HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 10

PAPER 2 – CHEMISTRY

NOVEMBER 2022

TIME : 2 HRS **TOTAL : 100**
TOTAL EXTENSION : 110

INSTRUCTIONS

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (10)
   SECTION B (90)

   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 are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Final answers must be rounded off to **two decimal** places.

FORMULA SHEET

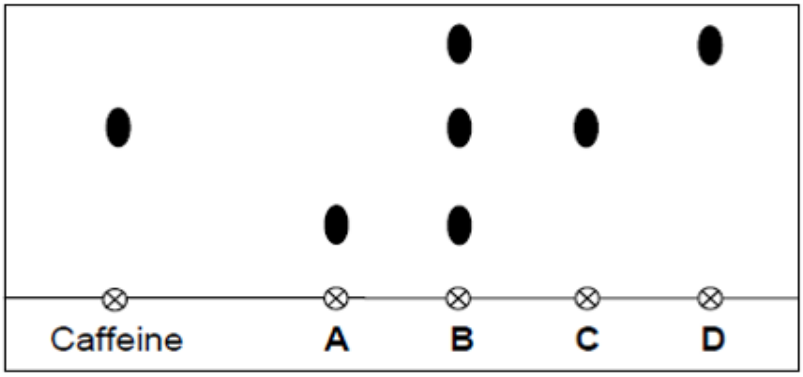
$n = \frac{m}{M}$	
$n = \frac{No}{NA}$	$N_A = 6.02 \times 10^{23}$
$n = \frac{V}{Vm}$	$V_o = 22.4\ dm^3$
$C = \frac{n}{V}$	

SECTION A

QUESTION 1: MULTIPLE-CHOICE **(2 x 5 = 10)**

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 – 1.5) in the ANSWER BOOK.

1.1 Caffeine is an addictive compound found in some cough syrups. The chromatograph below shows the results of four different syrups (A to D) being tested for the compound.



Which of the above syrups contains caffeine?

A. A , C and D

B. B and C

C. Only B

D. A , B, C and D

1.2 Study the equation below :

$$2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(g)$$

Which ONE of the statements below is correct?

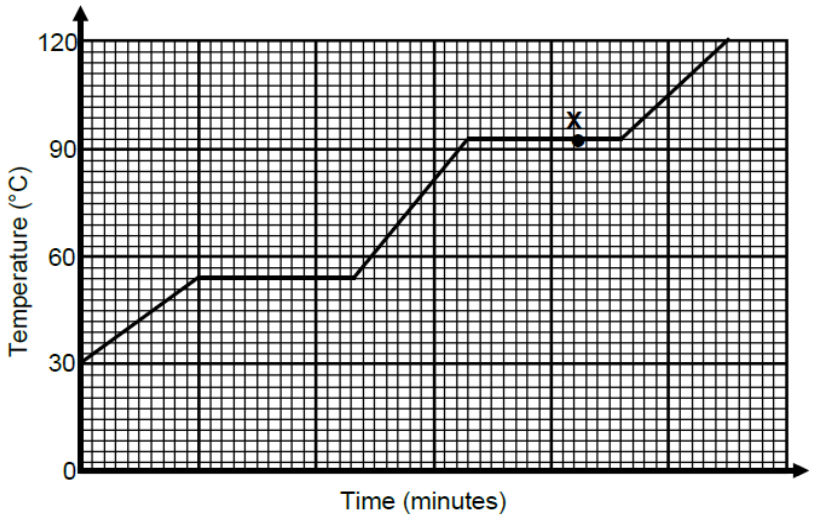
A. 2 molecules of hydrogen gas react with 1 atom of oxygen gas to form 2 atoms of water vapour?

B. 4 atoms of hydrogen gas react with 2 molecules of oxygen gas to form 2 moles of water vapour?

C. 2 moles of hydrogen gas react with 1 mole of oxygen gas to form 2 moles of water vapour?

D. 4g of hydrogen gas react with 16g of oxygen gas to form 20g of water vapour?

1.3 The heating curve for a pure substance at standard atmospheric pressure is shown on the graph below



Which of these statements is correct?

