the idiom mean- **avoid making a decision or choice.** Hence option (c) is the closest in the meaning.
18. (c) the idiom mean- **very rarely,** Hence option (c) is the closest in the meaning.
19. (d) the idiom mean- **under all circumstances, no matter how difficult,** Hence option (d) is the closest in the meaning.
20. (a) the idiom mean- **fundamentally different or incompatible,** Hence option (a) is the closest in the meaning.
21. (b) **QSPR is the correct sequence. S coherently continues after Q evident from “with”, while P follows S evident from “but” as it continues to provide further information.**
i.e. There are many ways of dealing with intransigent customers but perhaps the best way is to agree with them without excessive argumentation.
22. (d) **QPSR is the correct sequence. Q is an appropriate starting sentence after the rearrangement as it begins to talk about a topic, followed by P, S and R.**
i.e. India achieved remarkable economic development in the years following the landmark reforms inaugurated via liberalization in the year 1991.
23. (a) **SPQR is the correct sequence. P continues after S, evident from “was” in P, further followed by Q and R in this order as it makes a coherent and meaningful passage.**
i.e. the greatest moment in Indian Olympic history was the victory secured by the women’s hockey team in the arena of sport, perhaps against Australia in the Tokyo Olympics.
24. (c) **SPRQ is the correct sequence. S when followed by P makes a coherent pair, the presence of “which” in R makes it evident that it follows P, and Q being the last sentence after the rearrangement.**
i.e. economic progress is determined in terms of GDP and GNP which are the two major determinants for gauging the success of a nation.
25. (b) **RPSQ is the correct sequence. i.e. They can twist and shake their wobbly heads with the aplomb of a stage artist, mesmerizing the gullible into believing that they are not men of straw.**
26. (d) **RPQS is the correct sequence. i.e. On the one hand there is the immense beauty of its rain-soaked verdure and on the other there are the artifacts of its visible modernity.**
27. (a) **QRPS is the correct sequence. i.e. the causes of extreme poverty are often rooted in the inequalities of social systems.**
28. (a) **RPQS is the correct sequence. i.e. you must judge a person by the way he behaves and not by the way he looks.**
29. (c) **RSQP is the correct sequence. i.e. whenever in doubt always opt for the options that causes the least discomfort to the greatest number of people.**
30. (b) **SRQP is the correct sequence. i.e. faith and belief are our greatest defense against the despondency brought by bad times.**
31. (b) **refined** is correct antonym. **crude**- offensively coarse or rude. **Coarse**- rude or vulgar. **Eager**- keenly expectant or interested **Balanced**- taking everything into account; fairly judged or presented. **Refined**- elegant and cultured in appearance, manner, or taste.
32. (a) **diffidence** is correct antonym. **Diffidence**- modesty or shyness resulting from a lack of self-confidence. **Steadfastness**- the quality of being resolutely or dutifully firm and unwavering
33. (d) **dishonesty** is correct antonym. **Integrity**- the quality of being honest and having strong moral principles.

34. (c) **malevolent** is correct antonym. **Benevolent**- well meaning and kindly. **Muddled**- not arranged in order; untidy. **Malevolent**- having or showing a wish to do evil to others. **Ambivalent**- having mixed feelings or contradictory ideas about something or someone.
35. (a) **unstylish** is correct antonym. **Sartorial**- relating to tailoring, clothes, or style of dress.
36. (d) **fake** is correct antonym.
37. (b) **drought** is correct antonym **Deluge**- an overwhelming amount of something
38. (c) **apathy** is correct antonym,; meaning- lack of interest, enthusiasm, or concern
39. (b) **dullness** is correct antonym, remaining options seem to synonyms in varying degree of **Perspicacity**; **Perspicacity**- the quality of having ready insight into things; shrewdness.
40. (d) **dislike** is correct antonym **Penchant**- taste, liking or inclination.
41. (b) **Praise** is the correct synonym.
42. (a) **Praiseworthy** is the correct synonym. **Laudable**-deserving praise and commendation
43. (a) **Capable** is the correct synonym.
44. (d) **Conscientious** is the correct synonym. **Diligent**-having or showing care and conscientiousness in one's work or duties **Conscientious**- wishing to do one's work or duty well and thoroughly
45. (d) **withdrawn** is the correct synonym. **expansive**-covering a wide area in terms of space or scope; extensive **Reticent**- not revealing one's thoughts or feelings readily
46. (a) **cheerful** is the correct synonym. **Jovial**- cheerful and friendly.
47. (d) **sullen** is the correct synonym. **Morose**- sullen and ill-tempered.
48. (c) **unwilling** is the correct synonym. **Reluctant**-unwilling and hesitant; disinclined.
49. (d) **sanguine** is the correct synonym; meaning-optimistic or positive, especially in an apparently bad or difficult situation.
50. (a) **complaisant** is the correct synonym; meaning- willing to please others or to accept what they do or say without protest. **Covert**- not openly acknowledged or displayed **Complacent**- showing smug or uncritical satisfaction with oneself or one's achievements. **Conniving**- given to or involved in conspiring to do something immoral, illegal, or harmful.
51. (d) $\Delta Q = MS \Delta T$
- $$\Rightarrow m = \frac{\Delta Q}{S \Delta T}$$
- $$\Rightarrow m = \frac{20,000}{400 \times 10}$$
- $$\Rightarrow m = 5 \text{ kg}$$
52. (b) Latent heat of veporization is the amount of heat required by a substance to change unit mass from liquid to vapour without a change of temperature.
53. (a) Rate of evaporation
 \propto surface area
 \propto Temperature
54. (NONE)
 Incorrect data/or some data is missing.
55. (a) 
- as $R \propto l$
 So, all the five part will have 10 Q resistance.
- So, $\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10}$
- $$R_{eq} = \frac{10}{5} = 2\Omega$$
56. (d) 
- We can clearly see from figure electric line of field is $1r$ to conducting surface and directed outward.
57. (c) Alloy - solid solution
 Milk - colloidal solution
 Air - mixture
 Sugar solution -true solution
58. (b) fractional distillation : It is a process used for separating a mixture of two or more miscible liquid whose boiling point difference is very less. This method is employed in refining of petroleum.
59. (d) Milk turning sour is an example of chemical change as there is a change in chemical composition of milk in which lactose sugar of milk changes to lactic acid. Dissolution of sugar in water melting of ice and crystallization are the physical changes.
60. (a) NH_4^+ CO_3^{2-}
 Valency +1 -2
 Chemical formula $(\text{NH}_4)_2\text{CO}_3$
61. (c) Calcium oxide (CaO), Calcium nitride (Ca_3N_2), Zinc sulphide (ZnS) are ionic compounds
 Silicon carbide (SiC) is a covalent compound as this compound is linked by strong covalent bonding, Its structure is similar to diamond. It is very hard to break.

PART-B: GENERAL KNOWLEDGE

51. (d) $\Delta Q = MS \Delta T$
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- $$\Rightarrow m = \frac{20,000}{400 \times 10}$$
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- So, $\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10} + \frac{1}{10}$
- $$R_{eq} = \frac{10}{5} = 2\Omega$$
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 Sugar solution -true solution
58. (b) fractional distillation : It is a process used for separating a mixture of two or more miscible liquid whose boiling point difference is very less. This method is employed in refining of petroleum.
59. (d) Milk turning sour is an example of chemical change as there is a change in chemical composition of milk in which lactose sugar of milk changes to lactic acid. Dissolution of sugar in water melting of ice and crystallization are the physical changes.
60. (a) NH_4^+ CO_3^{2-}
 Valency +1 -2
 Chemical formula $(\text{NH}_4)_2\text{CO}_3$
61. (c) Calcium oxide (CaO), Calcium nitride (Ca_3N_2), Zinc sulphide (ZnS) are ionic compounds
 Silicon carbide (SiC) is a covalent compound as this compound is linked by strong covalent bonding, Its structure is similar to diamond. It is very hard to break.

62. (c) Argon is monatomic noble gas.
Atomic number of Argon is 18.
No. of proton of Ar = No. Of electron = 18
Number of neutron = Mass number - number of proton
 $40 - 18 = 22$

63. (a) correct order of valency of the given element is
Ne < Mg < N < Si
0 2 3 4

64. (b) $|\text{Hz}| = |\text{Cycle}| \text{sec}$
So, $3\text{Hz} = 3 \text{ cycles /sec}$

65. (d) $R = \frac{PI}{A}$

$$P = \frac{RA}{l} \Rightarrow \text{unit of } \frac{\text{ohm m}^2}{\text{m}} = \text{ohm - m}$$

So unit of resistivity will be Ωm .

