Name …… Index Number……...

School…… Stream …….

Candidate's Signature…… Date…….

233/2
CHEMISTRY
Paper 2
(THEORY)
September, 2021
2 hours

MARKING SCHEME

BURAMU 2 JOINT EXAM, TERM ONE, 2021
CHEMISTRY PAPER 2

Instructions to Candidates

a) *Write your name, index number, school and stream in the space provided above.*
b) *Sign and write the date of the exam in the spaces provided above.*
c) *Answer **all** questions in the spaces provided in the question paper.*
d) *All working **must** be shown clearly where necessary.*
e) *KNEC Mathematical tables and silent electronic calculators may be used*
f) *Answer the questions in English.*

For Examiner's use only

Question	Maximum Score	Candidate's Score
1	12	
2	14	
3	10	
4	10	
5	10	
6	14	
7	10	
Total Score	80	

1. The grid below shows part of the periodic table. Use it to answer the questions that follow. The letters are not actual symbols of the elements.

								P
K				S		T		
	M		R				N	Q
L								

i. What is the name given to the elements that lie within the shaded region? [1mk]
Transition metals

ii. Compare the atomic radius of: [2mks]

I. K to that of L
The atomic radius of K is smaller than that of L//atomic radius of L is larger than that of K

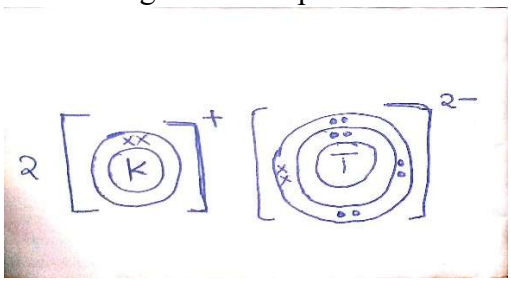
II. R to that of N
Atomic radius of R is larger than that of N.

iii. The stable ion of an element M is M^{2+}. If the electron configuration of this ion is 2.8, place M on the grid above. [1mk]

iv. In which chemical family does M belong? [1mk]
Alkaline earth metals

v. Explain why the melting point of N is higher than that of Q. [2mk]
N exist as a diatomic molecule while Q is monoatomic. The van der Waals forces between N molecules are thus stronger than those between Q atoms.

vi. Using dots (•) and crosses (x) to represent electrons, draw a diagram to illustrate the bonding in the compound formed between K and T. [2mks]



vii. The chloride of R was dissolved in water and a blue litmus paper dropped in the resulting solution. State and explain the observation made. [2mks]
The blue litmus paper turns red. The chloride of R gets hydrolyzed in water to form an acidic solution

viii. Give one use of element P. [1mk]

- *Used by deep sea divers and mountain climbers when mixed with oxygen*

- *Can be used instead of hydrogen in weather balloons for meteorological research*
- *Used in thermometers for measurement of very low temperatures*

2. a) A hydrocarbon **D** has an empirical formula CH_2 and a molecular mass of 56.

i. Determine the molecular formula of the hydrocarbon. [2mks]

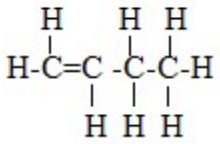
(12+2)n = 56

14n =56

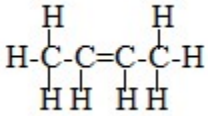
n= 4

$(CH_2)4 = C_4H_8$

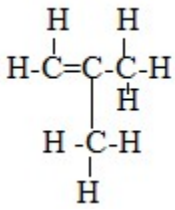
ii. Draw and name two possible structures of the hydrocarbon. [4mks]



