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[Q. Booklet Number]

ANSWERS & HINTS
for
WBJEE - 2010

by Aakash Institute & Aakash IIT-JEE

MULTIPLE CHOICE QUESTIONS

SUB : PHYSICS & CHEMISTRY

1. Experimental investigations show that the intensity of solar radiation is maximum for a wavelength 480 nm in the visible region. Estimate the surface temperature of sun. Given Wein's constant $b = 2.88 \times 10^{-3}$ mK.

(A) 4000 K (B) 6000 K (C) 8000 K (D) 10^6 K

Ans : (B)

Hints : $\lambda_m \times T = b$

$\lambda_m = 480$ nm

$$T = \frac{b}{\lambda_m} = \frac{2.88 \times 10^{-3}}{480 \times 10^{-9}} = 6000\,K$$

2. The temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K, the root mean square speed of gas molecules is v, then at 480 K it will be

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

Ans : (B)

Hints : $\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$

$$\frac{V_1}{V_2} = \sqrt{\frac{120}{480}} - = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

$V_2 = 2v$

3. Two mirrors at an angle θº produce 5 images of a point. The number of images produced when θ is decreased to θº – 30º is

(A) 9 (B) 10 (C) 11 (D) 12

Ans : (C)

Hints : No. of images = 5

$\therefore \theta = 60^o$

New angle = $\theta - 30^o = 30^o$. No of images = $\frac{360^o}{30^o} - 1 = 11$

4. The radius of the light circle observed by a fish at a depth of 12 meter is (refractive index of water = 4/3)

(A) $36\sqrt{7}$ (B) $\frac{36}{\sqrt{7}}$ (C) $36\sqrt{5}$ (D) $4\sqrt{5}$

Ans : (B)

Hints : $r = \dfrac{h}{\sqrt{\mu^2 - 1}} = \dfrac{12}{\sqrt{\dfrac{16}{9} - 1}} = \dfrac{12 \times 3}{\sqrt{7}} = \dfrac{36}{\sqrt{7}}$

5. In Young's double slit experiment, the fringe width is β. If the entire arrangement is placed in a liquid of refractive index *n*, the fringe width becomes :

(A) $n\beta$ (B) $\dfrac{\beta}{n+1}$ (C) $\dfrac{\beta}{n-1}$ (D) $\dfrac{\beta}{n}$

Ans : (D)

6. A plano-convex lens (f = 20 cm) is silvered at plane surface. Now focal length will be :

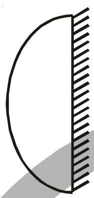
(A) 20 cm (B) 40 cm (C) 30 cm (D) 10 cm

Ans : (D)

Hints : $P = 2P_L + P_M$

$P_M = 0$

$P = \dfrac{1}{f} \times 2 = \dfrac{2}{f}$



$-\dfrac{1}{F} = \dfrac{2}{f}$

$F = -\dfrac{f}{2}$

7. The light beams of intensities in the ratio of 9 : 1 are allowed to interfere. What will be the ratio of the intensities of maxima and minima ?

(A) 3 : 1 (B) 4 : 1 (C) 25 : 9 (D) 81 : 1

Ans : (B)

Hints : $\dfrac{A_1}{A_2} = \dfrac{3}{1}$

$\dfrac{I_{max}}{I_{min}} = \dfrac{16}{4} = \dfrac{4}{1}$

8. If x_1 be the size of the magnified image and x_2 the size of the diminished image in Lens Displacement Method, then the size of the object is :

(A) $\sqrt{x_1 x_2}$ (B) $x_1 x_2$ (C) $x_1^2 x_2$ (D) $x_1 x_2^2$

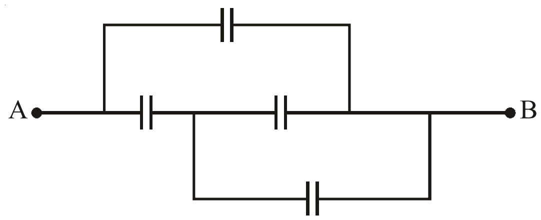
Ans : (A)

9. A point charge $+q$ is placed at the centre of a cube of side L. The electric flux emerging from the cube is

(A) $\dfrac{q}{\varepsilon_0}$ (B) Zero (C) $\dfrac{6qL^2}{\varepsilon_0}$ (D) $\dfrac{q}{6L^2\varepsilon_0}$

Ans : (A)

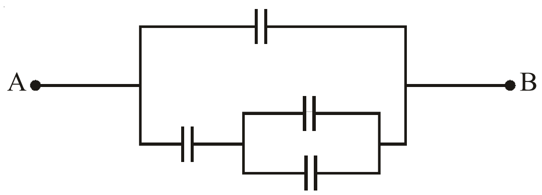
10. In the figure below, the capacitance of each capacitor is 3 μF. The effective capacitance between A and B is :



(A) $\frac{3}{4}\mu F$ (B) 3 μF (C) 6 μF (D) 5 μF

Ans : (D)

Hints :



$\frac{2C}{3} + C = 2 + 3 = 5\mu F$

11. n identical droplets are charged to v volt each. If they coalesce to form a single drop, then its potential will be

(A) $n^{2/3}v$ (B) $n^{1/3}v$ (C) nv (D) v/n

Ans : (A)

Hints : $n \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$

$\Rightarrow R = rn^{1/3}$

$C_0 = 4\pi\varepsilon_0 r$

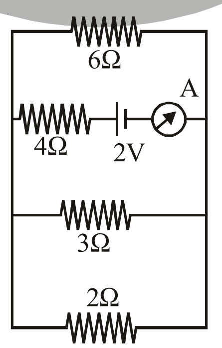
$q_0 = C_0 V = (4\pi\varepsilon_0 r)V$

Capacitance of Bigger drop,

$C = 4\pi\varepsilon_0 R$

So, $V = \frac{nq_0}{C} = \frac{n(4\pi\varepsilon_0 rV)}{4\pi\varepsilon_0 R} = n\left(\frac{r}{R}\right)V = n\left(\frac{1}{n^{1/3}}\right)V = n^{2/3}V$

