HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 11
PAPER 2- Chemistry

JUNE 2015
TIME: 3 HRS

Total: 150

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (18)
   SECTION B (132)

   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 – 1.10) in the ANSWER BOOK.

1.1. What is the number of moles in 500 l of He gas at STP?

A. 0,05 mol
B. 22.32 mol
C. 0,2mol
D. 90 mol

(2)

1.2. A solution with a precisely known concentration is called

A. Dilute acid
B. Concentrated acid
C. Amphiprotic
D. Standard solution

(2)

1.3. According to the collision theory the reaction rate increases if temperature is increased because

A. Activation energy is lowered when temperature is increased hence more particles collide.
B. Temperature can be regarded as a catalyst.
C. Kinetic energy of particles increases when temperature is increased hence more effective collisions.
D. Temperature is always a good factor to increase reaction rate

(2)

1.4. Which of the following describes the effect of positive catalyst on the net activation energy and heat of the reaction (ΔH) of a specific reaction?

	Net activation energy	ΔH
A	Increase	No effect
B	Decrease	Increase
C	No effect	Decrease
D	Decrease	No effect

(2)

1.5. Which of the following represents the products formed during hydrolysis of ammonium chloride?

A. $NH_{3(aq)}$ and $H_3O^+_{(aq)}$
B. $NH_{4\ (aq)}$+ and $Cl^-_{\ (aq)}$
C. $HCl_{\ (aq)}$ and $OH^-_{\ (aq)}$
D. $Cl^-_{\ (aq)}$ and $H_30^+_{(aq)}$

(2)

1.6. In a titration of NaOH and CH_3COOH, the best suitable indicator would be:

	INDICATOR	**pH RANGE**
A	Methyl Orange	2.9 – 4.0
B	Bromothymol Blue	6.0 – 7.6
C	Phenolphthalein	8.3 – 10.0
D	Litmus paper	No Range

(2)

1.7. The following characteristics may be used to describe an electrochemical cell (electrolytic or galvanic):

I The chemical reaction is self-sustaining.
II The reaction requires energy from an electrical source.
III The anode is the positive electrode of the cell.

Which of these characteristics are specific to an electrolytic cell?

A Only I
B Only II
C I and III
D II and III

(2)

1.8. The reactions below occur in two different electrochemical cells X and Y.

Cell X: $CuC\ell_2(aq) \rightarrow Cu(s) + C\ell_2(g)$

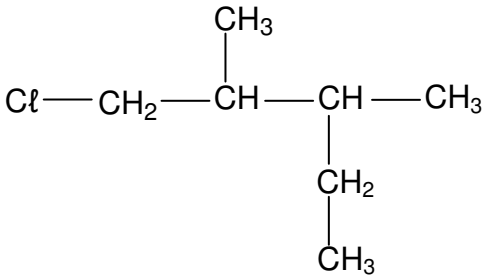
Cell Y: $Zn(s) + CuSO_4(aq) \rightarrow Cu(s) + ZnSO_4(aq)$

Which ONE of the following correctly describes the substance that forms at the CATHODE of each of these cells?

	Cell X	Cell Y
A	$C\ell_2(g)$	Cu(s)
B	Cu(s)	Cu(s)
C	$C\ell_2(g)$	$ZnSO_4(aq)$
D	Cu(s)	$ZnSO_4(aq)$

(2)

1.9. The condensed structural formula of an organic compound is given below.



Which ONE of the following is the correct IUPAC name of this compound?

A 1-chloro-2,3-dimethylbutane

B 1-chloro-2,3-dimethylpentane

C 1-chloro-3-ethyl-2-methylbutane

D 1-chloro-2-ethyl-3-methylpentane

(2)

1.10. The boiling points of branched alkanes are lower than those of straight chain alkanes containing the same number of carbon atoms because branched alkane chains have …

A Larger molecular masses.

B Shorter chain lengths.

C More electrons.

D Smaller effective molecular surface areas.

(2)
[20]

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

Ozone (O_3) reacts with nitrogen monoxide (NO) to produce NO_2 gas. The NO gas forms largely as a result of emissions from exhausts of motor vehicles and from certain jet planes.

The NO_2 gas also cause the brown smog (smoke and fog), which is seen over most urban areas. This gas is harmful, as it causes breathing problems.

