KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL

2024 WEIGHTED ASSESSMENT 1

Secondary 4 Express

NAME

CLASS

REG. NO

CHEMISTRY

6092

21 February 2024

Setter: Ms Koh Li Eng

45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.

This paper consists of 3 sections.

Section A consists of 5 multiple choice questions.
Answer **all** questions.
Write your answer on page 3.

Section B consists of 4 structured questions.
Answer **all** the questions in dark blue or black pen in the space provided on the Question Paper.

Section C consists of 1 free response question.
Answer the question in dark blue or black pen in the space provided on the Question Paper.

A copy of the Periodic Table is printed on page 12.

FOR EXAMINER'S USE	
Section **A**	/ 5
Section **B**	/ 20
Section **C**	/ 10
Total	/ 35

.....
Parent's signature/ Date

Section A (5 marks)

1 How many atoms of carbon are present in 18.0 g of glucose, $C_6H_{12}O_6$?

A 6.02×10^{22}
B 3.61×10^{23}
C 6.02×10^{23}
D 3.61×10^{24}

2 When solid sodium hydrogencarbonate (Mr = 84) is heated strongly, the following reaction occurs and carbon dioxide gas escapes into the surrounding.

$$2NaHCO_3\,(s) \rightarrow Na_2CO_3\,(s) + H_2O\,(l) + CO_2\,(g)$$

What is the loss of mass when 25.2 g of solid sodium hydrogencarbonate is heated?

A 2.7 g
B 6.6 g
C 9.3 g
D 10.6 g

3 On heating, ammonium nitrate decomposes to form dinitrogen monoxide and water as shown in the equation below.

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

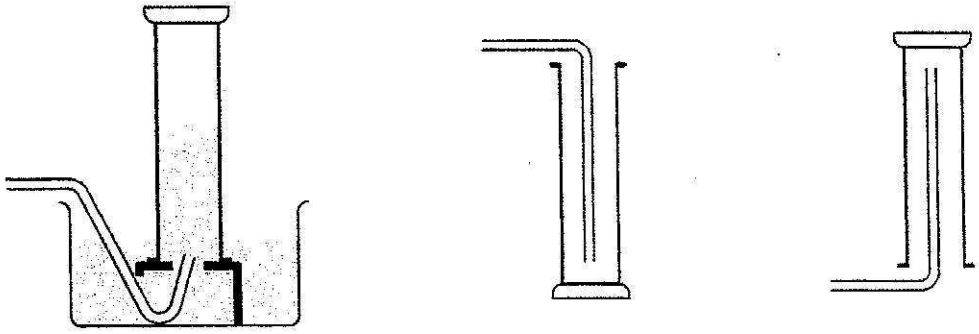
When 80 g of an impure sample ammonium nitrate is heated, 27 g of water is formed.

What is the percentage purity of ammonium nitrate in the impure sample?

A 16.9 %
B 33.8 %
C 67.5 %
D 75.0 %

4 Which of the following methods shown can be used to collect ammonia gas?

method 1 method 2 method 3



A method 1 and 2
B method 1 and 3
C method 2 only
D method 3 only

5 Which of the following statements is true for every Group in the Periodic Table?

A The elements are either all metals or all non-metals.
B The melting and boiling points of the elements always increase with increasing proton number.
C The reactivity of the elements decreases with increasing proton number.
D The valency of the elements is the same.

Answers to Section A:

1	2	3	4	5

Section B (20 marks)

Answer **all** the questions in the spaces provided.

An experiment was carried out to determine the end–point of the reaction between 25.0 cm^3 of potassium hydroxide solution and 1.0 mol/dm^3 of dilute sulfuric acid in order to calculate the concentration of potassium hydroxide solution.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

Fig. 1.1 shows the set-up of the apparatus for the titration.

