



## JEE Main – 2024

**27<sup>th</sup> JANUARY 2024 (Morning Shift)**

### General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300**.
2. The question paper consists of **3 Subjects** (Subject I: **Mathematics**, Subject II: **Physics**, Subject III: **Chemistry**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2** contains **10 Numerical Value Type Questions** Out of which **ONLY 5 (any)** questions have to be attempted. You will **NOT** be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.  
The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them.**

### Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

**SECTION-1**

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.

1. Consider the function

$$f(x) = \begin{cases} \frac{a(7x-12-x^2)}{b|x^2-7x+12|}, & x < 3 \\ \frac{\sin(x-3)}{2^{x-[x]}}, & x > 3 \\ b, & x = 3 \end{cases}$$

where  $[x]$  denotes the greatest integer less than or equal to  $x$ . If  $S$  denotes the set of all ordered pairs  $(a, b)$  such that  $f(x)$  is continuous at  $x = 3$ , then the number of elements in  $S$  is :

- (1) 2                      (2) Infinitely many                      (3) 4                      (4) 1

2. The distance, of the point  $\{7, -2, 11\}$  from the line  $\frac{x-6}{1} = \frac{y-4}{0} = \frac{z-8}{3}$  along the line

$$\frac{x-5}{2} = \frac{y-1}{-3} = \frac{z-5}{6}, \text{ is:}$$

- (1) 12                      (2) 14                      (3) 21                      (4) 18

3. If the shortest distance of the parabola  $y^2 = 4x$  from the centre of the circle  $x^2 + y^2 - 4x - 16y + 64 = 0$  is  $d$ , then  $d^2$  is equal to :

- (1) 36                      (2) 20                      (3) 24                      (4) 16

4. If  $(a, b)$  be the orthocentre of the triangle whose vertices are  $(1, 2)$ ,  $(2, 3)$  and  $(3, 1)$ , and

$$I_1 = \int_a^b x \sin(4x - x^2) dx, I_2 = \int_a^b \sin(4x - x^2) dx, \text{ then } 36 \frac{I_1}{I_2} \text{ is equal to:}$$

- (1) 88                      (2) 72                      (3) 66                      (4) 80

5. The portion of the line  $4x + 5y = 20$  in the first quadrant is trisected by the lines  $L_1$  and  $L_2$  passing through the origin. The tangent of an angle between the lines  $L_1$  and  $L_2$  is :

- (1)  $\frac{8}{5}$                       (2)  $\frac{2}{5}$                       (3)  $\frac{25}{41}$                       (4)  $\frac{30}{41}$

6. Let  $a_1, a_2, \dots, a_{10}$  be 10 observations such that  $\sum_{k=1}^{10} a_k = 50$  and  $\sum_{\forall k < j} a_k \cdot a_j = 1100$ . Then the standard deviation of  $a_1, a_2, \dots, a_{10}$  is equal to:

- (1) 5                      (2) 10                      (3)  $\sqrt{5}$                       (4)  $\sqrt{115}$

7.  ${}^{n-1}C_r = (k^2 - 8) {}^nC_{r+1}$  if and only if:

- (1)  $2\sqrt{3} < k < 3\sqrt{3}$                       (2)  $2\sqrt{3} < k \leq 3\sqrt{2}$                       (3)  $2\sqrt{2} < k < 2\sqrt{3}$                       (4)  $2\sqrt{2} < k \leq 3$

8. The number of common terms in the progressions 4, 9, 14, 19, ....., up to 25<sup>th</sup> term and 3, 6, 9, 12 ....., up to 37<sup>th</sup> term is:
- (1) 9 (2) 7 (3) 5 (4) 8
9. The length of the chord of the ellipse  $\frac{x^2}{25} + \frac{y^2}{16} = 1$ , whose mid-point is  $\left(1, \frac{2}{5}\right)$ , is equal to:
- (1)  $\frac{\sqrt{1741}}{5}$  (2)  $\frac{\sqrt{2009}}{5}$  (3)  $\frac{\sqrt{1691}}{5}$  (4)  $\frac{\sqrt{1541}}{5}$
10. If the shortest distance between the lines  $\frac{x-4}{1} = \frac{y+1}{2} = \frac{z}{-3}$  and  $\frac{x-\lambda}{2} = \frac{y+1}{4} = \frac{z-2}{-5}$  is  $\frac{6}{\sqrt{5}}$ , then the sum of all possible values of  $\lambda$  is:
- (1) 7 (2) 5 (3) 8 (4) 10
11. Let  $S = \{1, 2, 3, \dots, 10\}$ . Suppose  $M$  is the set of all the subsets of  $S$ , then the relation  $R = \{(A, B) : (A \cap B \neq \phi; A, B \in M)\}$  is:
- (1) symmetric and reflexive only (2) symmetric only  
(3) reflexive only (4) symmetric and transitive only
12. If  $a = \lim_{x \rightarrow 0} \frac{\sqrt{1+\sqrt{1+x^4}} - \sqrt{2}}{x^4}$  and  $b = \lim_{x \rightarrow 0} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1+\cos x}}$ , then the value of  $ab^3$  is:
- (1) 32 (2) 36 (3) 25 (4) 30
13. If  $\int_0^1 \frac{1}{\sqrt{3+x} + \sqrt{1+x}} dx = a + b\sqrt{2} + c\sqrt{3}$ , where  $a, b, c$  are rational numbers, then  $2a + 3b - 4c$  is equal to:
- (1) 4 (2) 8 (3) 7 (4) 10
14. Consider the matrix  $f(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$ .
- Given below are two statements:
- Statement I:**  $f(-x)$  is the inverse of the matrix  $f(x)$ .
- Statement II:**  $f(x)f(y) = f(x+y)$ .
- In the light of the above statements, choose the correct answer from the options given below:
- (1) Both Statement I and Statement II are true  
(2) Statement I is false but Statement II is true  
(3) Both Statement I and Statement II are false  
(4) Statement I is true but Statement II is false
15. The function  $f : N - \{1\} \rightarrow N$ ; defined by  $f(n) =$  the highest prime factor of  $n$ , is :
- (1) both one-one and onto  
(2) onto only  
(3) neither one-one nor onto  
(4) one-one only