The following chemical equation indicates the reaction between ozone and nitrogen monoxide.

$$O_{3\,(g)} + NO_{(g)} \longrightarrow O_{2\,(g)} + NO_{2\,(g)}$$

In one of such reactions 0,74g of O_3 reacts with 0,67g of NO

2.1. Calculate the number of moles of O_3 and NO present at the start of the reaction. (Round this answer off to 3 decimal places) (5)

2.2. Identify the limiting reagent in the reaction and justify your answer. (2)

2.3. Calculate the mass of NO_2 produced from this reaction. (4)

2.4. Determine the molecular formula of a compound with the following composition by mass; 48, 00 % C, 8, 00% H, 28, 00 % N and 16% O and its molar mass is 200 g. mol^{-1}. (9)

[20]

Question 3

5g of IMPURE copper (ii) oxide sample (CuO) reacts with $100cm^3$ nitric acid (HNO_3) of concentration 0, $8mol.dm^{-3}$.

3.1 Write down a balanced chemical equation for this reaction. (2)

3.2 Calculate the percentage purity of copper (ii) oxide sample. (7)

[9]

Question 4

Photosynthesis and Respiration

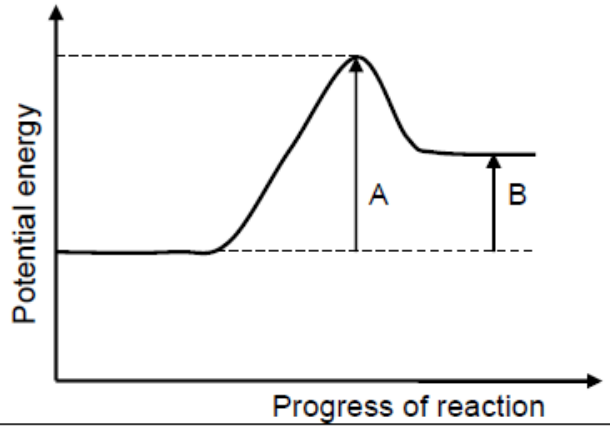
Plants manufacture their own food through the process of photosynthesis by making use of water, carbon dioxide and sunlight (energy). The balanced equation for this reaction is:

$$6CO_2\,(g) + 6H_2O\,(\ell) \longrightarrow C_6H_{12}O_6\,(s) + 6O_2\,(g) \qquad \Delta H > 0$$

The food gives the plants (and animals which eat it) energy to perform their daily life functions. The food is broken down during cellular respiration in the presence of oxygen to release the energy according to the following equation:

$$C_6H_{12}O_6\,(s) + 6O_2\,(g) \longrightarrow 6CO_2\,(g) + 6H_2O\,(\ell) \qquad \Delta H < 0$$

The graph which follows represents the change in potential energy for one of the two reactions listed above.



4.1. Is the reaction EXOTHEMIC or ENDOTHEMIC? Give a reason for your answer. (2)

4.2. Does the above graph show the change in potential for PHOTOSYTHESIS or CELLULAR RESPIRATION? Briefly explain how you got to chose the answer you chose. (3)

4.3. Supply labels for **A** and **B** which appear in the graph. (2)

4.4. The reaction for cellular respiration is catalysed by enzymes. Explain how the enzymes will influence the rate of reaction. (2)

4.5. Draw a graph showing how the enzymes will catalyse the cellular respiration reaction. (**Hint:** show activation energy, energy of reactants and products) (2)

[11]

Question 5

The apparatus shown below is used to investigate the rate at which hydrogen gas is produced when a certain amount of zinc reacts with an excess of a dilute hydrochloric acid solution

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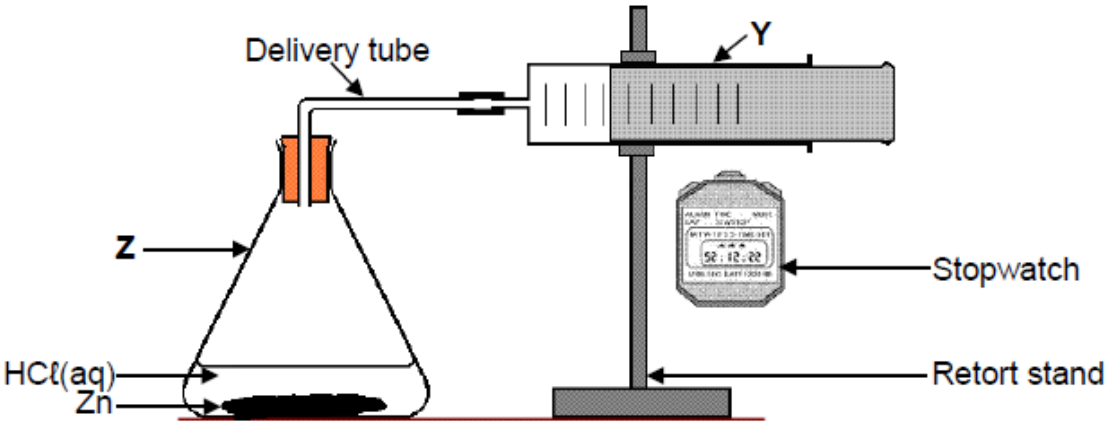


The reaction that takes place is represented by the following balance chemical equation:

$$2HCl_{(aq)} + Zn_{(s)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$$

5.1. Write down the name of the flask labelled Z. (1)

5.2. Write down ONE function of the apparatus labelled Y in THIS investigation. (1)

5.3. Define reaction rate in words. (2)

Two experiments are conducted using the apparatus above. The conditions for each experiment are given in the table below.

	Experiment 1	Experiment 2
Zinc	Powder	Powder
Hydrochloric acid	0,1 mol.dm^{-3}	0,2 mol.dm^{-3}
Temperature	25°C	25°C

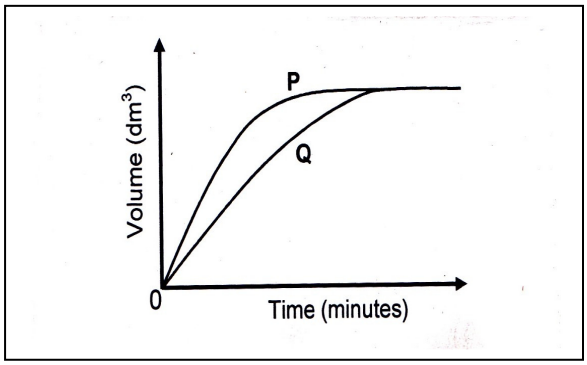
5.4. From the table above, write down:

5.4.1. The independent variable for this investigation. (1)

5.4.2. One controlled variable. (1)

5.5. Write the investigative question for this investigation. (2)

The volume of hydrogen gas produced was measured in each experiment. The graphs below show the results obtained.



5.6. Which graph, P or Q, represents Experiment 2? Refer to the data given in the table, as well as the shape of the graph, to explain how you arrived at the answer. (3)

5.7. Give a reason why the rate of hydrogen production slows down towards the end in both experiments. (1)

5.8. Calculate the mass of zinc used to prepare 0, 24 dm^3 of hydrogen gas at room temperature. Assume that 1 mole of hydrogen gas has a volume of 24, 04 dm^3 at room temperature. (5)

[17]

Question 6

In a reaction 0,1 mol.dm^{-3} of H_2CO_3 is diluted with 50 cm^3 of water to make a 75cm^3 solution. 59, 8 % of the dilute acid is titrated with NaOH. When the end point is reached it is found that 23 cm^3 of NaOH has neutralized the acid.

6.1. Define end-point. (2)

6.2. NaOH is a strong base, show by means of a chemical reaction that this is a strong base. (Write the dissociation reaction) (2)

6.3. Prove that the concentration of H_2CO_3 before titration is 0,03 mol.dm^{-3}. (2)

6.4. Write down a balanced chemical reaction showing the reaction of NaOH and H_2CO_3. (3)

6.5. Calculate the concentration of NaOH. (4)

6.6. Determine the pH of NaOH solution before titration. (6)

6.7. The resulting salt from the titration reaction can undergo hydrolysis. Write down the chemical reaction showing hydrolysis of this salt. (2)

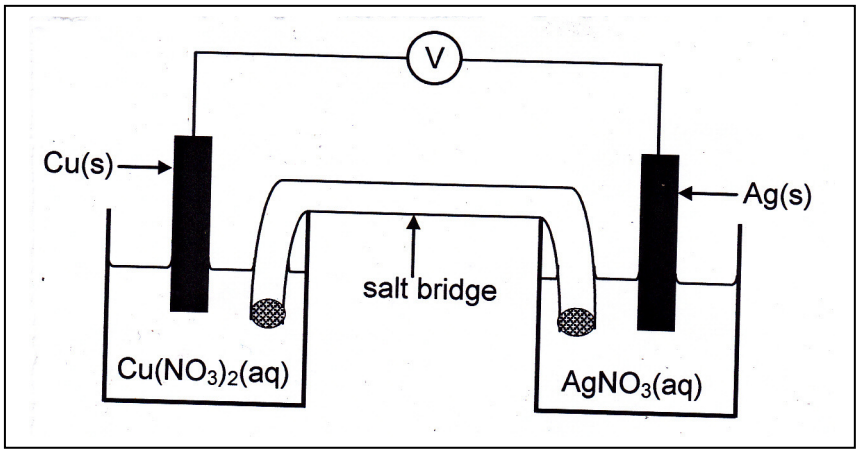
6.8. The colour of phenolphthalein is REDDISH-PINK in a base and COLOURLESS in an acid. What will the colour of phenolphthalein be in a hydrolysis reaction of this salt? (1)

6.9. Write down the CHEMICAL FORMULA of the substance (from the hydrolysis equation) that causes the colour change mentioned in 6.8. (1)

[23]

Question 7

The diagram below represents a galvanic cell operating under standard conditions.



