HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE

GRADE 10

PAPER 2 - Chemistry

NOVEMBER 2020
TIME: 2 HRS

Total 140

Instructions

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (120)

   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.

QUESTION 1

For each of the following questions, four possible answers are provided. Each question has only ONE correct answer. Choose the MOST correct answer from the list and write down the corresponding letter next to the question number.

1.1. The scientist that discovered that an atom contains positive and negative particles is…

A Rutherford
B Dalton
C Bohr
D Thomson

1.2. The number of neutrons in $^{24}_{12}Mg$ is:

A 6
B 12
C 24
D 36

1.3. Elements in the same period in the Periodic Table have the same number of…

A protons
B electrons
C nucleons
D energy levels

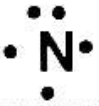
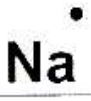
1.4. Which one of the following represents the electronic structure of phosphorus (P)?

A $1s^2 2s^2 2p^6 3s^2$
B $1s^2 2s^2 2p^6 3s^2 3p^3$
C $1s^2 2s^2 2p^6 3s^2 3p^5$
D $1s^2 2s^2 2p^6 3s^2 3p^6$

1.5. Which of the following mixtures can be separated using a separating funnel?

A Two solids with different particle sizes
B Two liquids with different boiling points
C Two liquids with different densities
D A solid suspended in a liquid

1.6. Which ONE of the following Lewis structures is INCORRECT?

A	
B	
C	
D	

1.7. In which ONE of the following compounds do BOTH ions have the same electron configuration as Argon?

A calcium sulfide
B magnesium oxide
C sodium sulfide
D calcium bromide

1.8. When an atom X of an element in Group 1 reacts to become X^+, the…

A mass number of X increases
B atomic number of X decreases
C charge of the nucleus increases
D number of occupied energy levels decreases

1.9. When a solid changes directly into a gas, … takes place.

A. evaporation
B. condensation
C. deposition
D. sublimation

1.10 Which ONE of the following represents one mole of gas as STP?

A 16 dm^3 O_2
B 28 dm^3 N_2
C 22,4 dm^3 Ar
D 44,8 dm^3 N_2

[10 x 2]

QUESTION 2

Sodium reacts with chlorine to form sodium chloride, NaCl, a substance used in all households as table salt.

2.1. Name the type of bonding of which sodium chloride is an example. (1)

2.2. Represent the FORMATION of sodium chloride with the aid of Lewis diagrams. (4)

2.3. For the sodium ION, write down its:

2.3.1 sp notation (2)

2.3.2 number of protons (1)

2.4 For the chlorine ATOM:

2.4.1 Draw its Aufbau diagram. (3)

2.4.2 Write down its number of valence electrons. (1)

2.4.3 State *Hund's Rule*. (2)

2.5. A chlorine atom can also bond to another chlorine atom to form a diatomic molecule.

2.5.1 Name the type of bond that forms between two chlorine atoms. (1)

2.5.2 Represent the chlorine molecule with a Lewis diagram. (2)

[17]

QUESTION 3

3.1 Below is a list of substances:

copper metal, sulfur dioxide gas, plastic, glass, muesli, air, water, sodium chloride crystals

Write down a material from the list that has the following properties:

3.1.1 An ionic compound that, when dissolved in water, can conduct electric current. (1)

3.1.2 A good conductor of heat and electricity that has a high melting point and can be beaten into shape. (1)

3.1.3 A heterogeneous mixture. (1)

3.1.4 A covalent compound. (1)

3.2 Write down the correct chemical formula for the following substances:

3.2.1 Carbon tetrachloride (1)

3.2.2 Copper (II) chloride (1)

3.2.3 Sodium phosphate (1)

3.3 Write down the names of the following compounds, using stock notation where applicable:

3.3.1 $Fe(NO_3)_3$ (2)

3.3.2 $KMnO_4$ (2)

3.3.3 N_2O (2)

3.4 Rewrite and balance the following equation:

$H_3PO_4 + Na_2CO_3 \rightarrow Na_3PO_4 + H_2O + CO_2$ (2)

[15]

QUESTION 4

Naturally occurring oxygen consists of three isotopes as indicated below.

ISOTOPE	PERCENTAGE ABUNDANCE (%)
O-16	99,76
O-17	0,04
O-18	X

4.1 Which sub-atomic particle is responsible for the occurrence of isotopes? (1)

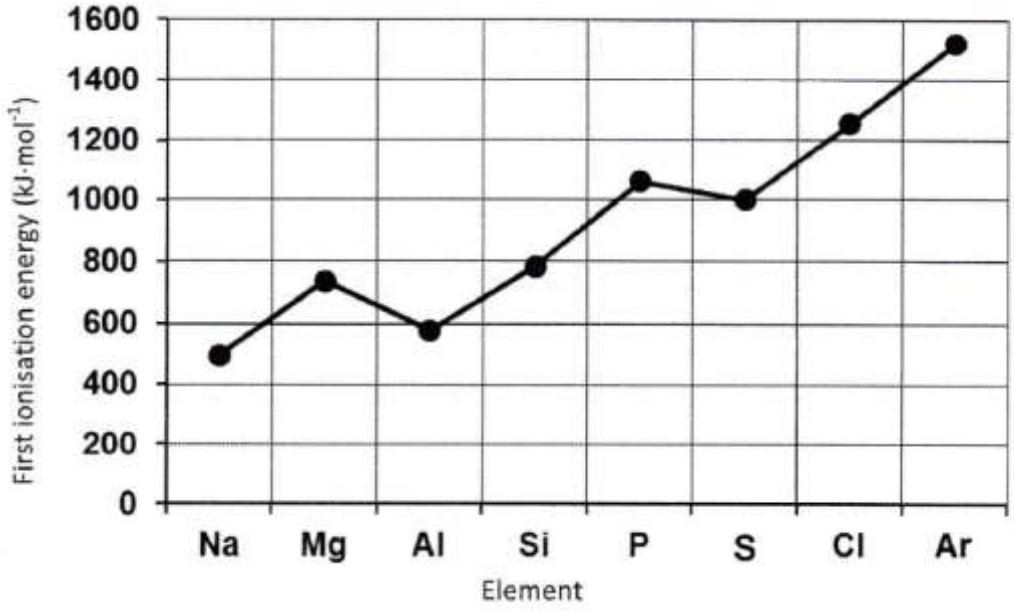
4.2 What is the percentage abundance of O-18? (1)

4.3 Calculate the relative atomic mass of oxygen. (4)

[6]

QUESTION 5

The graph shows the first ionisation energies of the elements of period 3 in the Periodic Table.



5.1 Define *Ionisation Energy*. (2)

5.2 Describe the general trend in the first ionisation energies from sodium to argon. (1)

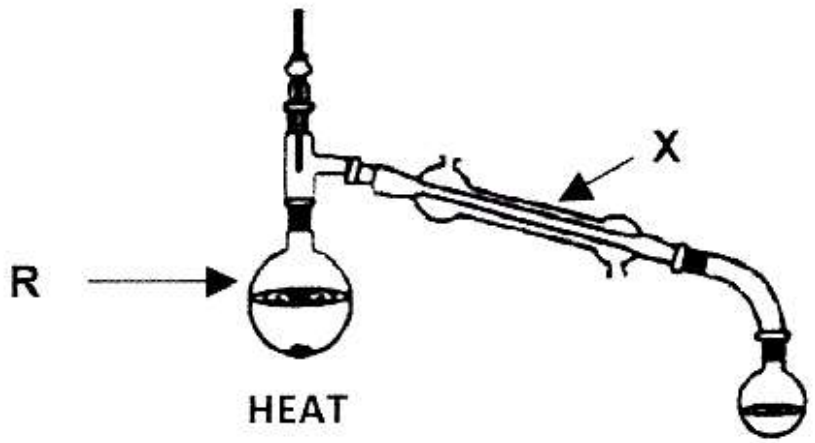
5.3 Explain the difference in the first ionisation energies of magnesium and chlorine. (3)

5.4 How will the SECOND ionisation energy for sodium compare to its FIRST ionisation energy? Choose from GREATER THAN, EQUAL TO or LESS THAN and explain your answer. (4)

[10]

QUESTION 6

6.1 Liquid A (Boiling point 40°C) dissolves in liquid B (Boiling point 85°C). A method to separate the solution is shown below:



6.1.1 What is the name given to this method of separation? (1)

6.1.2 What physical property of the substances is used to separate them? (1)

6.1.3 State the phase change that occurs in the flask labelled **R**. (1)

6.1.4 Name the process that occurs in the tube labelled **X**. (1)

6.1.5 Which liquid remains in flask **R** after the separation is complete? (1)

6.2 Identify the reactions below as a PHYSICAL or CHEMICAL change.

6.2.1 Ice melting (1)

6.2.2 Glass breaking (1)

6.2.3 Bread toasting (1)

6.3 The table below shows the boiling points and melting points of substances A, B and C.

SUBSTANCE	MELTING POINT	BOILING POINT
A	25	115
B	107	249
C	-47	59

6.3.1 Define *melting point*. (2)

6.3.2 Describe the phase change of substance **A** at 115°C. (1)

6.3.3 In what phase (solid, liquid or gas) are the particles of **B** at room temperature? (1)

6.3.4 Identify the substance that will change from LIQUID to GAS when it is heated from 0°C to 100°C. (1)

6.3.5 Which substance will change from SOLID to LIQUID when it is heated from 0°C to 100°C? (1)

6.3.6 By referring to the strength of the intermolecular forces and the energy of the particles, explain the changes that take place when substance C is cooled from 80°C to -10°C. (3)

[17]

QUESTION 7

7.1 Calculate:

7.1.1. the number of moles in 72 g sodium metal. (3)

7.1.2 the mass of 1,5 moles of aluminium carbonate, $Al_2(CO_3)_3$ (3)

7.1.3. the number of atoms in 660 cm^3 nitrogen gas at STP. (6)

7.1.4. the concentration of potassium sulfate K_2SO_4 if 6,5g of K_2SO_4 is dissolved in water to make a 265 cm^3 solution. (5)

7.2 The empirical formula for a certain compound is to be determined. On analysis, a sample of the compound was found to contain 48,7% C, 8,1% H and 43,2% O.

7.2.1 Define *empirical formula*. (1)

7.2.2 Determine the empirical formula of the compound. Show ALL calculations. (4)

7.3 Consider the balanced equation:

$$2\ Pb(NO_3)_2(s) \rightarrow 2\ PbO(s) + 4\ NO_2(g) + O_2(g)$$

7.3.1 Show that the Law of Conservation of Mass is TRUE for this reaction. (5)

7.3.2 When 6,62 g of lead nitrate, $Pb(NO_3)_2$, is heated, 4,46 g of solid is produced. What is the mass of gas that will be produced? (1)

[28]

QUESTION 8

8.1 A 150 g impure sample of calcium oxide is added to nitric acid. If 40 g of water forms during the reaction, calculate the percentage of impurities in the calcium oxide sample. The chemical equation below shows the reaction that takes place.

$$CaO + 2\ HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$$ (6)

8.2 Consider the balanced equation:

$$N_2 + 3\,H_2 \rightarrow 2\,NH_3$$

10 dm^3 of H_2 and sufficient N_2 are allowed to react together at STP.

8.2.1 Calculate the number of moles of ammonia that is produced in this reaction. (4)

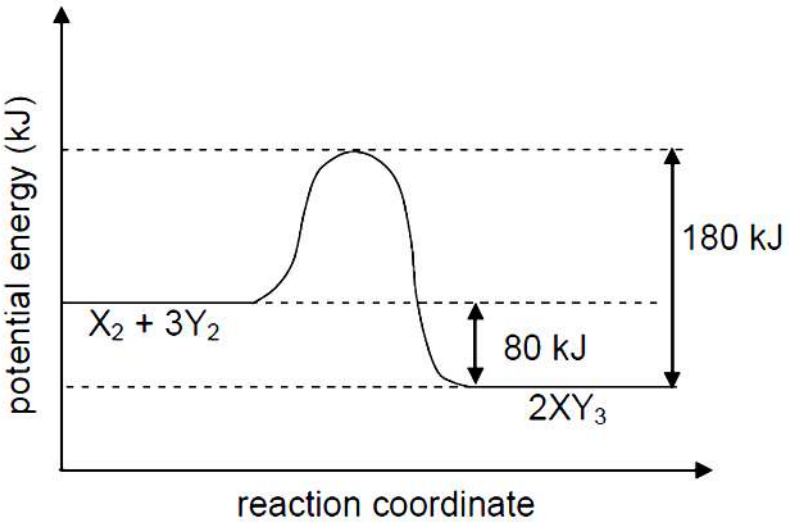
8.2.2 If the reaction produces 4,58 g of ammonia, calculate the percentage yield. (3)

[13]

QUESTION 9

The diagram below shows the change in potential energy for a hypothetical reaction, represented by the following equation:

$$X_2(g) + 3Y_2(g) \rightarrow 2XY_3(g)$$



9.1 Is the reaction ENDOTHERMIC or EXOTHERMIC? (1)

9.2 What is the Heat of Reaction, ΔH? (1)

9.3 Calculate the activation energy, Ea, for the FORWARD reaction. (2)

[4]

QUESTION 10

10.1 Write down the Bronsted-Lowry definition of a base. (1)

10.2 Consider the following substances:

$$H_2SO_4 \; ; \quad HSO_4^- \; ; \quad SO_4^{2-}$$

10.2.1 Write down the formula of the substance/s that can act as an ampholyte. (1)

10.2.2 Write down the formula of the substance that is the conjugate acid of HSO_4^-. (1)

10.3 Complete and balance the following reaction equation:

$HCl + MgCO_3 \rightarrow \ldots$ (3)

10.4 Write a balanced equation for the reaction between potassium and nitric acid. (4)

[10]

140 Marks

Data and Formulae

Periodic Table