

Chapter Two Study Guide Answers

Concepts

1. Know the law of conservation of mass
2. Know about the structure of the atom and who did what including Thomson, Rutherford, Millikan, Bohr
3. Know the three subatomic particles, their relative mass, charges and symbols
4. Know what isotopes and ions (anions and cations) are
5. Know how the average atomic weight is determined from masses of isotopes and relative abundances
6. Know where you find the metals, non-metals, inert (noble) gases, main group elements, transition elements, metalloids
7. Know the nomenclature of ions, ionic compounds and molecular compounds
8. Know how to write the formula for an ionic compound from the charges on the ions
9. Know the nomenclature for polyatomic ions

Outline

I. Early Chemical Theories and Laws

A. Law of definite proportions- **states that the elemental composition of a pure substance is always the same, regardless of its source (aka law of constant composition post. 4); when you mix two reactants, they mix in a constant composition to form C**



B. Law of multiple proportions- **if two elements A and B combine to form more than one compound, the masses of B that can combine with the given mass of A are in the ratio of small whole numbers. Ex. H:O in water is always 2:1)**

C. Law of Conservation of Mass- **aka conservation of matter—the total mass of materials present after a chemical reaction is the same as the total mass before the reaction (post. 3)**

D. Dalton's Atomic Theory-

1) each element is composed of extremely small particles called atoms

2) all atoms of a given element are identical; atoms of different elements are different and have different properties

3) atoms of an element aren't changed into different types of atoms by chemical reactions/ atoms are neither created nor destroyed in chemical reactions

II. Early Model of the Atom

A. Thomson and Millikan's Experiments- **Thomson experimented with the cathode ray tube and discovered electrons—Plum Pudding Model. Millikan did the oil droplet experiment between charged plates and measured the rate of drop to figure the charge of the electron—he could measure the mass to charge ratio based on how much the ray bent when the charge of the ray changed.**

B. Rutherford's Experiments- **Discovered alpha, beta, and gamma radiation; led to the nuclear model of the atom; used gold foil experiment; discovered but couldn't prove existence of the proton**

C. Bohr and Chadwick- **Bohr discovered line spectra. Chadwick proved the existence of the proton**

III. Composition of the atom

A. Subatomic Particles (relative mass, charges, and symbol)

- | | | | |
|--------------|--|-----------|----------|
| 1. Electron- | 5.486 X 10⁻⁴ amu (O) | -1 | e |
| 2. Proton- | 1.0073 amu | +1 | p |
| 3. Neutron- | 1.0087 amu | 0 | n |

B. Modified Atoms

1. Ions- **a charged particle as the result of electrons removed/added to a neutral atom**
 - a. Cations- **ion with a positive charge (usually metals lose e's to form)**
 - b. Anions- **ion with a negative charge (usually nonmetals gain e's to form)**
2. Isotopes- **atoms with different number neutrons but same number protons**

IV. Periodic Table

“A” Column- representative elements

Inert Gases don't form ions

Stairstep down table separates metals from nonmetals

Left- Metals – Cations

Right- Nonmetals - Anions

V. Types of Radiation

- a. Alpha- **particles identical to helium-4 nuclei, consisting of two protons and two neutrons**
- b. Beta- **energetic electrons emitted from the nucleus, negative -1 e charge**
- c. Gamma- **energetic electromagnetic radiation emanating from the nucleus of a radioactive atom; no charge**

Practice Problems

1. **True/False.** According to Dalton's Atomic Theory, reactions take place when atoms separate, combine, or rearrange.
2. Rutherford discovered a dense positively charged region in the center of the atom that he called the _____.
Nucleus
3. Thomson used a cathode ray tube to prove the existence of what subatomic particle?
electron
4. What are the relative masses and charges of the 3 subatomic particles?

Proton-	1	-1
Electron-	1640	+1
Neutron-	1640	0
5. How many electrons, neutrons and protons are there in Sulfur-34?

16 electrons, 16 protons, 18 neutrons

6. Give the names for the following formulas.

- a. CuSO_4 **Copper (II) Sulfate**
- b. NaOH **Sodium hydroxide**
- c. MgBr_2 **Magnesium dibromide**
- d. SiS_2 **Silicon disulfide**
- e. N_2O_4 **Dinitrogen Tetroxide**

7. Give the formula for the following compounds.

- a. Calcium chloride **CaCl_2**
- b. Nickel (II) nitrate **$\text{Ni}(\text{NO}_3)_2$**
- c. Magnesium carbonate **MgCO_3**
- d. Phosphorus pentafluoride **PF_5**
- e. Carbon dioxide **CO_2**

8. Choose the incorrect statement.

- a. The law of constant composition is the law of definite proportions
- b. Objects of like charge repel each other
- c. Electrons were once known as cathode rays
- d. Alpha rays are the same mass as a helium nucleus
- e. **Gamma rays are the same as electrons**

9. Which is the proper AZE notation for an ion having 35 protons, 36 electrons and 45 neutrons?



10. Write the formula of the lithium-containing compound made when lithium reacts with chlorine gas.



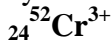
11. Write the proper name for SF_6 .

Sulfur hexafluoride

12. Which is the proper chemical symbol for tungsten?

- a. Te
- b. Ti
- c. Tm
- d. **W**
- e. Ts

13. An atom has 28 neutrons and 21 electrons. If it is a cation with a +3 charge, what is its correct symbol and AZE notation?



14. Write the proper formula for phosphorus pentachloride.



15. Write the proper name for CO_2 .

Carbon Dioxide

16. The total number of neutrons in an ${}^{192}\text{Ir}^{2+}$ cation is:

- a. **115**
- b. 77

- c. 192
- d. 75
- e. 269

17. Write the formula for the calcium-containing compound made when calcium reacts with oxygen.

CaO

18. Write the proper name for ZnO.

Zinc Oxide

19. Groups, or families, on the periodic table are

- a. **Vertical columns of elements with similar properties**
- b. Horizontal rows of elements with increasing atomic numbers
- c. Named for the first elements in the series; such as “actinides”
- d. Extremely reactive with each other
- e. Elements which all occur naturally in the same state

20. When decomposed chemically, 73.0 grams of a sample of HCl produce 71.0 g Cl₂ and 2.0 grams of H₂, while 34.0 g of a sample of H₂S produce 32.0 g of H and 2.0g H₂. This is an example of the Law:

- a. **of conservation of mass**
- b. of multiple proportions
- c. of definite proportions
- d. $E = mc^2$
- e. none of the above

21. Write the correct AZE notation for an anion with a -3 charge, with 16 neutrons and 18 electrons.

³¹₁₅P⁻³

22. Write the formula for the potassium-containing compound made when potassium reacts with oxygen.

K₂O

23. Write the proper formula for N₂O₅.

Dinitrogen pentoxide

24. Which of the following is a nonmetal?

- a. Mn
- b. Al
- c. **Ar**
- d. Li
- e. K

25. When a chemical reaction is carried out in a sealed container, the substances may change in color, temperature or state, but no change in mass is detected. This is evidence of the:

- a. **Law of conservation of mass**
- b. Law of constant composition
- c. Law of definite proportions
- d. Existence of electrons

- e. None of the above
26. The total number of neutrons, protons, and electrons in $^{31}\text{P}^{3-}$ are:
- 15 neutrons, 31 protons, 15 electrons
 - 16 neutrons, 15 protons, 18 electrons**
 - 31 neutrons, 15 protons, 18 electrons
 - 15 neutrons, 16 protons, 12 electrons
 - 16 neutrons, 16 protons, 18 electrons
27. Which of the following elements is a metal?
- K**
 - C
 - N
 - O
 - F
28. Which of the following elements is a metalloid?
- Li
 - In
 - As**
 - Se
 - Ar
29. Choose the correct statement.
- Neutrons have no charge and no mass
 - An electron has 1/1837 the mass of a proton**
 - The atomic number is the total number of protons and neutrons in the nucleus
 - The charge of a proton is 1837 times the charge of an electron
 - Electrons and protons have about the same mass
30. Write the correct AZE notation for a cation with a -2 charge, 16 neutrons, and 18 electrons.
- $_{16}^{32}\text{S}^{-2}$
31. Which of the following is neither a metal nor a nonmetal?
- S
 - Cl
 - Ge**
 - Mg
 - Ca
32. The total numbers of neutrons, protons, and electrons in $^{138}\text{Ba}^{2+}$ are:
- 138 neutrons, 56 protons, 54 electrons
 - 82 neutrons, 56 protons, 54 electrons**
 - 56 neutrons, 82 protons, 80 electrons
 - 82 neutrons, 56 protons, 58 electrons
 - 82 neutrons, 82 protons, 82 electrons

33. Write the proper formula for diselenium hexasulfide.



34. Write the proper name for NI₃.

Nitrogen triiodide

35. Which of the following elements is a nonmetal?

a. Mn

b. Al

c. Ar

d. Li

e. K