66. (b) $P = VI$

$$I = \frac{P}{V} = \frac{60}{240} = 0.25 \text{ A}$$

67. (a) By Biot - Savart's law

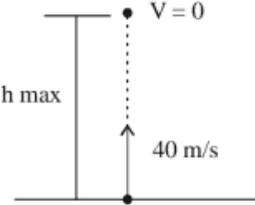
$$B = \frac{\mu_0 i}{2\pi r}$$

$$\text{So, } B \propto \frac{1}{\lambda}$$

68. (b) $F = G \frac{m_1 m_2}{r^2}$

$$[F] = \frac{[G][m_1 m_2]}{[r^2]}$$

$$[G] = \frac{[F][r^2]}{[m_1][m_2]} = \frac{\text{MLT}^{-2}\text{L}^2}{\text{M}^2} = \text{M}^{-1}\text{L}^3\text{T}^{-2}$$

69. (c) 

at $h \text{ max}$, $v = 0$

$$\text{Now, } V = u + a t \Rightarrow 0 = 40 - gt$$

$$\Rightarrow gt = 40 \Rightarrow t = \frac{40}{g}$$

$$\Rightarrow t = \frac{40}{10} = 4 \text{ sec}$$

$$70. (c) T = 2\sqrt{\pi} \sqrt{\frac{L}{g}} = 2\pi \sqrt{\frac{1}{10}} \approx 2 \text{ seconds}$$

71. (c) Living-organisms are able to perform growth and repair mechanism whereas non-living organism could not able to do this. Also, metabolism is a defining characteristic of all living organism only.

72. (b) **Leucoplast** is a type of plastid that stores starch, oil and protein granules

73. (d) Vacuoles are present in both animal and plant cells.

74. (a) Some aquatic plants have large air cavities in the parenchyma. This type of parenchyma is called **aerenchyma**. It helps in buoyancy.

75. (a) Silverfish is a insect, starfish is an Echinodermata. Jellyfish and sea jellies are the informal common names given to the medusa-phase of certain gelatinous members of the subphylum Medusozoa, a major part of the phylum Cnidaria.

76. (a) Bryophytes is also known as amphibians of plant kingdom because they require water for fertilization.

77. (d) Typhoid is a life-threatening illness caused by **Salmonella Typhi bacteria**. Paratyphoid fever is a life-threatening illness caused by Salmonella Paratyphi bacteria. AIDS, Dengue Fever And COVID-19 are caused by virus.

78. (c) The twinkling of a star is due to atmospheric refraction of starlight. The Starlight, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth, but path of light reepson changing slightly due to changing earth atmosphere so amount of light entering the eye changes, which cause star to appear sometime bright and some time dark

79. (b) $w = \vec{F} \cdot \vec{S}$
 $w = FS \cos \theta$

Here \vec{F} is antiparallel to \vec{S}

So $\theta = 180^\circ$ and $\cos 180^\circ = -1$

So, work done will be $w = -FS$

i.e work is negative.

80. (b) $a = \frac{F}{m}$

$$\Rightarrow a = \frac{5}{10} = 0.5 \text{ m/s}^2$$

81. (b) By law of conservation of linear momentum $\vec{P}_i = \vec{P}_f$

$$M_{\text{boy}} V_{\text{boy}} + M_{\text{cart}} V_{\text{cart}} = (M_{\text{boy}} + M_{\text{cart}}) V^1$$

[\because Boy jumped into cart, the final velocity (V^1) of the boy will be equal to that of the cart]

$$52 \times 2 + 3 \times 0 = (52 + 3) V^1$$

$$\Rightarrow \frac{104}{55} = V^1$$

$$\Rightarrow V^1 = 1.89 \text{ m/s}$$

82. (b) Potential energy arises due to change in shape size and position

83. (d) $V_{\text{sound}} = \lambda f = 0.5 \times 1000 = 500 \text{ m/s}$

$$\text{Required time} = \frac{1 \text{ km}}{500 \text{ m/s}} = \frac{1000 \text{ m}}{500 \text{ m/s}} = 2 \text{ sec}$$

84. (d) Atomic number 35 belongs to halogen hence, number of valence electron will be based on Bohr's atomic model.

85. (a) The reaction in which oxidation and reduction takes place simultaneously are known as redox reaction.

In reaction (a) there is no change in the oxidation number of any element hence it is not a redox reaction.