12. The reading of the ammeter in the following figure will be



(A) 0.8 A (B) 0.6 A (C) 0.4 A (D) 0.2 A

Ans : (C)

Hints : $\frac{1}{R} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = 1\Omega$

$R_{eq.} = 1 + 4 = 5\,\Omega$

$I = \frac{2}{5} = 0.4\,A$

13. A wire of resistance R is elongated n-fold to make a new uniform wire. The resistance of new wire

(A) nR (B) n^2R (C) $2n$R (D) $2n^2$R

Ans : (B)

Hints : $R' = n^2R$

14. The ratio of magnetic field and magnetic moment at the centre of a current carrying circular loop is x. When both the current and radius is doubled the ratio will be

(A) $x/8$ (B) $x/4$ (C) $x/2$ (D) $2x$

Ans : (A)

Hints : $B = \frac{\mu_0 I}{2a}$ $\quad M = I(\pi a^2)$

$\frac{B}{M} = \frac{\mu_0 I}{2a} \times \frac{1}{I\pi a^2} = \frac{\mu_0}{2\pi a^3} = x$

Again, Ratio $= \frac{\mu_0}{2\pi(2a)^3} = \frac{1}{8}\left(\frac{\mu_0}{2\pi a^3}\right) = \frac{x}{8}$

15. The current through a coil of self inductance L = 2mH is given by $I = t^2e^{-t}$ at time t. How long it will take to make the e.m.f. zero?

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

Ans : (B)

Hints : $I = t^2e^{-t}$

$\frac{dI}{dt} = 2te^{-t} - e^{-t}t^2 = e^{-t}t(2-t)$

$e = -L\frac{dI}{dt}$

$\Rightarrow \frac{dI}{dt} = 0 \Rightarrow e^{-t}t(2-t) = 0$

$t = 2$ sec

16. The magnetic flux through a loop of resistance 10 Ω is given by $\phi = 5t^2 - 4t + 1$ Weber. How much current is induced in the loop after 0.2 sec ?

(A) 0.4 A (B) 0.2 A (C) 0.04 A (D) 0.02 A

Ans : (B)

Hints : $\phi = 5t^2 - 4t + 1$

$\frac{d\phi}{dt} = 10t - 4$

$I = \frac{e}{R} = \frac{-d\phi/dt}{R} = -\frac{10t-4}{10}$

At $t = 0.2$ sec

$I = \frac{-(10\times 0.2 - 4)}{10} = -\frac{(2-4)}{10} = +\frac{2}{10} = +0.2\text{ A} = 0.2\text{ A}$

17. The decimal equivalent of the binary number $(11010.101)_2$ is

(A) 9.625 (B) 25.265 (C) 26.625 (D) 26.265

Ans : (C)

Hints : $(11010.101) = 0 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 + 1 \times 2^4 + 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} = 2+8+16+\frac{1}{2}+\frac{1}{8} = 26.625$

18. In a common emitter configuration, a transistor has $\beta = 50$ and input resistance 1 kΩ. If the peak value of a.c. input is 0.01 V then the peak value of collector current is

(A) 0.01 μA (B) 0.25 μA (C) 100 μA (D) 500 μA

Ans : (D)

Hints : $\beta = 50 \Rightarrow \beta = \frac{\Delta I_C}{\Delta I_B} \Rightarrow \Delta I_C = \beta \times \Delta I_B$

$$\Delta I_B = \frac{0.01}{10^3} = 10^{-2} \times 10^{-3} = 10^{-5}$$

$\Delta I_C = 50 \times 10^{-5} = 500 \times 10^{-6} = 500\ \mu A$

19. Half-life of a radioactive substance is 20 minute. The time between 20% and 80% decay will be :

(A) 20 min (B) 30 min (C) 40 min (D) 25 min

Ans : (C)

Hints : For 20% decay

$$\frac{80 N_0}{100} = N_0 e^{-\lambda t_1} \quad \text{.... (1)}$$

For 80% decay

$$\frac{20 N_0}{100} = N_0 e^{-\lambda t_2} \quad \text{... (2)}$$

On dividing

$4 = e^{\lambda (t_2 - t_1)}$

$$2 \ln 2 = \frac{\ln 2}{t_{1/2}} (t_2 - t_1)$$

$\Rightarrow t_2 - t_1 = 2 \times 20 = 40$ min

20. The energy released by the fission of one uranium atom is 200 MeV. The number of fissions per second required to produce 3.2 W of power is (Take 1 eV = 1.6×10^{-19} J)

(A) 10^7 (B) 10^{10} (C) 10^{15} (D) 10^{11}

Ans : (D)

Hints : $u = 200$ MeV $= 200 \times 10^6$ eV $= 200 \times 10^6 \times 1.6 \times 10^{-19}$ J

E = 3.2 J

$$\text{No of fissions} = \frac{3.2}{2 \times 1.6 \times 10^{-11}} = 10^{11}$$

21. A body is projected with a speed u m/s at an angle β with the horizontal. The kinetic energy at the highest point is 3/4th of the initial kinetic energy. The value of β is :

(A) 30º (B) 45º (C) 60º (D) 120º

Ans : (A)

Hints : (K.E.) at maximum height $= \frac{1}{2} m (u^2 \cos^2 \beta)$

K.E. = K $\cos^2 \beta$

Here, $K\cos^2\beta = \frac{3}{4}K$

$\cos\beta = \frac{\sqrt{3}}{2}$

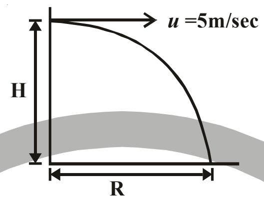
$\beta = 30^{o}$

22. A ball is projected horizontally with a velocity of 5 m/s from the top of a building 19.6 m high. How long will the ball take of hit the ground ?

