



HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 2- Chemistry



JUNE 2015
TIME: 2 HRS

Total 100

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (12)
SECTION B (88)

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 – 1.6) in the ANSWER BOOK.

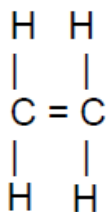
1.1 Consider the reaction represented below:



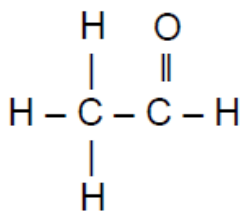
The term that best describes this reaction is ...

- A elimination.
- B addition.
- C cracking.
- D polymerisation. (2)

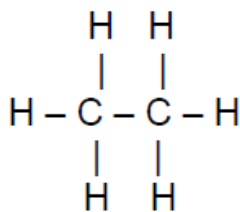
1.2 Which ONE of the following compounds will decolourise bromine water the fastest under normal conditions?



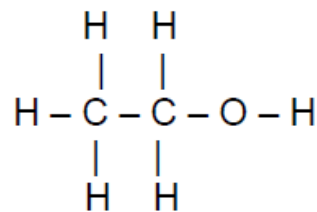
A



B



C



D

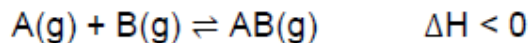
1.3 Which ONE of the following is a balanced equation for the combustion of octane?

- A $2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$
- B $\text{C}_8\text{H}_{18} + 16\text{O}_2 \rightarrow 8\text{CO}_2 + 9\text{H}_2\text{O}$
- C $\text{C}_8\text{H}_{18} + 32\text{O}_2 \rightarrow 8\text{CO}_2 + 18\text{H}_2\text{O}$
- D $2\text{C}_8\text{H}_{18} + 8\text{O}_2 \rightarrow 16\text{CO}_2 + 9\text{H}_2\text{O}$

1.4 Water undergoes auto-ionisation. During this process ...

- A a proton is transferred from one water molecule to another.
- B water molecules act as proton donors only.
- C water molecules act as proton acceptors only.
- D the pH of water will decrease.

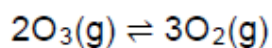
- 1.5 A hypothetical reaction reaches equilibrium at 10 °C in a closed container according to the following balanced equation:



The temperature is now increased to 25 °C. Which ONE of the following is correct as the reaction approaches a new equilibrium?

	REACTION RATE	YIELD OF PRODUCTS
A	Increases	Remains the same
B	Increases	Decreases
C	Increases	Increases
D	Decreases	Decreases

- 1.6 The following reaction reaches equilibrium in a closed container at a certain temperature. The pressure is now decreased by increasing the volume of the container at constant temperature.



Which ONE of the following is correct as the reaction approaches a new equilibrium?

	NUMBER OF MOLES OF O₃(g)	NUMBER OF MOLES OF O₂(g)	CONCENTRATION OF O₂(g)
A	Increases	Decreases	Decreases
B	Decreases	Increases	Increases
C	Decreases	Increases	Decreases
D	Increases	Decreases	Increases

[2 x 6 = 12]

SECTION B

INSTRUCTIONS AND INFORMATION

1. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to **TWO decimal** places

Question 2

The letters **A** to **F** in the table below represent six organic compounds.

A	Methyl ethanoate	B	$\begin{array}{ccccccc} & \text{H} & & \text{H} & & & \text{H} \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{C} - \text{H} \\ & & & & & & \\ & \text{H} & & \text{H} & & \text{O} & \text{H} \end{array}$
C	$\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{C} - \text{H} \\ & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & \text{O} \end{array}$	D	$\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{O} & \\ & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{O} - \text{H} \\ & & & & & & \\ & \text{H} & & \text{H} & & & \end{array}$
E	$\begin{array}{ccccccc} & & \text{CH}_3 & & & & \\ & & & & & & \\ \text{CH}_3 & - & \text{C} & - & \text{CH}_2 & - & \text{CH}_3 \\ & & & & & & \\ & & \text{O} & & & & \\ & & & & & & \\ & & \text{H} & & & & \end{array}$	F	$(-\text{CH}_2 - \text{CH}_2-)_n$

2.1 Write down the:

- 2.1.1 Name of the homologous series to which compound **D** belongs. (1)
- 2.1.2 IUPAC name of compound **C**. (1)
- 2.1.3 Structural formula of monomer of compound **F**. (2)
- 2.2 Compound **E** represents an alcohol. Classify this alcohol as primary, secondary or tertiary. (1)
- 2.3 Briefly explain why compounds **B** and **C** are classified as FUNCTIONAL ISOMERS. (2)

[7]

QUESTION 3

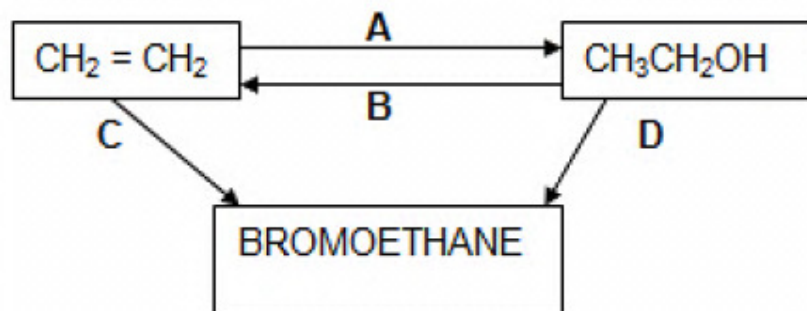
The table below shows data collected for three organic compounds, represented by the letters **A**, **B** and **C**, during a practical investigation:

	Organic compound	Relative molecular mass	Boiling point (°C)
A	CH ₃ CH ₂ CH ₂ CH ₃	58	-0,5
B	CH ₃ CH ₂ CH ₂ OH	60	97
C	CH ₃ COOH	60	118

- 3.1 Which variable was controlled during this investigation? (1)
- 3.2 Name the following in this investigation:
- 3.2.1 The dependent variable (1)
- 3.2.2 The independent variable (1)
- 3.3 Consider compound **A**:
- 3.3.1 Is compound **A** a saturated or an unsaturated hydrocarbon?
Give a reason for your answer. (2)
- 3.3.2 The compound 2-methylpropane is an isomer of compound **A**.
Predict whether the boiling point of 2-methylpropane will be HIGHER THAN, LOWER THAN or THE SAME as the boiling point of compound **A**. (1)
- 3.3.3 Explain your prediction in QUESTION 3.3.2. (3)
- 3.4 Refer to intermolecular forces and energy to explain why compound **B** will have a higher vapour pressure than compound **C** at 20 °C. (3)

[12]

Question 4



4.1 Name the type of reaction (ADDITION, SUBSTITUTION or ELIMINATION) represented by:

4.1.1 **A** (1)

4.1.2 **B** (1)

4.1.3 **D** (1)

4.2 Apart from the alkene, another reactant and a catalyst are needed in Reaction **A**.

Write down the NAME of the: (1)

4.2.1 Other reactant

4.2.2 Catalyst which was added to the alkene (1)

4.3 Use STRUCTURAL FORMULAE to write down a balanced chemical equation for the reaction represented by **C**. (3)

4.4 The ethanol produced in reaction **A** is made to react with a carboxylic acid in the presence of an acid catalyst. The compound formed is a STRAIGHT CHAIN ESTER which is a functional isomer of pentanoic acid.

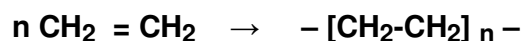
Write down the:

4.4.1 IUPAC NAME of the carboxylic acid that reacted with the alcohol (2)

4.4.2 Name given to this type of reaction (1)

4.4.3 STRUCTURAL FORMULA of the ester formed (2)

4.5 The polymerisation of ethene to produce polythene is represented by the equation below:



4.5.1 Define the term macromolecule. (1)

4.5.2 Classify this type of polymerisation. (1)

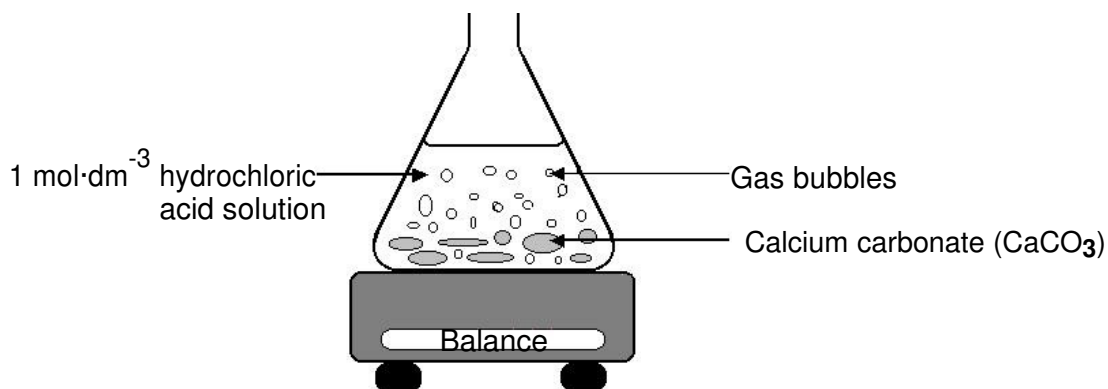
4.5.3 Name TWO industrial uses of polythene. (2)

[17]

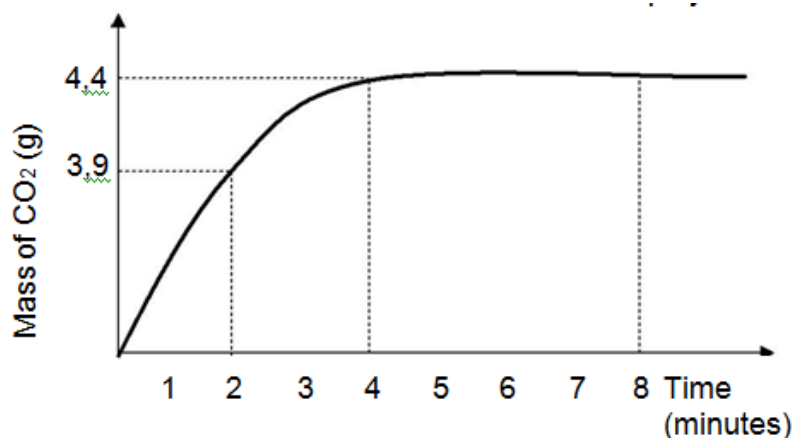
Question 5

The arrangement below is being used to investigate the rate of reaction of calcium carbonate and an excess $1 \text{ mol}\cdot\text{dm}^{-3}$ solution of hydrochloric acid.

The equation for the reaction is:



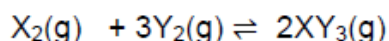
The mass of gas produced is obtained by measuring the loss in mass of the flask and its contents at one-minute intervals and the results are displayed in the graph below.



- 5.1 Give a reason for the loss in mass. (1)
- 5.2 Calculate the AVERAGE RATE (in $\text{g}\cdot\text{s}^{-1}$) of this reaction during the first four (4) minutes. (3)
- 5.3 Write down the loss in mass of the flask and its contents after 8 minutes. (2)
- 5.4 Give a reason why the curve flattens out after 4 minutes. (1)
- 5.5 Use the graph and any other relevant information to calculate the mass of calcium carbonate that reacted. (6)
- [13]**

QUESTION 6

When a number of moles of $\text{X}_2(\text{g})$ and $\text{Y}_2(\text{g})$ are placed in an empty, closed 2 dm^3 container at $800\text{ }^\circ\text{C}$, a reaction takes place and eventually reaches equilibrium according to the following equation:



At equilibrium there is $0,4\text{ mol}\cdot\text{dm}^{-3}$ of Y_2 and XY_3 present.

You are also given the following information for the reaction:

Temperature $^\circ\text{C}$	Kc
400	0,8
600	2,5
800	4,0

- 6.1 Calculate the initial number of moles of X_2 and Y_2 placed in the container. (9)
- 6.2 Is the forward reaction endothermic or exothermic? (1)
- 6.3 Explain your answer to QUESTION 6.2. (2)
- 6.4 What effect will adding more $\text{Y}_2(\text{g})$ at $800\text{ }^\circ\text{C}$ have on the following?
- Answer only INCREASE, DECREASE OR STAY THE SAME.
- 6.4.1 The rate of the reverse reaction (1)
- 6.4.2 Concentration of $\text{X}_2(\text{g})$ (1)
- 6.5 Which ONE of the following gases XY_3 or X_2 would be present in a higher concentration in the equilibrium mixture at $400\text{ }^\circ\text{C}$? (1)
- 6.6 Explain your answer to QUESTION 6.5. (2)

[17]

QUESTION 7

7.1 Define a *strong acid*. (2)

7.2 A solution of an unknown, monoprotic acid has a pH of 3.

7.2.1 Calculate the concentration of the hydrogen ions in this solution. (2)

7.2.2 How will the strength of this unknown acid compare to that of hydrochloric acid of the same concentration?

Write down only STRONGER THAN, WEAKER THAN or EQUAL TO (1)

7.2.3 Give a reason for your answer in QUESTION 7.2.2. (2)

7.3 Ammonium chloride is an example of a salt that can undergo hydrolysis.

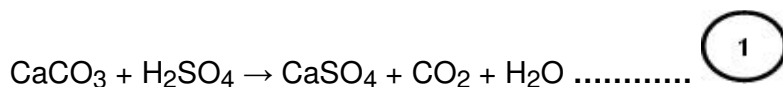
7.3.1 Define the underlined term. (2)

7.3.2 Write an equation to show the hydrolysis of ammonium chloride. (2)

7.3.3 What will the colour of phenolphthalein be in an ammonium chloride solution? (1)

7.4 A learner adds a sample of calcium carbonate to 50,0 cm³ of sulphuric acid. The sulphuric acid is in excess and has a concentration of 2,0 mol·dm⁻³.

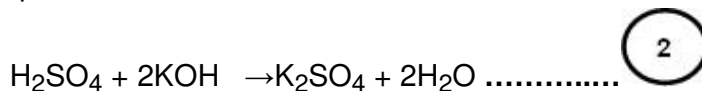
The balanced equation for the reaction that takes place is:



The reaction is allowed to proceed until all the CaCO₃ is used up.

The H₂SO₄ **left over** from REACTION 1 is now neutralised by 40,0 cm³ of a 0,4 mol·dm⁻³ potassium hydroxide solution.

The balanced equation for this reaction is:



Calculate the **mass** of calcium carbonate in the sample used in REACTION 1. (10)
[22]

Information sheets – Paper 2 (Chemistry)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^\ominus	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP	V_m	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature	T^\ominus	273 K
Charge on electron	e	$-1,6 \times 10^{-19} \text{ C}$

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at 298 K	
$E_{\text{cell}}^\ominus = E_{\text{cathode}}^\ominus - E_{\text{anode}}^\ominus$	
$E_{\text{cell}}^\ominus = E_{\text{reduction}}^\ominus - E_{\text{oxidation}}^\ominus$	
$E_{\text{cell}}^\ominus = E_{\text{oxidising agent}}^\ominus - E_{\text{reducing agent}}^\ominus$	