86. (b) Three important allotropes of carbon are graphite, diamond, and fullerene. Crystal structure of diamond is isomorphous with silicon.

87. (d) Hydrogen (H_2) is a nontoxic, nonmetallic, odorless, tasteless, colorless, and highly combustible diatomic gas.

88. (d) silica, is also known as silicon dioxide. It is compound of the two most abundant elements in Earth's crust, silicon and oxygen, SiO_2 . It is most commonly found in nature as quartz.

Zinc oxide is a white solid used as a pigment. Chalk is white solid made up of CaCO_3 . Whitewash is also a pigment containing mixture of lead carbonate and lead hydroxide ($\text{PbCO}_3, \text{Pb(OH)}_2$)

89. (a) Urea is a nitrogen containing fertilizer. It contains more percentage of nitrogen than other fertilizers. The main function of Urea fertilizer is to **supplement nitrogen to the plants**.

90. (a) Carbon compounds are poor conductor of electricity as they do not have the presence of free electrons.

91. (b) A decomposition reaction is a **chemical reaction in which one reactant breaks two or more products**. **Decomposition reactions require energy**. There are **mainly three** types of decomposition reactions: Thermal decomposition reactions; Electrolytic decomposition reactions; Photo decomposition reactions.

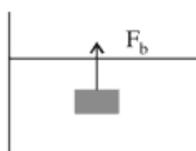
Reaction (b) is an example of photodecomposition reaction.

92. (d) The mechanism of action of hormonal contraception includes: Inhibition of ovulation (inhibits the release of egg).

93. (a) Papaya has unisexual flowers, male flowers, and female flowers are on separate plants.

94. (a) Smooth endoplasmic reticulum is involved in lipid synthesis.

95. (c) Buoyancy is an upward force which acts on an object immersed in liquid. Its value is equal to weight of liquid displaced by object.



96. (c) The middle finger represent direction of induced current.

97. (a) As $IR_2 = 2I_{R1}$

$$\text{So, } R_2 = 2R_1 \quad [Q R = \frac{PI}{A} \Rightarrow R \propto l]$$

$$\text{So, } R_{\text{eq}} = \frac{R_1 R_2}{R_1 + R_2} = \frac{R_1 (2R_1)}{R_1 + 2R_1} = \frac{2R_1^2}{3R_1} = \frac{2R_1}{3}$$

$$\text{Thus, } 3R_{\text{eq}} = 2R_1$$

$$\text{i.e. } 3R = 2R_1$$

98. (c) By lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{-5} - \frac{1}{u} = \frac{1}{-10} \quad [\because \text{concave lens always form image on same side as that of object. so } v \text{ is } -ve]$$

$$\Rightarrow \frac{1}{u} - \frac{1}{10} = \frac{1}{5}$$

$$\Rightarrow \frac{1}{u} = \frac{1-2}{10}$$

$$\Rightarrow \frac{1}{u} = \frac{1}{10}$$

$$\Rightarrow u = -10$$

$$\text{So, } m = \frac{v}{u} = \frac{-5}{-10} = \frac{1}{2} = 0.5$$

99. (d) $P = \frac{F}{\text{Area of contact}}$ or $\frac{F}{A}$

$$\text{So, } P = \frac{mg}{A} = \frac{2 \times 10}{30 \times 10 \times 10^{-4}} = 666.6 \text{ N/M}^2$$

100. (a) During take off for landing the type of aircrafts get charged due to friction between tyres and ground. It types are slightly conducting, the charges developed on the tyres will not stay on them and find its way to earth.

101. (c) The Arthashastra is an Ancient Indian Sanskrit treatise on statecraft, political science, economic policy and military strategy.

102. (b) Acharya Charaka was born around 300 BC and was a key contributor to Ayurveda's ancient art and science, medicine, and lifestyle philosophy that was developed in Ancient India. Charaka lived between AD 150-200 and 100 BC. He is well known as the editor of the medical treatise Charaka Samhita, one of the basic books of traditional Indian medicine and Ayurveda, which is contained in the Brhat-Trayi.

103. (d) Early Buddhist art did not show the Buddha in human form. In relief sculptures at early stupa sites, his presence is indicated by symbols such as the lotus (signifying

- purity), the eight-spoked wheel (emblem of the Buddha's law), the parasol (ancient symbol of royalty), and a footprint (the Buddha's presence).
104. (b) The Parliament of India is primarily based on the model of British Parliament
 105. (b) Chaudhary Charan Singh (23 December 1902 - 29 May 1987) served as the 5th Prime Minister of India between 28 July 1979 and 14 January 1980.
 106. (c) Collegiate Jurisdiction does not fall under the jurisdiction of the apex court of India.
 107. (c) A cloudburst is an extreme amount of precipitation in a short period of time, sometimes accompanied by hail and thunder, which is capable of creating flood conditions. Cloudbursts can quickly dump large amounts of water, e.g. 25 mm of precipitation corresponds to 25,000 metric tons per square kilometre (1 inch corresponds to 72,300 short tons over one square mile). However, cloudbursts are infrequent as they occur only via orographic lift or occasionally when a warm air parcel mixes with cooler air, resulting in sudden condensation.
 108. (a) Earth is not a perfect sphere. Its shape is an oblate spheroid. This just means that it flattens at the poles and widens out at the equator. Earth bulges at the equator because of the centrifugal force during rotation.
 109. (c) Both longitude and latitude of the place helps people locate places on the map. On small-scale maps, the grid is often made up of latitude and longitude lines. Latitude lines run east-west around the globe, parallel to the Equator, an imaginary line that circles the middle of the Earth. Longitude lines run north-south, from pole to pole.
 110. (d) The Global Positioning System (GPS) is a satellite constellation supporting highly accurate positioning, navigation and timing (PNT) measurements worldwide. As one of the first satellite positioning systems, GPS has become integral to work done worldwide, including precision agriculture, autonomous vehicles, marine or aerial surveying and defense applications.
 111. (d) The National Commission for Women (NCW) is the statutory body of the Government of India, generally concerned with advising the government on all policy matters affecting women. It was established on 31 January 1992 under the provisions of the Indian Constitution, as defined in the 1990 National Commission for Women Act.
 112. (b) Hiuen Tsang or Xuanzang was a Chinese Buddhist monk who travelled over land from China to India during the reign of King Harsha Vardhan to obtain Buddhist scriptures. He wrote 'Records of the Travel to Middle India'.
 113. (d) The 17th Lok Sabha was formed by the members elected in the 2019 Indian general election. Elections, all across India, were conducted in seven phases from 11 April 2019 to 19 May 2019 by the Election Commission of India.
 114. (b) Panchayati Raj (Council of five officials) is the system of local self-government of villages in rural India as opposed to urban and suburban municipalities.
 115. (c) Jefferson identified three natural rights in the Declaration of Independence: "Life, Liberty, and the Pursuit of Happiness."
 116. (a) 'Democracy is a government of the people, by the people and for the people' is said by Abraham Lincoln. He was the 16th president of the United States. He took the charge as president from March 4, 1861 to April 15, 1865. He defined his own definition for democracy.
 117. (d) Earth spins at a constant speed (i.e., there are no changes in its rotational speed) and we, humans that live on the surface, move along with it at the same speed, which is why we don't feel any direct, physical effects of Earth's spin. That's the same reason why, when we jump in the air, we land in the same (original) spot.
 118. (d) **Mass wasting** is the movement of rock and soil down slope under the influence of gravity. Rock falls, slumps, and debris flows are all examples of mass wasting. Often lubricated by rainfall or agitated by seismic activity, these events may occur very rapidly and move as a flow. **Erosion** is the geological process in which earthen materials are worn away and transported by natural forces such as wind or water. A similar process, weathering, breaks down or dissolves rock, but does not involve movement. **Weathering** is the breaking down or dissolving of rocks and minerals on Earth's surface. Once a rock has been broken down, a process called erosion transports the bits of rock and minerals away. Water, acids, salt, plants, animals, and changes in temperature are all agents of weathering and erosion.
 119. (c) A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. Slope movement occurs when forces acting down-slope (mainly due to gravity) exceed the strength of the earth materials that compose the slope. Causes include factors that increase the effects of down-slope forces and factors that contribute to low or reduced strength. Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. Earthquake shaking and other factors can also induce landslides underwater. These landslides are called submarine landslides. Submarine landslides sometimes cause tsunamis that damage coastal areas.
 120. (b) An avalanche is a rapid flow of snow down a slope, such as a hill or mountain. Avalanches can be set off spontaneously, by such factors as increased precipitation or snowpack weakening, or by external means such as humans, animals, and earthquakes. Primarily composed of flowing snow and air, large avalanches have the capability to capture and move ice, rocks, and trees.
 121. (d) On 2 February 1835, British historian and politician Thomas Babington Macaulay presented his 'Minute on

