**Chemistry**

**30/06/2021 08.30 AM - 11.30 AM**



S4 END OF YEAR EXAM, 2020/2021

SUBJECT: CHEMISTRY THEORY

COMBINATIONS:

MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)

PHYSICS-CHEMISTRY-BIOLOGY (PCB)

BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)

PHYSICS-CHEMISTRY-MATHEMATICS (PCM)

DURATION: 3 HOURS

**Instructions:**

1. There are 2 sections in this paper:

Section A (70 marks): Attempt all questions in this section

Section B (30 marks): Attempt 3 questions in this section.

1. Do not use periodic tables
2. Non-programmable calculators may be used
3. Answers should be written on blank papers provided
4. Use a blue or black pen only

**SECTION A: Attempt all questions in this section (70 marks)**

1 a) State 2 sub-atomic particles which are present in the nucleus of an atom.

(**2 marks**)

b) Describe the term **“atomic number”.** (**2 marks**)

2.a) Describe the term **“isotopes of an element”.** (**2 marks**)

b) State 2 properties of a neutron. (**2 marks**)

3. a) Describe the process by which particles of an element are ionized in a mass

spectrometer.(**2 marks**)

b) Explain the process by which particles (isotopes) of an element are detected

in a mass spectrometer after they have been ionized. (**2 marks**)

(c) A sample of boron contains 20% by mass of 10B and 80% by mass of 11B.

Calculate the relative atomic mass of boron in this sample. (**3 marks**)

4) Mass spectra enable you to find relative abundances of the isotopes of a

particular element.

a) Define relative atomic mass. (**2 marks**)

b) The mass spectrum of strontium contains the following lines for 1+ ions:

|  |  |
| --- | --- |
| m/z | % abundance |
| 84 | 0.56 |
| 86 | 9.86 |
| 87 | 7.00 |
| 88 | 82.58 |

1. Calculate the relative atomic mass of strontium. (**2 marks**)
2. Determine the number of protons, electrons and neutrons present in the

most abundant isotope of strontium ion, Sr+ (Sr atomic number is 38)

(**2 marks**)

5 a) State the colour of the light associated with the line emission spectrum of

sodium? **(1 mark**)

b) Explain how line emission spectra occur. (**2 marks**)

c) Explain the relationship between line emission spectra and energy levels in

atoms. (**2 marks**) 6 (a) Explain why metals are generally good conductors of electricity. (**2 marks**)

(b) Explain why most ionic crystals dissolve in water. (**2 marks**)

7 (a) Describe the formation of a “covalent bond”. (**2 marks**)

b) Distinguish between the nature of a sigma (σ) bond and a pi (π) covalent

bond. (**2 marks**)

8) Explain clearly, in terms of bonding, why:

a) Aluminium is a good conductor of electricity. (**2 marks**)

b) Sodium chloride is soluble in water. (**2 marks**)

c) Graphite is soft and slippery. (**2 marks**)

9 a)Define the term “first ionisation energy”. (**2 marks**)

b) Explain the trends in variation of first ionisation energy of elements across

the second period of the periodic table (i.e. Li to Ne). (**2 marks**)

c) Explain the trend in variation of first ionisation energy of the elements going

down Group II of the periodic table, i.e. the alkaline-earth metals. (**2 marks**)

10 a)Define atomic radius (covalent radius). (**2 marks**)

b) (i) Describe and account for the trend in atomic radii (covalent radii) of the

elements across the second period. (**2 marks**)

(ii) Describe and account for the trend in atomic radii (covalent radii) of the

elements down any group, of the periodic table. (**2 marks**)

11 (a) Write balanced equation for the reaction between sodium and water.

