

MARKING GUIDE (CHEMISTRY F4)

F4
S09

Date _____

I	ii	iii	iv	v	vi	vii	viii	ix	x
A	D	C	B	C	D	C	B	C	B.

2.	H/H ₂	A	i	ii	iii	iv	v	vi	
	List B	H	C	A	F	B/D	E		

SECTION B (54 Marks)

3 (a) Anhydrous Copper (II) sulphate (CuSO_4) is a white crystalline solid. When exposed to air for a long time, it absorbs moisture from the surroundings and turns blue.

Reason: Copper (II) sulphate exists as a pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in its hydrated form, meaning it has five molecules of water bonded to it. This form is blue. When heated, the water molecules are driven off, leaving the white anhydrous form. However upon exposure to air, the anhydrous form readily absorbs water vapour, converting back to the blue hydrated form.

Q3

(b) Carbon dioxide (CO_2) is denser than air.

This property allows for its collection using downward delivery method.

Method:

The gas is produced in a reaction vessel and directed downwards through a delivery tube into a collection container.

Positioned at a lower level. Since CO_2 is denser, it displaces the air in the container and accumulates at the bottom. (Q2)

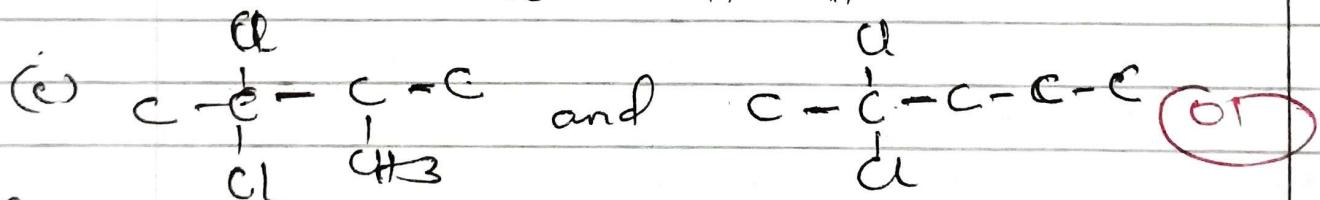
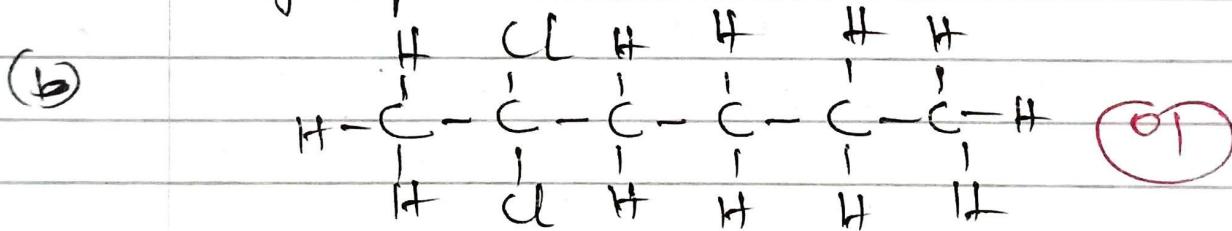
(C) Reason: Both sulphuric acid and Hydrogen sulphide are acidic. When they come in contact, they can react to form a white ppt of sulphur and water. This reaction can interfere with the drying process and potentially clog equipment. (Q2)

(D) Reason: Paraffin oil is a non-polar organic liquid that is unreactive to sodium. It forms a protective layer around the metal, preventing its contact with air and moisture. This prevents the exothermic reaction between Sodium and air/water which can generate H_2 gas as a potential fire hazard. (Q2)

4. (a) Water treatment in industrial settings is vital to prevent water pollution and ensure the quality of water used in processes. By removing impurities, chemicals and contaminants, water treatment minimizes environmental impacts and promotes sustainable industrial practices. (Q6)

4 (b) To remove dissolved organic matter by precipitation. (03)

- 5 (i) They have the same general formula
 (ii) Exhibit gradual change in physical properties such as boiling point and melting point as molecular size increases
 (iii) Have similar chemical properties due to same functional group
 (iv) Can be represented by a general structural formula
 (v) They show a regular gradation in chemical properties with a repeating unit of methylene group (CH_2) (05)



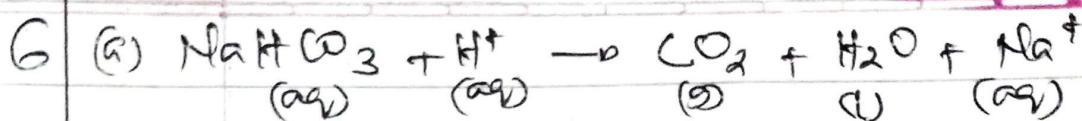
Reasons (i) Difference in arrangement of carbon atoms along the longest carbon skeleton (= chain)

(ii) Compounds of carbon (02)

(ii) Have the same molecular formula but different in structure.

MARKING GUIDE
CHEMISTRY F 4

Date _____ / _____ / _____



(03)

(b) Total vol of fanta consumed : $500 \text{ cans} \times 3.55 \text{ ml/can}$
 $= 177500 \text{ ml}$

Since the volume of each can is the same,
 we can assume the number of sugar molecules
 per can is also the same (unknown for now)
 Let x represent the number of sugar molecule
 s per can

proportion : $\frac{\text{Total molecules}}{177,500 \text{ ml}} = \frac{6.02 \times 10^{23} \text{ molecules/mole}}{3.55 \text{ ml/mole}}$

Total molecules = $\frac{6.02 \times 10^{23} \times 177500}{3.55}$

(06)

$\approx 2.99 \times 10^{25}$ molecules

7. (a) (i) Carbon dioxide is used in fire extinguishers because it doesn't support combustion and it is denser than air and so it settles on the burning substances and displaces air

(0½)

(0½)

(ii) As a refrigerant because

- It is non toxic
- Non-flammable
- Relatively non-reactive
- Has high cooling effect
- It is widely available
- Environment..

(0½)

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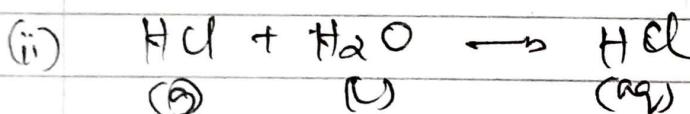
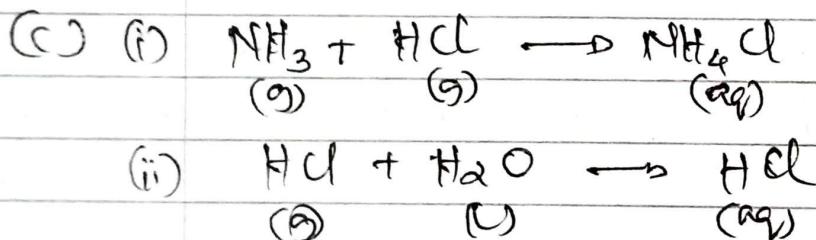
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- 7 (a) (iii) It is used in baking because it causes the dough to rise and give the bread its characteristic softness. 01
- (b) (i) Carbon monoxide reacts with oxygen to form a colourless gas which turns lime water milky i.e. $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$ 01
- (ii) Carbon monoxide has no reaction with NaOH because it is a neutral oxide i.e. $\text{CO} + \text{NaOH} \rightarrow$ No reaction 01
- (iii) Carbon monoxide acts as a reducing agent when it reacts with copper oxide to form copper and carbon dioxide $\text{CO} + \text{CuO} \rightarrow \text{Cu} + \text{CO}_2$. 01



- 8 (a) Removing SO_3 as it forms shifts the equilibrium to the right, favouring the production of more SO_3 . This ~~at~~ maximizes the yield of sulphuric acid without needing excessive starting materials or wasting energy due to high temperature. 04

3 (b) (i) Temperature

- Increase in temperature increase the rate of reaction (for endothermic reaction)
- Decrease in temperature increase the rate of a chemical reaction (for exothermic reaction) 02 01

(ii) Increase Concentration

- Increase in concentration increase the collision frequency of the colliding reacting particles thus increase the rate of reaction

(iii) surface area

- for Homogeneous reactions, surface area has no effect
- for heterogeneous reactions, the rate of reaction increase with increase in surface area of reacting particles

(iv) Catalyst

- Catalyst tend to speed up the rate of a chemical reaction. 02 01

(c) - Concentration

- Pressure

- Temperature

02
01

9

(a) Macronutrients

- i) are required by the plant in large quantity 01

eg. N, P, K

01

Micronutrients

- (b) Are required by the plant in small quantity. 01

eg Zn, Cu, Co, Fe, Cl

01

(b) Effects of Nitrogen deficiency

* Plant leaves turn yellow fall prematurely 01 1/2

(ii) Stunted growth in plants 01 1/2

(iii) chlorosis, that is leaves lose chlorophyll and turn yellow or yellowish green 01 1/2

(iv) In some crops, it cause production of pigments such as anthocyanin (purplish colouration) instead of chlorophyll. This lowers the efficiency of the plants to photosynthesise. 01 1/2

(c) Advantages of crop rotation

(i) It ensures the balance in utilising the soil nutrients 02 1/2

(ii) Helps in controlling pests and diseases 02 1/2

10 (a) (i) Renewable energy sources

→ Are those which are continually being replaced within short period of time

(01) 1/2

(ii) Non renewable energy sources

→ They cannot be replaced within short period of time

(01) 1/1

(b) (i) Solar energy, wind energy, biomass

(02)

(ii) Petroleum, Natural gas, coal

Nuclear energy

(02)

(c) Mass of water used \leq Vol \times Density

$$\leq 1000 \text{ kg/m}^3 \times 0.012 \text{ m}^3$$

$$\leq 12 \text{ kg}$$

change in temperature (ΔT)

$$\Delta T = T_f - T_i = (341.5 - 297.7) K = 43.8 K$$

$$Q = mc\Delta T$$

But $m = 12 \text{ kg}$, $c = 4.18 \text{ kJ/kg}^\circ\text{C}$ and

$$\Delta T = 43.8 K$$

Therefore

$$Q = 12 \text{ kg} \times 4.18 \text{ kJ/kg}^\circ\text{C} \times 43.8 K$$

$$\rightarrow 2197 \text{ kJ}$$

0.056 kg of biodiesel $\leq 2197 \text{ kJ}$

1 kg of biodiesel $\leq Q$?

$$Q = \frac{2197 \text{ kJ}}{0.056 \text{ kg}}$$

$$Q = 39,282 \text{ kJ/kg}$$

(08)

Date / /

(ii) (a) Electrolysis is the decomposition of an electrolyte by passing an electric current through it (02)

(ii) Factors

- The ease of discharge of the ion (02)
- Concentration of the ions
- The nature of the electrode

(b) During the electroplating process, the anode is usually made of the metal to be used for plating (that is Gold or Silver) while the object to be plated is made the cathode. During the electrolysis, the plating metal dissolves and is transferred to the cathode (the object to be plated such as earnings, wrist watches) (05)

(c) (i) $m = ZIT$

$$Z = 3.29 \times 10^{-4}$$

$$I = 10,000 A = 10^4 A$$

$$t = (1 \text{ sec} \times 60 \times 60) s = 4.32 \times 10^4 s$$

$$\text{Therefore } m = 3.29 \times 10^{-4} \times 10^4 \times 4.32 \times 10^4 \text{ kg} \\ = 142.1 \text{ kg.}$$

02/2

(ii) $\frac{E_1}{E_2} = \frac{m_1}{m_2}$

Chemical equivalent of Copper (E_1)

$$\rightarrow \frac{63.5}{2} = 31.75$$

Chemical equivalent of aluminium (Fe_2)

$$= \frac{27}{3} = 9$$

$$m_1 = 142.1 \text{ kg}$$

$$\frac{31.75}{9} = \frac{142.1 \text{ kg}}{m_2}$$

$$m_2 = 40.280 \text{ kg}$$

(02/2)