(i) the substance is water
(ii) the substance melts at 56°C
(iii) sublimation is occurring at X

A. (i) , (ii) and (iii)

B. (i) and (ii)

C. (ii) and (iii)

D. (ii) only

1.4 Natural nitrogen occurs as two isotopes, namely ^{15}N and ^{14}N

How many different types of nitrogen molecules will occur in air as a result of the combination of the above atoms?

A. 1

B. 2

C. 3

D. 4

1.5 Element X has a valence electron structure of s^2p^1 while element Y has a valence electron structure of s^2p^4. Which one of the following is the most likely formulas of a compound formed between X and Y ?

A. X_3Y_2

B. XY

C. X_2Y_3

D. X_3Y

SECTION B (90)

QUESTION 2 : ONE-WORD ANSWERS (4)

Give one word/term for each of the following descriptions.
Write only the word/term next to the question number (2.1-2.4)

2.1 a combination of two or more substances that are not chemically bonded to each other (1)

2.2 a solution of known concentration (1)

2.3 the formula that shows the simplest mole ratio in which the elements combine (1)

2.4 A solution that has uniform composition. (1)

QUESTION 3 (18)

Sodium metal reacts with chlorine gas to form sodium chloride, a substance used in cooking.

3.1 For the chlorine atom

3.1.1 draw the Aufbau diagram (3)

3.1.2 state the name of the group to which it belongs (1)

3.2 For the sodium atom

3.2.1 write down its electron configuration (s,p notation) (2)

3.2.2 state how many nucleons are found in the nucleus (1)

3.3 Represent the formation of sodium chloride with the aid of Lewis diagrams (4)

3.4 Write a balanced equation for the reaction (3)

3.5 State the

3.5.1 common name for sodium chloride (1)

3.5.2 type of bond that exists between the atoms of the chlorine molecule (1)

3.5.3 intermolecular force that exists between the molecules of chlorine (1)

3.5.4 intermolecular force that exists between the formula units of sodium chloride (1)

QUESTION 4 (6)

4.1 Name the following compounds using Stock Notation where necessary.

4.1.1 $CuCl_2$ (1)

4.1.2 $(NH_4)_3PO_4$ (1)

4.1.3 CH_3COOH (1)

4.2 Write formula for the following compounds.

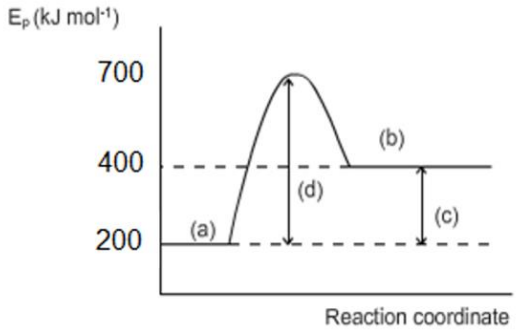
4.2.1 potassium permanganate (1)

4.2.2 iron (III) carbonate (1)

4.2.3 aluminium nitrate (1)

QUESTION 5 **(6)**

The energy graph for photosynthesis is shown below.



For the forward reaction

5.1 say whether the reaction is exothermic or endothermic (1)

5.2 identify the energy labelled d on the graph (1)

5.3 calculate the activation energy (2)

5.4 the enthalpy change for the reaction (2)

QUESTION 6 **(4)**

A sample of an element X is represented above. It occurs in two isotopic forms as X - 23 and X - 25.

