Hillcrest High School

PHYSICAL SCIENCE P2

Nov 2023

Grade 10

MARKS: 140(134)
TIME: 2 Hours

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

Instructions:

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (120)
4. Answer SECTIONS A and B in the ANSWER BOOK.
   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. 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 ONE of the following groups of elements are classified as halogens?

A. Li, Na, K
B. Ne, Ar, Kr
C. F, Cl, Br
D. I, Br, N

1.2 The process whereby solid substances change directly to gaseous phase is called…

A. Evaporation
B. Condensation
C. Sublimation
D. Melting

1.3 Which one of the following substances is a pure substance?

A. Steel
B. Juice
C. Sulphur
D. Salt water

1.4 If 30g of reactant A reacts completely with 25g of reactants B, which ONE of the following statements is CORRECT?

A. The total mass of products plus any unreacted reactants will be less than 55 g.
B. The total mass of products plus any unreacted reactants will be greater than 55 g.
C. The total mass of products plus any unreacted reactants will be 55 g.
D. The total mass of the products will be equal to 55 g.

Look at the diagram below to answer questions 1.5 and 1.6:

A group of Grade 10 learners combined different substances to make **heterogeneous** and **homogeneous** mixtures with water. Among these were the following:

A – Oil and water

B – Sand and water

C – Concentrated Oros juice and water

D – Salt and water

1.5 The property used to separate the substances in mixture A is:

A boiling point

B melting point

C density

D phase difference

1.6 The separation technique used to separate mixture B is:

A Evaporation
B Decantation
C Distillation
D Filtration

1.7 During the formation of ionic compounds, the valence electrons are…

A. transferred.
B. shared unequally.
C. destroyed.
D. shared equally.

1.8 The following substance **cannot** act as an ampholyte:

A HSO_4^{-1}
B HCO_3^{-1}
C H_2O
D NH_3

1.9 Consider the following reaction for the preparation of ammonia.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

The stoichiometry of this reaction is represented best by:

A	3 cm^3 N_2 (g)	+	2 cm^3 H_2 (g)	→	3 cm^3 NH_3 (g)
B	2 cm^3 N_2 (g)	+	1 cm^3 H_2 (g)	→	3 cm^3 NH_3 (g)
C	1 cm^3 N_2 (g)	+	3 cm^3 H_2 (g)	→	2 cm^3 NH_3 (g)
D	2 cm^3 N_2 (g)	+	6 cm^3 H_2 (g)	→	9 cm^3 NH_3 (g)

1.10 Consider the following electron configuration:

$1s^2 2s^2 2p^6 3s^2 3p^6$

This electron configuration represents:

A argon and chloride
B argon and potassium
C argon and sulphur
D argon and calcium

[2 X 10 = 20]

Question 2

2.1 A list of properties of metals are listed in the box below.

malleable; ductile; electrical conductors, lustrous, high density, thermal conductivity

Select the property which best fits the description in each of questions 2.1.1 – 2.1.3

2.1.1 Copper can be stretched into thin wires. (1)
2.1.2 Aluminium can be moulded(shaped) into pots and pans. (1)
2.1.3 It is dangerous to push an iron nail into a wall socket. (1)

2.2 Sugar dissolves in water to produce a sugar solution.

2.2.1 Give a reason why a sugar solution is a MIXTURE and not a COMPOUND. (2)
2.2.2 State whether the sugar solution is HOMOGENEOUS or HETEROGENEOUS. (1)
2.2.3 Give a reason for the answer to QUESTION 2.2.2. (2)
2.2.4 Is the dissolution process a PHYSICAL or a CHEMICAL change? (1)

[9]

Question 3

Element X has 8 protons and 8 neutrons and it supports combustion.

3.1 For element X, write down:

3.1.1 Its chemical name. (1)

3.1.2 The atomic mass number. (1)

3.2 An atom of element X forms an ion.

3.2.1 Write down the type of ION that forms when an atom gains electron.
(Choose from ANION or CATION). (1)

3.2.2 What will be the charge on the ion from atom X? (1)

3.2.3 From the periodic table, identify an element with the same electron configuration as the ion formed from atom X. (2)

3.2.4 Write down the chemical NAME for the ion that is formed from atom X. (2)

[8]

3.3 Potassium naturally exists as isotopes, ^{39}**K** and ^{41}**K.**

Isotope	% abundance	Atomic Mass number
^{39}K	93.258	38.964
^{41}K.	6.742	**X**

Question was unclear and thus removed

3.3.1 Define the term *isotope*. (2)

3.3.2 The relative atomic mas of potassium is 39. Determine the atomic mass number (**X**) of Potassium 41 isotope. (4)

[6]

Question 4

Complete the following table – you **must not draw the table out**.

Just **write the question number and answer next to it.**

Eg. 3.4.1 12

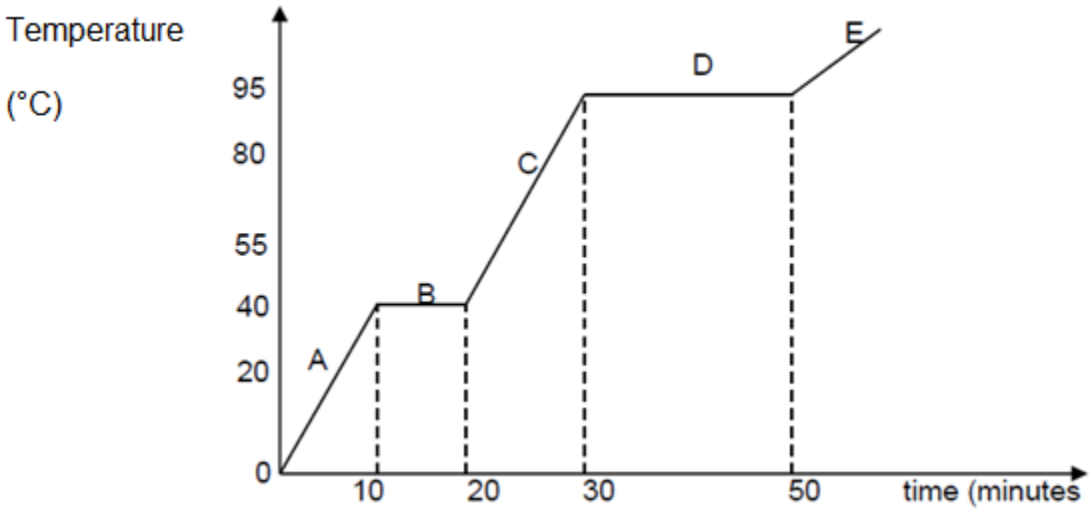
	Number of protons	Number of neutrons	Number of electrons	Write the electron configuration/ sp-notation	Draw the Aufbau diagrams/ energy level diagrams	Number of valence electrons	Charge
C-13	4.1	4.2	4.3		4.4 (2)		
Sodium ion	4.5		4.6				4.7
Fluoride			4.8	4.9 (2)		4.10	4.11

[13]

Question 5

Esihle, a grade 10 learner, investigates the relationship between the phase changes and the temperature of an unknown powder. A sample of the powder is placed in a test tube. The test tube is placed in a water bath and heated.

She records the temperature for the different times and uses the results to draw the graph shown below.



5.1 For <u>this</u> investigation write down:

5.1.1 an investigative question. (2)

5.1.2 the independent variable. (1)

5.1.3 the dependent variable. (1)

5.2 Define boiling point of a liquid. (2)

5.3 Refer to the graph and write down, for the unknown powder, the:

5.3.1 Melting point. (1)

5.3.2 Boiling point. (1)

5.4 Refer to the graph and write down the letter that shows a phase in which:

5.4.1 only a solid is present. (1)

5.4.2 only a gas is present. (1)

5.4.3 only a liquid is present. (1)

5.4.4 both a solid and liquid are present. (1)

[12]

Question 6

6.1 The s,p-notation of two elements P and Q, is given:

P: $1s^2\ 2s^2\ 2p^4$

Q: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

Write the name and symbol of:

6.1.1 the compound that forms when P and Q bond. (2)

6.2 Name the type of chemical bond that forms when P and Q react. (1)

6.3 Draw the Cooper-structure of the compound that forms. (2)

Q now reacts with SODIUM metal.

6.4 What type of compound is formed? Write down only IONIC or COVALENT. (1)

6.5 Draw the Lewis structure of the compound that forms. (4)

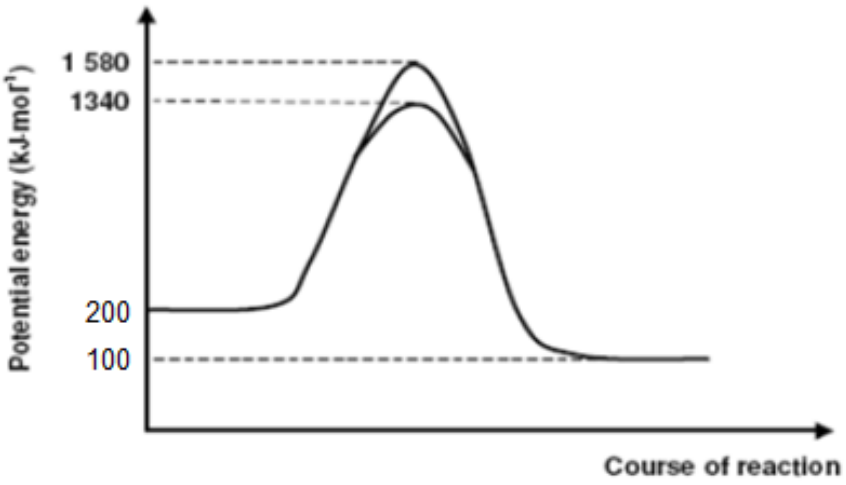
[10]

Question 7

The contact process is used to prepare sulphuric acid in high concentrations needed for industrial purposes. This process involves the oxidation of sulphur dioxide in the presence of a vanadium (V) oxide catalyst:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Use the reaction and the graph, where applicable to answer the questions that follow.



7.1 Is the forward reaction exothermic or endothermic? Prove your answer by calculating the value of ΔH for this reaction. (2)

7.2 What is the activation energy for the forward reaction in the absence of the vanadium(V)oxide catalyst? (1)

7.3 How much energy is released when the new bonds in the SO_3 molecules form from the activated complex. (1)

7.4 Determine the activation energy for the REVERSE REACTION in the presence of the vanadium (V) oxide catalyst. (1)

[5]

Question 8

8.1 Define a ***Compound.*** (2)

8.2 Calculate the percentage of chromium in $K_2Cr_2O_7$. (3)

8.3 An inorganic substance was analysed and found to be containing 65,31% of oxygen, 32,65% of Sulphur and **x** amount of hydrogen.

8.3.1 Define an ***empirical formula***. (1)

8.3.2 Calculate the percentage of hydrogen element in the substance. (2)

8.3.3 Determine the empirical formula for the compound. (4)

8.4 6,257 of hydrated copper sulphate was heated, and during heating the mass was recorded. The mass of the content was decreasing and after a while the mass remained unchanged at 4 g.

8.4.1 Give a reason why the mass decreased. (2)

8.4.2 Calculate the number moles of water in the original hydrated salt. (4)

[18]

Question 9

9.1 An unknown mass of Zinc granules was allowed to react with 25cm^3 of 0,12$mol.dm^{-3}$ hydrochloric acid solution as shown in the equation below:

$2HCl(aq) + Zn(s) \rightarrow ZnCl_2(aq) + H_2(g)$

9.1.1 Define *concentration*. (2)

9.1.2 State the test used to determine the gas formed in the above reaction. (1)

9.1.3 Calculate the mass of Zn that will react with the hydrochloric acid. (Write your answer in scientific notation.) (5)

9.2 If 5 dm^3 of hydrogen gas was collected after the reaction was complete, calculate the mass of zinc used in the reaction.(the reaction takes place at STP.) (5)

[13]

Question 10

10.1 Define a weak base (2)

Rewrite and complete the following equations in symbol form and then balance the equations

10.2 Copper(II) hydroxide + nitric acid →

10.3 Sodium carbonate + sulphuric acid → (2 x 5 = 10)

[12]

Question 11

Write the formulae of the following compounds:

11.1 iron (II) chloride

11.2 barium carbonate

11.3 ammonium sulphate

11.4 potassium dichromate **[2 x 4 = 8]**

Question 12

Write down the names of the following compounds:

12.1 $Ca(NO_3)_2$

12.2 $Al(OH)_3$

12.3 CuO **[2 x 3 = 6]**

Total 140

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																	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	10 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	18 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	36 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	54 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	86 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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa