**233/1 Marking Guide**

1. Below is a table showing the solubility of salts **Q** and **R** at different temperatures.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Temperature oC** |  | 0 | 10 | 20 | 30 | 40 | 50 |
| **Solubility in grams per 100g of water** | Salt **Q** | 3.0 | 5.0 | 7.4 | 10.0 | 14.0 | 19.0 |
| Salt **R** | 15.0 | 17.0 | 20.7 | 25.7 | 28.7 | 33.0 |

1. Define the term “Solubility of salt” (1mk)

* *The maximum mass of solute required to saturate 100g of solvent at a given temperature;*

1. If both salts **Q** and **R** are present in 100cm3 of saturated solution at 50oC, what will be the total mass of crystals formed if the solution was cooled to 20oC? (2mks)

*Q 19.0 - 7.4 = 11.6*

R 33.3 – 20.7 = 12.6

*Total mass=* 24.2

1. Name **two** areas where knowledge of solubility curves is applied (2mks)

* *Extraction of Trona and Sodium Chloride on Lake Magadi*
* *Separation of Soda ash and Ammonium Chloride in the Solvay process*

1. Two samples of hard water **C** and **D** were boiled. When tested with drops of soap, sample **D** formed lather easily while **C** did not:-
2. Name the possible salt that caused hardness in sample **D** (1mk)
   * + *Magnesium hydrogen carbonate*
     + *Calcium hydrogen Carbonate*
3. Explain how distillation can remove hardness in sample **C** (1mk)

* *When water is heated to boil, it evaporates and the vapour is condensed, distilled water free of Calcium and Magnesium ions is obtained.*

(c) Give **two** advantage of hard water (1mk)

* *Calcium ions are necessary for strong bones and teeth*
* *Good for beer brewing*

1. You are provided with a mixture of Lead (II) Chloride, ammonium chloride and sodium chloride. Explain how you would separate all the three solids (3mks)

* *Heat the mixture in a beaker covered with a watch glass containing ice cold water*
* *Ammonium chloride sublimes and is deposited as a sublimate*
* *Add water and stir to dissolve Sodium chloride*
* *Filter, Lead ii chloride as residue, sodium chloride as filtrate*
* *Heat to saturate the filtrate, Cool to crystallize*
* *Dry the sodium chloride crystals between filter papers*

1. Sodium Carbonate Decahydrate crystals were left exposed on a watch glass for two days.
2. State the observations made on the crystals after two days.(1mk)

* *Dry/loses their water of crystallization*

b) Name the property of salts investigated in the above experiment (1mk)

* *Efflorescence*

1. When a small piece of potassium metal is dropped in cold water, it bursts into a flame on the surface of water.
2. What causes this ignition?(1mk)

* *Heat produced ignites the hydrogen gas being produced*

1. Write an equation to show how this ignition occurs (1mk)

* *2H2(g) + O2(g) 2H2O(g)*

1. What is the colour of the flame (1mk)

* *Lilac*

1. How does the pH value of 0.25M KOH (aq) compare with that of 0.25M ammonia solution? Explain (2mks)

* *pH of 0.25M KOH is Higher*
* *KOH is a strong base/ completely or fully* *Dissociates/ionizes in water to produce more hydroxide ions*

1. (i) State Gay Lussac’s law. (1mk)

* *When gases combine, they do so in volumes which bear simple ratios to one another and to the product if gaseous*

(ii) 10cm3 of methane (CH4) gas is exploded with 150cm3 of air containing 20% oxygen and 80% nitrogen. The products were allowed to cool to room temperature. What will be the total volume of the gases at the end of the reaction (3mks)

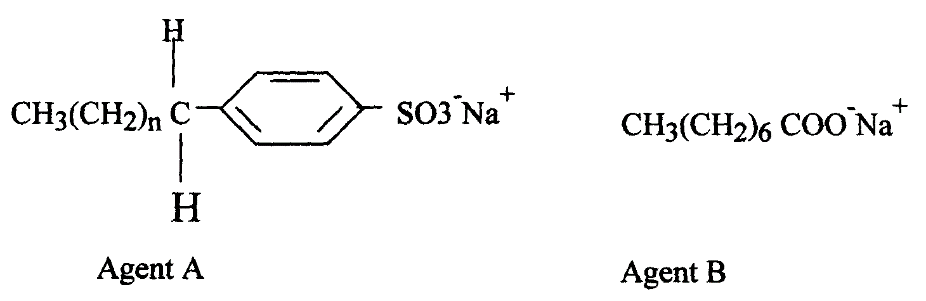
*CH4 (g) + 2O2 (g) CO2(g) + 2H2O(l)*

* *Vol ratios 1 2 1 2*
* *Total volume of oxygen in air 20/100 \*150 = 30cm3*
* *Volume of O2  that reacted with methane 2/1\*10 =20cm3*

