Hillcrest High School

PHYSICAL SCIENCE P2

Nov 2024

Grade 10

MARKS: 120
TIME: 2 Hours

EXAMINER: Mrs J. Knox-Whitehead
MODERATOR: Ms N. Badenhorst
Mrs M. Smith

Instructions:

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (100)
4. Answer SECTIONS A and B in the ANSWER BOOK.
5. Non-programmable calculators may be used.
6. Appropriate mathematical instruments may be used.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Data sheets are attached for your use.
9. Give brief motivations, discussions, et cetera where required.
10. 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 Which of the following is NOT a physical change?

A. Grinding of wheat
B. Sublimation of dry ice
C. Lighting a match
D. Dissolving sugar in water

1.2 According to the Kinetic Molecular Theory, gas particles are assumed to:

A. Attract each other strongly
B. Be stationary
C. Be in constant random motion
D. Form fixed shapes

1.3 Which of the following statements is true about the kinetic energy of particles?

A. Particles of liquids have lower kinetic energy than solids
B. The kinetic energy of particles increases as temperature decreases
C. The average kinetic energy of particles increases with an increase in temperature
D. Kinetic energy only exists in gases

1.4 According to the Kinetic Molecular Theory, which of the following occurs during the process of condensation?

A. Particles gain kinetic energy and move faster
B. Particles lose kinetic energy and move closer together
C. Particles remain in random motion
D. Particles completely stop moving

1.5 Which of the following substances is most likely to have ionic bonding?

A. NaCl
B. H_2O
C. Fe
D. CS_2

1.6 Which one of the following is amphoteric?

A. H_2SO_4

B. H_2O

C. NaOH

D. H_3O^+

1.7 Which of the following solutions is an example of a strong acid?

A. 1,0 mol.dm^{-3} CH_3COOH

B. 0,1 mol.dm^{-3} HCl

C. 0,1 mol.dm^{-3} NH_3

D. 1,0 mol.dm^{-3} NaOH

1.8 Refer to the following equation:

$$NH_3\ (g) + H_2O\ (l) \rightleftharpoons NH_4^+\ (aq) + OH^-\ (aq)$$

The two Brønsted-Lowry bases in the reaction equation are:

A NH_3 and H_2O
B NH_4^+ and OH^-
C NH_3 and OH^-
D H_2O and NH_4^+

1.9 How many moles of CO_2 are produced when 5 moles of oxygen gas react completely with methane (CH_4)?

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

A. 1 mole

B. 2.5 moles

C. 5 moles

D. 10 moles

1.10 What happens to the bonds in the reactants during an endothermic reaction?

A. Bonds in the reactants are broken, and energy is absorbed.

B. Bonds in the reactants are broken, and energy is released.

C. Bonds in the reactants are formed, and energy is absorbed.

D. Bonds in the reactants are formed, and energy is released.

[2 X 10 = 20]

SECTION B

Question 2

Most substances used in our daily lives are either pure substances or mixtures.

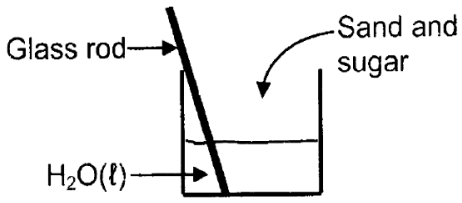
2.1 Define the term *homogeneous mixture*. (2)

2.2 Complete the table below. Write down only the answer next to the question number (2.2.1-2.2.4) in your answer book.

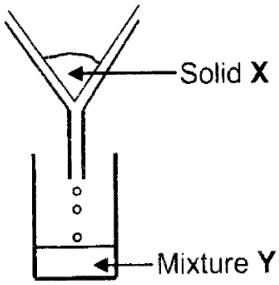
SUBSTANCE	ELEMENT / COMPOUND / MIXTURE	REASON
Ice	**2.2.1**	**2.2.2**
Brass	**2.2.3**	**2.2.4**

(4)

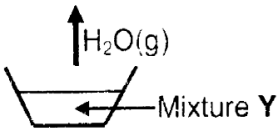
2.3 Some Grade 10 learners perform an experiment to separate a mixture of sand and sugar. The experiment is done in three steps, as shown in the diagrams below:



Step 1



Step 2



Step 3

2.3.1 Write down the name of:

(a) The process illustrated in **step 2**. (1)

(b) The process illustrated in **step 3**. (1)

(c) Solid **X**. (1)

(d) Mixture **Y**. (1)

2.3.2 Is **step 3** a CHEMICAL or PHYSICAL process? Give a reason for your answer. (2)

[12]

Question 3

3.1 Define the term *isotope*. (2)

3.2 Study the unknown elements **A** to **E** below and write down the letters of the elements that are isotopes of each other? (1)

