AIEEE 2007 Chemistry Answers and Solutions

Some Important Hints and Solutions:

1) 4	2) 3	3) 3	4) 1
5) 4	6) 4	7) 1	8) 1
9) 1	10) 4	11) 3	12) 4
13) 2	14) 4	15) 3	16) 4
17) 3	18) 2	19) 4	20) 1
21) 2	22) 3	23) 2	24) 2
25) 4	26) 4	27) 1	28) 1
29) 1	30) 3	31) 3	32) 4
33) 1	34) 3	35) 4	36) 3
37) 3	38) 3	39) 1	40) 4

Some Important Hints and Solutions:

1 $\Delta H = E_f - E_b$

$\Delta H = 80-100 = -20$

2 $nFE°_{cell} = -2.303\ RT \log(Zn^{2+}/Cu^{2+})$

$\Rightarrow 2\times96500\times1.10 = 2.303\times8.314\times298\times\log(Zn^{2+}/Cu^{2+})$

$\Rightarrow 37.3=\log(Zn^{2+}/Cu^{2+})$

$\Rightarrow \log(Zn^{2+}/Cu^{2+}) = 10^{37.3}$

3 Henderson-Hasselbalch equation:

$pH = pK_a + \log10$ [Conjugate Base]/[Acid]

$pH = 4.5 + \log_{10}\ 0.5c/0.5c$

$pH = 4.5$

$pOH = 14-4.5=9.5$

4 A first order reaction has a rate proportional to the concentration of one of the reactants.

In this case the rate of reaction is dependent on A and not dependent on B. So this is first order reaction.

So Rate = k[A][B]

=> mole/(liter.sec) = k(mole/liter)^2

=> k = mole^{-1}liter.sec^{-1}

5 4f is shielded more than 5f

6 Rh(I), Ir(I), Pd(II), Pt(II), and Au(III) belongs to square planar geometry.

7 The asymmetric molecules that have no center, axis of symmetry rotates the plane of polarized light.

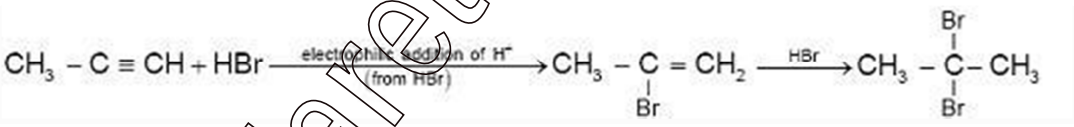
The simplest type of asymmetric molecules (chiral molecule)is one which have four different group attached to same carbon item.

Compound (1) does not have any plane of symmetry, so it is optically active.

8 Secondary structure in proteins consists α-helics and β-sheets structures.

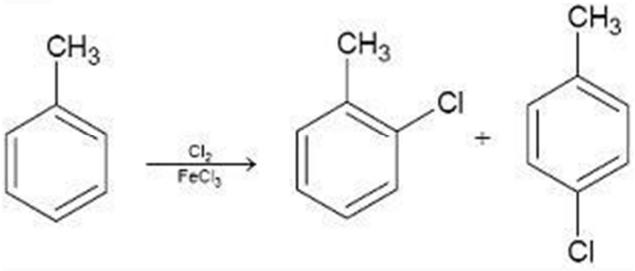
These structures are formed as a result of H-bonding between different peptide groups.

9



10 This is a Carbylamine reaction.
The Carbylamine reaction is a chemical test for detection of primary amines
So the outputs are:
C_2H_5NC and 3KCl

11



12 If a group takes a negative charge by induction, the group possess a -I effect. If a group takes a positive charge by induction, the group possess a +I effect. If a group takes a negative charge by resonance, the group possess a -R effect. If a group takes a positive charge by resonance, the group possess a +R effect.

$-NO_2$ group in benzene ring shows -I and -R effect, which deactivates the ring towards electrophilic substitution but activates it towards nucleophilic substitution.