6.1 What percentage of X - 23 occurs in the sample? (1)

6.2 Calculate the relative atomic mass of element X. (3)

QUESTION 7 **(8)**

An organic compound is composed of the following by mass :

54,5% carbon 9,1% hydrogen 36,4% oxygen

7.1 Determine the empirical formula of the compound. (5)

7.2 If the sample of the compound has a molar mass of 132 $g.mol^{-1}$, determine the molecular formula of the compound. (3)

QUESTION 8 **(3)**

The formula of a carbonate of an unknown Group 1 metal is represented by X with a formula mass of 286u as follows :

$$X_2CO_3 \cdot 10H_2O$$

8.1 Determine, by calculation the identity of the unknown Group 1 metal represented by X in the formula. (3)

QUESTION 9 **(12)**

Calculate :

9.1 the percentage carbon in a sugar molecule ($C_{12}H_{22}O_{11}$) (3)

9.2 the volume of 9 g of water vapour at STP (4)

9.3 the number of oxygen atoms in 300 g of $MgSO_4$ (5)

QUESTION 10 **(6)**

Consider the reaction

$$\mathbf{H_2\,(g) + O_2\,(g) \rightarrow H_2O\,(l) \quad (\Delta H < 0)}$$

10.1 Is the reaction exothermic or endothermic? (1)

10.2 What mass of water is formed when 5 moles of oxygen gas reacts with an excess of hydrogen gas? (5)

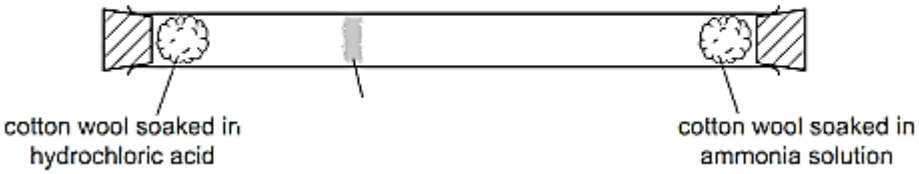
QUESTION 11 **(9)**

11.1 Define an acid in terms of the Bronsted-Lowry theory. (1)

11.2 Consider the following substances:

(i) HCl and (ii) NH_3

Substance (i) is mixed with a solution of substance (ii)



11.2.1 write a balanced equation for the reaction (2)

11.2.2 name of the product that forms in this reaction (1)

11.2.3 Calculate the volume of ammonia gas needed to form 107g of the product when an excess of the acid is available (5)

QUESTION 12 **(14)**

12.1 Calculate the mass of potassium hydroxide crystals that must be dissolved in 250cm^3 of water to make a solution of concentration 0,25$mol.dm^{-3}$ (4)

12.2 50cm^3 of the KOH $_{(aq)}$ solution is now reacted completely with the H_2SO_4 $_{(aq)}$ solution according to the balanced equation

$$2\ KOH_{(aq)} + H_2SO_4{}_{(aq)} \rightarrow K_2SO_4{}_{(aq)} + 2\ H_20_{(l)}$$

Calculate

12.2.1 the number of moles of KOH present in the 50cm^3 solution (3)

12.2.2 the maximum mass of K_2SO_4 that can be produced in the reaction (4)

When the experiment was performed in a laboratory, it was found that only 0,87g of K_2SO_4 was produced.

12.2.3 Calculate the percentage yield of the K_2SO_4 (3)

TOTAL 100

EXTENTION QUESTION **(10)**

QUESTION 13

Consider the reaction for the catalytic oxidation of ammonia.

$$4\ NH_3 + 5\ O_2 \xrightarrow{(Pt)} 4\ NO + 6\ H_2O$$

13.1 Determine the limiting reagent when 3 moles of O_2 reacts with 3 moles of NH_3 (3)

13.2 Calculate the mass of the reactant that is in excess at the end the end of the reaction. (5)

13.3 State the function of the catalyst in the reaction and say whether it has any effect on the volume of water that is formed. (2)

FORMULA SHEET

$n = \frac{m}{M}$	
$n = \frac{No}{NA}$	$N_A = 6.02 \times 10^{23}$
$n = \frac{V}{Vm}$	$V_m / V_o = 22.4\ dm^3$
$C = \frac{n}{V}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa