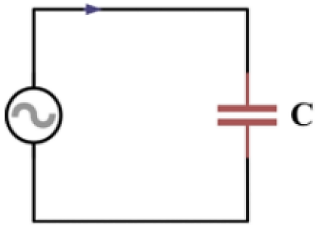
PART-I PHYSICS

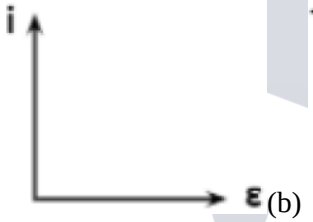
1. **Find the ratio of de Broglie wavelength of an electron and a proton having same Kinetic Energy. Given that the mass of electron is m_e and proton is m_p.**

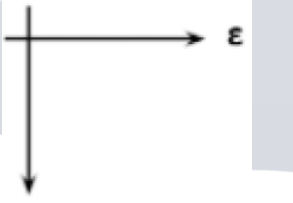
(a) $\frac{m_p}{m_e}$ (b) $\frac{m_e}{m_p}$

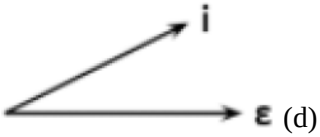
(c) $\sqrt{\frac{m_p}{m_e}}$ (d) $\sqrt{\frac{m_e}{m_p}}$

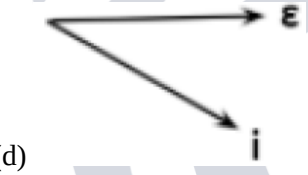
2. **If an AC source is connected to a capacitor in series. Then which of the graphs relating current and emf is correct?**



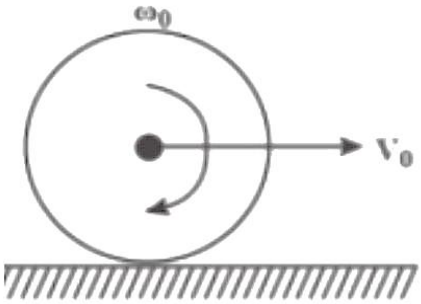
(a) 

(b) 

(c) 

(d) 

3. **A wheel is undergoing pure rolling on a horizontal surface as shown. The point on rim of wheel at a same horizontal level as center has velocity $\sqrt{x}V_0$. The x is**



(a) 1 (b) 2

(c) 3 (d) 4

4. **If a particle is performing SHM such that $X = A\sin(\omega t) + B\cos(\omega t)$. Then the equation of SHM can also be represented as $x = C\sin[\omega t + \phi]$. The C&ϕ are**

(a) $\sqrt{A^2+B^2}, \tan^{-1}\left[\frac{B}{A}\right]$ (b) $\sqrt{A^2+B^2}, \tan^{-1}\left[\frac{A}{B}\right]$

(c) $A+B, \tan^{-1}\left[\frac{B}{A}\right]$ (d) None

5. The intensity of sunlight at a place on earth is 0.92wm^{-2}. Find the amplitude of magnetic field at that place.

(a) 4.6×10^{-8} T (b) 5.6×10^{-8} T

(c) 6.7×10^{-8} T (d) 8.77×10^{-8} T

6. A long line charge of linear charge density $4 \times 10^{-5} \text{c/m}$ is placed along z-axis. An electric dipole of length 2 mm is placed along x-axis. The negative end of dipole is at 10 mm and positive end of dipole is at 12 mm. The force experienced by dipole is 4 N. Find charge of dipole Options:

(a) 0.5μC (b) 0.33μC

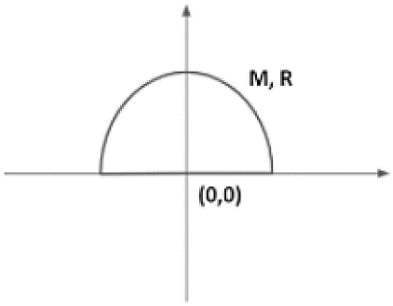
(c) 5μC (d) 8μC

7. The angle of Dip in plane is δ 'and true Dip in magnetic meridian is δ. Then Options:

(a) $\delta' > \delta$ (b) $\delta' < \delta$

(c) $\delta' = \delta$ (d) None

8. A semi-ring has mass m and radius R as shown. The COM of semi ring lies on Y axis at a distance of $\frac{xR}{\pi}$. Find (x).



(a) 1 (b) 2

(c) 3 (d) 4

9. If a ring and a solid cylinder of same mass and radius are released from the top of an inclined plane. If the time taken by ring to some down is t_1 and time taken by cylinder is t_2 while both perform pure rolling, then choose the correct option.

(a) $t_1 > t_2$ (b) $t_1 < t_2$

(c) $t_1 = t_2$ (d) Can't be related

10. Identify the correct statement/statements

Statement -1: Ferromagnetic converts to Paramagnetic on Heating.

Statement-2: Domains of Ferromagnetic material increase on Heating.

(a) 1 (b) 2

(c) Both 1 and 2 (d) Can't say

11. Find average kinetic energy of a monatomic gas molecule, assuming ideal behaviour.

(Given T is the temperature of the gas and k is Boltzmann constant)

(a) $\frac{1}{2}kT$ (b) $\frac{3}{2}kT$

(c) $\frac{5}{2}kT$ (d) kT

12. P is travelling along the vector $\vec{A} = \hat{\imath} + \hat{\jmath}$, Q is moving along the vector $\vec{B} = \hat{\jmath} + \hat{k}$, R is moving along the vector $\vec{C} = -\hat{\imath} + \hat{\jmath}$. All three particles collide at a point and after collision, P moves along $\vec{A} \times \vec{B}$ and Q moves along $\vec{B} \times \vec{C}$, then the angle between the direction of P and Q after collision-

(a) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (b) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

(c) $\sin^{-1}\left(\frac{1}{3}\right)$ (d) $\cos^{-1}\left(\frac{1}{3}\right)$

13. A TV transmitter has range of 1500 km. What is the approximate height of the TV transmission tower?

(a) 175 km (b) 200 km

(c) 150 km (d) 125 km

14. A ray of light is incident on a prism at an angle of incidence 45° and ray is undergoing minimum deviation such that the angle of deviation is 30°. Find the angle of prism

15. In 5 min, a body changes temperature from 75°C to 65°C at room temperature 25°C. What temperature will it have after another 5 min ?

(a) 60°C (b) 57°C

(c) 55°C (d) 53°C.

16. A section of a railway track is clamped between two nails. In summers it gets heated up and as a result, some elastic energy is stored in it. If $\Delta T = 10^\circ$C, $\propto = 10^{-6^\circ}\text{C}^{-1}$ = coefficient of linear expansion, $Y = 10^{11}\text{Nm}^{-2}$ = Young's modulus, $A = 0.01\ \text{m}^2$ = Area of cross section. Find the energy stored per unit length in the railway track.

(a) $5 \times 10^{-2}\text{Jm}^{-1}$ (b) $3 \times 10^{-2}\text{Jm}^{-1}$

(c) $2 \times 10^{-2}\text{Jm}^{-1}$ (d) 10^{-2}Jm^{-1}

17. Mass number of a nucleus is 184. It undergoes alpha decay. If Q value is 5.5MeV, find kinetic energy of the emitted alpha particle.

(a) 0.4MeV (b) 5MeV

(c) 5.4MeV (d) 0.1MeV

18. A pendulum has time period of small oscillations as T. What will be the new time period by length of pendulum is reduced to $\frac{1}{16}^{th}$ of its initial value?

(a) $\frac{T}{2}$ (b) $\frac{T}{4}$

(c) $\frac{T}{8}$ (d) $\frac{T}{16}$

19. Find projection of $\vec{A}$ on $\vec{B}$ given $\vec{A} = \hat{\imath} + \hat{\jmath} \& \vec{B} = \hat{\imath} + \hat{\jmath} + \hat{k}$

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

(c) $\frac{3}{2}$ (d) 2

20. A bullet of mass 4gm is shot from a gun of mass 4 kg. Bullet has speed $50\ ms^{-1}$. Find the impulse of bullet and velocity of recoil of gun?

(a) 200kgm/s, 5 m/s (b) 0.2kgm/s, 5 m/s

(c) 0.2kgm/s, 5 cm/s (d) 200kgm/s, 5 cm/s

21. An 80 kg object brought down by 80 cm at constant speed. Find work done by external agent.

(a) Zero (b) $+640J$

(c) -640 J (d) 645

22. A body is projected from surface of earth with escape velocity. Find the time taken by body to attain height h is (M = mass of earth, R = Radius of earth, G = Gravitational constant)

(a) $\frac{2\left[(R+h)^{\frac{3}{2}} - R^{\frac{3}{2}}\right]}{3\sqrt{2GM}}$ (b) $\frac{\left[(R+h)^{\frac{3}{2}} - R^{\frac{3}{2}}\right]}{3\sqrt{GM}}$

(c) $\frac{\left[(R+h)^{\frac{1}{2}} - R^{\frac{1}{2}}\right]}{3\sqrt{2GM}}$ (d) None

23. A cell of emf E is attached in a circuit having 5 ohms and 2 ohms resistor one by one. PD across 5 ohms comes out to be 1.25 V and across 2 ohms as 1 volt. If $E = \frac{x}{10}$, then find x.

PART-II CHEMISTRY

24. More dissolved oxygen is found in?

(a) Boiling water (b) Water at 4°C

(c) Water at 80°C (d) Polluted water

25. Match the following.

Compound	Hybridisation
I. SF_4	(A) $sp^3 d^2$
II. IF_5	(B) $sp^3 d$
III. NO_2^+	(C) sp^3
IV. NH_4^+	(D) sp
	(E) $sp^3 d^3$

(a) I → (B); II → (A); III → (D); IV → (C)

(b) I → (C); II → (B); III → (A); IV → (D)

(c) I → (D); II → (B); III → (C); IV → (A)

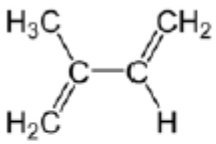
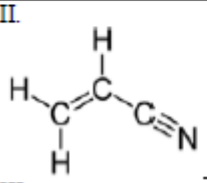
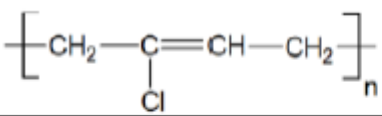
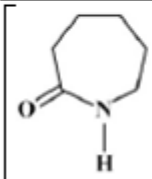
(d) I → (B); II → (C); III → (A); IV → (D)

26. Methylation of 10 g of benzene gives 9.2 g of toluene, the % yield is:

(a) 92% (b) 78%

(c) 90% (d) 70%

27. Identify the structure of isoprene, neoprene, acrylonitrile, caprolactam are

Column I	Column-II
I. 	(A) isoprene
II. 	(B) acrylonitrile
III. 	(C) neoprene
IV.	(D) Caprolactam
	

(a) I → (B); II → (A); III → (D); IV → (C)

(b) I → (C); II → (B); III → (A); IV → (D)

(c) I → (D); II → (B); III → (C); IV → (A)

(d) I → (A); II → (B); III → (C); IV → (D)

28. Isotope of hydrogen which emits low energy β-particle with half-life value greater than 12 years is:

(a) Protium (b) Tritium

(c) Deutrium (d) None of the above

29. When $AgNO_3$ is added to KI solution, the solution produced is:

(a) KI/NO_3^- (b) AgI/Ag^+

(c) AgI/NO_3^- (d) $AgNO_3/NO_3^-$

30. Which statement is not true for DI Mendeleev?

(a) He wrote the book Principles of chemistry

(b) He invented accurate barometer

(c) He proposed periodic table when structure of atoms were unknown

(d) Element with atomic number 101 is named after his name

31. Which of the following $0.06M$ solution has lowest freezing point? Options:

(a) K_2SO_4 (b) KI

(c) $C_6H_{12}O_6$ (d) $Al_2(SO_4)_3$

32. Number of acyclic structural isomers for pentene are:

(a) 2 (b) 3

(c) 4 (d) 5

33. Thiamine and pyridoxine are respectively:

(a) Vitamin B_1 and Vitamin B_6

(b) Vitamin B_2 and Vitamin B_{12}

(c) Vitamin C and Vitamin A

(d) Vitamin C_1 and Vitamin D

34. Which of the following is most reducing agent in group 15 elements?

(a) AsH_3 (b) SbH_3

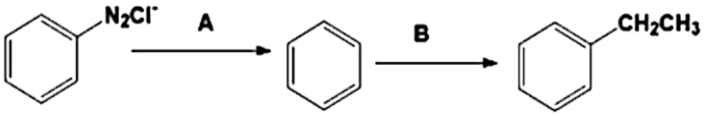
(c) BiH_3 (d) PH_3

35. Total number of unpaired electron $[Co(NH_3)_6]Cl_2$ and $[Co(NH_3)_6]Cl_3$

(a) 3,0 (b) 1,2

(c) 1,0 (d) 2,1

36.



A and B respectively are

(a) $A \rightarrow H_3PO_2/H_2O; B \rightarrow$ Anh. $AlCl_3, C_2H_5Cl$

(b) $A \rightarrow KMnO_4/H_2O; B \rightarrow H_2O$

(c) $A \rightarrow HCl; B \rightarrow C_2H_5OH$

(d) $Zn(Hg), HCl; B \rightarrow$ Anh. $AlCl_3$

37. Which of the following pair is paramagnetic as well as coloured? Options:

(a) Mn^{7+}, Mn^{2+} (b) Mn^{2+}, Cu^{2+}

(c) Mn^{7+}, Cu^{2+} (d) Mn^{7+}, Cu^{2+}

38. Which of the following about B_2H_6 is correct?

(a) Diborare is obtained by $NaBH_4 + I_2$

(b) It is a planar molecule

(c) Boron are sp^2 hybridised

(d) Contains one 3c-3e bond

39. Which compound does not give Friedel craft reaction?

(a) Benzene (b) Aniline

(c) Toluene (d) Ethyl benzene

40. Which of the following

(a) 3-ethye hex-3-ene (b) 3-methyl hex-2-ene

(c) hex-1-ene (d) None of these

41. If concentration of glucose $(C_6H_{12}O_6)$ in blood is 0.72 g/L. Its molarity is:

42. Number of electrons in p-orbitals of Vanadium

43. For $N_2O_4 \rightarrow 2NO_2$ $K_P = 476$ find K_C at 288 K

PART-III MATHEMATICS

44. The number of solution of $\sin^7 x + \cos^7 x = 1, x \in (0, 4\pi]$

(a) 7 (b) 11

(c) 9 (d) 5

45. Let s_n denote sum of first n-terms of ap, $s_{10} = s_{30}$, $s_5 = 140$ then $s_{20} - s_6$ Options:

(a) 1872 (b) 1842

(c) 1852 (d) 1862

46. If the domain $f(x) = \frac{\cos^{-1}\sqrt{x^2-x+1}}{\sqrt{\sin^{-1}\left(\frac{2x-1}{2}\right)}}$ is the integral (α, β) then $\alpha + \beta$ is

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

(c) 1 (d) 2

47. $11^n > 10^n + 9^n$ number of integers satisfy the relation in $\{1, 2, 3, \ldots, 100\}$

48. 0,2 ,4, 6, 8 number of numbers > 10000 which can be formed, if repetition not allowed.

49. $A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, number of matrices ' B ' which can be formed such that AB = BA; B can have elements $\{1, 2, 3, 4, 5\}$

50. 4 die rolled, numbers are first in 2×2 matrices. Find the probability that the matrices is non-singular & all entries are different.

51. If $E_1: \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1; a > b, E_2$ is an ellipse which touches E_1 at the end of major axis and end of minor axis E_1 are the foci of E_2. The eccentricity of both ellipse are equal. Find ' e '

52. If $36x^2 + 36y^2 - 108x + 120x + C = 0$ the circle does not cut/touch coordinate axis.

Find the range of ' c '.

(a) (100,165) (b) (100,156)

(c) (100, 181) (d) (100,171)

53. If $f(1) + f(2) + f(3) = 3$

$A = \{0, 1, 2, 3, \ldots, 9\}$

No. of objective functions $f: A \to A$ which satisfy?

54. If $P: y^2 = \alpha x; L: 2x + y = k$ L is a tangent to $x^2 - y^2 = 3$ and P. Find ' α '

(a) -24 (b) 24

(c) -19 (d) 19

55. If ' n ' is the number of solutions of $z^2 + 3\bar{z} = 0$, where $z \in C$, then find $\sum_{k=0}^{\infty} \frac{1}{n^k}$

56. ω be a cube root of unity r_1, r_2, r_3 are the numbers obtained on the dice then the probability of $\omega^{r_1} + \omega^{r_2} + \omega^{r_3} = 0$?

(a) $\frac{1}{18}$ (b) $\frac{1}{9}$

(c) $\frac{2}{9}$ (d) $\frac{1}{3}$

57. The number of elements in the set $\{x \in R: (|x| - 3)|x + 4| = 6\}$ is equal to

(a) 3 (b) 4

(c) 2 (d) 1

58. $\int \frac{e^x(2-x^2)}{(1-x)\sqrt{1-x^2}} dx$

59. $\int_0^{100\pi} \frac{\sin^2 x}{e^{\left(\frac{x}{2}[\frac{x}{\pi}]\right)}} dx = \frac{\alpha\pi^3}{1+4\pi^2}, \alpha \in R[x]$ is greatest integer

(a) $50(e-1)$ (b) $150(e^{-1}-1)$

(c) $200(1-e^{-1})$ (d) $100(1-e)$