IIT-JEE

WB-JEE - 2009

PHYSICS & CHEMISTRY QUESTIONS & ANSWERS

1. One Kg of copper is drawn into a wire of 1mm diameter and a wire of 2 mm diameter. The resistance of the two wires will be in the ratio

(A) 2 : 1 (B) 1 : 2 (C) 16 : 1 (D) 4 : 1

Ans : (C)

Hints : $\text{Mass} = (\pi r_1^2 \ell_1)\sigma$ (Ist wire)

$\text{Mass} = (\pi r_1^2 \ell_2)\sigma$ (2nd wire)

$(\pi r_1^2 \ell_1)\sigma = (\pi r_2^2 \ell_2)\sigma$

$$\frac{\ell_1}{\ell_2} = \left(\frac{r_2}{r_1}\right)^2$$

$$\frac{R_1}{R_2} = \frac{\rho\frac{\ell_1}{A_1}}{\rho\frac{\ell_2}{A_2}} = \frac{\ell_1}{\ell_2} \times \frac{A_2}{A_1} = \frac{\ell_1}{\ell_2} \times \left(\frac{r_2}{r_1}\right)^2$$

$$= \left(\frac{r_2}{r_1}\right)^4$$

$\Rightarrow$ 16 : 1

2. An electrical cable having a resistance of 0.2 Ω delivers 10kw at 200V D.C. to a factory. What is the efficiency of transmission?

(A) 65% (B) 75% (C) 85% (D) 95%

Ans : (D)

Hints : $P = VI \Rightarrow I = \frac{10\times10^3}{200} = 50A$, Power loss = $(50)^2$ (0.2) = 500W

$$\text{Efficiency} = \frac{10000\times100}{10000+500} = 95.23\%$$

3. A wire of resistance 5 Ω is drawn out so that its new length is 3 times its original length. What is the reistance of the new wire?

(A) 45 Ω (B) 15 Ω (C) 5/3 Ω (D) 5 Ω

Ans : (A)

Hints : $\left(\frac{r_1}{r_2}\right)^2 = \left(\frac{\ell_2}{\ell_1}\right) = \frac{3\ell}{\ell} = 3$

$$\left(\frac{R_2}{R_1}\right) = \frac{\ell_2}{\ell_1} \times \frac{A_1}{A_2} = 3 \times \left(\frac{r_1}{r_2}\right)^2 = 3 \times 3 \Rightarrow R_2 = 45$$

4. Two identical cells each of emf E and internal resistance r are connected in parallel with an external resistance R. To get maximum power developed across R, the value of R is

(A) R = r/2 (B) R = r (C) R = r/3 (D) R = 2r

Ans : (A)

Hints : $R_{eq} = \frac{r}{2} + R = \frac{r + 2R}{2}$

$$I = \frac{2E}{r + 2R}$$

For max. power consumption. I should be max. So denominator should be min. for that

$$r + 2R = \left(\sqrt{r} - \sqrt{2R}\right)^2 + 2\sqrt{r}\sqrt{2R} \Rightarrow \sqrt{r} - \sqrt{2R} = 0 \Rightarrow R = r/2$$

5. To write the decimal number 37 in binary, how many binary digits are required?

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

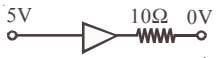
Ans : (B)

Hints :

2	37	1
2	18	0
2	9	1
2	4	0
2	2	0
	1	

$(100101) \Rightarrow 6$ *digits*

6. A junction diode has a resistance of 25 Ω when forward biased and 2500 Ω when reverse biased. The current in the diode, for the arrangement shown will be



(A) $\frac{1}{15}$ A (B) $\frac{1}{7}$ A (C) $\frac{1}{25}$ A (D) $\frac{1}{180}$ A

Ans : (B)

Hints : $R_{eq} = 25 + 10 = 35\Omega$

Because diode is forward biased. So $I = \frac{V}{R_{eq}} = \frac{5}{35} = \frac{1}{7} A$

7. If the electron in a hydrogen atom jumps from an orbit with level $n_1 = 2$ to an orbit with level $n_2 = 1$ the emitted radiation has a wavelength given by

(A) $\lambda = 5/3R$ (B) $\lambda = 4/3\,R$ (C) $\lambda = R/4$ (D) $\lambda = 3R/4$

Ans : (B)

Hints : $\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{3R}{4}$

$\Rightarrow \lambda = \frac{4}{3R}$

8. What is the particle x in the following nuclear reaction :

${}^{9}_{4}\mathrm{Be} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{12}_{6}\mathrm{C} + \mathrm{x}$

(A) electron (B) proton (C) Photon (D) Neutron

Ans : (D)

Hints : ${}^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{12}_{6}C + {}^{1}_{0}X$

Hence X represents neutron $\left({}^{1}_{0}n\right)$

9. An alternating current of rms value 10 A is passed through a 12 Ω resistor. The maximum potential difference across the resistor is

(A) 20 V (B) 90 V (C) 1969.68 V (D) none

Ans : (C)

Hints : $I_{rms} = 10A$

$I_{rms} = \frac{I_0}{\sqrt{2}} \Rightarrow I_0 = \sqrt{2} \times 10 = 10\sqrt{2}$

Max. P.D. = $\sqrt{2} \times 10 \times 12 = 120 \times 1.414 = 169.68\ V$

10. Which of the following relation represent Biot-Savart's law?

(A) $d\bar{B} = \frac{\mu_0}{4\pi}\frac{\bar{dl} \times \bar{r}}{r}$ (B) $d\bar{B} = \frac{\mu_0}{4\pi}\frac{\bar{dl} \times \hat{r}}{r^3}$ (C) $d\bar{B} = \frac{\mu_0}{4\pi}\frac{\bar{dl} \times \bar{r}}{r^3}$ (D) $d\bar{B} = \frac{\mu_0}{4\pi}\frac{\bar{dl} \times \bar{r}}{r^4}$

