HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 10
PAPER 2 - Chemistry

JUNE 2015
TIME: 3 HRS

Total 140

Instructions

1. Answer ALL the questions.

2. This question paper consists of TWO sections:

3. SECTION A (20)
   SECTION B (120)

   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 The second energy level of an atom can accommodate a maximum number of...

A. 2 electrons
B. 4 electrons
C. 8 electrons
D. 18 electrons

1.2 Which period in the periodic table would you find this element in?

A. Five
B. Six
C. Eight
D. Nine

1.3 What is the correct chemical formula for the nitrate ion?

A. N^{-3}
B. NO_2^{1-}
C. NO_3^{1-}
D. NO_3^{2-}

1.4 The electrons found in outer energy levels of atoms

A. Valence electrons

B. Core electrons

C. Free electrons

D. Anions

1.5 A chemical reaction in which energy is absorbed from the surroundings

A. Acid-base

B. Substitution

C Endothermic

D. Exothermic

1.6 Which ONE of the following is a physical change?

A. Dissolving salt in water

B. Iron rusting

C. Burning coal

D. Cooking steak

1.7 Which of the following methods would you use to separate caffeine from a solution?

A. Filtration

B. Manual separation

C. Magnetic separation

D. Chromatography

1.8 Which ONE of the following pairs of elements are BOTH non-metals?

A. Oxygen and Beryllium

B. Sulphur and Lead

C. Fluorine and Silicon

D. Chlorine and Krypton

1.9 Which ONE of the following solids does NOT have a covalent network structure?

A. Diamond

B. Potassium iodide

C. Phosphorus dioxide

D. Graphite

1.10 The state of matter in which there are very weak intermolecular forces between the molecules

A. Gas

B. Liquid

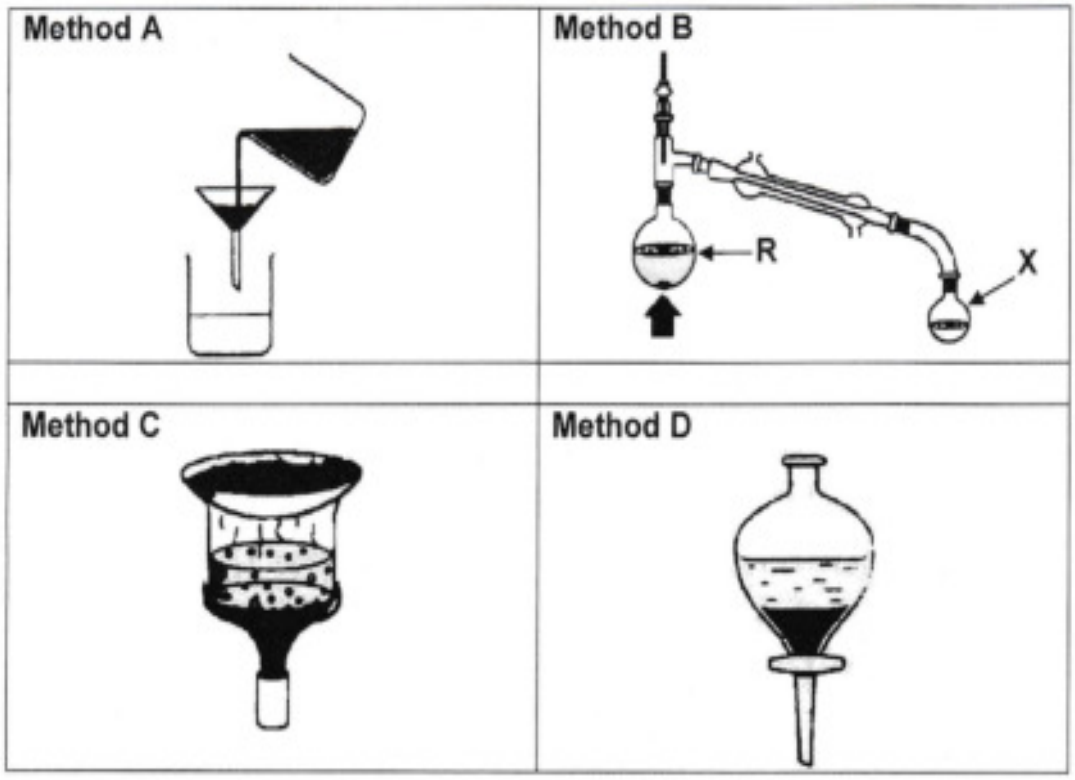
C. Solid

D. Plasma **[2 x 10 = 20]**

SECTION B

QUESTION 2

Four methods to separate mixtures are summarised in the table below.



2.1 Consider method **B**

2.1.1 What name is given to this method of separation? (1)

2.1.2 Is this method a PHYSICAL or CHEMICAL process?
Give a reason for your answer. (2)

2.1.3 What property of the substance is used to separate it? (1)

2.1.4 Define a homogeneous mixture (2)

2.1.5 What phase change occurs at R? (1)

2.1.6 What phase change occurs at X? (1)

Consider the following mixtures.

P: sodium chloride solution

Q: water and ethanol

R: water and oil

S: sulphur and iron filings

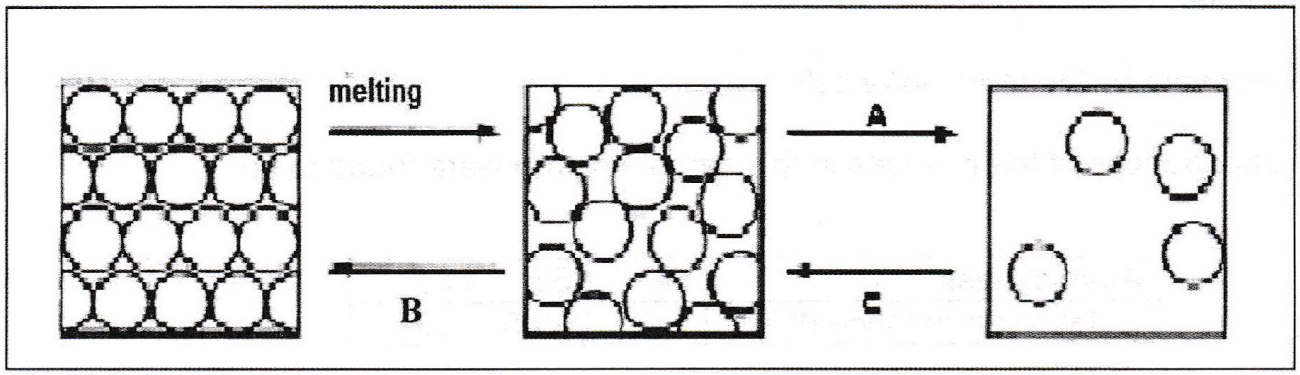
T: sand and water

2.2 Which ONE of the above mixtures (P-T) can be separated using:

2.2.1 Method A (1)
2.2.2 Method B (1)
2.2.3 Method C (1)
2.2.4 Method D (1)
[12]

QUESTION 3

The states of matter are solid, liquid and gas. The diagram below shows how the molecules are arranged in these three states.



3.1 Write down the name of the **process** represented by the following labels:

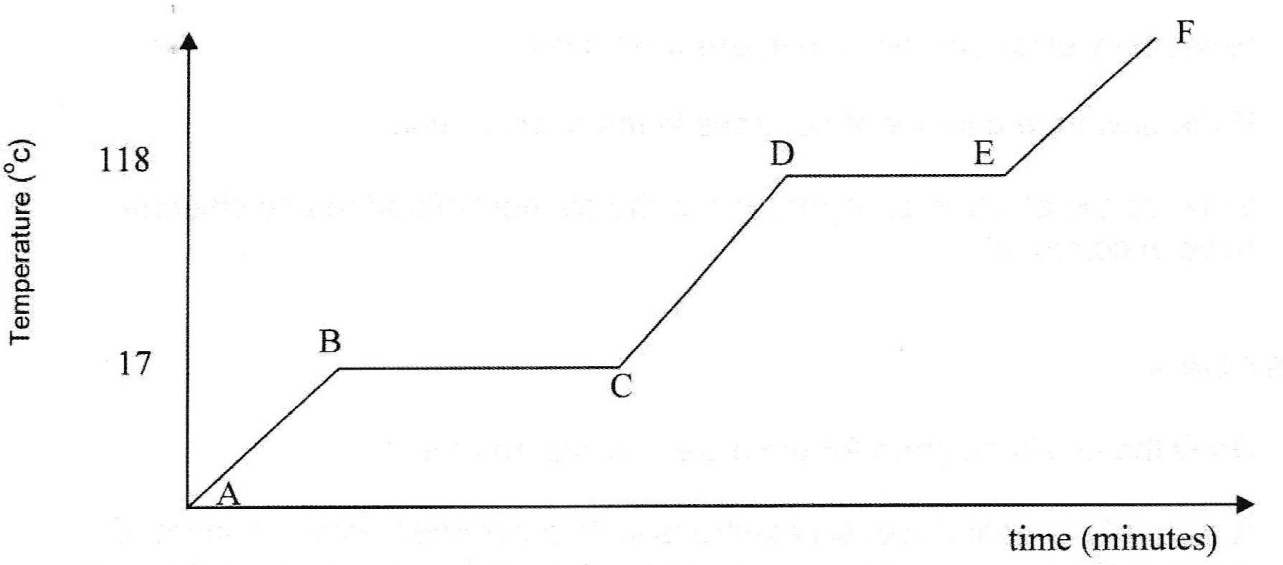
3.1.1 A (2)

3.1.2 B (2)

3.1.3 C (2)

3.2 Which of these processes, A,B or C is endothermic? Give a reason for your answer (2)

3.3 A substance is heated at a constant rate. The graph of its temperature against time is shown below.



3.3.1 Write down two sections on the graph at which two phases of the substance existed at the same time. (2)

3.3.2 What is the melting point of the substance? (1)

3.3.3 What is the boiling point of the substance? (1)

3.3.4 What is represented by section E-F? (1)
3.3.5 Write down the dependent variable (1)
3.3.6 Write down the independent variable (1)
[15]

QUESTION 4

A chemist conducts an investigation to determine the first ionisation energies of the first 18 elements. The results obtained are shown in the table below.

Atomic number	Ionisation energy ($kJ \cdot mol^{-1}$)	Atomic number	Ionisation energy ($kJ \cdot mol^{-1}$)
1	1317	10	2087
2	2378	11	502
3	526	12	744
4	905	13	577
5	807	14	786
6	1092	15	1060
7	1049	16	996
8	1319	17	1256
9	1687	18	1520

4.1 For this investigation write down the:

4.1.1 Independent variable (1)
4.1.2 Dependent variable (1)

4.2 Consider the element with atomic number **13**.

4.2.1 Name this element (1)
4.2.2 Write an equation to show how this element ionizes (2)

4.3 Describe any trends in ionisation energies that can be observed in the table from atomic numbers 3 to 10. (2)

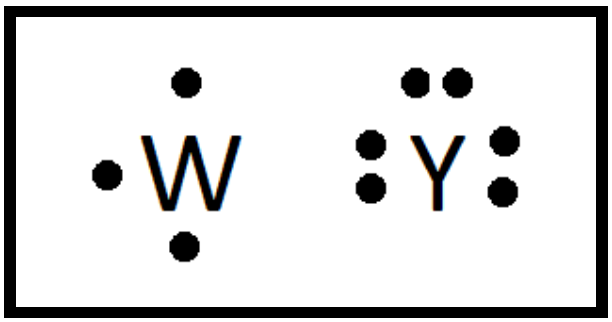
4.4 Use the periodic table together with the information in the given table to deduce the PERIOD in the periodic table that has the lowest ionisation energy. (1)

4.5 Explain your answer in QUESTION 4.4 by making reference to the valence electrons, atomic radius and energy needed. (2)

4.6 Refer to the information in the table and write down the SYMBOL of the element whose nucleus exerts the GREATEST force of attraction on its electrons.
Explain your answer. (2)
[12]

QUESTION 5

Consider the following electron-dot formulae for element W and Y. Element W is found in period three on the periodic table.



5.1.1 Will the compound that forms (when W and Y bond) be IONIC, COVALENT or METALLIC? (1)

5.1.2 Give a reason for your answer in QUESTION 5.1.1 (2)

5.1.3 Write down the formula for the compound formed by the combination of W and Y (in the form of W and Y) (2)

5.1.4 Write down the Lewis diagrams for the reaction when the compound of W and Y is formed. (show the formation of the molecule) (3)

5.2 Magnesium occurs in three isotopic forms ^{24}Mg, ^{25}Mg and ^{26}Mg. The natural abundance of the isotopes is 78.99% for ^{24}Mg, 10.00% for ^{25}Mg and 11.01% for ^{26}Mg.

5.2.1 Define the term ISOTOPE (2)

5.2.2 Use a calculation to determine the number of neutrons in the isotope ^{25}Mg. (2)

5.2.3 Use a calculation to show the relative atomic mass of Magnesium is 24,32 $g.mol^{-1}$. (3)

5.2.4 Write down any two properties of metals (2)
[17]

QUESTION 6

6.1 Write down the chemical formulae for the following:

6.1.1 Beryllium hydrogen carbonate (1)
6.1.2 Iron (III) hydroxide (1)
6.1.3 Potassium nitride (1)
6.1.4 Calcium oxide (1)
6.1.5 Carbon tetra fluoride (1)

6.2 Write down the name of the following formulae:

6.2.1 Mn_2S_7 (1)
6.2.2 ZnI_2 (1)
6.2.3 Na_3PO_4 (1)
6.2.4 $AgMnO_4$ (1)
6.2.5 $(NH_4)_2Cr_2O_7$ (1)

6.3 What is the common name for Hydrogen sulphate? (1)

6.4 Write down the ionic charges for the following polyatomic ions:

6.4.1 chlorate (1)
6.4.2 carbonate (1)
6.4.3 acetate ion (1)
6.4.4 sulphite (1)

[15]

QUESTION 7

Three chemical reactions are shown below:

REACTION A: CO_2 (g) + H_2O (l) → O_2 (g) + $C_6H_{12}O_6$ (s)

REACTION B: NH_3 (g) → N_2 (g) + H_2 (g)

REACTION C:
Hydrogen sulphate + Lithium carbonate → Lithium sulphate + Carbon dioxide + Water

7.1 Name the chemical law that is represented by a balanced chemical equation (2)
7.2 Rewrite and balance **REACTION A** (3)
7.3 Which reaction (A, B or C) represents a decomposition reaction? (2)

7.4 Write down a balanced chemical equation for the word equation represented in **REACTION C** (5)

[12]

QUESTION 8

8.1 The reaction between Copper (II) and dilute hydrochloric acid is represented by the balanced equation below.

$$2\ Cu\ (s) + 4\ HCl\ (aq) \rightarrow 2\ CuCl_2\ (aq) + 2\ H_2\ (g)$$

8.1.1 Define the term 'strong acid'. (2)

8.1.2 Write down the name and chemical formula for the ionic salt that forms when dilute sulphuric acid reacts with aluminium hydroxide. (2)

8.1.3 Calculate the number of moles found in 24g of $CuCl_2$. (4)

8.1.4 Calculate the number of chlorine atoms found in 48g of chlorine gas. (5)

8.2 Calculate the concentration of Silver nitrate ($AgNO_3$), if 2.25 grams is dissolved in water to make up a 250 cm^3 solution. (5)

8.3 The empirical formula of a certain compound is to be determined. On analysis of a sample of the compound it was found to contain 43.39 % sodium, 11.32% carbon and 45.28 % oxygen.

8.3.1 Define the term empirical formula (2)

8.3.2 Determine the empirical formula of the compound. Show ALL calculations. (5)

8.4 Calculate the percentage composition of KI (3)

8.5 Re-write the following reactions and identify the conjugate acid-base pairs:

8.5.1 $HNO_3 + H_2O \rightarrow NO_3^- + H_3O^+$ (2)

8.5.2 $HPO_4^{-2} + H_2O \rightarrow PO^{-3} + H_3O^+$ (2)

8.5.3 $NH_4^+ + F^- \rightarrow NH_3 + HF$ (2)

8.6 Define an ampholyte and give any two examples of ampholytes. (3)

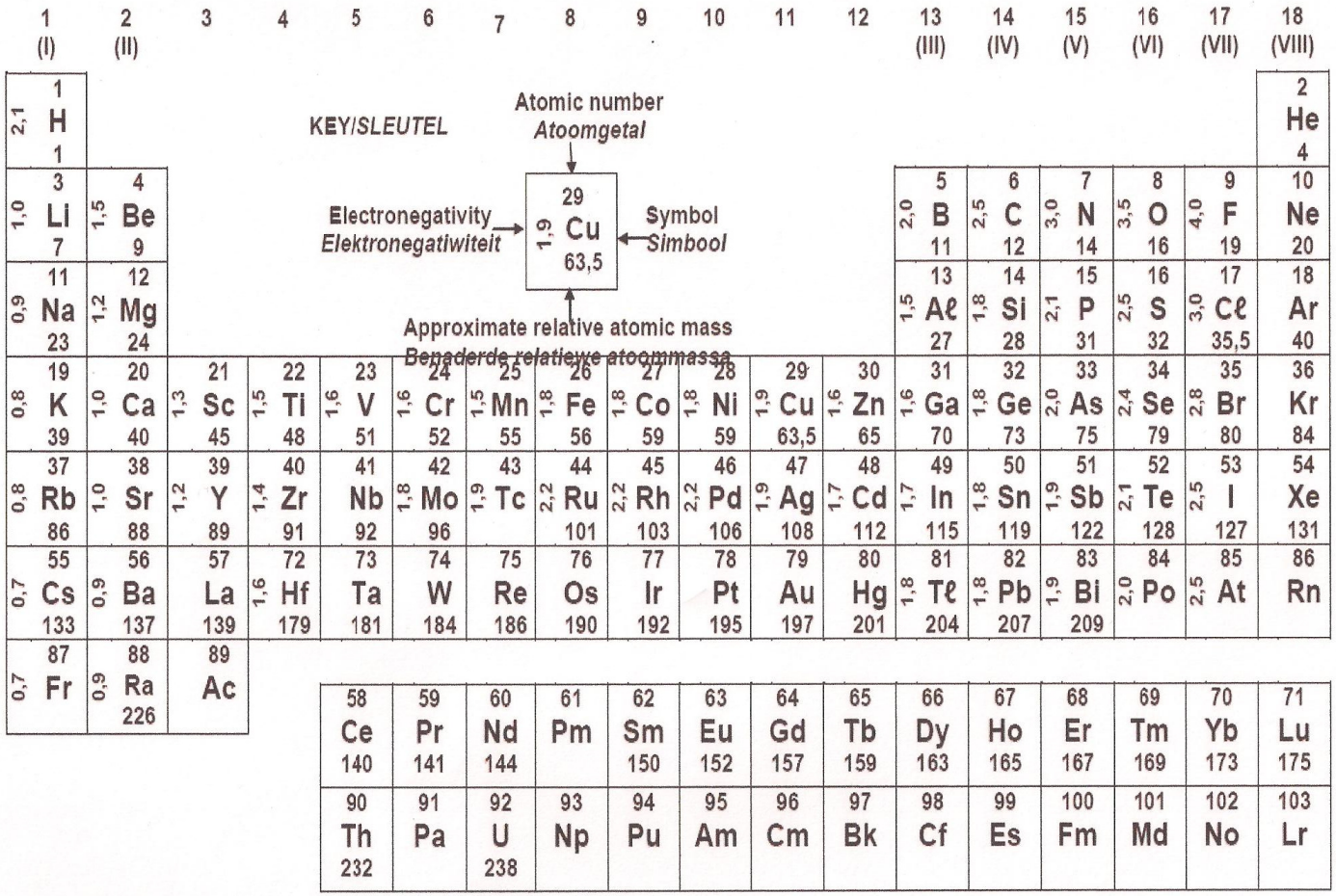
[37]

Subtotal Section B = 100
Grand total = 140

FORMULA SHEET

Mass formula	$n = \frac{m}{M}$	
Particle formula	$n = \frac{No}{NA}$	$N_A = 6.02 \times 10^{23}$
Volume formula	$n = \frac{V}{Vo}$	$V_o = 22.4\ dm^3$
Concentration formula	$C = \frac{n}{V}$	$mol.dm^{-3}$
Neutrons	$n^0 = A - Z$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE



1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	Xe 131
0,7 Cs 133	0,9 Ba 137	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190	Ir 192	Pt 195	Au 197	Hg 201	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	Rn
0,7 Fr	0,9 Ra 226	Ac															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr