Time : 3 Hours **Maximum Marks : 180**

PART – 1 : MATHEMATICS

- This question paper contains two sections, section A & B.
- **Section A** contains 20 multiple choice questions **(SCQs)** with four options (A),(B),(C),(D) out of which only one option is correct.
- **Section B** contains 10 **Integer Type** questions, out of which candidate have to attempt only 5 questions.

Section-I

- This Section contain 20 questions (Q.No. 1 to Q.No. 20)
- Answer to each question in **Section A** will be evaluated according to the following marking scheme:

Full Marks : **+4** for correct answer
Zero Marks : **0** If the question is unanswered;
Negative Marks: **−1** for incorrect answer

1. Which of the following is the smallest positive integer which gives the remainder 3 when divided with 4,6,8, and 10 ?

(A) 73 (B) 103 (C) 123 (D) 243

2. The ratio of total area of the rectangle to the total shaded area

(A) $\frac{2}{\pi}$ (B) $\frac{4}{4-\pi}$ (C) $\frac{4-\pi}{\pi}$ (D) $\frac{\pi}{4}$

3. The expression $3(a^2+1)^2+2(a-1)(a^2+1)-5(a-1)^2-4(0.75a^4+3a-1)$ when simplified reduces to

(A) $2a^3-a^2$ (B) $2a^2-a^3$ (C) $2a^3$ (D) $2a^2$

4. If $x+y=a$ and $x^2+y^2=b$, then the value of (x^3+y^3), is

(A) ab (B) a^2+b (C) $a+b^2$ (D) $\frac{3ab-a^3}{2}$

5. Suppose that $w=2^{1/2}, x=3^{1/3}, y=6^{1/6}$ and $z=8^{1/8}$. From among these number list, the biggest, second biggest numbers are

(A) w, x (B) x, w (C) y, z (D) x, z

6. The equation $\frac{2x^2}{x-1} - \frac{2x+7}{3} + \frac{4-6x}{x-1} + 1 = 0$ has the roots -

(A) 4 and 1 (B) only 1 (C) only 4 (D) Neither 4 nor 1

7. If A & B are two rational numbers and AB, A + B and A − B are rational numbers, then A/B is

(A) always rational (B) never rational

(C) rational when $B \neq 0$ (D) rational when $A \neq 0$

8. Solution set of the equation $3^{2x^2} - 2.3^{x^2+x+6} + 3^{2(x+6)} = 0$ is

(A) $\{-3,2\}$ (B) $\{6,-1\}$ (C) $\{-2,3\}$ (D) $\{1,-6\}$

9. If x, y are rational numbers such that $(x+y) + (x-2y)\sqrt{2} = 2x - y + (x-y-1)\sqrt{6}$ then

(A) $x = 1, y = 1$ (B) $x = 2, y = 1$

(C) $x = 5, y = 1$ (D) x & y can take infinitely many values

10. If a, b, c are real, then $a(a-b) + b(b-c) + c(c-a) = 0$, only if

(A) $a + b + c = 0$ (B) $a = b = c$

(C) $a = b$ or $b = c$ or $c = a$ (D) $a - b - c = 0$

11. Let $n = \sqrt{6+\sqrt{11}} + \sqrt{6-\sqrt{11}} - \sqrt{22}$ then

(A) $n \geq 1$ (B) $0 < n < 1$ (C) $n = 0$ (D) $-1 < n < 0$

12. The number of real roots of the equation $(x-1)^2 + (x-2)^2 + (x-3)^2 = 0$ is

(A) 0 (B) 1 (C) 2 (D) 3

13. If $x - a$ is a factor of $x^3 - a^2x + x + 2$, then ' a ' is equal to

(A) 0 (B) 2 (C) -2 (D) 1

14. If $2x^3 - 5x^2 + x + 2 = (x-2)(ax^2 - bx - 1)$, then a & b are respectively

(A) 2,1 (B) $2, -1$ (C) 1,2 (D) $-1, 1/2$

15. $|x^2 - 1| + x + 1 = 0$ then $x =$

(A) -1 (B) 2 (C) 1 (D) none of these

16. $x^2 - |3x+2| + x \geq 0$

(A) $(-\infty, -2-\sqrt{2}] \cup [1+\sqrt{3}, \infty)$ (B) $x = \phi$

(C) $x \in (-2, -\sqrt{2}, 1+\sqrt{3})$ (D) none of these

17. If $|x+1| + |2x-5| < 10$ then $x \in$

(A) $(-2, \infty)$ (B) $\left(-2, \frac{14}{3}\right)$ (C) $\left(\frac{14}{3}, \infty\right)$ (D) none of these

18. If $|x-1| + |x-3| = 2$ then x is equal to

(A) $x \in (-\infty, 1) \cup (3, \infty)$ (B) [1,3]

(C) $x = 1,3$ (D) none of these

19. If $|x| + |x+5| = 5$ then x is equal to

(A) $x = -5, 0$ (B) $x \in (-\infty, -5) \cup (0, \infty)$

(C) $[-5, 0]$ (D) none of these

20. $|x-1| + |x-2| + |x-3| = 2$ then $x =$

(A) -2 (B) 3 (C) 2 (D) none of these

Section-II

- This Section contain 10 questions (Q.No. 21 to Q.No. 30) whose answer to be filled as numerical value **(Attempt any five)**
- Answer to each question in **Section B** will be evaluated according to the following marking scheme:

Full Marks : **+4** for correct answer
Zero Marks : **0** If the question is unanswered;
Zero Marks : **0** for incorrect answer

21. If $x = 2 + 2^{2/3} + 2^{1/3}$, then the value of $x^3 - 6x^2 + 6x$ is

22. The least value of the expression $x^2 + 4y^2 + 3z^2 - 2x - 12y - 6z + 14$ is

23. Number of positive integers n for which $n^2 + 96$ is a perfect square is

24. The number of real roots of the equation $x^2 - 3|x| + 2 = 0$ is

25. Sum of the non-real roots of $(x^2 + x - 2)(x^2 + x - 3) = 12$ is

26. If $|x - 2| + |x - 3| = 1$, then $a \le x \le b$, then $(a + b)$ is

27. If $||x - 1| - 2| < 5$, then the solution set is $x \in (a, b)$ where $a, b \in$ Integer then $(a + b)$ is

28. If $|2x - 3| + |x - 1| = |x - 2|$, then $a \le x \le b$, then ab is -

29. If $|x^2 - 2x| + |x - 4| > |x^2 - 3x + 4|$, then $x \in (0, \alpha) \cup (\beta, \infty)$ then β/α is

30. If $\frac{2x-3}{3x-5} \ge 3$, then $x \in (a, b]$, where $a, b \in R$ then $(3a + 7b)$ is

PART – 2 : PHYSICS

- This question paper contains two sections, section A & B.
- **Section A** contains 20 multiple choice questions **(SCQs)** with four options (A),(B),(C),(D) out of which only one option is correct.
- **Section B** contains 10 **Integer Type** questions, out of which candidate have to attempt only 5 questions.

Section-I

- This Section contain 20 questions (Q.No. 1 to Q.No. 20)
- Answer to each question in **Section A** will be evaluated according to the following marking scheme:

Full Marks : **+4** for correct answer
Zero Marks : **0** If the question is unanswered;
Negative Marks: **−1** for incorrect answer

31. A force of 6 N and a force of 10 N can combine to form a resultant with a magnitude of which of the following?

(A) 0 (B) 2 N (C) 8 N (D) 20 N

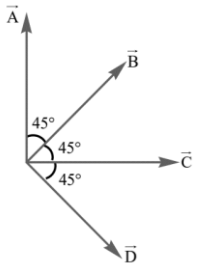
32. Two vector $\vec{a}$ and $\vec{b}$ add to give a resultant $\vec{c}=\vec{a}+\vec{b}$. In which of these cases angle between $\vec{a}$ and $\vec{b}$ is maximum? (a, b, c represent the magnitudes of respective vectors)

(A) $c=a+b$ (B) $c^2=a^2+b^2$ (C) $c=a-b$ (D) Can not be determined

33. $\vec{a}=3\hat{i}+5\hat{j};\ \vec{b}=2\hat{i}+7\hat{j},\ \vec{c}=\hat{i}+9\hat{j}$ which of the following combinations is in the same direction as $\vec{a}+\vec{b}-\vec{c}$?

(A) $2\vec{a}+\vec{b}$ (B) $2\vec{a}-\vec{b}$ (C) $\vec{a}-2\vec{b}$ (D) None of these

34. Four vectors $\left(\vec{A},\vec{B},\vec{C},\vec{D}\right)$ all have the same magnitude and lie in a plane. The angle between adjacent vectors is $45°$ as shown. Which of the following equation is incorrect?



