



HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE



GRADE 12

PAPER 2 - Chemistry

JUNE 2017

TIME: 2 HRS

Total 100

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (10)
SECTION B (90)

Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places.

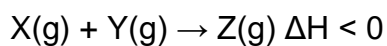
SECTION A

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (1.1–1.5) in the ANSWER BOOK.

- 1.1 $C_nH_{2n+1}OH$ is the GENERAL FORMULA for ...
- A Alkanes.
 - B Aldehydes.
 - C Alcohols.
 - D Alkenes. (2)
- 1.2. Which ONE of the following salts will LOWER the pH of distilled water when it is added to the water?
- A $NaCl$
 - B NH_4Cl
 - C Na_2CO_3
 - D CH_3COONa (2)
- 1.3. A small piece of zinc is added to a solution of hydrochloric acid (HCl). Which ONE of the following WILL NOT affect the initial rate at which hydrogen gas (H_2) is produced?
- A Using a larger piece of zinc
 - B Increasing the volume of the HCl solution used
 - C Decreasing the concentration of the HCl solution used
 - D Increasing the temperature of the HCl solution used

1.4 Study the following reaction that reaches equilibrium in a closed container:



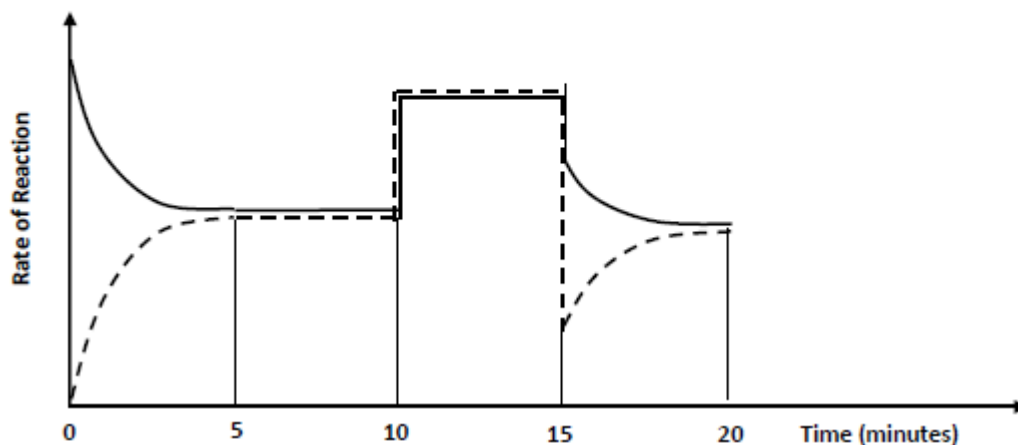
If the temperature is increased, the equilibrium position and the K_c value will be affected as follows:

Equilibrium position	K_c Value
A. Shifts to the right	Increase
B. Shifts to the right	Decrease
C. Shifts to the left	Increase
D. Shifts to the left	Decrease

1.5 The graphs represent the change in the rate of reaction versus time for the reversible reaction that took place when an amount of hydrogen (H_2) gas and iodine (I_2) gas was sealed off in a container.

The equation for the reaction is: $H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \quad \Delta H < 0$

Equilibrium was first established after 5 minutes.



What change in the conditions was made at **15 minutes** to change the rate of the reaction as indicated on the graph?

- A A catalyst was added.
- B The temperature was increased.
- C The temperature was decreased.
- D The external pressure on the reaction mixture was decreased. (2)

[10]

SECTION B
QUESTION 2

The letters **A** to **H** in the table below represent eight organic compounds.

A	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{O} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $	B	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{O} \\ & & & \\ \text{H} - \text{C} & - \text{C} & - \text{C} & - \text{C} - \text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \\ & & & \\ \text{H} & - \text{C} & - \text{H} & \\ & & & \\ \text{H} & - \text{C} & - \text{H} & \\ & & & \\ & \text{H} & & \end{array} $
C	<chem>CH3CHCH3CHC(CH3)CH2CH3</chem>	D	1,2-dibromo-3-methylbutane
E	Propanoic acid	F	<chem>CH3CCCH(C2H5)CH2CH3</chem>
G	<chem>CH3CHCH3CH2CH(CH3)CH2CH3</chem>	H	4-methylpentan-2-one

2.1 Write down the letter(s) that represent(s):

2.1.1 A compound with a carboxyl group as functional group (1)

2.1.2 An alkene (1)

2.1.3 An aldehyde (1)

2.1.4 Two compounds that are functional isomers (1)

2.2 Write down the IUPAC name of:

2.2.1 Compound **B** (2)

2.2.2 Compound **F** (2)

2.3 Write down the structural formula of compound **D** (2)

[10]

Consider the boiling points of the following alkanes:

Alkane	Boiling point ($^{\circ}\text{C}$)	Molecular Mass ($\text{g}\cdot\text{mol}^{-1}$)
Propane	-42	44
Methylpropane	-11,7	58
Butane	-0,5	58
Pentane	36	72

Consider the boiling points of the following alkanes:

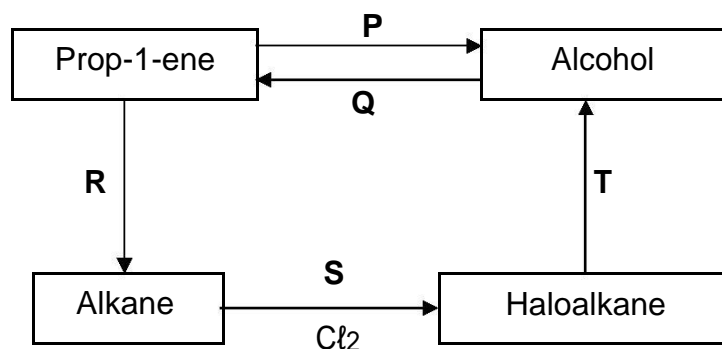
Alkane	Boiling point ($^{\circ}\text{C}$)	Molecular Mass ($\text{g}\cdot\text{mol}^{-1}$)
Propane	- 42	44
Methylpropane	- 11,7	58
Butane	- 0,5	58
Pentane	36	72

- 3.1. Explain why the boiling point of pentane is higher than that of butane. Refer to *structure*, *strength of intermolecular forces* (IMF's) and *energy* in your answer. (3)
- 3.2. Methylpropane is an isomer of butane. Explain why its boiling point is lower than that of butane despite having the same molecular mass. (2)
- 3.3. Why is it important, when comparing the boiling points of butane and methylpropane, that the compounds have identical (very similar) molecular mass? (1)
- 3.4. Which compound in the above table has the highest vapour pressure? (1)

[7]

QUESTION 4

In the flow diagram below prop-1-ene is used as starting reagent in the preparation of other compounds. **P** to **T** represent chemical reactions.



- 4.1 Name the type of reaction represented by:
 - 4.1.1 **P** (1)
 - 4.1.2 **S** (1)
 - 4.1.3 **Q** (1)

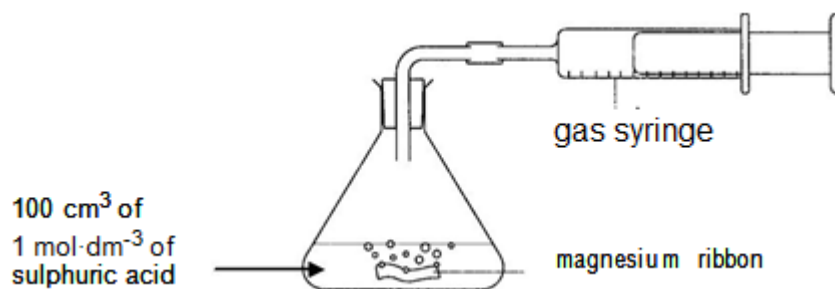
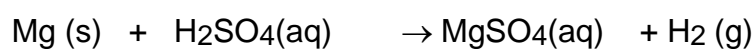
- 4.2 Consider reaction **P**. Write down the:
- 4.2.1 FORMULA of a suitable catalyst (1)
 - 4.2.2 Structural formula of the alcohol (2)
- 4.3 For reaction **R**, write down:
- 4.3.1 The type of addition reaction (1)
 - 4.3.2 A balanced equation using structural formulae (3)
- 4.4 During reaction **T**, the haloalkane reacts with a base to form the alcohol in QUESTION 4.2.2. Write down the:
- 4.4.1 IUPAC name of the haloalkane (2)
 - 4.4.2 NAME of a suitable base (1)
 - 4.4.3 TWO reaction conditions for this reaction (2)
- [15]**

QUESTION 5

The following apparatus was used by a group of learners in an investigation to find out how surface area affects the rate of reaction between solid magnesium metal and 100 cm^3 dilute sulphuric acid with a concentration of $1\text{ mol}\cdot\text{dm}^{-3}$.

During the reaction, the gas that forms is collected in the gas syringe which measures the volume of gas produced.

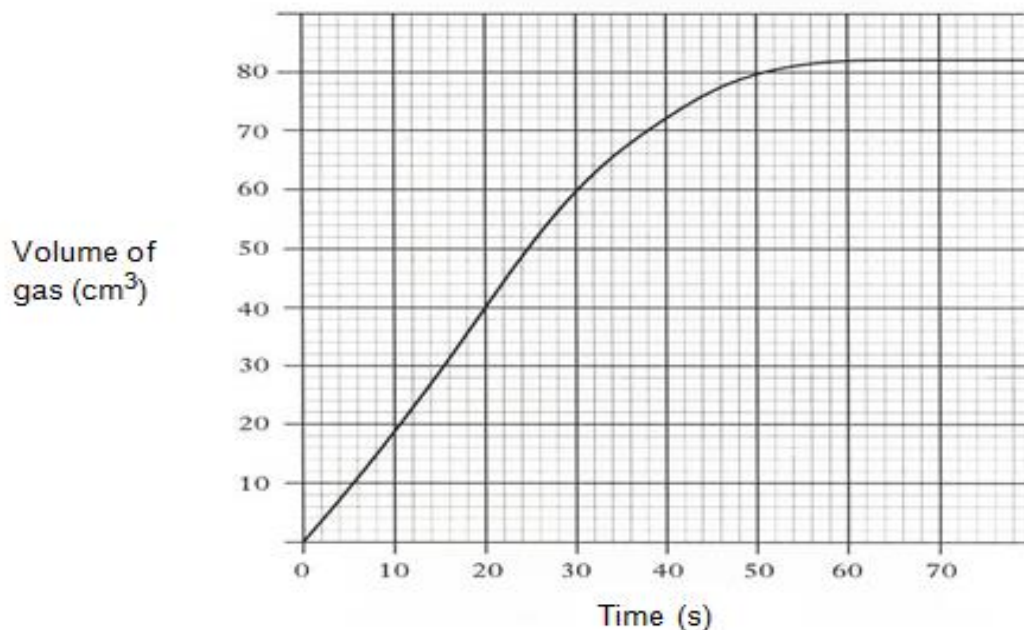
The equation for the reaction is:



In EXPERIMENT I, 20 g of magnesium, in the form of 5 small pieces, was used.

In EXPERIMENT II, 20 g of magnesium, in the

The learners performed the experiments and plotted a graph of their results for experiment one, which is represented below.

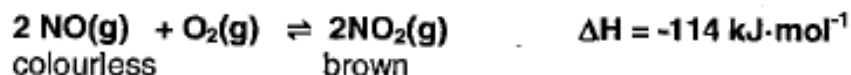


- 5.1 Besides the mass and the volume of the reactants, give ONE other variable that must be kept constant in this investigation (1)
- 5.2 Name the dependent variable for EXPERIMENT I. (1)
- 5.3 Use the graph to calculate the average rate of the reaction (in $\text{cm}^3 \cdot \text{s}^{-1}$) for the first 30 seconds. (3)
- 5.4 Will the rate of the reaction at 50s be GREATER THAN, LESS THAN or EQUAL TO that rate calculated in QUESTION 5.3? (1)
- 5.5 Give a reason for your answer in QUESTION 5.4. (1)
- 5.6 Predict how the gradient of EXPERIMENT II results would compare to EXPERIMENT I plotted above. Write only INCREASE, DECREASE or NO CHANGE. (1)
- 5.7 Use the collision theory to explain how the increase in surface area of the magnesium metal affects the rate of the reaction. (3)
- 5.8 Calculate the mass of magnesium metal that remains after the reaction has stopped. (5)
- 5.9 Catalytic converters are substances that are coated onto surfaces of car exhausts to act as positive catalysts.
Define a positive catalyst. (2)

[18]

Question 6

A certain amount of nitrogen monoxide gas and oxygen gas react in a 50 cm³ closed container at 230 °C to form nitrogen dioxide gas. The reaction reaches equilibrium according to the following balanced equation:



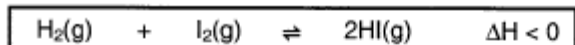
At 230 °C, the equilibrium constant for this reaction is $6,44 \times 10^5$.

