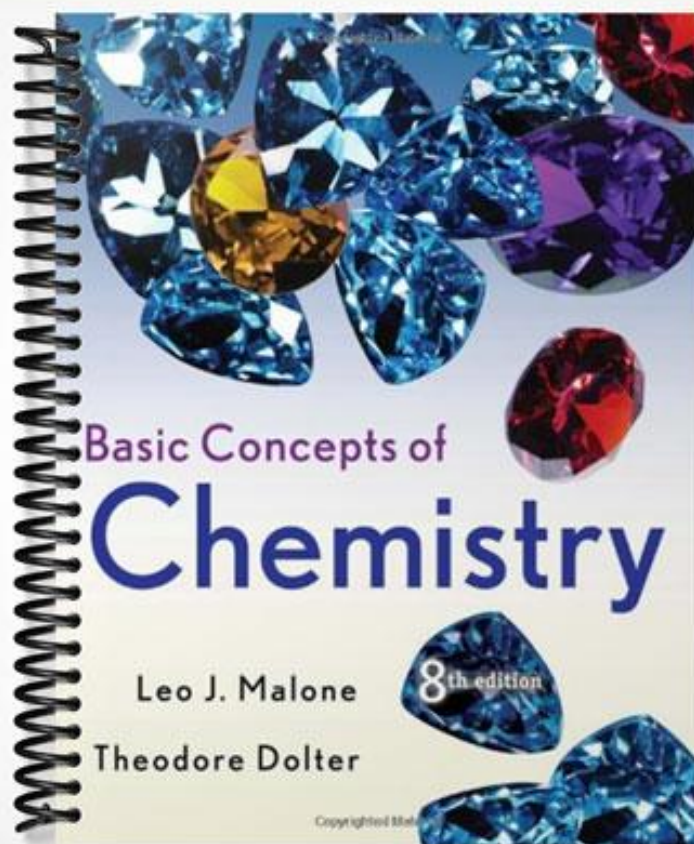


TEST BANK



Basic Concepts of

Chemistry

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8th edition

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Chapter 2

Elements and Compounds

Multiple Choice:

1. What is the name of one of the small rovers that landed on Mars in 2004?
 - a. Freedom
 - b. Phoenix
 - c. Opportunity
 - d. Challenger

Answer: C

2. Anything that has mass and occupies space is referred to as
 - a. volume.
 - b. the Atomic Theory.
 - c. chemistry.
 - d. matter.

Answer: D

3. The study of matter and the changes it undergoes falls under the domain of
 - a. chemistry.
 - b. biology.
 - c. physics.
 - d. matter.

Answer: A

4. What are the two basic types of matter?
 - a. compounds and atoms
 - b. elements and compounds
 - c. elements and molecules
 - d. compounds and mixtures

Answer: B

5. The Earth's crust is predominantly composed of which element?
 - a. silicon
 - b. oxygen
 - c. carbon
 - d. aluminum

Answer: B

6. The human body is primarily composed of which element?
 - a. hydrogen
 - b. carbon
 - c. oxygen
 - d. phosphorus

Answer: C

7. The core of planet Earth is primarily composed of
- oxygen and silicon
 - gold and silver
 - iron and nickel
 - hydrogen and helium

Answer: C

8. Which individual is credited with developing the atomic theory?
- Democritus
 - Aristotle
 - Dalton
 - Einstein

Answer: C

9. Which one of the following is not one of the four postulates of the atomic theory?
- atoms are divisible
 - atoms of the same element have the same properties
 - chemical compounds are composed of atoms of different elements
 - chemical reactions are merely rearrangements of the atoms.

Answer: A

10. Which of the following statements, or conclusions, is **not** a component of Dalton's Atomic Theory?
- Matter is composed of small, indivisible particles called atoms.
 - Any two elements will always form the same compound.
 - Atoms of the same element are identical and have the same properties.
 - Chemical reactions are merely the rearrangement of atoms into different combinations.

Answer: B

11. Which postulate in the atomic theory did the discovery of electrons contradict?
- atoms are indivisible
 - atoms of the same element have the same properties
 - chemical compounds are composed of atoms of different elements
 - chemical reactions are merely rearrangements of the atoms.

Answer: A

12. Which postulate in the atomic theory did the discovery of isotopes contradict?
- atoms are indivisible
 - atoms of the same element have the same properties
 - chemical compounds are composed of atoms of different elements
 - chemical reactions are merely rearrangements of the atoms.

Answer: B

13. The smallest fundamental particle of an element that has the properties of that element is the

- a. proton.
- b. atom.
- c. electron.
- d. neutron.

Answer: B

14. Which element, found in a thin layer of dust, aided in the development of a hypothesis for how the dinosaurs became extinct?

- a. sodium
- b. ruthenium
- c. iridium
- d. cobalt

Answer: C

15. Which one of the following identifies the chemical bonds that form molecular compounds?

- a. covalent
- b. ionic
- c. electrostatic
- d. isentropic

Answer: A

16. Ionic compounds are formed due to which type of attraction?

- a. gravitational
- b. magnetic
- c. electrostatic
- d. nuclear

Answer: C

17. Which one of the following does not naturally exist as a diatomic molecule?

- a. helium
- b. hydrogen
- c. nitrogen
- d. fluorine

Answer: A

18. How many atoms are in one molecule of capsaicin, $C_{18}H_{27}NO_3$?

- a. 4
- b. 49
- c. 48
- d. Not enough info

Answer: B

19. The formula for ethylene glycol, HOCH₂CH₂OH, is an example of a(n)
- empirical formula.
 - covalent formula.
 - molecular formula.
 - ionic compound formula.

Answer: C

20. Titanium is obtained from the ore ilmenite. This compound contains 3 oxygen atoms and 1 iron atom for each titanium atom. What is the molecular formula?
- 3 FeTiO
 - Fe₃TiO
 - FeTi·3O
 - FeTiO₃

Answer: D

21. Acetylsalicylic acid, commonly known as aspirin, has 9 carbons, 8 hydrogens, and 4 oxygen atoms. What is the molecular formula?
- C₉H₈O₄
 - Ca₉H₈O₄
 - C₉(OH₂)₄
 - C₉H₈O_{x4}

Answer: A

22. A metal atom that loses an electron is known as a(n)
- onion.
 - anion.
 - cation.
 - sodium ion.

Answer: C

23. A nonmetal atom that gains an electron is known as a(n)
- onion.
 - anion.
 - cation.
 - sodium ion.

Answer: B

24. How many chloride ions are required to neutralize one aluminum ion?
- 3
 - 2
 - 1
 - 3/2

Answer: A

25. The following two ions (X^{+2} and Y^{-2}) form a neutral chemical compound. How many total ions (cations + anions) are required to form a neutral compound?
- 4
 - 2
 - 1
 - 8

Answer: 2

26. The following two ions (X^{+4} and Y^{-3}) form a neutral chemical compound. How many total ions (cations + anions) are required to form a neutral compound?
- 7
 - 4
 - 3
 - Can't be neutralized

Answer: A

27. Titanium with a +4 charge and oxygen with a -2 charge form a compound. How many oxygen ions are required to neutralize the titanium ion?
- 1
 - 2
 - 4
 - 8

Answer: B

28. Based on the observed deflections of the charged alpha-particles (He^{2+}), some of which were quite large, Rutherford concluded that the
- atom was composed of a positively charged medium embedded with electrons.
 - atom was mostly empty space.
 - electrons from neighboring gold atoms attracted the alpha particles (He^{2+}).
 - atom consisted of a tiny, massive, positively charged core he called a nucleus.

Answer: A

29. The area of the atom that contains the largest mass and is the most dense is called
- the centroid.
 - the nucleus.
 - the nucleon.
 - the focus.

Answer: B

30. Protons and neutrons are composed of even smaller particles called

- a. sporks.
- b. sparks.
- c. quarks.
- d. quirks.

Answer: C

31. From the results of his gold foil experiment, Rutherford concluded that

- a. electrons have a charge of -1.6×10^{-19} C.
- b. atoms contain roughly equal numbers of neutrons and protons.
- c. atoms are composed of a small, dense nucleus surrounded by a cloud of electrons.
- d. alpha particles are helium nuclei.

Answer: C

32. The nucleons located in the nucleus of an atom are a combination of which of the following?

- a. protons and electrons
- b. electrons and neutrons
- c. neutrons and protons
- d. protons and alpha particles

Answer: C

33. Arrange the subatomic atomic particles in order of increasing (smallest to largest) mass.

- a. $p < n < e^-$
- b. $e^- < p < n$
- c. $q < p < n$
- d. $n < e^- < p$

Answer: B

34. From the experiments of JJ Thomson, which of the following is not one of his conclusions?

- a. electrons are negatively charged
- b. electrons are massless
- c. electrons are found in all neutral atoms
- d. the atom resembles "plum pudding"

Answer: B

35. The volume of space occupied by the electrons, in comparison to the nucleus, is

- a. about the same.
- b. many times larger.
- c. slightly smaller.
- d. slightly larger.

Answer: B

36. The atomic number of an atom is equal to which one of the following?
- number of electrons
 - number of atoms
 - number of protons
 - number of nucleons

Answer: C

37. The mass number of an atom is equal to which one of the following?
- number of electrons
 - number of neutrons
 - number of protons
 - number of nucleons

Answer: D

38. Which physical parameter distinguishes one element from another?
- The isotope
 - The mass number
 - The atomic number
 - The number of nucleons

Answer: C

39. Which of the following contains the largest number of protons?
- ^{128}Te
 - ^{121}Sb
 - ^{127}I
 - ^{107}Ag

Answer: C

40. The mass number for three isotopes is known to be 126, 130, 128. Which atom has the largest number of protons?
- the 126 atom
 - the 130 atom
 - the 128 atom
 - not enough information

Answer: D

41. Two atoms with the same number of protons, but a different number of neutrons, are known as
- elements.
 - isotopes.
 - atoms.
 - nucleons.

Answer: B

42. What is the identity of ${}_{99}^{185}\text{X}$?

- a. molybdenum (Mo)
- b. technetium (Tc)
- c. einsteinium (Es)
- d. copper (Cu)

Answer: C

43. A certain neutral atom has 23 electrons “orbiting” its nucleus and 28 neutrons in the nucleus. How many protons must this atom have in the nucleus?

- a. 28
- b. 23
- c. 51
- d. 5

Answer: B

44. A certain atom has a charge of +3 and has 33 protons and 42 neutrons in the nucleus. How many electrons does this atom possess?

- a. 30
- b. 36
- c. 33
- d. not enough information

Answer: A

45. A certain atom has a charge of -3 and is composed of 10 electrons and 7 neutrons. How many protons does this atom have in its nucleus?

- a. 13
- b. 17
- c. 7
- d. not enough information

Answer: A

46. The isotopic mass is based on which isotope?

- a. carbon-13
- b. carbon-12
- c. carbon-14
- d. oxygen-16

Answer: B

47. One atomic mass unit is what fraction of the mass of the carbon-12 (${}^{12}\text{C}$) isotope?

- a. 1/6
- b. 1/2
- c. 1
- d. 1/12

Answer: D

48. How many times more massive is ^{74}Se in comparison to ^{12}C ?
- 6.2
 - 62
 - 5.4
 - not enough information

Answer: A

49. To determine the atomic mass of an element,
- add the individual isotopic masses.
 - Use the isotopic mass of the most abundant isotope.
 - Determine the weighted average of the isotopic masses.
 - Add the individual isotopic masses and multiply by the natural abundance of the most common isotope.

Answer: C

50. Given the isotopic notation for nickel-60 ion ($^{60}_{28}\text{Ni}^{2+}$), which one of the following correctly represents the number of electrons, protons, and neutrons, respectively?
- 26, 28, 32
 - 28, 28, 32
 - 32, 28, 26
 - 26, 28, 28

Answer: A

51. Given the isotopic notation for tungsten-184 ion ($^{184}_{74}\text{W}^{6+}$), how many electrons are present?
- 74
 - 80
 - 68
 - 110

Answer: C

52. Given the isotopic notation for tungsten-184 ion ($^{184}_{74}\text{W}^{6+}$), how many neutrons are present?
- 74
 - 80
 - 68
 - 110

Answer: D

53. What is the atomic mass of ^{48}Ti if it is known to be 3.9996x larger than the mass of ^{12}C ?
- 12.000 amu
 - 3.0000 amu
 - 576.00 amu
 - 47.995 amu

Answer: D

54. Given the isotopic notation for tellurium-130 ion ($^{130}_{52}\text{Te}^{2-}$), how many electrons are present?
- 52
 - 78
 - 50
 - 54

Answer: D

55. Which ion has the largest number of electrons?
- $^{35}_{17}\text{Cl}^{1-}$
 - $^{16}_8\text{O}^{2-}$
 - $^{70}_{31}\text{Ga}^{3+}$
 - $^{40}_{20}\text{Ca}^{2+}$

Answer: C

56. Which of the following depicts the number of subatomic particles in the ion $^{202}\text{Hg}^{2+}$?
- 202 protons, 200 electrons, 80 neutrons
 - 80 protons, 78 electrons, 122 neutrons
 - 78 protons, 80 electrons, 158 neutrons
 - 80 protons, 82 electrons, 128 neutrons

Answer: B

57. Which one of the following elemental symbols represents a subatomic particle composition of 80 neutrons, 56 protons, and 54 electrons?
- $^{110}_{80}\text{Hg}$
 - $^{110}_{54}\text{Xe}$
 - $^{136}_{56}\text{Ba}^{2+}$
 - $^{136}_{56}\text{Ba}^{2-}$

Answer: C

Short Answer:

58. (T/F) The human body and the earth's crust are predominantly composed of carbon. **F**
59. (T/F) Chemical compounds are composed of atoms of different elements combined in specific ratios, such as $\text{HO}_{1/2}$. **F**
60. (T/F) A force called a covalent bond holds the atoms in a molecule together. **T**
61. (T/F) Atoms of the same element can possess different masses. **T**
62. (T/F) Cations and anions do not normally exist alone, but as the two oppositely charged parts of an ionic compound. **T**
63. (T/F) Atoms of the same element can possess a different number of protons. **F**
64. (T/F) Using isotopic notation, the number of neutrons in an atom is contained within the mass number. **T**
65. Electrostatic attractive forces, used to form ionic compounds, exist between _____ charged cations and _____ charged anions. **positively and negatively**
66. An element that is 2.5 times more massive than carbon is _____. **zinc**
67. The atoms in a molecule are held together by _____ bonds, whereas species in an ionic compound are held together by _____ bonds. **covalent and ionic**
68. A _____ is formed by the chemical combination of two or more atoms. **molecule**
69. Atoms with the same atomic number but with different mass numbers are known as _____. **isotopes**
70. Groups of atoms that are covalently bonded to each other and possess a net charge are referred to as _____ ions. **polyatomic**
71. The subatomic particles found in the core of the atom are collectively known as _____. **nucleons**
72. In the isotopic notation for molybdenum-98, ${}_{42}^{98}\text{Mo}^{3+}$, there are _____ protons, _____ neutrons, and _____ electrons. **42, 56, 39**

73. Two compounds have the same chemical formula but have different chemical and physical properties. Explain why the two compounds possess different properties.

Answer:

Although the two compounds have the same number and type of atoms, the difference in their properties is due to the arrangement of the bonded atoms in the compounds.

74. An ionic compound is formed between element X and Y, resulting in a formula unit of X_2Y . Explain what must occur in order for electrostatic attractions to pull these ions together to form a compound.

Answer:

Two atoms of element X must lose one electron each and one atom of element Y gains 2 electrons.

75. Explain how the following two ions are formed: Ba^{2+} and N^{3-} .

Answer:

Neutral barium atoms lose two electrons and neutral nitrogen atoms gain 3 electrons.

76. A chemical reaction between chemical A and chemical B produces a new chemical, C. How does Dalton's atomic theory explain this process?

Answer:

One of Dalton's postulates states that chemical reactions are simply the rearrangement of atoms into a different combination.

77. Explain how the discovery of isotopes, in 1932, contradicted a component of Dalton's atomic theory.

Answer:

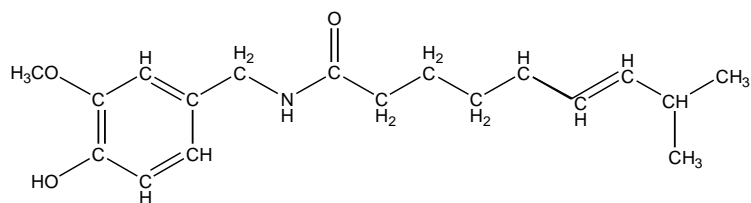
One of Dalton's postulates states that atoms of the same element are identical and have the same properties. Therefore, the discovery of isotopes (atoms of the same element with a different number of neutrons) illustrated that atoms of the same element can have different masses.

78. Explain how Thomson's discovery of the electron contradicted Dalton's atomic theory.

Answer:

One of Dalton's postulates states that matter is composed of indivisible, indestructible particles called atoms. Thomson's discovery of the electron showed that the atom is divisible, it can be broken down into a simpler substance. Discovery of the proton and neutron further supported the divisible atom.

79. Below is the structural formula for capsaicin, the chemical responsible for the heat of a chili pepper. Identify the number of atoms for each element in one



molecule of capsaicin and write the molecular formula.

Answer:

The capsaicin molecule contains 18 carbons, 26 hydrogens, 1 nitrogen, and 3 oxygens. **C₁₈H₂₆NO₃**

80. Discuss the difference between a 'symbol' and a 'formula'.

Answer:

A **symbol** is a shorthand representation for the full name of an **element**. A **formula** is a shorthand representation for a **chemical compound**.

81. How many chlorite ions (ClO₂¹⁻) are required to neutralize an aluminum ion (Al³⁺) in order to form the compound aluminum chlorite? Write the chemical formula.

Answer:

You will need 3 chlorite ions to neutralize the aluminum ion...Al(ClO₂)₃.

82. Describe the difference between the atoms ⁶³Cu and ⁶⁵Cu.

Answer:

Both atoms are isotopes of copper, but copper-65 has two more neutrons in the nucleus of the atom than does copper-63.

83. The three most naturally abundant isotopes of elemental nickel are ⁵⁸Ni, ⁶⁰Ni, and ⁶²Ni. Based on these three isotopes, calculate the average atomic mass for elemental nickel given the following isotopic masses and percent abundances.

<u>Isotope</u>	<u>Isotopic Mass</u>	<u>Percent Abundance</u>
⁵⁸ Ni	57.9353 amu	68.27
⁶⁰ Ni	59.9308 amu	26.10
⁶² Ni	61.9283 amu	3.59

Answer:

Multiply each respective isotopic mass by its percent abundance, then add the results from the three calculations to obtain the average atomic mass. **Average Atomic Mass = 57.42 amu**

84. Fill in the blanks in the table below:

Element	Symbol	No. protons	No. electrons
Iron			
	Br ⁻¹		
		30	28
Calcium (+2)			

Answer:

Element	Symbol	No. protons	No. electrons
Iron	Fe	26	26
Bromine	Br ⁻¹	35	36
Zinc (+2)	Zn ²⁺	30	28
Calcium (+2)	Ca ²⁺	20	18

85. Match the elemental symbol with the correct elemental name.

- | | |
|-------|---------------|
| a. V | 1. magnesium |
| b. P | 2. potassium |
| c. Mg | 3. silver |
| d. K | 4. boron |
| e. B | 5. vanadium |
| f. Ag | 6. manganese |
| g. Mn | 7. phosphorus |
| h. F | 8. fluorine |

Answer:

A5, B7, C1, D2, E4, F3, G6, H8

86. Complete the following table:

Isotope	Notation	Atomic Number	Mass Number	Protons	Electrons	Neutrons
Potassium-39						
		36	84			
	${}_{74}^{184}\text{W}^{+6}$					
				34	36	46

Answer:

Isotope	Notation	Atomic Number	Mass Number	Protons	Electrons	Neutrons
Potassium-39	${}_{19}^{39}\text{K}$	19	39	19	19	20
Krypton-84	${}_{36}^{84}\text{Kr}$	36	84	36	36	48
Tungsten-184	${}_{74}^{184}\text{W}^{+6}$	74	184	74	68	110
Selenium-80	${}_{34}^{80}\text{Se}^{2-}$	34	80	34	36	46

87. Silicon is composed of the following three isotopes; ${}^{28}\text{Si}$, ${}^{29}\text{Si}$, and ${}^{30}\text{Si}$. If the weighted average atomic mass of silicon is 28.0855 amu, which isotope is present in the greatest natural abundance? Explain.

Answer:

Since the weighted average is closest to the isotopic mass of ${}^{28}\text{Si}$, then logically this isotope has the largest natural abundance.

88. Silicon, in its natural state, is composed of three isotopes (^{28}Si , ^{29}Si , and ^{30}Si) that result in an average atomic mass of 28.09 amu for the element. Given the following information, calculate the isotopic mass of silicon-28.

<u>Isotope</u>	<u>Isotopic Mass</u>	<u>Percent Abundance</u>
^{28}Si		92.23
^{29}Si	28.9756 amu	4.67
^{30}Si	29.9738 amu	3.10

Answer:

Set the average atomic mass of silicon equal to the sum of the isotopic masses multiplied by the respective abundances for each isotope.

$$28.09 \text{ amu} = \Sigma (\text{isotope amu} * \text{abundance})$$

Solve the equation for the isotopic mass of ^{28}Si .

Isotopic mass for ^{28}Si = 28.0 amu

89. There are two naturally occurring isotopes for copper, ^{63}Cu and ^{65}Cu . Given the below information, show that the weighted average of these two isotopes is 63.54 amu.

<u>Isotope</u>	<u>Isotopic Mass</u>	<u>Percent Abundance</u>
^{63}Cu	62.9296 amu	69.17
^{65}Cu	64.9278 amu	30.83

Answer:

Calculating the weighted average, $(0.6917)(62.9296) + (0.3083)(64.9278)$, one obtains **63.55** amu for copper.

90. An isotope of fluorine may have been recently discovered at a world-renowned research laboratory. According to the report, which was published in the summer of 1998, the 'new isotopic form of fluorine' has an atomic number of 10 and a mass number of 20. Based on your knowledge of subatomic particles, explain why this report cannot possibly be identifying an isotope of fluorine.

Answer:

The number of **protons** in the nucleus of a **fluorine atom** will always be **9**. Isotopes have the same number of protons, but a different number of neutrons.