Name: SCHEME ..... Index No.....

School: ..... Class .....

Date: .....

233/1

CHEMISTRY THEORY

PAPER 1

TIME: 2 HOURS

KASSU JET EXAMINATIONS

JANUARY 2021

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 12 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

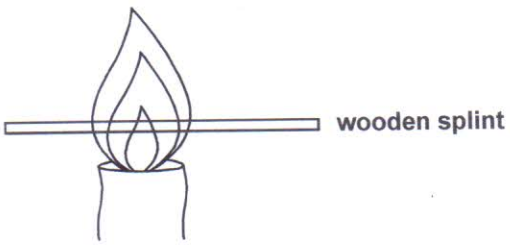
(h) Candidates should answer the questions in English

FOR EXAMINER'S USE ONLY

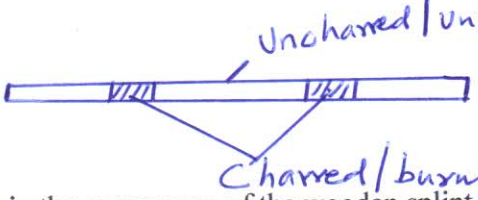
Question	Maximum score	Candidate's score
1 – 29	80	

This paper consists of 12 printed pages. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.

1. Study the diagram below then use it to answer the questions that follow.



a) Draw the wooden splint at the end of the experiment. If it was slipped then removed. (1 mark)



b) Explain the appearance of the wooden splint in (a) above. (2 marks)

Charred part is the hottest zone as a result of Complete Combustion of gases while Uncharred zone is as a result of Incomplete Combustion gases.

2. (a) The half-life of $^{210}_{83}M$ is 7 days. Determine the mass of remaining if 100g decayed in 35 days. (1 mark)

No. of Half lives $= \frac{35}{7} = 5$ half lives

$R = (\frac{1}{2})^{?} \times \text{original mass} = \frac{1}{32} \times 100$

$R = (\frac{1}{2})^{5} \times 100 = 3.125g$

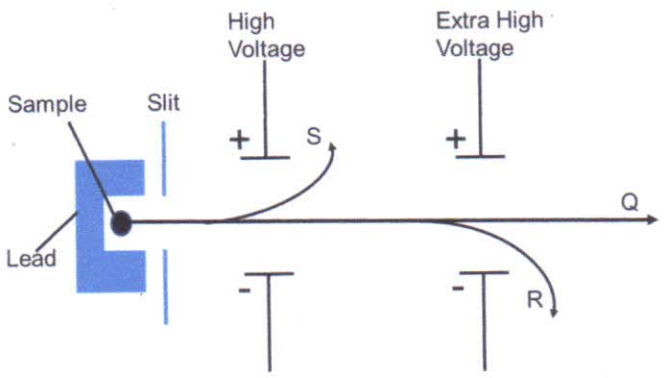
Alternatively.

1st 2nd 3rd 4th 5th

100 — 50 — 25 — 12.5 — 6.25 — 3.125

$\therefore R = 3.125$.

(b) The diagram below shows the radiations emitted by a radioactive sample.



(i) Identify radiation particles **S** and **R**. (1 mark)

S. Beta (β) Particles

R. Alpha (α) Particles.

(ii) Which emission causes most harm to human cells. Give a reason. (1mark)

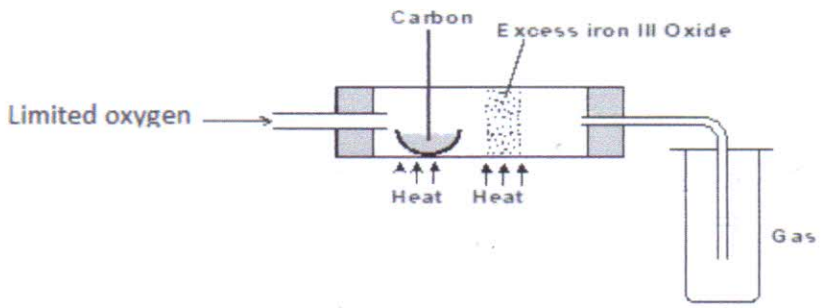
Alpha ✓ Has greater ionising effect ✓ 2

3. a) Starting with copper metal, describe how a solid sample of copper (II) carbonate can be prepared. (3 marks)

1

- Heat copper metal in air to obtain Copper(II) oxide.
- React CuO with dilute HNO_3 to obtain $Cu(NO_3)_2$ solution.
- Filter to obtain $Cu(NO_3)_2$ as filter and unreacted CuO as residue.
- React $Cu(NO_3)_2$ with Na_2CO_3 to obtain $CuCO_3$ & $NaNO_3$.
- Filter to obtain $CuCO_3$ as residue & $NaNO_3$ as filtrate.
- Dry between the filter papers to get $CuCO_{3(s)}$.

4. The set-up below was used to obtain a sample of iron.



Write two equations for the reactions which occur in the combustion tube. (2 marks)

$2C_{(s)} + O_{2(g)} \longrightarrow 2CO_{(g)}$

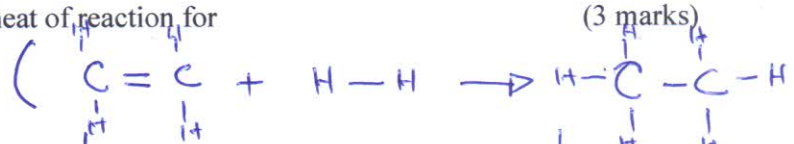
$Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe_{(s)} + 3CO_{2(g)}$

5. Below are the bond dissociation energies of some elements.

Bond	Bond dissociation energy
C – C	343 kJ mol^{-1}
C – H	414 kJ mol^{-1}
H – H	435 kJ mol^{-1}
C = C	612 kJ mol^{-1}

Use this information to calculate the heat of reaction for (3 marks)

$$C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(g)}$$



$\Delta H = BBE + BFE$

BBE

C=C = 612

C–H = 414×4 = 1656

H–H = 435

−2703 kJ/mol

BFE

C–C = 343

C–H = 414×6 = 2484

+2827

ΔH = −2703 + 2827

= +124 kJ/mol

6. Sulphur (IV) oxide is oxidized catalytically to sulphur (VI) oxide in the reaction.

$$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)} \quad \Delta H = -197kJ$$

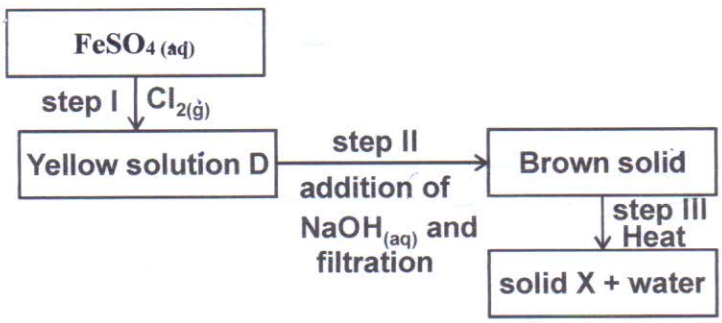
a) What information about the reaction is given by ΔH = -197kJ ? (1 mark)

Endothermic reaction.

b) Name one catalyst that can be used in this reaction. (1 mark)

Vanadium (V) oxide (Reject V_2O_5)

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



a) Write the formula of the cation present in solution D. (1 mark)

$Fe_2(SO_4)_3$

b) What property of chlorine is shown in step 1. (1 mark)

Oxidising agent.

c) Write an equation for the reaction which occurred in step III. (1 mark)

$2Fe(OH)_3 \rightarrow Fe_2O_3 + 3H_2O$ (s) (s) (l)

8. 0.63g of lead powder were dissolved in excess nitric (V) acid to form lead (II) nitrate solution. All the lead (II) nitrate was then reacted with sodium sulphate solution.

a) Write an ionic equation for the reaction between sodium sulphate solution and lead (II) nitrate solution. (1 mark)

$Pb^{2+}_{(aq)} + SO_{4(aq)} \rightarrow PbSO_{4(s)}$

b) Determine the mass of the lead salt formed in the reaction in (a) above (Pb = 207, S = 32, O = 16) (2 marks)

Mols of Pb = 0.63 / 207 = 0.003044 mols

M : R = 1 : 1

mols of $PbSO_4$ = 0.0030 4

Mass = 0.00304 × 303 = 0.92112 g

9. Use the cell representation below to answer the questions that follow.

$Cr_{(s)} / Cr^{3+}_{(aq)} // Fe^{2+}_{(aq)} / Fe_{(s)}$

a) Write an equation for the cell reaction. (1 mark)

$Fe^{2+}_{(aq)} + Cr_{(s)} \rightarrow Cr^{3+}_{(aq)} + Fe_{(s)}$

b) If the emf of the cell is 0.30V and the E^0 value for $Fe^{2+} / Fe_{(S)}$ is -0.44V. Calculate the E^0 value for $Cr_{(s)} / Cr^{3+}_{(aq)}$ (2 marks)

$E^0 = E^0_{Red.} - E^0_{Oxi}$

$0.30V = -0.44 - E^0_{Oxi}$

$E^0_{Cr/Cr^{3+}} = -0.44 - 0.30$

$= -0.74V$

10. An element Q has a relative atomic mass of 88. When a current of 0.5A was passed through the fused chloride of Q for 32 minutes and 10 seconds, 0.44g of Q were deposited at cathode. Determine the charge on the ion of Q. (1 Faraday = 96500 coulombs) (3 marks)

$$\text{Mass} = \frac{MIT}{ZF}$$

$$0.44g = \frac{88 \times 0.5 \times 1930}{Z \times 96500}$$

$$0.44 = \frac{0.88}{Z}$$

$$\frac{0.44Z}{0.44} = \frac{0.88}{0.44}$$

$$Z = +2$$

Q^{2+}

Alternatively

$Q = It$

$= 0.5 \times 1930$

$= 965C$

$0.44 = 965$

$88 = ?$

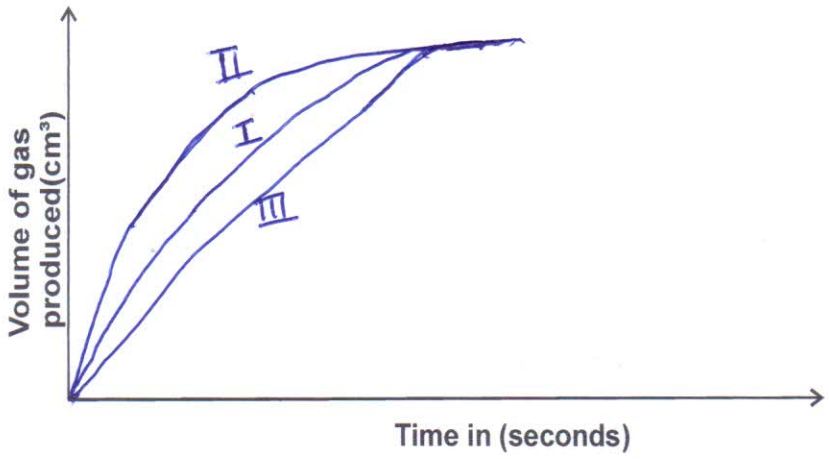
$\frac{88 \times 965}{0.44} = \frac{193000}{96500}$

$= +2$

11. The table below gives three experiments on the reaction of excess sulphuric (VI) acid and 0.5g Zinc done under different conditions. In each case the volume of gas liberated was recorded at different time intervals.

Experiment	Form of Zinc	Sulphuric (VI) acid
I	Powder	0.8M
II	Powder	1.0M
III	Granules	0.8M

On the axes below, draw and label the three curves that would be obtained from the results above. (3 marks)



12. a) Starting with red roses, describe how a solution containing the red pigments may be prepared? (2 marks)

- Crush roses using Pestle & Mortar.
- Add Propanone to dissolve the red Pigments.
- Filter to obtain red pigment solution as filtrate.

b) How can the solution be shown to be an indicator. (1 mark)

Add drops of the Pigment to diffent Types of acids or bases. It will show same Colour on acids and diffenent but same Colour on bases.

13. The table below provides data on the successive ionisation energies of carbon.

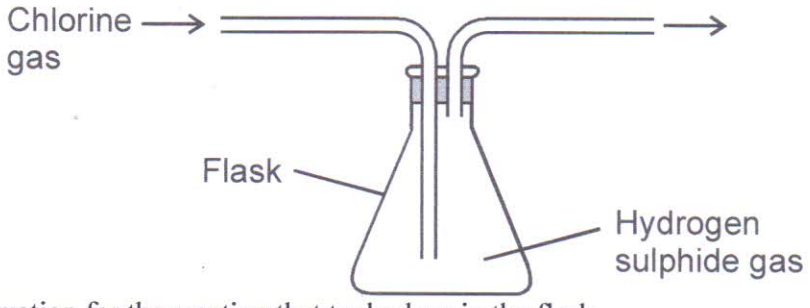
Ionisation numbers	1st	2nd	3rd	4th	5th	6th
Ionisation energy (kJ/mol)	1090	2350	4610	6220	37800	47300

a) Explain why each ionisation energy increase in nature. (2 marks)

After the removal of an electron, the overal nuclear Charge hold the remaining electrons firmly.

b) Write an equation for the 5th ionisation energy of carbon. (1 mark)

14. The figure below was set by a student to investigate the reaction between chlorine gas and hydrogen sulphide gas.



a) Write an equation for the reaction that took place in the flask. (1 mark)

$H_2S_{(g)} + Cl_{2(g)} \longrightarrow S_{(s)} + 2HCl_{(g)}$

b) What observation was made in the flask ? (1 mark)

Yellow deposits of Sulphur is formed.

18. (a) Give Bronsted and Lowry definition of an acid (1mk)

An acid is a proton donor.

(b) Differentiate between a strong acid and a concentrated acid (2mks)

- Strong acid is type of acid that dessociate fully into it ions while Concentrated acid is an acid that has More H^+ ions.

19. When a hydrated sample of $CaSO_4.xH_2O$ was heated until all water was lost, the following data was recorded

Mass of crucible	=	30.296 g
Mass of crucible + hydrated salt	=	33.111 g
Mass of crucible + anhydrous salt	=	32.781 g

Mass of Hydrated salt = 2.815

Mass of anhydrous salt = 2.485

Mass of water = 0.33

Determine the empirical formula of the hydrated salt. *($CaSO_4$=136, H_2O=18).* (3marks)

Compound	$CaSO_4$	H_2O
Mass	2.485	0.33
RFM	136	18
No. of Moles	0.01827	0.0183
Mole ratio	0.018271 :	0.01827

$CuSO_4 \cdot H_2O$

20. Describe a chemical test used to distinguish butane from butene in the laboratory. (2marks)

- Add browine water to butane & Butene in different test tubes.
- Test-tube Containing butene will decolorise bromine water while butane does not.

21. The table below gives the atomic numbers of elements W, X, Y and Z.

Element	W	X	Y	Z
Atomic number	14	17	16	19

a) Name the type of bonding that exist in the compound formed when **X** and **Z** reacts. (1mark)

Ionic

b) Select the letter representing the strongest reducing agent. Give a reason for your answer. (2mks)

Z. Has largest atomic radius lowest Ionization energy.

c) What precaution should be taken in carrying out the experiment ? (1 mark)

Performed in fume chamber/open air.
Chlorine is Poisonous gas.

