

### 3.E: The Elements - Basic Building Blocks of Green Chemicals (Exercises)

Access to and use of the internet is assumed in answering all questions including general information, statistics, constants, and mathematical formulas required to solve problems. These questions are designed to promote inquiry and thought rather than just finding material in the text. So in some cases there may be several “right” answers. Therefore, if your answer reflects intellectual effort and a search for information from available sources, your answer can be considered to be “right.”

1. Match the law or observation denoted by letters below with the portion of Dalton’s atomic theory that explains it denoted by numbers:

A. Law of Conservation of Mass B. Law of Constant Composition

C. The reaction of C with O<sub>2</sub> does not produce SO<sub>2</sub>

D. Law of Multiple Proportions

1. Chemical compounds are formed by the combination of atoms of different elements in definite constant ratios that usually can be expressed as integers or simple fractions

2. During the course of ordinary chemical reactions, atoms are not created or destroyed

3. During the course of ordinary chemical reactions, atoms are not changed to atoms of other elements

4. Illustrated by groups of compounds such as CHCl<sub>3</sub>, CH<sub>2</sub>Cl<sub>2</sub>, or CH<sub>3</sub>Cl

2. Explain why it is incorrect to say that atomic mass is the mass of any atom of an element. How is atomic mass defined?

3. Define what is meant by the notation <sup>A</sup>X. What do y, x, and A mean?

4. What is the Lewis symbol of hydrogen and what does it show? What is the Lewis formula of H<sub>2</sub> and what does it show?

5. Why should hydrogen be considered in a separate category of the periodic table?

6. Consider the Lewis symbol of helium and explain how the helium atom illustrates the concepts of electron shell, filled electron shell, and noble gases.

7. What does helium have to do with cryogenics?

8. Use three dots to show all the electrons in the lithium atom, Li. What does this show about inner and outer electrons and why Li produces Li<sup>+</sup> cation?

9. In what respect may it be argued that beryllium is definitely not a green element?

10. What are two elemental oxygen species other than molecular O<sub>2</sub> found at very high altitudes in the stratosphere? How do they get there?

11. In what respects may carbon be classified as the “element of life”?

12. How are a specific kind of fluorine compounds related to stratospheric ozone? What does this have to do with green chemistry?

13. How does neon illustrate important points about the octet and the octet rule?

14. Of the following, the **untrue** statement pertaining to matter, atoms, and elements is

A. All matter is composed of only about a hundred fundamental kinds of matter called elements.

B. Each element is made up of very small entities called atoms

C. All atoms of the same element have the same number of protons and neutrons and the same mass

D. All atoms of the same element behave identically chemically

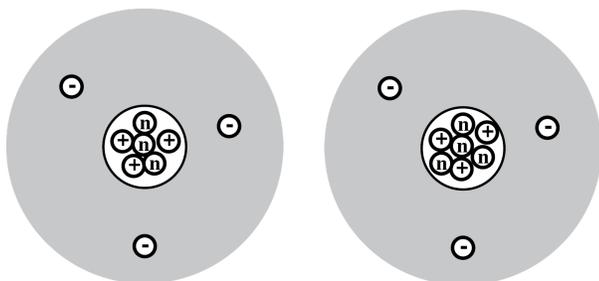
E. All atoms of the same element have the same number of protons

15. Given that in the periodic table elements with atomic numbers 2, 10, and 18 are gases that do not undergo chemical reactions and consist of individual molecules, of the following, the statement most likely to be true is

A. Elements with atomic numbers 3, 11, and 19 are also likely to be gases.

B. Elements with atomic numbers 3, 11, and 19 would not undergo chemical reactions.

- C. Elements with atomic numbers 10 and 18 would be at opposite ends of the table.
- D. The element with atomic number of 11 may well be a highly reactive metal.
- E. The properties of elements with atomic number 3, 11, and 19 would have chemical properties that are much different from each other.
16. The two atoms represented below
- A. Are of different elements.
- B. Are atoms of deuterium, a form of hydrogen, H.
- C. Are of the same element.
- D. Are **not** isotopes of the same element.
- E. Are of two elements with atomic numbers 6 and 7.



17. Of the following, the statement that is **untrue** regarding chemical bonding and compounds is
- A. Chemical bonds occur only in compounds, not in pure elements.
- B. Molecules of H<sub>2</sub> are held together by bonds consisting of shared electrons.
- C. Ionic compounds consist of charged atoms or groups of atoms.
- D. Both pure elemental hydrogen, H<sub>2</sub>, and the compound water, H<sub>2</sub>O, have covalent bonds.
- E. An atom that has more electrons than protons is an anion.
18. Suggest a material that is a source of electrons in a fuel cell used to generate electricity. What may accept electrons?
19. What are semiconductors? What is the most important semiconductor discussed in this chapter.
20. What is the most notable chemical characteristic of elemental oxygen?
21. What are some reasons that aluminum can be regarded as a green metal?
22. What are some of the toxic elements or elemental forms among the first 20 elements?
23. What is a common air pollutant gas that contains sulfur?
24. Why does the abbreviated periodic table stop at atomic number 20?
25. Suggest why calcium might be particularly important in the diet of (A) children and (B) older people?
26. Which elements among the first 20 are commonly present in fertilizers used to enhance the growth of food crops?
27. What is the special significance of the carbon isotope with 6 neutrons in its nucleus?
28. What is the single exception to the rule that all atoms contain at least 1 neutron?
29. What is the single exception to the rule that noble gases contain stable octets of electrons?
30. What is the outer-shell electron configuration of metals? What does this have to do with their chemical behavior?
31. What is it about the carbon atom that enables millions of organic compounds to exist?
32. What are some of the forms of elemental carbon and their uses? Which of these was discovered only relatively recently?

33. What is the major chemical characteristic of elemental nitrogen? What is a major advantage afforded by this characteristic? In what respect is this a problem?
34. What are two applications that elemental magnesium and aluminum have in common?
35. How do copper and silica differ in the way that they transfer communications signals?
36. Using the octet rule, propose a Lewis formula for  $O_2$ .

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