Ans : (C)

Hints : $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\left(d\vec{\ell} \times \vec{r}\right)}{r^3}$

Note :– In question paper current (I) is missing

11. $\vec{A}$ and $\vec{B}$ are two vectors given by $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = \hat{i} + \hat{j}$. The magnitude of the component of $\vec{A}$ along $\vec{B}$ is

(A) $\frac{5}{\sqrt{2}}$ (B) $\frac{3}{\sqrt{2}}$ (C) $\frac{7}{\sqrt{2}}$ (D) $\frac{1}{\sqrt{2}}$

Ans : (A)

Hints : Magnitude of components of $\vec{A}$ along $\vec{B} = \frac{\vec{A}.\vec{B}}{|\vec{B}|} = \frac{\left(2\hat{i} + 3\hat{j}\right)\left(\hat{i} + \hat{j}\right)}{\sqrt{2}} = \frac{5}{\sqrt{2}}$

12. Given $\vec{C} = \vec{A} \times \vec{B}$ and $\vec{D} = \vec{B} \times \vec{A}$. What is the angle between $\vec{C}$ and $\vec{D}$?

(A) 30° (B) 60° (C) 90° (D) 180°

Ans : (D)

Hints : $\vec{C}$ and $\vec{D}$ are antiparellel since $\vec{A} \times \vec{B} = -\left(\vec{B} \times \vec{A}\right)$

13. The acceleration 'a' (in ms^{-2}) of a body, starting from rest varies with time t (in s) following the equation a = 3t + 4
The velocity of the body at time t = 2s will be

(A) 10 ms^{-1} (B) 18 ms^{-1} (C) 14 ms^{-1} (D) 26 ms^{-1}

Ans : (C)

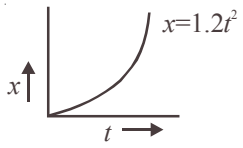
Hints : a = 3t + 4

$$\frac{dV}{dt} = 3t + 4$$

$$\int_0^V dV = \int_0^t (3t + 4)dt$$

$$V = \frac{3t^2}{2} + 4t = \frac{12}{2} + 8 = 14 \quad m/s$$

14. Figure below shows the distance-time graph of the motion of a car. If follows from the graph that the car is



(A) at rest (B) in uniform motion
(C) in non-uniform acceleration (D) uniformly accelerated

Ans : (D)

Hints : Slope is increasing with constant rate. i.e motion is uniformaly accelerated

$x = 1.2t^2 \Rightarrow v = 2.4t \Rightarrow a = 2.4\ m/s^2$

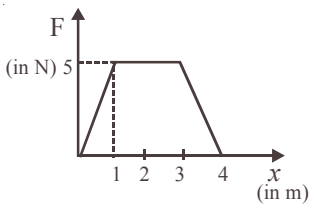
15. Two particles have masses m & 4m and their kinetic energies are in the ratio 2: 1. What is the ratio of their linear momenta ?

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{1}{2}$ (C) $\frac{1}{4}$ (D) $\frac{1}{16}$

Ans : (A)

Hints : $$\frac{KE_1}{KE_2} = \frac{\frac{p_1^2}{2m}}{\frac{p_2^2}{2 \times 4m}} = \frac{2}{1} \Rightarrow \frac{p_1}{p_2} = \frac{1}{\sqrt{2}}$$

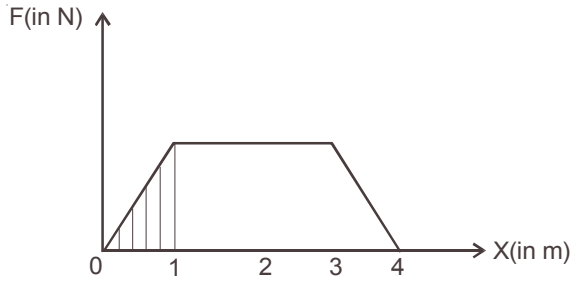
16. The force F acting on a particle moving in a straight line is shown below. What is the work done by the force on the particle in the 1st meter of the trajectory ?



(A) 5 J (B) 10 J (C) 15 J (D) 2.5 J

Ans : (D)

Hints : Work done in 1 meter = area of shaded curve = 1/2 × 1×5 =2.5 J



17. If the kinetic energy of a body changes by 20% then its momentum would change by –

(A) 20% (B) 24% (C) 40% (D) 44%

Ans : (No answer matching)

Hints : $$\frac{\frac{p_f^2}{2m}-\frac{p_i^2}{2m}}{\frac{p_i^2}{2m}}\times 100 = 20$$

$$\Rightarrow \frac{p_f}{p_i} = \sqrt{1.2} = 1.095 \Rightarrow \frac{p_f - p_i}{p_i} = 0.095$$

Therefore % increase = 9.5%

18. A bullet is fired with a velocity u making an angle of 60° with the horizontal plane. The horizontal component o the velocity of the bullet when it reaches the maximum height is

(A) u (B) 0 (C) $\frac{\sqrt{3u}}{2}$ (D) $\frac{u}{2}$

Ans : (D)

Hints : Horizontal velocity would be constant so the value of velocity at the highest point will be u/2

19. A particle is projected at 60° to the horizontal with a kinetic energy K. The kinetic energy at the highest point is

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

Ans : (C)

Hints : At highest point kinetic energy = 1/2m (v cos 60°)^2 = 1/4 × 1/2m v^2 = K/4