15. A certain carbonate, QCO_3, reacts with dilute hydrochloric acid according to the equation given below.

$$QCO_{3(S)} + 2HCl_{(aq)} \rightarrow QCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

If 1g of the carbonate reacts completely with 20cm³ of 1M hydrochloric acid. Calculate the relative atomic mass of Q.(C = 12.0, O=16.0) (3 marks)

1 Mole ⟶ 1000cm³
20cm³

$\frac{20 \times 1}{1000}$ = 0.02 moles

Mole ratio QCO_3 : HCl
1 : 2

Moles of QCO_3 = $\frac{0.02}{2}$ = 0.01 moles

$RFM = \frac{Mass}{RFM}$

$= \frac{1}{0.01} = 100$

$100 = Q + 12 + 48$

$100 = Q + 60$

$Q = 40$ ✓

16. When bismuth (III) chloride is added to water, a reaction occurs and a white precipitate forms as shown below.

$BiCl_{3(aq)} + H_2O_{(l)} \rightleftharpoons BiOCl_{(s)} + 2HCl_{(aq)}$

What would be the effect on the amount of the precipitate formed if sodium hydroxide solution is added to the equilibrium mixture? Explain your answer. (2marks)

White Precipitate ~~[illegible]~~ Increases Intensities; When Hydroxide is introduced it reacts with H^+ from the Hcl hence system shift from Left to right.

17. (a) State the Gay Lussac's Law. (1 mark)

When gases react, they do so in volumes that bear a simple whole number ratio to one another and to those of products if gaseous at constant temperature and Pressure.

(b) 10cm³ of a gaseous hydrocarbon, C_2H_X required 30cm³ of oxygen for complete combustion. If steam and 20cm³ of carbon (IV) oxide were produced, what is the value of X? (2 marks)

20cm³

$C_2H_X + 3O_2 \rightarrow 2CO_2 + 2H_2O$

10cm³ (g) 30cm³ (g) 20cm³ (g) (g)

x = 4

18. (a) Give Bronsted and Lowry definition of an acid (1mk)

An acid is a proton donor.

(b) Differentiate between a strong acid and a concentrated acid (2mks)

- Strong acid is type of acid that dissociate fully into it ions while Concentrated acid is an acid that has More H^+ ions.

19. When a hydrated sample of $CaSO_4.xH_2O$ was heated until all water was lost, the following data was recorded

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Mass of Hydrated salt = 2.815

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Mass of water = 0.33

Determine the empirical formula of the hydrated salt. *($CaSO_4$=136, H_2O=18).* (3marks)

Compound	$CaSO_4$	H_2O
Mass	2.485	0.33
RFM	136	18
No. of moles	0.01827	0.0183
Mole ratio	0.01827 / 0.01827 :	0.0183 / 0.01827 : 1

$CuSO_4 \cdot H_2O$

20. Describe a chemical test used to distinguish butane from butene in the laboratory. (2marks)

- Add browine water to butane & Butene in different test tubes.
- Test-tube Containing butene will decolorise bromine water while butane does not.

21. The table below gives the atomic numbers of elements W, X, Y and Z.

Element	W	X	Y	Z
Atomic number	14	17	16	19

a) Name the type of bonding that exist in the compound formed when **X** and **Z** reacts. (1mark)

Ionic

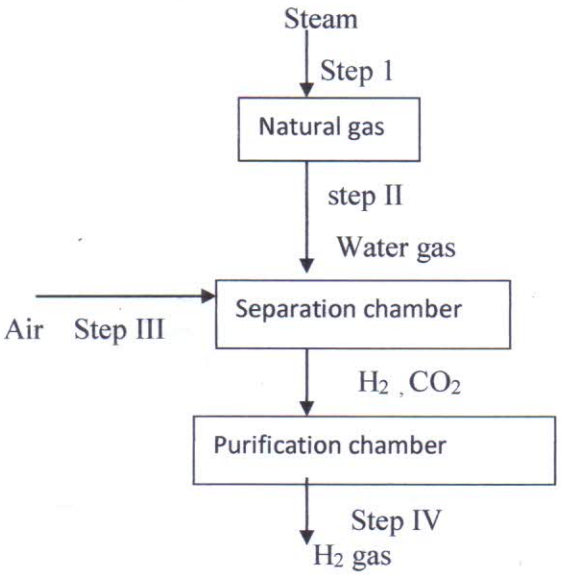
b) Select the letter representing the strongest reducing agent. Give a reason for your answer. (2mks)

Z. Has largest atomic radius / lowest Ionization energy

22. In an electrochemical cell, the standard hydrogen electrode uses platinized platinum. State **three** functions of the platinized platinum. (3 marks)

- Acts as an inert metal collector to the $H_2|H^+_{(aq)}$ system
- Provides a surface area on which dissociation of H_2 molecule take place
- Serves as an electrical conductor to the external circuit.

23. The flowchart below shows the scheme for extraction of Hydrogen from hydrolysis of natural gas, study it and answer the questions that follow.



a) In step II water gas is formed. State one use of water gas. (1marks)

In fuel in Cells

b) When air is added in step III CO is converted to CO_2 name one chemical substance that can be used to separate CO_2 from H_2 in step IV (1marks)

Calcium hydroxide

c) State one large scale use of Hydrogen gas formed. (1marks)

Any Correct

24. Aluminium is obtained from the ore with the formula $Al_2O_3.2H_2O$. The ore is first heated and refined to obtain pure aluminium oxide (Al_2O_3). The oxide is then electrolysed to get Aluminium and oxygen gas using carbon anodes and carbon as cathode.

i) Give the common name of the ore from which aluminium is extracted. (1 mark)

Bauxite

ii) What would be the importance of heating the ore first before refining it ? (1 mark)

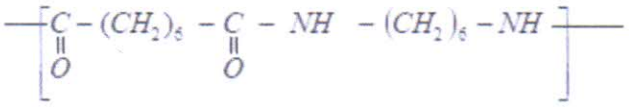
iii) The refined ore has to be dissolved in cryolite first before electrolysis. Why is this necessary? (1 mark)

to lowe the Melting Point for

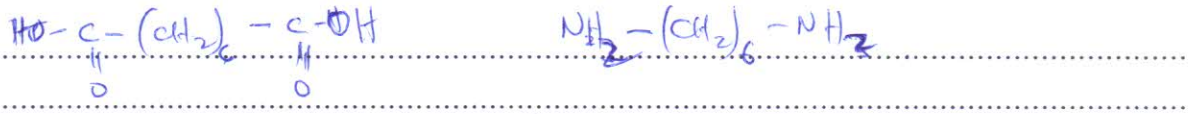
iv) Why are the carbon anodes replaced every now and then in the cell for electrolysing aluminium oxide? (1 mark)

they are eaten away due to reaction with Oxygen und high temperature.

26. Nylon polymer has the structure below.



i) Determine the structures of the monomers. (2mks)



ii) State the type of polymerization. (1mk)

Condensation

27. (a) Define the term solubility. (1 mark)

the maximum amount of solute that can saturate 100g of solvent at a particular temperature

b) The following were the results obtained in an experiment to determine solubility of potassium nitrate at room temperature.

Mass of evaporating dish = 14.32 g

Mass of evaporating dish + saturated solution = 35.70 g

Mass of evaporating dish + salt (residue) = 18.60 g

Calculate the solubility of potassium nitrate from the above results. (2 marks)

Mass of solute (= 18.60 − 14.32 = 4.28 g

Mass of solvent = (35.70 − 18.60) = 17.1 g

4.28 g → 17.1 g of solvent

∴ 100 g of solvent × 4.28 g / 17.1 = 25.03 g | 100 g of solvent

28. Describe a simple laboratory experiment that can be used to distinguish between sodium sulphide and sodium carbonate. (2mks)

- React with acid separately
- test the gas produced using acidified $K_2Cr_2O_7$
- Sulphide produces gas that turns orange acidified $K_2Cr_2O_7$ green while for Carbonate it remains orange

Accept any other correct

29. (a)Give **one** reason some of the laboratory apparatus are made of ceramics. **(1 mark)**

Can withstand strong heating

(b) Name **two** apparatus that can be used to measure approximately 75 cm^3 of dilute sulphuric (VI) acid. **(2 marks)**

100cm^3 measuring cylinder

100cm^3 beaker

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