

HILLCRESTHIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 2- Chemistry



JUNE 2014

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 In which of the following polymers was propylene the monomer?

A	<p>The diagram shows a polymer chain with six carbon atoms in a row. The first and third carbons are connected to two hydrogens each. The second, fourth, and sixth carbons are each connected to one hydrogen and one oxygen atom. Each oxygen atom is double-bonded to a carbon atom, which is in turn single-bonded to a methyl group (CH₃). The methyl groups on the second, fourth, and sixth carbons are colored red, while the methyl group on the first carbon is colored blue. The chain is labeled "etc" at the end.</p>
B	<p>The diagram shows a polymer chain with six carbon atoms in a row. The first, third, and fifth carbons are each connected to two hydrogens. The second, fourth, and sixth carbons are each connected to one hydrogen and one methyl group (CH₃). The methyl groups on the second, fourth, and sixth carbons are colored red, while the hydrogens on the first, third, and fifth carbons are colored blue. The chain is labeled "etc" at the end.</p>
C	<p>The diagram shows a polymer chain with six carbon atoms in a row. The first, third, and fifth carbons are each connected to two hydrogens. The second, fourth, and sixth carbons are each connected to one hydrogen and one chlorine atom (Cl). The chlorine atoms on the second, fourth, and sixth carbons are colored green, while the hydrogens on the first, third, and fifth carbons are colored blue. The chain is labeled "etc" at the end.</p>
D	<p>The diagram shows a polymer chain with six carbon atoms in a row. The first, third, and fifth carbons are each connected to two hydrogens. The second, fourth, and sixth carbons are each connected to one hydrogen and one phenyl ring (C₆H₅). The phenyl rings on the second, fourth, and sixth carbons are colored red, while the hydrogens on the first, third, and fifth carbons are colored blue. The chain is labeled "etc" at the end.</p>

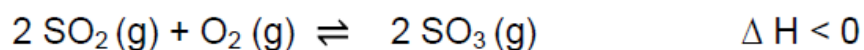
1.2 Use your knowledge about the strength of the intermolecular forces between the molecules to predict which substance below would have the highest vapour pressure.

	Substance
A	He
B	CO
C	H ₂ O
D	HF

1.3 2-bromopropane dissolved in alcohol reacts with aqueous sodium hydroxide to form propan-2-ol. This reaction is an example of a/an ...

- A addition reaction.
- B substitution reaction.
- C elimination reaction.
- D dehydration reaction.

1.4 The value of the equilibrium constant (K_c) for the equilibrium reaction during the preparation of sulphur trioxide according to the reaction,



may be INCREASED by ...

- A. decreasing the temperature at constant pressure.
- B. increasing the temperature at constant pressure.
- C. the addition of a catalyst at constant temperature.
- D. a decrease in pressure at constant temperature.

Use the table below to answer questions 1.5 and 1.6

	Concentration (mol.dm ⁻³)	Acid
A	0,2	HCl
B	0,001	CH ₃ COOH
C	0,01	HNO ₃
D	0,15	H ₂ SO ₄

- 1.5 Which of the above acids is the most dilute, strong, monoprotic acid?
(Write only the correct letter from the table above).
- 1.6 Between acids A and D, which one would you expect to have the highest electrical conductivity?
(Write only the correct letter from the table above).

[2 x 6 = 12]

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

Neutralization reactions are used in everyday life, the use of antacids for heartburn or using baking soda to calm a bee sting. In the lab a titration is performed in order for an acid and base to reach end point.

In order to perform a titration a NaOH solution is made up by adding 20 g of NaOH to 1 litre of water.

- 2.1.1 Write down the reaction of the dissociation of the NaOH in water (2)
- 2.1.2 Prove by calculation that the concentration of the NaOH solution is $0,5\text{mol}\cdot\text{dm}^{-3}$. (4)
- 2.1.3 Calculate the pH of this NaOH solution. (6)

2.2 $0,25\text{ dm}^3$ of this solution ($\text{NaOH}_{(\text{aq})}$) is then titrated against $0,1\text{ dm}^3$ of $\text{H}_2\text{SO}_{4(\text{aq})}$, until the reaction reaches end point.

- 2.2.1 Write a balanced reaction for the reaction between NaOH and sulfuric acid. (3)
- 2.2.2 Calculate the concentration of the sulfuric acid. (4)

[19]

Question 3

As human beings we make use of many organic compounds in our daily lives. In the table below the letters A to E represent a few of these compounds.

	COMPOUND
A	$\text{H} - \text{C} \equiv \text{C} - \text{H}$
B	$ \begin{array}{ccccccc} & \text{H} & & \text{O} & & \text{H} & & \text{H} \\ & & & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & & & \\ & \text{H} & & & & \text{H} & & \text{H} \end{array} $
C	penta-1,3-diene
D	2,2,4-trimethylhexane
E	butyl propanoate
F	pentane

- 3.1 Write down the IUPAC name of compound B. (1)
- 3.2 Draw the structural formula of compound C. (2)
- 3.3 Write down the homologous series of compound E. (1)
- 3.4 Write down the functional group of compound A. (1)
- 3.5 Define an isomer. (1)
- 3.6 Draw an isomer of compound B. (2)
- 3.7 Write down the balance combustion reaction of compound F, using molecular formulae. (3)

[11]

Question 4

4.1 Ethane gas is mixed with chlorine gas and left in the sun for a while.

4.1.1 Write a balanced chemical equation for the reaction by using

4.2.3 Name the catalyst in this reaction, and state the property of the catalyst that makes it suitable to be used in this reaction. (2)

4.3 The following reaction takes place in excess water:



4.3.1 Draw the structural formula for the product that forms. (2)

4.3.2 Write down one other condition for this reaction. (1)

4.3.3 What type of reaction is this? (1)

[16]

Question 5

A laboratory technician is supplied with three unlabelled bottles containing an alcohol, an aldehyde and an alkane respectively of comparable molecular mass. She takes a sample from each bottle and labels them **P**, **Q** and **R**.

- 5.3 Which sample (**P**, **Q** or **R**) is the:
- 5.3.1 Alkane (1)
 - 5.3.2 Alcohol (1)
 - 5.3.3 Refer to boiling point and the type of intermolecular forces present between alcohol molecules to give a reason for the answer in QUESTION 5.3.2 (2)
- 5.4 The alkane is identified as pentane. Will the boiling point of hexane be HIGHER THAN or LOWER THAN that of pentane? Refer to MOLECULAR STRUCTURE, INTERMOLECULAR FORCES and ENERGY needed to explain the answer. (4)

[11]

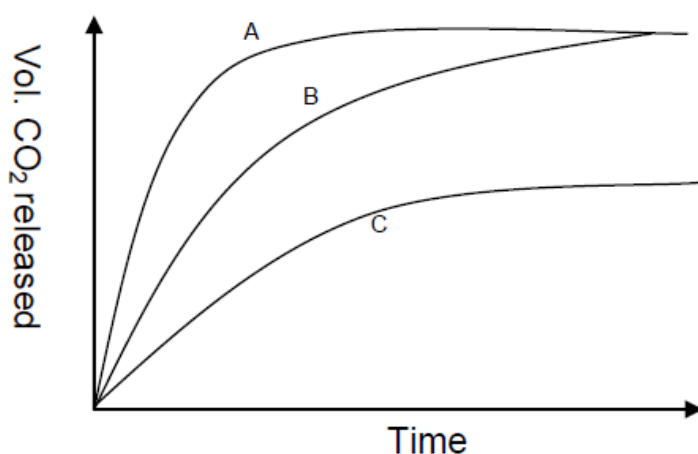
Polyethene is the most common plastic with over 80 million metric tons produced each year. It is commonly known as polyethylene.

- 6.1 Define polymerisation (2)
- 6.2 Write down an equation for the polymerisation of ethene to produce polyethene, using structural formulae. (2)

[4]

Question 7

- 7.1 The graph shows the results of three experiments in which dilute hydrochloric acid (HCl) reacted with marble chips (calcium carbonate: CaCO₃). Details of the experiments are given in the table below the graph.



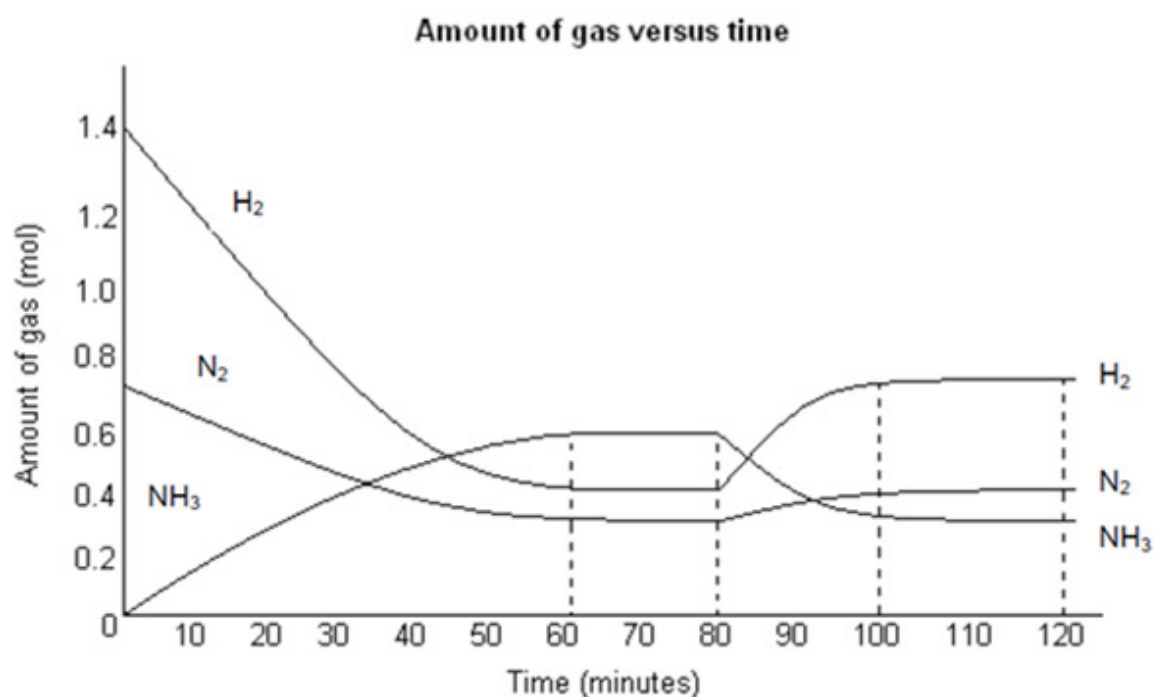
Experiment	1	2	3
Volume of acid (HCl) (cm ³)	60	15	60
Volume of water (cm ³)	60	15	60
Temperature of liquids (°C)	40	20	40
Marble (CaCO ₃): W = Whole; P = Powder	W	W	P

- 7.1.1 Match the graphs to the experiments in the table (e.g. A-1). (3)
- 7.1.2 Which factor remains constant in every experiment? (2)
- 7.1.3 Refer to the graph. Identify the independent variable. (1)
- 7.1.4 Which graph represents the fastest reaction rate? Provide an explanation for your answer by referring to the information in the table. (1+2) (3)
- 7.1.5 Identify the two factors (which have an effect on the reaction rate) that are being investigated here. (2)

[14]

Question 8

In 1912 the German scientist Fritz Haber produced ammonia gas by the direct combination of nitrogen gas from air and hydrogen gas from natural gas. The reaction is as follows.



8.1 What do the horizontal lines between 60 s and 80 s represent? (1)

8.2 After 80 s the temperature of the system is increased to 450°C.

8.2.1 Explain using Le Chatelier's principle how this change in temperature will affect the equilibrium of the system? (3)

8.2.2 What happens to the value of the equilibrium constant (K_c) at 450°C? (INCREASES, DECREASES, REMAINS THE SAME) (1)

8.3 Another investigation carried out by the chemists based on the reversible reaction, reached equilibrium in the closed container of volume 5 dm³ at 500°C. The

Total 100