

4.7: Atoms, Molecules, and Ions (Exercises)

The following questions are related to the material covered in this chapter. Answers to selected questions, only.

4.1-4.2 Matter and Changes

1. Match the following terms with their meaning.

Terms	Definitions
(a) Mass	a. a measure of the total quantity of matter in an object
(b) Volume	b. a measure of how strongly gravity pulls on an object
(c) Weight	c. a measure of the space occupied by an object

2. Identify each as either matter or not matter.

- a book
- hate
- light
- a car
- a fried egg

3. Give an example of matter in each phase: solid, liquid, or gas.

4. Does each statement represent a physical property or a chemical property?

- Sulfur is yellow.
- Steel wool burns when ignited by a flame.
- A gallon of milk weighs over eight pounds.

5. Does each statement represent a physical property or a chemical property?

- A pile of leaves slowly rots in the backyard.
- In the presence of oxygen, hydrogen can interact to make water.
- Gold can be stretched into very thin wires.

6. Does each statement represent a physical change or a chemical change?

- Water boils and becomes steam.
- Food is converted into usable form by the digestive system.
- The alcohol in many thermometers freezes at about -40 degrees Fahrenheit.

7. Does each statement represent a physical change or a chemical change?

- Graphite, a form of elemental carbon, can be turned into diamond, another form of carbon, at very high temperatures and pressures.
- The house across the street has been painted a new color.
- The elements sodium and chlorine come together to make a new substance called sodium chloride.

8. Distinguish between an element and a compound. About how many of each are known?

9. What is the difference between a homogeneous mixture and a heterogeneous mixture?

10. Identify each as a heterogeneous mixture or a homogeneous mixture.

- Salt is mixed with pepper.
- Sugar is dissolved in water.
- Pasta is cooked in boiling water.

11. Identify each as a heterogeneous mixture or a homogeneous mixture.

- air
- dirt
- a television set

Answers

2.
 1. matter
 2. not matter
 3. not matter
 4. matter
 5. matter
8. An element is a fundamental chemical part of a substance; there are about 115 known elements. A compound is a combination of elements that acts as a different substance ; there are over 50 million known substances.
11.
 1. homogeneous
 2. heterogeneous
 3. heterogeneous

Molecules and Molecular Compounds

1. Which of these formulas represent molecules? State how many atoms are in each molecule.
 - a. Fe
 - b. PCl_3
 - c. P_4
 - d. Ar
2. Which of these formulas represent molecules? State how many atoms are in each molecule.
 - a. I_2
 - b. He
 - c. H_2O
 - d. Al
3. What is the difference between CO and Co?
4. What is the difference between H_2O and H_2O_2 (hydrogen peroxide)?
5. Give the proper formula for each diatomic element.
6. In 1986, when Halley's comet last passed the earth, astronomers detected the presence of S_2 in their telescopes. Why is sulfur not considered a diatomic element?
7. What is the stem of fluorine used in molecule names? CF_4 is one example.
8. What is the stem of selenium used in molecule names? SiSe_2 is an example.
9. Give the proper name for each molecule.
 - a. PF_3
 - b. TeCl_2
 - c. N_2O_3
10. Give the proper name for each molecule.
 - a. NO
 - b. CS_2
 - c. As_2O_3
11. Give the proper name for each molecule.
 - a. XeF_2
 - b. O_2F_2
 - c. SF_6
12. Give the proper name for each molecule.
 - a. P_4O_{10}
 - b. B_2O_3
 - c. P_2S_3
13. Give the proper name for each molecule.
 - a. N_2O
 - b. N_2O_4

c. N_2O_5

14. Give the proper name for each molecule.

- a. SeO_2
- b. Cl_2O
- c. XeF_6

15. Give the proper formula for each name.

- a. dinitrogen pentoxide
- b. tetraboron tricarbide
- c. phosphorus pentachloride

16. Give the proper formula for each name.

- a. nitrogen triiodide
- b. diarsenic trisulfide
- c. iodine trichloride

17. Give the proper formula for each name.

- a. dioxygen dichloride
- b. dinitrogen trisulfide
- c. xenon tetrafluoride

18. Give the proper formula for each name.

- a. chlorine dioxide
- b. selenium dibromide
- c. dinitrogen trioxide

19. Give the proper formula for each name.

- a. iodine trifluoride
- b. xenon trioxide
- c. disulfur decafluoride

20. Give the proper formula for each name.

- a. germanium dioxide
- b. carbon disulfide
- c. diselenium dibromide

Answers

- 1.
 - a. not a molecule
 - b. a molecule; four atoms total
 - c. a molecule; four atoms total
- 2.
- 3. CO is a compound of carbon and oxygen; Co is the element cobalt.
- 4.
- 5. H_2 , O_2 , N_2 , F_2 , Cl_2 , Br_2 , I_2
- 6.
- 7. fluor-
- 8.
- 9.
 - a. phosphorus trifluoride
 - b. tellurium dichloride
 - c. dinitrogen trioxide
- 10.
- 11.
 - a. xenon difluoride
 - b. dioxygen difluoride
 - c. sulfur hexafluoride
- 12.

