**CHOGORIA MURUGI FORM 4 JOINT EXAMINATION 2023**

**233/2 CHEMISTRY MARKING SCHEME**

1.a) H✓½ I✓½ group VII✓½ gains one electron✓½ to form ion

b) Giant ionic structure✓½ - A is a metal, oxygen is a non-metal hence form ionically, bounded compound✓½

c) H ✓ is more reactive than I . H is more✓½ electronegative element

d) The oxide of D is covalently bounded hence has simple molecular structure✓½and weak van der waals forces while that of C has ionic bond, hence giant ionic structure✓½

e) i) A ✓½ the most electropositive element the only element in group I✓½ i.e. metallic element in group I has the highest ability to✓½ loose valence electron from ion. Due to weakest electrostatic✓½ forces

 ii) H ✓½is the most electronegative element. the only element in group VII✓½ which has the shortest/shorter✓½ atomic radius, has the highest✓½ ability to gain electron to form iron✓½

f) i) B has larger✓½ atomic radius than H, B belong to group II. B has less charge nuclear charge✓½ than H:

 ii) E has large✓½ atomic radius than D for E has 3 energy levels i.e. belongs in third period while D has✓½ two energy levels, in 2nd period.

g) The brown ✓½ solid of copper changes to blue✓½ solution of copper (II) nitrate solution brown gas ✓½ of nitrogen (IV) oxide gas formed. The copper metal is oxidized by conc HNO3 to Cu2+ while the acid is reduced to NO2 gas and water

2. a) i) Purifies – removes dust particles and other impurities that would otherwise poison

 the catalyst. √ (½)

 ii) Heat exchanger – Heats the ammonia – air mixture reactions from the compressor

 while it cools the hot gaseous products from the catalytic chamber√ (½)

b) i) Gas A – Ammonia /NH3 √( ½)

 ii) Gas B – Nitrogen (II) Oxide /NO √ (½)

 iii) Catalyst C– Platinum – rhodium √ (½)

 c) i) 4NH3(g) + 5O2(g) → 4NO(g) + 6H2O(g) 🗸 1

 ii) 2NO2 (g) + H2O (l) → HNO3 (aq) + HNO2 (aq) 🗸 1

(d).RFM HNO3 = 1 + 14 + 48 = 63 √( ½)

1cm3 (1.42 x 68/100) √ (½) g of HNO3 = 0.9656g

 1cm3 (1.42 x 68) √ (½) moles of HNO3 = 0.015326 moles √ (½)

 63 100

∴ 1000 1000 x 1.42 x 68 √ (½)

 1 63 100

 = 15.33 M (½) **total *3 mk***

e)i) Effervescence of red / brown gas / fumes are produced(√ 1)

 ii) Hot conc. HNO3 oxidizes sulphur to sulphuric (VI) acid and itself is reduced to

 nitrogen (IV) oxide (√ 1)

 ***Or*** S(s) + 6HNO3 (aq) → H2SO4 (aq)  + 6NO2 (g)  + 2H2O (l)

3. a) Gas D – Sulphur (IV) Oxide // Sulphure dioxide 🗸 ½

 Gas L – Hydrogen Sulphide 🗸 ½

 Gas V – Hydrogen gas🗸 ½ ***Accept – name only 1½mk***

b)i)Compound B – Iron (III) Chloride // FeCl3 🗸 ***½***

ii)Compound T – Iron (II) Sulphide // FeS 🗸 **½**

iii)Solid A – Iron (III) oxide // Fe2O3 🗸 ½

iv)Solid V – Iron (III) hydroxide // Fe(OH)3 🗸 **½**

v)Solid X – Iron (II) hydroxide // Fe(OH)2 🗸 **½**

 ***Accept – name or formula***. ***Rej if name and formula do not tally 2½mk***

c)Rusting 🗸 1 ***1mk***

d)Dirty green/green 🗸1

e)Step 1 2Fe(s) + 3Cl2(g)  2FeCl3 🗸 1 ***1mk***

Step 5 FeS(s)  + 2HCl2(ag)  2FeCl2(s) + H2 S(g)🗸 1

 ***Deny ½ if state symbols are wrong or missing.***

f)An oxidizing agent 🗸1 ***1mk***

4.a) **I**.

 i) **Conc.** Sulphuric (VI) acid 🗸 ½ / sulphuric acid ***Acc. formula***

 ii) Hydrogen gas // H2🗸 ½

 **II.** AlCl3 🗸 1

 b) i) NaCl(s) + H2SO4(l) NaHSO4(aq) + HCl(g) 🗸1 ***1 mk***or ***Deny ½ if state symbols wrong or missing***

 H2SO4(l) + Cl-(aq) H2SO4(aq) + HCl(g)

ii) 2Al(s) + 6HCl (g) 2AlCl3(s) + 3H2(g) 🗸1 ***1 mk***

1. Sublimation 🗸 ½
2. Gas is acidic 🗸1 therefore reacts 🗸 ½ with the basic 🗸 ½ calcium oxide ***2mk***
3. Unreacted HCl 🗸 ½ gas dissolves forming a **strong acidic**🗸 ½ solution

 ***acc- correct equation*** ***1mk***

1. $moles of HCL=\frac{480}{24000}=0.02 mols$ 🗸 ½

 Moles ratio HCl : AlCl3 is 3:1

 Moles of AlCl3 = 0.02 x 1/3

 = 0.0066 moles 🗸 ½ ***2mk***

 RFM 🗸 ½ = 133.5

 Mass of T = 0.0066 x 133.5 = 0.8811 g🗸 ½

1.

 ***1mk***

Water

Inverted funnel 🗸 1

1. Hydrogen Chloride does not dissociate into ions in methylbenzene (it exists in molecular form). ✓ On addition of water, HCl dissociates✓ and H+(aq) reacts with carbonates evolving Carbon (IV) Oxide gas (CO2 (g))

i) HCl(g ) + NH3(g) NH4Cl (s) 🗸 ½ ***1mk***

White Fumes 🗸 ½

***The observation must be mentioned / indicated***

5.i) Hygroscopy

ii) Deliquescence

iii) efflorescence

 2+

b) i) (Zn(OH)4) 2+🗸1mk ii) CU(OH)4 √1

(c)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| element | Fe | S | O | H2O |
| mass | 20.2 | 11.5 | 23.0 | 45.3 |
| Ram  | 56 | 32 | 16 | 18 |
| mols | 0.36 | 0.36 | 1.44 | 2.52🗸1mk |
| Mole ratio | 1 | 1 | 4 | 7 |

Empirical formula is FeSO4.7H2O

n(FeSO4.7H2O)=278

278n=278

n=1🗸1mk

Formula FeSO4.7H2O🗸1mk

d)

* Add excess lead carbonate to dilute HNO3  acid 🗸 1mk
* Filter 🗸1/2mk
* Add excess dilute HCl to the filtrate 🗸1/2mk
* Filter the residue is lead(ii) chloride 🗸1/2mk
* Rinse residue with distilled water and dry between filter paper to obtain solid PbCl2🗸1/2mk

6. (a) i) phosphorous smolders ✓1

 Its reaction with air is exothermic ✓1

 ii) phosphorous (iii)oxide formed is an acidic oxide which dissolves in water to form

 phosphoric oxide. phosphoric(iii) acid ✓1

 iii) volume of air used = 30.65 – 24. 28 = 6.37 cm3

 percentage volume = 6.37/30.65 x 100 = 20.78%✓1

b) black powder changes to red brown bead and White ash formed ✓1

 Zn reduces CuO to copper metal and Zn is oxidized to MgO✓1

c) carbon (II) oxide ✓1

 Sulphuric (IV) oxide✓1

 Nitrogen (IV) oxide

 Carbon (iv) oxide

d) i)3Mg(s) + N2(g) Mg3N2(s)

 ii) a colourless gas with a characteristic pungent smell is produced. Magnesium nitride is

 hydrolyzed by water producing ammonia gas.

 iii) blue litmus paper **remained blue**

7.(a) i) R.F.M of E.M.F = 58

 R.F.M = 116

 n = $\frac{RFM}{RFM of EMp }= \frac{116}{58}$✓½ =1.7= 2✓½

 Molecular formula = (Emp formula) x n

 = (C3H6O) x✓½ = C6H12O2✓½

 ii) % of C =$\frac{mass of C}{RFM} ×100\%$

 = $\frac{3 ×12}{116} ×100$ = $\frac{36}{116} ×100$✓½ = 31.03% ✓½

I) few drops of **conc**.sulphuric acid✓1

II) i) Z -self-addition polymerisation. **Reject** polymerisation

 ii) L - Hydrolysis✓1

 iii) E -Oxidation of ethanol✓1 by acidified KMnO4

 iv) N - Esterification✓1

III) i) ii)

 ✓½ ✓½

 1, 2 – difluoroethane✓½ Ethanoic acid ✓½

iii)

O

║

CH3— C —O—CH2CH3

 Ethylethanoate✓½