(A) $\sqrt{2}$ s (B) 2 s (C) $\sqrt{3}$ s (D) 3 s

Ans : (B)

Hints : $T = \sqrt{\frac{2H}{g}} = \sqrt{\frac{2\times 19.6}{9.8}} = 2\text{ sec}$



23. A stone falls freely from rest and the total distance covered by it in the last second of its motion equals the distance covered by it in the first three seconds of its motion. The stone remains in the air for

(A) 6 s (B) 5 s (C) 7 s (D) 4 s

Ans : (B)

Hints : $u = 0$

$S_3 = 0 + \frac{1}{2}gt^2 = \frac{1}{2}\times 10\times 9 = 45$

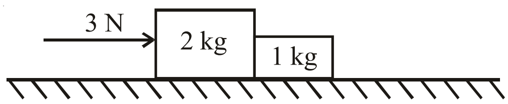
$S_t\text{th} = u + (2t-1)\frac{g}{2}$

$S_t\text{th} = 0 + 5(2t\text{ - }1) = 45$

$2t - 1 = 9$

$t = 5$ sec

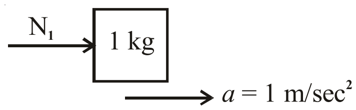
24. Two blocks of 2 kg and 1 kg are in contact on a frictionless table. If a force of 3 N is applied on 2 kg block, then the force of contact between the two blocks will be :



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

Ans : (B)

Hints : Common acceleration = $\frac{3}{3} = 1\text{ m/sec}^2$



$N_1 = 1$ N

25. If momentum is increased by 20%, then kinetic energy increases by

(A) 48% (B) 44% (C) 40% (D) 36%

Ans : (B)

Hints : $K = \frac{P^2}{2m}$

Here $P' = 1.2\,P$

Hence, $K' = \frac{(1.2P)^2}{2m}$

$K' = 1.44\frac{P^2}{2m}$

$K' = 1.44\,K$ or Percentage increase in $K = 44\%$

26. A boy of mass 40 kg is climbing a vertical pole at a constant speed. If the coefficient of friction between his palms and the pole is 0.8 and $g = 10\ m/s^2$, the horizontal force that he is applying on the pole is

(A) 300 N (B) 400 N (C) 500 N (D) 600 N

Ans : (C)

Hints : Here $\mu = 0.8$

Frictional force $= \mu N_1 = mg$

$N_1 = \frac{mg}{\mu} = \frac{400}{0.8} = 500\,N$

27. The value of 'λ' for which the two vectors $\vec{a} = 5\hat{i} + \lambda\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + \hat{k}$ are perpendicular to each other is

(A) 2 (B) – 2 (C) 3 (D) – 3

Ans : (C)

Hints : For $\vec{a} \perp \vec{b}$

$\vec{a}.\vec{b} = 0$

i.e., $5 - 2\lambda + 1 = 0$

$\lambda = 3$

28. If $\vec{a} + \vec{b} = \vec{c}$ and $a + b = c$, then the angle included between $\vec{a}$ and $\vec{b}$ is

(A) 90º (B) 180º (C) 120º (D) Zero

Ans : (D)

Hints : Here $\vec{a} + \vec{b} = \vec{c}$ & $c = a + b$

Now, $c = \sqrt{a^2 + b^2 + 2ab\cos\theta}$

$(a + b) = \sqrt{a^2 + b^2 + 2ab\cos\theta}$

$a^2 + b^2 + 2ab = a^2 + b^2 + 2ab\cos\theta$

$\cos\theta = 1, \theta = 0^\circ$

29. The height vertically above the earth's surface at which the acceleration due to gravity becomes 1% of its value at the surface is (R is the radius of the Earth)

(A) 8 R (B) 9 R (C) 10 R (D) 20 R

Ans : (B)

Hints : $g' = \frac{g}{\left(1 + \frac{h}{R}\right)^2} \Rightarrow \frac{g}{100} = \frac{g}{\left(1 + \frac{h}{R}\right)^2}$

$1 + \frac{h}{R} = 10 \Rightarrow \frac{h}{R} = 9,\ h = 9R$

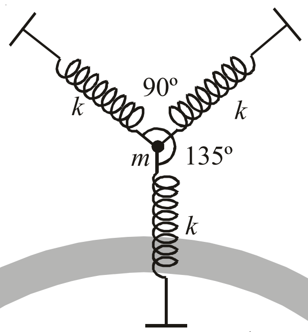
30. The change in the gravitational potential energy when a body of mass m is raised to a height nR above the surface of the Earth is (here R is the radius of the Earth)

(A) $\left(\frac{n}{n+1}\right)mg\text{R}$ (B) $\left(\frac{n}{n-1}\right)mg\text{R}$ (C) $nmg\text{R}$ (D) $\frac{mg\text{R}}{n}$

Ans : (A)

Hints : $\Delta \text{U} = \frac{mgh}{1+\frac{h}{\text{R}}} = \frac{mg\times n\text{R}}{1+\frac{n\text{R}}{\text{R}}} = \frac{nmg\text{R}}{n+1}$

31. A particle of mass m is attached to three identical massless springs of spring constant 'k' as shown in the figure. The time period of vertical oscillation of the particle is



(A) $2\pi\sqrt{\frac{m}{k}}$ (B) $2\pi\sqrt{\frac{m}{2k}}$ (C) $2\pi\sqrt{\frac{m}{3k}}$ (D) $\pi\sqrt{\frac{m}{k}}$

Ans : (B)

Hints : $\text{T} = 2\pi\sqrt{\frac{m}{\text{K}_{\text{eq}}}}$

$\text{F} = \text{K}x + 2\text{K}x\cos^2 45$

$\text{K}_{\text{eq}}x = \text{K}x + \text{K}x$

$\text{K}_{\text{eq}} = 2\text{K}$

32. A spring of force constant k is cut into three equal parts. The force constant of each part would be

(A) $\frac{k}{3}$ (B) $3k$ (C) k (D) $2k$

Ans : (B)

Hints : $\text{K} \propto \frac{1}{l}$

33. A body floats in water with 40% of its volume outside water. When the same body floats in oil, 60% of its volume remains outside oil. The relative density of the oil is

(A) 0.9 (B) 1.2 (C) 1.5 (D) 1.8

Ans : (C)