(A) $\vec{A}-\vec{C}=-\sqrt{2}\vec{D}$ (B) $\vec{B}+\vec{D}-\sqrt{2}\vec{C}=0$ (C) $\vec{A}+\vec{B}=\vec{B}+\vec{D}$ (D) $\dfrac{\left(\vec{A}+\vec{C}\right)}{\sqrt{2}}=\vec{B}$

35. There are four forces $\vec{F}_1, \vec{F}_2, \vec{F}_3, \vec{F}_4$ acting on particle such that particle is in equilibrium. Suddenly $\vec{F}_4$ vanishes. The resultant of remaining forces acting on the particle is :

(A) $\vec{F}_1 + \vec{F}_2$ (B) $F_1 + F_2 + F_3$ (C) $\vec{F}_1 - \vec{F}_2 + \vec{F}_3$ (D) $-\vec{F}_4$

36. **Statement-1 :** During a trip consisting of n different displacements along an arbitrary path the resultant displacement is vector sum of displacement for each part of trip. $\vec{S}_R = \sum_{i=1}^{n} \vec{S}_i$

Statement-2 : If a trip starts at position vector $\vec{r}_1$, proceeds to $\vec{r}_2$ ..... than finally $\vec{r}_n$ resultant displacement is given by $\sum_{i=1}^{n} \vec{r}_i$.

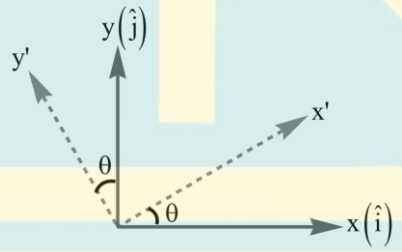
(A) Statement – 1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

(C) Statement-1 is true, statement-2 is false

(D) Statement-1 is false, statement-2 is true

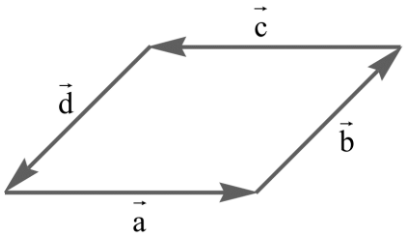
37. A co-ordinate system consisting of x-y axis, is rotated by an angle θ in anticlockwise direction in the same plane. The unit vector along new set of axes, $\hat{x}'$ and $\hat{y}'$ are respectively:



(A) $\cos\theta\hat{i}$ and $\sin\theta\hat{j}$ (B) $\cos\theta\hat{i} + \sin\theta\hat{j}$ and $-\sin\theta\hat{i} + \cos\theta\hat{j}$

(C) $\cos\theta\hat{i} + \sin\theta\hat{j}$ and $\sin\theta\hat{i} + \cos\theta\hat{j}$ (D) $\sin\theta\hat{i} + \cos\theta\hat{j}$ and $\cos\theta\hat{i} + \sin\theta\hat{j}$

38. On the basis of given diagram, choosen the pair of vectors which have an acute angle between them :



(A) $\vec{a}$ and $\vec{c}$ (B) $\vec{a}$ and $\vec{d}$ (C) $\vec{b}$ and $\vec{c}$ (D) $\vec{c}$ and $\vec{d}$

39. The following set represents magnitudes of three vectors. Which set of vectors can never give a zero vector on addition?

(A) 3, 4, 5 (B) 2, 1, 3 (C) 10, 10, 23 (D) 13, 5, 12

40. An object moves in the xy plane with an acceleration that has a positive x component. At t = 0 the object has a velocity given by $\vec{v} = 3\hat{i} + 0\hat{j}$. What can be concluded about the y component of the acceleration?

(A) The y component must be positive and constant

(B) The y component must be negative and constant

(C) The y component must be zero

(D) Nothing at all can be concluded about the y component

41. A bird starts from $(1, 0, 0)$ in the direction $\left(2\hat{i} + 3\hat{j} - 6\hat{k}\right)$ with a speed 21 m/s for 5 sec, then along the direction $\left(3\hat{i} + 4\hat{j} + 5\hat{k}\right)$ with a speed $5\sqrt{2}$ m/s for 5 sec. Find the final displacement of the bird so that is reaches the origin.

(A) $30\hat{i} + 45\hat{j} - 4\hat{k}$ (B) $-45\hat{i} - 65\hat{j} + 65\hat{k}$

(C) $-46\hat{i} - 65\hat{j} + 65\hat{k}$ (D) $46\hat{i} - 65\hat{j} - 65\hat{k}$

42. Statement-1 : When two non-parallel forces $\vec{F}_1$ and $\vec{F}_2$ act on a body, the magnitude of the resultant force acting on the body is less than sum of F_1 and F_2.

Statement-2 : In a triangle, any side is less than the sum of the other two sides.

(A) Statement – 1 is true, statement-2 is true and statement-2 is correct explanation for statement-1

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1

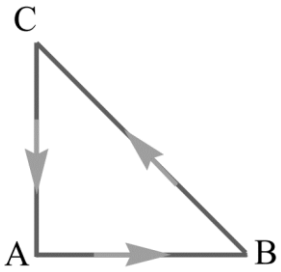
(C) Statement-1 is true, statement-2 is false

(D) Statement-1 is false, statement-2 is true

43. Consider east as positive x-axis, north as positive y-axis. A girl walks 10m east first time then 10m in a direction $30°$ west of north for the second time and then third time in unknown direction and magnitude so as to return to her initial position. What is her third displacement in unit vector notation?

(A) $-5\hat{i} - 5\sqrt{3}\hat{j}$ (B) $5\hat{i} - 5\sqrt{3}\hat{j}$ (C) $-5\hat{i} + 5\sqrt{3}\hat{j}$ (D) She cannot return

44. Three forces start acting simultaneously on a particle moving with velocity $\vec{v}$. These forces are represented in magnitude and direction by the three sides of a triangle ABC (as shown). The particle will now move with velocity:



(A) $|v|$ in the direction of the largest force BC

(B) $\vec{v}$, remaining unchanged

(C) less than $\vec{v}$

(D) greater than $\vec{v}$

45. There are two force vectors, one of 5 N and other of 12 N. At what angle the two vectors be added to get resultant vector of 17 N, 7 N and 13 N respectively?

(A) $0°, 180°$ and $90°$ (B) $0°, 90°$ and $180°$ (C) $0°, 90°$ and $90°$ (D) $180°, 0°$ and $90°$

46. The integral $\int_1^5 x^2 dx$ is equal to

(A) $\frac{125}{3}$ (B) $\frac{124}{3}$ (C) $\frac{1}{3}$ (D) 45

47. If $y = \sqrt{x} + \frac{1}{\sqrt{x}}$, then $\frac{dy}{dx} =$

(A) $\frac{1}{2}x^{-1/2} - \frac{1}{2}x^{-3/2}$ (B) $\frac{1}{2}x^{-1/2} + \frac{1}{2}x^{-3/2}$ (C) $\frac{1}{2}x^{1/2} - \frac{1}{2}x^{3/2}$ (D) $\frac{1}{2}x^{1/2} + \frac{1}{2}x^{3/2}$

48. If $y = 4\sin(3x)$, Then $\frac{dy}{dx} =$

(A) $-12\cos(3x)$ (B) $12\sin(3x)$ (C) $12\cos(3x)$ (D) $4\cos(3x)$

49. $y = \frac{\sin x}{x}$

(A) $\frac{x\cos x + \sin x}{x^2}$ (B) $\frac{x\cos x - \sin x}{x^2}$ (C) $\frac{x\sin x + \cos x}{x^2}$ (D) $\frac{x\sin x - \cos x}{x^2}$

50. If $y = Axe^{Bx}$, Then $\frac{dy}{dx} =$

(A) Ae^{Bx} (B) $ABxe^{Bx}$ (C) $Ae^{Bx}[Bx+1]$ (D) $Ae^{Bx} + A$.

Section-II

- This Section contain 10 questions (Q.No. 21 to Q.No. 30) whose answer to be filled as numerical value **(Attempt any five)**
- Answer to each question in **Section B** will be evaluated according to the following marking scheme:

Full Marks : **+4** for correct answer
Zero Marks : **0** If the question is unanswered;
Zero Marks : **0** for incorrect answer

51. Determine the average value of $y = 2x + 3$ in the interval $0 \le x \le 1$.

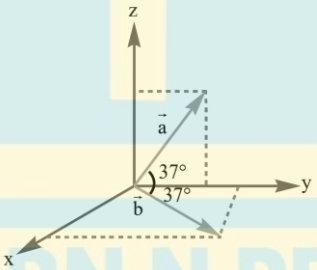
52. $\int_{\pi/6}^{\pi/2} \sin x dx$ is equal to equal to $\frac{\sqrt{3}}{2}$n

53. A force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ newton produces acceleration $1\ m/s^2$ in a body. The mass of the body is $10\sqrt{n}$ kg. Find n?

