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Negative marking is -1 for each incorrect answer

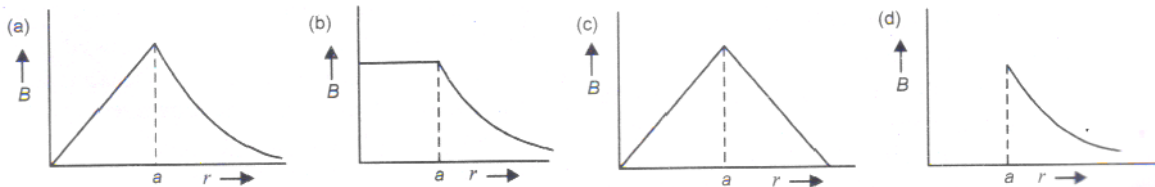
Marks for each correct answer is 4

Each subject has 20 questions that contain 80 marks

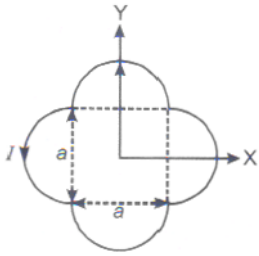
PHYSICS

1. Biot-Savart law indicates that the moving electrons (velocity V) produce a magnetic field B such that
- (a) $B \perp v$ (b) $B \parallel v$ (c) It obeys inverse cube law
(d) It is along the line joining the electron and point of observation

2. The magnetic field due to a straight conductor of uniform cross-section of radius a and carrying a steady current is represented by

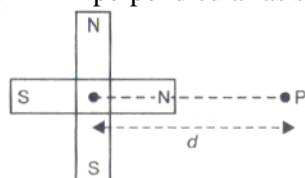


3. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the
- (a) Acceleration remains unchanged
(b) velocity remains unchanged
(c) speed of the particle remains unchanged
(d) direction of the particle remains unchanged
4. A proton, an electron and a helium nucleus, have the same speed. They are in circular orbits in a plane due to magnetic field perpendicular to the plane. Let r_p , r_e and r_{He} be their respective radii, then
- (a) $r_e < r_p = r_{He}$ (b) $r_e > r_p = r_{He}$ (c) $r_e < r_p < r_{He}$ (d) $r_e > r_p > r_{He}$
5. A charge q moving in a straight line is accelerated by a potential difference V . It enters a uniform magnetic field B , perpendicular to its path. Then the radius of the circular path in which it travels will be
- (a) $\sqrt{\frac{2mV}{qB^2}}$ (b) $\sqrt{\frac{mV}{qB^2}}$ (c) $\sqrt{\frac{qB^2}{2mv}}$ (d) $\sqrt{\frac{qB^2}{mv}}$
6. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the $+x$ -direction and a magnetic field along the $+z$ direction, then
- (a) Positive ions deflect towards $+y$ direction and negative ion towards $-y$ direction
(b) All ions deflect towards $+y$ direction
(c) All ion deflect towards $-y$ direction
(d) positive ions deflect towards $-y$ direction and negative ions towards $-y$ direction
7. A circular coil of one turn and area A carrying a current has a magnetic dipole moment M . The current through the coil is
- (a) MA (b) A/M (c) M/A (d) M/A^2
8. A loop carrying current I lies in the x - y -plane as shown in figure. The unit vector \hat{k} is coming out of the plane of the paper. The magnetic moment of the current loop is



- (a) $a^2 \hat{k}$ (b) $\left(\frac{\pi}{2} + 1\right) a^2 \hat{k}$ (c) $-\left(\frac{\pi}{2} + 1\right) a^2 \hat{k}$ (d) $(2\pi + 1) a^2 \hat{k}$
9. A particle of charge q and mass m circulates under magnetic field B , the frequency of revolution of charged particle is
 (a) $\frac{qB}{2\pi m}$ (b) $\frac{2\pi B}{qm}$ (c) $\frac{qB}{2m}$ (d) $\frac{qmB}{2\pi}$
10. The magnetic moment and magnetic permeability has dimension of
 (a) $[LA]$ and $[M^1L^1T^{-1}A^{-2}]$ (b) $[L^2A]$ and $[M^1L^1T^{-1}A^{-2}]$
 (c) $[LT^{-1}]$ and $[M^2L^2T^{-1}A^0]$ (d) $[L^2T^{-1}]$ and $[M^1L^2T^2A^{-2}]$
11. Two streams of protons moving parallel to each other in same direction will
 (a) attract each other
 (b) cancel the electric field of each other
 (c) repel each other
 (d) cancel the magnetic field of each other.
12. A magnet of magnetic dipole moment p_m is freely suspended in a constant uniform magnetic field of intensity B . Calculate the work done in deflecting the magnet through an angle θ from the direction of B
 (a) $p_m B$ (b) $p_m B \cos \theta$ (c) $p_m B (1 - \cos \theta)$ (d) $p_m B (1 - \sin \theta)$
13. A bar magnet of length l and magnetic dipole moment \vec{p}_m is bent in the form of an arc making an angle of 60° . The new magnetic dipole moment will be
 (a) $\frac{2}{\pi} \vec{p}_m$ (b) $\frac{\vec{p}_m}{2}$ (c) \vec{p}_m (d) $\frac{3}{\pi} \vec{p}_m$
14. A substance of susceptibility A is placed in a magnetic field of $4 \times 10^{-4} \text{ Am}^{-1}$. Then the intensity of magnetization in the units of Am^{-1} is
 (a) 1.33×10^8 (b) 0.75×10^8 (c) 12×10^{-8} (d) 1.4×10^{-8}
15. A magnetized wire of magnetic moment M and length l is bent in the form of a semicircle of radius r . The new magnetic moment is
 (a) M (b) $M/2\pi$ (c) M/π (d) $2M/\pi$
16. A straight wire carrying current I is made into a circular loop. If M is the magnetic moment associated with the loop. Then the length of wire is
 (a) $\sqrt{\frac{4\pi M}{I}}$ (b) $\sqrt{\frac{2\pi M}{I}}$ (c) $\sqrt{\frac{\pi M}{I}}$ (d) $\sqrt{\frac{\pi M}{2I}}$
17. Two magnets of magnetic moments M and $2M$ are placed in a vibration magnetometer, with the identical poles in the same direction. The time period of vibration is T_1 . If the magnets are placed with opposite poles together and vibrate with time period T_2 , then
 (a) T_2 is infinite (b) $T_2 = T_1$ (c) $T_2 > T_1$ (d) $T_2 < T_1$
18. The coercivity of a small magnet is $3 \times 10^3 \text{ Am}^{-1}$. The current required to be passed in a solenoid of length 10 cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is
 (a) 6A (b) 30 mA (c) 60mA (d) 3A

19. Two similar short magnets of magnetic moment p_m are fixed at the middle so that, they are mutually perpendicular as shown in figure. The magnetic induction at P will be



- (a) $\frac{\mu_0 p_m}{4\pi d^3} \sqrt{3}$ (b) $\frac{\mu_0 2p_m}{4\pi d^3}$ (c) $\frac{\mu_0 2p_m}{4\pi d^3} \sqrt{5}$ (d) $\frac{\mu_0 2p_m^2}{4\pi d^3}$

20. A dipole of magnetic moment $\vec{M} = 30\hat{j}$ Am² is placed along the Y-axis in a uniform magnetic field $\vec{B} = (2\hat{i} + 5\hat{j})$ T. The torque acting on it is

- (a) $-40\hat{k}$ Nm (b) $-50\hat{k}$ Nm (c) $-60\hat{k}$ Nm (d) $-70\hat{k}$ Nm