(**2 marks**)

(b) Write balanced equation to show the thermal decomposition of lithium

nitrate, LiNO3. (**2 marks**)

12) Explain the following observations:

a) Sodium carbonate solution turns red litmus blue. (**2 marks**)

b) Lithium chloride readily dissolves in ethanol than water. (**2 marks**)

13) Magnesium oxide MgO, forms a similar ionic lattice to that of sodium chloride.

a) Suggest the reason why MgO has higher melting point than NaCl. (**2 marks**)

b) Explain why the boiling point of group 17 elements increases down the

group. (**2 marks**)

14) Consider the following reversible chemical reaction which is normally carried

out at 450 0C, 200 atmospheres of pressure and using finely divided iron

catalyst:

N2(g) + 3H2(g) 2NH3(g) ∆H= -92 KJ mol-1

a)Use Le Chatelier’s principle to predict the levels of the yield of ammonia

when equilibrium is established.

(i) If the temperature is increased so much (eg to 1000 0C) (**2 marks**)

(ii) If the pressure is increased very much (eg to 250 atmospheres).

(**2 marks**)

b) What is the importance of the iron catalyst in the production of ammonia?

(**2 marks**)

**SECTION B: Attempt any three questions in this section (30 marks)**

15 a) Briefly describe how the elements beryllium, magnesium and calcium react

with water. (**3 marks**)

b) Describe how ethylene is obtained from calcium. (**2 marks**)

c) Compare the reactivity of metals of group I and group II (**2 marks**)

d) The elements Be, Mg and Ba belong to group II in the periodic table

(i) State two common chemical properties shown by these elements.**(1 mark)**

(ii) Explain the trends in solubility of their hydroxides. **(1 mark**)

(iii) State two properties in which Be differ from the rest of the group

member. **(1 mark)**

16 a) State two properties in which carbon differs from the rest of group 14

elements. (**2 marks**)

b) By using the appropriate chemical equations, explain two similarities

between tin and lead.

(**2 marks**)

c) Write the balanced equation between water and Silicon tetrachloride.

(**2 marks**)

d) Explain why carbon tetrachloride is insoluble in water. (**2 marks**)

e) Write equations to show the amphoteric nature of lead (II) oxide. (**2 marks**)

17 a) Describe the term **“standard enthalpy change of formation”**. (**1 mark**)

b) (i) Define the first law of thermodynamics. (**2 marks**)

(ii) Describe what the internal energy of a system is made up of. (**1 mark**)

c) Describe the 3 types of a thermodynamic systems and give an example for

each type. (**3 marks**)

d) Calculate the work done by a gas that expands by 6 litres against an external

pressure of 4.5 atmospheres. (**3 marks**)

(1 atmosphere = 101,325 Pa)

1. a) Define the term:

(i) Acid according to the “Lewis theory”. (**2 marks**)

(ii) Base according to the “Brønsted-Lowry theory”. (**2 marks**)

b) Identify the group which functions as a conjugate base on the left side and

another conjugate base on the right hand side of the equation below for the

dissociation of nitrous acid (HNO2): (**2 marks**)

HNO2 + H2O NO2- + H3O+

c) Explain why an aqueous solution of AlCl3 has a PH less than 7 **(2 marks)**

d) Describe the difference between a strong acid and a weak acid in water

according to “the Arrhenius theory”. **(2 marks)**

**MARKING SCHEME: CHEMISTRY (S4)**

**End of Year Examination: (100 marks)**

**End of Year Examination: 2020**

**SECTION A: (70 marks)**

1.a) 2 sub-atomic particles which are present in the nucleus of an atom: (**2 marks**)

-Proton

-Neutron

**(Give 1 mark for each answer)**

b) Describe the term **“atomic number”.** (**2 marks**)

The atomic number of an element is the number of protons in the nucleus.

2.a) Isotopes of an element: (**2 marks**)

Isotopes of an element are different atoms having the **same number of protons** but **with different number of neutrons**.

**(Give 1 mark for each underlined statement)**

b) 2 properties of a neutron: (**2 marks**)

-The electric charge of a neutron is zero

-The mass of a neutron is equal to that of a proton.

**(Give 1 mark for each answer)**

3. a) The process by which particles of an element are ionized in a mass spectrometer.(**2 marks**)

The vapourised sample passes through the ionization chamber where a **heated metal coil gives off electrons** which are attracted to the electron trap (positively charged plate). These **electrons knock off one or more electrons** from atoms or molecules to give positive ions.

**(Give 1 mark for each underlined statement)**

b)The process by which particles (isotopes) of an element are -Detection in a mass spectrometer: (**2 marks**)

A stream of ions makes it to the detector to **produce a current** which is a measure of **the number of ions** against mass per charge (m/z)

**(Give 1 mark for each underlined statement)**

(c) The relative atomic mass of boron in this sample. (**3 marks**)

= **10.80**

**(Give 2 marks for the working method and 1mark for the final answer)**

4. a)Relative atomic mass is the ratio of the average mass of atoms of a chemical element in a given sample of the atomic mass constant. (2 marks)

**(Accept other correct definitions)**

b) (i) The relative atomic mass of strontium. (**2 marks**)

= **87.71**

**(Give 1 mark for the working method and 1mark for the final answer)**

(ii) The most abundant isotope of strontium ion, Sr+ :

Number of protons= 38 **(0.5 mark)**

Number of electrons=37 **(0.5 mark)**

Number of neutrons=50 **(1 mark)**

5.a) Colour: Yellow**(1 mark**)

b) Origin of line emission spectra: (**2 marks**)

The emission spectrum of a chemical element or chemical compound is the spectrum of frequencies of electromagnetic radiation emitted due to an **atom or molecule making transition from a high energy state to a lower energy state**. Different lines are obtained due to the movement of electrons **from different initial energy states to reach different final energy states**.

c) The relationship between line emission spectra and energy levels in atoms: (**2 marks**)

The movement of an electron from different energy level to the lowest energy level is associated with a certain energy which corresponds to the characteristic colour of the wavelength.

**(Accept other correct answers)**

6. (a) Metals are generally good conductors of electricity: (**2 marks**)

Metals are good conductors of electricity because there are **free mobile electrons** around positive ions in the metal structure. These electrons carry charges from one position to another **under the influence of a potential difference**.

**(Give 1 mark for each underlined statement)**

(b) Most ionic crystals dissolve in water: (**2 marks**)

Most ionic crystals dissolve in water because the lattice bonds are broken when a certain amount of **energy (lattice energy) is absorbed by the crystal** and the resulting ions are then surrounded by water molecules with attraction between the ions and the partial charges on H2O.

This results in **liberation of energy (hydration energy)** which in turn enables more of the crystal to dissociate.

**(Give 1 mark for each underlined statement)**

7.(a) Formation of a covalent bond: (**2 marks**)

A covalent bond is formed when **each of the two atoms contributes one electron** to form a **pair for the bond between the two atoms**.

**(Give 1 mark for each underlined statement)**

b) A sigma bond (σ) is formed by **head to head overlap of atomic orbitals** whereas the pi (π) bond is formed by the **sideways overlap of two atomic orbitals**. (**2 marks**)

**(Give 1 mark for each underlined statement)**

8. a) Aluminium is good conductors of electricity because there are **free mobile electrons** around positive ions in the metal structure. (**2 marks**)

b) Sodium chloride dissolves in water because the lattice bonds are broken when a certain amount of **energy (lattice energy) is absorbed by the crystal** and the resulting ions are then surrounded by water molecules with attraction between the ions and the partial charges on H2O **to liberate hydration energy** (exothermic energy). (**2 marks**)

**(Give 1 mark for each underlined statement)**

c) Graphite is soft and slippery due to: (**2 marks**)

Graphite is formed by a layer structure in which **each carbon is linked to 3 other carbon atoms** by covalent bonds and the fourth electron of carbon is free to move. There are **no covalent bonds to attach carbon atoms between one layer to another**. So graphite becomes slippery.

**(Give 1 mark for each underlined statement)**

9.a) The first ionization energy is the minimum amount of energy required to **remove one mole of the most loosely bound electrons** of an element **in its gaseous state**. (**2 marks**)

**(Give 1 mark for each underlined statement)**

b) As you move across the second period, the first ionization energy increases due to the **increase in the number of protons in the nucleus** but with no increase in the number of shells.

This results in the **increase of the attraction of electrons towards the nucleus**. **(2 marks**)

**(Give 1 mark for each underlined statement)**

c) The first ionisation energy of the elements decreases as you go down group II of the periodic table.

This is due to **the increase in the number of shells** making the outermost shell electrons to be **farther away from the nu**cleus and become **less attracted to the nuclear charge** and therefore **more easily removed** with less energy. (**2 marks**)

**(Give 0.5 mark for each underlined statement)**

10.a) The atomic radius is the total distance from an atom’s nucleus to the outermost orbital of electrons. (**2 marks**)

b)i) The atomic radius decreases across the second period, the decrease in atomic radius is due to the **increase in the number of protons in the nucleus** but with no increase in the number of shells.

The net effect is the decrease in atomic radius because **the outermost shell electrons keep on being pulled more strongly to the nucleus** as you move across the period. (**2 marks**)

**(Give 1 mark for each underlined statement)**

ii) Down the group, **atomic radius increases** because **more shells are added as you move down the group**. (**2 marks**)

**(Give 1 mark for each underlined statement)**

11. (a) Balanced equation for the reaction between sodium and water:

2Na(s) + 2H2O(l) → 2NaOH(aq) + H2(g)  **(2 marks**)

**(Give 1 mark for unbalanced equation)**

(b) Equation:

2LiNO3(s) → 2LiNO2(s) + O2(g) (**2 marks**)

**(Give 1 mark for unbalanced equation)**

12. a) Sodium carbonate dissolves in water to produce OH- which in turn changes red litmus to blue. (**2 marks**)

b) **Lithium chloride is covalent** due to the small size of Li+ ion with a high charge. So **LiCl dissolves in a organic solvents** such as ethanol. (**2 marks**)

**(Give 1 mark for each underlined statement)**

13.a) Mg2+ ion possesses a higher charge than Na+ ion. So the electrostatic attraction between Mg2+ and O2- is greater than in NaCl. (**2 marks**)

b) The boiling points of group 17 elements increase down the group because the **inter-molecular van der waals forces of attraction** keep on increasing as you move down group 17 due to the **increase in the surface area**. (**2 marks**)

14. a)i) If the temperature is increased so much (eg to 1000 0C), the **equilibrium will shift to the left** to form N2 and H2 since the **forward reaction is effected with liberation of energy** (exothermic reaction) (**2 marks**)

**(Give 1 mark for each underlined statement)**

ii) If the pressure is increased very much (eg to 250 atmospheres), the **equilibrium will shift to the right** to form NH3 since the **forward reaction is effected with decrease in volume** (4 volumes produce 2 volumes). (**2 marks**)

**(Give 1 mark for each underlined statement)**

b) The importance of the iron catalyst in the production of ammonia is **to increase the rate of the reaction** at a low temperature **so that the yield of NH3 increases**. (**2 marks**)

**(Give 1 mark for each underlined statement)**

**SECTION B: Attempt three questions in this section (30 marks)**

15. a) Reactivity of beryllium, magnesium and calcium elements with water. (**3 marks**)

-Be reacts with hot steam at 700 0C to produce BeO and H2 gas.

-Mg reacts with steam to form Mg(OH)2 and H2 gas.

-Ca, Sr and Ba react vigorously with cold water to give corresponding hydroxides and H2 gas.

The reactivity increases as you move down the group.

**(Give 1 mark for each answer)**

b) Calcium carbide reacts with water to produce ethylene. (**2 marks**)

CaC2(s) + 2H2O(l) → C2H2 + Ca(OH)2(aq)

**(Give 1 mark for unbalanced equation)**

**(Accept the explanation in words if the equation is not provided)**

c) Reactivity of metals of group I and group II (**2 marks**)

-A group I metal is more reactive than a group II metal which is found in the same period.

For example, Na reacts with cold water whereas Mg does not react with cold water but with hot steam.

d) The elements Be, Mg and Ba belong to group II in the periodic table

i) Two chemical properties shown by these elements. **(1 mark)**

-They all react with acids to form hydrogen gas

-They all react with oxygen gas to form oxides.

**(Give 0.5 mark for each answer)**

(ii) The trends in solubility of the hydroxides. (1 **mark**)

-The solubility of group 2 hydroxides increases as you move down the group.

So Ba(OH)2 is more soluble than Mg(OH)2

(iii) Two properties in which Be differ from the rest of the group member: **(1 mark)**

-The oxides of Be are amphoteric while the oxides of the rest of group 2 elements are alkaline.

-BeC is covalent while carbides of other group 2 elements are ionic.

**(Accept other correct answers)**

**(Give 0.5 mark for each answer)**

16.a) Two properties in which carbon differs from the rest of group 14 elements. (**2 marks**)

-Carbon tetrachloride does not react with water while other members tetrachlorides of the group react with H2O

-Carbon forms catenation with other carbon atoms while other group members do not.

**(Accept other correct answers)**

**(Give 1 mark for each correct answer)**

b) Appropriate chemical equations, to explain similarities between tin and lead: (**2 marks**)

-Oxides of tin and lead are amphoteric:

Reaction with a base: PbO(s) +2OH-(aq) → PbO32-(aq)

Reaction with an acid: PbO(s) + 2H+(aq) → Pb2+(aq) + H2O(l)

The similar reactions occur for tin with acids and bases.

-Tetrachlorides of both tin and lead react with H2O:

PbCl4 + 2H2O → PbO2 + 4HCl

SnCl4 + 2H2O → SnO2 + 4HCl

c) Balanced equation between water and Silicon tetrachloride. (**2 marks**)

SiCl4 + 2H2O → SiO2 + 4HCl

**(Give 1 mark for unbalanced equation)**

d) Carbon tetrachloride is insoluble in water because: (**2 marks**)

CCl4 does not react with water because the carbon does not have vacant d-orbitals to accept (accommodate) incoming H2O molecules.

e) Equations to show the amphoteric nature of lead (II) oxide: (**2 marks**)

Reaction with a base: PbO(s) +2OH-(aq) → PbO32-(aq)

Reaction with an acid: PbO(s) + 2H+(aq) → Pb2+(aq) + H2O(l)

17.a) Standard enthalpy change of formation of a compound is the change of enthalpy during the formation of one mole of the substance from its constituent elements, with all the substances in their standard states. (**1 mark**)

b)i) The first law of thermodynamics states that energy cannot be created nor destroyed but it can be transformed from one form to another. (**2 marks**)

ii) The internal energy of a system is the total energy that includes potential and kinetic energy contained within a system.

The internal energy of a system can be increased by introduction of matter or by heat, or reduced when thermodynamic work is done by the system. (**1 mark**)

c) The 3 types of a thermodynamic systems and give an example for each type. (**3 marks**)

-An open system can exchange both energy and matter with the surroundings. Example: Boiling water in an open saucepan.

-A closed system can exchange only energy with the surroundings not matter. Example: Boiling water in a closed aluminium saucepan.

-An isolated system can neither exchange energy nor matter with the surroundings.

Example: Keeping hot water in a thermos flask.

**(Give 1 mark for each answer)**

d) The work done by a gas that expands by 6 litres against an external pressure of 4.5 atmospheres. (**3 marks**)

Work done = -P ∆V = - 101325 X 4.5 X 6

Work done = -**2,735,775 Joules**

**(Give 2 marks for the working method and 1 mark for the final answer)**

**(Accept other correct working methods)**

18.a) i) A Lewis acid is a chemical species that contains an empty orbital which is capable of accepting a pair of electrons from a Lewis base. (**2 marks**)

ii) Base according to the “Brønsted-Lowry theory”. (**2 marks**)

Brønsted-Lowry base is a solution that behaves as a proton (H+) acceptor.

b) Equation: HNO2 + H2O NO2- + H3O+

**H2O** is the conjugate base on the left side of the equation.

**NO2-** is the conjugate base on the right side of the equation. (**2 marks**)

**(Give 1 mark for each answer)**

c) An aqueous solution of AlCl3 has a PH less than 7 **(2 marks)**

Al3+ ion has a high charge with a small ion, therefore **it hydrolyses H2O molecules** to **produce H+ ions** in aqueous solution.

**(Give 1 mark for each underlined statement)**

d) -According to the Arrhenius theory, a strong acid is a substance that can dissociate to produce **many hydrogen ions** water.

-A weak acid is a substance that dissociates to produce **very few hydrogen ions** in water. **(2 marks)**

**(Give 1 mark for each answer)**

………………………………………………………………………………………



**Chemistry**

**24/06/ 2021 08.30 AM - 11.30 AM**

**S4 END OF YEAR EXAM, 2020/2021**

**SUBJECT: PRACTICAL EXAM**

**COMBINATIONS:** -**BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)**

**-MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)**

**-PHYSICS-CHEMISTRY-BIOLOGY (PCB)**

**- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**

**DURATION: 1 HOUR 30 MINUTES**

**INSTRUCTIONS:**

1. Please read carefully before you start and make sure that you have all the apparatus and chemicals that you may need.
2. This paper has one question.
3. Answer the questions in this paper and record your answers in the spaces provided.

**Experiment to identify element Y:Al(NO3)3 = 1 mole/litre**

Procedure:

i) Put 1 ml solution **Y** in 4 test tubes.

ii) Add 2 ml of a 1 mole/litre KI solution in the first test tube containing element **Y**.

iii) Add 2 ml of a 1 mole/litre NaOH solution in the second test tube containing element **Y** then add more 4 ml of the NaOH solution.

iv) Add 2 ml of a 1 mole/litre NH3 solution in the third test tube containing element **Y** then add more 4 ml of the NH3 solution.

v) Add a small piece of copper (copper turning, Cu) to 1 ml of a solution Y then add 1 ml of concentrated H2SO4 (original H2SO4 = 98%).

vi) Note the observation.

a) Fill the table given below: **(16 marks)**

|  |  |  |
| --- | --- | --- |
| **Y +Reagent** | **Observation** | **Conclusion** |
| Y+ KI(aq) |  |  |
| Y+ NaOH(aq) |  |  |
| Y +NH3(aq) |  |  |
| Y + Cu and H2SO4(aq) |  |  |

1. Write the chemical equation for the reaction between YandNaOH solution. **(1 mark)**
2. Cation in Y is: **(1 mark)**

1. Anion in Y is: **(1 mark)**
2. Write the chemical equation for the reaction between substance Y and Copper in H2SO4(aq). **(1 mark)**



**Chemistry**

**24/06/ 2021 08.30 AM - 11.30 AM**

**S4 END OF YEAR EXAM, 2020/2021**

**SUBJECT: ALTERNATIVE TO PRACTICAL EXAM**

**COMBINATIONS:** -**BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)**

**-MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)**

**-PHYSICS-CHEMISTRY-BIOLOGY (PCB)**

**- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**

**DURATION: 1 HOUR 30 MINUTES**

**INSTRUCTIONS:**

1. Please read carefully before you start.
2. This paper has one question.
3. Answer the questions appropriately.

**Experiment to identify group IIa elements.**

You are provided with five elements of group IIa denoted by **symbols of reference** (V, W, X, Y).

You will be required to deduce their **scientific symbols** (e.g P is the scientific symbol of phosphorous).

Study the data in the table given below and answer the questions that follow:

|  |  |  |
| --- | --- | --- |
| **Combustion group IIa metal** | **Observation** | **Conclusion** |
| i) V | Bright white flame |  |
| ii) W | Brick red flame |  |
| iii) X | Green flame |  |
| iv) Y | Crimson red flame |  |

a) Write the symbol/name of possible metal in each row of the **conclusion**.

i) V is:…………………………………………………..……...**(1 mark)**

ii) W is: ……………………………………………………......**(1 mark)**

iii) X is:………………………………………………..…….....**(1 mark)**

iv) Y is:……………………………………………….………..**.(1 mark)**

b) Metal V reacts with aqueous dilute HCl acid but does not react with aqueous dilute NaOH solution.

Write the chemical equation for the reaction between the **exact symbol** of metal V and HCl. **(3 marks)**

c) Write the chemical equation for the reaction between the **exact symbol** of cation X and concentrated H2SO4 :………………………………………………………………….. **(2 marks)**

d) Element Y reacts with Cl2 gas to produce a covalent compound.

i) Write the chemical equation for the reaction between Y and Cl2 (use the **exact symbol** of element Y). **(2 marks)**

ii) State 2 chemical properties of element beryllium in which it differs from the rest of the elements of group IIa:……………………… **(2 marks)**

e) State a chemical reagent that can be used to distinguish between element V and W and describe the observations in each case. **(2 marks)**

**MARKING SCHEME CHEMISTRY (ALTERNATIVE)**

**S4: ADVANCED LEVEL EXAMINATION 2020/2021**

**SUBJECT: CHEMISTRY**

**COMBINATIONS:** -**BIOLOGY-CHEMISTRY-GEOGRAPHY (BCG)**

**-MATHEMATICS-CHEMISTRY-BIOLOGY (MCB)**

**-PHYSICS-CHEMISTRY-BIOLOGY (PCB)**

**- PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**

**DURATION: 1 HOUR 30 MINUTES**

**INSTRUCTIONS:**

1. Please read carefully before you start.
2. This paper has one question.
3. Answer the questions appropriately.

**Experiment to identify group IIa elements.**

You are provided with five elements of group IIa denoted by **symbols of reference** (V, W, X, Y).

You will be required to deduce their **scientific symbols** (e.g P is the scientific symbol of phosphorous).

Study the data in the table given below and answer the questions that follow:

|  |  |  |
| --- | --- | --- |
| **Combustion group IIa metal** | **Observation** | **Conclusion** |
| i) V | Bright white flame |  |
| ii) W | Brick red flame |  |
| iii) X | Green flame |  |
| iv) Y | Crimson red flame |  |

a) Write the symbol/name of possible metal in each row of the **conclusion**.

i) V is: Mg…………………………………………………..……...**(1 mark)**

ii) W is: Ca ……………………………………………………......**(1 mark)**

iii) X is: Ba………………………………………………..…….....**(1 mark)**

iv) Y is: Sr……………………………………………….………..**.(1 mark)**

b) Metal V reacts with aqueous dilute HCl acid but does not react with aqueous dilute NaOH solution.

Write the chemical equation for the reaction between the **exact symbol** of metal V and HCl.

Mg(s)+ 2HCl(aq) → MgCl2(aq) + H2(g) **(3 marks)**

c) Write the chemical equation for the reaction between the **exact symbol** of cation X and concentrated H2SO4  . **(2 marks)**

Ba(s) + H2SO4(aq) → BaSO4(s) + H2(g)

d) Element Y reacts with Cl2 gas to produce a covalent compound.

i) Write the chemical equation for the reaction between Y and Cl2 (use the **exact symbol** of element Y).

Sr(s) + Cl2(g) → SrCl2(s) **(2 marks)**

ii) State 2 chemical properties of element beryllium in which it differs from the rest of the elements of group IIa:  **(2 marks)**

- Beryllium forms amphoteric oxides whereas the other alkaline earth metals form basic oxides.

- Beryllium does not react with water whereas the other group members react with it.

e) State a chemical reagent that can be used to distinguish between element V and W and describe the observations in each case. **(2 marks)**

Reagent: Dilute H2SO4 acid.

The reaction between V and H2SO4 acid forms a **colourless solution**.

The reaction between W and H2SO4 acid forms a **white precipitate**.