7.1. Write down:

7.1.1. The energy conversion which takes place in this cell (1)
7.1.2. A balanced equation for the overall cell reaction. (3)
7.1.3. The cell notation for this cell (3)

7.2. Calculate the initial emf of this cell (4)

7.3. In which direction will electrons flow? Write down 'from Ag to Cu' or 'from Cu to Ag. (1)

7.4. The cell is allowed to discharge for a period of time during which the mass of the copper electrode changes by 3,2g.

Calculate the expected mass change of a silver electrode. (Assume that the change in mass is a result of the oxidation-reduction reaction occurring as the cell discharges) (4)

7.5. The silver half-cell is now replaced with the standard hydrogen half-cell.

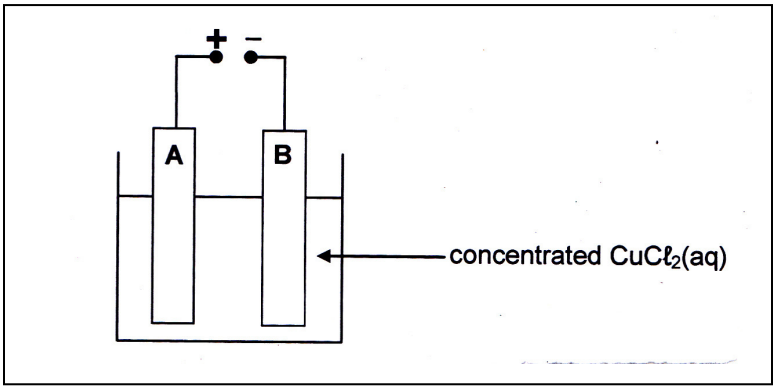
7.5.1. Is the copper electrode the POSITIVE or NEGATIVE electrode? Refer to the relative strength of reducing agents to explain the answer. (4)

7.5.2. Write down the emf of the cell. (1)

[21]

Question 8

The diagram below represents the apparatus used in the electrolysis of a concentrated $CuCl_2$ solution. A and B are two carbon electrodes connected to a power supply.



8.1. Which electrode (A or B) is anode? (1)

8.2. Is the electrolysis process endothermic or exothermic? (1)

8.3. Write down THREE observations that can be made during this process. (3)

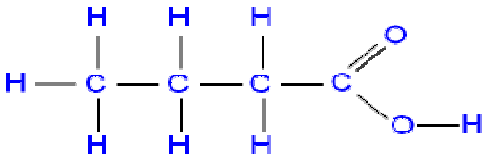
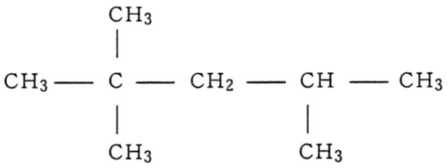
8.4. Write down the overall cell reaction. (3)

8.5. Give ONE reason why the salt needs to be in a solution in this process. (2)

[10]

Question 9

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

A		**B**	Butan-2-ol
C		**D**	pentanal
E	C_2H_5OH	**F**	Methyl propanoate

9.1. Write down the letter that represents a compound that:

9.1.1. Is saturated (1)
9.1.2. Is a structural isomer of compound A (1)
9.1.3. Is an aldehyde (1)
9.1.4. Belongs to the same homologous series as compound B (1)

9.2. Write down the:

9.2.1. IUPAC name of compound C (2)
9.2.2. Full structural formula of compound B (2)
9.2.3. Name the homologous series to which compound F belongs (1)

[9]

Question 10

Different structural isomers are possible for the organic compound with the molecular structure $C_4H_8O_2$.

10.1. What are isomers? (2)

10. 2. Write down IUPAC name, structural formula and different homologous series for two isomers possible for the organic compound with the molecular formula ($C_4H_8O_2$). Redraw the table column in your answer book to answer the questions.

Condensed structural formula	**IUPAC name**	**Homologous series**
10.2.1. (2)	10. 2. 2. (2)	10.2.3. (1)
10.2.4. (2)	10.2.5. (2)	10.2. 6. (1)

[12]

Total : 150