- 16.** Let  $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ ,  $\vec{b} = 3(\hat{i} - \hat{j} + \hat{k})$ . Let  $\vec{c}$  be the vector such that  $\vec{a} \times \vec{c} = \vec{b}$  and  $\vec{a} \cdot \vec{c} = 3$ , Then  $\vec{a} \cdot ((\vec{c} \times \vec{b}) - \vec{b} - \vec{c})$  is equal to:
- (1) 24                      (2) 36                      (3) 32                      (4) 20
- 17.** If A denotes the sum of all the coefficients in the expansion of  $(1 - 3x + 10x^2)^n$  and B denotes the sum of all the coefficients in the expansion of  $(1 + x^2)^n$ , then:
- (1)  $A = B^3$               (2)  $A = 3B$               (3)  $B = A^3$               (4)  $3A = B$
- 18.** Four distinct points  $(2k, 3k)$ ,  $(1, 0)$ ,  $(0, 1)$  and  $(0, 0)$  lie on a circle for  $k$  equal to :
- (1)  $\frac{3}{13}$                       (2)  $\frac{5}{13}$                       (3)  $\frac{1}{13}$                       (4)  $\frac{2}{13}$
- 19.** Let  $x = x(t)$  and  $y = y(t)$  be solutions of the differential equations  $\frac{dx}{dt} + ax = 0$  and  $\frac{dy}{dt} + by = 0$  respectively,  $a, b \in R$ . Given that  $x(0) = 2$ ;  $y(0) = 1$  and  $3y(1) = 2x(1)$ . The value of  $t$ , for which  $x(t) = y(t)$ , is:
- (1)  $\log_{4/3} 2$               (2)  $\log_4 3$               (3)  $\log_{2/3} 2$               (4)  $\log_3 4$
- 20.** If  $S = \{z \in C : |z - i| = |z + i| = |z - 1|\}$ , then,  $n(S)$  is:
- (1) 3                      (2) 0                      (3) 1                      (4) 2

**SECTION-2**

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be rounded off to the nearest integer.

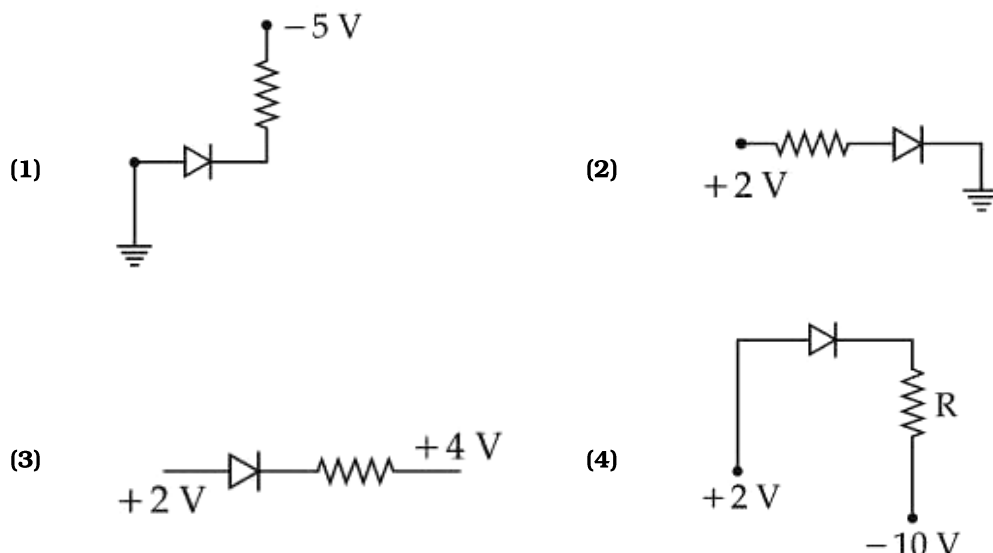
21. If  $8 = 3 + \frac{1}{4}(3+p) + \frac{1}{4^2}(3+2p) + \frac{1}{4^3}(3+3p) + \dots, \infty$ , then the value of  $p$  is \_\_\_\_\_.
22. If  $\alpha$  satisfies the equation  $x^2 + x + 1 = 0$  and  $(1+\alpha)^7 = A + B\alpha + C\alpha^2$ ,  $A, B, C \geq 0$ , then  $5(3A - 2B - C)$  is equal to \_\_\_\_\_.
23. A fair die is tossed repeatedly until a six is obtained. Let  $X$  denote the number of tosses required and let  $a = P(X = 3)$ ,  $b = P(X \geq 3)$  and  $c = P(X \geq 6 | X > 3)$ . Then  $\frac{b+c}{a}$  is equal to \_\_\_\_\_.
24. If the solution of the differential equation  $(2x + 3y - 2)dx + (4x + 6y - 7)dy = 0$ ,  $y(0) = 3$ , is  $\alpha x + \beta y + 3 \log_e |2x + 3y - \gamma| = 6$ , then  $\alpha + 2\beta + 3\gamma$  is equal to \_\_\_\_\_.
25. Let for a differentiable function  $f : (0, \infty) \rightarrow R$ ,  $f(x) - f(y) \geq \log_e \left( \frac{x}{y} \right) + x - y$ ,  $\forall x, y \in (0, \infty)$ . Then  $\sum_{n=1}^{20} f' \left( \frac{1}{n^2} \right)$  is equal to \_\_\_\_\_.
26. The least positive integral value of  $\alpha$ , for which the angle between the vectors  $\alpha \hat{i} - 2\hat{j} + 2\hat{k}$  and  $\alpha \hat{i} + 2\alpha \hat{j} - 2\hat{k}$  is acute, is \_\_\_\_\_.
27. Let the area of the region  $\{(x, y) : x - 2y + 4 \geq 0, x + 2y^2 \geq 0, x + 4y^2 \leq 8, y \geq 0\}$  be  $\frac{m}{n}$ , where  $m$  and  $n$  are coprime numbers. Then  $m + n$  is equal to \_\_\_\_\_.
28. Let  $f(x) = x^3 + x^2 f'(1) + x f''(2) + f'''(3)$ ,  $x \in R$ . Then  $f'(10)$  is equal to \_\_\_\_\_.
29. Let  $A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ ,  $B = [B_1, B_2, B_3]$  are column matrices, and  $AB_1 = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ ,  $AB_2 = \begin{bmatrix} 2 \\ 3 \\ 0 \end{bmatrix}$ ,  $AB_3 = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$ .  
If  $\alpha = |B|$  and  $\beta$  is the sum of all the diagonal element of  $B$ , then  $\alpha^3 + \beta^3$  is equal to \_\_\_\_\_.
30. Let the set of all  $\alpha \in R$  such that the equation  $\cos 2x + \alpha \sin x = 2\alpha - 7$  has a solution be  $[p, q]$  and  $r = \tan 9^\circ - \tan 27^\circ - \frac{1}{\cot 63^\circ} + \tan 81^\circ$ , then  $pqr$  is equal to \_\_\_\_\_.

**SUBJECT II: PHYSICS****MARKS: 100****SECTION-1**

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

31. A plane electromagnetic wave propagating in  $x$ -direction is described by  
 $E_y = (200 \text{ V m}^{-1}) \sin[1.5 \times 10^7 t - 0.05 x]$ ; The intensity of the wave is : (Use  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ )
- (1)  $106.2 \text{ Wm}^{-2}$     (2)  $53.1 \text{ Wm}^{-2}$     (3)  $35.4 \text{ Wm}^{-2}$     (4)  $26.6 \text{ Wm}^{-2}$
32. The radius of third stationary orbit of electron for Bohr's atom is  $R$ . The radius of fourth stationary orbit will be:
- (1)  $\frac{3}{4}R$     (2)  $\frac{9}{16}R$     (3)  $\frac{4}{3}R$     (4)  $\frac{16}{9}R$
33. 0.08 kg air is heated at constant volume through  $5^\circ\text{C}$ . The specific heat of air at constant volume is  $0.17 \text{ kcal/kg}^\circ\text{C}$  and  $J = 4.18 \text{ joule/cal}$ . The change in its internal energy is approximately.
- (1) 298 J    (2) 318 J    (3) 284 J    (4) 142 J
34. Position of an ant ( $S$  in metres) moving in  $Y$ - $Z$  plane is given by  $S = 2t^2\hat{j} + 5\hat{k}$  (where  $t$  is in second). The magnitude and direction of velocity of the ant at  $t = 1 \text{ s}$  will be :
- (1) 16 m/s in  $y$ -direction    (2) 4 m/s in  $y$ -direction  
 (3) 4 m/s in  $x$ -direction    (4) 9 m/s in  $z$ -direction
35. Given below are two statements :
- Statement (I) :** Planck's constant and angular momentum have same dimensions.  
**Statement (II) :** Linear momentum and moment of force have same dimensions.
- In the light of the above statements, choose the correct answer from the options given below :
- (1) Both Statement I and Statement II are true  
 (2) Statement I is false but Statement II is true  
 (3) Both Statement I and Statement II are false  
 (4) Statement I is true but Statement II is false
36. A body of mass 1000 kg is moving horizontally with a velocity 6 m/s. If 200 kg extra mass is added, the final velocity (in m/s) is :
- (1) 3    (2) 5    (3) 6    (4) 2