- 6.1 Initially, 1 mol of NO(g) and an unknown quantity of O₂(g) were placed in the container. At equilibrium, the **number of particles** of NO(g) present is $3,01 \times 10^{21}$. Calculate the initial number of moles of O₂(g) placed in the container. (9)
- 6.2 The above reaction is the second step of the Ostwald process. What would be the significance of such a high K_c for the industrial production of NO₂ (g)? (1)
- 6.3 Will the colour of the mixture of gases become LIGHTER or DARKER as the temperature is decreased to room temperature? (1)
- 6.4 Using Le Chatelier's principle, explain the answer to QUESTION 6.3. (3)
- 6.5 How will a change in the pressure of the gases influence the equilibrium constant at room temperature? (1)
- Write down only **INCREASES**, **DECREASES** or **NO EFFECT**. (1)

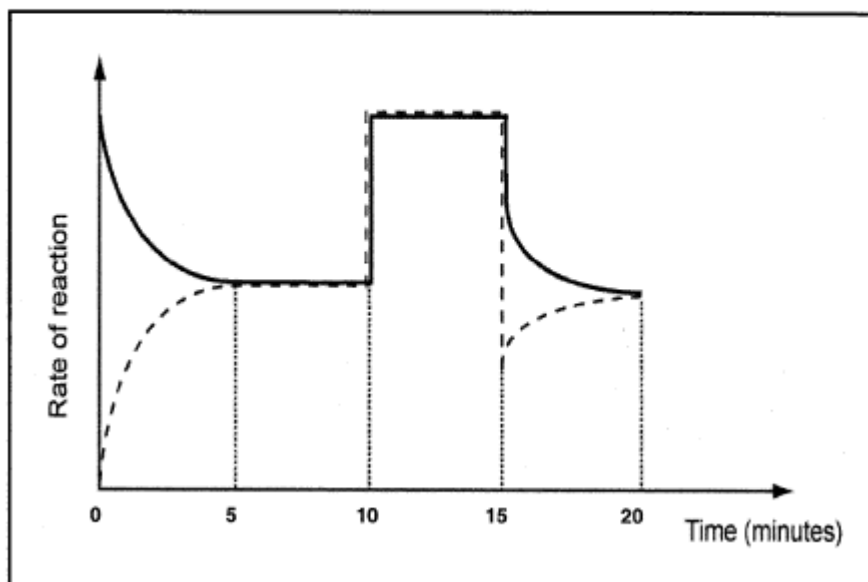
[15]

Question 7

The following reversible reaction reaches equilibrium in a closed container:



Equilibrium was first established after 5 minutes. (The broken line represents the reverse reaction.)



- 7.1 What change in the conditions was made at $t = 10$ minutes to cause the rate of both the forward and reverse reactions to increase by the same amount? (1)
- 7.2 Give a reason for your answer in 7.1. (2)
- 7.3 Why are both graphs flat and parallel to the x-axis between $t=5$ and $t= 10$? (1)
- [4]**

Question 8

- 8.1 Define an acid in terms of Bronsted-Lowry theory. (2)

A solution of an unknown diprotic acid has a concentration of $0.005 \text{ mol.dm}^{-3}$ and pH of 3.

- 8.2 State whether the acid would classify as a strong or weak acid, and explain why? (4)
- 8.3 Calculate the pH of a $0,025 \text{ mol.dm}^{-3}$ sulphuric acid solution. (4)

8.4. A certain solution X, has a pH of 12,8.

8.4.1. Which of the ions OH^- or H^+ is in excess? (1)

8.4.2. Acetic acid (CH_3COOH) is added to a solution X, is the pH of the solution going to INCREASE, DECREASE OR REMAIN THE SAME. (1)

8.5

A learner accidentally spills 15 cm^3 of $0,4 \text{ mol.dm}^{-3}$ sulphuric acid solution in the laboratory. He adds 25 cm^3 of $0,2 \text{ mol.dm}^{-3}$ of sodium hydroxide to the spilled sulphuric acid in an attempt to neutralise it.

The equation for the reaction is given below:



Calculate the pH of the FINAL solution if it does not reach neutrality (10)

[22]