FIRST YEAR HIGHER SECONDARY EXAMINATION MARCH 2016

CHEMISTRY – ANSWER KEY

1. a) Gay – Lussac's law of Gaseous volumes (1)

   b) The relative number of moles means %/atomic mass.

Elements	%	Relative no. of moles	Simple ratio	Simplest whole no. ratio
A	70	1.25	1.25/1.25 = 1	2
B	30	1.88	1.88/1.25 = 1.5	3

   Emperical formula is A_2B_3

   (Here at. Mass is not given. But it can be find out from % composition and the no. of moles as follows)

   Atomic mass of A = %/no. of moles = 70/1.25 = 56

   Atomic mass of B = %/no. of moles = 30/1.88 = 15.96

   So, emp. Formula mass = 56 x 2 + 15.96 x 3 = 159.88 = 160

   n = mol.mass/emp. Formula mass = 160/160 = 1

   Molecular formula = (emp. Formula)n = (A_2B_3)x 1 = A_2B_3 (3)

2. a) Principal quantum number (n), Azimuthal quantum number (l), Magnetic quantum number (m) and Spin quantum number (s). (2)

   b) i) 1s ii) 2p (2)

   c) 2 (1)

3. a) i) because of the half filled electronic configuration of N. (N- $1s^2\ 2s^2\ 2p^3$)

   ii) due to their small size, high electronegativity and ionisation enthalpy, large charge/radius ratio and due to the absence of vacant d-orbitals. (3)

   b) Ca^{2+} and Br^- (1)

4. a) i) M.O confn. of F_2 - $\sigma1s^2\ \sigma^*1s^2\ \sigma2s^2\ \sigma^*2s^2\ \sigma2p_z^2\ \pi2p_x^2\ \pi2p_y^2\ \pi^*2p_x^2\ \pi^*2p_y^2$

   ii) Bond order = ½ [Nb-Na] = ½ [10-8] = 1 (2)

   b) Low ionisation enthalpy of the electropositive atom (metal atom)

   High negative electron gain enthalpy of the electronegative atom (non-metal atom)

   High lattice enthalpy of the ionic compound formed. [Any 2 required] (2)

   c) i) NH_4^+ - Tetrahedral ii) $HgCl_2$ – Linear (1)

5. a) van der Waals equation. The equation is $(P + n^2a/V^2)(V- nb) = nRT$ (2)

   b) surface tension (1)

   c) The law states that at constant temperature, the total pressure exerted by a mixture of non-reacting gases is equal to the sum of the partial pressures of the component gases. (Or, write its mathematical form.) (1)

6. a) Hess's law (1)

   b) The required equation is $C(s) + 2H_2(g) \rightarrow CH_4(g)$

   The given data are:

   $C(s) + O_2(g) \rightarrow CO_2(g)$, ΔH = -393.7 kJ/mol ……………….. (1)

   $H_2(g) + ½\ O_2(g) \rightarrow H_2O(l)$, ΔH = -285.8 kJ/mol ………….. (2)

   $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l)$, ΔH = -890.4 kJ/mol …………….. (3)

   Multiply equation (2) by 2, we get $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$, ΔH = 2 x -285.8 = -571.6 kJ/mol ………… (4)

   (1) + (4) – (3) gives :

$C(s) + O_2(g) + 2H_2(g) + O_2(g) - CH_4(g) - 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l) - CO_2(g) + 2\ H_2O(l)$, ΔH = -393.7 + -571.6 – (-890.4)

   On simplifying we get,

   $C(s) + 2H_2(g) \rightarrow CH_4(g)$, ΔH = -74.9 kJ/mol (3)

7. a) $Kc = \frac{[CuSO_4.3H_2O][H_2O]^2}{[CuSO_4.5H_2O]}$ Or, $Kc = [H_2O]^2$, since the concentration of any solid is unity.

   b) Ksp of $Al(OH)_3 = 1 \times 10^{-36}$

The dissolution of $Al(OH)_3$ in water can be given by:

$Al(OH)_3 \rightleftharpoons Al^{3+}(aq) + 3\ OH^-(aq)$

Let the solubility of $Al(OH)_3$ be S. Then

$Al(OH)_3 \rightleftharpoons Al^{3+}(aq) + 3\ OH^-(aq)$

S S 3S

$Ksp = [Al^{3+}][OH^-]^3$

$Ksp = S \times (3S)^3 = 27\ S^4$

$S^4 = Ksp/27 = 1 \times 10^{-36}/27 = 0.037 \times 10^{-36}$

Or, $S = \sqrt[4]{(0.037 \times 10^{-36})} = 0.4386 \times 10^{-9}$

So, solubility of $Al(OH)_3$ is 0.4386×10^{-9} mol/L (2)

OR

a) According to this concept acids are electron pair acceptors and bases are electron pair donors.
Or, Substances which donate electron pair are called Lewis bases and substances which accept electron pair are called Lewis acids.

Example for Lewis acids are BF_3, $AlCl_3$ etc.

Example for Lewis bases are NH_3, H_2O^- etc. (3)

b) Henderson Hasselbalch equation for an acidic buffer is pH = pKa + log [salt]/[acid]

Here Ka for acetic acid is 1.8×10^{-6}.

pKa = -logKa = $-\log(1.8 \times 10^{-6})$ = 5.745

pH = pKa + log [salt]/[acid]

= 5.745 + log(0.5/0.1)

= 5.745 + 0.69897 = 6.44 (2)

8. a) The solution becomes blue colour due to the formation of Cu^{2+} ions. (1)

b) Ag^+ ($AgNO_3$) is the oxidising agent and Cu is the reducing agent. (1)

c) O.N of Cr in $K_2Cr_2O_7$ is +6 and P in $H_2P_2O_5$ is +4 (1)

9. a) This is due to the oxidising action of H_2O_2. (2)

$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$

b) Here H atoms are allowed to recombine on the surface to be welded to generate the temperature of 4000K. (2)

10. a) The blue colour of the solution is due to the formation of ammoniated electron [which absorbs energy in the visible region and gives blue colour to the solution]. (2)

b) i) $CaSO_4$. ½ H_2O Or, $(CaSO_4)_2.H_2O$ (1)

ii) Setting of plaster of paris. (1)

11. a) Diamond, graphite, fullerene [any 2 required] (1)

b) In diamond, each carbon atom undergoes sp^3 hybridisation and linked to four other carbon atoms in a tetrahedral manner. So it has a a rigid three dimensional network of carbon atoms.
[Or, the structure of graphite or fullerene is required.] (2)

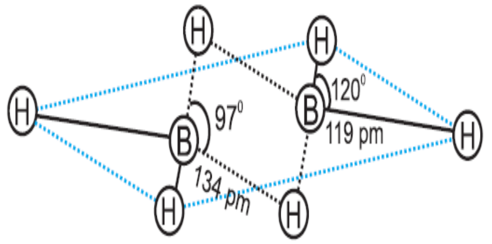
c) This is due to the absence of vacant d-orbitals in carbon. (1)

OR

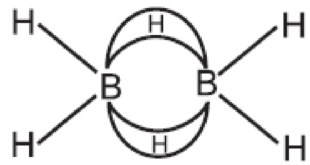
a) Diborane (1)

b) In diborane, the two boron atoms and 4 hydrogen atoms lie in one plane. These four H atoms are called terminal hydrogen. The other two hydrogen atoms lie one above and one below this plane. These H atoms are called bridging hydrogen atoms. The four terminal B-H bonds are regular two centre-two electron bonds while the two bridge (B-H-B) bonds are three centre- two electron (3c-2e) bonds.

Or, any one of the following diagram:



Or,

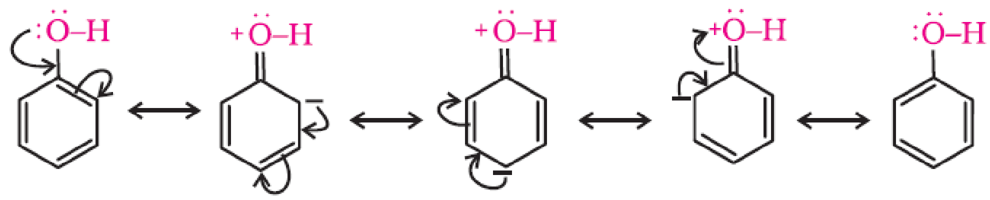


(2)

c) Boron compounds are electron deficient. Or, boron compounds have only six electrons around B. Or, due to the presence of vacant orbitals in B. (1)

12. a) i) 3-chloropropanal ii) 3-methylpentanenitrile (2)

b) i) Resonance structures of phenol



(2)

ii) – OH group is an ortho-para directing group. (2)

OR

a) $CH_2 = CH - CH_2 - CH(OH) - CH_3$

$CH_3\text{-}CH(OH)\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CHO$ (2)

b) i) A reagent that brings an electron pair is called a nucleophile. Or, nucleophiles are electron rich species attack at electron deficient centre.

Example for nucleophiles are OH^-, CN^-, NO_2^-, Cl^-, Br^-, I^-, H_2O, NH_3, $R\text{-}NH_2$ etc.

A reagent that takes away an electron pair is called an electrophile. Or, electrophiles are electron deficient species attack at electron rich centre.

Example for electrophiles are carbocations (R^+), -CHO, >CO etc. (3)

ii) homolysis or hemolytic fission (1)

13. a) Ethyne reacts with sodium to form sodium ethynide and liberate H_2. It reacts with sodamide ($NaNH_2$) to form sodium ethynide and liberate ammonia.

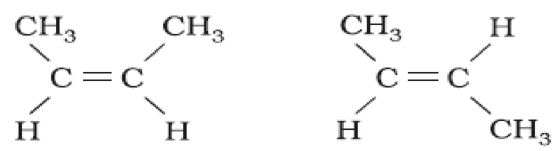
$CH{\equiv}CH + Na \rightarrow CH{\equiv}C^-Na^+ + \frac{1}{2} H_2$

$CH{\equiv}CH + NaNH_2 \rightarrow CH{\equiv}C^-Na^+ + NH_3$ (2)

b) iii) $C_3H_6 + HBr$ (1)

c) i) Geometrical isomerism or, cis-trans isomerism

ii)



cis-But-2-ene *trans*-But-2-ene

Cis -2-butene is more polar. (2)

14. a)

A	B
CFC's	Ozone depletion
Oxides of nitrogen	Red haze in the traffic

Cadmium	Kidney damage
Nitrates	Blue baby syndrome

(2)

b) i) **Dry Cleaning of Clothes**: Liquefied CO_2, with a suitable detergent is used for dry cleaning clothes.

ii) **Bleaching of Paper**: Hydrogen peroxide (H_2O_2) with suitable catalyst is used for bleaching paper.

iii) **Synthesis of some chemicals** [Any 2 required] (1)

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