20. The poisson's ratio of a material is 0.5. If a force is applied to a wire of this material, there is a decrease in the cross-sectional area by 4%. The percentage increase in the length is :

(A) 1 % (B) 2% (C) 2.5% (D) 4%

Ans : (D)

Hints : Poisson ratio = 0.5

Therefore density is constant hence change in volume is zero we have

V = A × ℓ = constant

$$\log V = \log A + \log \ell \text{ or } \frac{dA}{A} + \frac{d\ell}{\ell} = 0 \Rightarrow \frac{d\ell}{\ell} = -\frac{dA}{A}$$

That is 4%

21. Two spheres of equal masses but radii r_1 and r_2 are allowed to fall in a liquid of infinite column. The ratio of their terminal velocities is

(A) 1 (B) $r_1 : r_2$ (C) $r_2 : r_1$ (D) $\sqrt{r_1} : \sqrt{r_2}$

Ans : (Data incomplete)

Hints : We have $v_T = \dfrac{2r^2(\sigma - \rho)g}{9\eta}$

$\dfrac{v_1}{v_2} = \left(\dfrac{r_1}{r_2}\right)^2 \dfrac{(\sigma_1 - \rho)}{(\sigma_2 - \rho)}$; given $m_1 = m_2 \Rightarrow \left(\dfrac{r_1}{r_2}\right)^3 = \dfrac{\sigma_2}{\sigma_1}$

22. Two massless springs of force constants K_1 and K_2 are joined end to end. The resultant force constant K of the system is

(A) $K = \dfrac{K_1 + K_2}{K_1 K_2}$ (B) $K = \dfrac{K_1 - K_2}{K_1 K_2}$ (C) $K = \dfrac{K_1 K_2}{K_1 + K_2}$ (D) $K = \dfrac{K_1 K_2}{K_1 - K_2}$

Ans : (C)

Hints : In series $K_{eff} = \dfrac{K_1 K_2}{K_1 + K_2}$

23. A spring of force constant k is cut into two equal halves. The force constant of each half is

(A) $\dfrac{k}{\sqrt{2}}$ (B) k (C) $\dfrac{k}{2}$ (D) 2k

Ans : (D)

Hints : As $K\ell$ = constant

$K' = 2K$

24. Two rods of equal length and diameter have thermal conductivities 3 and 4 units respectively. If they are joined in series, the thermal conductivity of the combination would be

(A) 3.43 (B) 3.5 (C) 3.4 (D) 3.34

Ans : (A)

Hints : In series $R = R_1 + R_2$

$\dfrac{2\ell}{K_{eff} A} = \dfrac{\ell}{K_1 A} + \dfrac{\ell}{K_2 A}$

$K_{eff} = \dfrac{24}{7} = 3.43$

25. 19 g of water at 30° C and 5 g of ice at – 20° C are mixed together in a calorimeter. What is the final temperature of the mixture? Given specific heat of ice = 0.5 cal $g^{-1}(°C)^{-1}$ and latent heat of fusion of ice = 80 cal g^{-1}

(A) 0° C (B) – 5° C (C) 5° C (D) 10° C

Ans : (C)

Hints : $5 \times .5 \times 20 + 5 \times 80 + 5t = 19 \times 1 \times (30 - t)$

$t = 5°C$

26. It is difficult to cook rice in an open vessel by boiling it at high altitudes because of

(A) low boiling point and high pressure (B) high boiling point and low pressure

(C) low boiling point and low pressure (D) high boiling point and high pressure

Ans : (C)

Hints : At high altitude pressure is low and boiling point also low

27. The height of a waterfall is 50 m. If g = 9.8 ms^{-2} the difference between the temperature at the top and the bottom of the waterfall is:

(A) 1.17 °C (B) 2.17° C (C) 0.117° C (D) 1.43° C

Ans : (C)

Hints : $\frac{mgh}{J} = ms\Delta t \Rightarrow \Delta t = 0.117°C$

28. The distance between an object and a divergent lens is m times the focal length of the lens. The linear magnification produced by the lens is

(A) m (B) $\frac{1}{m}$ (C) m+1 (D) $\frac{1}{m+1}$

Ans : (D)

Hints : u = – mf

$$\frac{1}{v} - \frac{1}{(-mf)} = -\frac{1}{f} \Rightarrow \quad \frac{1}{v} = -\frac{1}{f}\left(1+\frac{1}{m}\right) \Rightarrow \; -\frac{v}{u} = \left(\frac{1}{1+m}\right)$$

29. A 2.0 cm object is placed 15 cm in front of a concave mirror of focal length 10 cm. What is the size and nature of the image?

(A) 4 cm. real (B) 4 cm, virtual (C) 1.0 cm, real (D) None

Ans : (A)

Hints : $\frac{1}{v} - \frac{1}{15} = \frac{1}{-10} \Rightarrow v = -30 \text{ cm}$

$m = \frac{-30}{-15} = 2$, image size = 4 cm

30. A beam of monochromatic blue light of wavelength 4200 Å in air travels in water of refractive index 4/3. Its wavelength in water will be:

(A) 4200 Å (B) 5800 Å (C) 4150 Å (D) 3150 Å

Ans : (D)

Hints : In water $\lambda = \frac{4200}{\frac{4}{3}} = 3150 \overset{0}{\text{A}}$

31. Two identical light waves, propagating in the same direction, have a phase difference δ. After they superpose the intensity of the resulting wave will be proportional to

(A) cos δ (B) cos (δ/2) (C) $\cos^2(\delta/2)$ (D) $\cos^2\delta$

Ans : (C)

Hints : $I = 4I_0 \cos^2\left(\frac{\delta}{2}\right) \Rightarrow I \propto \cos^2\left(\frac{\delta}{2}\right)$