- Indian Education' that sought to establish the need to impart English education to Indian 'natives'. Hence, began the beginning of the western education system in India.
122. (c) The term "Industrial Revolution" was first used by the French writers. But it was popularised by the English economic historians 'Arnold Toynbee' to denote Britain's economic developments that took place between 1760 to 1840.
 123. (b) The khudai khidmatgar movement was led by Abdul Ghaffar Khan, known locally as Bacha Khan, Badshah Khan, or Sarhadi Gandhi. It gradually became more political as its members were being targeted by the British Raj. By 1929 its leadership was exiled from the province and large numbers were arrested.
 124. (a) Mahad Satyagraha was a satyagraha led by B. R. Ambedkar on 20 March 1927 to allow untouchables to use water in a public tank in Mahad (currently in Raigad district), Maharashtra, India.
 125. (b) Satyashodhak Samaj (Truth-seekers' Society) was a social reform society founded by Jyotiba Phule in Pune, Maharashtra, on 24 September 1873. It espoused a mission of education and increased social rights and political access for underprivileged groups, focused especially on women, Shudras, and Dalits, in Maharashtra.
 126. (c) The Lekhapaddhati, also known as Lekhapañcasika, is a collection of Sanskrit documents written between the 8th and 15th centuries during the Chaulukya rule in Gujarat, India. It was later also composed in Prakrit and it contained rules for drafting variety of documents like documents related to land grants, treaties between the rulers and rule of administration. The collection of these documents served as a repository used mainly for administrative purposes by the court officials and for private correspondence.
 127. (d) In 1961, drawing on the principles agreed at the Bandung Conference of 1955, the Non-Aligned Movement was formally established in Belgrade, Yugoslavia, through an initiative of Yugoslav President Josip Broz Tito, Indian Prime Minister Jawaharlal Nehru, Egyptian President Gamal Abdel Nasser, Ghanaian President Kwame Nkrumah and Indonesian President Sukarno. Kwame Nkrumah was the first Prime Minister and President of Ghana, having led the Gold Coast to independence from Britain in 1957. An influential advocate of Pan-Africanism, Nkrumah was a founding member of the Organization of African Unity and winner of the Lenin Peace Prize from the Soviet Union in 1962.
 128. (a) The Bombay plan was a set of proposal of a small group of industrialist in 1844. The idea of planning in independent India was drawn from it.
 129. (d) The correct answer is cyclones. Cyclones around the world are named by Regional Specified Meteorological Centers and Tropical Cyclone Warning Centers.
 130. (c) Manipur's Imphal will be the fourth capital city in the mountainous northeastern region expected to come on the Indian railway map. A passenger train Rajdhani Express from Assam's Silchar railway station has reached the Vaingaichunpao railway station in Manipur for a trial run, putting the state on the Indian Railways map. The train covered the distance of 11 km between the two northeastern stations, with railway officials onboard.
 131. (b) January 2021 saw prolonged Forest Fire in Uttarakhand, Himachal Pradesh (Kullu Valley) and Nagaland-Manipur border (Dzukou Valley).
 132. (a) Currently, India comprises 28 States and 8 Union Territories.
 133. (a) Rain, Snow sleet or hails are the different forms of precipitation. Precipitation is any type of water that forms in the Earth's atmosphere and then drops onto the surface of the Earth. The rain that falls from clouds but freezes before it reaches the ground is called sleet or ice pellets. Snow is precipitation that falls in the form of ice crystals. Hail forms when very cold water droplets freeze, or turn solid, as soon as they touch things like dust or dirt. Water vapor in the atmosphere is visible as clouds and fog.
 134. (a) The two main types of weathering which occur in deserts are Mechanical weathering, which is the disintegration of a rock by mechanical forces that do not change the rock's chemical composition and Chemical weathering, which is the decomposition of a rock by the alteration of its chemical composition. The arid or hot desert areas dominated by mechanical weathering. Due to the high diurnal range of temperature in the arid areas, repeated expansion and contraction of the outer layer of the rock takes place.
 135. (c) New York City and Tokyo were the first known megacities, both reaching an urban conglomeration of over 10 million by the 1950s.
 136. (b) Peninsular Plateau consists of stable table land with highly dissected plateaus, denuded rocks and developed series of scarps.
 137. (d) These occur in the areas which receive rainfall less than 50 cm and desert areas. It includes semi-arid areas of south west Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh and Uttar Pradesh. These consist of a variety of grasses and shrubs. In these forests, plants remain leafless for most part of the year and give an expression of scrub vegetation. Important species found are babool, ber and wild date palm, khair, neem, khejri, palas, etc. Tussocky grass upto a height of 2m as the under growth.
 138. (c) The three processes that change one rock to another are crystallization, metamorphism, and erosion and sedimentation. Any rock can transform into any other rock by passing through one or more of these processes. This creates the rock cycle. The rock cycle is a process in which rocks are continuously transformed between the three rock types igneous, sedimentary and metamorphic.
 139. (a) In geology, denudation is the long-term sum of processes that cause the wearing away of the Earth's