*Unreacted O2 30-20 =10cm3*

* *Volume of CO2 formed 1/1\*10= 10cm3*
* *Volume of N2 150-30= 120cm3*
* *Volume of gases mixture at end 120+10+10=****140cm3***

1. The formulae below represents active ingredients of two cleansing agents **A** and **B**



1. Name the class to which each of the cleansing agent belongs(2mks)

* **A** *Soapless detergent/detergent*
* **B** *Soapy detergent/soap*

1. Which one of the cleaning agent above is not environmental friendly? Explain (2mk)

* **B**

1. Which one of the cleansing agent would be suitable to be used in water containing magnesium hydrogen carbonate? Explain (2mks)

* **A**

1. During Saponification process, a small amount of Sodium Chloride is added Give a reason (1mk)

* *To help precipitate the soap/reduce its solubility in glycerol*

1. (a) Write an equation showing how ammonium nitrate may be prepared starting with ammonia gas (1mk)

* *NH3(g) + HNO3(aq) NH4NO3(aq*

(b) Calculate the maximum mass of ammonium nitrate that can be prepared using 5.3kg of ammonia (H=1, N=14, O=16) (2mks) (***accept direct method)***

* *Moles of Ammonia 5300/17 = 311.76471 ½ mk*
* *Moles of Ammonium nitrate 1/1\*311.76471=311.76471 ½ mk*
* *Mass Ammonium nitrate 311.76471\*96=29929.4112g/* ***29.929kg 1mk***

10. Plastics and rubber are extensively used to cover electrical wires.

(a) What Name is used to describe plastic and rubbers used in this way? (1mk)

* *Insulators*

(b) Explain why plastics and rubbers are used for this purpose (1mk)

* *They are Non conductor*

1. **G** grams of a radioactive isotope take 120days to decay to 3.5grams. The half-life period of the isotope is 20days

(a) Find the initial mass of the isotope (2mks)

* *No of half lifes 120/20 =6* ***½ mk***

***1 2 3 4 5 6***

***3.5 7 14 28 56*** *112* ***224g 1 ½ mks***

***Or*** *Remaining mass = (½) n \*Original mass* ***½ mk***

*3.5=(½)6\*Om*

*Om=3.5/(½)6* ***½ mk***

*=****224g ½ mk***

(b) Give **two** applications of radioactivity in medicine (2mks)

* *Gamma rays are used to detect bone fractures and healing(****any 2 correct, with correct example)***
* *Gamma rays are used to sterilize surgical equipment*
* *Iodine 331 treatment of hyperthyroidism*
* *Cancer treatment/Radiotherapy/kll malignant tumors- gamma radiation*

(c) Uranium -238 disintegrates by emitting an alpha particle to form substance **Y**. Nuclide **Y** emits a beta particle to form substance **Z**. Write down nuclear equations to show how substance **Y** and **Z** are formed (U=92) (2mks)

* *238 92***U** 234 90 **Y +** 4 2 **He (*accept******the greek symbols of the particles*)**
* 234 90 **Y** 234 91**Z +** 0-1**e**

12. Study the flow chart below and answer the questions that follow:

Copper Pyrites

CuFeS2

**Step (I)**

Froth floatation,

Air

**Gas Q**

**Gas Q**

**Step (II)**

Cu2S(s)

Cu2O

Cu(s)

Pure Copper

Air

**Step (III)**

Cu2S

**Step (IV)**

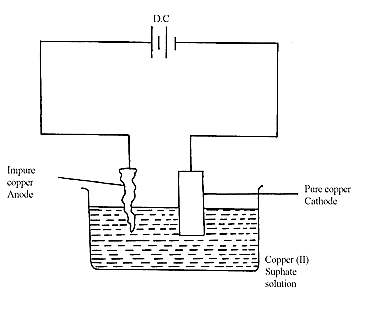
FeO

**Step (V)**

1. Name gas **Q** (1mk)

* *Sulphur iv oxide*

1. With the help of diagram, describe how step (V) is carried out (3mks)



* *Workable diagram* ***1mk***
* *Labels* ***1mk***

*Impure copper is the Anode while pure copper is cathode. During electrolysis copper ions migrate/attracted to the cathode where they are discharged as pure copper* ***1mk (accept equation)***

*Cu2+ + 2e Cu(s)*

1. During purification of copper by electrolysis, 1.48g of copper were deposited when a Current was passed through aqueous copper (II) sulphate for 2 ½ hours. Calculate the amount of current passed (Cu = 63.5 1Faraday = 96500C) (3mks)

