2021-2022
MOCK EXAM
S.6 CHEM

PAPER 1B

B

Good Hope School
Mock Examination 2021 – 2022
S.6 Chemistry
Paper 1

Section B: Question-Answer Book B

This paper must be answered in English

請在此貼上電腦條碼
Please stick the barcode label here

Student Number						

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your Student Number in the spaces provided on Page 1 and stick your labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) Answer **ALL** questions.

(4) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Supplementary answer sheets will be supplied on request. Mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.

(6) Present your answers in paragraphs wherever appropriate.

(7) The diagrams in this section are **NOT** necessarily drawn to scale.

(8) No extra time will be given to students for filling in the Student Number and the question number boxes after the 'Time is up' announcement.

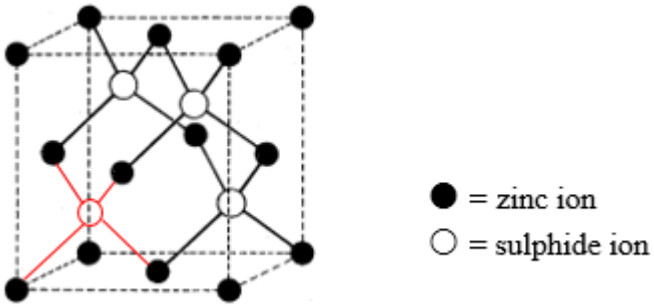
Part I

Answer **ALL** questions**.** Write your answers in the spaces provided.

Overall performance:

Q.1 Well done	Q.2 Well done	Q.3 Well done	Q.4 Poor	Q.5 Satisfactory
Q.6 Very good	Q.7 Good	Q.8 Well done	Q.9 Very good	Q.10 well done
Q.11 Fair	Q.12 Poor	Q.13 Satisfactory	Q.14 Satisfactory	15. Fair

1. The diagram below shows a part of the structure of zinc sulphide with one sulphide ion missing.



(a) Complete the diagram by adding the missing sulphide ion and drawing lines to show to which zinc ions the sulphide ion is bonded.

(1 mark)

Common mistake: Other than the one inside, ions outside the unit cell are drawn.

(b) (i) If all the zinc ions and sulphide ions were replaced by carbon atoms, what substance would the diagram represent?

Diamond [1]

(1 mark)

(ii) Explain whether the substance in (i) has a high or low melting point.

The structure has a (very) high melting point because a lot of heat is needed to break the network of strong covalent bonds between the carbon atoms. [1]

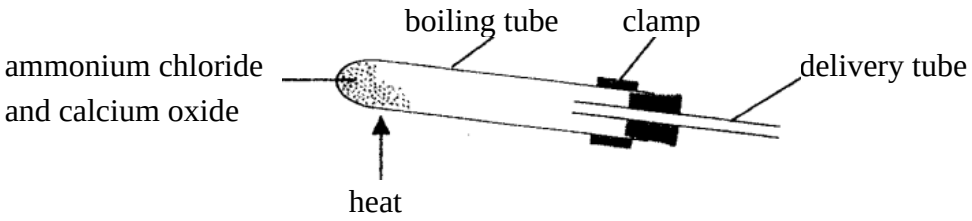
Common mistakes:

(a) Wrongly described the structure of zinc sulphide, not the one in (i).

(b) A few described the structure as having 'ions' held by strong covalent bonds.

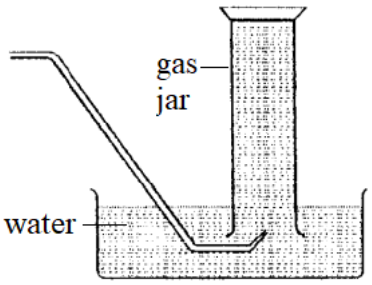
(1 mark)

2. (a) The diagram below shows an incomplete set-up for the preparation of ammonia gas:

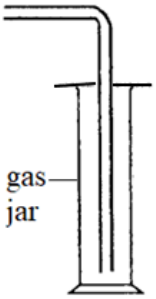


Which of the following set-ups, I, II or III, should be connected to the delivery tube to collect the ammonia gas produced? Explain your answer.

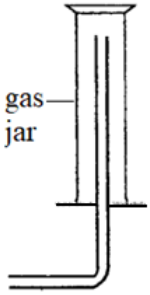
Set-up I



Set-up II



Set-up III



Set-up III. [1]
Ammonia is less dense than air / lighter than air, so set-up II is not suitable [1]
and is very soluble in water / reacts with water, so set-up I is not suitable [1]

(3 marks)

Comment: Many students simply mentioned the properties of NH_3 without saying anything on its suitability for the different designs.
Some students thought that as ammonia is less dense than air, it will escape if set up III is used.

(b) State the expected observation(s) when $NH_3(aq)$ is added dropwise to $CuSO_4(aq)$ until in excess. Account for the observation(s) with the aid of chemical equation(s).

A pale blue precipitate is formed. [1]
The precipitate dissolves in excess $NH_3(aq)$ to give a deep blue solution. [1]
$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ [1]
$Cu(OH)_2(s) + 4NH_3(aq) \rightarrow [Cu(NH_3)_4]^{2+}(aq) + 2OH^-(aq)$ [1]

Common mistakes:
(a) Some used Cu^{2+} to represent the blue precipitate in the ionic equation.
(b) Many did not know the formula for the deep blue complex formed and the equation for its formation was unbalanced.
(c) For the formation of deep blue complex, some considered it a reaction between the blue precipitate and $OH^-(aq)$ ions.
(d) Some failed to give the correct colours of the precipitate and solution formed

(4 marks)

3. Titanium can be obtained from titanium(IV) oxide (TiO_2) by the following steps:

Step 1: Heating titanium(IV) oxide with carbon and chlorine.

$$TiO_2(s) + C(s) + 2Cl_2(g) \rightarrow TiCl_4(s) + CO_2(g)$$

Step 2: Reacting the chloride formed with sodium.

$$TiCl_4(s) + 4Na(s) \rightarrow Ti(s) + 4NaCl(s)$$

(a) Explain which of the reagents is a reducing agent in the reaction involved in *Step 1*.
Carbon is the reducing agent because the oxidation number of C increases from 0 to +4.
(1 mark)

(b) Suggest why the reaction involved in *Step 2* is carried out in an atmosphere of argon gas.
So that the sodium involved will not be oxidized by atmospheric oxygen.
[Also accept: 'So that sodium will not be oxidized.', 'So that sodium will not react with oxygen.'
Not accept: 'To provide an inert environment.' , 'Argon is stable.']
(1 mark)
Comment: Students needed to know that they had to explain why the original setting did not work. That is why a different environment is used.
Common mistake: Stated the property of argon without explaining why it is needed

(c) Based on the reaction involved in *Step 2*, comment on the relative reactivity of titanium and sodium. (1 mark)
Sodium is more reactive than titanium as sodium can displace titanium from its chloride.
Common mistake: Answers given were not based on reaction.
Gave answer without explanation.
Failed to describe the displacement reaction properly (e.g. of wrong answers: 'displace Ti^{4+} to form NaCl', 'displace Ti^{4+} from $TiCl_4$', 'remove Ti from $TiCl_4$')

(d) Suppose in *Step 2*, 5.70 g of titanium(IV) chloride are allowed to react with 1.90 g of sodium. Calculate the mass of titanium produced.
(Relative atomic masses: Na = 23.0, Cl = 35.5, Ti = 47.9)
No. of moles of $TiCl_4$ = 5.70 / (47.9 + 35.5 × 4) = 5.70 / 189.9 = 0.0300 mol
No. of moles of Na = 1.90 / 23.0 = 0.0826 mol
According to the equation, $TiCl_4$: Na = 1 : 4, 0.03 mol of $TiCl_4$ reacts with 0.12 mol of Na, thus Na is the limiting reactant. [1]
No. of moles of Ti produced = 0.0826 / 4 = 0.0207 mol [1]
Mass of Ti produced = 0.0207 × 47.9 = 0.989 g [1]
Common mistakes:
(a) Did not consider mole ratio when deciding the limiting reactant.
(b) Some students expressed the answer in 2 sig. fig. instead of 3.
(3 marks)

(e) State one property of titanium and its corresponding daily application.
Titanium is very strong / has a low density / has a high resistance to corrosion [1],
thus it is used in aircraft production [1]. /
Titanium is very strong/ biocompatible/ has a low density/ a high resistance to corrosion [1],
thus it is used to make metal implants / joints in human body [1].
(2 marks)

Common mistake:
(a) Described titanium as light instead of low density.
(b) Property and use did not match.

4. (a) Explain why the electrical conductivity of 17.5 M sulphuric acid is lower than that of 2.0 M sulphuric acid.

2.0 M sulphuric acid is almost completely ionized in water whereas 17.5 M sulphuric acid mainly consists of molecules.

(1 mark)

Comment:
Students did not answer in terms of degree of ionization. They simply compared the concentration of mobile ions which can be deduced directly from their difference in electrical conductivity.

*(b) Discuss two differences in chemical properties of 17.5 M sulphuric acid and 2.0 M sulphuric acid. Illustrate your answer using appropriate examples.

First, 17.5 M sulphuric acid acts as a dehydrating agent, but 2.0 M sulphuric acid does not. [1]

For example, 17.5 M sulphuric acid will change the colour of hydrated copper(II) sulphate from blue to white. 2.0 M sulphuric acid will not. [1]

$$CuSO_4 \cdot 5H_2O(s) \xrightarrow{\text{conc. } H_2SO_4(l)} CuSO_4(s) + 5H_2O(l)$$

Second, 17.5 M sulphuric acid has a stronger oxidizing power than 2.0 M sulphuric acid. [1]

For example, 17.5 M sulphuric acid reacts with copper readily to form sulphur dioxide, but 2.0 M sulphuric acid cannot. [1]

$$Cu(s) + 2H_2SO_4(l) \rightarrow SO_2(g) + CuSO_4(aq) + 2H_2O(l)$$

OR, hot 17.5 M sulphuric acid slowly oxidizes carbon / sulphur to its oxide, but 2.0 M sulphuric acid cannot. [1]

$$C(s) + 2H_2SO_4(l) \rightarrow CO_2(g) + 2SO_2(g) + 2H_2O(l) /$$
$$S(s) + 2H_2SO_4(l) \rightarrow 3SO_2(g) + 2H_2O(l)$$

OR, hot 17.5 M sulphuric acid oxidizes hydrogen bromide to bromine, but 2.0 M sulphuric acid cannot. [1]

$$2HBr(g) + H_2SO_4(l) \rightarrow Br_2(g) + SO_2(g) + 2H_2O(l)$$

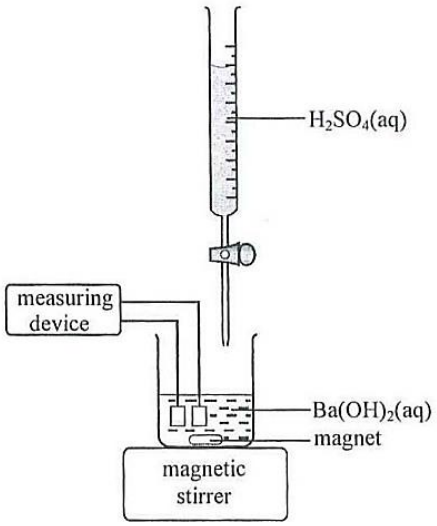
Effective communication [1]

(5 marks)

Comment:
(a) Students were not familiar with the specific properties of conc. sulphuric acid.
(b) Students needed to either state that conc. H_2SO_4 is a strong oxidizing agent or it is a stronger oxidizing agent than dil. H_2SO_4 because dil. H_2SO_4 also has oxidizing power (e.g. its reaction with reactive metals).

5. The diagram below shows the experimental set-up of a titrimetric experiment involving the following reaction:

$$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$



H_2SO_4(aq) is added gradually to $Ba(OH)_2$(aq) until in excess. The electrical conductivity of the reaction mixture is measured and recorded.

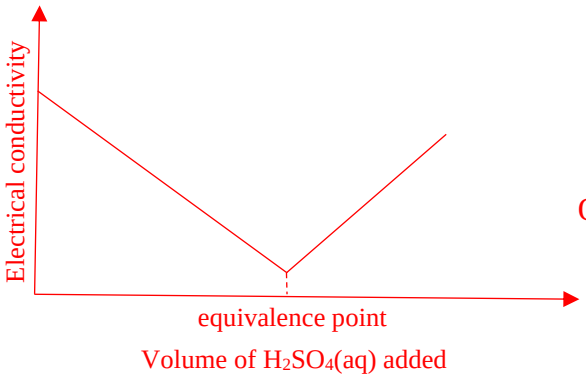
(a) Sulphuric acid is dibasic acid. What is a 'dibasic acid'?

Dibasic acid is an acid which each of its molecule can produce a maximum of 2 hydrogen ions by complete ionization when dissolved in water. [1]

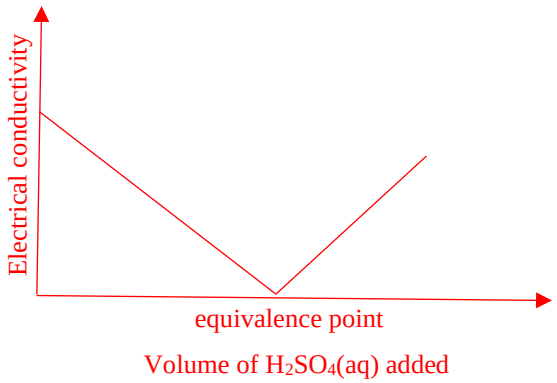
[also accept: '...each molecule has 2 ionizable H^+ ions when dissolved in water.', '... each molecule can produce 2 H^+ ions by complete ionization when dissolved in water.']

(1 mark)

(b) Sketch a graph to show the variation in electrical conductivity with the volume of H_2SO_4(aq) added. Label the equivalence point in your graph.



Or



[Correct shape & label of equivalence point – 1]
[Wrong axes – 0]

(1 mark)

Common mistakes:
(a) Labelled the x-axis as the 'time' axis.
(b) Drew a curve for the graph instead of two straight lines.
(c) Wrongly labelled the equivalence point as 'end point'

5. (c) Explain the shape of your graph in (b).

As $H_2SO_4(aq)$ is added, $H^+(aq)$ reacts with $OH^-(aq)$ to give $H_2O(l)$, and $BaSO_4(s)$ formed is precipitated. Concentration of mobile ions in the beaker decreases. Thus, electrical conductivity decreases before the equivalence point. [1]

The electrical conductivity at equivalence point is the lowest as the $H_2SO_4(aq)$ added has just reacted with all $Ba(OH)_2(aq)$. Only water slightly ionizes to give a small amount of ions. Thus, the concentration of mobile ion is minimal. [1] Or
The electrical conductivity at equivalence point is zero as the $H_2SO_4(aq)$ added has just reacted with all $Ba(OH)_2(aq)$. Thus, there is no mobile ions. (1)

After the equivalence point, electrical conductivity increases as the excess $H_2SO_4(aq)$ added ionizes in water, causing an increase in the concentration of mobile ions. [1]

(3 marks)

Common mistake:
Explained in terms of the amount of mobile ions instead of concentration of mobile ions.

Comment:
Students did not clearly state that $BaSO_4$ was water insoluble and they did not explain in term of reaction between $H^+(aq)$ and $OH^-(aq)$ ions.

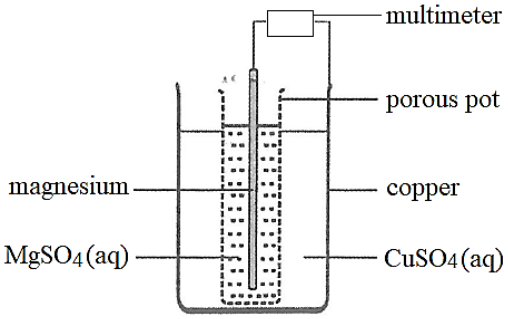
(d) State the reason why reacting barium carbonate with sulphuric acid is inappropriate for preparing barium sulphate.

When barium carbonate reacts with sulphuric acid, the barium sulphate formed will wrap / coat the surface of the unreacted barium carbonate, hindering further reaction / the reaction will not be completed / pure barium sulphate cannot be obtained. [1]

(1 mark)

Common mistake:
Stated that it would be difficult to separate $BaSO_4$ from a mixture of 2 solids.

6. Consider the chemical cell as shown below:



(a) What is the function of the porous pot? (1 mark)

Separate the $MgSO_4(aq)$ and $CuSO_4(aq)$./ Allow ions to pass through./ Complete the circuit. [1]

(b) Write the half equation for the change that occurs at the cathode. (1 mark)

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ [1]

(c) The multimeter in the above chemical cell gives a reading of +1.52 V. Would the voltmeter reading become more positive, less positive or remain unchanged if the magnesium and $MgSO_4(aq)$ is replaced by zinc and $ZnSO_4(aq)$, while the other conditions remain unchanged? Explain your answer. (2 marks)

Less positive [1]

Zinc loses electrons less readily than magnesium/ smaller difference in the tendency of losing electrons. [1]

Comment:

Students simply mentioned the reason was due to a smaller difference in the positions between Zn and Cu compared to that between Mg and Cu in the ECS.

(d) The magnesium electrode and $MgSO_4(aq)$ in the above chemical cell is replaced by a graphite electrode and a solution of $Br_2(aq)$ and KBr(aq), while the other conditions remain unchanged.

(i) Write the half equation for the change occurs at the graphite electrode. (1 mark)

$Br_2(aq) + 2e^- \rightarrow 2Br^-(aq)$ [1]

Common mistake:

Considered the discharge of $Br^-(aq)$ ions instead of the reduction of Br_2.

(ii) State the expected observation at the copper electrode. (1 mark)

The electrode decreases in size. / Colour around the electrode deepens. [1]

Common mistake:

Increase in the size of copper electrode / color around the electrode fades.

7. A mixture of powdered Al(s) and $NH_4ClO_4(s)$ is used as the solid propellant to provide energy for launching the rockets carrying the shuttle up to the upper atmosphere. When ignited, the solid propellant reacts to give $Al_2O_3(s)$, $AlCl_3(s)$, NO(g) and $H_2O(g)$.

(a) State Hess's law. (1 mark)

The total enthalpy change of a chemical reaction is independent of the pathway between the initial and final states. [1]

(b) Write the chemical equation for the reaction of Al(s) with $NH_4ClO_4(s)$. (1 mark)

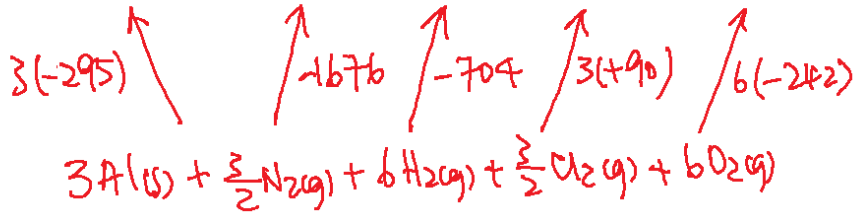
$3Al(s) + 3NH_4ClO_4(s) \rightarrow Al_2O_3(s) + AlCl_3(s) + 3NO(g) + 6H_2O(g)$ [1]

Common mistake:
Failed to give a balanced chemical equation

(c) Given the following standard enthalpy changes of formation, calculate the standard enthalpy change, at 298 K, of the reaction.

Compound	Standard enthalpy change of formation at 298 K / kJ mol^{-1}
$Al_2O_3(s)$	–1676
$AlCl_3(s)$	–704
$H_2O(g)$	–242
$NH_4ClO_4(s)$	–295
NO(g)	+90

$3Al(s) + 3NH_4ClO_4(s) \rightarrow Al_2O_3(s) + AlCl_3(s) + 3NO(g) + 6H_2O(g)$



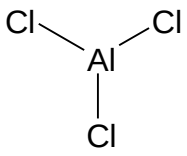
Standard enthalpy change of the reaction
= (–1676) + (–704) + 3(90) + 6(–242) – 3(–295) [1]
= –2677 kJ mol^{-1} [1]

Common mistakes:
Incorrect coefficients used in the enthalpy expression.

(2 marks)

8. (a) When Al(s) is heated with $Cl_2(g)$, it gives $AlCl_3(s)$ which exists as discrete $AlCl_3$ molecules.

(i) Draw the three-dimensional structure of a $AlCl_3$ molecule.



[1]

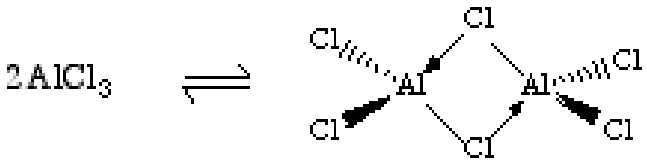
Common mistake:
A trigonal pyramidal shape for $AlCl_3$ was drawn instead of trigonal planar.

(ii) When solid $AlCl_3$ melts, it exists as a dimer with the formula Al_2Cl_6 using dative covalent bond. Describe how two $AlCl_3$ molecules dimerize to form Al_2Cl_6.

In $AlCl_3$, there are three electron pairs / there is a vacant site / 6 electrons only / electron deficient in the outermost shell of Al atom. [1]

By accepting the lone electron pair of electrons from the chlorine atom of another $AlCl_3$ / forming dative bond with Cl, Al attains the stable electronic configuration of Ne (a noble gas) [1]

OR diagram



Award [1] if there is only 1 correct dative covalent bond

Common mistake:
Stated that there was a lone pair in $AlCl_3$ OR Al
Comment:
Should focus on (a) an electron deficient atom (b) an atom with available lone pair of electrons.

(2 marks)

(iii) Al(s) forms an amphoteric oxide, $Al_2O_3(s)$. Write equations to show that $Al_2O_3(s)$ is amphoteric.

Warming $Al_2O_3(s)$ with dilute HCl:
$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$ / $Al_2O_3 + 6H^+ \rightarrow 2Al^{3+} + 3H_2O$ [1]

Warming $Al_2O_3(s)$ with dilute NaOH:
$Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$ / $Al_2O_3 + 3H_2O + 2OH^- \rightarrow 2Al(OH)_4^-$ [1]

Only equations are accepted.

(2 marks)

Common mistake:
(a) Equation was unbalanced
(b) Wrong formula for the complex ion

8. *(b) Explain the following decreasing order of the boiling points of three substances:

$$H_2O > H_2Se > H_2S$$

Both molecules of H_2Se and H_2S are held by van der Waals' forces. [1]
The van der Waals' forces between H_2Se molecules are stronger than that between H_2S molecules because of the larger molecular size of H_2Se than H_2S / there are more electrons in H_2Se molecules than those in H_2S molecules. [1]

Hydrogen bonds exist among H_2O molecules and hydrogen bonds are stronger than van der Waal's forces. [1]

1 mark for effective communication: chemical knowledge 2/3 with no misconception.

Common mistake:
(a) Did not compare the strengths of hydrogen bonding with van der Waals' forces.
(b) Considered van der Waals' forces a chemical bond

(4 marks)

9. (a) Both polyethene (PE) and polyvinyl chloride (PVC) can be used as packaging material. For example, they are commonly used in plastic container for pharmaceutical products.

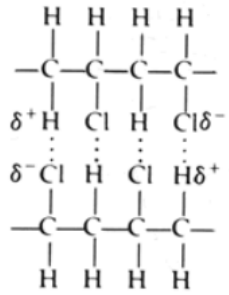
(i) PE is made from ethene. State how ethene is produced in industry.

Cracking of large hydrocarbon / petroleum fractions [1]

(1 mark)

Common mistake:
Stated cracking of oil / petroleum instead of referring to petroleum fractions.

(ii) In terms of intermolecular force, explain why PVC is more suitable than PE in making water pipes.


PVC

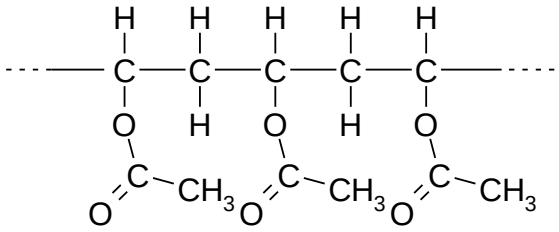
PVC is stronger / has higher tensile strength [1]

Due to the presence of polar C-Cl bonds along the polymer chains, polymer chains are held by polar attraction (force) which is stronger than van der Waals' forces between PE. [1] /
The molecular sizes of PVC are larger [1], hence it has a larger dispersion force or van der Waals forces or intermolecular forces than that in PE.

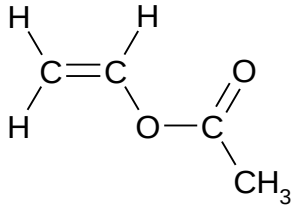
Common mistake:
Compared the van der Waals' forces based on their sizes instead of the presence of polar bonds along the chain.

(2 marks)

(b) The structure of poly(vinyl acetate) is shown below:



Draw the structure of the monomer of this polymer.

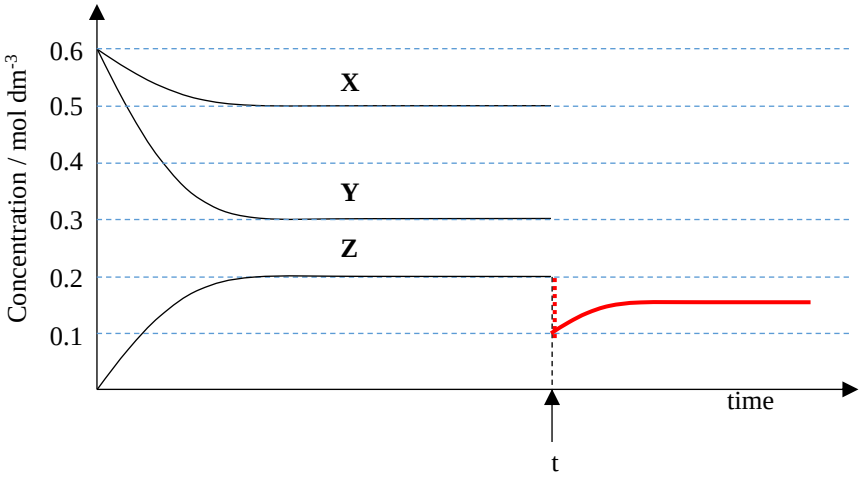


[1]

(1 mark)

Common mistake:
One oxygen atom is missing in some of the answers.

10. **X**(g) and **Y**(g) react to form **Z**(g). The graph below shows the concentrations of **X**, **Y** and **Z** at different time.



(a) According to the graph, how do you know that the reaction is reversible?

None of **X**, **Y** and **Z** is zero / all the concentrations of **X**, **Y** and **Z** remain unchanged for a long time.

Comment:

Simply mentioned that the concentrations of X, Y and Z remained unchanged is not enough because this happens for both reversible and irreversible reactions. However, the key point here is that the reactant curves would never be zero for any reversible reactions.

(1 mark)

(b) Write the equation for the reaction between **X** and **Y** to form **Z**. (1 mark)

$X + 3Y \rightleftharpoons 2Z$

Common mistake:

Used single-headed arrow

(c) After the equilibrium has reached, some **Z** is removed from the system at time t as indicated in the graph so that its concentration becomes 0.1 mol dm^{-3}. Sketch, in the above diagram, the variation of concentration **Z** from time t until a new equilibrium is established. (1 mark)

Comment:

After the addition / removal of a reactant / product, the curve of the reactant / product involved will never return back to the original concentration.

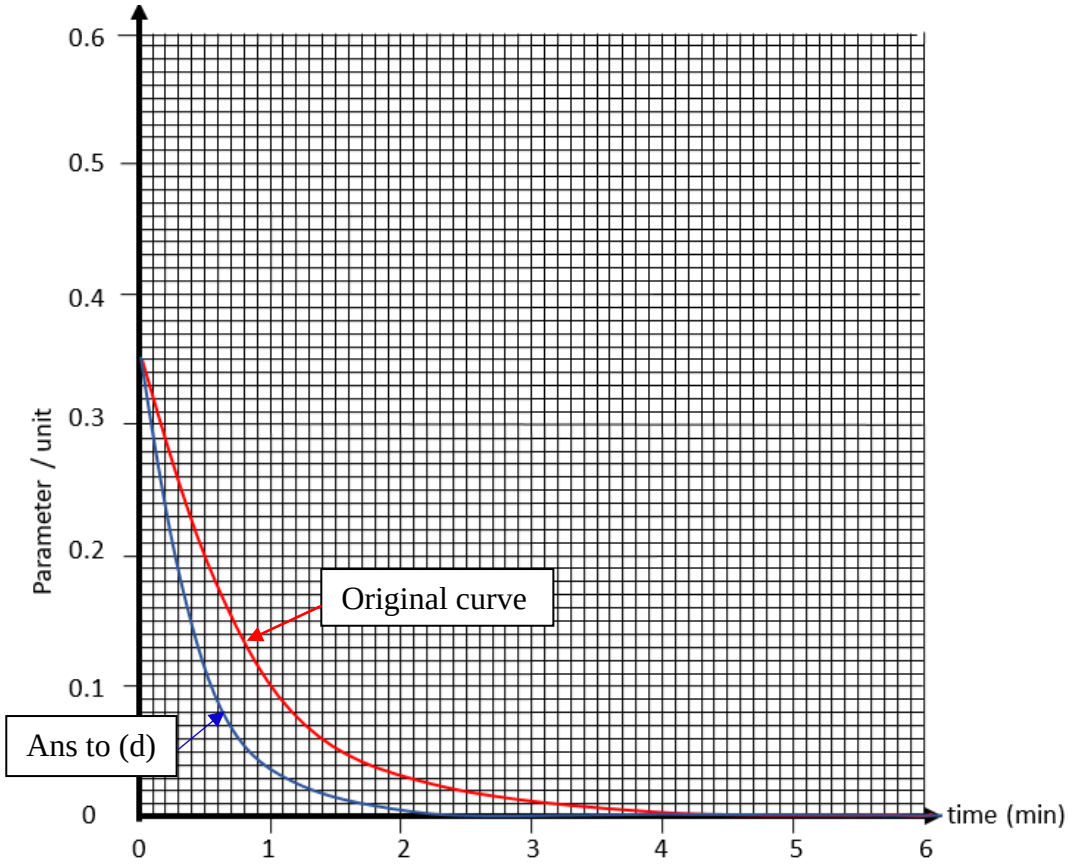
Part II

Answer **ALL** questions**.** Write your answers in the spaces provided.

11. Consider the following reaction:

$I_2(aq) + CH_3COCH_3(aq) \rightarrow HI(aq) + CH_3COCH_2I(aq)$

In an experiment to study the rate of consumption of I_2 (aq), equal volumes of 0.1 M $I_2(aq)$ and 0.1 M $CH_3COCH_3(aq)$ were mixed. The progress of the reaction was followed by measuring a certain parameter of the reaction system using a colorimeter. The graph below shows the results from the start of the reaction.



(a) It is given that the rate of change of the parameter with time can represent the rate of reaction. Suggest what the parameter should be. (1 mark)

Absorbance / colour intensity [1]

(b) Calculate the average rate of consumption of the $I_2(aq)$ from the 1st minute to the 4th minute.

– [(0.1 – 0) unit / (1 – 4) min] [1]
= 0.033 unit min^{-1} OR 0.00056 unit s^{-1} [1]

Common mistakes:
Calculated the average rate from 0 min to 4th min
Comment:
As it is 'average rate of consumption', so the answer should be a positive value.

(2 marks)

11. (c) The initial rate is faster than the calculated value in (b). Explain this at molecular level.

The initial concentration is the highest / higher than that in (b) [1] and the frequency of effective collisions is higher than that at any other time / in (b) [1]. So the rate is faster than the calculated value in (b).

(2 marks)

Comment:
The initial concentration is always the highest.
Should explain in terms of 'effective collision' instead of 'collision'

(d) The experiment was repeated by mixing equal volumes of 0.1 M $I_2(aq)$ and 0.2 M $CH_3COCH_3(aq)$ were mixed. Sketch on the above graph how the curve would be like.

(1 mark)

Comment:
The initial colour intensity / absorbance depends on the concentration of $I_2(aq)$ which remains changed. Thus, the slope of curve should be steeper because of a higher concentration of CH_3COCH_3.

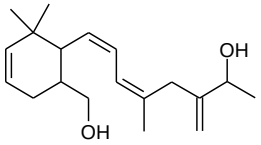
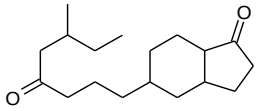
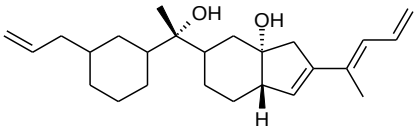
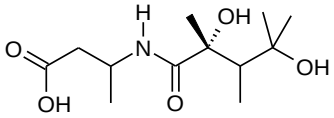
(e) Suggest how the experiment can be modified to study the effect of temperature of the reaction mixture on the rate of reaction. (1 mark)

Repeat the same experiment with the same volumes and concentrations of $I_2(aq)$ and $CH_3COCH_3(aq)$ at different temperature. [1]

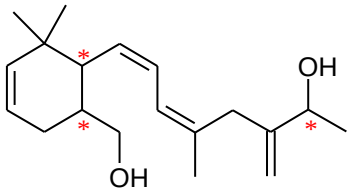
Common mistake:
(a) Did not mention that the experiment was to be repeated under the same concentrations and volumes, i.e. repeat the 'same' experiment under different temperatures.
(b) Monitor the experiment by varying the temperature continuously.

Comment:
Fair test concept: same conditions (controlled variables) and
'at different temperatures' (one independent variable)

12. The structures of some compounds are shown below:

Compound	Structure
W	
X	
Y	
Z	

(a) Label all chiral centre(s), if any, by using '* ' on the structure of **W** below. (1 mark)



Common mistake: Point out only one chiral carbon (there should be three altogether).

(b) Consider the following reagents:

$Br_2(aq)$ acidified $K_2Cr_2O_7(aq)$ $Na_2CO_3(aq)$

(i) Suggest which one of the above reagents can be used to perform a chemical test, in order to distinguish **Z** from **X** and **Y**. State the observation of the test. (2 marks)

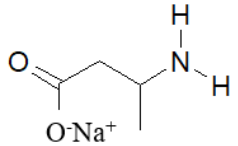
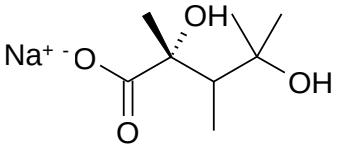
Use $Na_2CO_3(aq)$ [1], only **Z** gives colourless gas bubbles. [1]

Common mistake:

(a) Used acidified $K_2Cr_2O_7(aq)$ and claimed that Z was oxidizable, yet all three were not oxidizable by acidified $K_2Cr_2O_7(aq)$. (X consists of ketone, Y consists of 3° alcohol, Z consists of ketone, 3° alcohol and carboxylic acid)

(b) Only mentioned the observation for Z but not the other two.

(ii) Heating **Z** under reflux in 2 M NaOH(aq) gives two optically active organic compounds. Draw the structures of these two compounds. (2 marks)

 [1] and  [1]

Common mistake:

(a) Did not convert carboxyl group into sodium carboxylate.

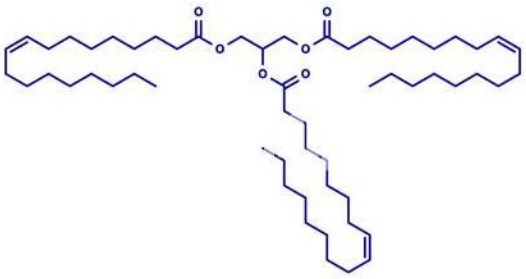
(b) Splitted the molecule by breaking a bond other than the amide bond.

(c) Drew two enantiomers of **Z** probably due to the words 'two optically active organic compounds' in the question.

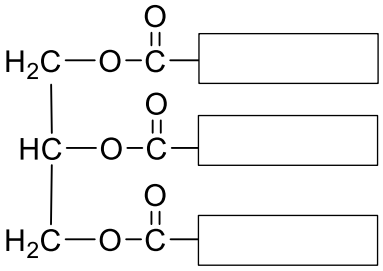
(d) Did not aware of the presence of amide group in the compound/ Not knowing that this is an alkaline hydrolysis reaction

13. The hydrolysis of 1 mole of an olive oil **Q** gave 1 mole of propane-1,2,3-triol and 3 moles of oleic acid, $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$.

(a) Draw the structure of **Q**. (You may represent the hydrocarbon part, $CH_3(CH_2)_7CH=CH(CH_2)_7-$, of olecic acid by ☐— .) (1 mark)



OR



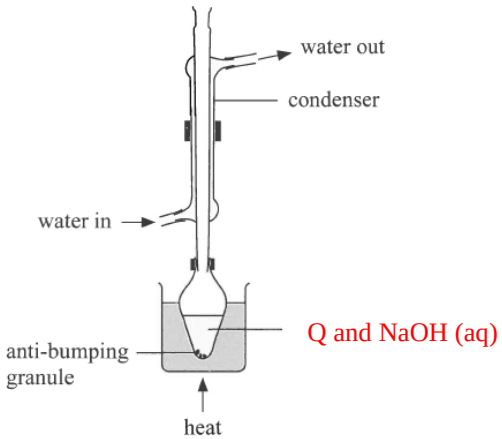
Common mistake:
(a) The three esters were drawn separated from one another.
(b) The number of hydrogen atoms in the skeleton was incorrect.

(b) Suggest a chemical test to show that **Q** is unsaturated. (2 marks)

Shaken the fat with bromine/ iodine [0.5] in CCl_4 [0.5] in darkness.
Unsaturated fat would turn it from orange/ purple to colourless [1].
Common mistake:
Wrong colour change: from brown to colourless for I_2 in organic solvent.

(c) **Q** was heated under reflux with an excess of NaOH (aq). The mixture was then distilled. One of the products distilled off and the others were left in the distillation flask.

(i) Draw a labelled diagram to show the set-up used for heating the mixture under reflux. (2 marks)



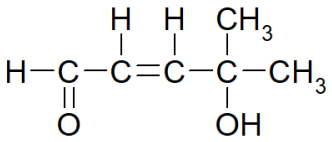
Water in/out – 1M
Diagram: flask + condenser + heat – 1M
Direct hear without water both is also accepted

Common mistake:
(a) Water condenser was stoppered / closed at the top.
(b) Water condenser and pear-shaped flask was drawn as one piece.
(c) Heat source was missing.
(d) Drew a distillation set-up instead of a reflux set-up.

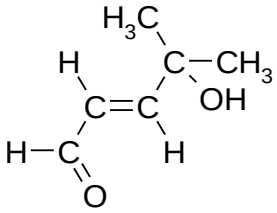
(ii) State ONE use of the products remained in the distillation flask. (1 mark)

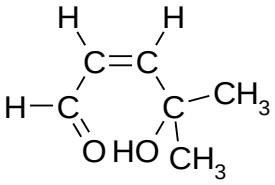
Soap / detergent [1]

14. Compound **X** has the following structural formula:



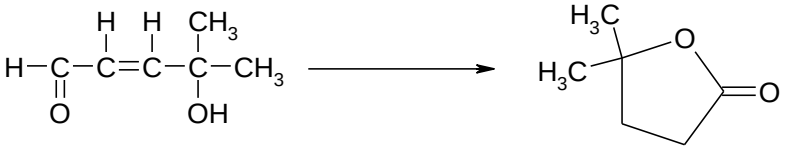
(a) Compound **X** exhibits cis-trans isomerism. Draw structures of the two cis-trans isomers so that their difference is clearly distinguished. (1 mark)





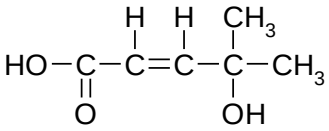
[1]

(b) Outline a synthetic route, with no more than three steps, to accomplish the following conversion. For each step, give the reagent(s), the conditions (as appropriate) and the structure of the organic product.

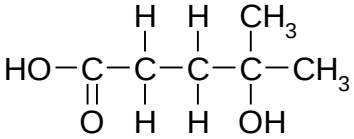


compound **X** compound **Y**

Step 1: acidified $K_2Cr_2O_7$, heat [1]

⇒ 

Step2: H_2, Pt/Pd (heat) [1]

⇒ 

Step 3: Conc. sulphuric acid, heat [1] (3 marks)

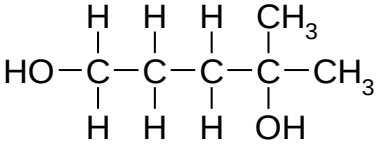
Common mistake:

(a) Missing heating for step 1.

(b) Go straight to condensation after step 1, not realizing that there is no C=C group in **Y**.

(c) Dilute sulphuric acid is used for step 3.

(c) Suggest how compound **X** can be converted into the following compound:



(1 mark)

First step: Use $LiAlH_4$ in dry ether, followed by $H^+(aq)$ / HCl(aq)

Second step: H_2, Pt/Pd (heat)

OR

First step: $NaBH_4$, H_2O

Second step: H_2, Pt/Pd (heat)

15. Consider the reaction represented by the equation below:

$$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$$

(a) In an experiment, 2.18 mol of SO_2 (g) and 1.36 mol of O_2 (g) are mixed in a 4.0 dm^3 closed container maintained at 500 K. When equilibrium is attained, 25.0 % of SO_2 (g) is consumed.

Calculate the equilibrium constant K_C for the above reaction under the experimental conditions.

	$2SO_2\,(g)$	+	$O_2\,(g)$	⇌	$2SO_3\,(g)$	
Initial conc.	2.18/4		1.36/4		0	[1]*
	=0.545		=0.340			
Equil. Conc.	0.545×0.75		0.340-0.068125		0.545×0.25	
	=0.40875		0.271875		0.13625	

$K_c = \frac{(0.13625)^2}{(0.40875)^2(0.271875)}$ / $K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ [1]

= 0.40868 $dm^3\ mol^{-1}$

(answer should have correct unit; not accept M^{-1}) [1]

(3 marks)

Common mistake:
Wrong calculation for the concentration changes for O_2.
Forgot to divide the number of moles by the volume to obtain the concentration.
Comment:
Better put down the K_c expression in terms of molecular formulae before substituting numeral values.

(b) Some N_2(g) is injected into the system. How will (i) the pressure, (ii) the equilibrium position of the system be affected if the volume of the container is kept at 4.0 dm^3?

(i) Effect on pressure	(ii) Effect on equilibrium position
Increased	No change

Each correct answer [1]

(2 marks)

Common mistake:
There was a change on equilibrium position, either to the left or to the right.
Comment:
However, at constant temperature, the equilibrium position of a gas sample will change only if there are changes in the concentrations of the reactants and products. This often occurs when there is a change in the volume of the container, but not for this question as the volume is kept the same.
Adding N_2(g) into the system does not change the concentrations of reactants and products of the reaction.

END OF SECTION B
END OF PAPER

PERIODIC TABLE 周期表

GROUP 族

atomic number 原子序

relative atomic mass 相對原子質量

I	II											III	IV	V	VI	VII	0
				1 **H** 1.0													2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 40.0
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 * **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ** **Ac** (227)	104 **Rf** (261)	105 **Db** (262)													

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
**	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)