surface by moving water, ice, wind and waves, leading to a reduction in elevation and relief of landforms and landscapes. Denudation is the wearing away of landmass by various processes like weathering, mass movement, erosion and transportation. It results in lowering the level of land, rounding exposed rock surfaces and levelling the peaks. Various agents of erosion like water, wind, and glaciers are involved in the process of denudation.

140. (d) Moraines, eskers and outwash plains can be observed in the union territory of Ladakh. Outwash plains and eskers form due to the flow of meltwater in front of (outwash plains) or beneath (eskers) that glacier ice. They are composed of glacial sediments that have been reworked by flowing water. The moraine lies about 3 km north of Leh at 3650 m altitude. The irrigated and relatively fertile outwash fan stands in sharp contrast to the adjacent alluvial fans and mountainsides that are devoid of most vegetation.
141. (c) Pandit Birju Maharaj was an Indian dancer, composer, singer and exponent of the "Lucknow Kalka-Bindadin" Gharana of Kathak dance in India.
142. (b) India got its first ever export order for BrahMos missiles on when the Philippines' Defence Ministry signed USD 374 million contract with the BrahMos Aerospace Pvt Ltd (BAPL) to supply undisclosed number of missiles. The BAPL, an India-Russian joint venture, produces the supersonic cruise missile BrahMos that can be launched from submarines, ships, aircraft, or from land platforms. The USD 374 million contract is to supply shore-based anti-ship BrahMos missiles to the Philippines' Navy.
143. (a) The Supreme Court had appointed its former judge Indu Malhotra as chairperson of a panel to investigate Prime Minister Narendra Modi's security lapse in Punjab in January. The committee was made to look into the causes of the security breach that left PM Modi's convoy stuck on a flyover for 15-20 minutes while it was on its way to the National Martyrs Memorial in Hussainiwala, a few kilometres away from the Pakistan border.
144. (d) New Zealand legend Ross Taylor finished his Test career by bagging the wicket of Ebadot Hossain of Bangladesh at Hagley Oval in Christchurch.
145. (d) Senior rocket scientist S Somanath has been appointed as the tenth chairman of the Indian Space Research Organisation (ISRO) and secretary, department of space (DoS).
146. (b) Forest Survey report 2021 was released in the month of January 2022. The reports say that there has been an increase of 2,261 sq km in the total forest and tree cover of the country in last two years. Area-wise Madhya Pradesh has the largest forest cover in the country. Maximum increase in forest cover witnessed in Andhra Pradesh (647 sq km) followed by Telangana (632 sq km) and Odisha (537 sq km). 17 states/UT's have above 33 percent of the geographical area under forest cover. Total carbon stock in country's forest is estimated to be 7,204 million tonnes, an increase of 79.4 million. Total mangrove cover in the country is 4,992 sq km, an increase of 17 sq Km observed.
147. (b) The Union Finance Minister Nirmala Sitaraman is the current chairman of the GST Council. The Governing body of the GST is the GST Council. The GST Council has 31 members representing the States and Union Territories.
148. (b) Red Sanders (Red Sandalwood) has fallen back into the '**endangered**' category in the International Union for Conservation of Nature's (IUCN) Red List.
149. (c) "Government of India has decided to commemorate December 26 as 'Veer Baal Diwas' in the honour of supreme sacrifice made by Sahibzada Zorawar Singh and Sahibzada Fateh Singh.
150. (b) Ministry of AYUSH Govt. of India organized a large scale virtual Surya Namaskar programme to mark the occasion of Makar Sankranti on 14th January, 2022 under Azadi ka Amrit Mahotsav celebrations.