

Name..... Index No...../.....

Candidates Signature.....

Date .....

**233/1**  
**CHEMISTRY**  
**Paper 1**  
2 Hours

**CANDIDATES 2020 TRIAL KCSE MOCK EXAM**

*Kenya Certificate of Secondary Education (K.C.S.E)*

**233/1**  
**CHEMISTRY**  
Paper 1  
  
2 Hours

**Instructions to Candidates**

- (a) Write your name and index number in the spaces provided above.
- (b) Sign and write the date of examination in the spaces provided above
- (c) Answer **ALL** the questions in the spaces provided in the question paper
- (d) KNEC Mathematical tables and electronic calculators may be used for calculations
- (e) All working **MUST** be clearly shown where necessary
- (f) This paper consists of 15 printed pages
- (g) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing
- (h) Candidates should answer the questions in English

**FOR EXAMINER'S ONLY**

QUESTION	MAXIMUM SCORE	CANDIDATES SCORE
1-29	80	

*This paper consists of 13 printed pages. Candidates should check the question paper to Ensure that all the pages are printed as indicated and no questions are missing*

1. Give the name and formula of;

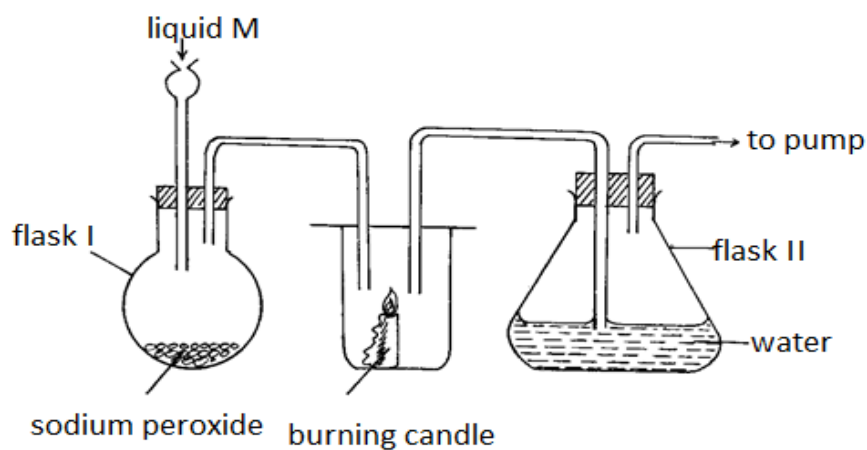
(i) A complex cation containing a transition metal (1mark)

.....  
.....

(ii) A complex anion containing a transition metal (1mark)

.....  
.....

2. The diagram below shows a set up of apparatus used to prepare oxygen gas and pass it over burning candle. The experiment was allowed to run for several minutes.



(i) Identify liquid M. (1mk)

.....  
.....

(ii) Write an equation for the reaction that forms oxygen gas in the set up. (1mk)

.....  
.....

(iii) The pH of the solution in flask II was found to be less than 7. Explain. (1mk)

.....  
.....

3. During heating of a hydrated copper (II) sulphate crystals, the following readings were got.

Mass of evaporating dish = 300g

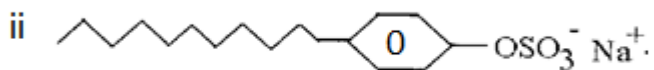
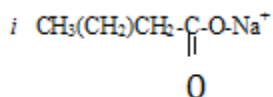
Mass of evaporating dish + hydrated salt = 305g

Mass of evaporating dish + dehydrated salt = 303.2g

Calculate the empirical formula of hydrated copper (II) sulphate. (Cu = 63.5, S=32, O=16, H=1)

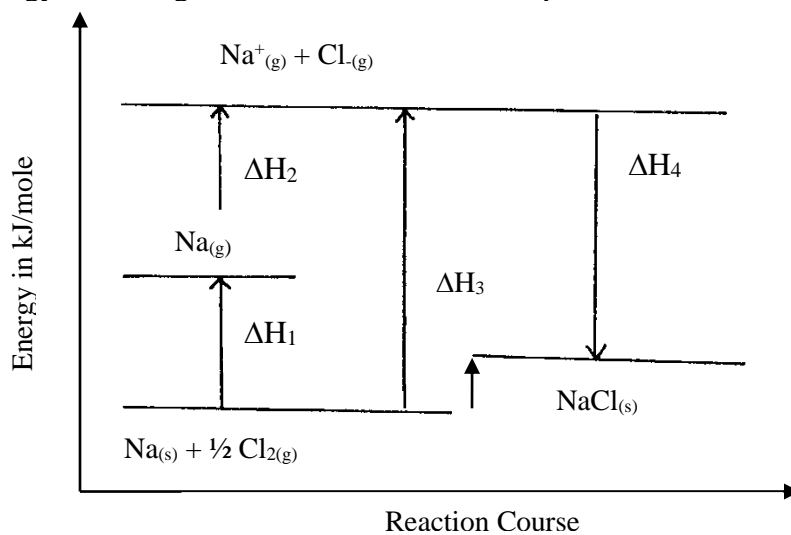
(3mks)

4. (a). Identify the following cleansing agents. (1 mk)



(b). State one disadvantage of using the cleansing agent in (a) (ii) above. (1 mk)

5. Study the energy level diagram below and answer the questions that follow.



(a). Identify the enthalpy changes represented by  $\Delta H_1$  ..... 1/2 mk

$\Delta H_2$  ..... 1/2 mk

$\Delta H_4$  ..... 1/2 mk

(b). Given that

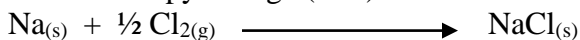
$\Delta H_1 = + 434 \text{ KJ/Mol}$

$\Delta H_2 = + 371 \text{ KJ/Mol}$

$\Delta H_3 = + 483 \text{ KJ/Mol}$

$\Delta H_4 = - 781 \text{ KJ/Mol}$

Calculate the enthalpy change ( $\Delta H$ ) for the reaction. (1 1/2 mks)



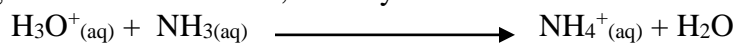
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6. Giving a reason in each case, identify an acid and a base in the equation.



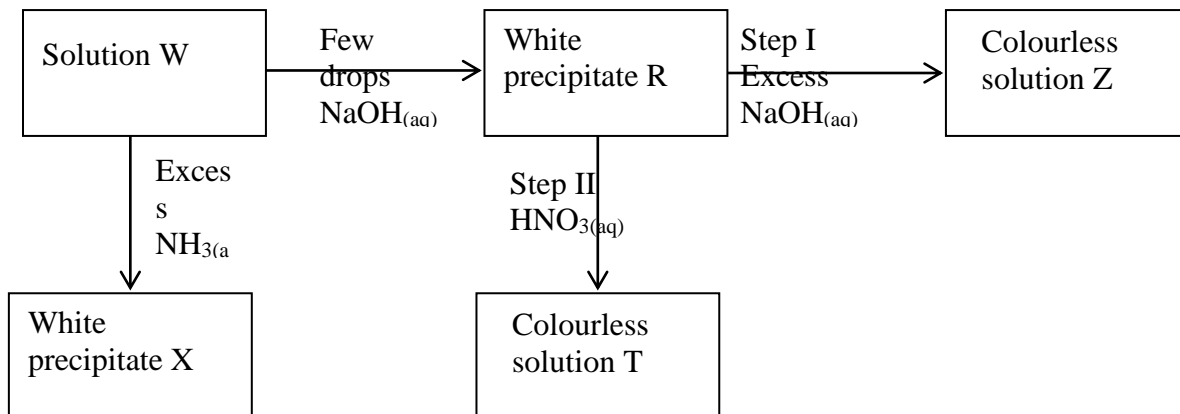
Acid .....½ mk

Reason .....½ mk

Base .....½ mk

Reason .....½ mk

7. Study the reaction scheme **below** and answer the questions that follow.



(a) What property of the white precipitate **R** is demonstrated by steps **I** and **II**. (1 mark)

.....  
 .....

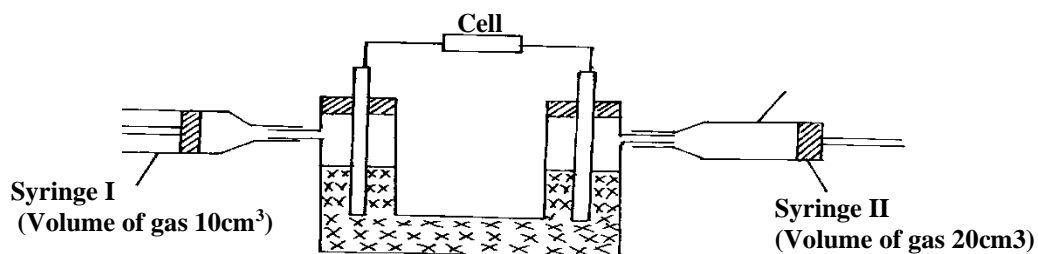
(b) If the metal ion in solution **W** is divalent suggest its identity. (1 mark)

.....  
 .....

(c) Write an ionic equation for the reaction taking place in step **I**. (1 mark)

.....  
 .....

8. The diagram below shows a set up that was used to electrolyse aqueous magnesium chloride.



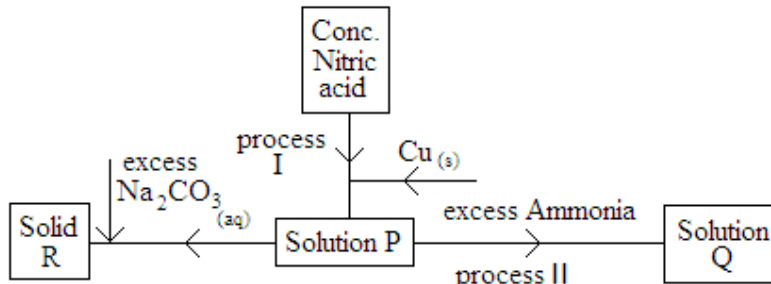
i) On the diagram above, using arrows, show the direction of flow of electrons. (1mk)

ii) Identify the syringe in which oxygen gas would be collected. (1mk)

.....

iii) State and explain the change of magnesium chloride concentration at the end of the experiment. (1 ½ mks)

9. Study flow chat below and answer the questions that follow.



(i).Write a chemical equation to show how solid R is formed. (1mk)

(ii).Write observation made in process (II). (1mk)

10. The table below shows the standard reduction potentials for four half-cells. Study it and answer the questions that follow (letter are not the actual symbols for the elements)

				$E^\theta$ (Volts)	
$F_{2(aq)}$	+	$2e$	$\longrightarrow$	$2F_{(aq)}^-$	+0.54
$G^{2+}_{(aq)}$	+	$2e$	$\longrightarrow$	$G_{(s)}$	-0.44
$H^{2+}_{(aq)}$	+	$2e$	$\longrightarrow$	$H_{(s)}$	+0.34
$2J^+_{(aq)}$	+	$2e$	$\longrightarrow$	$J_{2(g)}$	0.00

i. Identify the strongest reducing agent. (1mark)

ii. Write the equation for the reaction which takes place when solid G is added to a solution containing  $H^{2+}$  ions. (1 mark)

iii. Calculate the  $E^0$  value for the reaction in (ii) above. (1mark)

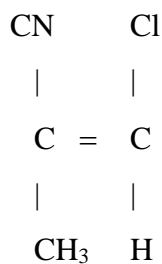
11. (a) State the Charles' law. (1mark)

.....  
.....

(b) A certain mass of gas occupies  $146\text{dm}^3$  at  $291\text{K}$  and  $98.31\text{kPa}$ . What will be its temperature if its volume is reduced to  $133\text{dm}^3$  at  $101.325\text{ kPa}$ ? (2 marks)

.....  
.....  
.....

12. Below is the structure of a monomer used in polymerization.



a) Draw the structure of part of the polymer involving 3 units. (1mk)

b) What type of polymerisation takes place? (1mk)

.....  
.....

c) Give one advantage of artificial fibres over natural ones. (1mk)

.....  
.....

13.  $20.0\text{cm}^3$  of  $\text{NaOH}$  solution containing  $8.0\text{gdm}^{-3}$  were required for complete neutralization of  $0.118\text{g}$  of a dibasic acid. Calculate the Relative Molecular Mass (R.M.M) of the acid.

( $\text{Na}=23, \text{O}=16, \text{H}=1$ ) (3mks)

.....  
.....  
.....  
.....  
.....

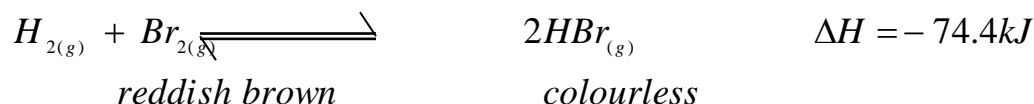
14. The table below shows the results obtained when a current of 2 amperes is passed through copper II sulphate solution for 15 minutes.

Initial mass of cathode	1.0g
Final mass on cathode	1.60g
Change in mass at the cathode	0.60g

**Calculate** the quantity of electricity required to deposit one mole of copper (Cu= 63.5) (2mks)

.....  
.....  
.....  
.....

15. The following equation shows a reversible reaction.



**(a). State** and explain the observation that can be made when:-

(i). Temperature is increased. (1½mks)

.....  
.....

(ii).Pressure is reduced. (1½mks)

.....  
.....