32. The equation of state for n moles of an ideal gas is PV = nRT, where R is a constant. The SI unit for R is

(A) JK^{-1} per molecule (B) $JK^{-1}\,mol^{-1}$ (C) $J\,Kg^{-1}\,K^{-1}$ (D) $JK^{-1}\,g^{-1}$

Ans : (B)

Hints : $JK^{-1}\,mol^{-1}$

33. At a certain place, the horizontal component of earth's magnetic field is $\sqrt{3}$ times the vertical component. The angle of dip at that place is

(A) 30° (B) 60° (C) 45° (D) 90°

Ans : (A)

Hints : $\tan\theta = \frac{V}{H} = \frac{1}{\sqrt{3}} \Rightarrow \theta = 30°$

34. The number of electron in 2 coulomb of charge is

(A) 5×10^{29} (B) 12.5×10^{18} (C) 1.6×10^{19} (D) 9×10^{11}

Ans : (B)

Hints : $n = \frac{2}{1.6\times10^{-19}} = 12.5\times10^{18}$

35. The current flowing through a wire depends on time as $I = 3t^2 + 2t + 5$. The charge flowing through the cross section of the wire in time from t = 0 to t = 2 sec. is

(A) 22 C (B) 20 C (C) 18 C (D) 5 C

Ans : (A)

Hints : $Q = \int_0^2 \left(3t^2 + 2t + 5\right) dt = 22\,C$

36. If the charge on a capacitor is increased by 2 coulomb, the energy stored in it increases by 21%. The original charge on the capacitor is

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

Ans : (B)

Hints : $\frac{\frac{q_f^2}{2C} - \frac{q_i^2}{2C}}{\frac{q_i^2}{2C}} \times 100 = 21 \quad and \quad q_f - q_i = 2$

solving we get $q_i = 20$ coulomb

37. The work done in carrying a charge Q once around a circle of radius r about a charge q at the centre is

(A) $\frac{qQ}{4\pi\varepsilon_0 r}$ (B) $\frac{qQ}{4\pi\varepsilon_0}\frac{1}{\pi r}$ (C) $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{1}{2\pi r}\right)$ (D) 0

Ans : (D)

Hints : Work done by conservative force in a round trip is zero

38. Four capacitors of equal capacitance have an equivalent capacitance C_1 when connected in series and an equivalent capacitance C_2 when connected in parallel. The ratio $\frac{C_1}{C_2}$ is:

(A) 1/4 (B) 1/16 (C) 1/8 (D) 1/12

Ans : (B)

Hints : $C_1 = \frac{C}{4} \quad and \quad C_2 = 4C \Rightarrow \frac{C_1}{C_2} = \frac{1}{16}$

39. Magnetic field intensity H at the centre of a circular loop of radius r carrying current I e.m.u is

(A) r/I oersted (B) 2πI/r oersted (C) I/2πr oersted (D) 2πr/I oersted

Ans : (B)

Hints : $H = \frac{\mu_0 I}{2r} = \frac{\mu_0}{4\pi} \times \frac{2\pi I}{r}$

In e.m.u system $\frac{\mu_0}{4\pi} = 1$. So $H = \frac{2\pi I}{r}$

40. Which of the following materials is the best conductor of electricity?

(A) Platinum (B) Gold (C) Silicon (D) Copper

Ans : (D)

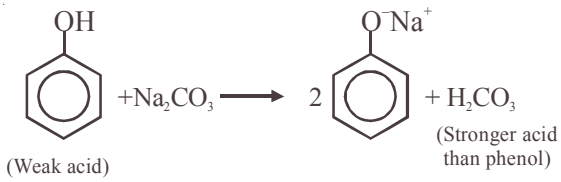
41. Which statement is incorrect

(A) Phenol is a weak acid (B) Phenol is an aromatic compound

(C) Phenol liberates CO_2 from Na_2CO_3 soln (D) Phenol is soluble in NaOH

Ans : (C)

Hints : Phenol does not liberate CO_2 from Na_2CO_3 solution



Note : Strong acid is not formed by weak acid

42. In which of the following reactions new carbon-carbon bond is not formed :

(A) Cannizaro reaction (B) Wurtz reaction (C) Aldol condensation (D) Friedel-Craft reaction

Ans : (A)

Hints : In cannizaro's reaction no new C–C bond is formed

e.g. $H\text{-}\overset{O}{\overset{\|}{C}}\text{-}H + H\text{-}\overset{O}{\overset{\|}{C}}\text{-}H \xrightarrow{50\%NaOH} CH_3OH + HCOO^-Na^+$

43. A compound is formed by substitution of two chlorine for two hydrogens in propane. The number of possible isomeric compounds is

(A) 4 (B) 3 (C) 5 (D) 2

Ans : (C)

Hints : $C_3H_8 \xrightarrow[+2Cl]{-2H} C_3H_6Cl_2$, following isomers of $C_3H_6Cl_2$ is possible

(I) (II) (III) (IV)

Due to presence of chiral carbon compound (IV) is optically active and forms an enantiomer. So total no of isomers =5

44. Which one of the following is called a carbylamine?

(A) R CN (B) R $CONH_2$ (C) R–CH=NH (D) R NC

Ans : (D)

45. For making distinction between 2-pentanone and 3-pentanone the reagent to be employed is

(A) $K_2Cr_2O_7/H_2SO_4$ (B) Zn-Hg/HCl (C) SeO_2 (D) Iodine/NaOH

Hints : In 2-pentanone *ie.,* $CH_3-\overset{O}{\overset{\|}{C}}-CH_2CH_2CH_3$, $CH_3-\overset{O}{\overset{\|}{C}}-$ group is present due to which it can show iodoform test. *i.e.*,