54. The projection of the vector $3\hat{i} + 4\hat{k}$ on y-axis is :

55. Given that $\vec{P} + \vec{Q} = \vec{R}$ and $\vec{R} \perp \vec{P}$. What is the angle (in degrees) between $\vec{P}$ and $\vec{Q}$ if $|\vec{P}| = |\vec{R}|$?

56. Figure shows two vectors $\vec{a}$ (in y-z plane) and $\vec{b}$ (in x-y plane) such that $|\vec{a}| = |\vec{b}| = 5$ units. The angle between $\vec{a}$ and $\vec{b}$ is $\theta = \cos^{-1}\left(\frac{X}{Y}\right)$. Find the value of X + Y.

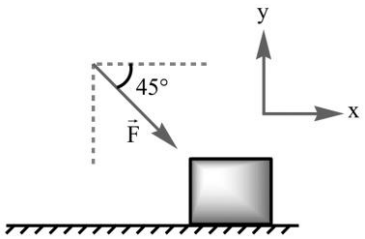


57. If $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j}$, then $\frac{\text{projection of } \vec{a} \text{ on } \vec{b}}{\text{projection of } \vec{b} \text{ on } \vec{a}}$ =

58. A man moves in an open field such that after moving 10m in a straight line, he makes a sharp turn of 60° to his left. Find the total displacement (in meters) of the man just after 7 such turns.

59. $\vec{A} = \hat{i} + \hat{j} - \hat{k}; \vec{B} = 2\hat{i} + 3\hat{j} + 5\hat{k}$ angle (in degrees) between $\vec{A}$ and $\vec{B}$ is:

60. A person pushes a box kept on horizontal surface with force of 100 N. In unit vector notation force $\vec{F}$ can be expressed as $a\sqrt{b}\left(\hat{i} - \hat{j}\right)$. Find the value of a + b.



PART – 3 : CHEMISTRY

- This question paper contains two sections, section A & B.
- **Section A** contains 20 multiple choice questions **(SCQs)** with four options (A),(B),(C),(D) out of which only one option is correct.
- **Section B** contains 10 **Integer Type** questions, out of which candidate have to attempt only 5 questions.

Section-I

- This Section contain 20 questions (Q.No. 1 to Q.No. 20)
- Answer to each question in **Section A** will be evaluated according to the following marking scheme:

  Full Marks : **+4** for correct answer

  Zero Marks : **0** If the question is unanswered;

  Negative Marks: **−1** for incorrect answer

61. Two electrons occupying the same orbital are distinguished by

(A) Principal quantum number

(B) Magnetic quantum number

(C) Azimuthal quantum number

(D) Spin quantum number

62. A given orbital is labelled by m=-1. This cannot be:

(A) s-orbital (B) p-orbital (C) d-orbital (D) f-orbital

63. Select the correct statement for Ne.

(A) It is not isoelectronic with O^{-2}

(B) Last electron enters in s-orbital

(C) The value of ' m ' must be zero for last electron

(D) The value of ' r ' must be ' 1 ' for last electron

64. The sum of azimuthal quantum number of the orbital whose electron cause maximum screening and the one whose cause minimum screening (for same value of ' n ') is equal to

(A) The value of principal quantum number

(B) Number of different orbitals present in a shell

(C) Number of different subshells possible in a shell.

(D) Shell number of the penultimate shell.

65. Which of the following set of quantum numbers are permitted

(A) $n = 3, l = 2, m = -2, s = +1/2$

(B) $n = 3, l = 2, m = -1, s = 0$

(C) $n = 2, l = 2, m = +1, s = -1/2$

(D) $n = 2, l = 2, m = +1, s = -1/2$

66. "Electron pairing cannot occur in p, d and f-orbitals until each orbital of a given subshell contains one electron". This is known as

(A) Aufbau's rule

(B) Pauli's exclusion principle

(C) Hund's rule

(D) Fajan's rule

67. Electronic configuration  has violated:-

(A) Hund's rule (B) Pauli's principle

(C) Aufbau principle (D) (n + l) rule

68. In an atom, for how many electrons, the quantum numbers will be,

$n = 3, l = 2, m = +2, s = +1/2$

(A) 18 (B) 6 (C) 24 (D) 1

69. For a 7 s electron the values of n, 1, m, s respectively could be:

(A) 7,4,4, +1/2 (B) 7,2,0, +1/2 (C) 7,1,0, +1/2 (D) 7,0,0, +1/2

70. Consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, l = 1 and 2 are, respectively

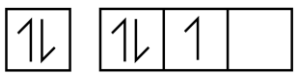
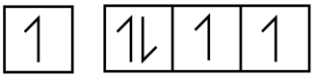
(A) 12 and 4 (B) 12 and 5