16. *You are provided with:*

A clean metallic spatula

Distilled water

Lead (II) nitrate solution

Source of heat

A rack of test – tubes

A white solid suspected to be sodium chloride

*Required*

Draft a procedure you would use to enable you test and confirm that the white solid is a chloride compound. (3mks)

Test	Observation	Inference

17. Sulphur is one of the elements with varying oxidation States

(a) What is oxidation state? (1mk)

.....  
 .....

(b) Determine the oxidation state of sulphur in  $\text{SO}_3^{2-}$  (1mk)

.....  
 .....

(c) Give the electron pattern of sulphur in  $\text{SO}_3^{2-}$  (1mk)

.....  
 .....

18. When fuels burn in the internal combustion engine at high temperature, one of the products formed is nitrogen (II) oxide.

(a) Write the equation for the formation of nitrogen (II) oxide. (1 mark)

.....  
 .....

(b) Give a reason why nitrogen (II) oxide is not formed at room temperature. (1mark)

.....  
 .....

(c) Describe how formation of nitrogen (II) oxide in the internal combustion engine leads to gaseous pollution? (1 mark)

.....  
 .....



19. Use part of the periodic table grid below to answer questions that follow. (Letters do not represent actual symbols of the elements)

				A		B	C	
D			E	F			G	
							H	

a) Which is the most reactive non-metal? Explain. (1 mark)

.....  
 .....

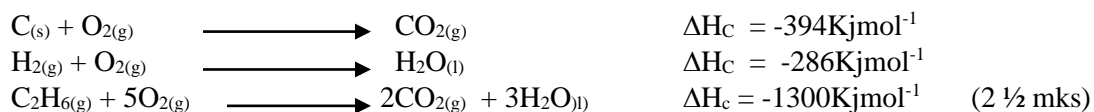
b) Name the bond type formed when element A and B react. Explain. (1 mark)

.....  
 .....

c) Giving a reason compare the atomic radius of element D and E. (1 mark)

.....  
 .....

20. Use the standard enthalpies of combustion given below to calculate the enthalpy of formation of ethane.

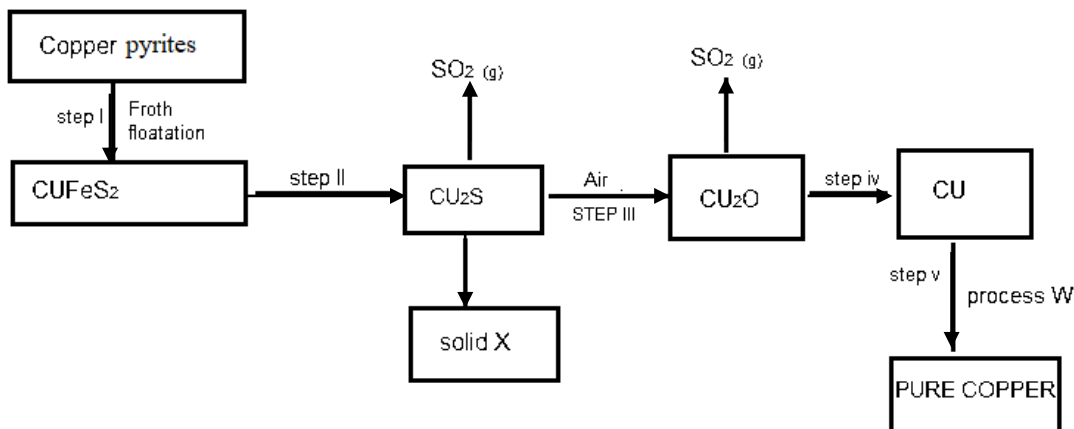


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21. Describe how a solid sample of Lead (II) Sulphate would be prepared using the following reagents. Dilute Sulphuric (VI) acid, Nitric (V) acid, solid lead (II) Carbonate. (3marks)

.....  
 .....

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



a. Identify  
i. Solid X (½ mk)

.....

ii. Process W (½ mk)

.....

b. Write an equation for the reaction in step II. (1mk)

.....

.....

c. Explain why Copper is suitable in making soldering equipment. (1mk)

.....

.....

23. The table below gives the rate of decay for a sample of radioactive element P.

Mass of P(g)	Number of days
48	0
18	90
6	180

a) Determine its half-life (1mk)

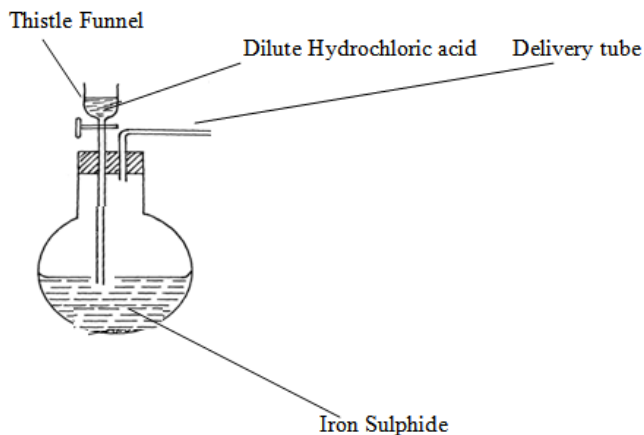
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.....

b) Complete the following nuclear equation (1mk)



24. Complete this set up below for the preparation and collection of dry Hydrogen Sulphate. (3mks)

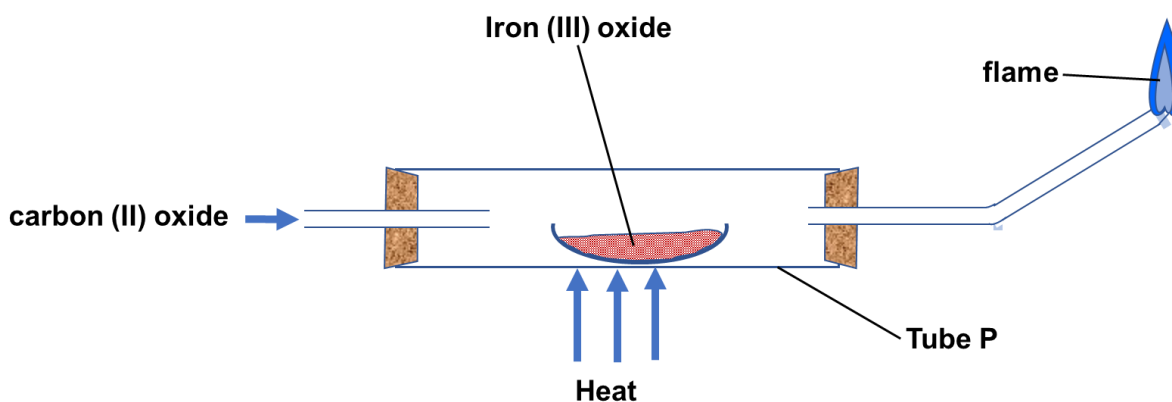


25. Using dots (.) and crosses (x) to represent elections draw diagram to represent

(i)  $\text{NH}_4^+$  (1½ mark)

(ii)  $\text{Mg}_3\text{N}_2$  (1½ mark)

26. A sample of carbon (II) oxide gas was passed through hot iron (III) oxide in a combustion tube P.



(i) State the observation made in **Tube P**. (1 mark)

.....

.....

(ii) Write a chemical equation for the reaction that took place in **Tube P**. (1 mark)

.....  
.....

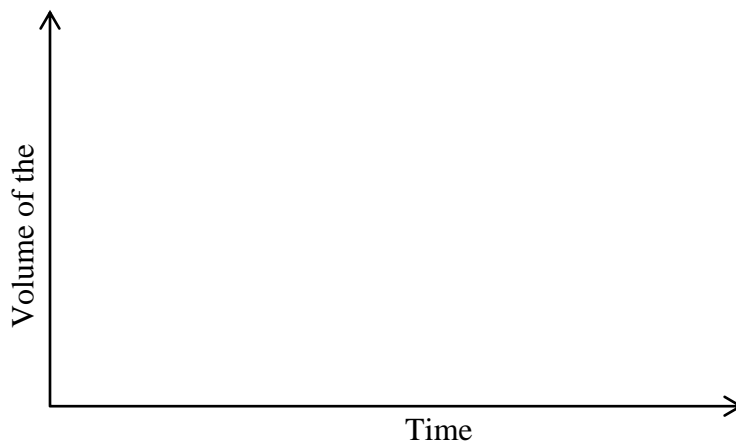
27. A student performed three experiments on the reaction of magnesium with dilute hydrochloric acid and collected the hydrogen gas evolved for each experiment.

(i) **Experiment I:** Reacted 2g of magnesium ribbon with 1M hydrochloric acid.

(ii) **Experiment II:** Reacted 2g of magnesium powder with 1M hydrochloric acid

(iii) **Experiment III:** Reacted 2g of magnesium ribbon with 0.5M hydrochloric acid

On the grid **below** sketch the graphs for each of the three experiments performed. (3mks)



28. In the manufacture of sodium carbonate by solvay process, ammoniated brine trickles down the carbonator while carbon (IV) oxide rises up the same tower.

a) What is ammoniated brine? (1/2 mk)

.....  
.....

b) What is the main source of carbon (IV) oxide in the above process? (1/2 mk)

.....  
.....

c) Write two equations for the reactions in the carbonator (2 mks)

.....  
.....  
.....

29. The table below shows the solubility of a salt at various temperatures.

Temperature <sup>0</sup> C	Solubility (g/100g water)
0	36
40	30
80	25
100	22
120	20

(a) Define the term **Fractional Crystallization**. (1 mark)

.....  
.....

(b) A saturated solution of the salt at 40<sup>0</sup>C was heated to 100<sup>0</sup>C. State and explain the observation made. (1mark)

.....  
.....  
.....

(c) Calculate the mass of salt formed when a saturated solution of the salt at 0<sup>0</sup>C is place in a water bath maintained at 100<sup>0</sup>C. (1 mark)

## CHEMISTRY P1 MARKING SCHEME

- $[\text{Zn}(\text{NH}_3)_4]^{2+}$  ✓ 1 / Tetraamine zinc (II) ions
  - $[\text{Zn}(\text{OH})_4]^{2-}$  ✓ 1 / Zincate ion
- water// $\text{H}_2\text{O}$
  - $2\text{Na}_2\text{O}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \longrightarrow 4\text{NaOH}(\text{aq}) + \text{O}_2(\text{g})$
  - Carbon (IV) oxide formed from burning candle dissolved in the water to form a weak carbonic acid (pH less than 7).
- |                                  |   |       |   |     |   |      |
|----------------------------------|---|-------|---|-----|---|------|
| Mass of hydrated salt            | = | 305   | - | 300 | = | 3g   |
| Mass of anhydrous salt           | = | 303.2 | - | 300 | = | 3.2g |
| Mass of water of crystallization | = | 5     | - | 3.2 | = | 1.8g |

$\text{CuSO}_4$	:	$\text{H}_2\text{O}$	
<u>3.2</u>		<u>1.8</u>	
159.5		18	Formula: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
0.02		0.1	
1		5	
- Soapy
    - Soapless
  - Is non-biodegradable thus environmental pollutant
- $\Delta H_1$  Atomization energy of Na
  - $\Delta H_2$  Ionization energy for Na
  - $\Delta H_4$  Lattice energy
  - $\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3 + \Delta H_4$   
 $= 434 + 371 + 483 + -781$   
 $= 507 \text{ kJ/mole}$
- Acid:  $\text{H}_3\text{O}^+$  Reason: it donates a proton ( $\text{H}^+$ ) to  $\text{NH}_3$  to form  $\text{NH}_4^+$

Base:  $\text{NH}_3$  Reason: accepts the donated  $\text{H}^+$
- It is amphoteric ✓ 1
  - Lead ion ✓ 1 //  $\text{Pb}^{2+}$
  - $\text{Pb}(\text{OH})_2(\text{aq}) + 4\text{OH}^-(\text{aq}) \longrightarrow [\text{Pb}(\text{OH})_4]^{2-}(\text{aq})$  ✓ 1
- from left right  $\longrightarrow$
  - Syringe 1
  - Concentration increases  
- In electrolysis of dilute  $\text{MgCl}_2$ , Hydrogen and Oxygen are discharged ( $\text{H}_2$  O)  
//equivalent to discharge of water molecules
- $\text{Na}_2\text{CO}_3(\text{s}) + \text{Cu}(\text{NO}_3)_2(\text{aq}) \longrightarrow \text{CuCO}_3(\text{s}) + 2\text{NaNO}_3(\text{aq})$  ✓ 1
  - Blue precipitate formed ✓ ½ which dissolve to give deep blue solution. ✓ ½
- G ✓ 1
  - $\text{G}(\text{s}) + \text{H}^{2+}(\text{aq}) \longrightarrow \text{G}^{2+}(\text{aq}) + \text{H}(\text{s})$  ✓ 1
  - $E_{\text{red}} - E_{\text{ox}}$   
 $= +0.34 - (-0.44)$  ✓ 1  
 $= 0.78\text{V}$  ✓ 1

11. (a) Volume of a fixed mass of an gas is directly proportional to its absolute temperature provided pressure is kept constant

$$(b) \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \sqrt{\frac{1}{2}}$$

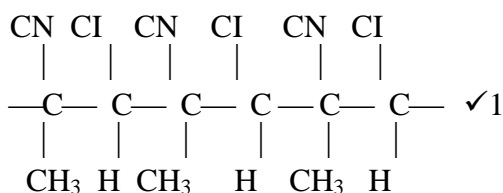
$$\frac{98.31 \times 146}{291} = \frac{101.325 \times 133}{T_2} \sqrt{\frac{1}{2}}$$

$$T_2 = \frac{101.325 \times 133 \times 291}{98.31 \times 146}$$

$$= \frac{3921581.475}{14353.26} \sqrt{\frac{1}{2}}$$

$$= 273.2 \text{K} \sqrt{\frac{1}{2}}$$

12. (a).



(b) Addition  $\checkmark 1$

(c) -Cheaper  $\checkmark 1$

- Not easily attacked by chemicals
- Do not Grease
- Are lighter
- Dry faster.

13. molarity of NaOH = 8/40

$$= 0.2 \text{M} \sqrt{1}$$

$$\text{Moles of NaOH} = \frac{0.2 \times 20}{1000}$$

$$= 0.004 \text{moles} \sqrt{1}$$

$$\text{Moles of acid} = 0.002 \text{moles}$$

$$\text{RMM} = 0.118 / 0.002$$

$$= 56 \sqrt{1}$$

14. Equation:  $\text{Cu}^{2+}(\text{aq}) + 2\text{e} \longrightarrow \text{Cu}(\text{s})$

1 mole (63.5g) Cu is discharged by 2 x 96500 C

0.6g will be discharged by

$$\frac{0.6 \times 2 \times 96500}{63.5}$$

$$= 1823.622 \text{ C}$$

15. (i) Forward reaction is exothermic, thus increase in temperature shifts equilibrium to the left (backward reaction favoured) increasing the intensity of the red-brown colour of Br<sub>2</sub> gas.

(ii) The ratio of volumes of reactants to products is 1:1 therefore, decrease in pressure will have no effect on the equilibrium state of the reaction

16.

Test	Observation	Inference
Put less than half spatula end-full of the white solid in a test tube. Add about 5ml of distilled water and shake thoroughly.	White solid dissolves to form a colourless solution	-Soluble substance. -coloured ions absent; Cu <sup>2+</sup> , Fe <sup>2+</sup> , and Fe <sup>3+</sup>
To a small portion of solution formed above, add 3 drops of lead (II) nitrate solution. Warm the mixture and allow it to cool	White precipitate on addition of lead (II) nitrate which dissolves on warming and reappears on cooling	Cl <sup>-</sup> confirmed present

17. a) A number showing a charge a species has in a compound or valency of an element or ion bearing the charge.

b)  $S + 3(-2) = -2$

$$S - 6 = -2$$

$$S = +4$$

c) S<sup>+4</sup> has electron pattern 2.82

18. (a)  $N_2(g) + O_2(g) \longrightarrow 2NO(g)$  ✓ 1

(b) a lot of heat is required to break the triple bonds between the nitrogen atoms ✓ 01

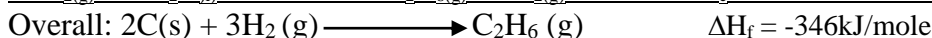
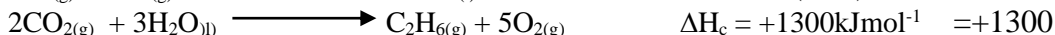
(c) NO is readily oxidized to form nitrogen(IV)oxide which is responsible for acid rain ✓ 01

19. a) C ; it is the most electronegative//it easily gain electrons// has smallest atomic radius

b) Covalent bond. They react by sharing valence electrons

c) E has smaller atomic radius than D. Across the period, nuclear force of attraction increases leading a stronger pull on the energy levels reducing overall size.

20.



21. React lead (II) carbonate in excess  $\frac{1}{2}$  with dilute nitric acid until effervescence stops,  $\frac{1}{2}$  filter  $\frac{1}{2}$  out the unreacted carbonate. To the filtrate add dilute sulphuric acid  $\frac{1}{2}$  to precipitate out lead sulphate, filter the mixture to obtain residue  $\frac{1}{2}$ , wash with distilled water and dry  $\frac{1}{2}$  between filter papers

