Checkups and follow-ups

CHAPTER 2 ANSWER KEY

ST
Questions 1–6, 17–23, 27–29, 31–33, A and C

# **Molecules and solutions**

## Checkup

1	1 WHAT IS A MOLECULE? (pp. 40–50)					
1.	Are the follow	ving substances molecules? Explain your answer.				
	a) NaCl	Yes, it is a molecule because it contains two different atoms: sodium and chlorine.				
	<b>b)</b> O <sub>2</sub>	Yes, it is a molecule because it contains two oxygen atoms.				
	<b>c)</b> Au	No, it is not a molecule; it is only one atom: gold.				
	<b>d)</b> Co	No, it is not a molecule; it is only one atom: cobalt.				
	<b>e)</b> CO	Yes, it is a molecule because it contains two different atoms: carbon and oxygen.				
	f) H <sub>2</sub> SO <sub>4</sub>	Yes, it is a molecule because it contains several different atoms: two hydrogen atoms, one sulphur atom and four oxygen atoms.				
2.	What is the n electrons?	atural tendency of each of the following elements with regard to gaining or losing				
	a) potassiur	n Potassium tends to lose an electron.				
	<b>b)</b> oxygen	Oxygen tends to gain two electrons.				

Name:		Group:	Date:
<b>c)</b> aluminum	Aluminum tends to lose three el	ectrons.	
<b>d)</b> krypton	Krypton is a noble gas, so it do	es not tend to gain o	or lose electrons.

- **3.** Metals give up electrons. Consequently, do they tend to form positive or negative ions? *They tend to form positive ions.*
- 4. Calculate the sum of the charges for each of the following electron transfers, and indicate the net charge of the resulting ion.

<b>a)</b> A calcium atom loses two electrons.	c) An iodine atom gains one electron.	
(+20) protons	(+53) protons	
+ (-18) electrons	<u>+ (-54) electrons</u>	
+2	-1	
A $Ca^{2+}$ ion is obtained.	An $I^-$ ion is obtained.	
<b>b)</b> A nitrogen atom gains three electrons.	d) An aluminum atom loses three electrons.	
<b>b)</b> A nitrogen atom gains three electrons. (+7) protons	<b>d)</b> An aluminum atom loses three electrons. (+13) protons	
<b>b)</b> A nitrogen atom gains three electrons. (+7) protons + (-10) electrons	<b>d)</b> An aluminum atom loses three electrons. (+13)  protons + (-10)  electrons	
<b>b)</b> A nitrogen atom gains three electrons. (+7)  protons +(-10)  electrons -3	d) An aluminum atom loses three electrons. (+13)  protons $+ (-10)  electrons$ $+3$	
<b>b)</b> A nitrogen atom gains three electrons. (+7)  protons $+ (-10)  electrons$ $-3$ An N <sup>3-</sup> ion is obtained.	<b>d)</b> An aluminum atom loses three electrons. (+13)  protons $+ (-10)  electrons$ $+3$ An Al <sup>3+</sup> ion is obtained.	

5. Do the models below represent atoms or ions? Explain your answers.



6. Iron has the ability to form one of two ions: Fe<sup>2+</sup> or Fe<sup>3+</sup>. How many protons and electrons does each of these ions contain?

 $Fe^{2+}$ : 26 protons and 24 electrons

 $Fe^{3+}$ : 26 protons and 23 electrons

 $\Rightarrow$  Questions 7 to 16 are not intended for students in the ST program.

#### 2 PROPERTIES OF SOLUTIONS (pp. 50–61)

17. Name the substances that act as solvents and solutes in each of the following solutions.

Solution	Solvent	Solute
<ul> <li>a) Air is composed of approximately</li> <li>80 percent nitrogen and 20 percent</li> <li>oxygen.</li> </ul>	Nitrogen	Oxygen
b) Steel is an alloy of iron with a small amount of carbon.	Iron	Carbon
c) Seawater contains many mineral salts.		
	Water	Mineral salts

**18.** Fruit juices, body fluids and cleaning solutions for contact lenses are all examples of aqueous solutions. What is the solvent in these solutions?

In aqueous solutions, the solvent is water.

**19.** Brine is a solution of sodium chloride (NaCl) at 18% m/V, which is used to preserve certain foods. To prepare 250 mL of brine, how much salt must be dissolved?

Problem-solving steps	Application		
1. Determine what you are looking for.	The mass of salt needed to prepare 250 mL of brine at 18% m/V		
2. Determine the different variables and their respective values.	C = 18% m/V V = 250 mL m = ? g		
<i>3. Choose the appropriate formula.</i>	$C = \frac{m}{V}$		
4. Replace each variable by its value and isolate the unknown variable.	$\frac{18 \text{ g}}{100 \text{ mL}} = \frac{? \text{ g}}{250 \text{ mL}}$ Therefore m = 45 g		
5. Check your solution and answer the problem question.	The amount of salt needed to prepare 250 mL of brine at 18% m/V is 45 g.		

Date:



Problem-solving steps	Application
1. Determine what you are looking for.	The concentration of the solution in g/L
2. Determine the different variables and their respective values.	C = ? g/L V = 80 mL = 0.08 L m = 10 g
<i>3. Choose the appropriate formula.</i>	$C = \frac{m}{V}$
4. Replace each variable by its value and isolate the unknown variable.	$C = \frac{10 g}{0.08 L} = 125 g/L$
5. Check your solution and answer the problem question.	The concentration of the solution is 125 g/L.

21. The label on a bottle of water says that the water contains 45 ppm of sodium.

#### a) What does this mean?

It means that the water contains 45 parts of sodium per million parts of solution.

Name:

b) What is the concentration of sodium in g/L?

 $45 \, ppm = \frac{45 \, mg}{1 \, L} = \frac{0.045 \, g}{1 \, L}$ 

*The sodium concentration is 0.045 g/L.* 

**22.** The water in a lake is contaminated. To determine the concentration of the contaminant, a technician takes a 50-mL sample of the water. After several tests, he concludes that the sample contains 3.75 mg of contaminant. Calculate the concentration of the contaminant, in ppm.

$$\frac{3.75 \text{ mg}}{50 \text{ mL}} = \frac{? \text{ mg}}{1000 \text{ mL}} = 75 \text{ mg/L} = 75 \text{ ppm}$$

The concentration of the contaminant is 75 ppm.

**23.** Certain minerals are essential to good health. For example, a person should take in approximately 350 mg of magnesium daily. Magnesium can be found in many foods, such as whole wheat bread, which contains about 850 ppm. Assuming that a slice of whole wheat bread has a mass of about 30 g, how many would a person have to eat to obtain the recommended daily dose of magnesium? Show your calculations.

$$850 \, ppm = \frac{850 \, mg}{1000 \, g} = \frac{350 \, mg}{? \, g}$$
$$\frac{411.8 \, g}{30 \, g} = 13.73$$

A person would have to eat approximately 14 slices of bread to obtain the recommended daily dose of magnesium.



 $\Rightarrow$  Questions 24 to 26 are not intended for students in the ST program.

27. Which of the beakers below probably contains an electrolyte? Explain your answer.

The beaker containing the calcium sulphate,
because the light is on, which means that
current is flowing through the solution.
28. How does a solution conduct electricity?
<u>Through the presence of dissolved ions. The ions</u>
<u>are electrically charged and, in the presence of</u>
<u>electric current, they start to move. The</u>
current can then flow through the solution.

- **29.** Are the following equations of electrolytic dissociation written correctly? Explain your answers.
  - a) MgO<sub>(s)</sub> → Mg<sup>2+</sup><sub>(aq)</sub> + O<sup>2−</sup><sub>(aq)</sub>
     The equation is written correctly. There are two oppositely charged ions, and the sum of their charges is neutral.
  - **b)** CaBr<sub>2(s)</sub>  $\xrightarrow{H_2O}$  Ca<sup>2+</sup><sub>(aq)</sub> + Br<sup>-</sup><sub>(aq)</sub>

The equation is not written correctly because the sum of the charges of the ions is not neutral.

**c)**  $\text{LiH}_{(s)} \xrightarrow{\text{H}_2\text{O}} \text{Li}^+_{(aq)} + \text{H}^+_{(aq)}$ 

The equation is not written correctly because both ions are positively charged.

**d)**  $Al_2O_{3(s)} \xrightarrow{H_2O} 2 Al^{3+}_{(aq)} + 3 O^{2-}_{(aq)}$ 

The equation is written correctly. There are two oppositely charged ions, and the sum of their charges is neutral.



a) What is the pH of this solution? <u>The solution has a pH of 2.</u>
b) Is the solution acidic, basic or neutral?

 $\Rightarrow$  Question 30 is not intended for students in the ST program.

31. Is each of the following substances an acid, a base or a salt?

b) Is the solution acidic, basic or neutral? Explain your answer. The solution is acidic because its pH is less

An acid

A base

A salt

**32.** Look at the photo opposite.

The solution is acidic because its pH is less than 7.

**33.** Rain has a pH of about 5, while the pH of seawater is about 8. How many times more acidic is rainwater than seawater?

d) ZnSO₄

e)  $H_3PO_4$ 

f) Cu(OH)<sub>2</sub> A base

A salt

An acid

Rain is 1000 times more acidic than seawater.

### **REVIEW QUESTIONS**

$\Rightarrow$	<b>Question B</b>	is not intended	for students	in the ST	program.
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**A.** A coalition was formed recently to protest the use of dihydrogen monoxide. According to the coalition, the widespread use of this substance has harmful effects on human health and the environment.

Dihydrogen monoxide is both colourless and odourless. It exists as a solid, liquid and gas, but it is usually sold in liquid form. Certain precautions must be taken during its use. Its vapour can cause burns, while prolonged exposure to the compound in its solid form can cause frostbite. Inhaling it in its liquid form has resulted in many deaths.

- **a)** What is the chemical formula for dihydrogen monoxide?
- **b)** Dihydrogen monoxide is the main component of acid rain. Is it the solute or the solvent? Explain your answer.

It is the solvent because it represents the greater part of the solution.

a) HBr

b) KOH

c)  $BaF_2$ 



 $H_2O$ 

Group: \_\_\_\_\_ Date: \_\_\_\_

c) In its pure state, this substance does not conduct electricity, yet it is used to manufacture batteries. Explain how this is possible.

The electrolytes dissolved in the substance can carry an electric current.

**d)** Soil erosion by this substance dissolves the minerals in the soil and carries them into lakes and rivers. How does this affect the concentration of minerals in the lakes and rivers?

Under these conditions, the mineral content increases.

e) If the total concentration of dissolved matter in a lake is 500 mg/L, what is its concentration in ppm?

Given that 1 mg/L = 1 ppm500 mg/L = 500 ppm

f) Should the use of dihydrogen monoxide be banned? Explain your answer.

No, because dihydrogen monoxide is, in fact, water.

**C.** Prepare your own summary of Chapter 2 by building a concept map. *See the* Concept maps *section in Guide B*.

## **Follow-up**

**1.** To fight air pollution, we must reduce our reliance on fossil fuel combustion. What can each person do to contribute to this reduction?

Answers will vary. Examples: We can choose a means of transportation that uses little or no fossil

fuels, such as walking, biking or taking public transit.

-As much as possible, we can prefer local products to items that are shipped long distances by

truck or boat.

2. Describe some consequences of acid rain in your region.

Answers will vary. Examples: Acid rain has a negative impact on maple syrup production because it

damages maple trees.

- It damages stone buildings.

- It affects the health of fish.