37. Which of the following circuits is reverse - biased ?



38. A wire of length 10 cm and radius  $\sqrt{7} \times 10^{-4} m$  connected across the right gap of a meter bridge. When a resistance of  $4.5 \Omega$  is connected on the left gap by using a resistance box, the balance length is found to be at 60 cm from the left end. If the resistivity of the wire is  $R \times 10^{-7} \Omega m$ , then value of R is :

- (1) 66                      (2) 70                      (3) 63                      (4) 35

39. A convex lens of focal length 40 cm forms an image of an extended source of light on a photo electric cell. A current  $I$  is produced. The lens is replaced by another convex lens having the same diameter but focal length 20 cm. The photoelectric current now is :

- (1)  $\frac{I}{2}$                       (2)  $I$                       (3)  $2I$                       (4)  $4I$

40. Given below are two statements :

**Statement (I) :** Viscosity of gases is greater than that of liquids.

**Statement (II) :** Surface tension of a liquid decreases due to the presence of insoluble impurities.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Both Statement I and Statement II are incorrect  
 (2) Both Statement I and Statement II are correct  
 (3) Statement I is correct but Statement II is incorrect  
 (4) Statement I is incorrect but Statement II is correct

41. A wire of resistance  $R$  and length  $L$  is cut into 5 equal parts. If these parts are joined parallelly, then resultant resistance will be :

- (1)  $\frac{1}{5}R$                       (2)  $\frac{1}{25}R$                       (3)  $5R$                       (4)  $25R$

42. If the refractive index of the material of a prism is  $\cot\left(\frac{A}{2}\right)$  where  $A$  is the angle of prism then the angle of minimum deviation will be :

- (1)  $\frac{\pi}{2} - 2A$                       (2)  $\pi - 2A$                       (3)  $\pi - A$                       (4)  $\frac{\pi}{2} - A$

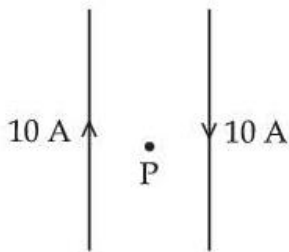
- 43.** A rectangular loop of length 2.5 m and width 2 m is placed at  $60^\circ$  to a magnetic field of 4 T. The loop is removed from the field in 10 s. The average emf induced in the loop during this time is :
- (1)  $-2\text{ V}$                       (2)  $-1\text{ V}$                       (3)  $+2\text{ V}$                       (4)  $+1\text{ V}$
- 44.** The acceleration due to gravity on the surface of earth is  $g$ . If the diameter of earth reduces to half of its original value and mass remains constant, then acceleration due to gravity on the surface of earth would be :
- (1)  $4g$                       (2)  $2g$                       (3)  $\frac{g}{4}$                       (4)  $\frac{g}{2}$
- 45.** An electric charge  $10^{-6}\mu\text{C}$  is placed at origin  $(0, 0)m$  of  $X - Y$  co-ordinate system. Two points  $P$  and  $Q$  are situated at  $(\sqrt{3}, \sqrt{3})m$  and  $(\sqrt{6}, 0)m$  respectively. The potential difference between the points  $P$  and  $Q$  will be :
- (1)  $\sqrt{6}\text{ V}$                       (2)  $0\text{ V}$                       (3)  $3\text{ V}$                       (4)  $\sqrt{3}\text{ V}$
- 46.** Two bodies of mass 4 g and 25 g are moving with equal kinetic energies. The ratio of magnitude of their linear momentum is :
- (1)  $3 : 5$                       (2)  $4 : 5$                       (3)  $5 : 4$                       (4)  $2 : 5$
- 47.** A train is moving with a speed of 12 m/s on rails which are 1.5 m apart. To negotiate a curve of radius 400 m, the height by which the outer rail should be raised with respect to the inner rail is:  
(Given,  $g = 10\text{ m/s}^2$ )
- (1) 5.4 cm                      (2) 4.8 cm                      (3) 4.2 cm                      (4) 6.0 cm
- 48.** A proton moving with a constant velocity passes through a region of space without any change in its velocity. If  $\vec{E}$  and  $\vec{B}$  represent the electric and magnetic fields respectively, then the region of space may have :
- (A)  $E = 0, B = 0$       (B)  $E = 0, B \neq 0$       (C)  $E \neq 0, B = 0$       (D)  $E \neq 0, B \neq 0$
- Choose the most appropriate answer from the options given below :
- (1) (A), (B) and (C) only                      (2) (A), (B) and (D) only  
(3) (B), (C) and (D) only                      (4) (A), (C) and (D) only
- 49.** Identify the physical quantity that cannot be measured using spherometer :
- (1) Thickness of thin plates  
(2) Radius of curvature of concave surface  
(3) Radius of curvature of convex surface  
(4) Specific rotation of liquids
- 50.** The average kinetic energy of a monoatomic molecule is 0.414 eV at temperature:  
(Use  $K_B = 1.38 \times 10^{-23}\text{ J/mol-K}$ )
- (1) 1500 K                      (2) 3000 K                      (3) 3200 K                      (4) 1600 K



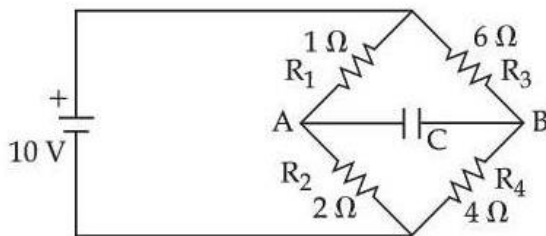
## SECTION-2

**Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted.** The answer to each question should be rounded off to the nearest integer.

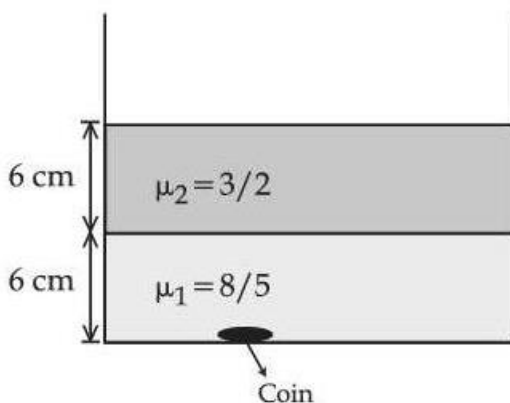
- 51.** If average depth of an ocean is 4000 m and the bulk modulus of water is  $2 \times 10^9 \text{ Nm}^{-2}$ , then fractional compression  $\frac{\Delta V}{V}$  of water at the bottom of ocean is  $\alpha \times 10^{-2}$ . The value of  $\alpha$  is \_\_\_\_\_.  
(Given,  $g = 10 \text{ ms}^{-2}$ ,  $\rho = 1000 \text{ kgm}^{-3}$ )
- 52.** A particle starts from origin at  $t = 0$  with a velocity  $5 \hat{i} \text{ m/s}$  and moves in x-y plane under action of a force which produces a constant acceleration of  $(3\hat{i} + 2\hat{j}) \text{ m/s}^2$ . If the x-coordinate of the particle at that instant is 84 m, then the speed of the particle at this time is  $\sqrt{\alpha} \text{ m/s}$ . The value of  $\alpha$  is \_\_\_\_\_.
- 53.** Two long, straight wires carry equal currents in opposite directions as shown in figure. The separation between the wires is 5.0 cm. The magnitude of the magnetic field at a point P midway between the wires is  $\mu T$ . (Given :  $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$ )



- 54.** The charge accumulated on the capacitor connected in the following circuit is \_\_\_\_\_  $\mu C$ . (given  $C = 150 \mu F$ )



- 55.** Two immiscible liquids of refractive indices  $\frac{8}{5}$  and  $\frac{3}{2}$  respectively are put in a beaker as shown in the figure. The height of each column is 6 cm. A coin is placed at the bottom of the beaker. For near normal vision, the apparent depth of the coin is  $\frac{\alpha}{4}$  cm. The value of  $\alpha$  is \_\_\_\_\_.