Chemistry

21 A 0.004M solution of Na₂SO₄ is isotonic with a 0.01M solution of glucose at same temperature. The apparent degree of dissociation of Na₂SO₄ is

- (a) 25% (b) 50% (c) 75% (d) 85%

22 Total vapour pressure of mixture of 1 mol A ($p_A^0 = 150$ torr) and 2 mol B ($p_B^0 = 240$ torr) is 200 torr. In this case -

- (a) There is positive deviation from Raoult's law
 (b) There is negative deviation from Raoult's law
 (c) There is no deviation from Raoult's law
 (d) Molecular masses of A and B are also required for calculating the deviation

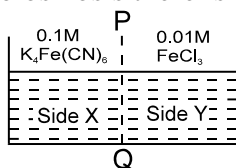
23 K_f for water is 1.86 K kg mol⁻¹. If your automobile radiator holds 1.0 kg of water, how many grams of ethylene glycol (C₂H₆O₂) must you add to get the freezing point of the solution lowered to -2.8°C ?

- (a) 72 g (b) 93 g (c) 39 g (d) 27 g

24 If vapour pressures of pure liquids 'A' & 'B' are 300 and 800 torr respectively at 25°C. When these two liquids are mixed at this temperature to form a solution in which mole percentage of 'B' is 92, then the total vapour pressure is observed to be 0.95 atm. Which of the following is true for this solution.

- (a) $\Delta V_{\text{mix}} > 0$ (b) $\Delta H_{\text{mix}} < 0$
 (c) $\Delta V_{\text{mix}} = 0$ (d) $\Delta H_{\text{mix}} = 0$

25 FeCl₃ on reaction with K₄[Fe(CN)₆] in aq. solution gives blue colour. These are separated by a semipermeable membrane PQ as shown. Due to osmosis there is-



- (a) Blue colour formation in side X
 (b) Blue colour formation in side Y
 (c) Blue colour formation in both of the sides X and Y
 (d) No blue colour formation

26 Standard electrode potentials of three metals A, B and C are + 0.5 V, - 3.0 V and - 1.2 V respectively. The reducing power of these metals is in the order

- (a) B > C > A (b) A > B > C
 (c) C > B > A (d) A > C > B

27 If 0.224 L of H₂ gas is formed at the cathode, the volume of O₂ gas formed at the anode under identical conditions, is

- (a) 0.224 L (b) 0.448 L (c) 0.112 L (d) 1.12 L

28 In H_2-O_2 fuel cell the reaction occurring at cathode is

- (a) $2H_2O + O_2 + 4e^- \longrightarrow 4OH^-$
(b) $2H_2 + O_2 \longrightarrow 2H_2O(l)$
(c) $H^+ + OH^- \longrightarrow H_2O$
(d) $H^+ + e^- \longrightarrow H_2$

29 Three faradays of electricity are passed through molten Al_2O_3 , aqueous solution of $CuSO_4$ and molten $NaCl$ taken in different electrolytic cells. The amount of Al Cu and Na deposited at the cathodes will be in the ratio of

- (a) 1mole : 2mole : 3mole (b) 3mole : 2mole : 1mole
(c) 1mole : 1.5mole : 3mole (d) 1.5mole : 2mole : 3mole

30 When electricity is passed through the solution of $AlCl_3$, 13.5 gm of Al are deposited. The number of Faraday must be

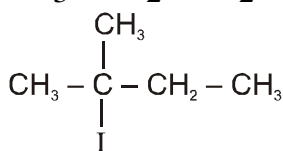
- (a) 0.50 (b) 1.00 (c) 1.50 (d) 2.00

31 Sec. Butyl chloride will undergo alkaline hydrolysis in the polar solvent by hydrolysis.

- (a) S_N2 (b) S_N1 (c) S_N1 and S_N2 (d) None

32 Which one of the following compounds undergoes $E1$ reaction most readily?

- (a) $CH_3-CH_3-CH_2-Br$ (b) $CH_3-CH_2-CH_2-Br$



- (c) $CH_3-CH_2-CH_2-I$ (d)

