**MID TERM SERIES-TERM 1-2023**

**CHEMISTRY PAPER 2 (233/2)**

**FORM FOUR (4)**

**TIME: 2 HOURS**

**MARKING SCHEME**

1. **1** (a) Alkaline-earth metals (1mk)

(b) B (1mk)

(c) (i) A2B3 (½mk) (ii) H2SO4 (½mk)

(d)

+

-

Distribution of electrons (1mk) and charges (1mk)

No label (0mk)

(e) D has a smaller atomic size than C//C has larger atomic size than D (1mk)

D has more protons than C//D has stronger nuclear charge than C (1mk)

(f) H (½mk). Loses electrons most readily/largest atomic radius/weakest nuclear charge (explanation ½mk)

(g) 2A(s) + 6HCl(aq) 2ACl3(aq) + 3H2(g) 1mk

Moles of A = = 0.003moles ½mk

Mole ratio 1:3

Moles of HCl = 0.003x3 = 0.009moles ½mk

½mk = 0.45M ½mk

(h) The melting point increase with increase in atomic number. 1mk

This is due to increase in the strength of van der waal’s forces (inter-molecular forces) 1mk

**2** (a)(i) A fuel is a substance that can be used as a source of energy. (1 mk)

OR A substance that produces useful energy when it undergoes a chemical or nuclear reaction.

(ii) molar mass of C3H8 = 12x3+1x8= 44 g mol-1 ½mk

Heating value 1 mk

= 50 kJ/g ½mk

(b) (i) molar enthalpy of combustion is the heat change when one mole of a substance is burnt completely in oxygen. (1mk)

(ii) 2C(s) + H2(g) +226 C2H2(g)

1/2O2

2O2

2(-394)

- 5/2O2 (1 mk)

-286

2CO2(g) + H2O(l)

**∆HC(ethyne)= -(+226) + 2(-394)+ (-286) (1 mk)**

**= -226-788-286**

**= -1300 kJ mol-1 (1 mk)**

(c) (i) ∆Hsoln= -(-2237) + (-1650)+ (2X-364) (1 mk)

=  **-141 kJ mol-1** (1 mk)

(ii)

*√*½

*√*½

*√*½

Ca2+(aq) + 2Cl-(aq)

-2378

-141

*√*½

*√*½

*√*½

Ca2+(g) + 2Cl-(g)

Energy (3 mks)

+2237

CaCl2(s)

Reaction path

**3** (a) (i) ***Potassium nitrate (Reject KNO3)*** (1mk)

(ii) ***(NH4)2SO4 (S) + 2KNO3(s) K2SO4(s) +2H2O(l) +N2O(g)*** (1mk)

(iii)***The magnesium ribbon continues to burn with a dazzling flame forming white solid.*(1mk)**

***This is because burning magnesium produces sufficient heat to dissociate nitrogen (I) oxide into oxygen and nitrogen gases(*½mk)*. The oxygen supports combustion of magnesium to form white magnesium oxide while nitrogen combines with hot magnesium metal to form white magnesium nitride. (*½mk)**

(iv) I ***2Mg(s) + O2(s) 2MgO(s)*** (1 mk)

II. ***3Mg(s) + N2(g) Mg3N2(s)*** (1 mk)

(v) ***Mg3N2(s) + 6H2O(l) 3Mg(OH)2(s) + 2NH3(g)*** (1mk)

1. (i) *Manufacture of nitrogenous fertilizers such as ammonium nitrate.* (any two correct uses)

*Manufacture of textile dyes*

*Manufacture of explosives*

(ii)

***HNO3(l) + NH3(g) NH4NO3(s) √ 1mk***

***Mole ratio: 1:1:1***

***Molar mass of ammonia = 17g***

***Molar mass of ammonium nitrate = 80g √***½mk

***80g NH4NO3 17g***

***4800000g 17x4800000 = 1020000g***

***80 √***1mk

***= 1020kg of ammonia gas. √***½mk

**4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Total volume of water added(cm3) | 10.0 | 20.0 | 30.0 | 40.0 | 50.0 |
| Mass of KClO3(g) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Temperature at which crystals appear(0C) | 80.0 | 65.0 | 55.0 | 45.0 | 30.0 |
| Solubility of KClO3(g/100gH2O) | *50.0√½* | *25.0√½* | *16.7√½* | *12.5√½* | *10.0√½* |

NB: *√½mk for expressing solubility values to the same number of decimal points*

1. Graph marking points: scale (graph to cover ˃= ½ grid)*√½*

*Labeling of axes√½*

*Plotting of points √1*

*Curve (smooth) √1*

1. *i) 11g/100gH2O √1*

*ii) 720C (+/- 0.5)√1*

1. *Solubility of KClO3 increases with increase in temperature/more KClO3dissolves as temperature rises√1*
2. *Extraction of soda ash(Sodium carbonate) from Trona√1*

*Extraction of common salt(sodium chloride). Etc.*

**5**  *(a)*

*i) R/R2√½Its Eθvalue is zero meaning it is the reference electrode/half-cell√1*

*ii)* - 2.90V*√1*

*iii)*

Eθ(Volts)

P2+ (aq) + 2e P (s) *- 2.90 -0.33 = -3.23√½*

Q2+(aq) + 2e Q (s) *-2.36-0.33 = -2.69√½*

R+ (aq) + e ½R2 (g) *0.00-0.33 = -0.33√½*

S2+ (aq) + 2e S (s) *+ 0.33-0.33 = 0.00√½*

½ T2 (g) + e T- (aq) *+2.86-0.33 = +2.53√½*

Q2+(aq)*√½*

V

Salt

Bridge*√½*

Q*√½*

S*√½*

S2+ (aq)*√½*

*√½ Complete & functional Diagram*

*iv)*

*b) No. of moles of e- needed for the reaction Au3+ (aq) + 3 e-→Au(s)*

*0.293g ×3mol of e√½ = 0.00446 mol of e-√½*

*197g*

*No. of coulombs in 0.00446 mole- =0.00446 mole- ×96,485 C/mol√½ = 431 C√½*

*If current is 1.03 A, how long does it take for 431 C to flow?*

*Q = I ×t ⇒ t= Q/I = 431/1.03√½*

*= 418s√½*

1. (a) -Iron(III)oxide ½mk

Limestone ½mk

Coke ½mk

(b) A: Slag (1 mk)

B: Molten iron (1 mk)

1. L, K, J (1 mk)
2. C(s) + O2(g) CO2(g) (1 mk)
3. Provide blast of hot air (1 mk)
4. Cast iron is more impure than wrought iron (1 mk)
5. 2Fe(s) + 3Cl2(g) 2FeCl3(s) (1 mk)
6. 60 60 0

Fe Ni + 2 e- (1 mk)

26 28 -1

1. Use of stainless steel;-

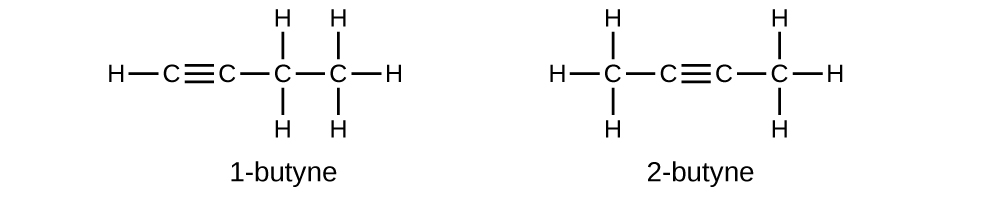
Surgical instruments (½mk)

Cutlery

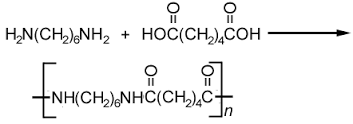
Sinks

Vats

**7** (a)



But – 1 – yne But – 2 – yne (structure ½mk, name ½mk total 2mks)

(b) Nylon 1mk 1mk

(c) (i) Harmful rays from the sun reaches the earth’s surface causing harm to humans 1mk

(ii) Contribute to global warming 1mk

(d) (i) I Oxidation (½mk)

II A: Propene B: Sodium propanoate C: Ethane (1½mk)

(ii) 2C2H6 + 7O2 4CO2 + 6H2O (1mk)

(iii) Used in manufacture of polypropene used in making ropes, plastic crates, buckets, basins, plastic tables and chairs etc

Manufacture of other chemicals e.g. acetone, propan-1-ol etc

Used as an alternative to ethyne(acetylene) in welding flame

(e) Add sodium carbonate/ sodium hydrogen carbonate to separate samples of each 1mk. Propanoic acid produces bubbles of a gas/effervescence/fizzling while propan-1-ol does not 1mk