

Checkups and follow-ups

CHAPTER 1 ANSWER KEY

ST

Questions 1–9, 13–18, 28–31, A and C

# Atoms and elements

## Checkup

### 1 WHAT IS AN ATOM? (pp. 6–17)

1. Why is it useful to represent an atom with a model?

*Because an atom is too small to be examined directly.*

2. Look at the two photos below.

A



B



- a) Which photo represents a model in which matter can be infinitely divided? Explain your answer.

*The photo of the glass of water, because the water gives an impression of uniformity.*

- b) Which photo represents a model in which matter cannot be infinitely divided? Explain your answer.

*The photo of the dish of sand, because the grains of sand represent atoms. Matter can be divided into small indivisible particles.*

3. Here is a representation of a molecule of water ( $\text{H}_2\text{O}$ ). Does it respect the principles behind Dalton's atomic model? Explain your answer.



*No, this figure does not represent a water molecule correctly according to Dalton's atomic model.*

*Dalton believed that the atoms of different elements have different masses and dimensions. The hydrogen atoms should therefore look different from the oxygen atom.*

4. What conclusion did Thomson draw from each of the following observations?

a) The cathode rays cause a small propeller inside the tube to turn.

*The rays are made up of particles of matter.*

b) The rays are identical regardless of the metal used to make the cathode.

*The rays are common to all elements.*

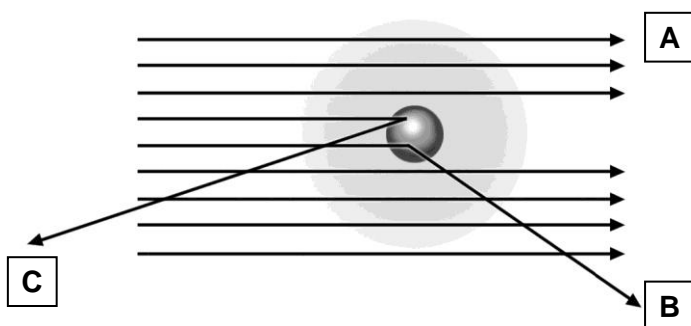
c) The cathode rays are attracted to the positive pole of an electrical field.

*The cathode rays are negatively charged.*

5. What type of radiation did Rutherford use for his research on atomic structure?

*Alpha radiation*

6. Look at the illustration below. Each letter corresponds to an observation made by Rutherford. Describe each observation and match it with one of Rutherford's conclusions.



*A: These particles are not deflected. Rutherford concluded that most of an atom is empty space.*

*B: These particles are strongly deflected. Rutherford concluded that the atom contains a very small, dense nucleus.*

*C: These particles bounce back. Rutherford concluded that the nucleus of the atom is positive.*

7. Which positively charged particle is found in the nucleus?

*The proton*

8. The bright colours of fireworks amaze and delight us. Each colour is the result of the combustion of a specific substance. For example, potassium chloride produces a purple flame, and sodium chloride, an orange-yellow flame. Which theory, proposed by Bohr, explains this phenomenon?

*When an atom receives energy, its electrons become excited. They can then jump to electron shells farther from the nucleus (higher levels of energy) for a short period of time. When they return to their original shells, they release the surplus energy they had accumulated, emitting light of a specific colour.*

9. Match a characteristic of the Rutherford-Bohr atomic model with each of the following statements.

a) An atom contains as many protons as electrons.

*An atom is electrically neutral.*

b) Alpha particles pass easily through gold foil.

*An atom is mostly empty space.*

c) Alpha particles are strongly repelled by the nucleus.

*The nucleus of an atom is small, dense and positively charged.*

d) A heated gas emits light waves of a specific length.

*Electrons jump to a higher level of energy when they receive energy and then release the energy in the form of light.*

⇒ Questions 10 to 12 are not intended for students in the ST program.

## 2 THE PERIODIC CLASSIFICATION OF THE ELEMENTS (pp. 17–26)

13. Where are the nonmetals in the periodic table?

*They are all located to the right of the staircase, except hydrogen.*

14. What do elements of the same group have in common?

*They all have the same number of valence electrons, so they have similar chemical properties.*

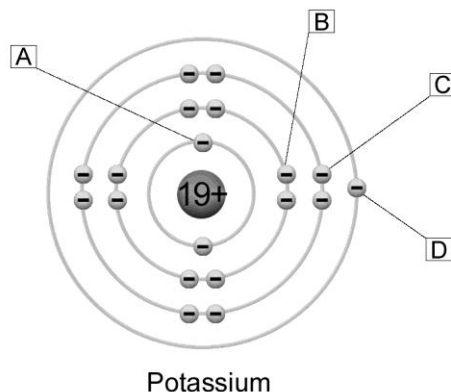
15. Hydrogen is a nonmetal, but it is in the same column as the alkali metals. Explain your answer.