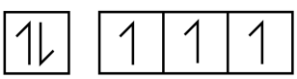
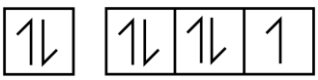
(C) 16 and 4 (D) 16 and 5

71. Which of the following has maximum number of unpaired electron (atomic number of Fe = 26)

(A) Fe (B) Mn^{2+} (C) Fe (III) (D) Both (B) and (C)

72. The orbital diagram in which aufbau principle is violated is :

(A)  (B) 

(C)  (D) 

73. Which of the following paramagnetic ions would exhibit a magnetic moment (spin only) of the order of 5 BM ? (At. No : Mn = 25, Cr = 24, V = 23, Ti = 22)

(A) V^{2+} (B) Ti^{2+} (C) Mn^{2+} (D) Cr^{2+}

74. X^{-}, Y^{-2} and Z^{-3} are isotonic and isoelectronic. Thus increasing order of atomic number of X, Y and Z is

(A) $X < Y < Z$ (B) $Z < Y < X$ (C) $X = Y = Z$ (D) $Z < X < Y$

75. Which of the following is correct for compounds:

(A) They are same as mixture

(B) Compound can be separated in its components by a physical process

(C) They have different type of atoms chemically combined in fixed mass ratio.

(D) All are correct

76. Which of the following is not characterized by principal quantum number(n) ?

(A) shell

(B) size of the atomic orbital

(C) Energy of atomic orbital

(D) spatial orientation of atomic orbital

77. Which of the following is not a pair of isodiaphers:

(A) $^{208}_{84}Po$, $^{204}_{82}Pb$

(B) $^{234}_{92}U$, $^{230}_{90}Th$

(C) $^{222}_{88}Ra$, $^{218}_{86}Rn$

(D) $^{234}_{92}U$, $^{235}_{92}U$

78. Select the correct order of energy level in H-atom:

(A) 1 s < 2 s < 2 p < 3 s < 3 p < 4 s < 3 d

(B) 1 s < 2 s = 2p < 3 s = 3p = 3 d < 4 s

(C) 1 s < 2 s = 3 s = 4 s

(D) 1 s < 2 s = 2p < 3 s = 3p < 3 d < 4 s

79. The penetrating power of the orbitals for a particular principal quantum number runs as

(A) s < p < d < f

(B) p > d > f > s

(C) f > p > d > s

(D) s > p > d > f

80. Maximum number of electrons in a subshell is:

(A) $(21 + 1)^2$

(B) $2^2(21 + 1)$

(C) $2(21 + 1)$

(D) $(21 + 1)$

Section-II

- This Section contain 10 questions (Q.No. 21 to Q.No. 30) whose answer to be filled as numerical value **(Attempt any five)**
- Answer to each question in **Section B** will be evaluated according to the following marking scheme:

Full Marks : **+4** for correct answer
Zero Marks : **0** If the question is unanswered;
Zero Marks : **0** for incorrect answer

81. For principle quantum number n = 4, the total number of orbitals having $\ell = 3$ is

82. Total number of possible shells in uranium atom (atomic no. z = 92)

83. What is the maximum numbers of electrons that can be associated with the following set of quantum number ? n = 3, $\ell = 1$ and m = −1

84. The total number of orbitals associated with the principal quantum number 5 is :

85. Find the number of electrons having the value of azimuthal quantum number $'1 = 1$ for Cd^{2+}.

86. What is the maximum number of electrons possible in Ni^{+}having same spin.

87. The mass number of an element ' X ' is ' A '. If X^{4-} contains 10 electrons and 6 neutrons, then the value of $\frac{A}{3}$ is

88. Find maximum number of electrons in $_{13}Al$ in which $\frac{l \times m}{n} = 0$.

89. If Hund's rule is violated and all other rules stands true then find number of among followings which are having number of unpaired electrons greater than those present in Fe^{2+}.
$Cr^{+3}, Mn^{+2}, Cu^{+1}, Zn^{+1}, Co^{+1}, Sc^{3+}, Ni^{2+}$

90. How many orbitals, contain at least one electron in the ground state electronic configuration of Chromium atom?