A	**B**	**C**	**D**	**E**
$^{19}_{9}X$	$^{19}_{10}X$	$^{20}_{9}X$	$^{21}_{11}X$	$^{19}_{8}X$

3.3 Natural chlorine consists of Cℓ-35 and Cℓ-37.

3.3.1 Write down the sp-notation for Cℓ-37. (2)

3.3.2 The relative atomic mass of chlorine is 35,5. Calculate the percentage of Cℓ-35 in natural chlorine. (3)

3.4 Chlorine gas ($C\ell_2$) consists of molecules. Write down the:

3.4.1 number of valence electrons in a chlorine atom (1)

3.4.2 type of bonding in chlorine molecules (1)

3.4.3 Lewis structure for the chlorine molecule (2)

3.5 Calcium reacts with chlorine to form calcium chloride.

3.5.1 Write down the chemical symbols of the ions found in the calcium chloride crystal lattice. (2)

3.5.2 Draw the Aufbau diagram for a calcium ion. (3)

[17]

Question 4

4.1 The table below shows the boiling and melting points of substances A to D.

SUBSTANCE	BOILING POINT (°C)	MELTING POINT (°C)
A	78	–117
B	444	133
C	–188	–220
D	184	90

4.1.1 Define the term *boiling point*. (2)

4.1.2 From the above table, write down the letter (**A**-**D**) that represents the substance which is a:

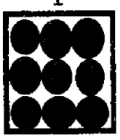
(a) liquid at 100°C (1)

(b) solid at 100°C (1)

(c) gas at 25°C (1)

4.1.3 Which one of the following diagrams represents the PARTICLE ARRANGEMENT of substance **A** at -115°C? Write down only **I**, **II** or **III**.

