HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 10
PAPER 2 - Chemistry

NOVEMBER 2013
TIME: 2 HRS

Total 150

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (25)
   SECTION B (125)

   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: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) in the ANSWER BOOK.

1.1 The bond between sodium and chloride in sodium chloride.

1.2 In matter the type of change that can be seen or felt, but does not involve the break-up of the particles in a reaction.

1.3 The measure of the amount of solute that is dissolved in a given volume of liquid and it is measured in $mol.dm^3$

1.4 A substance that ionises only partially in solution (to form a low concentration of hydrogen ions).

1.5 The name of the gas that is formed when an acid reacts with a metal.

[1 x 5 = 5]

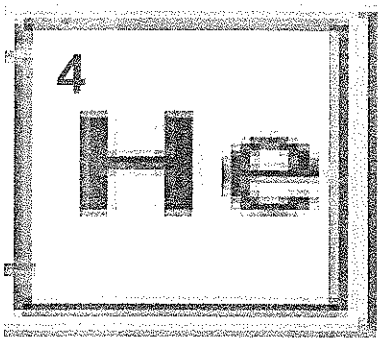
QUESTION 2: MULTIPLE-CHOICE QUESTIONS

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.

2.1 The electron was discovered by:

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

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



A. Atomic mass

B. Atomic number

C. Formula mass

D. The number of electrons

2.3 What is the correct chemical formula for the carbonate ion?

A. C

B. CO_2

C. Co^{2+}

D. CO_3^{2-}

2.4 What is the maximum number of electrons found in any one energy orbitals?

A. 1

B. 6

C. 2

D. 4

2.5 A base will cause litmus paper to turn what colour?

A. Red

B. Blue

C. Pink

D. Green

2.6 Element with the greatest atomic radius....

A. Oxygen
B. Carbon
C. Nitrogen
D. Potassium

2.7 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. $1s^2\ 2s^2\ 3s^2\ 3p^5\ 4s^1$

2.8 A phase change that is opposite to evaporation is called?

A. Condensation

B. Boiling

C. Fusion

D. Solidification

2.9 Which one of the following substances is not an example of an ampholyte?

A. HCl

B. H_2O

C. HSO_4^{-1}

D. HCO_3^{-1}

2.10 Condensation occurs when:

A. A gas changes to a liquid

B. A liquid changes to gas

C. A solid changes to a liquid

D. A gas changes directly to a solid **[2 x 10 = 20]**

SECTION B

INSTRUCTIONS AND INFORMATION

1. Leave ONE line between two sub questions, for example between QUESTION 3.1 and QUESTION 3.2.
2. Show the formulae and substitutions in ALL calculations.
3. Round off your numerical answers to **TWO** decimal places.

QUESTION 3

3.1 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 (3.1.1-3.1.7) on your folio.

COLUMN A	COLUMN B
3.1.1 potassium chloride crystals	A. heterogeneous mixture
3.1.2 a good conductor of electricity	B. homogeneous mixture
3.1.3 non-metal	C. silicon
3.1.4 sugar dissolved in water	D. mole
3.1.5 blood	E. sulphur
3.1.6 increase in conductivity with increase in temperature	F. compound
3.1.7 amount of substance	G. Cu

(7)

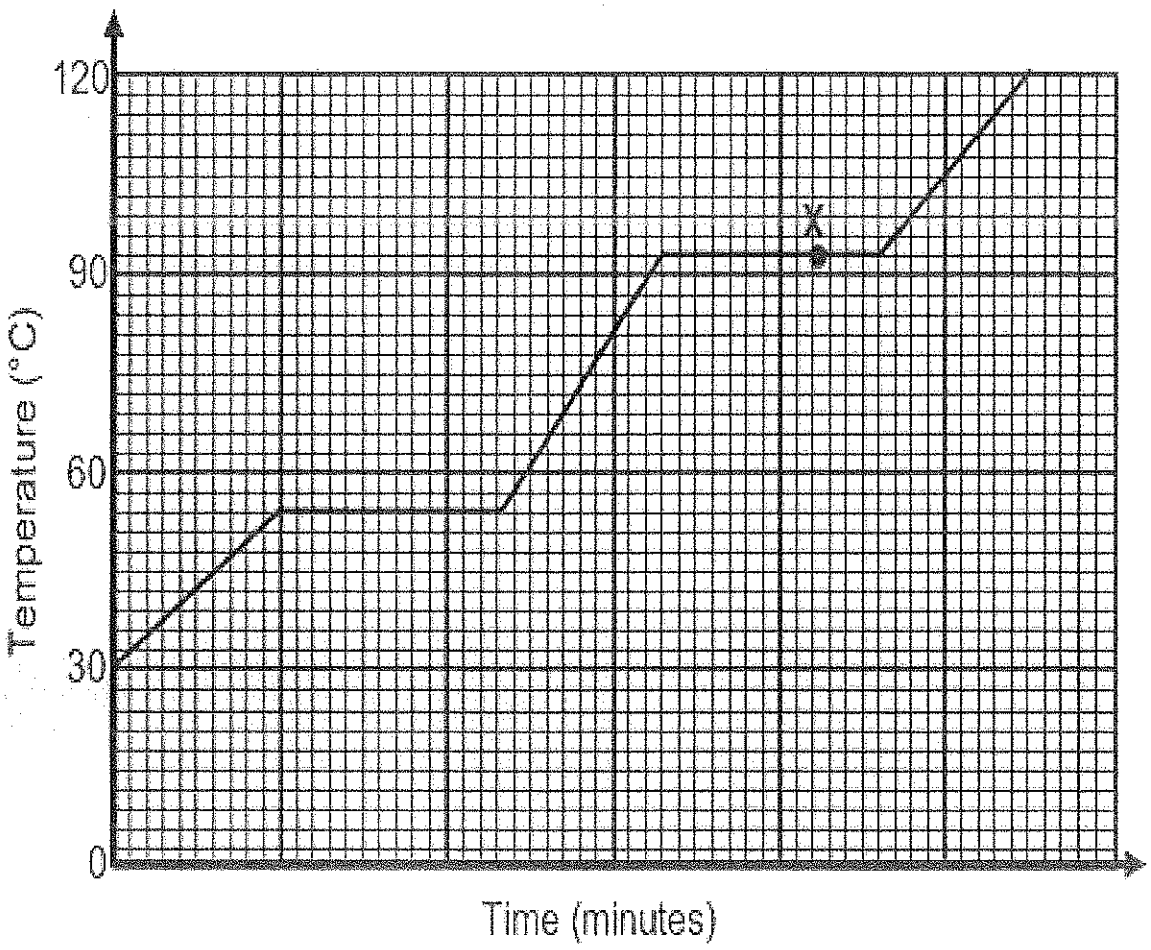
3.2 Solid carbon dioxide is known as dry ice. Under normal circumstances dry ice sublimes as it warms up.
Define the term sublimation. (2)

3.3 When you take a block of butter out of the fridge, it is hard. However, after 15 minutes at room temperature it is soft enough to spread.
Use the kinetic theory to explain the above observation. (3)

[12]

QUESTION 4

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



4.1 Write down the following for this pure substance:

4.1.1 Melting point (2)

4.1.2 Boiling point (2)

4.2 What is the physical state(s) of the substance at:

4.2.1 Point X shown on the horizontal line (2)

4.2.2 Room temperature (25°C) (1)

4.3 What happens to the temperature while the substance melts? Only write down INCREASE, DECREASE or REMAIN THE SAME. Explain this observation. (2)

4.4 State whether the above graph shows and endothermic **or** exothermic reaction. (1)

4.5 Draw a simplified graph to show the profile of an exothermic reaction. (1)

[11]

QUESTION 5

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	32.1	$1s^2 2s^2 2p^6 3s^2 3p^4$
Q	3	6.94	$1s^2 2s^1$
R	20	40.1	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
S	18	39.9	$1s^2 2s^2 2p^6 3s^2 3p^6$
T	17	35.45	$1s^2 2s^2 2p^6 3s^2 3p^5$
Y	19	39.1	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

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

5.1.1 Has 22 neutrons in each atom (1)
5.1.2 Is a noble gas (1)
5.1.3 Has 2 core electrons in each atom (1)

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

5.2.1 The letters representing these TWO elements (1)
5.2.2 Their group **name** and **number** on the periodic table (2)

5.3 ONE of the elements represented above is Calcium. Write down:

5.3.1 The letter representing Calcium (1)
5.3.2 The number of valence electrons for Calcium (1)

5.4 **Using the correct symbols from the periodic table**, write down the chemical formula of the compounds formed represented by the combinations below:

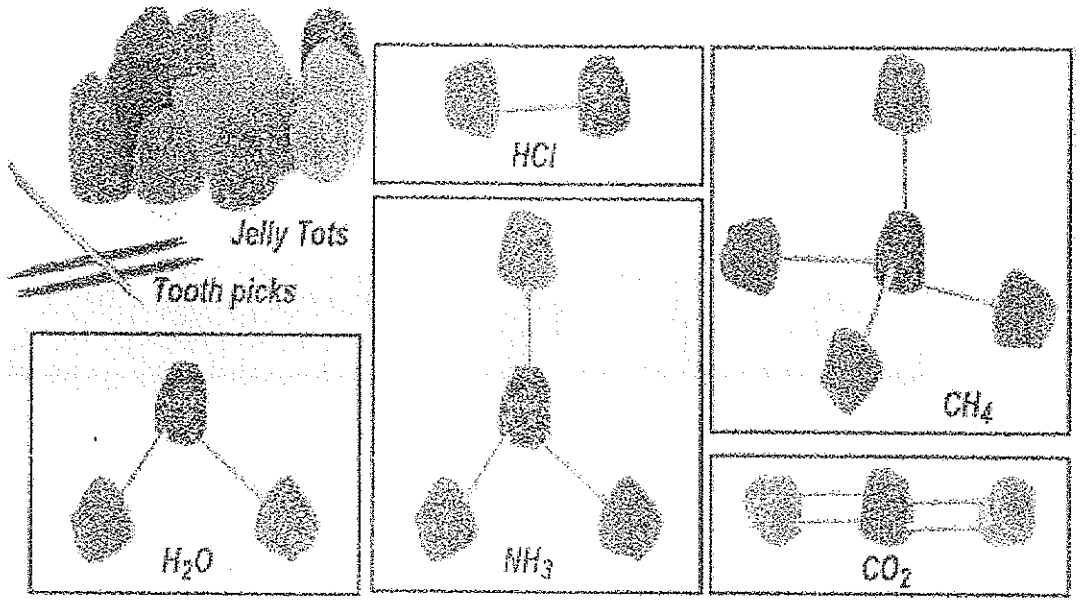
5.4.1 Q and P (2)
5.4.2 R and T (2)

5.5 Write down the NAME and draw the afbau structure for element T (4)

[16]

QUESTION 6

Susan and her friends use Jelly tots and toothpicks to build the following molecules.



6.1 Name the type of bond that forms between all these molecules. Give a reason for your answer. (2)

6.2 Give the names for the molecules:

6.2.1 HCl (1)
6.2.2 NH_3 (1)

6.3 Draw the Lewis structures for the molecules:

6.3.1 CH_4 (2)
6.3.2 CO_2 (2)

6.4 Calculate the relative molecular mass for H_2O (2)

[10]

QUESTION 7

Three elements **A, B** and **C** have atomic numbers **between 10 and 18**.
Atom **A** has one electron less than a noble gas.
Atom **B** has one more electron than a noble gas.
Atom **C** has three electrons less than a noble gas.
Atom **D** has the atomic number 16.

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

7.1.1 A and B (1)
7.1.2 B and C (1)

7.2 What type of bond will be found between:

7.2.1 TWO atoms of B (1)
7.2.2 A and B (1)

7.3 Name the element represented by atom **B** (1)
7.4 State whether the element represented by atom **C** is a metal, non-metal or metalloid (1)
7.5 Draw Lewis structures to show the formation of the chemical bond that forms between atoms B and D (4)
7.6 Define the term **ionisation energy** (2)
[12]

QUESTION 8

Magnesium has three naturally occurring isotopes as shown in the table:

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

8.1 Define the term isotope (2)
8.2 Show by using a calculation how many neutrons a natural atom of ^{24}Mg contains (3)
8 .3 Use the information in the table to calculate the relative atomic mass of magnesium (3)
[10]

QUESTION 9

Three chemical reactions are shown below:

REACTION A: $Na_3PO_4 + KOH \rightarrow NaOH + K_3PO_4$

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

REACTION C: $NH_3 \rightarrow N_2(g) + H_2(g)$

9.1 Name the chemical law that is represented by a balanced chemical equation (1)

9.2 What does (g) represent in **REACTION C**? (1)

9.3 Rewrite **REACTION A** as a word equation (4)

9.4 Which reaction (A, B or C) represents a decomposition reaction (1)

9.5 Write down a balanced chemical equation for the word equation represented in REACTION B. (6)

[13]

QUESTION 10

A learner tested the pH of a number of domestic substances with universal indicator. The results obtained are shown below:

SUBSTANCE	pH
Pain killers	3
Toothpaste	8
Water	7
Vinegar	3
Sugar water	7
Caustic soda	12
Washing powder	8

10.1 Define a Bronsted-Lowry base (2)

Use the table of results obtained above to answer the following questions:

10.2 Which substance is the most alkali? (1)

10.3 Which two substances have the highest degree of acidity? (2)

10.4 Name one neutral substance (1)

10.5 Which TWO of the following substances will increase the pH of vinegar? Only write down the name of the substances.

i) Battery acid
ii) Pain killers
iii) Sodium hydroxide
iv) Washing powder (2)

10.6 Which ions make a solution acidic? (1)

10.7 Write down a balanced chemical equation for the reaction between sulphuric acid (H_2SO_4) and dilute sodium carbonate (Na_2CO_3). (3)

10.8 Name the type of reaction that took place in question 10.7. (1)
10.9 Identify the conjugate acid-base pairs in the following reaction:

$CH_3COOH\ (aq) + NH_3\ (aq) \rightarrow \quad CH_3COO^-\ (aq) + NH_4^{+1}\ (aq)$ (2)

[15]

QUESTION 11

11.1 During an experiment magnesium reacts with dilute hydrochloric acid to produce hydrogen gas at STP.

Calculate the:

11.1.1 Mass (in gram) of 0.0625 mole hydrogen gas produced (3)
11.1.2 Volume (in dm^3) of the 0.0625 moles of hydrogen gas produced at STP (3)
11.1.3 Mass (in gram) of 0.0625 moles $MgCl_2$ produced (3)
11.1.4 Number of chlorine atoms present in0.0625 moles $MgCl_2$ (4)

11.2 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) in the compound. (4)

11.3 The empirical formula of a certain compound is to be determined. On analysis of a sample of the compound it was found to contain 71,65% Cl, 24,27% C and 4,07% H.

11.3.1 Define the term empirical formula (2)
11.3.2 Determine the empirical formula of the compound. Show ALL calculations. (5)

11.4 Calculate the percentage composition of $Ba(OH)_2.8H_2O$ (4)

[30]

Subtotal Section B = 125
Grand total = 150

FORMULA SHEET

Mass formula	$n = \frac{m}{M}$	(M) $g.mol^{-1}$
Particle formula	$n = \frac{N_o}{N_A}$	$N_A = 6.02 \times 10^{23}$
Volume formula	$n = \frac{V}{V_o}$	$V_o = 22.4\ dm^3$
Concentration formula	$C = \frac{n}{V}$	$Mol.dm^{-3}$
Neutrons	$n^0 = A - Z$	

PERIODIC TABLE OF THE ELEMENTS
PERIODIEKE INDELING VAN DIE ELEMENTE

IA (1)	IIA (2)	IIIB (3)	IVB (4)	VB (5)	VIB (6)	VIIB (7)	VIII (8)	VIII (9)	VIII (10)	IB (11)	IIB (12)	IIIA (13)	IVA (14)	VA (15)	VIA (16)	VIIA (17)	0 (18)
1 H 1,01																	2 He 4,00
3 Li 6,94	4 Be 9,01											5 B 10,8	6 C 12,0	7 N 14,0	8 O 16,0	9 F 19,0	10 Ne 20,2
11 Na 23,0	12 Mg 24,3											13 Al 27,0	14 Si 28,1	15 P 31,0	16 S 32,1	17 Cl 35,45	18 Ar 39,9
19 K 39,1	20 Ca 40,1	21 Sc 45,0	22 Ti 47,9	23 V 50,9	24 Cr 52,0	25 Mn 54,9	26 Fe 55,8	27 Co 58,9	28 Ni 58,7	29 Cu 63,5	30 Zn 65,4	31 Ga 69,7	32 Ge 72,6	33 As 74,9	34 Se 79,0	35 Br 79,9	36 Kr 83,8
37 Rb 85,5	38 Sr 87,6	39 Y 88,9	40 Zr 91,2	41 Nb 92,9	42 Mo 95,9	43 Tc (98)	44 Ru 101,1	45 Rh 102,9	46 Pd 106,4	47 Ag 107,9	48 Cd 112,4	49 In 114,8	50 Sn 118,7	51 Sb 121,8	52 Te 127,6	53 I 126,9	54 Xe 131,3
55 Cs 132,9	56 Ba 137,3	57 La 138,9	72 Hf 178,5	73 Ta 180,9	74 W 183,8	75 Re 186,2	76 Os 190,2	77 Ir 192,2	78 Pt 195,1	79 Au 197,0	80 Hg 200,6	81 Tl 204,4	82 Pb 207,2	83 Bi 209,0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226,0	89 Ac 227,0	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)									

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lanthanides / lantaniede	58 Ce 140,1	59 Pr 140,9	60 Nd 144,2	61 Pm (145)	62 Sm 150,4	63 Eu 152,0	64 Gd 157,3	65 Tb 158,9	66 Dy 162,5	67 Ho 164,9	68 Er 167,3	69 Tm 168,9	70 Yb 173,0	71 Lu 175,0
actinides / aktiniede	90 Th 232,0	91 Pa 231,0	92 U 238,0	93 Np 237,0	94 Pu (244)	95 Am (234)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (258)	103 Lr (260)

13 Al 27,0 — atomic number / atoomgetal; symbol / simbool; atomic mass / atoommassa