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-CH_3 \xrightarrow{I_2/NaOH} \underset{\text{(Yellow ppt.)}}{CHI_3\downarrow} + CH_3CH_2-CH_2-\overset{O}{\overset{\|}{C}}-O^-Na^+$$

46. Which one of the following formulae does not represent an organic compound?

(A) $C_4H_{10}O_4$ (B) $C_4H_8O_4$ (C) $C_4H_7ClO_4$ (D) $C_4H_9O_4$

Ans : (D)

Hints : Unsaturation factor = 0, 1, 1, 0.5 Hence (D)

47. The catalyst used for olefin polymerization is

(A) Ziegler-Natta Catalyst (B) Wilkinson Catalyst (C) Raney nickel catalyst (D) Merrifield resin

Ans : (A)

Hints : $TiCl_3 + (C_2H_5)_3Al$

48. The oxidant which is used as an antiseptic is :

(A) $KBrO_3$ (B) $KMnO_4$ (C) CrO_3 (D) KNO_3

Ans : (B)

49. Which of the following contributes to the double helical structure of DNA

(A) hydrogen bond (B) covalent bond (C) disulphide bond (D) van-der Waal's force

Ans : (A)

50. The monomer used to produce orlon is

(A) $CH_2=CHF$ (B) $CH_2=CCl_2$ (C) $CH_2=CHCl$ (D) $CH_2=CH-CN$

Ans : (D)

Hints : Orlon or PAN

Monomer $\Rightarrow CH_2=CH-CN$

51. 1 mole of photon, each of frequency 2500 S^{-1}, would have approximately a total energy of :

(A) 1 erg (B) 1 Joule (C) 1 eV (D) 1 MeV

Ans : (A)

Hints : Total Energy = $Nhv = 6.022 \times 10^{23} \times 6.626 \times 10^{-34}$ J.S. $\times$ 2500 $s^{-1} = 9.9$ erg $\approx$ 10 erg

In (A) option, it should be 10 erg instead of 1 erg.

52. If n_t number of radioatoms are present at time t, the following expression will be a constant :

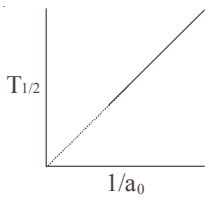
(A) n_t/t (B) In n_t/t (C) d In n_t/dt (D) $t.n_t$

Ans : (C)

Hints : $-\frac{dN}{dt} = \lambda N \Rightarrow -\frac{d \ln N}{dt} = \lambda$

Hence (C)

53. The following graph shows how $T_{1/2}$ (half-life) of a reactant R changes with the initial reactant concentration a_0.



The order of the reaction will be :

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

Ans : (C)

Hints : $t_{½} \propto \frac{1}{a^{n-1}}$

Hence (C)

54. The second law of thermodynamics says that in a cyclic process :

(A) work cannot be converted into heat (B) heat cannot be converted into work

(C) work cannot be completely converted into heat (D) heat cannot be completely converted into work

Ans : (D)

Hints : Because 0 K temperature is unattainable.

55. The equilibrium constant (K) of a reaction may be written as :

(A) $K = e^{-\Delta G/RT}$ (B) $K = e^{-\Delta G^0/RT}$ (C) $K = e^{-\Delta H/RT}$ (D) $K = e^{-\Delta H^0/RT}$

Ans : (B)

Hints : $\Delta G^o = -RT \ln K$

$$\Rightarrow \frac{\Delta G^o}{-RT} = \ln K$$

$$\therefore K = e^{-\Delta G^o/RT}$$

56. For the reaction $SO_2 + \frac{1}{2}O_2 = SO_3$, if we write $K_p = K_c(RT)^x$, then x becomes

(A) –1 (B) $-\frac{1}{2}$ (C) $\frac{1}{2}$ (D) 1

Ans : (B)

Hints : $K_P = K_C(RT)^x$

$x = (\Sigma n_{(g)})_P - (\Sigma n_{(g)})_R$

$$= 1 - \frac{3}{2} = -\frac{1}{2}$$

57. If it is assumed that $^{235}_{92}U$ decays only by emitting α and β particles, the possible product of the decay is :

(A) $^{225}_{89}Ac$ (B) $^{227}_{89}Ac$ (C) $^{230}_{89}Ac$ (D) $^{231}_{89}Ac$

Ans : (B)

Hints : New mass no. = 235 – 2 × 4 = 227

New at. no. = 92 – 2 × 2 + 1 = 92 – 4 + 1 = 89

58. The time taken for 10% completion of a first order reactin is 20 mins. Then, for 19% completion, the reaction will take

(A) 40 mins (B) 60 mins (C) 30 mins (D) 50 mins

Ans : (A)

Hints : $t = \frac{2.303}{\lambda}\log\frac{N_0}{N}$

$$20 = \frac{2.303}{\lambda}\log\frac{100}{90} \quad \text{..... (i)}$$

$$t = \frac{2.303}{\lambda}\log\frac{100}{81} \quad \text{.....(ii)}$$

equation (i) / (ii)

$\therefore t = 40$ min.

59. Which of the following will decrease the pH of a 50 ml solution of 0.01 M HCl?

(A) addition of 5 ml of 1 M HCl (B) addition of 50 ml of 0.01 M HCl

(C) addition of 50 ml of 0.002 M HCl (D) addition of Mg

Ans : (A)

Hints : 50 ml 0.01 M $\equiv 50 \times 0.01 = 0.5$ millimole

5 ml 1 (M) $\equiv 5 \times 1 = 5$ millimole

Total millimoles = 5.5 millimole

Total volume = 55 ml.

$$\text{Molarity} = \frac{5.5}{55} = 0.1(\text{M}) = 10^{-1}\ (\text{M})$$

pH = 1

60. Equal volumes of molar hydrochloric acid and sulphuric acid are neutralised by dilute NaOH solution and x kcal and y kcal of heat are liberated respectively. Which of the following is true?

(A) x=y (B) $x = \frac{y}{2}$ (C) x=2y (D) none of the above

Ans : (B)

Hints : Enthalpy of 1 g equivalent of strong acid and 1 g equivalent strong base = 13.7 kcal

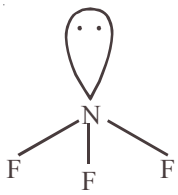
Equal volume contains double eq. of H_2SO_4 than HCl

61. Hybridisation of central atom in NF_3 is

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

Ans : (A)

Hints :



3σ & 1 lone pair

Hyb. = sp^3

62. Of the following compounds the most acidic is

(A) As_2O_3 (B) P_2O_5 (C) Sb_2O_3 (D) Bi_2O_3

Ans : (B)

Hints : In a group as we go downwards, the oxide basic character increases hence maximum acidic oxide is P_2O_5

63. The half-life of a radioactive element is 10 hours. How much will be left after 4 hours in 1 g atom sample?

(A) 45.6×10^{23} atoms (B) 4.56×10^{23} atoms (C) 4.56×10^{21} atoms (D) 4.56×10^{20} atoms

Ans : (B)

Hints : $t_{½} = 10$ hr. $\quad K = \frac{0.693}{10}$

$$4 = \frac{2.303 \times 10}{0.693} \log \frac{1}{N}$$

$$\log \frac{1}{N} = \frac{4 \times 0.693}{2.303 \times 10} = 0.12036$$

$\log N = -0.12036 = \bar{1}.87964$

$N = 7.575 \times 10^{-1}$ g atoms

$\therefore$ No. of atoms $= 7.575 \times 10^{-1} \times 6.023 \times 10^{23}$ atoms $= 4.56 \times 10^{23}$ atoms

64. For the Paschen series the values of n_1 and n_2 in the expression $\Delta E = Rhc\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ are

(A) n_1=1, n_2=2, 3, 4..... (B) n_1=2, n_2=3, 4, 5..... (C) n_1=3, n_2=4, 5, 6..... (D) n_1=4, n_2=5, 6, 7.....

Ans : (C)

Hints : In Paschen series electron shifting to third shell i.e., $n_1 = 3$ to $n_2 = 4, 5, 6, ...$

65. Under which of the following condition is the relation $\Delta H = \Delta E + P\Delta V$ valid for a closed system?

(A) Constant Pressure (B) Constant temperature

(C) Constant temperature and pressure (D) Constant temperature, pressure and composition

Ans : (A)

Hints : This is applicable when pressure remains constant.

66. An organic compound made of C, H and N contains 20% nitrogen. Its molecular weight is :

(A) 70 (B) 140 (C) 100 (D) 65

Ans : (A)

Hints : Nitrogen at. wt. = 14 in a molecule minimum one atom of N is present

i.e., 20% ≡ 14 Molecular weight = 70

100% ≡ 14 × 5 = 70

67. In Cu-ammonia complex, the state of hybridization of Cu^{+2} is

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

Ans : (D)

Hints : In $[Cu(NH_3)_4]^+$

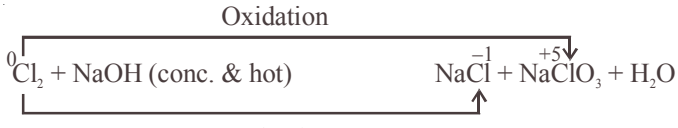
Cu^{+2} is in a state of dsp^2 hybridization and shape of the complex is square planar. (One e^- is excited from 3*d* to 4*p* during complex formation)

68. The reaction that takes place when Cl_2 gas is passed through conc. NaOH solution is :

(A) Oxidation (B) Reduction (C) Displacement (D) Disproportionation

Ans : (D)

Hints :



Hence the reaction is disproportionation

69. "Electron" is an alloy of

(A) Mg and Zn (B) Fe and Mg (C) Ni and Zn (D) Al and Zn

Ans : (A)

Hints : Electron is an alloy of Mg(95%) + Zn(4.5%) and Cu(0.5%)

70. Blackened oil painting can be restored into original form by the action of :

(A) Chlorine (B) BaO_2 (C) H_2O_2 (D) MnO_2

Ans : (C)

Hints : Blackening of oil painting is due to PbS which is oxidised by H_2O_2 to form white $PbSO_4$

$PbS + H_2O_2 \rightarrow PbSO_4 + H_2O$

(Black) (white)

71. Of the following acids the one which has the capability to form complex compound and also possesses oxidizing and reducing properties is :

(A) HNO_3 (B) HNO_2 (C) HCOOH (D) HCN

Ans : (B) $H\overset{+3}{N}O_2$

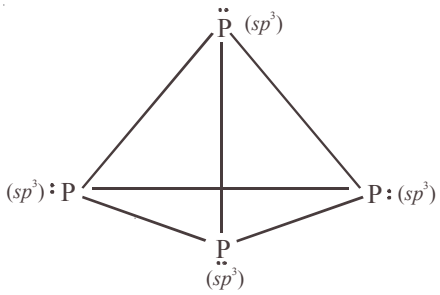
Hints : Here oxidation state of N lies between –3 to +5

72. Atoms in a P_4 molecule of white phosphorus are arranged regularly in the following way :

(A) at the corners of a cube
(B) at the corners of a octahedron
(C) at the corners of a tetrahedron
(D) at the centre and corners of a tetrahedron

Ans : (C)

Hints :



73. Which of the following statements is not correct

(A) Silicon is extensively used as a semiconductor
(B) Carborundum is SiC
(C) Silicon occurs in free state in nature
(D) Mica contains the element silicon

Ans : (C)

Hints : Silicon exist in nature in combined state as SiO_2

74. In aluminium extraction by the Bayer process, alumina is extracted from bauxite by sodium hydroxide at high temperature and pressures :

$$Al_2O_3(s) + 2OH^-(aq) \rightarrow 2Al_2O_2^-(aq) + H_2O(1)$$

Solid impurities such as Fe_2O_3 and SiO_2 are removed and then $Al(OH)_4^-$ is reprecipitated :

$2Al(OH)_4^- \rightarrow Al_2O_3.3H_2O(s) + 2OH^-(aq)$. In the industrial world :

(A) Carbon dioxide is added to precipitate the alumina
(B) Temperature and pressure are dropped and the supersaturated solution seeded
(C) Both (A) and (B) are practised
(D) The water is evaporated

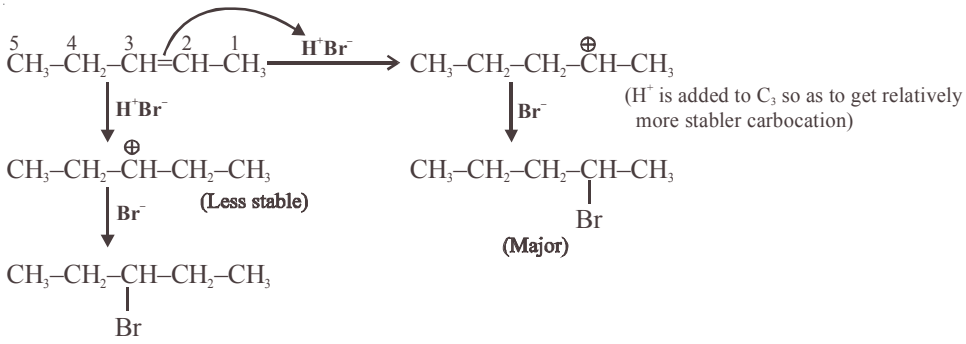
Ans : (B)

75. The addition of HBr to 2-pentene gives

(A) 2-bromopentane only
(B) 3-bromopentane only
(C) 2-bromopentane and 3-bromopentane
(D) 1-bromopentane and 3-bromopentane

Ans : (C)

Hints :



76. Ethelene can be separated from acetylene by passing the mixture through :

(A) fuming H_2SO_4 (B) pyrogallol (C) ammoniacal Cu_2Cl_2 (D) Charcoal powder

Ans : (C)

Hints : $H–C\equiv C–H + Cu_2Cl_2 \rightarrow Cu^+C^- \equiv C^-Cu^+\downarrow$

Red ppt.

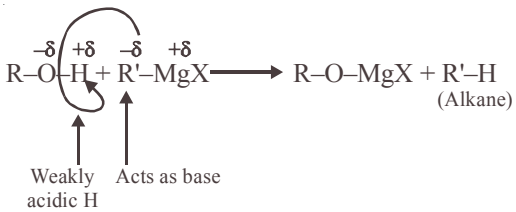
$H_2C=CH_2 + Cu_2Cl_2 \rightarrow$ No. ppt

77. Reaction of R OH with R′MgX produces :

(A) RH (B) $R'H$ (C) $R-R$ (D) $R'-R'$

Ans : (B)

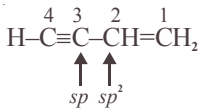
Hints :



78. In the compound $HC \equiv C - CH = CH_2$ the hybridization of C–2 and C–3 carbons are respectively :

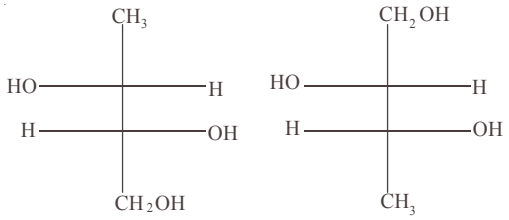
(A) sp^3 & sp^3 (B) sp^2 & sp^3 (C) sp^2 & sp (D) sp^3 & sp

Ans : (C)

Hints : 

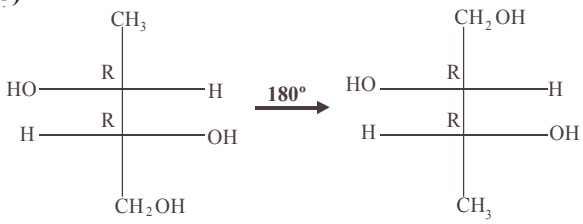
(Double bond is preferred)

79. The two structures written below represent



(A) pair of diastereomers (B) pair of enantiomers (C) same molecule (D) both are optically inactive

Ans : (C)



I & II are same Fischer projection because 180° rotation doesn't change configuration

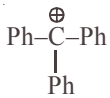
Hints :

I II

80. Which of the following carbocations will be most stable ?

(A) $Ph_3\overset{+}{C}$ (B) $CH_3-\overset{+}{C}H_3$ (C) $(CH_3)_2\overset{+}{C}H$ (D) $CH_2=CH-\overset{+}{C}H_2$

Ans : (A)

Hints : 

(Highly resonance stabilized)

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PHYSICS

SECTION-II

1 The displacement x of a particle at time t moving under a constant force is t = $\sqrt{x}+3$, x in meters, t in seconds. Find the work done by the force in the interval from t = 0 to t = 6 second.