But-1-ene

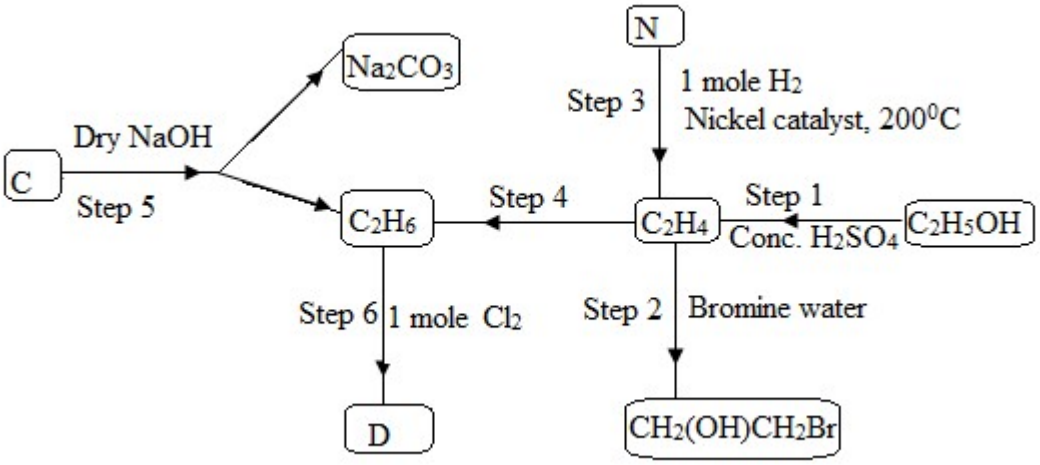


But-2-ene



2-methylpropene

b) Study the flow chart below and answer the questions that follow.



i. Name substance: [2mks]

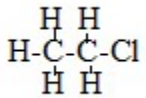
I. C

Sodium propanoate

II. N

Ethyne

ii. Draw the open structural formula of D. [1mk]



iii. What is the role of concentrated sulphuric (VI) acid in step 1? [1mk]

It dehydrates ethanol

iv. Name the reagents that can be used to prepare N in the laboratory. [1mk]

Calcium carbide and water

v. State the observation made in step 2. [1mk]

Bromine water is decolorized

Or

Bromine water changes from red/orange/yellow to colorless

vi. How was the sodium hydroxide (NaOH) in step 5 kept dry? [1mk]

By mixing it with calcium oxide

vii. Under what condition would the reaction in step 6 **NOT** take place? [1mk]

In darkness/ in the absence of UV light

3. a) At 25^0C, 50g of potassium nitrate were added to 100g of water to make a saturated solution. What is meant by a saturated solution? [1mk]

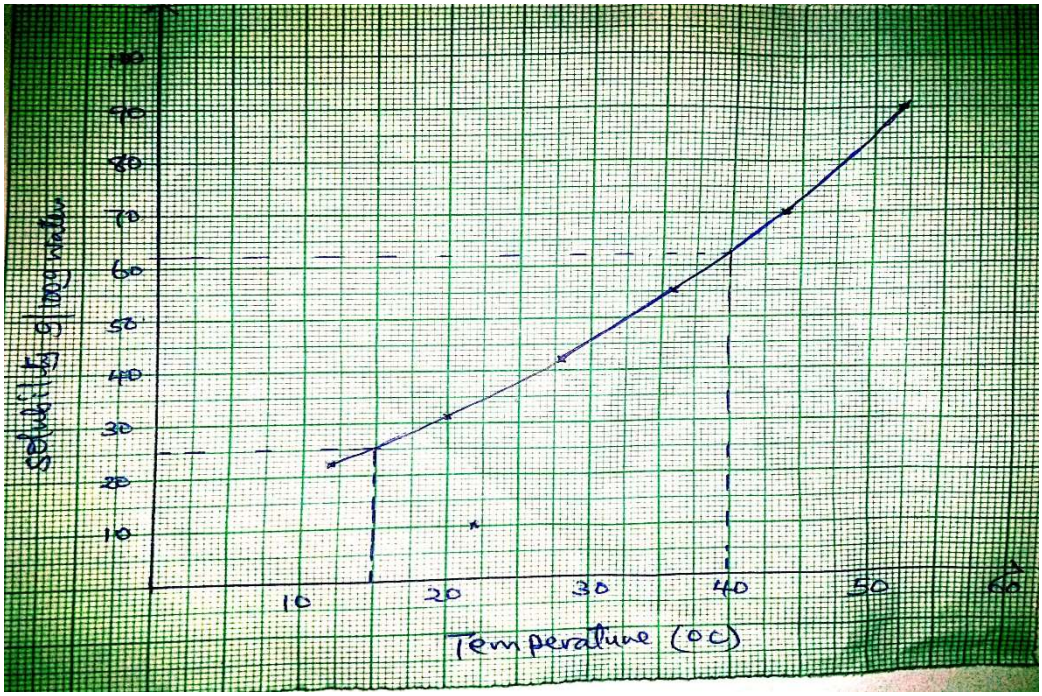
a solution in which no more solute can dissolve at a given temperature

b) the table below gives the solubilities of potassium nitrate at different temperatures.

Temperature (^{0}C)	12	20	28	36	44	52
Solubility g/100g of water	22	31	42	55	70	90

i. Plot a graph of the solubility of potassium nitrate (vertical axis) against temperature. [3mks]

- *Correct labelling of axes…….1/2mks*
- *Scale ……1/2mks*
- *Plotting ……1mk*
- *Smooth curve…….....1mk*



ii. Using the graph:

I. Determine the solubility of potassium nitrate at 15^0C. [1mk]

- *Correct showing on the graph…….1/2mks*
- *Correct reading of solubility from the graph……1/2mks*
  25g/100gof water

II. Determine the mass of potassium nitrate that remained undissolved given that 80g of potassium nitrate were added to 100 cm^3 of water and warmed to 40^0C. (density of water is 1g/cm^3) [2mks]

Solubility at 40^0C = 62g/100gwater……1mk

Mass undissolved = 80-62 =18g…….1mk

iii. Determine the molar concentration of potassium nitrate at 15^0C. (K=39.0, N=14.0, O=16.0). [3mks]

Molar mass of KNO_3 = 101

Moles of KNO_3 in 100cm^3 of solution $= \frac{25}{101} = 0.2475$

Molar concentration $= \frac{0.2475 \times 1000}{100} = 2.475M$

4. a) Hydrogen chloride gas is commercially obtained from the reaction between hydrogen and chlorine gas. State the sources of hydrogen and chlorine gas in this process. [2mks]

Hydrogen: electrolysis of brine, cracking of long chain alkanes

Chlorine: electrolysis of molten sodium chloride or brine

b) Explain why small amounts of hydrogen gas are burnt in excess chlorine during commercial preparation of hydrogen chloride gas. [1mk]

To prevent an explosion

c) Write an equation for the reaction between chlorine and hydrogen gas. [1mk]

$Cl_{2\,(g)} + H_{2\,(g)} \rightarrow 2HCl_{(g)}$

d) hydrogen chloride gas reacts with lead (II) ions in solution according to the equation:

$2HCl_{(g)} + Pb^{2+}_{(aq)} \rightarrow PbCl_{2\,(s)} + 2H^{+}_{(aq)}$

2.4 litres of hydrogen were carefully bubbled through 50 cm^3 of 1.2 M solution of lead (II) ions at room temperature.

i. Name a suitable salt that was used to prepare lead (II) ions. [1mk]

Lead (II) nitrate

ii. Calculate:

I. The number of moles of lead (II) ions that reacted. [2mks]

Moles of HCl = 2.4/24 =0.1

Moles of Pb^{2+} = 0.1/2=0.05

II. The mass in grams of lead (II) chloride formed. [2mks]

(one mole of a gas occupies 24 dm^3 at r.t.p, Cl = 35.5, Pb =207)

Molar mass of $PbCl_2$ = (207 +71) =278g/mol

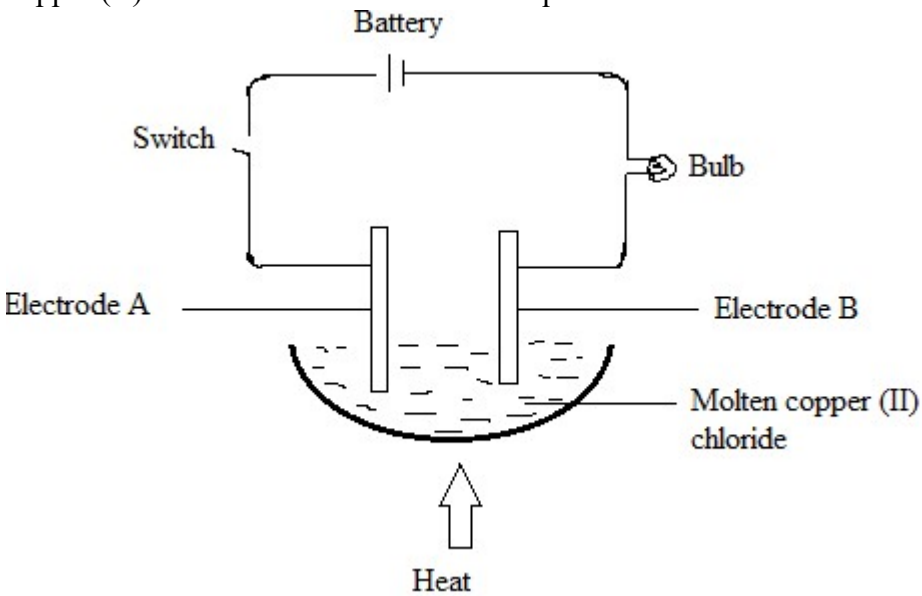
Moles of $PbCl_2$ = 0.05

Mass = 278× 0.05 = 13.9g

iii. State one use of hydrogen chloride. [1mk]

- *Manufacture of hydrochloric acid*
- *Manufacture of pvc*

5. The set-up below was used to investigate the effect of an electric current on molten copper (II) chloride. Use it to answer the questions that follow.



i. Identify the anode and cathode. [2mks]

A-anode

B- cathode

ii. State three observations that were made in the above set-up when the switch was closed. [3mks]

- *The bulb lights*
- *A red-brown solid deposit on electrode B(cathode)*

- *Green-yellow gas at electrode A(anode)*

iii. Write an equation for the reaction that occurred at electrode A. [1mk]
$2Cl^-_{(l)} \rightarrow Cl_{2\,(g)} + 2e^-$

iv. What would happen if the source of heat was withdrawn in the above set-up? Explain. [2mks]
The bulb becomes dim then goes off. Copper (II) chloride solidifies and hence won't allow an electric current to pass through

v. Give two application of electrolysis. [2mk]
- *Electroplating of metals to prevent corrosion and also make them attractive*
- *Extraction of reactive metals such as sodium and aluminium*
- *Purification of metals like copper*
- *Manufacture of pure chemicals such as hydrogen, chlorine and sodium hydroxide*

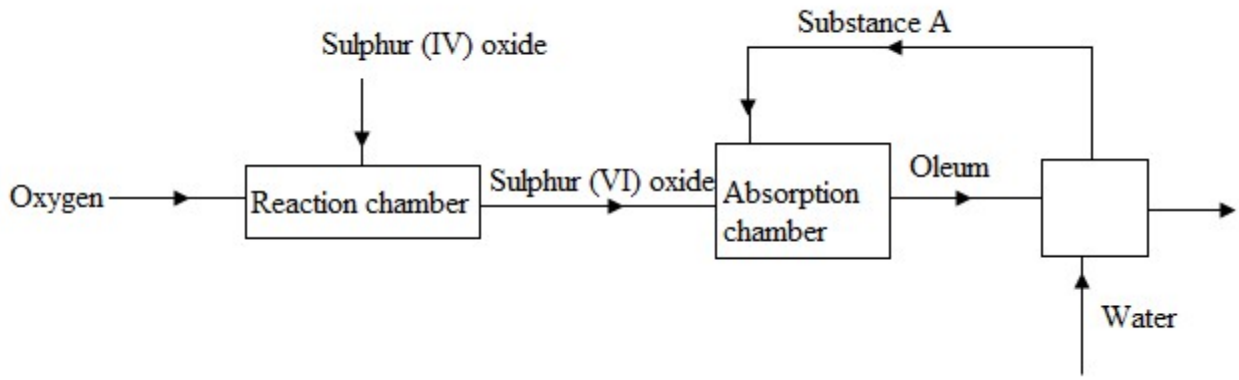
6.

i. Sulphur exhibits allotropy. What is meant by the term allotropy? [1mk]
Existence of an element in more than one form but in the same physical state

ii. Name one non-crystalline allotrope of Sulphur. [1mk]
Plastic Sulphur, colloidal Sulphur, powdery Sulphur

iii. Extraction of Sulphur is done by the Frasch process. State the role of superheated water in the Frasch process. [1mk]
To melt Sulphur

iv. The flow chart below shows some of the processes involved in the large-scale production of sulphuric (VI) acid. Use it to answer the questions that follow.



I. Describe how oxygen is obtained from air on large scale. [3mks]
Air is first passed through concentrated sodium hydroxide to remove carbon (IV) oxide. It is then cooled to -25^{0}C to remove water. Through repeated compression and expansion, air is cooled to a liquid at -200^{0}C. through fractional distillation, oxygen is separated from nitrogen and argon.

II. Name substance A. [1mk]
Concentrated sulphuric (VI) acid

III. Write an equation for the reaction that takes place in the absorption chamber. [1mk]
$H_2SO_{4\,(l)} + SO_{3\,(g)} \rightarrow H_2S_2O_{7\,(l)}$

IV. Give two reasons why vanadium (V) oxide is commonly used as a catalyst in the above process. [2 mks]
It is cheaper, not easily poisoned/has a longer lifespan

v. A form three student carried out the following tests using different concentrations of sulphuric (VI) acid.

Test 1
Copper turnings were added to 5 cm^3 of 18M sulphuric (VI) acid in a boiling tube and the mixture warmed.

Test 2
Copper turnings were added to 5 cm^3 of 0.1M sulphuric (VI) acid in a boiling tube and the mixture warmed.

State and explain the observations made in each test.

Test 1

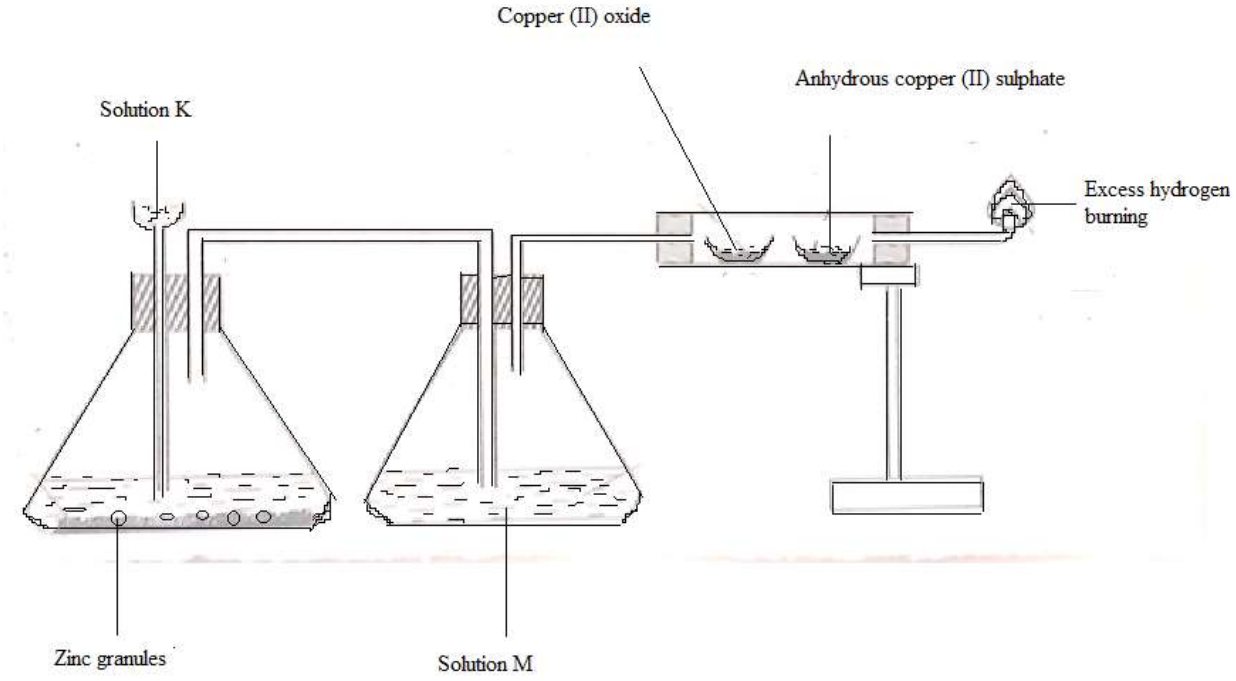
Observation [1mk]
Effervescence/ bubbles
Blue solution

Explanation [1mk]
18M sulphuric (VI) acid is a strong oxidizing agent and oxidises copper to copper (II) sulphate which is blue. Sulphur (IV) oxide gas is given out.

Test 2
Observation [1mk]
No effervescence/bubbles

Explanation [1mk]
0.1M sulphuric (VI) acid does not react with copper

7. The set-up below was used to prepare hydrogen and investigate one of its properties. Study it and answer the questions that follow.



a. Identify:
   i. Solution K [1mk]
      Dilute hydrochloric acid/dilute sulphuric (VI) acid
   ii. Solution M [1mk]
      Concentrated sulphuric (VI) acid

b. State two properties of solution M that make it suitable to perform the role it does in the above set-up. [2mks]
   - *It absorbs moisture*
   - *Does not react with hydrogen gas*

c. Write an equation for the reaction that occurs in the conical flask. [1mk]
   $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2\,(aq)} + H_{2\,(g)}$
   $Zn_{(s)} + H_2SO_{4\,(aq)} \rightarrow ZnSO_{4\,(aq)} + H_{2\,(g)}$

d. What would be observed in the combustion tube at the end of the experiment? [2mks]
   - *Red-brown solid*
   - *Blue solid*

e. What type of reaction is undergone by hydrogen in the above set-up? Explain [2mks]
   Oxidation. Oxygen is added to it to form water

f. Other than industrial manufacture of hydrochloric acid, give any other industrial use of hydrogen. [1mk]
   - *Manufacture of ammonia*
   - *Hydrogenation*