30.6 CHEMISTRY (233)

30.6.1 Chemistry Paper 1 (232/1)

1. (a) Energy required to remove 1 mole of electrons from 1 mole of gaseous atoms. ***(1 mark)***

   (b) B (l)
   It loses electrons most readily (1) ***(2 marks)***

2. (a) $Ca(HCO_3)_{2\,(aq)} \longrightarrow CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)}$ /

   $Mg(HCO_3)_{2(aq)} \longrightarrow MgCO_{3(s)} + H_2O_{(l)} + CO_{2\,(g)}$ ***(1 mark)***

   (b) Sodium carbonate (1)
   Calcium hydroxide (1)
   (Accept correct formulae) ***(2 marks)***

3. (i) 2.8.8
   (ii) 2.8.2 ***(2 marks)***

4. (a) Water (1) ***(1 mark)***

   (b) The second/other product of burning candle is carbon (IV) oxide (1). It can be prevented from getting into the environment by passing it through a hydroxide solution/alkaline solution e.g. KOH, NaOH or aqueous ammonia. (1) ***(2 marks)***

5. Oxygen exists as diatomic molecules/simple molecules (½)
   The forces of attraction between the molecules are very weak (½) therefore less energy is required to separate them (½).
   Atoms in sodium are held by strong metallic bonds (1). These require a lot of energy to break them. (½)
   (3 marks)

6. $^{64}_{30}E^{2+}$ ½ mark for 30, 64 + ½ for E^{2+} ***(1 mark)***

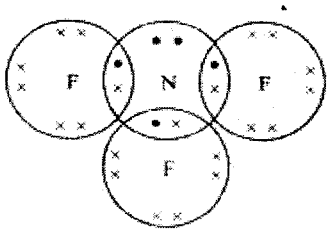
7. (a) $Al^{3+}_{(l)} + 3e \longrightarrow Al_{(s)}$ (1)

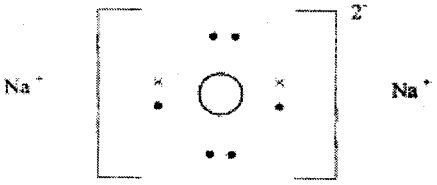
   (b) 27 g requires 3 Faradays (1)

   $\therefore$ 1800 x 1000g require $\frac{3 \times 1800 \times 1000}{27}$ (½)

   = 2 x 10^5 Faradays (½) ***(3 marks)***

8.





(2 marks)

9. (a) Heat change when one mole of a solute dissolves in excess of the solvent (1)

(b) (i)
$\Delta H_1 = +733 \text{ kJ mol}^{-1}$
$\Delta H_2 = -406 \text{ kJ mol}^{-1}$
$\Lambda H_3 = -335 \text{ kJ mol}^{-1}$
} (1½)

(c) Molar heat of solution
$733 - (+406 + 335) = 733 - 406 - 335$
$= -8 \text{ kJ mol}^{-1}$ (½)

(3 marks)

10. A t anode $4OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2\,(g)} + 4e$ (1)

A t cathode $4H^+_{(aq)} + 4e \rightarrow 2H_{2\,(g)}$

OR

$4OH^-_{(aq)} + 4H^+_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2\,(g)} + 2H_{2\,(g)}$ (1)

Therefore for every one mole of oxygen gas produced, two moles of hydrogen gas are produced.

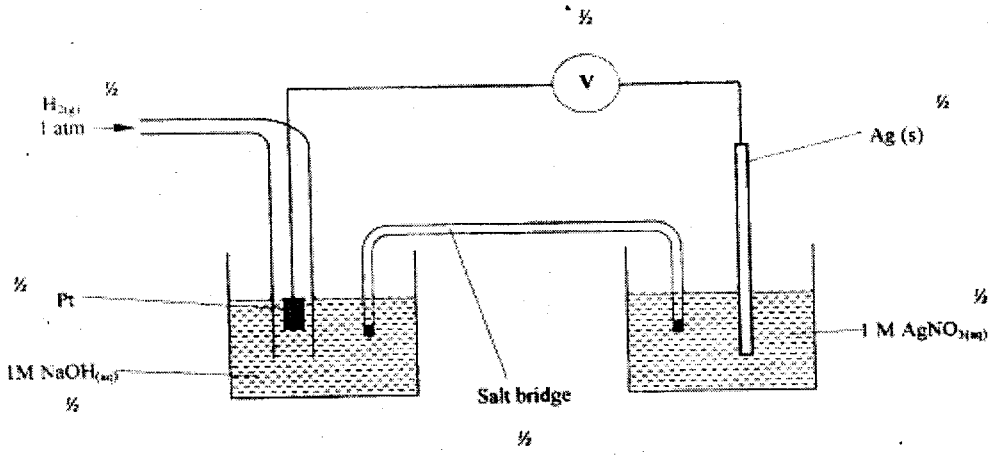
(2 marks)

11.

- To 50 cm^3 of 2.8 M NaOH, add 25 cm^3 of 2.8 M H_2SO_4 OR 50 cm^3 of 1.4 M H_2SO_4 (1)
- Heat mixture to concentrate (½)
- Cool it for crystals to form (½)
- Filter (½)
- Dry the residue (½)

(3 marks)

12.



Max. 3 marks

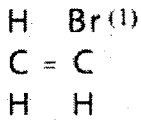
13. Moles of oxygen $= \frac{0.83}{32} = 0.02594$ (½)

Moles of $NaNO_3$ = 2 x 0.02594 (½)
= 0.05188
R.M.M. of $NaNO_3$ = 85
Mass of $NaNO_3$ converted = 0.05188 × 85 (½)
4.4098 (½)

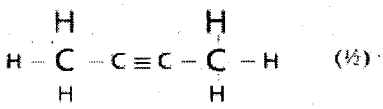
$$\% = \frac{4.4098}{8.53} \times 100 \text{ (½)}$$

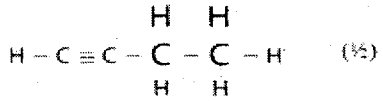
= 51.698% (½) ***(3 marks)***

14.

(a)  (1) Bromoethene (1)

(2 marks)

(b)  (½)

 (½)

(1 mark)

15. (a) The gas burns with a blue flame (1)

(b) (i) The iron is less reactive than magnesium (1)

(ii) Heat the iron powder (1) **(3 marks)**

16. (a) To be read from graph (x) = 79 g/100g water **(1 mark)**

(b) R.M.M. of $KNO_3 = 101$ *(½ mark)*

Molar concentration $= \frac{79}{101} \times 10$ *(1 mark)*

$= 7.82$ M *(½ mark)*

17. 10 electrons (1)
Single bonds constitute 2 electrons
Double bond 4 electrons } (1)
(2 marks)

18.

Bottle	Correct Label
1	Sodium chloride
2	Sugar
3	Sodium carbonate

(3 marks)

19. (a) Catalyst (1)
(b) Add bromine water or acidified potassium manganate (VII) (1) if they decolourise, (½) then gas is either an alkene or an alkyne (½) **3 marks**

20. (a) Chemical change
(b) Physical change
(c) Chemical change *(3 marks)*

21. Magnesium Phosphide *(1 mark)*

22. Tests 2 (½) and 3 (½) for test 2 iron is above hydrogen in the reactivity series hence it displaces hydrogen (1). For test 3, dilute sulphuric acid is not an oxidizing agent (1). *(3 marks)*

23. (a) Pale green solution (½) , turns yellow (½)
(b) Sodium hydroxide (1)
(c) Water (1) *(3 marks)*

24. (a) $Si H_4$ (silane) (½), it has a higher boiling point (½)

(b) No hydrogen bonding in CH_4 and $Si H_4$ (1) while the hydrogen bond in H_2O is stronger than that in H_2S (1) *(3 marks)*

25. (a) Colourless solution becomes brown/black (½)
$I_{2\,(aq)}/_{(s)}$ (½)

(b) Blue PPt dissolving to form a deep blue solusion (1) $Cu(NH_3)_4^{2+}$ (1) *(3 marks)*

26. (a) Temperature and pressure are directly proportional (1)

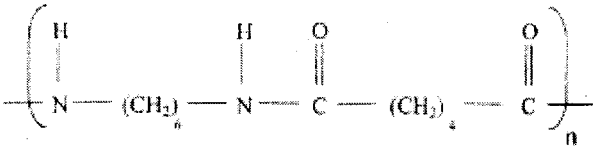
(b) With increase in temperature, the gas particles gain more Kinetic energy (1) They move faster and collide with the walls of the container more frequently hence increasing pressure (1) *(3 marks)*