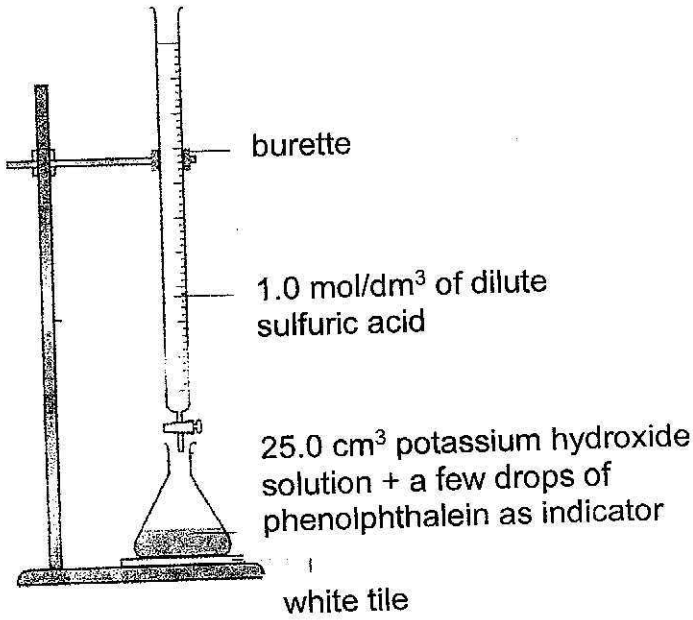


Fig. 1.1

The volume of dilute sulfuric acid added and the colour of the solution in the conical flask are shown in Table 1.2.

Table 1.2

volume of dilute sulfuric acid / cm^3	colour of solution in conical flask
11.85	pink
11.90	pink
11.95	pink
12.00	colourless
12.05	colourless
12.10	colourless

(a) State the volume of dilute sulfuric acid needed for complete neutralisation.

..... [1]

(b) Hence, calculate the concentration, in mol/dm^3, of potassium hydroxide solution.

concentration of potassium hydroxide = ... [3]

2 Elements **P** to **U** are found in Period 3 of the Periodic Table. The letters given (**P**, **Q**, **R**, **S**, **T** and **U**) are **not** the actual symbols of the elements. The following information is given.

Element **P** has five valence electrons.

Element **Q** is known as an alkali metal.

Element **R** is used to fill up the filament bulb.

Element **S** forms ion with a charge of 2–.

Element **T** is known as a halogen.

Element **U** forms a positive ion with the highest charge in the Period.

Based on the information given, place the six elements, **P** to **U**, according to their Group numbers in the table below.

Group	1	2	13	14	15	16	17	18
element								

[3]

3 Fig. 3.1 shows the set up used to bubble chlorine gas, Cl_2, through colourless potassium bromide solution, KBr.

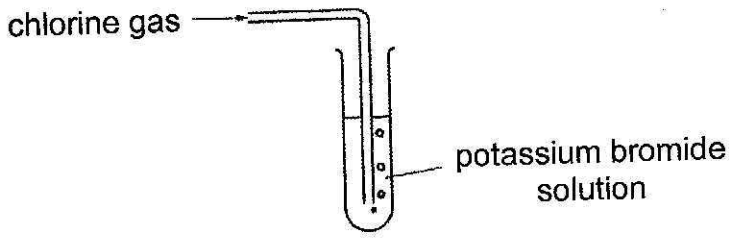


Fig. 3.1

(a) State the name given to the type of reaction shown in Fig. 3.1.

..... [1]

(b) Write the balanced chemical equation for the reaction that occurs in Fig. 3.1.

..... [2]

(c) Describe an observation that could be made during this chemical reaction.

..... [1]

(d) Name one other halogen that will be able to react in the same manner as chlorine with potassium bromide solution.

..... [1]

(e) 12 cm^3 of chlorine gas was bubbled into the potassium bromide solution. Calculate the number of moles of Cl_2 gas used in the reaction.

number of moles of Cl_2 = ... [1]

4 The information of eleven metals, consisting of ten transition metals and one Group 1 metal are shown in Table 4.1. These metals are found across Period 4 of the Periodic Table.

The letters ***A*** to ***K*** are not the actual symbols of the metals in the Periodic Table. Use the letters to answer the question.

Table 4.1

element	***A***	***B***	***C***	***D***	***E***	***F***	***G***	***H***	***I***	***J***	***K***
density (g/cm^3)	2.99	4.50	5.96	7.20	7.20	7.86	8.90	8.90	8.92	7.14	0.86
melting point (°C)	1541	1660	1890	1857	1244	1535	1495	1455	1083	420	64
common oxidation state(s) that occur in compounds	+3	+4 +3 +2	+5 +4 +3 +2	+6 +5 +4 +3 +2	+7 +6 +5 +4 +3 +2	+6 +5 +4 +3 +2	+5 +4 +3 +2	+4 +3 +2	+3 +2	+2	+1

(a) (i) Which of the metals could be from Group 1? Give two pieces of evidence to support your answer.

.....

.....

.....

.....

..... [2]

(ii) Describe and explain a chemical reaction that could be used to distinguish the Group 1 metal from the rest of the transition metals.

.....

.....

.....

.....

..... [2]

(b) Some scientists do not consider two of the metals found in Period 4 as 'transition metals'.

(i) Using the information provided, identify one of the two metals.

..... [1]

(ii) Using your knowledge about transition elements and the information provided, explain your answer in **(b)(i)**.

.....

.....

.....

.....

..... [2]

Section C (10 marks)

Show your working and answer the question in the spaces provided.

5 In the chemical industry, Haber and Contact processes are used to manufacture ammonia and sulfuric acid respectively.

(a) In the Haber process, nitrogen reacts with hydrogen to form ammonia in a reversible reaction.

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$$

(i) State the optimum conditions of the Haber process.

..... [1]

(ii) The wall of the reaction chamber in the Haber process is usually made of iron.

Suggest a reason for this.

.....

..... [1]

(iii) For a given temperature, increasing the pressure of the reactants will increase the percentage yield of ammonia.

Suggest a reason why this is rarely done in the industry.

.....

..... [1]

(iv) The ammonia gas produced is soluble in water and forms a weak alkali.

Explain, with the aid of an ionic equation, why ammonia forms a weak alkali when dissolved in water.

.....

.....

.....

..... [2]

(b) Table 5.1 shows some information about the manufacturing of sulfuric acid using the Contact process. There are three stages in the Contact process.

Table 5.1

Stage 1 Solid sulfur is burnt in a stream of dry purified air to form sulfur dioxide. $S(s) + O_2(g) \rightarrow SO_2(g)$
Stage 2 Sulfur dioxide continues to burn in air to form sulfur trioxide. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
Stage 3 Sulfur trioxide is dissolved in concentrated sulfuric acid to form oleum, $H_2S_2O_7$. $SO_3(g) + H_2SO_4(l) \rightarrow H_2S_2O_7(l)$ equation (1) Oleum is then carefully diluted with water to make concentrated sulfuric acid. $H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(l)$ equation (2)

(i) Combining equations (1) and (2), write a balanced chemical equation with state symbols to represent the overall reaction in **stage 3** of the Contact process.

..... [1]

(ii) The most important stage in the entire Contact process is **stage 2** as the reaction is reversible.

State what is meant by the term "*reversible*".

.....

..... [1]

(iii) Using the information given in Table 5.1, calculate the number of moles of concentrated sulfuric acid produced if 16 g of sulfur and 24 dm^3 of oxygen was used at the start.

[3]

-End of Paper-

The Periodic Table of Elements

Group 1	2											13	14	15	16	17	18
																	2 He helium 4
3 Li lithium 7	4 Be beryllium 9						1 H hydrogen 1					5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actintoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).
The Avogadro constant, $L = 6.02 \times 20^{23}$ mol^{-1}.

KUO CHUAN PRESBYTERIAN SECONDARY SCHOOL
WA 1 (TERM 1)
SECONDARY FOUR EXPRESS
CHEMISTRY 2024
MARK SCHEME

Section A: Multiple Choice Questions [5 marks]

Q1	Q2	Q3	Q4	Q5
B	B	D	D	D

Section B: Structured Questions [20 marks]

1	(a)	12.00 cm^3 Penalise if no unit given, wrong d.p.	1
	(b)	No of mol of sulfuric acid = 12/1000 x 1.0 = 0.0120 mol Mole ratio of KOH : H_2SO_4 is 2 : 1 No of mol of KOH = 2 x 0.012 = 0.0240 mol Conc. of KOH = 0.024 / (25/1000) = 0.960 mol/dm^3 Allow ECF from 1(a)	1 1 1
2		group: **1** **2** **13** **14** **15** **16** **17** **18** element: **Q** **U** **P** **S** **T** **R** Every 2 correct answers - 1mark	3
3	(a)	Displacement	1
	(b)	Cl_2 + 2KBr → 2KCl + Br_2 1m for correct formulae, 1m for balancing (only if formulae are correct)	2
	(c)	Colourless solution turns reddish brown / brown / orange brown (due to formation of aqueous bromine).	1
	(d)	Fluorine Penalise for spelling mistake	1
	(e)	No, of mole of Cl_2 = 12 / 24000 = 0.000500 mol	1

4	(a)(i)	K. It has a low density of 0.86 g/cm^3 as group 1 elements floats on water. OR It has a low melting point of 64 °C as group 1 elements have low melting and boiling point. OR It has a fixed oxidation state of +1 which shows that it has 1 valence electron. Any 2 out of the 3 evidence to support. 1m for each evidence only if K is correctly identified. No marks awarded for identification of K.	2
	(a)(ii)	Add all the metals to (cold) water. K is the only metal / only Group 1 metal produces effervescence. Only Group 1 metals react with water to form alkaline solution (alkalis) and hydrogen gas.	1 1
	(b)(i)	A or J Accept 'scandium/Sc or zinc/Zn' since question asked for 'identify' Reject: Two answers given even if both correct.	1
	(b)(ii)	A have only one or a fixed oxidation state instead of the variable oxidation states shown by transition metals. A has a low density instead of high density like the transition metals. OR Sc has a lower density as compared to the rest of the transition metals. OR J have only one or a fixed oxidation state instead of the variable oxidation states shown by transition metals. J has a low melting point as compared to the high melting points of transition metals. OR Zn has a much lower melting point as compared to the others. Need to compare A or J with other transition metals.	1 1 1 1

Section C: Structured Questions [10 marks]

5	(a)(i)	450°C, 250 atm and (finely divided) iron (as catalyst)	1
	(a)(ii)	This is to provide a larger surface area for the catalyst in order to increase the rate of reaction further/more.	1
	(a)(iii)	Increasing the pressure require more powerful / expensive / special pumps or stronger pipes. This is not done to reduce the production cost of ammonia. ***Note*** Must link cost to equipment / pump. Reject 'costly/expensive without giving explanation'.	1
	(a)(iv)	Ammonia, when dissolved in water forms aqueous ammonia which partially dissociated in water to form low concentration of hydroxide ions and ammonium ions. Ionic eqn: NH_3 (g) + H_2O (*l*) ⇌ NH_4^+ (aq) + OH^- (aq)	1 1
	(b)(i)	SO_3 (g) + H_2O (*l*) → H_2SO_4 (*l*)	1
	(b)(ii)	The reaction can go both forward and backward at the same time.	1
	(b)(iii)	No of mole of S used = 16 / 32 = 0.500 mol No of mole of O_2 used = 24 / 24 = 1.00 mol Mole ratio of H_2SO_4 : SO_3 : SO_2 : S is 1 : 1 : 1 : 1 No of mole of H_2SO_4 = 0.500 mol	1 1 1