*Because hydrogen has only one valence electron, like the alkali metals.*

16. What are the elements in the second column of the periodic table called? What do they have in common?

*Alkaline earth metals. They all have two valence electrons.*

17. In the atomic model of potassium below, which letter represents a valence electron? Explain your answer.



*The letter D, because this electron is in the outermost electron shell.*

18. What do elements of the same period have in common?

*They have the same number of electron shells in their atoms.*

⇒ Questions 19 to 27 are not intended for students in the ST program.

### 3 REPRESENTING ATOMS (pp. 26–29)

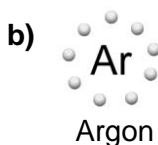
28. How is Lewis notation useful?

*Lewis notation illustrates only the valence electrons of an atom.*

29. Are the atomic representations below correct Lewis structures? If not, explain your answer.



*It is illustrated correctly.*



*It is not illustrated correctly because argon has eight valence electrons, not nine.*





Chlorine

*It is illustrated correctly.*

30. Represent the following atoms in Lewis notation.



Aluminum

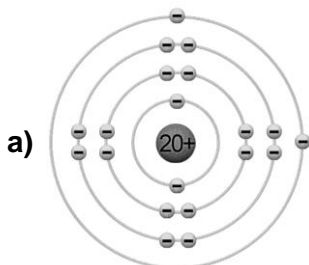


Iodine



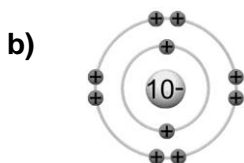
Barium

31. Are the atomic representations below correct according to the Rutherford-Bohr model? If not, explain your answer.



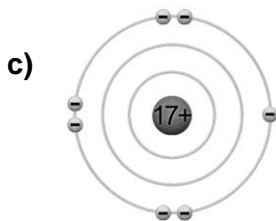
Calcium

*Yes, it is correct.*



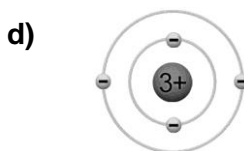
Neon

*No, it does not follow the model. The protons should be in the nucleus, and the electrons should be in the shells around the nucleus.*



Chlorine

*No, it does not follow the model. An atom must have the same number of protons and electrons.*



Lithium

*No, it does not follow the model. An atom must have the same number of protons and electrons.*

⇒ Questions 32 and 33 are not intended for students in the ST program.

#### 4 THE CONCEPT OF MOLE (pp. 30–31)

⇒ The questions in this section are not intended for students in the ST program.

#### REVIEW QUESTIONS

⇒ Question B is not intended for students in the ST program.

- A. The chemical reactivity of elements depends on their ability to give up their valence electrons. The most reactive metal in the periodic table is francium. Explain why, using the Rutherford-Bohr atomic model.

*Like all alkali metals, francium has only one valence electron. It therefore has a natural tendency to give up this electron to resemble the closest noble gas in the periodic table, namely, radon. In addition, francium has seven electron shells. As a result, its single valence electron is far from the nucleus and more loosely bound to it than the valence electrons of other alkali metals are bound to their nuclei. Consequently, francium reacts easily with other elements.*

- C. Prepare your own summary of Chapter 1 by building a concept map.

*See the Concept maps section in Guide B.*

### Follow-up

1. The Amazon is not the only place affected by mercury contamination. Relatively high concentrations can also be found in Québec landfills. Name three commonplace objects that you use that might contain mercury. Explain your answers.

*Answers will vary. Examples: compact fluorescent light bulbs, because the symbol Hg appears on either the packaging or the bulb*

*– batteries, for the reasons discussed in the textbook, on page 20*

*– old mercury thermometers.*

2. Mercury is a heavy metal. Using atomic models and the periodic table of the elements, explain why it belongs to this category of elements.

*Answers will vary. Example: The atomic mass of mercury is 200.59 u. Its atomic mass is therefore relatively high compared to that of gold, for example. Moreover, its atomic number is 80, and it belongs to the sixth period, which means it has a nucleus containing 80 protons, surrounded by six electron shells.*