33 Which of the following on heating with aqueous KOH, produces acetaldehyde

- (a) CH_3CH_2Cl (b) CH_2ClCH_2Cl
(c) CH_3CHCl_2 (d) CH_3COCl

34 Which among the following is most reactive to give nucleophilic addition?

- (a) FCH_2CHO (b) $ClCH_2CHO$
(c) $BrCH_2CHO$ (d) ICH_2CHO

35 Which of the following does not answer iodoform test?

- (a) N-Butyl alcohol (b) Sec-Butyl alcohol
(c) Acetophenone (d) Acetaldehyde

36 An organic compound (X) with molecular formula $C_9H_{10}O$ gives positive 2,4- DNP and Tollen's tests. It undergoes cannizzaro reaction and on vigorous oxidation it gives 1,4- benzenedicarboxylic acid. Compound (X) is

- (a) Benzaldehyde (b) o-Methylbenzaldehyde
(c) p-ethylbenzaldehyde (d) 2,2-dimethylhexanal

37 Which of the following compounds would have the smallest value for PK_a ?

- (a) $CHF_2CH_2CH_2COOH$ (b) $CH_3CH_2CF_2COOH$
(c) CH_2FCFCH_2COOH (d) $CH_3CF_2CH_2COOH$

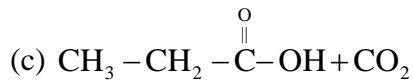
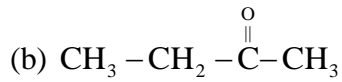
38 What happens when a carboxylic acid is treated with lithium aluminium hydride?

- (a) Aldehyde is formed. (b) Primary alcohol is formed.
(c) Ketone is formed. (d) Grignard reagent is formed.

39 -OH group present in alcohols is neutral while it is acidic in carboxylic acid because

- (a) In carboxylic acid -OH group is attached to electron withdrawing carbonyl group.
(b) In alcohols - OH group is attached to alkyl group which is electron withdrawing.
(c) Carboxylic group is an electron releasing group.
(d) Alcoholic group is an electron withdrawing group.

40 Addition of water to alkynes occurs in acidic medium and in the presence of Hg^{2+} ions as a catalyst. Which of the following products will be formed on addition of water to but-1-yne under these conditions?



Mathematics

Q.41 If $(\cos x)^y = (\sin y)^x$, then $\frac{dy}{dx}$ equals-

(A) $\frac{\log \sin y - y \tan x}{\log \cos x + x \cot y}$

(B) $\frac{\log \sin y + y \tan x}{\log \cos x - x \cot y}$

(C) $\frac{\log \sin y + y \tan x}{\log \cos x + x \cot y}$

(D) None of these

Q.42 If a function $f(x) = \cos |x| - 2ax + b$ is an increasing function on whole number line, then the value of a is -

(A) b

(B) $\frac{b}{2}$

(C) $a \leq -\frac{1}{2}$

(D) $a > -\frac{3}{2}$

Q.43 If $f: \mathbb{R} \rightarrow \mathbb{R}$, $f(x) = \tan x$, then pre-image of -1 under f is-

(A) $\left\{ n\pi - \frac{\pi}{4} \mid n \in \mathbb{I} \right\}$

(B) $\left\{ n\pi + \frac{\pi}{4} \mid n \in \mathbb{I} \right\}$

(C) $\{ n\pi \mid n \in \mathbb{I} \}$

(D) None of these

Q.44 If $y = e^{\log \cos^{-1} x} + e^{\log \sin^{-1} x}$, $0 < x < 1$, then which of the following statement is true -

