CHEMISTRY
OPENER EXAMINATION: TERM 2 2024

TIME:2 HOURS

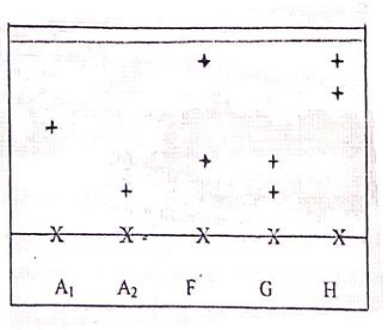
FORM 3

MARKING SCHEME

INSTRUCTIONS.

- Answer all the questions in the spaces provided.

1. Samples of urine from three participants F,G and H at an international sports meeting were spotted onto a chromatography paper alongside two from illegal drugs A1 and A2. A chromatogram was run using methanol. The figure below shows the chromatogram.



i. Identify the athlete who had used an illegal drug. (1mk)
- ***G***

ii. Which drug is more soluble in methanol? (1mk)
- ***A1***

2. Using electrons in the outermost energy level, draw the dot(.) and cross (x) diagrams for the molecules H_2O^+ and Naf. (H=1, Na=11, F=9, O=8)
   i. Hydroxonium ion, H_3O^+. (2mks)

   ii. Sodium floride, Naf (2mks)

3. The table below gives the first ionization energies of the alkali metals.

Element	**1st ionization energy Kj mol^{-1}**
A	494
B	418
C	519

   a) Define the term first ionization energy. (1mk)
   - ***This is the energy needed to remove the first electron completely from an atom in gaseous state.***

   b) Which of the three metals is the least reactive? Give a reason. (2mks)

- ***C; its outermost electron is strongly attracted to the nucleus hence not easily lost/ requires highest amount of energy to remove an electron during a reaction.***

4. Element K (not actual symbol of element) has isotopes with relative abundance as show below.

Isotope	**Abundance (%)**
$^{10}_{5}K$	18.69
$^{11}_{5}K$	81.31

Calculate the relative atomic mass of element. (2mks)

RAM = $\frac{18.69 \times 10 + 81.31 \times 11}{100}$

= 10.813

5. a) What is meant by the term?

i) Atom (1mk)

- ***The smallest indivisible particle of an element that can take part in a chemical reaction.***

ii) Isotope (1mk)

- ***Are atoms of the same element with the same atomic number but different mass numbers.***

b) The formula for a sulphate of titanium is $Ti_2(SO_4)_3$. What is the formula of its chloride? (1mk)

- ***$TiCl_3$***

6. In an experiment to determine the relative formula mass of gas P; the time taken for equal volumes of oxygen and gas P under identical conditions of temperature and pressure was measured and the results were shown on the table below. (O=16.0) (3mks)

Gas	**Oxygen**	**P**
Time in seconds	20.3	30.3

$$\frac{T1}{T2} = \sqrt{\frac{M_1}{M_2}}$$

$$\frac{20.3}{30.3} = \sqrt{\frac{32}{M_2}}$$

$$\left(\frac{20.3}{30.3}\right)^2 = \frac{32}{M_2}$$

$$M_2 = \frac{32 \times 30.3^2}{20.3^2}$$

$$M_2 = 71.92$$

7. Calculate the number of chloride ions in a $250cm^3$ of 1M solution calcium chloride (Avagadro's number is 6.0×10^{23}) (3mks)

$CaCl_2(aq) \longrightarrow Ca^{2+}(aq) + 2Cl^-(aq)$

No. of moles of $CaCl_2$

250 x 1
1000
= 0.25mol
No of moles of Cl^- ion = 0.25 x 2= 0.5mol
No of chloride ions 0.5 x 6.0 x 10^{23}
= 3.0 x 10^{23} ions

8. The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbols.

				Q				
W			Y			R	S	
	T					K	U	
V							Z	

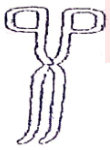
a) Hydrogen can be placed in group I or group VII. Explain. (1mk)
- ***Hydrogen reacts by losing one electron like group 1 elements to form H.***
- ***Hydrogen can react to gain an electron like group 7 elements to form H.***

b) Write the formula of the compound formed between element T and Z. (1mk)

- ***TZ^2***

c) How does the atomic radii of T and K compare. Explain. (1mk)
- ***It is smaller than T; because K has more protons in the nucleus than T. there is therefore a grater pull in the K than T to the nucleus.***

9. Identify and state the use of the apparatus represented below. (2mks)



i. Name
- ***Pair of tongs***

ii. Use
- ***Used for holding corrosive/hot solids.***

10. A fixed mass of gas occupies 105cm^3 at -14^{o}C and 650mmHg. At what temperature will it have a volume of 15cm^3 if pressure is adjusted to 690? (3mks)

$\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$ $T_2=\frac{T_1P_2V_2}{P_1V_1}$

$T2=\frac{259k \times 690 \times 15}{650 \times 105}$
=39.28K

11. An oxide of copper in a porcelain boat was reduced was reduced by a stream of hydrogen. The results obtained were as follows;
Mass of porelain boat=4.5g
Mass of boat + oxide = 6.4g
Mass of boat +copper =6.02g

i. Deduce the empirical formula of the oxide. (3mks)

Mass of copper = (6.02 -4.5)g = 1.52g
Mass of oxygen = (6.40-4.5) – 1.52 =0.38g

Element	***Cu***	***O***
Mass	***1.52***	***0.38***
Moles	***1.52***	***0.38***
	63.5	***16***
	0.02375	
	0.02375 =1	***Ef = CuO***

ii. If the relative formula of the oxide is 80, determine its chemical formula. (Cu=64, O=16) (2mks)

n(CuO) = MF
n(80)=80
n=1
chemical formula CuO

12. a) State Gay-Lussac's law. (1mk)

- ***Gases react in simple whole numbers ratios to one another and to the ratio of the products if gaseous.***

b) When 100cm^3 of gaseous hydrocarbon (C_xH_y) burns in 300cm^3 of oxygen, 200cm^3 of carbon (IV) oxide and 200cm^3 of steam are formed. Deduce the formula of the hydrocarbon. (2mks)

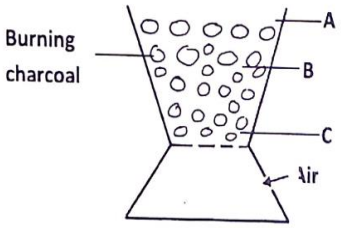
$C_xH_y(g)$ + $O_2(g)$	***→***	***$CO_2(g)$ + $H_2O(l)$***	
100	***300***	***200***	***200***
1 vol	***3vol***	***2vol***	***2vol***

$C_xH_y(aq)3O_2(g)$ → $2CO_2(g)+2H_2O(g)$
Formula is C_2H_4

13. 30cm^3 of 0.5M hydrochloric acid was used to neutralize 25cm^3 of sodium hydroxide solution. Determine the concentration of sodium hydroxide in grams per litre. (4mks)

NaOH(aq) + HCl → NaCl (aq) + $H_2O(l)$
Moles of HCl= 30 x0.5 ÷1000=0.015
Moles of NaOH = 0.015 (rato = 1:1)
Concentration moles /litre
= 0.015 x 1000÷25 =0.6M
Concentration grams/litres = RFM x molarity
= 40 x0.6 =24g/l

14. The following diagram represents a charcoal burner. Study it and answer the questions that follow.



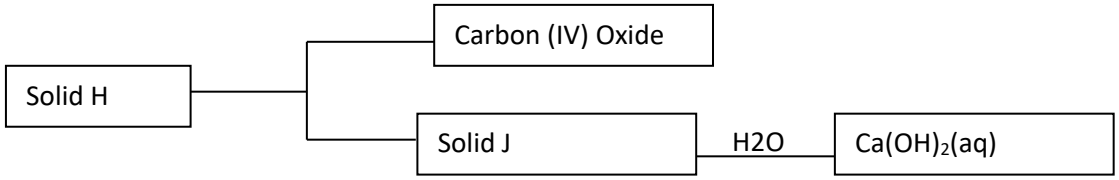
Write the equations for the reaction at; (3mks)

i. A – $2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$

ii. B – $CO_2(g) + C(s) \longrightarrow 2CO(g)$

iii. C – $C(s) + O2(g) \longrightarrow CO_2(g)$

15. Use the scheme below to answer the questions that follow.



a) Identify the solids;

i. H - $CaCO_3$ (1mk)

ii. J - CaO (1mk)

iii. Write a balanced equation to show thermal decomposition of H for formation of J. (1mk)

$CaCO_3(s) \xrightarrow{heat} CaO(s) + CO_2(g)$ *(heat must be shown for full mark)*

b) State one laboratory use of $Ca(OH)_2(aq)$ (1mk)

- ***Used to detect the presence of carbon (IV) Oxide gas.***

16. Explain why potassium is kept under paraffin while phosphorous is kept under water. (2mks)

- ***Potassium does not react with paraffin but react with water while phosphorous react with paraffin but does not react with water.***

17. A fixed mass of an ideal gas occupies $200cm^3$ at a pressure of 740mmHg.

a) State Charle's law. (1mk)

- ***It state that the volume of a fixed mass of a gas is directly proportional to the absolute temperature at constant pressure.***

b) Calculate the volume of the gas at 77mmHg pressure. (2mks)

- $P_1V_1 = P_2V_2$

$$\frac{740 \times 200}{770} = 770 \times V_2$$

$V_2 = 192.2cm^3$

18. A mass of 2.5g of acid HX was dissolved in water and the resulting solution was diluted to a total of $250cm^3$. $15cm^3$ of the final solution was required to neutralize $25.0cm^3$ of 0.1M aqueous potassium

hydroxide. Calculate the relative molecular mass of acid.
(4mks)

HX(aq) + KOH(aq) ⟶ KX(aq) + H2O(l)
Moles ration 1:1
No of moles of KOH = $\frac{0.1 \times 25}{1000}$ = 0.0025mol
Since mole ratio is 1:1
Number of moles in 15cm^3 of diluted Hx is 0.0025 mol
Molarity = $\frac{1000 \times 0.0025}{15}$
If 2.5g= 250cm^3
? = 1000

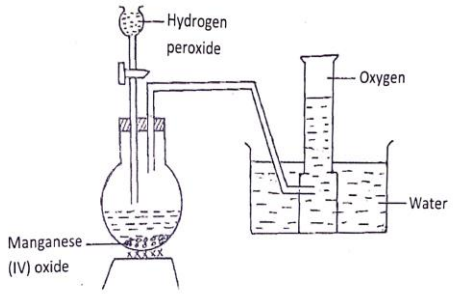
2.5 x 1000÷ 250
=10g/litre
Molarity = $\frac{g/litre}{R.M.M}$
= 0.167

=10g/l
R.M.M
0.167RMM = 10g/l
RMM = 10g/l
0.167 =59.8
=60

19. Name three sub-atomic particles found in an atom and state where they are found. (3mks)

Sub-atomic particle	**Location**
Protons	***Nucleus***
Electrons	***Energy levels***
Neutrons	***Nucleus***

20. The diagram below represent a set up that can be used to prepare and collect oxygen gas.



a) Write an equation for the reaction that takes place. (1mk)

$$2H_2O_2(aq) \xrightarrow{MnO_2} 2H_2O(l) + O_2(g)$$

b) What property of oxygen makes it possible for its collection as indicated in the diagram. (1mk)

- ***It is slightly soluble in water.***

21. The reaction below refers to the preparation of lead (II) sulphate starting with lead metal.

Lead metal $\xrightarrow{\text{Reagent A}}$ solution X $\xrightarrow[\text{solution}]{\text{Sodium sulphate}}$ Mixture Y Residue Z

a) Name the type of reaction between solution X and sodium sulphate solution. (1mk)

- ***Precipitation (double decomposition)***

b) Write an ionic equation for the reaction in (a) above. (1mk)

- $Pb^{2+}(aq) + SO^{2-}{}_4(aq) \longrightarrow PBSO_4(s)$

c) Explain why it is not possible to prepare residue Z using lead metal and dilute sulphuric acid. (1mk)

- ***An insoluble coating of $PbSO_4(s)$ would prevent contact of the metal with the acid and stop the reaction almost immediately***

22. Below are pH values of some solutions.

Solution	Z	Y	X	W
pH	6.5	13.5	2.2	7.2

a) Which solution is likely to be; (2mks)

I. Acid rain
- ***Z***

II. Potassium
- ***Y***

b) A basic substance V reacted with both solution Y and X. What is the nature of V. (1mk)

- ***Amphoteric***

23. Hydrogen gas was passed over hot copper (II) oxide in a combustion tube.

a) Write an equation for the reaction which took place. (1mk)

$CUO(s) + H_2(g) \longrightarrow Cu(s) + H_2O(l)$

b) What observations were made in the combustion tube? (1mk)

A brown solid was seen.

c) Name any other gas which could be used to reduce copper (II) oxide. (1mk)

Ammonia

Carbon (II) oxide

24. a) Element why solid chloride does not conduct electricity while sodium chloride solution conducts. (1mk)

- ***Solid sodium chloride does not contain free ions while sodium chloride solution contains free ions.***

25. 'Dry ice' is preferred to ordinary ice as a refrigerant. Explain. (2mks)

- ***Dry ice sublimes leaving no liquid unlike ordinary ice.***

26. State one use of argon which is also a use of nitrogen gas. (1mk)

- ***Filing electric bulb***

27. The table below gives properties of four substances.

Substance	**Melting points**	**Boiling points**	**Electrical conductivity**	
			Solid	**liquid**
A	1083	2567	Good	Good
B	-182	-164	Poor	Poor
C	1723	2230	Poor	Good
D	993	1695	Poor	Poor

State with a reason which of the above is:-

i. An ionic compound. (1mk)

- ***C, conduct in liquid state and not solid state.***

ii. A metallic structure. (1mk)

- ***A, conduct in both liquid and solid state with high M.P/B.P***

iii. A giant atomic structure. (1mk)

- ***D, has high M.P/B.P and does not conduct in both liquid and solid state.***