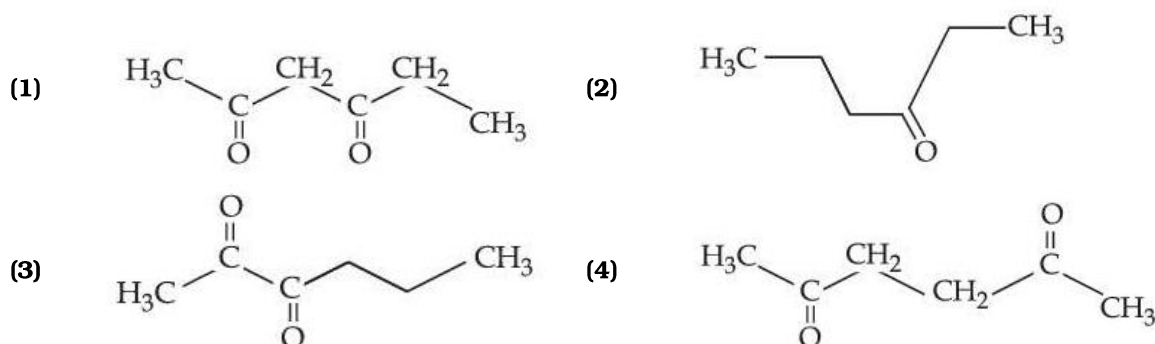
56. Two coils have mutual inductance 0.002 H. The current changes in the first coil according to the relation  $i = i_0 \sin \omega t$ , where  $i_0 = 5A$  and  $\omega = 50 \pi$  rad/s. The maximum value of emf in the second coil is  $\frac{\pi}{\alpha} V$ . The value of  $\alpha$  is \_\_\_\_\_.
57. Four particles each of mass 1 kg are placed at four corners of a square of side 2 m. Moment of inertia of system about an axis perpendicular to its plane and passing through one of its vertex is \_\_\_\_\_  $\text{kgm}^2$ .
58. A thin metallic wire having cross sectional area of  $10^{-4} \text{ m}^2$  is used to make a ring of radius 30 cm. A positive charge of  $2\pi C$  is uniformly distributed over the ring, while another positive charge of 30 pC is kept at the centre of the ring. The tension in the ring is \_\_\_\_\_ N ; provided that the ring does not get deformed (neglect the influence of gravity).  $\left( \text{given, } \frac{1}{4\pi \epsilon_0} = 9 \times 10^9 \text{ SI units} \right)$
59. A particle executes simple harmonic motion with an amplitude of 4 cm. At the mean position, velocity of the particle is 10 cm/s. The distance of the particle from the mean position when its speed becomes 5 cm/s is  $\sqrt{\alpha}$  cm, where  $\alpha =$  \_\_\_\_\_.
60. In a nuclear fission process, a high mass nuclide ( $A \approx 236$ ) with binding energy 7.6 MeV/Nucleon dissociated into middle mass nuclides ( $A \approx 118$ ), having binding energy of 8.6 MeV/Nucleon. The energy released in the process would be \_\_\_\_\_ MeV.

**SUBJECT III: CHEMISTRY****MARKS: 100****SECTION-1**

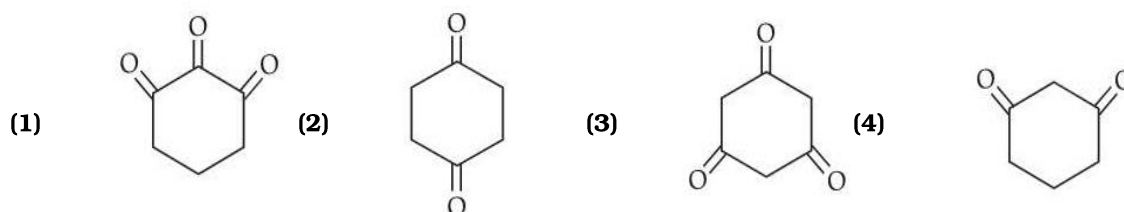
This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.


61. Yellow compound of lead chromate gets dissolved on treatment with hot NaOH solution. The product of lead formed is a :
- (1) Dianionic complex with coordination number six
  - (2) Tetraanionic complex with coordination number six
  - (3) Neutral complex with coordination number four
  - (4) Dianionic complex with coordination number four
62. Consider the following complex ions
- $$P = [\text{FeF}_6]^{3-}$$
- $$Q = [\text{V}(\text{H}_2\text{O})_6]^{2+}$$
- $$R = [\text{Fe}(\text{H}_2\text{O})_6]^{2+}$$
- The correct order of the complex ions, according to their spin only magnetic moment values (in B.M.) is:
- (1)  $Q < P < R$
  - (2)  $R < Q < P$
  - (3)  $Q < R < P$
  - (4)  $R < P < Q$
63. The electronic configuration for Neodymium is :
- [Atomic Number for Neodymium 60]
- (1)  $[\text{Xe}] 4f^1 5d^1 6s^2$
  - (2)  $[\text{Xe}] 4f^6 6s^2$
  - (3)  $[\text{Xe}] 4f^4 6s^2$
  - (4)  $[\text{Xe}] 5f^7 7s^2$
64. Given below are two statements :
- Statement (I) :** Aqueous solution of ammonium carbonate is basic.
- Statement (II) :** Acidic/basic nature of salt solution of a salt of weak acid and weak base depends on  $K_a$  and  $K_b$  value of acid and the base forming it.
- In the light of the above statements, choose the most appropriate answer from the options given below :
- (1) Statement I is incorrect but Statement II is correct
  - (2) Both Statement I and Statement II are correct
  - (3) Both Statement I and Statement II are incorrect
  - (4) Statement I is correct but Statement II is incorrect
65. Given below are two statements :
- Statement (I) :** p-nitrophenol is more acidic than m-nitrophenol and o-nitrophenol.
- Statement (II) :** Ethanol will give immediate turbidity with Lucas reagent.
- In the light of the above statements, choose the correct answer from the options given below :
- (1) Statement I is false but Statement II is true
  - (2) Both Statement I and Statement II are false
  - (3) Both Statement I and Statement II are true
  - (4) Statement I is true but Statement II is false

66. Given below are two statements :
- Statement (I) :** The  $4f$  and  $5f$  - series of elements are placed separately in the Periodic table to preserve the principle of classification.
- Statement (II) :** s-block elements can be found in pure form in nature.
- In the light of the above statements, choose the most appropriate answer from the options given below :
- (1) Statement I is false but Statement II is true  
 (2) Both Statement I and Statement II are false  
 (3) Both Statement I and Statement II are true  
 (4) Statement I is true but Statement II is false
67. Choose the polar molecule from the following :
- (1)  $\text{CO}_2$  (2)  $\text{CCl}_4$  (3)  $\text{CH}_2 = \text{CH}_2$  (4)  $\text{CHCl}_3$
68. Which of the following electronic configuration would be associated with the highest magnetic moment ?
- (1)  $[\text{Ar}] 3d^8$  (2)  $[\text{Ar}] 3d^7$  (3)  $[\text{Ar}] 3d^6$  (4)  $[\text{Ar}] 3d^3$
69. Two nucleotides are joined together by a linkage known as :
- (1) Glycosidic linkage (2) Phosphodiester linkage  
 (3) Peptide linkage (4) Disulphide linkage
70. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
- Assertion (A) :** Melting point of Boron (2453 K) is unusually high in group 13 elements.
- Reason (R) :** Solid Boron has very strong crystalline lattice.
- In the light of the above statements, choose the most appropriate answer from the options given below :
- (1) (A) is false but (R) is true  
 (2) Both (A) and (R) are correct and (R) is the correct explanation of (A)  
 (3) (A) is true but (R) is false  
 (4) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
71. The correct statement regarding nucleophilic substitution reaction in a chiral alkyl halide is :
- (1) Retention occurs in  $\text{S}_{\text{N}}1$  reaction and inversion occurs in  $\text{S}_{\text{N}}2$  reaction.  
 (2) Racemisation occurs in  $\text{S}_{\text{N}}1$  reaction and inversion occurs in  $\text{S}_{\text{N}}2$  reaction.  
 (3) Racemisation occurs in  $\text{S}_{\text{N}}1$  reaction and retention occurs in  $\text{S}_{\text{N}}2$  reaction.  
 (4) Racemisation occurs in both  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$  reactions.
72. Which of the following has highly acidic hydrogen?



73. Highest enol content will be shown by :





74. Cyclohexene  is \_\_\_\_\_ type of an organic compound.

- (1) Benzenoid aromatic (2) Alicyclic  
(3) Benzenoid non-aromatic (4) Acyclic

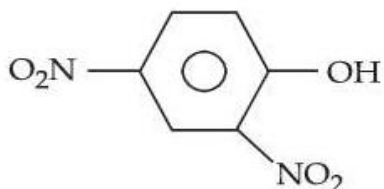
75. The ascending order of acidity of —OH group in the following compounds is :

(A) Bu — OH

(B) 

(C) 

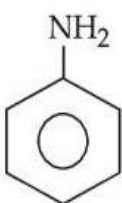
(D) 

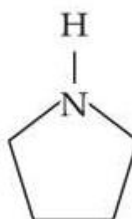
(E) 

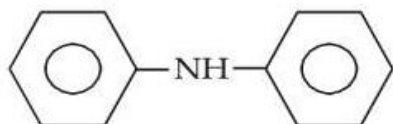
Choose the correct answer from the options given below :

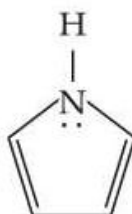
- (1) (A) < (C) < (D) < (B) < (E) (2) (C) < (D) < (B) < (A) < (E)  
(3) (A) < (D) < (C) < (B) < (E) (4) (C) < (A) < (D) < (B) < (E)

76. Which of the following is strongest Bronsted base ?

(1) 

(2) 

(3) 

(4) 

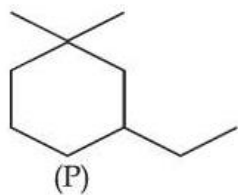
77. A solution of two miscible liquids showing negative deviation from Raoult's law will have :

