JINJA JOINT EXAMINATIONS BOARD

UCE

CHEMISTRY

Paper 2

545/2 MARKING GUIDE- 2020

NB: *Allow* **ionic equations** *in* **ALL** *Cases.* ✓ ***(0½ mark)*** ✓ ***(01 mark)***

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1. (a) (i) Potassium carbonate ✓

(ii) Zinc carbonate ✓

(b) Filtration ✓

(c) (i) White solid ✓ turned yellow ✓ when hot and white on cooling.

(ii) $ZnCO_3\,(s) \xrightarrow{\checkmark} ZnO\,(s) + CO_2\,(g)$

(d) Fractional crystallization ✓

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05 marks

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2. (a) (i) (concentrated) Hydrochloric acid ✓

(ii) Hydrogen peroxide ✓

(b) (i) $2H_2O_2\,(aq) \xrightarrow{\quad} 2H_2O\,(l) + O_2\,(g)$

Accept: $2KClO_3\,(s) \longrightarrow 2KCl\,(s) + 3O_2\,(g)$

(ii) $MnO_2\,(s) + 4HCl\,(aq) \longrightarrow MnCl_2\,(aq) + 2H_2O\,(l) + Cl_2\,(g)$

(c) (i) Tri-iron tetra oxide (***or its Equivalent***)

(ii) Iron (III) chloride

05 marks

3. (a) 2 : 8 : 3

(b) Exist as diatomic molecules.

React with metals to form salts.

(c) (i) U

(ii) $2U\,(s) + 2H_2O\,(l) \longrightarrow 2UOH\,(aq) + H_2\,(g)$

(d) (i) $R(NO_3)_2$

(ii) Used as fertilizers (***or its Equivalent***)

05 marks

4. (a) (i) Heat

Dry ammonia

(ii) Reducing property

(b) Moles of lead $= \frac{3.105}{207}$

3 moles of lead are produced by 2 moles of ammonia

Moles of ammonia $\frac{2}{3} \times \frac{3.105}{207}$

1 mole of gas occupies 22.4 dm^3

$\left(\frac{2 \times 3.105}{3 \times 207}\right)$ mole of ammonia occupies $\left(\frac{2 \times 3.105}{3 \times 207} \times 22.4\right)$ dm^3

$= 0.224\ dm^3$

(c) Copper (II) oxide (or equivalence)

05 marks

5. (a) Is a large molecule formed by repeated combination of small molecules (monomers).

(b) (i) Rubber, Cotton, Hair, Rayon etc

(ii) Polyethene, Nylon, Polyester etc.

(c) (i) Cotton – For making textiles (cloths).

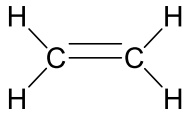
(ii) Polyethene – For making polyethene bags.

05 marks

6. (a) (i) (Concentrated) Sulphuric acid.

(ii) $C_2H_5OH\ (l) \xrightarrow[170 - 180\ ^\circ C]{\text{Conc. } H_2SO_4 \text{ / Excess}} C_2H_4\ (g) + H_2O\ (l)$

(iii)



(b) Bromine solution turned from reddish-brown to colourless.

(c) $C_2H_4\ (g) + 3O_2\ (g) \longrightarrow 2CO_2\ (g) + 2H_2O\ (l)$

05 marks

7. (a) (i) Is a solution with a known concentration

(ii) R.F.M of $NaHCO_3 = (23 \times 1) + (1 \times 1) + (1 \times 12) + (16 \times 3)$

= 84

100 cm^3 of solution contain 3.36 g of $NaHCO_3$

∴ 1000 cm^3 of solution will contain $\left(\frac{3.36}{100} \times 1000\right)$ g

= 33.6 g

84 g of NaHCO3 is mole

∴ 33.6 g of will be $\left(\frac{3.36}{84} \times 1\right)$ mole

= 0.4 $moldm^{-3}$

(b) 1000 cm^3 of solution contain 0.4 mole

∴ 25 cm^3 of solution will contain $\left(\frac{0.4}{1000} \times 25\right)$ mole

= 0.01 mole

200 cm^3 of solution contain 0.01 mole

∴ 1000 cm^3 of solution will contain $\left(\frac{0.01}{200} \times 100\right)$ mole

= 0.05 $moldm^{-3}$

05 marks

8. (a) (i) Is a substance that absorbs water vapour from the atmosphere.

(ii) $CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (s)$

(b) (i) $CaO\ (s) + SiO_2\ (s) \rightarrow CaSiO_3\ (s)$

(ii) Calcium oxide <u>does not react</u> with ammonia.

05 marks

9. (a) Excess oxygen

Burning sodium

(b) (i) $2Na\ (s) + O_2\ (g) \longrightarrow Na_2O_2\ (s)$

(ii) $2Na_2O_2\ (s) + 2H_2O\ (l) \longrightarrow 4NaOH\ (aq) + O_2\ (g)$

(c) Used in the manufacture of oxygen.

05 marks

10. (a) (i) Brown solid deposited.

(ii) Copper (II) ion is lower than hydrogen ion in the electrochemical series.

(iii) Oxygen

(b) (i) $Cl_2\ (g) + H_2O\ (g) \longrightarrow HCl\ (aq) + HOCl\ (aq)$

(ii) $NH_3\ (g) + HCl\ (g) \longrightarrow NH_4Cl\ (s)$

05 marks

11. (a) (Dilute) Hydrochloric acid is added through a tap funnel to calcium carbonate in a reaction flask fitted with a delivery tube. Effervescence occurs and a colourless gas is produced. The gas is passed through sodium-hydrogen carbonate solution to acid the acid fumes/sprays and then through concentrated sulphuric acid to dry the gas. The pure and dry gas is then collected by downward delivery since its more dense than air.

$CaCO_3\ (s) + 2HCl\ (aq) \longrightarrow CaCl_2\ (aq) + H_2O\ (l) + CO_2\ (g)$

(b) (i) White precipitate formed.

(ii) $2NaOH\ (aq) + CO_2\ (g) \longrightarrow Na_2CO_3\ (aq) + H_2O\ (l)$

$Na_2CO_3\ (aq) + H_2O\ (l) + CO_2\ (g) \longrightarrow 2NaHCO_3\ (s)$

(c) (i) Magnesium continues to burn for a short time with a spluttering flame leaving black specks (particles) and white solid.

(ii) $2Mg\ (s) + CO_2\ (g) \longrightarrow 2MgO\ (s) + C\ (s)$

(d) R.F.M of $KHCO_3 = (39 \times 1) + (1 \times 1) + (1 \times 12) + (16 \times 3)$

$= 39 + 1 + 12 + 48$

$= 100$

Moles of $KHCO_3 = \frac{4.0}{100}$

$= 0.04$ mole

2 moles of $KHCO_3$ produced 1 mole of CO_2

$\therefore$ 0.04 mole of $KHCO_3$ produced $\left(\frac{1}{2} \times 0.04\right)$ mole

$= 0.02$ mole

But 1 mole of gas occupies 24.0 dm^3 at room temperature.

$\therefore$ 0.02 mole will occupy $\left(\frac{24.0}{1} \times 0.02\right)$ dm^3

$= 0.48\ dm^3$

15 marks

12. (a) Enthalpy of neutralisation is the heat change that occurs when one mole of hydrogen ions react with one mole of hydroxyl (hydroxide) ions to form one mole of water.

(b) See graph paper.

(c) (i) Initial temperature is 23 ℃

(ii) 20 cm^3

(iii) (29.0 – 23.0) = 6.5 ℃

(d) (i) Moles of the acid $= \left(\frac{25 \times 2}{1000}\right)$

= 0.05 mole

Mass of solution at neutralisation

Total volume of solution = (25 + 20) cm^3

= 45 cm^3

Mass of solution $= (45 \times 1)$ g

= 45 g

Heat produced by solution $= mc\theta$

$= (45 \times 4.2 \times 6.5)$ J

$= 1228.5$ J

0.05 mole of HCl produced 1228.5 J

∴ 1 mole of HCl will produce $\left(\frac{1228.5}{0.05} \times 1\right)$ J

$= 24570$ $Jmol^{-1}$

∴ ΔH_n of HCl $= -24.57$ $kJmol^{-1}$

(ii) $NaOH\ (aq) + HCl\ (aq) \longrightarrow NaCl\ (aq) + H_2O\ (l)$

1 mole of HCl reacted with 1 mole of NaOH

∴ Moles of NaOH = 0.05 mole

20 cm^3 of NaOH contained 0.05 mole

∴ 1000 cm^3 of solution contained $\left(\frac{0.05}{20} \times 1000\right)$ moles

= 2.5 M

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15 marks

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13. (a) **Name:** Anhydrous sodium carbonate

Formula: Na_2CO_3

(b) (i) Mass of water $= (6.3 - 2.3)$ g

= 4.0 g

R.F.M of $Na_2CO_3 = (2 \times 23) + (1 \times 12) + (3 \times 16)$

= 106

R.F.M of $H_2O = (2 \times 1) + (1 \times 16)$

= 18

	Na_2CO_3	:	H_2O
Mass:	2.3	:	4.0
Number of moles:	$\frac{2.3}{106}$	:	$\frac{4.0}{18}$
	0.022	:	0.222
Mole ratio:	$\frac{0.022}{0.022}$	:	$\frac{0.222}{0.022}$
	1	:	10

$\therefore \ n = 10$

(ii) Hydrated sodium carbonate (***or its Equivalent***)

(iii) $Na_2CO_3.10H_2O\ (s) \longrightarrow Na_2CO_3\ (s) + 10H_2O\ (l)$

(c) (i) Lead (II) nitrate

Sodium carbonate (***or its Equivalent***)

(ii) $Pb(NO_3)_2\ (aq) + Na_2CO_3\ (aq) \longrightarrow PbCO_3\ (s) + 2NaNO_3\ (aq)$

(d) White solid turned reddish-brown when hot and yellow on cooling.

$PbCO_3\ (s) \longrightarrow PbO\ (s) + CO_2\ (g)$

(e) (i) Potassium iodide solution (***or its Equivalent***)

(ii) With Pb^{2+}; Yellow precipitate

With Zn^{2+}; No observable change

15 marks

14. (a) (i) Sewage is used water.

Or water containing waste materials used in homes, industries etc.

(ii) **Sludge:**

This is the solid matter that settles down during sedimentation process in sewage treatment.

Effluent:

This is the treated sewage (water) that is directed to the river or lake.

(iii) Used as fertilizers, Road tarmacking etc

(iv) Sewage contains;

- Smelling gases that impart smell to water.
- Colouring matter that impart colour to water.
- Germs or bacteria which are added to water.
- Chemicals that render water acidic or alkaline.
- Oils that prevent air entry into the water.

(b) **Sedimentation:**

This is when sewage is allowed to stand so as for the solid matter to settle down.

Aeration:

This is when a mixture of gases (air) is blown through the sewage. This air contains oxygen used by aerobic bacteria that decompose sewage. It also contains ammonia and hydrogen sulphide that are used to precipitate heavy metals eg. Iron, lead etc

Chlorination:

This is when chlorine solution is added to sewage to kill excess germs.

(c) (i) Methane

(ii) The gas mixture contains ammonia gas and hydrogen sulphide gas which precipitate heavy metals present in the sewage.

$$Pb^{2+}(aq) + H_2S(g) \longrightarrow PbS(s) + 2H^{+}(aq)$$

OR

$$Fe^{3+}(aq) + 3NH_4OH(aq) \longrightarrow Fe(OH)_3(s) + 3NH_4^{+}$$

15 marks

END