13 Bond order is the number of bonds between a pair of atoms. Bond order= 1/2(number of bonding orbital - number of anti bonding orbital)

In C_2, bond order=2 (diamagnetic)
In C_2^+, bond order=1.5 (paramagnetic)

In NO, bond order=2.5 (paramagnetic)
In NO^+, bond order=3 (diamagnetic)

In O_2, bond order=2 (diamagnetic)
In O_2^+, bond order=2.5 (paramagnetic)

In N_2, bond order=3 (diamagnetic)
In N_2^+, bond order=2.5 (paramagnetic)

14 The actinoids exhibit more number of oxidation states than lanthanoids because 5f orbitals is further from the nucleus than the 4f orbitals. So, 5f orbital electrons are held less strongly than the 4f orbital electrons.

15 In a mixture of ideal gases, partial pressure is the pressure which the gas would have if it would have alone occupied the volume. The total pressure of a gas mixture is the sum of the partial pressures of each individual gas in the mixture.

Molecular weight of methane (CH_4) = 16
Molecular weight of oxygen (O_2) = 32

Let weight of methane (CH_4) = y
Let weight of oxygen (O_2) = y

Total number of moles in gas mixture = y/16 + y/32 = 3y/32
Mole fraction of oxygen = (y/32)/(3y/32) = 1/3
So partial pressure exerted by oxygen = 1/3

16 An isotonic solution is a solution having the same osmotic pressure as another with which it is compared.

17 H_2O [liquid][(n_g=0)] ----------> H_2O [gas](n_g=1)
Δn_g=1-0=1
$\Delta H = \Delta U + \Delta nRT$
$\Delta U = 41 - 8.3\times10^{-3}\times373$
$\Delta U = 37.9$ kJmole^{-1}

18 Solubility constant (K_{sp}) = [Ag^+ (aq)][IO_3^-(aq)]
$1\times10^{-8} = s^2$
=> s = 10^{-4} mole litre^{-1}
Molecular weight of $AgIO_3$ = 282.767
So s=282.767×10^{-4} gm litre^{-1}
=> s=282.767×10^{-7} gm ml^{-1}
=> s=2.83×10^{-3} gm 100ml^{-1}

19 Half life of radioactive element

$t_{1/2} = \ln(2)/\lambda$

so, $30 = \ln(2)/\lambda$
=> $\lambda = 0.023105$

$A = \lambda N$

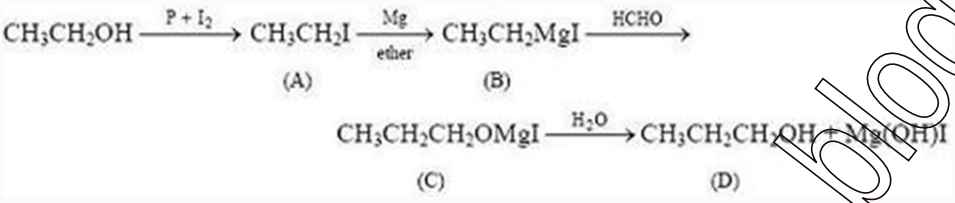
Let initial activity is = A_1
Let number of particles at initial stage = N_1
Let permissible activity is = A_2
Let number of particles at permissible stage = N_2
$A_1/A_2 = N_1/N_2$
$10 = N_1/N_2$
$N_1 = 10N_2$
$N_t = N_0e^{-\lambda t}$
$N_2 = N_1e^{-\lambda t}$
$0.1 = e^{-0.023105t}$
$\ln 0.1 = -0.023105t$
$-2.3026 = -0.023105t$
t = 100 days (approx.)

20 Chiral objects are not superposable on its mirror image.

Twisted boat is chiral as it does not have plane of symmetry.

21 Steric hindrance happens when the size of groups, within a molecule prevents the chemical reactions that are observed in related smaller molecules.

22



23 The orbital that have highest value of (n + l) has higher energy. (n+l) is highest for (n=3 and l=2)

24 The more the difference in electronegativity H and the other electronegative atom, stronger is the bond. Fluorine is the most electronegative element. So the HF bond is the strongest.