22. a) i. Solid X: Iron silicate// FeSiO<sub>3</sub>

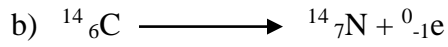
ii. Process W: Electrolysis



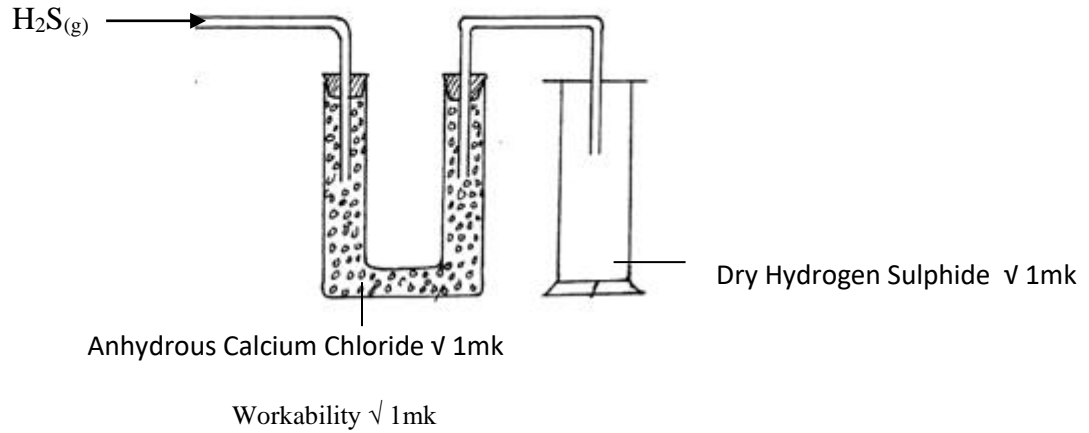
c) Copper has very high thermal conductivity



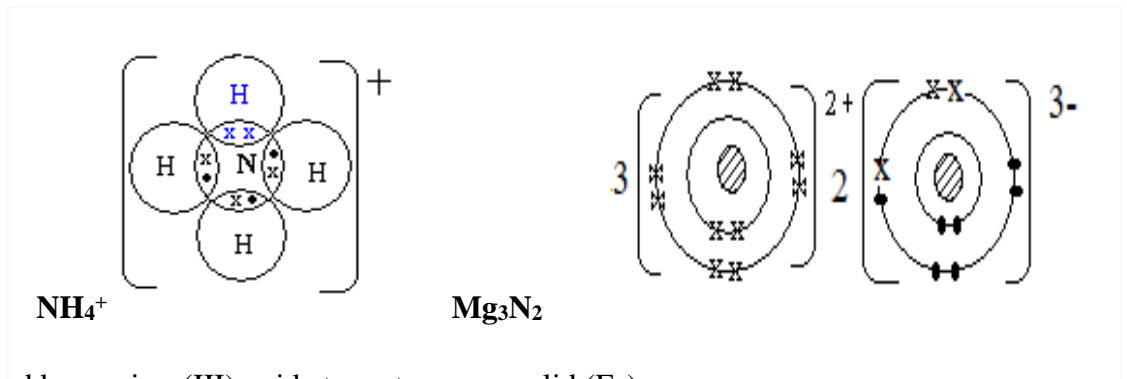
23. a) Half life    48  $\longrightarrow$  24  $\longrightarrow$  12  $\longrightarrow$  6  
 3 half lives                    180 days  
 1 half life                        ?  
 $\frac{180 \times 1}{3} = 60$  days



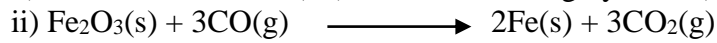
24.



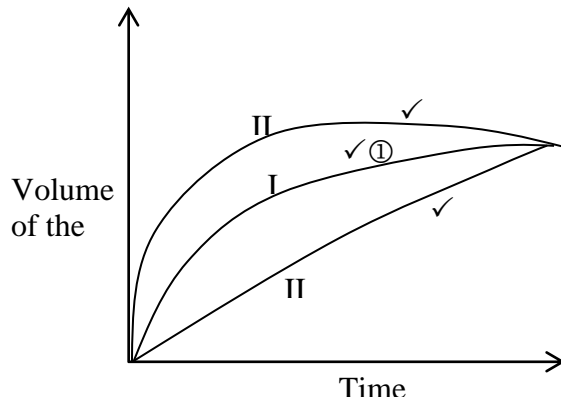
25. Electronic Structures



26. i) The red brown iron(III) oxide turns to a grey solid (Fe)



27.



28. (a). Sodium chloride saturated with Ammonia ✓ ½  
 b) Heating limestone/calcium carbonate ✓ ½  
 c) I.  $\text{NH}_3(\text{aq}) + \text{CO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l}) \longrightarrow \text{NH}_4\text{HCO}_3(\text{aq})$  ✓ 1  
 II.  $\text{NH}_4\text{HCO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \longrightarrow \text{NH}_4\text{Cl}(\text{aq}) + \text{NaHCO}_3(\text{s})$  ✓ 1
29. a) Separation of salts in a mixture due to difference in their solubilities at different temperatures  
 b) Some crystals of the salt were deposited. The solubility of this salt decreased with increase in temperature  
 c) Mass deposited  $36 - 20 = 16\text{g}$