Hints : Fraction of immersed part $f = \frac{d}{\rho}$

Case-1,

$f = 1 - 0.4 = 0.6$

$0.6 = \frac{d}{1}$

$d = 0.6$

Case-2,

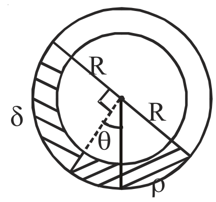
$f = 1 - 0.6 = 0.4$

$$f = \frac{d}{\rho_{oil}}$$

$$0.4 = \frac{0.6}{\rho_{oil}}$$

$\rho_{oil} = 1.5$

34. A uniform long tube is bent into a circle of radius R and it lies in vertical plane. Two liquids of same volume but densities ρ and δ fill half the tube. The angle θ is



(A) $\tan^{-1}\left(\frac{\rho-\delta}{\rho+\delta}\right)$ (B) $\tan^{-1}\frac{\rho}{\delta}$ (C) $\tan^{-1}\frac{\delta}{\rho}$ (D) $\tan^{-1}\left(\frac{\rho+\delta}{\rho-\delta}\right)$

Ans : (A)

Hints : $\delta g\text{R}(\cos\theta + \sin\theta) = \rho g\text{R}(\cos\theta - \sin\theta)$

$\delta\cos\theta + \delta\sin\theta = \rho\cos\theta - \rho\sin\theta$

$\sin\theta(\delta+\rho) = \cos\theta(\rho-\delta)$

$$\tan\theta = \frac{\rho-\delta}{\rho+\delta}$$

35. Two solid spheres of same metal but of mass M and 8 M fall simultaneously on a viscous liquid and their terminal velocities are v and nv then value of n is

(A) 16 (B) 8 (C) 4 (D) 2

Ans : (C)

Hints : $m = \frac{4}{3}\pi r^3 \times \rho$

$m \propto r^3$

$$\left(\frac{r_1}{r_2}\right)^3 = \frac{1}{8}$$

$$\frac{r_1}{r_2} = \frac{1}{2}$$

$$6\pi\eta r\text{V} = \frac{4}{3}\pi r^3(d = \rho)$$

$\text{V} \propto r^2$, $\frac{\text{V}_1}{\text{V}_2} = \frac{1}{4}$

$n = 4$

36. A particle is executing linear simple harmonic motion of amplitude A. At what displacement is the energy of the particle half potential and half kinetic ?

(A) $\frac{\text{A}}{4}$ (B) $\frac{\text{A}}{2}$ (C) $\frac{\text{A}}{\sqrt{2}}$ (D) $\frac{\text{A}}{\sqrt{3}}$

Ans : (C)

Hints : Total Energy (E) $= \frac{1}{2} m\omega^2 A^2$

P.E. $= \frac{1}{2} m\omega^2 x^2$

As P.E. $= \frac{E}{2}$

Then, $\frac{1}{2} m\omega^2 A^2 \times \frac{1}{2} = \frac{1}{2} m\omega^2 x^2$

$x^2 = \frac{A^2}{2} \Rightarrow x = \frac{A}{\sqrt{2}}$

37. The equation of a progressive wave is $y = 4 \sin (4\pi t - 0.04x + \pi/3)$ where x is in meter and t is in second. The velocity of the wave is

(A) 100π m/s (B) 50π m/s (C) 25π m/s (D) π m/s

Ans : (A)

Hints : Velocity of wave $= \frac{\omega}{K} = \frac{4\pi}{0.04} = 100\pi$ m/sec

38. A longitudinal wave is represented by $x = x_0 \sin 2\pi(nt - x/\lambda)$. The maximum particle velocity will be four times the wave velocity if :

(A) $\lambda = \frac{\pi x_0}{4}$ (B) $\lambda = 2\pi x_0$ (C) $\lambda = \frac{\pi x_0}{2}$ (D) $\lambda = 4\pi x_0$

Ans : (C)

Hints : Maximum particle velocity $(V_p) = A\omega = 2\pi n x_0$

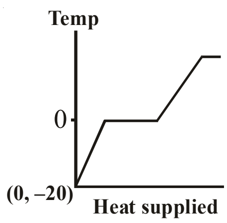
Wave velocity $(V_\omega) = n\lambda$

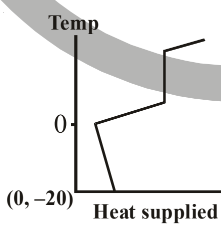
Here, $V_P = 4V_\omega$

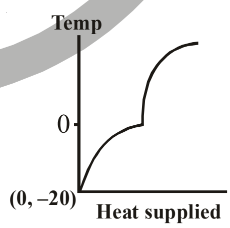
$2\pi n x_0 = 4n\lambda$

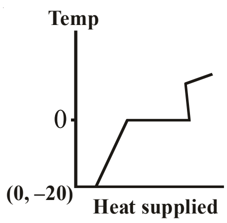
$\lambda = \frac{\pi}{2} x_0$

39. A block of ice at temperature –20 ºC is slowly heated and converted to steam at 100 ºC. Which of the following diagram is most appropriate ?

(A) 

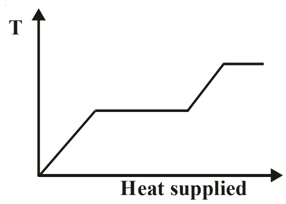
(B) 

(C) 

(D) 

Ans : (A)

Hints :



40. Two black bodies at temperatures 327 ºC and 427 ºC are kept in an evacuated chamber at 27 ºC. The ratio of their rates of loss of heat are :

(A) $\frac{6}{7}$ (B) $\left(\frac{6}{7}\right)^2$ (C) $\left(\frac{6}{7}\right)^3$ (D) $\frac{243}{464}$

Ans : (D)

Hints : Rate of loss of heat $\propto (T^4 - T_0^4)$

$$\frac{E_1}{E_2} = \frac{T_1^4 - T_0^4}{T_2^4 - T_0^4} = \frac{(600)^4 - (300)^4}{(700)^4 - (300)^4} = \frac{6^4 - 3^4}{7^4 - 3^4}$$

$$\frac{E_1}{E_2} = \frac{243}{464}$$

41. At identical temperature and pressure, the rate of diffusion of hydrogen gas is $3\sqrt{3}$ times that of a hydrocarbon having molecular formula C_nH_{2n-2} . What is the value of 'n' ?

(A) 1 (B) 4 (C) 3 (D) 8

Ans : (B)

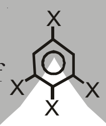
Hints : $\frac{r_{H_2}}{r_{C_nH_{2n-2}}} = \sqrt{\frac{M_{C_nH_{2n-2}}}{M_{H_2}}} = \sqrt{\frac{M_{C_nH_{2n-2}}}{2}}$

$\because \sqrt{\frac{M_{C_nH_{2n-2}}}{2}} = 3\sqrt{3} = \sqrt{27}$

$\Rightarrow M_{C_nH_{2n-2}} = 27 \times 2 = 54$

Hence, $12n + (2n-2) \times 1 = 54 \Rightarrow 14n = 56 \Rightarrow n = 4$

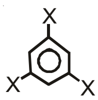
Thus Hydrocarbon is C_4H_6

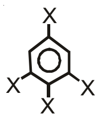
42. Dipole moment of  is 1.5D. The dipole moment of  is

(A) 1.5 D (B) 2.25 D (C) 1D (D) 3D

Ans : (A)

Hints : Given for this molecule  $\mu_1 = 1.5D$

For  $\mu = 0$ (as it is symmetrical)

Hence for  μ will be 1.5D

43. Which of the following thermodynamic relation is correct ?

(A) $dG = VdP - SdT$ (B) $dE = PdV + TdS$ (C) $dH = -VdP + TdS$ (D) $dG = VdP + SdT$

Ans : (A)

Hints : $dG = dH - TdS - SdT$ (as $G = H - TS$)

again, $H = U + PV$

$\therefore dH = dU + PdV + VdP$

& $dU = TdS - PdV$

Thus $dG = (TdS - PdV) + PdV + VdP - TdS - SdT$

$= VdP - SdT$

44. In the hydrolysis of an organic chloride in presence of large excess of water; $RCI + H_2O \rightarrow ROH + HCl$

(A) Molecularity and order of reaction both are 2 (B) Molecularity is 2 but order of reaction is 1

(C) Molecularity is 1 but order of reaction is 2 (D) Molecularity is 1 and order of reaction is also 1

Ans : (B)

Hints : As water used is in large excess.

45. The potential of a hydrogen electrode at pH = 10 is

(A) 0.59 V (B) 0.00 V (C) –0.59 V (D) –0.059

Ans : (C)

Hints : $H^+(pH=10)|H_2(1\,atm)|Pt(s)$

Reaction : $2H^+(p^H=10)+2e \rightarrow H_2\,(1\text{ atm})$

$$E = E^0 - \frac{0.0591}{2}\log\left(\frac{P_{H_2}}{[H^+]^2}\right)$$

$$= 0 - \frac{0.0591}{2}\log\frac{1}{(10^{-10})^2} = -\frac{0.0591}{2}\times 2\log\frac{1}{10^{-10}} = -0.0591\times 10 = -0.591$$

i.e. E = –0.591 V

46. Calculate K_C for the reversible process given below if $K_P = 167$ and T = 800^0C

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

(A) 1.95 (B) 1.85 (C) 1.89 (D) 1.60

Ans : (C)

Hints : $K_p = K_C(RT)^{\Delta n}$

for eq^n $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, $\Delta n = 1$

$$K_C = \frac{K_P}{(RT)^{\Delta n}} = \frac{167}{(0.0821\times 1073)^1} = 1.89$$

47. For a reversible chemical reaction where the forward process is exothermic, which of the following statements is correct ?

(A) The backward reaction has higher activation energy than the forward reaction

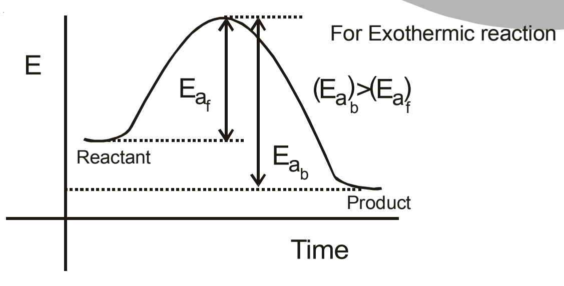
(B) The backward and the forward processes have the same activation energy

(C) The backward reaction has lower activation energy

(D) No activation anergy is required at all since energy is liberated in the process.

Ans : (A)

Hints :



48. In Sommerfeld's modification of Bohr's theory, the trajectory of an electron in a hydrogen atom is

(A) a perfect ellipse

(B) a closed ellipse – like curve, narrower at the perihelion position and flatter at the aphelion position

(C) a closed loop on spherical surface

(D) a rosette

Ans : (C)

49. In the reaction of sodium thiosulphate with I_2 in aqueous medium the equivalent weight of sodium thiosulphate is equal to

(A) molar mass of sodium thiosulphate
(B) the average of molr masses of $Na_2S_2O_3$ and I_2
(C) half the molar mass of sodium thiosulphate
(D) molar mass of sodium thiosulphate × 2

Ans : (A)

Hints : $2Na_2\overset{+2}{S_2}O_3 + I_2 \longrightarrow Na_2\overset{+2.5}{S_4}O_6 + 2NaI$

n-factor = 1

$E = \dfrac{M}{1} = M$

50. 0.1 (M) HCI and 0.1 (M) H_2SO_4 each of volume 2ml are mixed and the volume is made up to 6 ml by adding 2ml of 0.01 (N) NaCl solution. The pH of the resulting mixture is

(A) 1.17 (B) 1.0 (C) 0.3 (D) log 2 – log 3

Ans : (B)

Hints : Mili moles of $H^+ = 0.1\times2 + 0.1\times2\times2 = 0.6$

Total volume in ml = 6

$pH = -\log_{10}[H^+] = -\log\left(\dfrac{0.6}{6}\right) = -\log 0.1 = 1$

51. The molarity of a NaOH solution by dissolving 4 g of it in 250 ml water is

(A) 0.4 M (B) 0.8 M (C) 0.2 M (D) 0.1 M

Ans : (A)

Hints : Molarity $= \dfrac{4/40}{250/1000} = 0.4$

52. If a species has 16 protons, 18 electrons and 16 neutrons, find the species and its charge

(A) S^{1-} (B) Si^{2-} (C) P^{3-} (D) S^{2-}

Ans : (D)

Hints : 16p means z = 16

18e$^-$ means , 2 unit negative charge is present.

Hence species is S^{-2}

53. In a periodic table the basic character of oxides

(A) increases from left to right and decreases from top to bottom
(B) decreases from right to left and increases from top to bottom
(C) decreases from left to right and increases from top to bottom
(D) decreases from left to right and increases from bottom to top

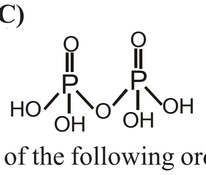
Ans : (C)

54. Which one of the following contains P – O – P bond ?

(A) Hypophosphorus acid (B) Phosphorus acid (C) Pyrophosphoric acid (D) Orthophosphoric acid

Ans : (C)

Hints :



55. Which of the following orders regarding ionization energy is correct ?

(A) N > O > F (B) N < O < F (C) N > O < F (D) N < O > F

Ans : (C)

Hints : As IE_1 N > O (because of half filled orbitals of N)

and O < F (because of smaller size of F)

56. Which of the following statements regarding ozone is not correct ?

(A) The Ozone molecule is angular in shape
(B) The Ozone is a resonance hybrid of two structures
(C) The Oxygen– Oxygen bond length in ozone is identical with that of molecular oxygen
(D) Ozone is used as germicide and disinfectant for the purification of air.

Ans : (C)

Hints : Due to resonance the bond order in ozone is 1.5, hence O – O bond length in O_3 > O – O bond length in O_2

57. P_4O_{10} is the anhydride of

(A) H_3PO_2 (B) H_3PO_3 (C) H_3PO_4 (D) $H_4P_2O_7$

Ans : (C)

Hints : $4H_3PO_4 \longrightarrow P_4O_{10} + 6H_2O$

58. Which of the following metals has the largest abundance in the earth's crust ?

(A) Aluminium (B) Calcium (C) Magnesium (D) Sodium

Ans : (A)

59. Which of the following orbitals will have zero probability of finding the electron in the yz plane ?

(A) P_x (B) P_y (C) P_z (D) d_{yz}

Ans : (A)

Hints : P_x orbital lies along x-axis only.

60. What type of orbital hybridisation is considered on P in PCl_5 ?

(A) sp^3d (B) dsp^3 (C) sp^3d^2 (D) d^2sp^3

Ans : (A)

61. For which element the inertness of the electron pair will not be observed?

(A) Sn (B) Fe (C) Pb (D) In

Ans : (B)

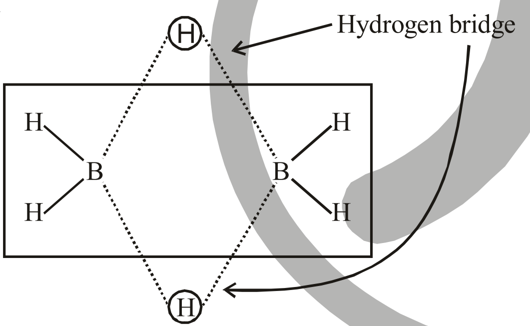
Hints : Inert pair effect is exhibited only by heavy metals of p-block elements

62. In which of the following molecules is hydrogen bridge bond present?

(A) Water (B) Inorganic benzene (C) Diborane (D) Methanol

Ans : (C)

Hints :



63. When a manganous salt is fused with a mixture of KNO_3 and solid NaOH the oxidation number of Mn changes from +2 to

(A) +4 (B) +3 (C) +6 (D) +7

Ans : (C)

Hints : $\overset{(+2)}{Mn^{+2}} + NO_3^- + O\bar{H} \rightarrow \overset{(+6)}{M}nO_4^{-2} + H_2O$

64. In hemoglobin the metal ion present is

(A) Fe^{2+} (B) Zn^{2+} (C) Co^{2+} (D) Cu^{2+}

Ans : (A)

65. Ortho-and para-hydrogens have

(A) Identical chemical properties but different physical properties

(B) Identical physical and chemical properties

(C) Identical physical properties but different chemical properties

(D) Different physical and chemical properties

Ans : (A)

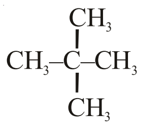
66. The bond order of CO molecule is
(A) 2 (B) 2.5 (C) 3 (D) 3.5
Ans : (C)

Hints : $CO \rightarrow \sigma(1S)^2, \sigma^*(1S)^2, \sigma(2S)^2, \sigma(2P_z)^2, \pi(2P_x)^2 = \pi(2P_y)^2, \sigma^*(2S)^2$

$$B.O = \frac{N_b - N_o}{2} = \frac{10-4}{2} = 3$$

67. Vitamin C is
(A) Citric acid (B) Lactic acid (C) Paracetamol (D) Ascorbic acid
Ans : (D)

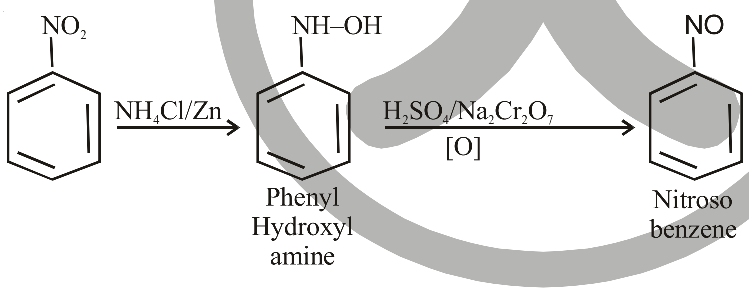
68. On mixing an alkane with chlorine and irradiating with ultra-violet light, it forms only one mono-chloro-alkane. The alkane is
(A) Propane (B) Pentane (C) Isopentane (D) Neopentane
Ans : (D)
Hints : Neopentane



contains all hydrogen atom equivalent

69. Keto-enol tautomerism is not observed in
(A) $C_6H_5COC_6H_5$ (B) $C_6H_5COCH{=}CH_2$ (C) $C_6H_5COCH_2COCH_3$ (D) $CH_3COCH_2COCH_3$
Ans : (A) as contains no α - H

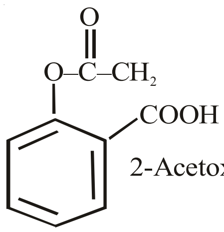
70. What is obtained when nitrobenzene is treated sequentially with (i) NH_4Cl/Zn dust and (ii) $H_2SO_4/Na_2Cr_2O_7$?
(A) meta-chloronitrobenzene (B) para-chloronitrobenzene
(C) nitrosobenzene (D) benzene
Ans : (C)

Hints :


71. Boiling water reacts with $C_6H_5N_2^+Cl^-$ to give
(A) aniline (B) benzylamine (C) phenol (D) benzaldehyde
Ans : (C)

Hints : $C_6H_5N_2^+Cl^- \xrightarrow[(Boil)]{H_2O} C_6H_5OH\ (S_NAr)$

72. Aspirin is
(A) Acetyl salicylic acid (B) Benzoyl salicylic acid
(C) Chloro benzoic acid (D) Anthranilic acid
Ans : (A)

Hints : 

2-Acetoxy benzoic acid

73. $X \xrightarrow{PCl_5} C_2H_5Cl$

$Y \xrightarrow{PCl_5} CH_3COCl$

X and Y are

(A) $(C_2H_5)_2O$ and CH_3CO_2H (B) C_2H_5I and C_2H_5CHO (C) C_2H_5OH and CH_3CO_2H (D) C_2H_5OH and C_2H_5CHO

Ans : (C)

Hints : $C_2H_5OH \xrightarrow{PCl_5} C_2H_5Cl + POCl_3 + HCl$

$CH_3CO_2H \xrightarrow{PCl_5} CH_5COCl + POCl_3 + HCl$

74. Which of the following compounds shows evidence of the strongest hydrogen bonding?

(A) Propan–1–ol (B) Propan–2–ol (C) Propan–1,2–diol (D) Propan–1,2,3–triol

Ans : (D)

Hints : Propan-1,2,3 triol have three polar –OH group.

75. When AgCl is treated with KCN

(A) Ag is precipitated (B) a complex ion is formed

(C) double decomposition takes place (D) no reaction takes place

Ans : (B)

Hints : $AgCl + 2KCN \rightarrow K\left[Ag(CN)_2\right] + KCl$

76. Which one of the following produced when acetone is saturated with HCl gas?

(A) Acetone alcohol (B) Phorone (C) Mesityl oxide (D) Benzene

Ans : (C)

Hints : $2CH_3COCH_3 \xrightarrow{\text{HCl gal}} \underset{\text{Mesityl oxide}}{CH_3COCH = C(CH_3)_2} + H_2O$ [Note : Phorone is formed as minor product]

77. Which one of the following is an example of co-polymer?

(A) Buna–S (B) Teflon (C) PVC (D) Polypropylene

Ans : (A)

Hints : Buna -S is a co-polymer of butadiene and styrene

$\left(CH_2–CH= CH–CH_2–\underset{}{\overset{C_6H_5}{\overset{|}{C}H}}– CH_2 \right)_n$

78. Identify [A] and [B] in the following

${}^{227}_{89}Ac \xrightarrow{-\beta} [A] \xrightarrow{-\alpha} [B] \xrightarrow{-\alpha} Rn$

(A) Po, Rn (B) Th, Po (C) Ra, Th (D) Th, Ra

Ans : (D)

Hints : ${}^{227}_{89}Ac \xrightarrow{-\beta} {}^{227}_{90}Th \xrightarrow{-\alpha} {}^{223}_{88}Ra$

79. A weak acid of dissociation constant 10^{-5} is being titrated with aqueous NaOH solution. The pH at the point of one-third neutralisation of the acid will be

(A) $5 + \log 2 - \log 3$ (B) $5 - \log 2$ (C) $5 - \log 3$ (D) $5 - \log 6$

Ans : (B)

Hints : $K_a = 10^{-5} \Rightarrow pK_a = -\log K_a = -\log 10^{-5} = 5$

	HA	+ NaOH ⟶	NaA	+ H_2O
Initial	1mole	0	0	0
Final	$(1-\frac{1}{3})$ mole $= \frac{2}{3}$ mole		$\frac{1}{3}$ mole	$\frac{1}{3}$ mole

(Assumed weak acid to be monoprotic, since only one dissociation constant value is provided)

Final solution acts as an acidic buffer.

$$\Rightarrow pH = pK_a + \log\frac{[\text{salt}]}{[\text{Acid}]} \Rightarrow pH = 5 + \log\frac{\frac{1}{3}}{\frac{2}{3}} = 5 + \log\frac{1}{2} \Rightarrow pH = 5 - \log 2$$

80. Radioactivity of a sample (z=22) decreases 90% after 10 years. What will be the half life of the sample?

(A) 5 years (B) 2 years (C) 3 years (D) 10 years

Ans : (C)

Hints : t = 10 yrs $t_{\frac{1}{2}} = ?$

$$\lambda = \frac{2.303}{t}\log\frac{N_o}{N_t}$$

Since radioactivity decreases 90% in 10 yrs. $\Rightarrow N_0 = 100$ & $N_t = 10$

$$\text{Thus } \lambda = \frac{2.303}{10}\log\frac{100}{10} \Rightarrow \lambda = \frac{2.303}{10}$$

$$\text{since } t_{\frac{1}{2}} = \frac{0.693}{\lambda} = \frac{2.303\times\log 2}{\lambda} \Rightarrow t_{\frac{1}{2}} = \frac{2.303\times\log 2}{2.303/10}$$

$$\Rightarrow t_{\frac{1}{2}} = (\log 2)\times 10 \simeq 3 \text{ years}$$

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DESCRIPTIVE TYPE QUESTIONS

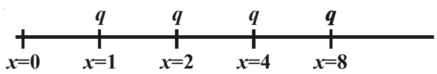
SUB : PHYSICS & CHEMISTRY

1 A circular disc rolls down on an inclined plane without slipping. What fraction of its total energy is translational?

A. Fraction $= \dfrac{\frac{1}{2}mV^2}{\frac{1}{2}mV^2 + \frac{1}{2}(mK^2)\frac{V^2}{R^2}} = \dfrac{1}{1+\frac{K^2}{R^2}} = \dfrac{1}{1+\frac{1}{2}} = \dfrac{2}{3}$

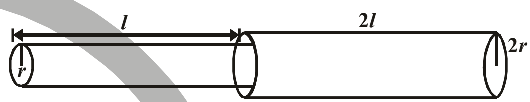
2 An infinite number of charges, each equal to q, are placed along the x-axis at $x = 1$, $x = 2$, $x = 4$, $x = 8$ and so on. What is the potential at $x = 0$ due to this set of charges ?

A. $V = \dfrac{q}{4\pi\varepsilon_0}\left[1+\dfrac{1}{2}+\dfrac{1}{2^2}+\dfrac{1}{2^3}+....\right] = \dfrac{q}{4\pi\varepsilon_0}\dfrac{1}{1-\frac{1}{2}} = \dfrac{2q}{4\pi\varepsilon_0}$



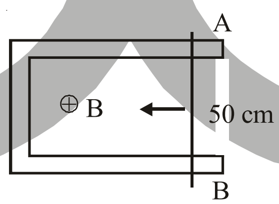
3 A liquid flows through two capillary tubes A and B connected in series. The length and radius of B are twice those of A. What is the ratio of the pressure difference across A to that across B?

A. $Q = \dfrac{\pi P_1 r_1^4}{8nl_1} = \dfrac{\pi P_2 r_2^4}{8nl_2}$



$\dfrac{P_1}{P_2} = \left(\dfrac{r_2}{r_1}\right)^4 \times \dfrac{l_1}{l_2} = \left(\dfrac{2r}{r}\right)^4 \times \dfrac{l}{2l} = 16 \times \dfrac{1}{2} = 8$

4 A 50 cm long conductor AB moves with a speed 4 m/s in a magnetic field B = 0.01 Wb/m^2 as shown. Find the e.m.f. generated and power delivered if resistance of the circuit is 0.1 Ω.



A. e.m.f. $(e) = vBl = 4 \times 0.01 \times 50 \times 10^{-2} = 200 \times 10^{-4} = 2 \times 10^{-2}$ V

Power = $P = \dfrac{e^2}{R} = \dfrac{4\times10^{-4}}{0.1} = 4\times10^{-3}$ watt

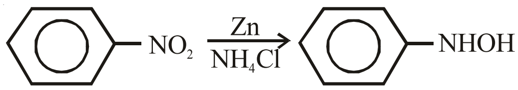
5 An electron is moving with a velocity $(2\hat{i}+2\hat{j})$ m/s in an electric field of intensity $\vec{E} = \hat{i}+2\hat{j}-8\hat{k}$ Volt/m and a magnetic field of $\vec{B} = (2\hat{j}+3\hat{k})$ tesla. Find the magnitude of force on the electron.

A. $\vec{F} = q(\vec{E}+\vec{V}\times\vec{B}) = (1.6\times10^{-19})(7\hat{i}-4\hat{j}-4\hat{k})$

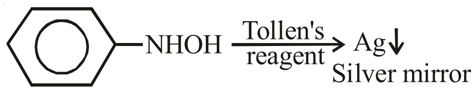
$|\vec{F}| = 1.6\times10^{-19}\times9 = 14.4\times10^{-19}$ N

6. How nitrobenzene is identified using Mulliken-Barker test?

A : Nitrobenzene is reduced using Zn and NH_4Cl in alcohol medium.



The N-phenyl hydroxylamine when reacts with Tollen's reagent gives bright silver miror.



7. Calculate the ratio of the rate of diffusion of oxygen to the rate of diffusion of hydrogen at constant temperature and pressure.

A : $\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{2}{32}} = \frac{1}{4}$

8. Why B_2 is paramagnetic whereas C_2 is diamagnetic?

A : For $B_2\left(10\bar{e}\right)$ the MO configuraiton is $(\sigma 1S)^2\left(\sigma^* 1S\right)^2(\sigma 2S)^2\left(\sigma^* 2S\right)^2\left(\pi 2P_x^1 = \pi 2P_y^1\right)$

Due to presence of unpaired electron $\left\{\pi 2P_x^1 = \pi 2P_y^1\right\}$ it shows paramagnetism.

$C_2\left(12\bar{e}\right)$ the MO configuration is $(\sigma 1S)^2\left(\sigma^* 1S\right)^2(\sigma 2S)^2\left(\sigma^* 2S\right)^2\left(\pi 2P_x^2 = \pi 2P_y^2\right)$

No unpaired electrons are there in C_2 $\left\{\pi 2P_x^2 = \pi 2P_y^2\right\}$, hence it shows diamagnetism.

9. Explain briefly the cause of Lanthanoid contraction.

A : On moving in the lanthanid series from left to right successive electrons enter into ante penultimate 4f-subshell which imparts very poor shielding effect (due to its diffused nature), hence effective nuclear charge gradually increases with increase in atomic number. That is why shrinkage is observed on moving through lanthanide series, this is known as lanthanide contraction.

10. Explain why aniline is not as basic as ammonia.

A : In aniline the lone-pair over nitrogen atom is in conjugation with the π-electrons of the benzene ring and it takes part in resonance. That is why availability of lone-pair is not as that as in ammonia. Thus aniline is less basic than ammonia.

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