A. $t=\sqrt{x}+3 \Rightarrow x=(t-3)^2 \Rightarrow v=2(t-3)$

v at t = 0, – 6 m/s

v at t = 6 sec., 6 m/s

change in KE is zero $\Rightarrow$ work done = 0

2 Calculate the distance above and below the surface of the earth at which the acceleration due to gravity is the same

A. $$\frac{GM}{(R+h)^2}=\frac{GM(R-h)}{R^3}$$

on solving we get

$-Rh + R^2 - h^2 = 0$

$$h=\frac{-R+\sqrt{R^2+4R^2}}{2}=\frac{(\sqrt{5}-1)R}{2}$$

3 A ray of light travelling inside a rectangular glass block of refractive index $\sqrt{2}$ is incident on the glass-air surface at an angle of incidence of 45°. Show that the ray will emerge into the air at an angle of refraction equal to 90°

A. Given C = 45°

$$\sin c=\frac{1}{\mu}=\frac{1}{\sqrt{2}}=\sin 45°$$

So the ray will graze the interface after refraction at an angle of 90°

4 Two cells each of same e.m.f 'e' but of internal resistances r_1 and r_2 are connected in series through an external resistance R. If the potential difference between the ends of the first cell is zero, what will be the value of R in terms r_1 and r_2 ?

A. $I=\frac{2e}{r_1+r_2+R}$; now $e - Ir_1 = 0$

$\Rightarrow r_2 - r_1 + R = 0$, $R = (r_1 - r_2)$

5 At time t = 0, a radioactive sample has a mass of 10 gm. Calculate the expected mass of radioactive sample after two successive mean lives.

A. Two successive mean lives = $\frac{2}{\lambda}$

No. of nuclei after two mean lives = $N_0 e^{-(\lambda)\left(\frac{2}{\lambda}\right)}=\frac{N_0}{e^2}$

Therefore mass = $\frac{10}{e^2}\ gm$

CHEMISTRY

SECTION-II

6 Calculate the number of H^+ ion present in 1 ml of a solution whose pH is 10.

A. pH = 10

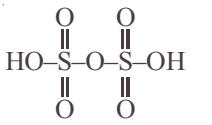
$[H^+] = 10^{-10}$ M

In 1000 ml solution there are 6.023×10^{13} H^+ ions

In 1 ml solution there are 6.023×10^{10} H^+ ions

7 Give the structure of pyro-sulfuric acid. How would you prepare it? What would you observe when colourless HI is added to pyro-sulfuric acid?

A.



$(H_2S_2O_7)$

(Pyro-sulfuric acid)

(Oleum)

Preparation of $H_2S_2O_7$: $\underset{\textbf{(98\%)}}{H_2SO_4} + SO_3 \longrightarrow \underset{\textbf{(Oleum)}}{H_2S_2O_7}$

$\underset{\textbf{(Colourless)}}{H_2SO_4 + 2HI} \longrightarrow 2H_2O + \underset{\textbf{(Violet colour)}}{SO_2 + I_2}$

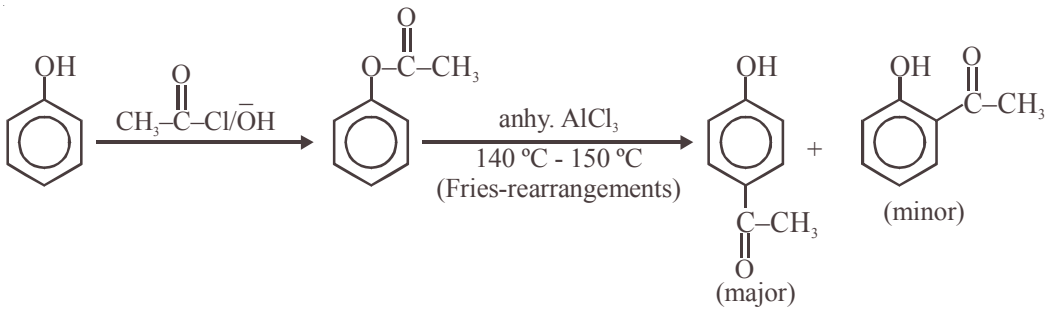
8 Write with a balanced chemical equation how gypsum is used for the conversion of ammonia into ammonium sulfate without using H_2SO_4.

A. Balanced reaction is

$2NH_3 + CaSO_4 + CO_2 + H_2O = (NH_4)_2SO_4 + CaCO_3$

9 Convert phenol to p-hydroxy acetophenone in not more than 2 steps.

A.



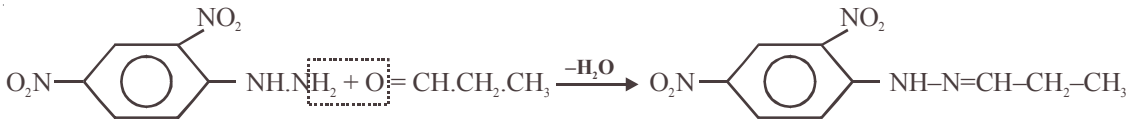
10 An organic compound 'A' on treatment with ammoniacal silver nitrate gives metallic silver and produces a yellow crystalline precipitate of molecular formula $C_9H_{10}N_4O_4$, on treatment with Brady's reagent. Give the structure of the organic compound 'A'.

A. Compound (A) is an aldehyde. It should be propanal CH_3CH_2CHO

Reactions :

(i) $CH_3CH_2CHO \xrightarrow[AgNO_3]{\text{Ammoniacal}} Ag\downarrow$

(Tollen's reagent)

(ii) 

(2, 4-Dinitro phenyl hydrazine)

(Brady's reagent)

(Yellow ppt. with mol. formula $C_9H_{10}N_4O_4$)

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