27. The amount of hydrogen would reduce (1) increase in pressure shifts the reaction to the side with fewer molecules (1) *(2 marks)*

28. (a) Energy of the activated/intermediate complex of the uncatalysed reaction (1)

(b) Catalyst lowers the activation energy (1) therefore more molecules will take part in effective collision (1) *(3 marks)*

29. (a)



(b) Making synthetic fibre such as for
- rope
- blouses
- stockings *(2 marks)*

30. (a) Crush the roses with a suitable solvent (½) Filter to obtain pigment (½)

(b) Add pigment to an acid (1). It turns read (1)

30.6.2 Chemistry Paper 2 (233/2)

1. (a) (i) $MnO_{2(s)} + 4HCl_{(aq)} \rightarrow MnCl_{2(aq)} + Cl_{2(g)} + 2H_2O_{(l)}$ *(1 mark)*

(ii) $KMnO_4/PbO_2/CaOCl_2$ *(1 mark)*

(iii)

(iv) Chlorine gas is passed through a U-tube containing anhydrous $CaCl_2$. or Cl_2 is passed through conc. H_2SO_4 in a flask. *(2 marks)*

Or accept any other correct method.

(b) (i) A – Aluminium chloride/$AlCl_{3(g)}$ *(1 mark)*

(ii) $2Al_{(s)} + 3Cl_{2(g)} \longrightarrow 2AlCl_{3(s)}$ *(1 mark)*

(iii) Moles of aluminium metal used = $\frac{0.84}{27} = 0.0311$ *(1 mark)*

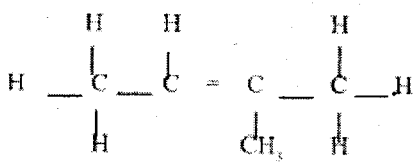
$$\text{Condensed form} = \frac{0.84}{27} \times \frac{3}{2} \times 24 = 1.12 \text{ dm}^3$$

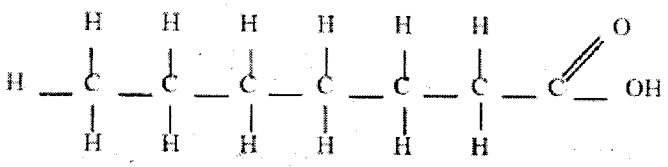
$$\text{Moles of } Cl_s \text{ gas} = 0.0311 \times \frac{3}{2} = 0.047$$ *(1 mark)*

$\therefore$ Vol. of $Cl_2 = 0.047 \times 24 = 1.12\,dm^3$ *(1 mark)*

(v)
- prevent moisture or water vapour from entering the apparatus by absorbing it
- prevent the hydrolysis of $AlCl_3$
- to react with excess chlorine hence prevent environmental pollution
- prevent pollution by Cl_2 *(2 marks)*

2. (a)

(i)  I

(ii)  I

(b) Determine the boiling points of the two alkanols. Hexanol has the highest boiling point. ***(2 marks)***

OR

Add equal amount of water to equal amounts of alkanos and shake. For hexanol, two layers of liquid are formed , methanol forms no layers.

Determine the density of the two alkanols. Hexanol has a higher density than methanol.

Refactivc index /m.p.

(c) (i) I Esterification/Condensation ***(1 mark)***

II Chloroethane (CH_3CH_2Cl) ***(1 mark)***

Or
Monochloroethane C_2H_5Cl

(ii) Sodium ethoxide (CH_3CH_2ONa) or $C_2H_5ONa^-$ ***(1 mark)***

(iii) H_2 High Temperature $(150 - 250^0)$, High pressure $(200 - 300_{at})$

Note: - Correct reagent (H_2) ---------
- Correct catalyst
- High temperature $(150\text{-}250^0)$/High pressure $(200 - 300_{at})$

(3 marks)

3. (a) (i) (I) $D_{(l)}^{2+} + 2e \longrightarrow D(s)$ ***(1 mark)***

(II) $2Br^-_{(l)} \longrightarrow Br_{2(g)} + 2e^-$ ***(1 mark)***

(ii) Anode – Carbon
Reason: it will not be attacked by/react with bromine gas. ***(2 marks)***

(iii) Bromine gas is poisonous ***(1 mark)***

(iv) I Weigh the cathode metal D before the start of the experiment
Weigh the cathode after the experiment
Then get the difference ***(3 marks)***

II Q = It

$= 0.4 \times 90 \times 60 = 2160C$ (1)

1 mole of D = 96500

R.A.M. = $\frac{2.31 \times 2 \times 96500}{2160}$ (1)

= 206.4 (1) ***(3 marks)***

4. (a) (i) Pump sea water to shallow pond (1), evaporation of H_2O takes place, leaving NaCl to crystallize out (1). ***(2 marks)***

(ii) I $NH_3(g) + CO_{2\,(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3\,(aq)}$ ***(1 mark)***

II $NH_4HCO_{3\,(aq)} + NaCl_{\,(aq)} \longrightarrow NaHCO_{3\,(s)} + NH_4Cl_{\,(aq)}$ ***(1 mark)***

(iii) I Filtration ***(1 mark)***

II Heating ***(1 mark)***

(iv) I $Na_2CO_{3\,(s)} + H_2SO_{4\,(aq)} \longrightarrow Na_2SO_{4\,(aq)} + CO_{2\,(g)} + H_2O_{\,(l)}$ (1)

Moles of $H_2SO_4 = \frac{40 \times 0.5}{1000} = 0.02$ (½)

Moles of $Na_2CO_3 = 0.02$ (½) ***(2 marks)***

II Mass of $Na_2CO_3 = 0.02 \times 106 = 2.12_{\,g}$ (1)

% purity = $\frac{2.12}{2.15} \times 100 = 98.6\%$ (1) ***(2 marks)***

(b)

- Glass making
- Softening water
- Detergent
- Drugs
- anti-acid
- Textile industry
- Photography
- Paper industry
- In the manufacture of NaOH
- used as a food additive ***(2 marks)***

5. (a) (i) I Condensation ***(1 mark)***

II Melting ***(1 mark)***

(ii) Iodine/ benzoic acid/ Naphthlene/ solid ice/ dry ice ***(1 mark)***

(iii) $H_2O_{\,(g)} \longrightarrow H_2O_{\,(s)}$ ***(1 mark)***

(b) (i) I Van der waals and hydrogen bonding ***(1 mark)***

II Van der waals forces ***(1 mark)***

(ii) I In melting, H-bond & Van der waals are weakened.
In vaporisation, H-bond & Van der waals are broken ***(2 marks)***

II OR is larger than NP OR heating time for QR is

bigger than that of NP *(1 mark)*

(c) (i) Hydrogen when burned produces H_2O which is a non-pollutant (1)
Has high energy content. Small amount of hydrogen produces a lot of energy (1)
H_2 is a renewable energy – so it cannot be exhausted.(1) *(3 marks)*

(ii) It can easily explode when burning
OR
Accept high cost of production/ it is expensive **1 mark**

6.

Ion	Number of protons	Number of neutrons	Mass number	Electron arrangement
W	17 (½)	20	37 (½)	2.8.8
X^{4+}	14	14 (½)	28	2.8. (½)

(2 mark)

(b) (i) Sodium burns with a **yellow flame** and changes from grey to White powder *(1 mark)*

Copper burns with a **green/blue** flame and changes from brown to a **black** powder *(1 mark)*

Sodium: Rapid effervescence, darts or floats on the water surface

: The solution turns pink immediately *(1 mark)*

Magnesium: Sinks in the water

: Slow effervescence – the solution turns pink gradually *(1 mark)*

(c) Magnesium (1)
It has a higher nuclear attraction charge which pulls outer elections strongly (1) *(2 marks)*

(d) (i) It is $^{238}_{92}Y$ For highest abundance *(1 mark)*

(ii) The relative atomic mass of Uranium is

$$= \frac{(0.001\times 234)+(0.727)+(99.27\times 238)}{100}\ (1)$$

$$= 237.978\ (1)$$ *(2 marks)*

(iii) $^{235}_{92}Y \longrightarrow {}^{231}_{90}Th + {}^{4}_{2}He$ *(1 mark)*

(iv) Control thickness of paper *(1 mark)*

7. (a) Coke/coal/charcoal/carbon *(1 mark)*

(b) $C_{(s)} + CO_{2(g)} \longrightarrow 2CO_{(g)}$ *(1 mark)*

(c) The reaction between coke/carbon and the incoming hot air is highly exorthermic *(2 marks)*

(d) Slag is immiscible with molten iron *(1 mark)*

(e) Nitrogen (IV) oxide forms acid rain which corrodes metallic materials and destroys vegetation in the environment, aquatic life *(2 marks)*

Or

NO_2 is toxic/poisonous – causes bronchitis, respiratory diseases

(f) (i) By passing or throwing in oxygen through molten iron which converts carbon into carbon (IV) oxide *(2 marks)*

(ii) To increase the tensile strength of the iron produced *(1 mark)*

Or

Make the material more brittle

Or

Makes it more ductile, malleable (any one of the three)

30.6.3 Chemistry Paper 3 (233/3)

1. Table 1

	I	II	III
Final burette reading	22.20	21.50	22.50
Initial burette reading	0.00	0.00	1.00
Volume of solution C used (cm^3)	22.20	21.50	21.50

(4 marks)

(a) (i) Average volume of solution C used

$$= \frac{21.50 + 21.50}{2} = 21.50$$

(1 mark)

(ii) Moles of sodium hydroxide in the average volume of solution C used.

1000 cm^3 of sodium contains 0.3 moles of NaOH.

$\therefore$ 21.50cm^3 of solution contains $\frac{0.3x21.5}{1000}$

= 0.00645 moles *(1 mark)*

(iii) Moles of hydrochloric acid in 25.0 cm^3 of solution D.

= 0.00645 moles *(1 mark)*

(iv) Molarity of hydrochloric acid in solution D.

25cm^3 of solution contains 0.00645 moles HCl

$\therefore$ 1000 cm^3 of solution contains $\frac{0.00645x1000}{25}$

= 0.258M *(1 mark)*

Table 2

	I	II	III
Final burette reading	21.50	20.90	20.90
Initial burette reading	0.00	0.00	0.00
Volume of solution **D** used (cm^3)	21.50	20.90	20.90

(4 marks)

(b) (i) Average volume of solution D used

$$\frac{20.90 + 20.90}{2} = 20.90cm^3$$ ***(1 mark)***

(ii) Moles of hydrochloric acid in average volume of solution **D** used

$1000cm^3$ of solution contains 0.258 moles HCl

$\therefore$ $20.90cm^3$ of solution contains $\frac{0.258 \times 20.90}{1000}$ Moles

= 0.0054 moles ***(1 mark)***

(iii) Moles of the metal carbonate, solid A in $25.0cm^3$ of solution **A**.

Mole ratio of acid to carbonate 2:1 ***(1 mark)***

$\frac{1}{2} \times 0.0054$

= 0.0027 moles. ***(1 mark)***

(iv) The solubility of the metal carbonate in g/100g of solution

Mass of carbonate = 0.0027 x 74

In $25.0cm^3$ of solution = 0.1998g. ***(1 mark)***

$\therefore$ 100g of solution will contain $\frac{0.1998 \times 100g}{25}$ of carbonate

= 0.7992 g/100g of solution ***(1 mark)***

	Observations	**Inferences**
2. (a)	- A colourless liquid condenses on the cooler parts of test tube	- Hydrated salt/compound
	- Gas produced forms white fumes with HCl. (2 marks)	- Ammonia gas (1 mark)

	Observations	**Inferences**
(b)	(i) White ppt. insoluble in excess (1 mark)	Pb^{2+} or Al^{3+} present (1 mark)

Observations	**Inferences**

(ii) No white ppt No effervescence (1 mark)	Pb^{2+} absent or Al^{3+} present CO_3^{2-} absent (2 marks)

Observations	Inferences
(iii) White ppt. (1 mark)	SO_4^{2-} present (1 mark)

	Observations	Inferences
3. (a)	White Solid dissolves to form a Colourless solution (1 mark)	A non polar compound present. (1 mark)

Observations	Inferences
(i) $P^H = 7$ (1 mark)	Neutral solution. (1 mark)

Observations	Inferences
(ii) No effervescence (1 mark)	Solution not acidic (1 mark)

	Observations	Inferences
(b)	- Effervescence giving off a coloureless gas. - Colourless solution formed. (1 mark)	Carboxylic/alkanoic acid preset Or – COOH present (1 mark)

Observations	Inferences
(ii) Does not turn green (1 mark)	Alcohol absent OH – absent (1 mark)

Observations	Inferences
(iii) Not decolourized (1 mark)	(1 mark)