25 6 mole of HCl produces 3 mole of H_2 gas.

So, 1 mole of HCl produces 0.5 mole of H_2 gas.

Volume of 0.5 mole of H_2 gas is 11.2 L.

26 x is a salt of strong acid and weak base.

In aqueous solution it produces ammonium ion. That increases the acidity of soil.

27 In an isolated system, a process is spontaneous if the change in entropy is positive.

28 Isotope have same number of protons but different numbers of neutrons.

So neutron particle emission will generate Isotope.

29 (Incomplete)

$\Lambda^\circ_{CH3CO2Na} = \lambda^\circ_{CH3CO2^-} + \lambda^\circ_{Na^+}$ ..... (a)

$\Lambda^\circ_{HCl} = \lambda^\circ_{H^+} + \lambda^\circ_{Cl^-}$ ..... (b)

Add (a) and (b)

$\Lambda^\circ_{CH3CO2Na} + \Lambda^\circ_{HCl} = \lambda^\circ_{CH3CO2^-} + \lambda^\circ_{Na^+} + \lambda^\circ_{H^+} + \lambda^\circ_{Cl^-}$

$=> \Lambda^\circ_{CH3CO2Na} + \Lambda^\circ_{HCl} = \lambda^\circ_{CH3CO2^-} + \lambda^\circ_{NaCl} + \lambda^\circ_{H^+}$

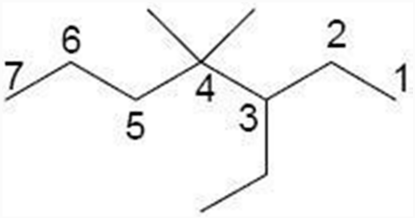
$=> \Lambda^\circ_{CH3CO2H} = \lambda^\circ_{CH3CO2^-} + \lambda^\circ_{H^+}$

30 overall basic strength varies as
2° > 1° > 3°

31 In aliphatic compounds, carbon atoms are joined together in straight chains, branched chains, or non-aromatic rings

Any aliphatic carbon with hydrogen attached to it, in combination with benzene ring, will be oxidized to benzoic acid by $KMnO_4/H^+$

32



3-ethyl-4, 4-dimethylheptane

33 $O_2^{2-} = 18\ \sigma1s^2\ \sigma^*1s^2\ \sigma2s^2\ \sigma^*2s^2\ \sigma2P_z^2\ ,\ \pi2P_x^2$

$= \pi2P_y^2\ ,\ \pi^*2P_x^2 = \pi^*2P_y^2$

Hence diamagnetic

34 Due to inert pair effect +2 oxidation state increases as we move down this group in group 14.

So , $SiX_2 << GeX_2 << SnX_2 << PbX_2$

35 $3Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

So 4 is incorrect

36 Greater the charge/size ratio of a cation, the mote is its polarizing power.

So 3 is correct

37 Molecular weight of H_2SO_4 = 98
Molarity of solution given = 3.6
So 1 liter of solution contains 3.6 moles of H_2SO_4
So 1 liter of solution contains 3.6×98 gm of H_2SO_4
Let the density of solution = D gm/ml
So 1000D gm of solution contains 3.6×98 gm of H_2SO_4
Now (3.6×98)/(1000D) = 0.29
So D = 1.2 gm/ml

38 $K = K_1 \times K_1$

$\Rightarrow K = 1.0\times10^{-5} \times 5.0\times10^{-10}$

$\Rightarrow K = 1.0\times10^{-15}$

39 As per Raoult's law:

Vapor pressure of an ideal solution is dependent on the vapor pressure of each chemical component and the mole fraction of the component present in the solution.
So, 290 = 200×0.4 + P×0.6

$\Rightarrow P = 350$

40 $\Delta G = \Delta H - T\Delta S = 0$

$\Rightarrow \Delta H = T\Delta S$

$\Rightarrow T = 179.1/160.2 = 1118$ (approx.)