

## Reviewing Content

34. The smallest particle of an element that still has the properties of that element.
35. Democritus's ideas were not helpful in explaining chemical behavior because they lacked experimental support.
36. Dalton would agree with all four statements because they all fit his atomic theory.
37. The atoms are separated, joined, and rearranged.
38. a. A beam of electrons (cathode rays) is deflected by an electric field toward the positively charged plate.  
b. The cathode rays were always composed of electrons regardless of the metal used in the electrodes or the gas used in the cathode-ray tube.
39. repel
40. The mass of the proton and neutron are equal; protons are positively charged and neutrons are neutral.
41. Atoms are neutral: number of protons = number of electrons. Loss of an electron means that the number of  $p^+$  is greater than the number of  $e^-$ , so the remaining particle is positively charged.
42. The electrons were stuck in a lump of positive charge.
43. He did not expect alpha particles to be deflected at a large angle.
44. positive
45. protons and neutrons (Rutherford suspected there was something in the nucleus in addition to protons—but didn't know them as neutrons.)
46. It has equal numbers of protons and electrons.
47. the number of protons in the nucleus
48. a. 15                      b. 42  
c. 13                        d. 48  
e. 24                        f. 82
49. The atomic number is the number of protons. The mass number is the sum of the protons and neutrons.
- 50.
- |    |    |    |    |    |    |
|----|----|----|----|----|----|
| 9  | 19 | 9  | 10 | 9  | F  |
| 14 | 29 | 14 | 15 | 14 | Si |
| 22 | 47 | 22 | 25 | 22 | Ti |
| 25 | 55 | 25 | 30 | 25 | Mn |
51. mass numbers, atomic masses, number of neutrons, relative abundance
52. because of the existence of isotopes
53. which isotopes exist, their masses, and their natural percent abundance
54. Average atomic mass is the arithmetic mean of the isotopes. Weighted average atomic mass considers both the mass and the relative abundance of the isotopes.
55. The atomic mass is the weighted average of the masses of all the isotopes.
56. according to their atomic numbers
57. Answers will vary.

## Understanding Concepts

58. very, very, very tiny—but larger than protons and electrons
59. The nucleus is very small and very dense compared with the atom.
60. 5 protons and 6 neutrons in the nucleus; 5 electrons outside the nucleus
61. All atoms of the same element are not identical (isotopes). The atom is not the smallest particle of matter.
62. He used the quantity of charge value and the charge-to-mass ratio measured by Thomson.
63. They are the same value.
64. The masses of isotopes in a sample of the element are averaged, based on relative abundance. The result is the element's atomic mass.
65. 207 amu

66. No; in general he proposed a valid theory in line with the experimental evidence available to him.
67. Atoms are the smallest particle of an element that retains the properties of that element.
68. a. 92.90%                      b. 99.89%  
c. 0.00993%
69.  ${}^{14}_7\text{N}$  : 14.003 amu; 99.63%  ${}^{15}_7\text{N}$  : 15.000 amu; 0.37%  
average atomic mass = 14.01 amu
70. They were attracted to a positively charged plate.
71. Atomic number is the same as the number of protons and electrons; mass number minus atomic number equals number of neutrons.
72. Because they have identical numbers of protons, they also have identical numbers of electrons; electrons are the subatomic particles that are responsible for chemical behavior.
73. The pattern repeats.

## Critical Thinking

74. a. the nucleus of an atom;  
b. very small volume; almost all the mass of the atom; high density; positive charge;  
c. electron
75. Change the metal used as a target and account for differences in deflection patterns.
76. The following are reasonable hypotheses: The space in an individual atom is large relative to the volume of the atom, but very
- small relative to an object the size of a hand. There are many layers of atoms in a wall or a desk. The space that exists is distributed evenly throughout the solid, similar to the distribution of air pockets in foam insulation.
77. The theory must be modified and then retested.
78. Yes—but answers will vary.
79. In a chemical change, atoms are not created or destroyed; they are rearranged.

## Concept Challenge

80. Because diamond is more dense than graphite, pressure could be used to “squeeze” the carbon atoms closer together.
81. 92.5%
82.  $4 \times 10^{-25}$  g

## Cumulative Review

83. Pure chemistry involves the accumulation of scientific knowledge for its own sake. Applied chemistry is accumulating knowledge to attain a specific goal.
84. Scientific theory attempts to explain why experiments give certain results. Scientific law describes a natural phenomenon but does not explain it.
85. a. element                      b. mixture  
c. mixture                      d. mixture
86. 48 g
87.  $6.38 \times 10^5$  cm<sup>3</sup>
88. 99.5 g