(A) $y_1 = 0$

(B) $y_2 = 5$

(C) y_1 does not exist

(D) None of these

Q.5 Function $f(x) = \sin x - \cos x$ is monotonic increasing when -

(A) $x \in (0, \pi/2)$

(B) $x \in (-\pi/4, \pi/4)$

(C) $x \in (\pi/4, 3\pi/4)$

(D) No where

Q.46 If $f(x) = x^2 + kx + 1$ is increasing function in the interval $[1, 2]$, then least value of k is -

(A) 2

(B) 4

(C) -2

(D) -4

Q.47 The derivative of $(\tan x)^x$ is equal to-

(A) $x (\tan x)^{x-1}$

(B) $(\tan x)^x [\sec x + \tan x]$

(C) $(\tan x)^x [x \sec x \operatorname{cosec} x + \log \tan x]$

(D) $(\tan x)^x [\sec^2 x + x \tan x]$

Q.48 $f(x) = 2x^2 - \log |x|$ ($x \neq 0$) is monotonic increasing in the interval -

- (A) $(1/2, \infty)$
- (B) $(-\infty, -1/2) \cup (1/2, \infty)$
- (C) $(-\infty, -1/2) \cup (0, 1/2)$
- (D) $(-1/2, 0) \cup (1/2, \infty)$

Q.49 Let x, y be two variables and $x > 0, xy = 1$. Then minimum value of $x + y$ is -

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

Q.50 The function $\tan x - x$ is -

- (A) Always decreasing
- (B) Always increasing
- (C) Never increasing
- (D) Never decreasing

Q.51 $f(x) = 2x^3 - 21x^2 + 36x + 7$ has a maxima at -

- (A) $x = 2$ (B) $x = 1$ (C) $x = 6$ (D) $x = 3$

Q.52 $d/dx (x^{\log x})$ is equal to-

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

Q.53 $\int \cot (\sin x) dx$ equals-

- (A) $\log \cos (\sin x) + c$ (B) $\log \sin (\sin x) + c$
- (C) $-\log \cos (\sin x) + c$ (D) $-\log \sin (\sin x) + c$

Q.54 $\int \cos^3 x dx$ is equal to-

- (A) $\cos x - \frac{1}{3} \cos^3 x + c$
- (B) $\sin x + \frac{1}{3} \sin^3 x + c$
- (C) $\sin x - \frac{1}{3} \sin^3 x + c$
- (D) $\cos x + \frac{1}{3} \cos^3 x + c$

Q.55 If $f(x) = x + \frac{1}{x}$, then -

- (A) $f(x^2) = [f(x)]^2$
- (B) $f(x + y) = f(x) + f(y)$
- (C) $f(-x) = f(x)$
- (D) $f(1/x) = f(x)$

Q.56 If $x = p$ and $x = q$ are respectively the maximum and minimum points of the function $x^5 - 5x^4 + 5x^3 - 10$, then -

- (A) $p = 0, q = 1$ (B) $p = 1, q = 0$

(C) $p = 1, q = 3$ (D) $p = 3, q = 1$

Q.57 If x is the radius of a circle and $f(x) = \pi x^2$, then domain of f is -

(A) \mathbb{R} (B) \mathbb{R}^+ (C) \mathbb{R}^- (D) \mathbb{R}_0

Q.58 If $y = e^{ax+b}$, then $(y_2)_0$ is equal to -

(A) ae^b (B) e^b
(C) a^2e^a (D) a^2e^b

Q.59 If $f(x) = x^2 - 3x + 1$ and $g(x) = \frac{1}{x-2}$, then

domain of $(f - g)$ is -

(A) \mathbb{R} (B) \mathbb{R}^+
(C) $\mathbb{R} - \{2\}$ (D) None of these

Q.60 Let $f(x) = (x^2 - 4)^{n+1}(x^2 - x + 1)$, $n \in \mathbb{N}$ and $f(x)$ has a local extremum at $x = 2$ then -

(A) $n = 2$ (B) $n = 6$
(C) $n = 3$ (D) none