- (1) decreased vapour pressure, decreased boiling point  
(2) increased vapour pressure, decreased boiling point  
(3) decreased vapour pressure, increased boiling point  
(4) increased vapour pressure, increased boiling point

78. NaCl reacts with conc.  $\text{H}_2\text{SO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  to give reddish fumes (B), which react with NaOH to give yellow solution (C). (B) and (C) respectively are :

- (1)  $\text{Na}_2\text{CrO}_4$ ,  $\text{CrO}_2\text{Cl}_2$  (2)  $\text{CrO}_2\text{Cl}_2$ ,  $\text{KHSO}_4$   
(3)  $\text{CrO}_2\text{Cl}_2$ ,  $\text{Na}_2\text{Cr}_2\text{O}_7$  (4)  $\text{CrO}_2\text{Cl}_2$ ,  $\text{Na}_2\text{CrO}_4$

79. IUPAC name of following compound (P) is :



- (1) 3-Ethyl-1,1-dimethylcyclohexane
- (2) 1-Ethyl-5,5-dimethylcyclohexane
- (3) 1-Ethyl-3,3-dimethylcyclohexane
- (4) 1,1-Dimethyl-3-ethylcyclohexane

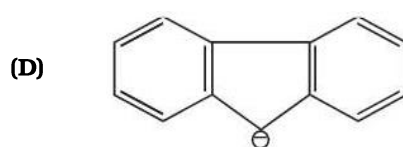
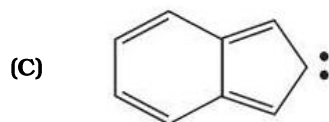
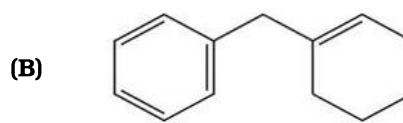
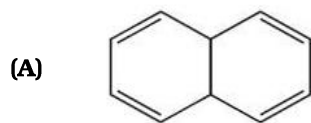
80. Element not showing variable oxidation state is :

- |            |             |              |              |
|------------|-------------|--------------|--------------|
| (1) Iodine | (2) Bromine | (3) Fluorine | (4) Chlorine |
|------------|-------------|--------------|--------------|

**SECTION-2**

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be rounded off to the nearest integer.

81. Among the given organic compounds, the total number of aromatic compounds is \_\_\_\_\_.



82. Mass of methane required to produce 22 g of  $\text{CO}_2$  after complete combustion is \_\_\_\_\_ g.  
(Given Molar mass in  $\text{g mol}^{-1}$ , C = 12.0, H = 1.0, O = 16.0)

83. The mass of silver (Molar mass of Ag :  $108 \text{ g mol}^{-1}$ ) displaced by a quantity of electricity which displaces 5600 mL of  $\text{O}_2$  at S.T.P. will be \_\_\_\_\_ g.

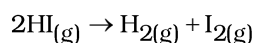
84. 3-Methylhex-2-ene on reaction with HBr in presence of peroxide forms an addition product (A). The number of possible stereoisomers for 'A' is \_\_\_\_\_.

85. The number of electrons present in all the completely filled subshells having  $n = 4$  and  $s = +\frac{1}{2}$  is \_\_\_\_\_. (Where  $n$  = principal quantum number and  $s$  = spin quantum number)

86. From the given list, the number of compounds with +4 oxidation state of Sulphur is \_\_\_\_\_.  
 $\text{SO}_3$ ,  $\text{H}_2\text{SO}_3$ ,  $\text{SOCl}_2$ ,  $\text{SF}_4$ ,  $\text{BaSO}_4$ ,  $\text{H}_2\text{S}_2\text{O}_7$

87. Sum of bond order of CO and  $\text{NO}^+$  is \_\_\_\_\_.

88. Consider the following data for the given reaction



	1	2	3
HI ( $\text{mol L}^{-1}$ )	0.005	0.01	0.02
Rate ( $\text{mol L}^{-1}\text{s}^{-1}$ )	$7.5 \times 10^{-4}$	$3.0 \times 10^{-3}$	$1.2 \times 10^{-2}$

The order of the reaction is \_\_\_\_\_.

89. Among the following, total number of meta directing functional groups is \_\_\_\_\_.  
(Integer based)

$-\text{OCH}_3$ ,  $-\text{NO}_2$ ,  $-\text{CN}$ ,  $-\text{CH}_3$ ,  $-\text{NHCOCH}_3$ ,  $-\text{COR}$ ,  $-\text{OH}$ ,  $-\text{COOH}$ ,  $-\text{Cl}$

90. If three moles of an ideal gas at 300 K expand isothermally from  $30 \text{ dm}^3$  to  $45 \text{ dm}^3$  against a constant opposing pressure of 80 kPa, then the amount of heat transferred is \_\_\_\_\_ J.