

# CHEMISTRY HOME EXERCISES

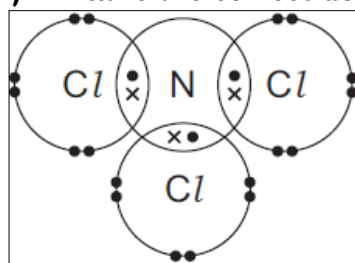
## [FOR SENIOR 2]

**Instructions:**

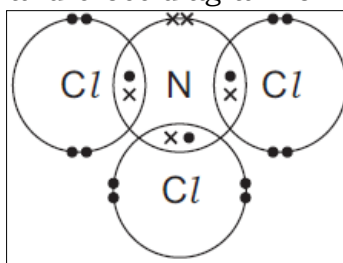
- ♦ Attempt all questions
- ♦ Max.: **120 marks**

Teacher: **Clément NGIRABATWARE****Question 1****(10 marks)**

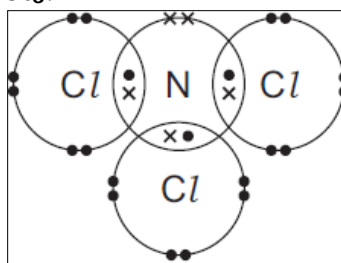
- (a) Which species contains the smallest number of electrons?
- (i)  $B^{3+}$
  - (ii)  $Be^{2+}$
  - (iii)  $H^-$
  - (iv)  $He^+$
- (b) Which of the following is correct?
- (i) Diamond is the hardest substance known.
  - (ii) Graphite has very low melting point.
  - (iii) Graphite does not conduct electricity.
  - (iv) Diamond burns on strong heating to form helium gas.
- (c) Which statement is correct for all ionic compounds?
- (i) They dissolve in water.
  - (ii) They are formed when metals share electrons with non-metals.
  - (iii) They conduct electricity in the molten state.
  - (iv) They conduct electricity in the solid state.
- (d) When a piece of sodium is heated in air, it reacts with oxygen to form the ionic compound sodium oxide,  $Na_2O$ . In terms of electrons, which statement correctly explains what happens when sodium reacts with oxygen?
- (i) An oxygen atom shares two electrons with two sodium atoms.
  - (ii) A sodium atom loses two electrons which are transferred to an oxygen atom.
  - (iii) A sodium atom shares its outer shell electron with two oxygen atoms.
  - (iv) Two sodium atoms each lose one electron which are both transferred to one oxygen atom.
- (e) The total number of electrons in one atom of element **Q** is 17 and in one atom of element **R** is 19. Which statement about elements **Q** and **R** is correct?
- (i) **Q** and **R** react together to form a covalent compound.
  - (ii) **Q** forms positive ions.
  - (iii) **R** has more outer shell electrons than **Q**.
  - (iv) **R** is more metallic than **Q**.
- (f) What is the correct dot-and-cross diagram for  $NCl_3$ ?



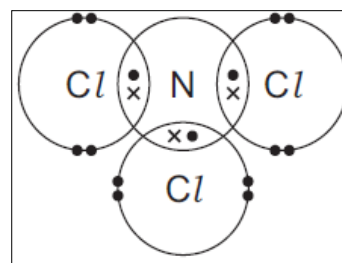
(i)



(ii)



(iii)



(iv)

- (g) Magnesium oxide has a high melting point. It is used to line the inside of furnaces that operate at high temperatures. Why does magnesium oxide have a high melting point?
- (i) It has metallic bonds.
  - (ii) It has strong forces between its molecules.
  - (iii) It is a simple molecular substance.
  - (iv) It is an ionic compound.

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- A simplified periodic table diagram with the following layout:
- Period 1:** Two boxes. The right box contains 'Z'.
  - Period 2:** Two boxes on the left, followed by a gap, followed by two boxes on the right. The rightmost box contains 'Y'.
  - Period 3:** A row of 18 boxes. The first box contains 'W'. The 11th box contains 'X'.
  - Period 4:** One box in the center, aligned with the 11th box of Period 3.

**(i)** W and X

(ii)  $W$  and  $Y$

(iii)  $X$  and  $Y$

(iv) Y and Z

- (i)** Their melting points decrease and their reaction with water becomes less vigorous.

(ii) Their melting points decrease and their reaction with water becomes more vigorous.

**(iii)** Their melting points increase and their reaction with water becomes less vigorous.

**(iv)** Their melting points increase and their reaction with water becomes more vigorous.

**(15 marks)**

<b>Isoelectronic</b>	<b>Covalent</b>	<b>Three</b>	<b>Good-conductors</b>	<b>Nuclear</b>
<b>Valence</b>	<b>Ionic</b>	<b>Landfills</b>	<b>Four</b>	<b>Carbon dioxide</b>
<b>Ammonium</b>	<b>Reducing</b>	<b>Ductility</b>	<b>Gained</b>	<b>Semi-conductors</b>
<b>Electrostatic</b>	<b>Composting</b>	<b>Malleability</b>	<b>Delocalized</b>	<b>Removed</b>
<b>Charged</b>	<b>Oxidising</b>	<b>Oppositely</b>	<b>Metallic</b>	<b>Recycling</b>

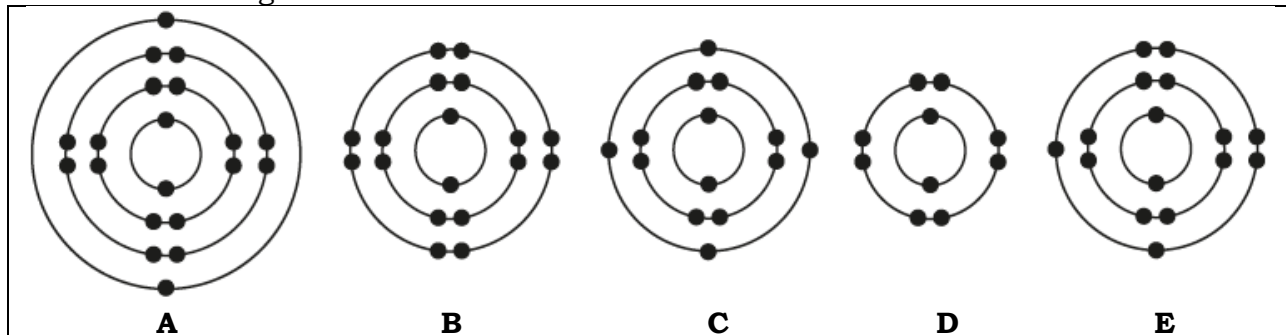
- Page 2 of 7

- (k) Reactivity is usually determined by how easily electrons can be \_\_\_\_\_ and how atoms want to take other atom's electrons because it is the interaction of electrons that is the basis of chemical reactions.
- (l) The most common form of waste disposal, important component of an integrated waste management system is \_\_\_\_\_.
- (m) For non-metals, across the period from left to right, the reactivity increases because the smaller atoms can gain electrons more easily due to an increased \_\_\_\_\_ charge.
- (n) Nitric acid and concentrated sulphuric acid act as \_\_\_\_\_ agents and react with some non-metals to form their oxides or acids.
- (o) If we burn graphite in oxygen, then only \_\_\_\_\_ gas is formed and nothing is left behind. This shows that graphite is made up of carbon only.

### Question 3

**(10 marks)**

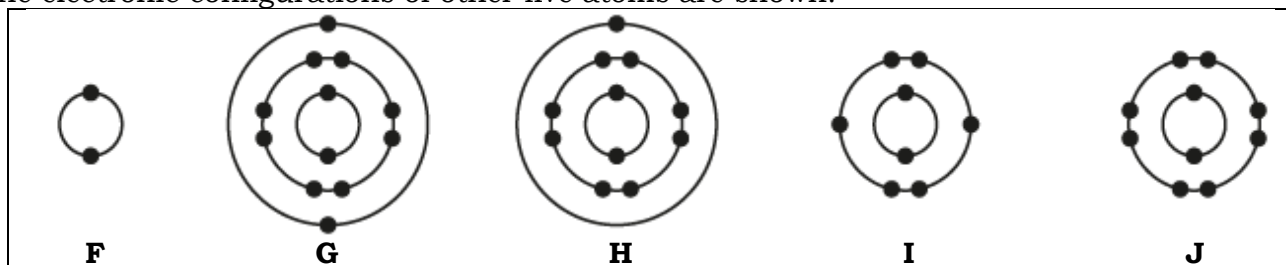
- (a) The electronic configurations of five atoms are shown.



Which electronic configuration represents each of the following descriptions? *[Each electronic configuration may be used once, more than once or not at all].*

- |   |          |
|---|----------|
| (i) A sulphur atom  | (1 mark) |
| (ii) A metal atom   | (1 mark) |
| (iii) An atom with a proton number of 14  | (1 mark) |
| (iv) An atom of a noble gas with three occupied electron shells                           | (1 mark) |
| (v) An atom which forms a noble gas electronic configuration when it loses two electrons. | (1 mark) |

- (b) The electronic configurations of other five atoms are shown.



Which electronic configuration represents each of the following descriptions? Each electronic configuration may be used once, more than once or not at all.

- |   |          |
|---|----------|
| (i) A sodium atom   | (1 mark) |
| (ii) An atom of a reactive non-metallic element   | (1 mark) |
| (iii) An atom with a proton (atomic) number of 12   | (1 mark) |
| (iv) An atom of a noble gas found in period 2.  | (1 mark) |
| (v) An atom which forms a noble gas electronic configuration when it gains two electrons. | (1 mark) |

### Question 4

**(3 marks)**

Phosphorus is an element in Group V of the Periodic Table.

- (a) How many electrons are found in a phosphide ion,  $\text{P}^{3-}$ . (1 mark)
- (b) Phosphine,  $\text{PH}_3$ , is a covalent compound. Draw a 'dot-and-cross' diagram of phosphine. Only draw the outer shell electrons. (1 mark)
- (c) Phosphorus burns in oxygen to form phosphorus (V) oxide. Write the equation for this reaction. (1 mark)

**Question 5****(5 marks)**

(a) Nitrogenous fertilisers can cause eutrophication to occur in rivers. Eutrophication involves the five stages listed.

1. The fertiliser is washed into the river.
2. Oxygen levels become depleted in the river.
3. Plants die.
4. Plants begin to decay.
5. Plants in the river grow at an increased rate.

In which order do these five stages occur during eutrophication?

**(2 marks)**

(b) Waste management includes all the processes of handling waste and reducing it. The six steps to follow are given here below. Match each step as given with its explanation. **(3 marks)**

<b>Prevention (1)</b>	<b>A.</b> Burying (landfill and composting)
<b>Minimisation (2)</b>	<b>B.</b> Converting waste into usable heat, electricity or fuel
<b>Reuse (3)</b>	<b>C.</b> Collecting used, reused or unused items and processing them to form new products
<b>Recycling (4)</b>	<b>D.</b> Reducing waste by not wasting it but reusing it
<b>Energy Recovery (5)</b>	<b>E.</b> Reducing the creation of waste material
<b>Disposal (6)</b>	<b>F.</b> Avoiding the waste completely

**Question 6****(6 marks)**

(a) Explain the reason why was polythene banned in Rwanda?

**(2 marks)**

(b) State and explain two common ways of preventing water pollution.

**(2 marks)**

(c) Using two tangible examples of Rwandan case, describe how useful products can be made from wastes.

**(2 marks)****Question 7****(4 marks)**

The following figure shows a part of a Periodic Table.

1 H							2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar

(a) How many non-metals are there in the following figure?

**(1 mark)**

(b) State the names of all metalloids present in the figure.

**(1 mark)**

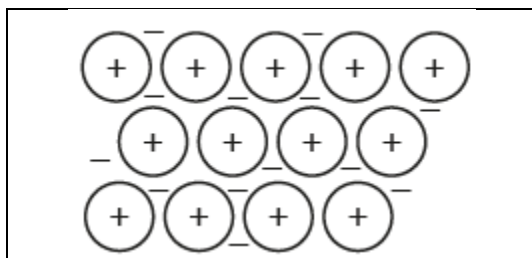
(c) Write the formula of the oxide formed from the *Group 14* and *Period 3* element.

**(1 mark)**


(d) Calcium nitrate contains the ions  $\text{Ca}^{2+}$  and  $\text{NO}_3^-$ . Give the formula of calcium nitrate.

**(1 mark)****Question 8****(3 marks)**

The diagram shows the structure of a metal.



Refer to this structure to:

- (a) Label the significance of  and  $-$  signs. (2 marks)  
 (b) Explain why metals conduct electricity. (1 mark)

### Question 9

(10 marks)

- (a) Hydrogen sulphide,  $\text{H}_2\text{S}$ , is a covalent compound with a simple molecular structure. It is soluble in water. Suggest **two** other physical property of hydrogen sulphide. (2 marks)  
 (b) Potassium reacts with sulphur to make the ionic compound potassium sulphide.  
 (i) Write the equation for this reaction. (1 mark)  
 (ii) Describe what happens when **two** atoms of potassium react with **one** atom of sulphur (Give your answer in terms of electron transfer and give the formulae of the ions formed). (3 marks)  
 (iii) Predict **two** physical properties of potassium sulphide. (2 marks)  
 (c) River water contains dissolved minerals and gases. Carbon dioxide is one of the gases dissolved in river water. Draw the 'dot-and-cross' diagram to show the bonding in a molecule of carbon dioxide. Only draw the outer-shell electrons. (2 marks)

### Question 10

(5 marks)

The Periodic Table is an arrangement of elements in groups and periods.

- (a) Describe how the position of an element in the Periodic Table is related to its electronic configuration. (2 marks)  
 (b) Aluminium is an element in Group III of the Periodic Table.  
 (i) Deduce the electronic configuration of the aluminium ion. (1 mark)  
 (ii) Aluminium reacts with oxygen to form aluminium oxide,  $\text{Al}_2\text{O}_3$ . Write the balanced equation for this reaction. (2 marks)

### Question 11

(4 marks)

- (a) A student heats a small piece of magnesium ribbon in a crucible for several minutes. Some magnesium oxide is produced.  
 (i) Describe the appearance of the magnesium before heating. (2 marks)  
 (ii) Construct the equation for this reaction. (1 mark)  
 (b) When magnesium is added to dilute sulphuric acid a gas is produced. Write a balanced equation for this reaction. (1 mark)

### Question 12

(10 marks)

Water for use in the home is treated using carbon and chlorine.

- (a) Explain the purpose of using carbon and chlorine in water treatment. (2 marks)  
 (b) In some parts of the world, drinking water is purified by desalination. What is meant by the term *desalination*? (1 mark)  
 (c) River water may contain pollutants from agricultural sources. These pollutants may cause eutrophication. Give the names of two anions present in fertilisers which contribute to eutrophication. (1 mark)  
 (d) What are the health hazards associated with drinking of polluted water? (2 marks)  
 (e) What role do education and awareness play in preventing water pollution? (2 marks)  
 (f) What do you understand by "**polluter pays principle**"? (2 marks)

### Question 13

(7 marks)

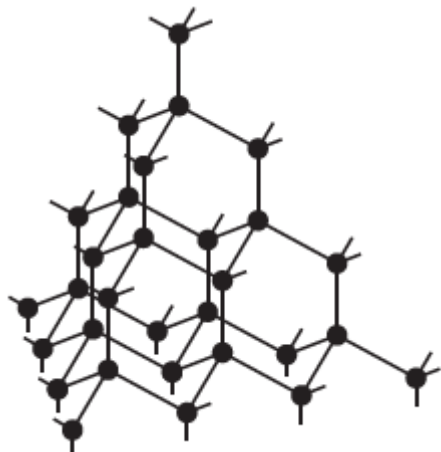
Copy and complete the following table. Do not copy the "structure row".

Structure				
Formula				
Name				
Molar mass				
Similarity				

### Question 14

(20 marks)

The structure of diamond shown.



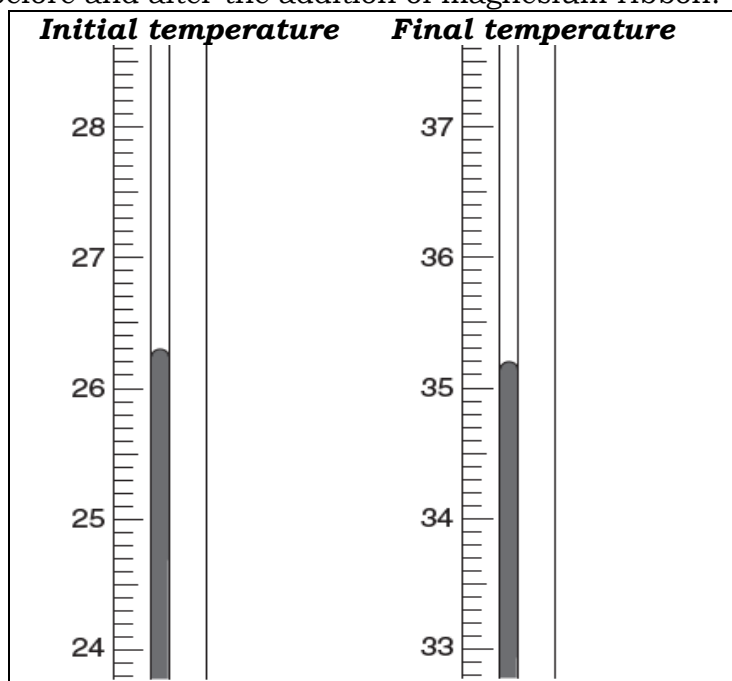
- How can an atom achieve stability? (1 mark)
- Distinguish between covalent and ionic bond. (2 marks)
- Compare between the properties of ionic and covalent compounds. (3 marks)
- Explain the formation of sodium ion. (2 marks)
- Give four examples of each
  - Ionic compounds
  - Covalent compounds
- Compare the conductivity of distilled water with sodium chloride solution. (1 mark)
- Write two uses of diamond. (1 mark)
- Draw the structure of graphite. (2 marks)
- Explain why diamond does not conduct electricity. (1 mark)
- Illustrate the physical properties of metals. (3 marks)

### Question 15

(8 marks)

A student adds magnesium ribbon to dilute hydrochloric acid and the temperature of the dilute hydrochloric acid changes.

The diagrams below show parts of the *thermometer stem* giving the temperatures of the dilute hydrochloric acid both before and after the addition of magnesium ribbon.



- A gas is produced during the reaction. Name this gas. Give a test and observation to identify the gas. (3 marks)
- Construct the equation for the reaction between magnesium and dilute hydrochloric acid.

**(1 mark)**

**(c)** Copy and complete the following table and calculate the change in temperature. **(3 marks)**

Final temperature of the acid ( $^{\circ}\text{C}$ )	
Initial temperature of the acid ( $^{\circ}\text{C}$ )	
Change in temperature ( $^{\circ}\text{C}$ )	

**(d)** What type of reaction does this temperature change indicate? (Choose between endothermic and exothermic reactions). **(1 mark)**