13.
 - a. dinitrogen monoxide
 - b. dinitrogen tetroxide
 - c. dinitrogen pentoxide
- 14.
15.
 - a. N_2O_5
 - b. B_4C_3
 - c. PCl_5
- 16.
17.
 - a. O_2Cl_2
 - b. N_2S_3
 - c. XeF_4
- 18.
19.
 - a. IF_3
 - b. XeO_3
 - c. S_2F_{10}

Ions and Ionic Compounds

1. Explain how cations form.
2. Explain how anions form.
3. Give the charge each atom takes when it forms an ion. If more than one charge is possible, list both.
 - a. K
 - b. O
 - c. Co
4. Give the charge each atom takes when it forms an ion. If more than one charge is possible, list both.
 - a. Ca
 - b. I
 - c. Fe
5. Give the charge each atom takes when it forms an ion. If more than one charge is possible, list both.
 - a. Ag
 - b. Au
 - c. Br
6. Give the charge each atom takes when it forms an ion. If more than one charge is possible, list both.
 - a. S
 - b. Na
 - c. H
7. Name the ions from Exercise 3.
8. Name the ions from Exercise 4.
9. Name the ions from Exercise 5.
10. Name the ions from Exercise 6.
11. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Mg^{2+} and Cl^-
 - b. Fe^{2+} and O^{2-}
 - c. Fe^{3+} and O^{2-}
12. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. K^+ and S^{2-}
 - b. Ag^+ and Br^-
 - c. Sr^{2+} and N^{3-}
13. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Cu^{2+} and F^-

- b. Ca^{2+} and O^{2-}
 - c. K^{+} and P^{3-}
14. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Na^{+} and N^{3-}
 - b. Co^{2+} and I^{-}
 - c. Au^{3+} and S^{2-}
15. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. K^{+} and SO_4^{2-}
 - b. NH_4^{+} and S^{2-}
 - c. NH_4^{+} and PO_4^{3-}
16. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Ca^{2+} and NO_3^{-}
 - b. Ca^{2+} and NO_2^{-}
 - c. Sc^{3+} and $\text{C}_2\text{H}_3\text{O}_2^{-}$
17. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Pb^{4+} and SO_4^{2-}
 - b. Na^{+} and I_3^{-}
 - c. Li^{+} and $\text{Cr}_2\text{O}_7^{2-}$
18. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. NH_4^{+} and N^{3-}
 - b. Mg^{2+} and CO_3^{2-}
 - c. Al^{3+} and OH^{-}
19. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Ag^{+} and SO_3^{2-}
 - b. Na^{+} and HCO_3^{-}
 - c. Fe^{3+} and ClO_3^{-}
20. Give the formula and name for each ionic compound formed between the two listed ions.
 - a. Rb^{+} and O_2^{2-}
 - b. Au^{3+} and HSO_4^{-}
 - c. Sr^{2+} and NO_2^{-}
21. What is the difference between SO_3 and SO_3^{2-} ?
22. What is the difference between NO_2 and NO_2^{-} ?

Answers

1. Cations form by losing electrons.
- 2.
3.
 - a. 1+
 - b. 2-
 - c. 2+, 3+
- 4.
5.
 - a. 1+
 - b. 1+, 3+
 - c. 1-
- 6.
7.
 - a. the potassium ion
 - b. the oxide ion
 - c. the cobalt(II) and cobalt(III) ions, respectively
- 8.

9.
 - a. the silver ion
 - b. the gold(I) and gold(III) ions, respectively
 - c. the bromide ion
- 10.
11.
 - a. magnesium chloride, MgCl_2
 - b. iron(II) oxide, FeO
 - c. iron(III) oxide, Fe_2O_3
- 12.
13.
 - a. copper(II) fluoride, CuF_2
 - b. calcium oxide, CaO
 - c. potassium phosphide, K_3P
- 14.
15.
 - a. potassium sulfate, K_2SO_4
 - b. ammonium sulfide, $(\text{NH}_4)_2\text{S}$
 - c. ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$
- 16.
17.
 - a. lead(IV) sulfate, $\text{Pb}(\text{SO}_4)_2$
 - b. sodium triiodide, NaI_3
 - c. lithium dichromate, $\text{Li}_2\text{Cr}_2\text{O}_7$
- 18.
19.
 - a. silver sulfite, Ag_2SO_3
 - b. sodium hydrogen carbonate, NaHCO_3
 - c. iron(III) chlorate, $\text{Fe}(\text{ClO}_3)_3$
- 20.
21. SO_3 is sulfur trioxide, while SO_3^{2-} is the sulfite ion.

Acids

1. Give the formula for each acid.
 - a. perchloric acid
 - b. hydriodic acid
2. Give the formula for each acid.
 - a. hydrosulfuric acid
 - b. phosphorous acid
3. Name each acid.
 - a. $\text{HF}(\text{aq})$
 - b. $\text{HNO}_3(\text{aq})$
 - c. $\text{H}_2\text{C}_2\text{O}_4(\text{aq})$
4. Name each acid.
 - a. $\text{H}_2\text{SO}_4(\text{aq})$
 - b. $\text{H}_3\text{PO}_4(\text{aq})$
 - c. $\text{HCl}(\text{aq})$
5. Name an acid found in food.
6. Name some properties that acids have in common.

Answers

1.
 - a. $\text{HClO}_4(\text{aq})$
 - b. $\text{HI}(\text{aq})$
- 2.
3.
 - a. hydrofluoric acid

- b. nitric acid
 - c. oxalic acid
- 4.
5. oxalic acid (answers will vary)

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