**WESTLANDS JOINT**

**MARKING SCHEME**

**CHEM PAPER 2 DECEMBER 2021**

1. **a)** The grid below represents part of a periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of elements.

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1. Identify the most reactive non-metal 1mark

***X***

1. Which of the metal sis the most reactive? Explain. 1mark

**Q. has largest atomic radius, outermost electrons are loosely held hence lost easily.**

1. What name is given to the family of elements to which X and T belong? 1mark

***Halogens***

1. Give reasons for the following

Ionic radius of Q is smaller than that of M 1mark

***Q forms ion by losing electron hence remaining electrons are pulled more close to nucleus, M forms ion by gaining electron, the gained electron is repelled by existing electrons hence repulsive effect increases ionic radius***

Atomic radius of Q is greater than that of S 1mark

***Q has many energy levels than S hence a greater atomic radius than S***

1. Give an element that does not form compounds under ideal conditions.

Explain. 2marks

**V, *already is in the stable octet configuration hence does not lose or gain electron***

1. Give formula of compound formed between E and Z 1mark

**ZE2**

**b)**  Study the table below and answer the questions that follow.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Substance**  | **A** | **B** | **C** | **D** | **E** | **F** |
| **Melting point (°C)** | 801 | 113119 | -39 | 5 | -101 | 1356 |
| **Boiling point(°C)** | 1410 | 445 | 457 | 54 | -36 | 2860 |
| **Electrical Conductivity (Solid)** | Poor | Poor | Good | Poor | Poor | poor |
| **Electrical Conductivity (Liquid)**  | Good | Poor | Good | Poor | Poor | Poor |

1. Identify a substance with:
2. Giant metallic structure 1mark

***C***

1. Has a molecular structure and exists in gaseous state at room temperature

 and pressure 1mark

 ***E***

1. Suggest a reason why substance B has two melting points. 1mark

***Its allotropic // exhibit allotropy***

1. Substances A and C conduct electric current in the liquid state. State how the two substances differ as conductors of electric current. 2marks

***A is an ionic compound conduct in liquid state as ions are free .in solid they’re fixed. C is a metal, conduct in all states using free electrons.***

1. Study the flow chart below and answer the questions that follow.

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1. Name ore N 1mark

***bauxite***

1. Explain why the ore is first dissolved in excess sodium hydroxide solution. 1mark

***To remove impurities of silica and iron iii oxide.***

1. Name the major compound present in the residue. 1mark

***Iron (iii) oxide.***

1. Give the formula of the aluminium compound present in solution 1mark

***[Al(OH)4]2+***

1. **i)** Explain how to obtain aluminium hydroxide from solution X 1mark

***By seeding with pure aluminium hydroxide crystals // bubbling carbon (iv) oxide into it***

**ii)** Write equation for reaction that takes place in (e) above 1mark

***2[Al(OH)4]- + CO2(g) 2Al(OH)3 + CO32-(aq) + H2O(l)***

 ***2[Al(OH)4]-(aq)Al(OH)3  Al(OH)3(s) + OH-(aq)***

 **iii)** What is the role of cryolite in the extraction of aluminium. 1mark

 ***added as impurity to lower melting point of aluminium oxide for electrolysis process***

1. Aluminium is a good conductor of electricity. State two uses of aluminium based

on this property. 2marks

 **used *make overhead cables***

1. If sodium carbonate is added to aluminium nitrate solution, effervescence occurs. Explain. 2marks

***Aluminium compounds easily hydrolyse releasing hydrogen ions that react with carbonate releasing carbon(iv) oxide causing effervescence.***

3. Study the flow chart below and answer the questions that follow.

1. Give the names of the following
2. Compound K (1mark)

…………………*ethan – 1,2 -diol*…………………………………

1. Substance Y (1mark)

…………………*sodium propoxide*…………………………………………

1. Product obtained in step 4 (1mark)

………………*propylbutanoate*…………………………………

 (b) Identify the **type of reaction** that takes place in step 1 and give one other condition necessary for the reaction other than the temperature indicated.

Type of reaction…hydration………………………. (1mark)

Condition……*pressure of 60 – 70 atm and phosphoric (V) acid as catalyst*…………………. (1mark)

 c)Draw the structural formula of the following

i) Polymer M (1mark)

ii) Acid Q (1mark)

d) Give the **industrial application** for the reaction in step 3 (1mark)

…………*Hardening of liquid oil into solids in manufacture of margarine*…………………

e) Write chemical equations for the reactions in step 6 and step 7 . (2marks)

Step 6 …… *Na + C3H7OH C3H7ONa + H2*

Step 7

……… *C3H6O2 + MgCO3 (CH3CH2COO)2Mg + CO2 +H2O*

f) The following are structures of two cleansing agents.

 **R** **SO**$\genfrac{}{}{0pt}{}{-}{3}$ **Na+**

In the table below, give one advantage and one disadvantage of each of them. (2marks)

|  |  |  |
| --- | --- | --- |
| Cleansing Agent | Advantage | Disadvantage |
| **R-COO-Na+** |  *Biodegradable thus non – pollutant* | *Wastes soap, since does not lather readily with hard water forms scum* |
| **R-OSO3-Na+** | *Does not form scum, since readily lather with hard water* | *Non - biodegradable thus pollutant* |

4. The flow chart below illustrates two industrial processes. Harber process and the contact process.

Air

 D

B

Nitrogen

Haber process

Oxygen

water

Hydrogen

 H2S04(I)

Sulphur(VI) acid

 C

Contact process

Sulphur (IV) oxide

A

(a).Name the process of obtaining nitrogen from atmospheric air. ( 1 mark)

Fractional distillation of liquid air

(b). List TWO sources of obtaining large volumes of hydrogen for industrial use.

(i) Electrolysis of acidified water ( ½ mk)

(ii)Cracking of hydrocarbons ( ½ mk)

Steam over carbon \hydrocarbon

(c) Write equation for Haber process. ( 1 mark )

N2(g) +3H2(g) 2NH3(g)

 Fe

 (d) Name the catalysts for:

(i) Haber process Finely divided iron ( ½mk)

(ii) Contact process Vanadium (IV) oxide\platinised astestos ( ½ mk)

(e) Identify substances:

(i) D Ammonium sulphate /( NH4)2SO4 ( ½ mk)

(ii) C oleum, /H2S2O7 ( ½ mk)

(f) Give ONE major use of compound D ( 1 mark )

Fertilizers

(g) Write an equation for dilution of C with water. (1 mark)

H2S2O7(I)+H2O(I) 2H2SO4(I)

h) A farmer has three plots each measuring 0.25 acres. He applied nitrogenous fertilizers as follows.

-plot A 250 kg of ammonium phosphate

-plot B 250 kg of urea CO(NH2)2

- Plot C 250kg of ammonium nitrate

Which plot received the highest nitrogen content? (3 marks)

H = 1, N = 14, 0 = 16. P = 31, C = 12.

42/149\*100=28.19

CO(NH2)2

28/60\*100=46.67

28/80\*100=35

CO(NH2)2-has a highest % of Nitrogen

5. h) A farmer has three plots each measuring 0.25 acres. He applied nitrogenous fertilizers as follows.

- Plot A 250 kg of ammonium phosphate - Plot B 250 kg of urea CO(NH2)2

- Plot C 250kg of ammonium nitrate -(H = 1, N = 14,O = 16, P = 31,C = 12).

Which plot received the highest nitrogen content? (3mks)

 ***Ammonium phosphate***

 ***42 ×100% = 28.19%***

 ***149***

 ***Urea 28 ×100% = 46.67%***

 ***60***

***Ammonium nitrate***

 ***28 × 100% = 35%***

 ***80***

***Plot B Accept if kg are used instead of %.***

6. Study the diagram below and answer the questions which follow.



**Lead II Oxide**

**Ice cold water**

**Flame**

**H2**

**Liquid M**

1. State **two** observations made when dry hydrogen gas pass over hot Lead (II) oxide. (2marks)

 ***- Lead (II) oxide changes colour from orange to grey.***

 ***- Droplets of a colourless liquid form on cool sides of the combustion tube.***

1. Write the equation for the reaction which occurs in the combustion tube. (1mark)

***PbO (s) + H2 (g) → Pb (s) + H2O (l)***

1. What property of hydrogen is shown in the experiment above (1mark)

 ***Reducing property.***

(iv) Identify liquid M and describe the test for its purity (2marks)

***Water, Heat liguid M to boiling while measuring the temperature. B.P of***

***1000C indicates that M is pure***

1. What would be observed if MgO was used instead of Lead II Oxide: Explain (2marks)

***No change on MgO because H2 can not reduce MgO***

(vi) What is the colour of the flame (1mark)

***Blue***

(vii) Write a chemical equation of the reaction producing the flame. (1mark)

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

 (vii) Apart from hydrogen peroxide, state **two** other reagents that can be used to prepare oxygen gas. (1mark)

 ***Sodium peroxide and water.***

 (viii) Write an equation to show how hydrogen gas is formed from the reagents chosen in (vii) above (1mark)

***2Na2O2 (l)  + 2H2O (l) → 4NaOH (aq) + O2 (g)***

7.I. Use the data below to calculate the enthalpy change for the reaction below

 CH4(g) + 2O2(g) CO2(g) + 2H20 (l) (3marks)

 **Bond** **Energy (KJ)**

 C – H 314

 O = O 296

 C = O 149

 H – O 283

***Ans = -418kJ/mol***

II. Given the following Standard Molar enthalpies of combustion. Calculate the standard heat of formation of butane (C4H8). (3marks)

ΔH$\genfrac{}{}{0pt}{}{θ}{c}$Carbon (Graphite) = -393.5KJ/mol **(well drawn energy cycle - 2marks)**

ΔH$\genfrac{}{}{0pt}{}{θ}{c}$Hydrogen = -285.8KJ/mol

ΔH$\genfrac{}{}{0pt}{}{θ}{c}$butene = -2877KJ/mol

 ***Ans = +159.8kJ/mol***

III. Use the following information to answer the questions that follow

**ΔH lattice MgCl2 = -2489 kJ/ mol-1**

**ΔH hydration Mg2+ = - 1891 kJ/ mol**

**ΔH hydrationCl - = -384 kJ/ mol**

 b) Using energy level diagram calculate the molar heat of solution of magnesium chloride. (4marks)

 **(well drawn energy level diagram - 3marks) *Ans = - 175kJ/mol***