*63.5g= (96500\*2) C ½ mk*

*1.48= (96500\*2\*1.48)/63.5 ½ mk*

*=4498.267C ½ mk*

*I=Q/t*

*4498.267/(2.5\*60\*60) ½ mk =****0.4998A 1mk***

***Or***

*Moles of copper deposited 1.48/63.5 = 0.02331moles ½* ***mk***

*Quantity of charge used 193000 (****½ mk*** *)\*0.02331 = 4498.83C* ***½ mk***

*I=Q/t*

*4498.83/ (2.5\*60\*60)* ***½*** *mk =****0.4998A 1mk***

1. What is meant by the term Froth Floatation(2mks)

*Involves crushing the ore into fine powder,* ***( ½ mk)*** *dissolving the powder in a suitable solvent such as oil, water or detergent solution,(* ***½ mk)*** *then air is blown into the mixture (****½ mk****)A froth which is a more concentrated ore floats on the surface and is separated.* ***( ½ mk****)*

1. Name two impurities present in the ore of copper (1mks)

* *Gold*
* *Silver*

13. State **two** properties of Duralumin that make it suitable for use in making aircraft parts? (1mk)

* *Low density/light (****any two ½ mk each****)*
* *High tensile strength/tough*
* *Resistant to corrosion*
* *Malleable and ductile*

14. The flow chart below shows a sequence of chemical reactions starting with Zinc. Study it and answer the questions that follow:-

Zn(s)

Step 1

Zn2+(aq)

Step 2

NaOH(aq)

Zn(OH)2(s)

Step 3

Heat

Zn(s)

Zn2+(aq)

Step 5

Metal **T**

Step 4 H2SO4(aq)

ZnO(s)

Dilute hydrochloric acid

1. In step 1, excess 3M hydrochloric acid was added to 0.5g of Zinc powder
2. State **one** observation which were made when the reaction was in progress (1mk)

* *Effervescence*

1. Explain why hydrogen gas is not liberated when dilute nitric acid is used in **step 1** (1mk)

* *Hydrogen produced is oxidized to water*

1. a) Write an ionic equation for the reaction that took place in **step 1** (1mk)

* Zn (s) + 2H+ (aq) Zn2+(aq) +H2(g)

1. Calculate the volume of 3M hydrochloric acid that was needed to react completely with0.5g of Zinc powder (Zn = 65.0) (2mks

*Moles of Zinc 0.5/65 =0.007692 moles ½* ***mks***

*Moles of HCl 2\* 0.007692 = 0.015385moles ½* ***mks***

*Volume of HCl (1000\*0.015385)/3 (½* ***mks****)*

*=****5.1cm3 ½ mks***

15. Briefly describe how a pure sample of lead ii iodide can be prepared in the lab given Distilled water, solid lead ii nitrate and solid Potassium iodide (3mks)

* *Add water to the two solids* ***½ mk***
* *Mix the two solutions to form a yellow precipitate of lead ii iodide* ***½ mk***
* *Filter to obtain the precipitate* ***½ mk***
* *Wash the precipitate with distilled water* ***1mk***
* *Dry the precipitate between filter papers* ***½ mk***

16. Using equations explain how slag is formed in the extraction of iron (2mks)

* *CaO(s) + SiO2(s) CaSiO3 (l)*
* *CaO(s) + Al2O3(s) Ca Al2O4 (l)*

17. Using dots and crosses to represent electrons draw the structure of Phosphorous chloride (PCl3) (1mk)

19. Study the information in the table below and answer the questions that follow:

(The letters do not represent the actual symbols of the elements)

|  |  |  |
| --- | --- | --- |
| **Element** | **Electronic configuration** | **Ionization energy KJmol-1** |
| **P** | 2:1 | 519 |
| **Q** | 2:8:1 | 494 |
| **R** | 2:8:8:1 | 418 |

1. What is meant by ionization energy? (1mk)

*Minimum amount of energy required to completely remove a loosely held electron from an atom in gaseous state*

1. Element **R** has the lowest ionization energy. Explain. (1mk)

*Largest atomic size/radius/ valence Electron far away/greatest distance from nucleus* ***( ½ mk)*** *hence its loosely held/require least energy to be removed/experiences weak nuclear force of attraction* ***( ½ mk****)*

1. When a piece of element **Q** is placed on water it melts and a hissing sound is produced as it darts on the water surface. Explain these observations. (1 1/2mks)

* *Melts – exothermic/ heat is produced*
* *Hissing sound- production of hydrogen gas*
* *Darts on water surface- less dense than water*

1. Write the equation for the reaction between element **Q** and water.(1mk)

* *2Q (s) + 2H2O(l) 2QOH(aq) + H2 (g)*

20. Chlorine has a higher boiling point than Argon. Give a reason (1mk)

* *Chlorine gas has larger* ***Diatomic molecules*** *which experience stronger intermolecular forcesmthan the smaller* ***monoatomic molecules*** *of Argon*

21. i) State Graham’s Law of diffusion (1mk)

* *Under similar conditions of temperature and pressure, the rate of diffusion of a gas is inversely proportional to the square root of Its density*

ii) Gas **B** takes 110 seconds to diffuse through a porous pot, how long will it take for the

Same amount of ammonia to diffuse under the same conditions of temperature and pressure?

(RMM of **B** = 34 RMM of ammonia = 17) (2mks)

*T NH3/TB = MNH3/MB*

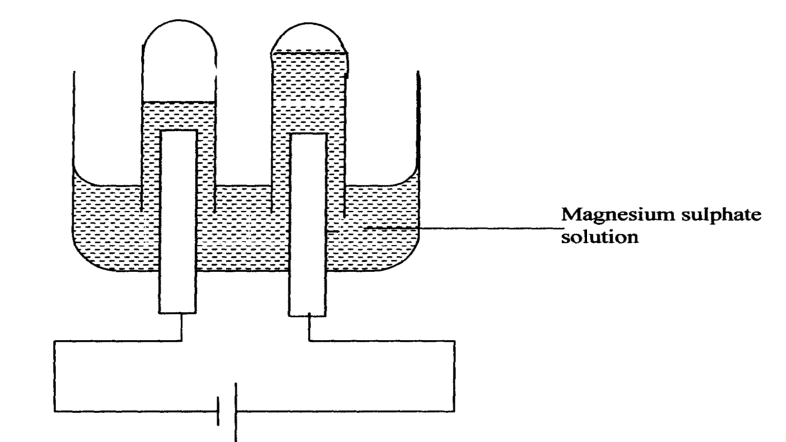
*T NH3  = MNH3/MB \* TB formula* ***½ mk****, subt=* ***½ mk***

*= 0.70710\*110*

*=****77.78seconds 1mk***

22. The setup below was used to carry out the electrolysis of Magnesium sulphate solution using

Inert electrodes



*Cathode* **½ mk** *Anode* **½ mk**

1. Name a suitable pair of electrode that can be used in the above process. ( ½ mk)

* *Platinum/Carbon/Graphite*

1. State and explain the changes on the concentration of magnesium sulphate solution as the process proceeds. (1mk)

* *Increases- H+ and OH- ions of water are being discharged*

1. Label on the diagram the Cathode and anode(1mk

23. i. Bond energies for some bonds are tabulated below:-

|  |  |
| --- | --- |
| **BOND** | **BOND ENERGY KJ/mol** |
| H – H | 436 |
| C = C | 610 |
| C- H | 410 |
| C - C | 345 |

Use the bond energies to estimate the enthalpy for the reaction

C2H4(g) + H2(g)  C2H6(g)  (2mks)

* *2686* ***( ½ mk)*** *- 2805* ***( ½ mk)******= -119 kJ (1mk)***

ii. Study the diagram below and answer the questions that follow:

NH4+(g) +Cl-(g)

NH4g +

∆H2

NH4+(g) +Cl-(g)

NH4+(aq) + Cl-(aq)

∆H3

∆H1

NH4Cl(s)

Energy

Reaction Co-ordinate

a) What do ∆H1 and ∆H2 represent? (1mk)

∆H1 *Lattice* ***½ mk***

∆H2 *Hydration* ***½ mk***

1. Write an expression to show the relationship between ∆H1, ∆H2 and ∆H3. (1mk)

* ***∆H1 + ∆H2= ∆H3***

24. (a)Name one substance that is added to Aluminium oxide during electrolysis in the manufacture of Aluminium metal ( ½ mk)

* ***cryolite*** */sodium hexafluoroaluminate*

1. Give a reason why the substance named above is added (1mk)

***Lower*** *the melting point from 2015* ***oC*** *to about* ***800oC (½ mk)****to save on the electrical energy needed( ½ mk)*

25. a) State Le Chatelier’s Principle (1mk)

*if a stress/change is applied to a system in dynamic equilibrium, the system readjust/shift/move/behave so as to remove/ reduce/ counteract/ oppose the stress/change*

1. An equilibrium exists in the Haber process as shown in the equation below

N2(g) + 3H2 (g) 2NH3 (g) ΔH = -92kJ

State and explain the effect of the following factors on the yield of Ammonia

1. Increase in Pressure (1 ½ mks)

*shift the equilibrium forward/to the right*  ***½ mk*** *where there is less volume/molecules* ***( ½ mk****)* ***More/higher yield*** *of ammonia is attained (* ***½ mk****)*

1. Increase in Temperature (1 ½ mks)

*shift the equilibrium to the left/favours reverse reaction* ***½mk*** *because forward reaction is exothermic(ΔH = -92kJ)*  ***½ mk*** *. Ammonia formed* ***decomposes*** *back to Nitrogen and Hydrogen/ a* ***less*** *yield of ammonia is formed* ***½ mk***

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