I

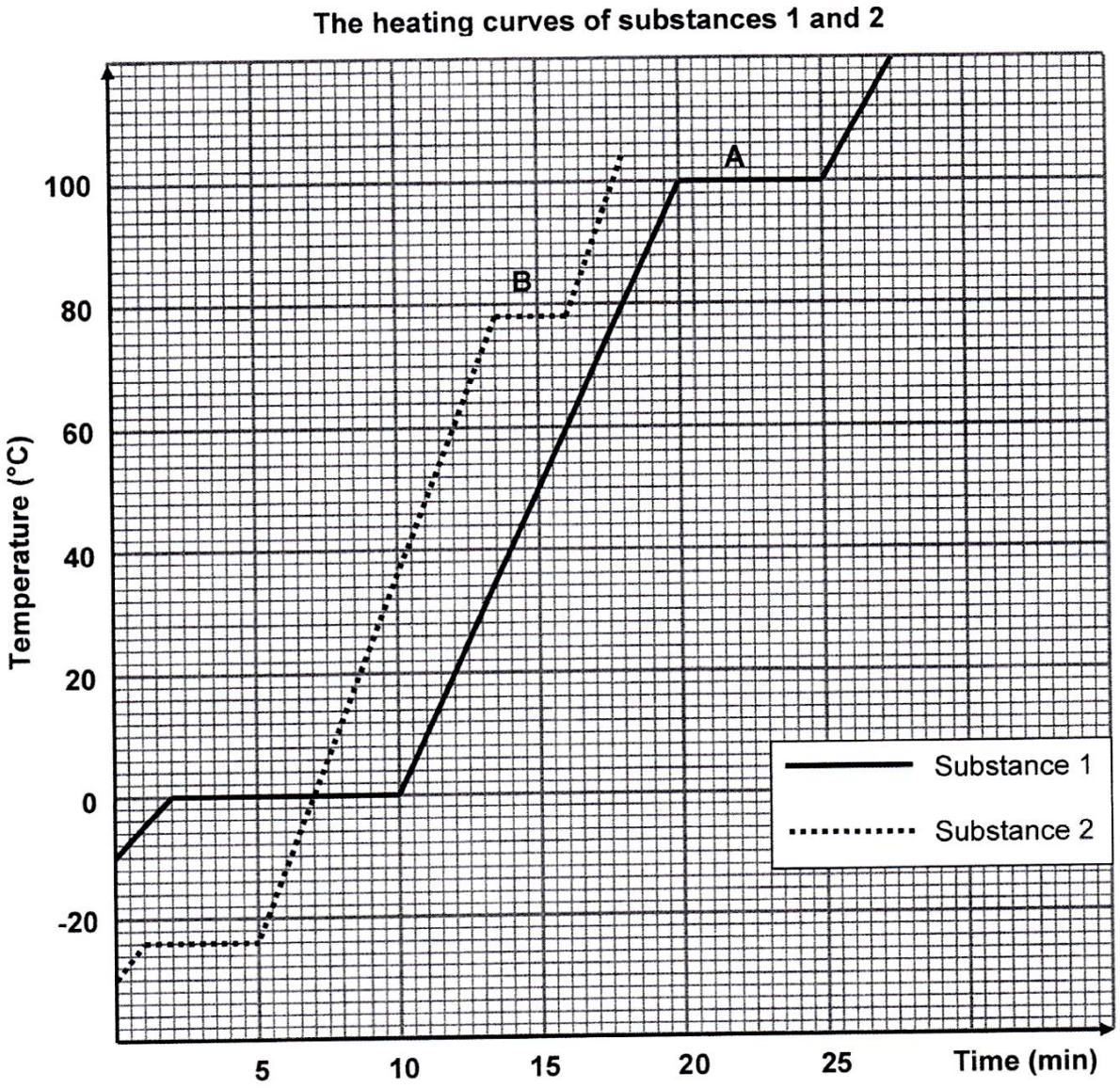


II

III

(1)

4.2 Grade 10 learners are investigating the effect of increasing temperature on two different substances (**1** and **2**) over a period of time. Study the temperature vs time graphs below and answer the questions that follow:



4.2.1 Write down the dependent variable for this investigation. (1)

4.2.2 In which phase is substance **1** at -10°C? (1)

4.2.3 At what temperature does substance **2** melt? (1)

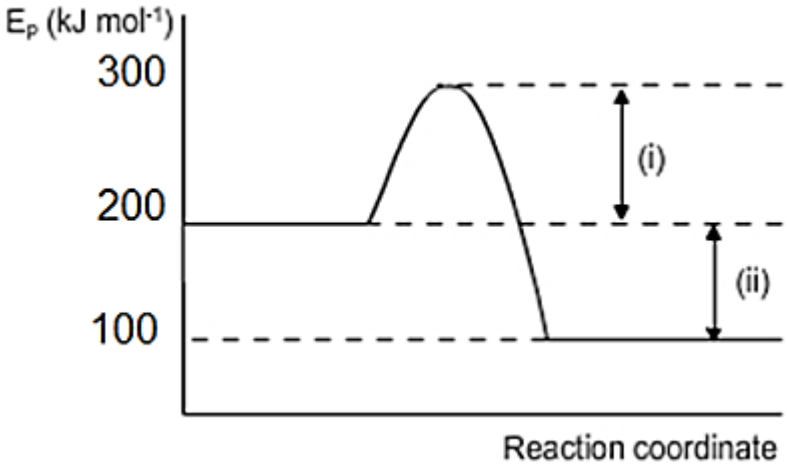
4.2.4 State the phase change that takes place at **B**. (1)

4.2.5 Which substance on the graph has the weakest intermolecular forces between the molecules in the liquid phase? Give a reason for your answer. (2)

4.2.6 Name the apparatus used to measure the average kinetic energy of the particles. (1)

[13]

Question 5



5.1 State whether the above graph of the potential energy of a reaction represents an ENDOTHERMIC or EXOTHERMIC reaction. (1)

5.2 Calculate ΔH for the forward reaction and explain how this answer proves your answer to QUESTION 5.1. (4)

5.3 Write down the value for the activation energy for the reverse reaction. (1)

5.4 Describe the change that would be observed in this graph if a catalyst was added. (1)

[7]

Question 6

The reaction between sodium and water is represented by the following balanced chemical equation:

$$2Na(s) + 2H_2O(\ell) \rightarrow 2NaOH(aq) + H_2(g)$$

During the reaction 10 g of sodium metal reacts with excess water to produce hydrogen gas at STP. The volume of the aqueous solution resulting from this reaction was 2 dm^3.

6.1 Calculate the volume of hydrogen gas that will be produced. (6)

6.2 Calculate the mass of NaOH that will be produced. (3)

6.3 Define *concentration*. (2)

6.4 Calculate the concentration of the resulting aqueous sodium hydroxide solution. (3)

6.5 Calculate the <u>actual mass</u> of sodium hydroxide that would have been produced if the yield of the reaction was only 96,5%. (2)

[16]

Question 7

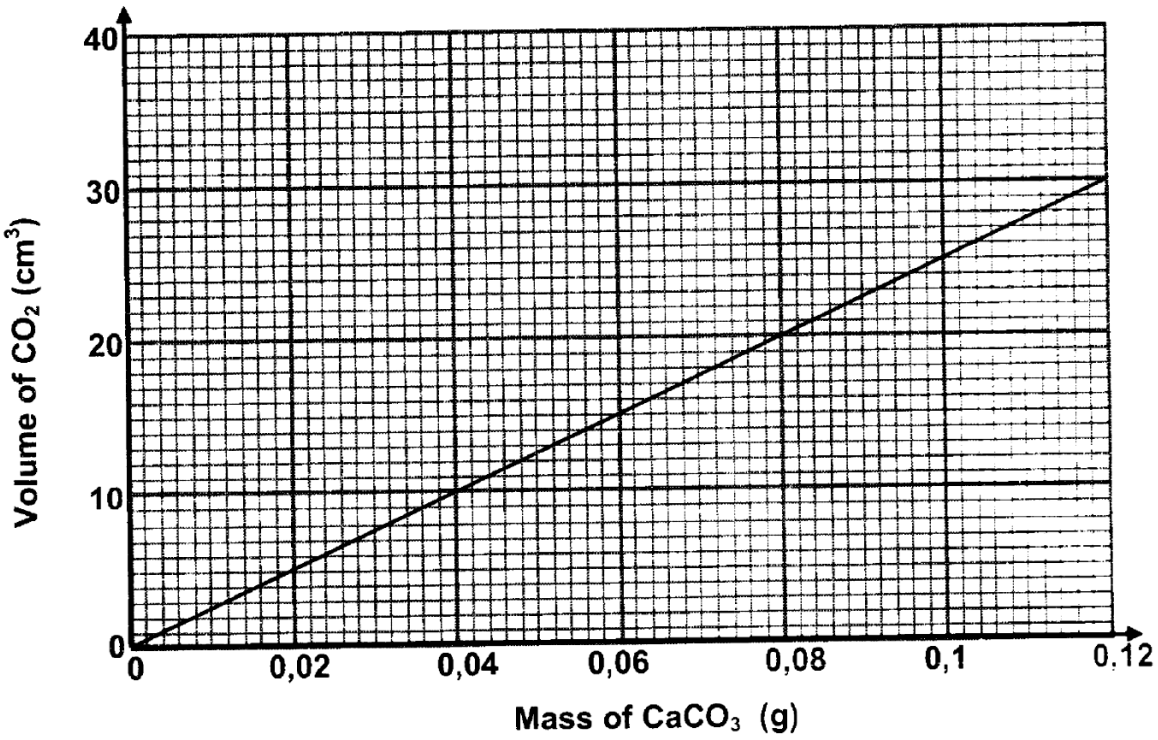
7.1 When 207 g of lead, Pb, combines with oxygen, 239 g of a certain oxide of lead is formed. Use a calculation to determine the molecular formula of this oxide of lead. (5)

7.2 A certain antacid tablet contains calcium carbonate, $CaCO_3$, which reacts with hydrochloric acid in the stomach according to the following balanced equation:

$$CaCO_3(s) + 2\,HC\ell(aq) \rightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(\ell)$$

7.2.1 Use the law of conservation of mass to show that mass is conserved during this reaction. (4)

The graph below shows the relationship between the volume of carbon dioxide gas formed from this reaction compared to the mass of calcium carbonate used.



$$CaCO_3(s) + 2\,HC\ell(aq) \rightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(\ell)$$

7.2.2 It is found that 25 cm^3 of $CO_2(g)$ is formed when one antacid tablet completely reacts. Use the information in the graph to determine the mass of $CaCO_3(s)$ in one antacid tablet. (1)

7.2.3 If the concentration of the stomach acid is 0,1 $mol.dm^{-3}$, calculate the volume of hydrochloric acid that will be neutralised by ONE antacid tablet. (5)

[15]

Question 8

8.1 Define an acid according to the Bronsted-Lowry definition. (1)

8.2 Copy and complete the following reactions to give BALANCED chemical equations:

8.2.1 $Zn + HC\ell \rightarrow$ ….. (3)

8.2.2 $H_2CO_3 + Ba(OH)_2 \rightarrow$ ….. (3)

8.3 Write a balanced chemical equation to represent the reaction between nitric acid and aluminium carbonate. (5)

[12]

Question 9

9.1 Write the formulae of the following compounds:

9.1.1 copper (II) fluoride (2)

9.1.2 magnesium phosphate (2)

9.2 Write down the names of the following compounds:

9.2.1 $K_2Cr_2O_7$ (2)

9.2.2 $Fe(OH)_3$ (2)

[8]

Total 120

EXTENSION QUESTION 10 – For Miss Badenhorst's classes ONLY

Only answer this question when you have FINISHED the rest of the exam.

Consider the balanced equation:

$$\mathbf{4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O}$$

42.5g of NH_3 and 80g of O_2 are added together.

10.1 Show by means of calculation which reactant is used up first (limiting reagent). **(6)**

10.2 What mass of the reactant in excess remains over after the reaction? **(3)**

[9]

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)
2,1 **H** 1																	**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**															

Ce 140	**Pr** 141	**Nd** 144	**Pm**	**Sm** 150	**Eu** 152	**Gd** 157	**Tb** 159	**Dy** 163	**Ho** 165	**Er** 167	**Tm** 169	**Yb** 173	**Lu** 175
Th 232	**Pa**	**U** 238	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa