HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 10
PAPER 2 - Chemistry

JUNE 2014
TIME: 3 HRS

Total 150

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (130)

   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 (2.1 – 2.10) in the ANSWER BOOK.

1.1 The electron was discovered by:

A. Dalton
B. Rutherford
C. Thomson
D. Bohr

1.2 What value is indicated for the element in the diagram?

A. Atomic mass
B. Atomic number
C. Formula mass
D. The number of electrons

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

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

1.4 The electrons found in completely filled energy levels

A. Valence electrons

B. Core electrons

C. Free electrons

D. Anions

1.5 A chemical reaction in which there is an energy transfer to the surroundings

A. Acid-base

B. Substitution

C. Endothermic

D. Exothermic

1.6 The name given to the monoatomic gaseous elements found in Group 8 on the periodic table of elements

A. Halogen gases

B. Non-metals

C. Transition gases

D. Noble gases

1.7 Which of the following represents the correct electron configuration for $^{19}_{9}F$?

A. $1s^1\ 2s^2\ 2p^6$

B. $1s^2\ 2s^2\ 2p^5$

C. $1s^2\ 2s^1\ 2p^6$

D. $1s^2\ 2s^2\ 3s^2\ 3p^5\ 4s^1$

1.8 A phase change that is opposite to solidification (freezing) is called?

A. Condensation

B. Boiling

C. Melting

D. Sublimation

1.9 During the heating of water the:

A. temperature remains constant during the phase change

B. temperature increases during the phase change

C. temperature decreases during the phase change

D. temperature will first decrease then increase

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

A. Gas

B. Liquid

C. Solid

D. Plasma **[2 x 10 = 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

2.1 Choose an item from COLUMN B that best matches a description in COLUMN A. Write only the letter (A-G) next to the question number (2.1.1-2.1.7) on your folio.

COLUMN A	COLUMN B
2.1.1 type of bond in sodium chloride	A. heterogeneous mixture
2.1.2 a good conductor of electricity	B. neutron
2.1.3 a chemical reaction in which elements break down into simpler compounds	C. atom
2.1.4 the smallest part of an element that can take part in a chemical reaction	D. decomposition
2.1.5 fruit salad	E. alloy
2.1.6 mixture of metals	F. ionic
2.1.7 nuclear particle with zero charge	G. Cu

(7)

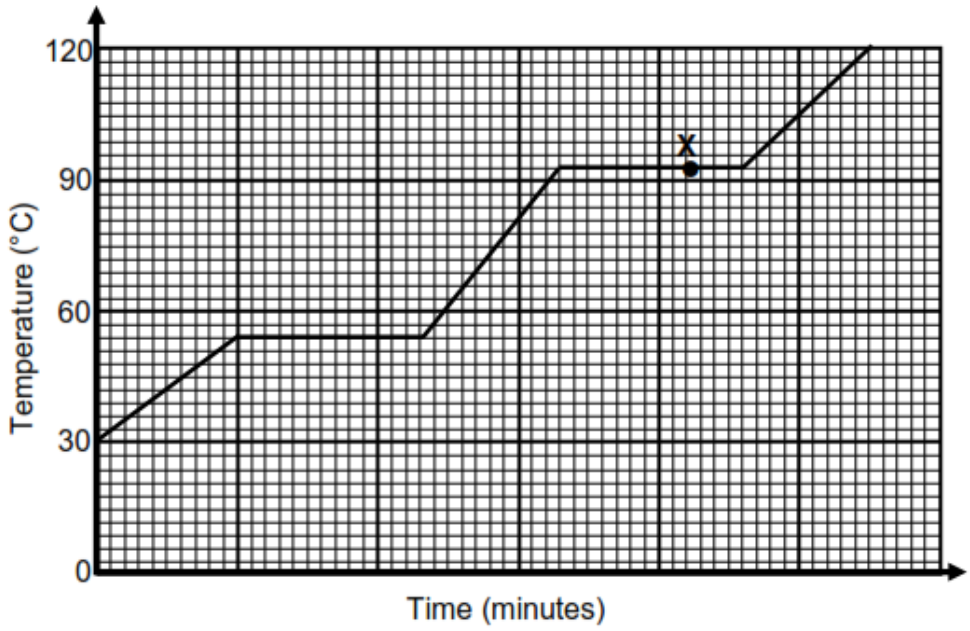
2.2 Solid carbon dioxide is known as dry ice. Under normal circumstances dry ice sublimes as it warms up.
Define the term sublimation. (2)

2.3 Use the kinetic theory to explain how water droplets are formed on the outside of a glass of ice water on a hot summer's day. (3)

[12]

QUESTION 3

The heating curve for a pure substance at atmospheric pressure is shown in the graph below.



3.1 Write down the:

3.1.1 Dependent variable (1)

3.1.2 Independent variable (1)

3.2 Write down the following for this pure substance:

3.2.1 Melting point (1)

3.2.2 Boiling point (1)

3.3 What is the physical state of the substance at:

3.3.1 Point X shown on the graph (1)

3.3.2 Room temperature (1)

3.3.3 100 ºC (1)

3.4 What happens to the temperature while the substance melts? Only write down INCREASE, DECREASE or REMAINS THE SAME. Explain this observation. (3)

[10]

QUESTION 4

Information of six elements, represented as P, Q, R, S, T and Y, are given in the table below.

ELEMENT	ATOMIC NUMBER	MASS NUMBER	ELECTRON STRUCTURE
P	16	32	$1s^2 2s^2 2p^6 3s^2 3p^4$
Q	3	7	$1s^2 2s^1$
R	20	40	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
S	18	40	$1s^2 2s^2 2p^6 3s^2 3p^6$
T	17	35.5	$1s^2 2s^2 2p^6 3s^2 3p^5$
Y	19	39	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

4.1 Which element (P, Q, R, S, T or Y):

4.1.1 Has 20 neutrons in each atom (1)
4.1.2 Is a noble gas (1)
4.1.3 Has 7 valence electrons in each atom (1)

4.2 TWO of the above elements are in the same group of the periodic table.
Write down:

4.2.1 The letters representing these TWO elements (2)
4.2.2 Their group name and number on the periodic table (2)

4.3 ONE of the elements represented above is Sulphur. Write down:

4.3.1 The letter from the given table, representing Sulphur (1)
4.3.2 The number of core electrons for Sulphur (1)

4.4 Write down the chemical formula of the compound formed by the combination of elements:

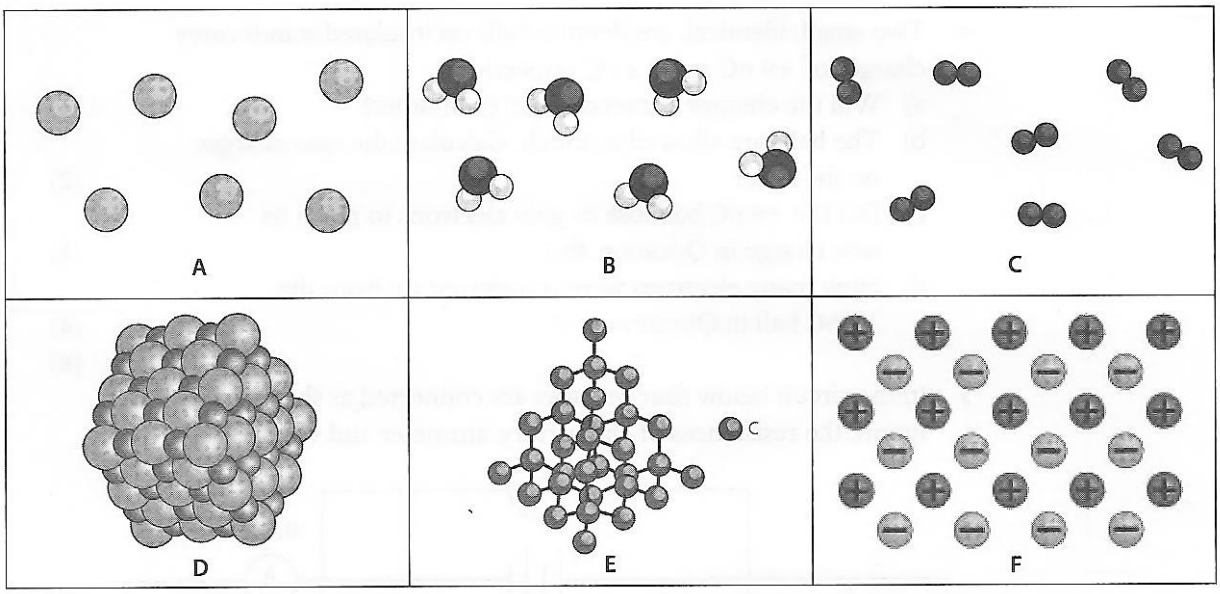
4.4.1 P and R (2)
4.4.2 Q and T (2)

4.5 Write down the NAME and draw the afbua structure for element Y (4)
4.6 Write down the type of chemical bond that element Y forms with itself (1)

[18]

QUESTION 5

The diagrams below show different ways in which atoms combine to form various substances.



5.1 Redraw and complete the table below by choosing the correct grouping of atoms from above. Write down only the correct given symbols for the illustrations. (6)

The atoms are arranged to form	Symbol
Diatomic molecules	
Metal	
Noble gas	
Covalent network structure	
Ionic salt	
Covalent molecule	

5.2 Name a substance that would look like the compound shown in B. (1)

5.3 D, E and F show solid structures. Explain the difference in the arrangement (how electrons move) during the bonding process for these structures. (3)

5.4 Give an example of a substance that has the same electron arrangement as D. (1)

5.5 Give the names for the molecules:

5.5.1 CCl_4 (1)

5.5.2 SO_2 (1)

5.6 Draw the Lewis structures for the molecules:

5.6.1 NH_3 (3)

5.6.2 CO_2 (2)

5.7 Calculate the relative molecular mass for $C_{12}H_{22}O_{11}$ (2)

[20]

QUESTION 6

Information of **FOUR** elements, represented as **J, K, L and M** are given in the table below.

ELEMENT	ATOMIC MASS NUMBER
J	24
K	31
L	9
M	80

6.1 What is the chemical formula for the simplest compound that forms between:

6.1.1 J and K (1)
6.1.2 L and M (1)

6.2 What type of bond will be found between **K** and **L**? (1)
6.3 Name the element represented by atom **K** in the table. (1)
6.4 State whether the element represented by atom **M** is a metal, non-metal or metalloid as well as the phase it is found in at room temperature. (2)
6.5 Draw Lewis structures to show the reaction for the formation of the chemical bond that forms between atoms of element **J** and Fluorine. (4)

[10]

QUESTION 7

Element X has three naturally occurring isotopes as shown in the table:

	% OCCURANCE	RELATIVE ISOTOPE MASS
$^{24}X_{12}$	78.99	23.985
$^{25}X_{12}$	10.00	24.986
$^{26}X_{12}$	11.01	25.985

7.1 Define the term isotope (2)
7.2 Show by using a calculation how many neutrons a natural atom of ^{24}X contains (3)
7.3 Use the information in the table to calculate the relative atomic mass of this element (4)
7.4 Give the name of element X (1)

[10]

QUESTION 8

Three chemical reactions are shown below:

REACTION A: C_8H_{18} (l) + O_2 (g) → CO_2 (g) + H_2O (l) + energy

REACTION B: Hydrogen nitrate + Copper → Copper(II)nitrate + nitrogen dioxide + water

REACTION C: $NaHCO_3$ (s) → Na_2CO_3 (s) + H_2O (l) + CO_2 (g)

8.1 Name the chemical law that is represented by a balanced chemical equation (1)
8.2 What does (l) represent in **REACTION A**? (1)
8.3 Rewrite **REACTION C** as a word equation (4)
8.4 Which reaction (A, B or C) represents a decomposition reaction? (1)
8.5 Write **REACTION B in** chemical symbol form and balance the equation. (6)
8.6 Rewrite and balance **REACTION A** (4)

[17]

QUESTION 9

9.1 The reaction between aluminium and dilute hydrochloric acid is represented by the balanced equation below.

2 Al (s) + 6 HCl (aq) → 2 $AlCl_3$ (aq) + 3 H_2 (g)

9.1.1 Define the term 'weak acid'. (2)
9.1.2 Give the name and physical state at room temperature, of the **acid** represented in the above chemical reaction. (2)
9.1.3 Write down the name and chemical formula for the ionic salt that forms when dilute sulphuric acid reacts with sodium hydroxide. (2)
9.1.4 Calculate the number of moles found in 24g of $AlCl_3$. (3)
9.1.5 Calculate the number of chlorine atoms found in 24g of $AlCl_3$. (4)

9.2 The molar mass of hydrated sodium carbonate is found to be 268 $g.mol^{-1}$. The formula of the hydrated sodium carbonate is $Na_2CO_3.xH_2O$.

Calculate the number of moles water of crystallisation (x) is in the compound. (5)

9.3 Calculate the concentration of Potassium nitrate (KNO_3), if 4.25 grams is dissolved in water to make up a 250 cm^3 solution. (5)

9.4 The empirical formula of a certain compound is to be determined. On analysis of a sample of the compound it was found to contain 29.41 % calcium, 23.53 % sulphur and 47.06 % oxygen.

9.4.1 Define the term empirical formula (1)

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

9.5 Calculate the percentage composition of H_2SO_4 (4)

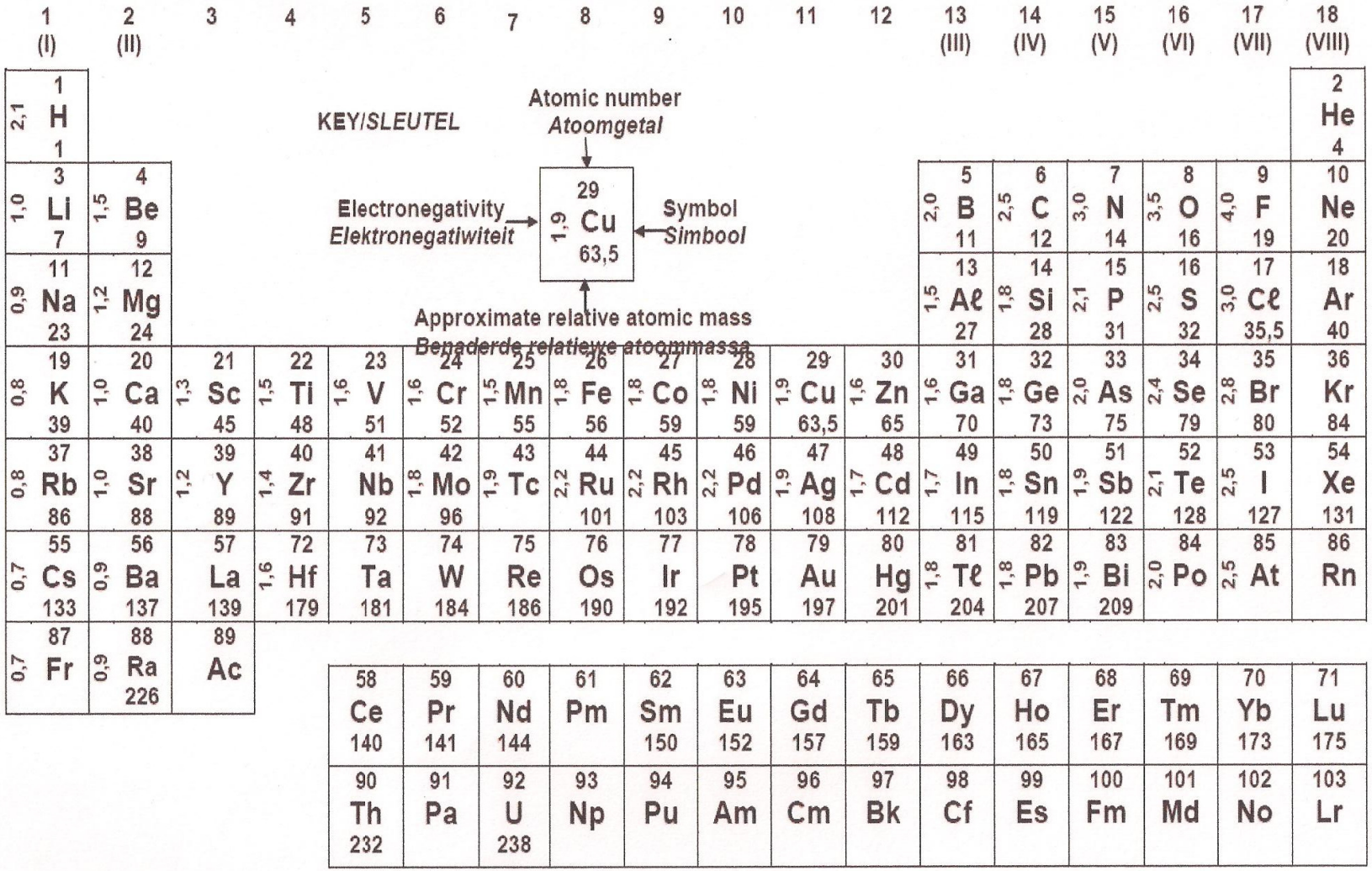
[33]

Subtotal Section B = 130
Grand total = 150

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	$C = \frac{n}{V}$	
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)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 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