



7. Millikan's oil-drop experiment
- A) established the charge on an electron.
  - B) showed that all oil drops carried the same charge.
  - C) provided support for the nuclear model of the atom.
  - D) suggested that some oil drops carried fractional numbers of electrons.
  - E) suggested the presence of a neutral particle in the atom.
- Ans: A Difficulty: E
8. In a Millikan oil-drop experiment, the charges on several different oil drops were as follows:  $-5.92$ ;  $-4.44$ ;  $-2.96$ ;  $-8.88$ . The units are arbitrary. What is the likely value of the electronic charge in these arbitrary units?
- A)  $-1.11$
  - B)  $-1.48$
  - C)  $-2.22$
  - D)  $-2.96$
  - E)  $-5.55$
- Ans: B Difficulty: M
9. Who is credited with discovering the atomic nucleus?
- A) Dalton
  - B) Gay-Lussac
  - C) Thomson
  - D) Millikan
  - E) Rutherford
- Ans: E Difficulty: E
10. Rutherford bombarded gold foil with alpha ( $\alpha$ ) particles and found that a small percentage of the particles were deflected. Which of the following was not accounted for by the model he proposed for the structure of atoms?
- A) the small size of the nucleus
  - B) the charge on the nucleus
  - C) the total mass of the atom
  - D) the existence of protons
  - E) the presence of electrons outside the nucleus
- Ans: C Difficulty: M
11. Which one of the following statements about atoms and subatomic particles is correct?
- A) Rutherford discovered the atomic nucleus by bombarding gold foil with electrons.
  - B) The proton and the neutron have identical masses.
  - C) The neutron's mass is equal to that of a proton plus an electron.
  - D) A neutral atom contains equal numbers of protons and electrons.
  - E) An atomic nucleus contains equal numbers of protons and neutrons.
- Ans: D Difficulty: M
12. The chemical symbol for potassium is
- A) P.
  - B) Po.
  - C) Pt.
  - D) Pm.
  - E) K.
- Ans: E Difficulty: E
13. Which of the following symbols does not represent an element?
- A)  $O_2$
  - B) Co
  - C) HF
  - D) Cs
  - E) Xe
- Ans: C Difficulty: E

14. When an atom is represented by the symbol  ${}^A_Z\text{X}$ , the value of A is the
- number of neutrons in the atom.
  - number of protons in the atom.
  - atomic mass of the element.
  - total number of electrons and neutrons in the atom.
  - total number of protons and neutrons in the atom.
- Ans: E Difficulty: E
15. An isotope of which of the following elements is chosen as a standard in measuring atomic mass?
- carbon
  - oxygen
  - hydrogen
  - neon
  - helium
- Ans: A Difficulty: E
16. One amu is defined as
- the mass of a proton.
  - 1/12 the mass of an atom of  ${}^{12}\text{C}$ .
  - the mass of an atom of  ${}^1\text{H}$ .
  - 1/20 the mass of an atom of  ${}^{20}\text{Ne}$ .
  - 1/16 the mass of an atom of  ${}^{16}\text{O}$ .
- Ans: B Difficulty: E
17. Bromine is the only nonmetal that is a liquid at room temperature. Consider the isotope bromine-81,  ${}^{81}_{35}\text{Br}$ . Select the combination which lists the correct atomic number, neutron number, and mass number, respectively.
- 35, 46, 81
  - 35, 81, 46
  - 81, 46, 35
  - 46, 81, 35
  - 35, 81, 116
- Ans: A Difficulty: E
18. Atoms X, Y, Z, and R have the following nuclear compositions:
- $${}^{410}_{186}\text{X} \quad {}^{410}_{183}\text{Y} \quad {}^{412}_{186}\text{Z} \quad {}^{412}_{185}\text{R}$$
- Which two are isotopes?
- X & Y
  - X & R
  - Y & R
  - Z & R
  - X & Z
- Ans: E Difficulty: E
19. Lithium forms compounds which are used in dry cells and storage batteries and in high-temperature lubricants. It has two naturally occurring isotopes,  ${}^6\text{Li}$  (isotopic mass = 6.015121 amu) and  ${}^7\text{Li}$  (isotopic mass = 7.016003 amu). Lithium has an atomic mass of 6.9409 amu. What is the percent abundance of lithium-6?
- 92.50%
  - 86.66%
  - 46.16%
  - 7.503%
  - 6.080%
- Ans: D Difficulty: H





36. Select the incorrect statement about elements and compounds.
- A) All ionic compounds are neutral.
  - B) Some elements exist as molecules.
  - C) The bonding in compounds may be covalent or ionic.
  - D) The molecular formula of a compound provides more information than the structural formula.
  - E) Among the elements, there are more metals than non-metals.
- Ans: D Difficulty: M
37. Which, if any, of the following elements do not occur in the major classes of organic compounds?
- A) H
  - B) C
  - C) N
  - D) O
  - E) All the above elements occur in the major classes of organic compounds.
- Ans: E Difficulty: M
38. Which of the following is the empirical formula for hexane,  $C_6H_{14}$ ?
- A)  $C_{12}H_{28}$
  - B)  $C_6H_{14}$
  - C)  $C_3H_7$
  - D)  $CH_{2.3}$
  - E)  $C_{0.43}H$
- Ans: C Difficulty: E
39. Sodium oxide combines violently with water. Which of the following gives the formula and the bonding for sodium oxide?
- A)  $NaO$ , ionic compound
  - B)  $NaO$ , covalent compound
  - C)  $Na_2O$ , ionic compound
  - D)  $Na_2O$ , covalent compound
  - E)  $Na_2O_2$ , ionic compound
- Ans: C Difficulty: E
40. Barium fluoride is used in embalming and in glass manufacturing. Which of the following gives the formula and bonding for barium fluoride?
- A)  $BaF_2$ , ionic compound
  - B)  $BaF_2$ , covalent compound
  - C)  $BaF$ , ionic compound
  - D)  $BaF$ , covalent compound
  - E)  $Ba_2F$ , ionic compound
- Ans: A Difficulty: E
41. The colorless substance,  $MgF_2$ , is used in the ceramics and glass industry. What is its name?
- A) magnesium difluoride
  - B) magnesium fluoride
  - C) magnesium(II) fluoride
  - D) monomagnesium difluoride
  - E) none of the above, since they are all misspelled
- Ans: B Difficulty: M

42. The compound, BaO, absorbs water and carbon dioxide readily and is used to dry gases and organic solvents. What is its name?

- A) barium oxide  
 B) barium(II) oxide  
 C) barium monoxide  
 D) baric oxide  
 E) barium peroxide

Ans: A Difficulty: M

43. What is the name of Na<sub>2</sub>O?

- A) disodium monoxide  
 B) sodium monoxide  
 C) sodium dioxide  
 D) sodium(I) oxide  
 E) sodium oxide

Ans: E Difficulty: M

44. The substance, CaSe, is used in materials which are electron emitters. What is its name?

- A) calcium monoselenide  
 B) calcium(II) selenide  
 C) calcium selenide  
 D) calcium(I) selenide  
 E) calcium(II) selenium

Ans: C Difficulty: M

45. The substance, CoCl<sub>2</sub>, is useful as a humidity indicator because it changes from pale blue to pink as it gains water from moist air. What is its name?

- A) cobalt dichloride  
 B) cobalt(II) chloride  
 C) cobalt chloride  
 D) cobaltic chloride  
 E) copper(II) chloride

Ans: B Difficulty: M

46. In the ionic compound with the general formula M<sub>2</sub>X<sub>3</sub>, the likely charge on X is

- A) +1. B) +3. C) -1. D) -2. E) -3.

Ans: D Difficulty: M

47. Which one of the following combinations of names and formulas of ions is incorrect?

- A) O<sub>2</sub><sup>-</sup> oxide  
 B) Al<sup>3+</sup> aluminum  
 C) NO<sub>3</sub><sup>-</sup> nitrate  
 D) PO<sub>4</sub><sup>3-</sup> phosphate  
 E) CrO<sub>4</sub><sup>2-</sup> chromate

Ans: A Difficulty: H

48. Which one of the following is a polyatomic cation?

- A) nitrate  
 B) chromate  
 C) permanganate  
 D) hydronium  
 E) potassium

Ans: D Difficulty: M









73. The name for HF(g) is  
 A) hydrofluoric acid. D) hydrogen fluorine.  
 B) hydrogen(I) fluoride. E) fluoric acid.  
 C) hydrogen fluoride.  
 Ans: C Difficulty: M
74. Which one of the following combinations of names and formulas is incorrect?  
 A)  $\text{H}_3\text{PO}_4$  phosphoric acid D)  $\text{H}_2\text{CO}_3$  carbonic acid  
 B)  $\text{HNO}_3$  nitric acid E) KOH potassium hydroxide  
 C)  $\text{NaHCO}_3$  sodium carbonate  
 Ans: C Difficulty: M
75. What is the name of  $\text{PCl}_3$ ?  
 A) phosphorus chloride D) trichlorophosphide  
 B) phosphoric chloride E) phosphorus trichloride  
 C) phosphorus trichlorate  
 Ans: E Difficulty: E
76. The compound,  $\text{P}_4\text{S}_{10}$ , is used in the manufacture of safety matches. What is its name?  
 A) phosphorus sulfide D) tetraphosphorus decasulfide  
 B) phosphoric sulfide E) phosphorus pentasulfide  
 C) phosphorus decasulfide  
 Ans: D Difficulty: M
77. What is the name of  $\text{BBr}_3$ ?  
 A) boron bromide D) tribromoboride  
 B) boric bromide E) bromine triboride  
 C) boron tribromide  
 Ans: C Difficulty: M
78. What is the name of  $\text{IF}_7$ ?  
 A) iodine fluoride D) heptafluoroiodide  
 B) iodic fluoride E) heptafluorine iodide  
 C) iodine heptafluoride  
 Ans: C Difficulty: M
79. What is the name of  $\text{P}_4\text{Se}_3$ ?  
 A) phosphorus selenide D) phosphoric selenide  
 B) phosphorus triselenide E) tetraphosphorus triselenide  
 C) tetraphosphorus selenide  
 Ans: E Difficulty: M

80. Diiodine pentaoxide is used as an oxidizing agent that converts carbon monoxide to carbon dioxide. What is its chemical formula?  
A)  $I_2O_5$  B)  $IO_5$  C)  $2IO_5$  D)  $I_5O_2$  E)  $(IO_5)_2$   
Ans: A Difficulty: E
81. Tetrasulfur dinitride decomposes explosively when heated. What is its formula?  
A)  $S_2N_4$  B)  $S_4N_2$  C)  $4SN_2$  D)  $S_4N$  E)  $S_2N$   
Ans: B Difficulty: E
82. Chlorine dioxide is a strong oxidizer that is used for bleaching flour and textiles and for purification of water. What is its formula?  
A)  $(ClO)_2$  B)  $Cl_2O$  C)  $Cl_2O_2$  D)  $Cl_2O_4$  E)  $ClO_2$   
Ans: E Difficulty: E
83. The formula of heptane is  
A)  $C_6H_{12}$ . B)  $C_6H_{14}$ . C)  $C_7H_{14}$ . D)  $C_7H_{16}$ . E)  $C_8H_{16}$ .  
Ans: D Difficulty: M
84. Ammonium sulfate,  $(NH_4)_2SO_4$ , is a fertilizer widely used as a source of nitrogen. Calculate its molecular mass.  
A) 63.07 amu D) 128.11 amu  
B) 114.10 amu E) 132.13 amu  
C) 118.13 amu  
Ans: E Difficulty: E
85. Sodium chromate is used to protect iron from corrosion and rusting. Determine its molecular mass.  
A) 261.97 amu D) 138.98 amu  
B) 238.98 amu E) 74.99 amu  
C) 161.97 amu  
Ans: C Difficulty: M
86. Iodine pentafluoride reacts slowly with glass and violently with water. Determine its molecular mass.  
A) 653.52 amu D) 202.90 amu  
B) 259.89 amu E) 145.90 amu  
C) 221.90 amu  
Ans: C Difficulty: E
87. Determine the molecular mass of iron (III) bromide hexahydrate, a substance used as a catalyst in organic reactions.  
A) 403.65 amu D) 313.57 amu  
B) 355.54 amu E) 295.56 amu  
C) 317.61 amu  
Ans: A Difficulty: M

88. Name the three important “laws” that were accounted for by Dalton's atomic theory.

Ans: laws of conservation of mass; definite composition; multiple proportions

Difficulty: M

89. Dalton's atomic theory has required some modifications in the light of subsequent discoveries. For any three appropriate postulates of Dalton's atomic theory

a. state the postulate in its original form.

b. in one sentence, describe why the postulate has needed modification.

Ans: 1. Matter consists of atoms which are indivisible, cannot be created or destroyed.

But, atoms are divisible, as the existence of subatomic particles shows.

2. Atoms of one element cannot be converted into atoms of another element. They can be converted in various nuclear reactions, including radioactive decay.

3. Atoms of an element are identical in mass and other properties. Isotopes of an element differ in their masses and other properties.

Difficulty: M

90. Fill in the blank spaces and write out all the symbols in the left hand column in full, in the form  ${}^A_Z\text{X}$  (i.e., include the appropriate values of  $Z$  and  $A$  as well as the correct symbol  $X$ ).

<u>Symbol</u>	<u># protons</u>	<u># neutrons</u>	<u># electrons</u>
...	17	18	...
Au	...	118	...
...	...	20	20

Ans: 

<u>Symbol</u>	<u># protons</u>	<u># neutrons</u>	<u># electrons</u>
${}^{35}_{17}\text{Cl}$	17	18	17
${}^{197}_{79}\text{Au}$	79	118	79
${}^{20}_{20}\text{Ca}$	20	20	20

Difficulty: M

91. The following charges on individual oil droplets were obtained during an experiment similar to Millikan's. Use them to determine a charge for the electron in coulombs (C), showing all your working.

Charges (C):  $-3.184 \times 10^{-19}$ ;  $-4.776 \times 10^{-19}$ ;  $-7.960 \times 10^{-19}$

Ans:  $-1.59 \times 10^{-19}$  C

Difficulty: M

92. State the two important experimental results (and the names of the responsible scientists) which enabled the mass of the electron to be determined.

Ans: Thomson measured  $m/e$ , the mass-to-charge ratio. Millikan measured  $e$ , the charge. Thus, the mass  $m$  could be calculated.

Difficulty: M

93. For each of the following elements, indicate whether it is a metal, a non-metal, or a metalloid:

- a. S
- b. Ge
- c. g
- d. H
- e. I
- f. Si

Ans: a. nonmetal  
b. metalloid  
c. metal  
d. nonmetal  
e. nonmetal  
f. metalloid

Difficulty: E

94. Give the common name of the group in the periodic table to which each of the following elements belongs:

- a. Rb
- b. Br
- c. Ba
- d. Ar

Ans: a. alkali metals  
b. halogens  
c. alkaline earth metals  
d. noble gases

Difficulty: E

95. a. Give the names of the following ions:

- (i)  $\text{NH}_4^+$
- (ii)  $\text{SO}_3^{2-}$

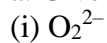
b. Write down the formulas of the following ions:

- (i) aluminum
- (ii) carbonate

Ans: a. (i) ammonium  
(ii) sulfite  
b. (i)  $\text{Al}^{3+}$   
(ii)  $\text{CO}_3^{2-}$

Difficulty: M

96. a. Give the names of the following ions:



b. Write down the formulas of the following ions:

(i) ammonium

(ii) nitrate

Ans: a. (i) peroxide

(ii) sulfate

b. (i)  $\text{NH}_4^+$

(ii)  $\text{NO}_3^-$

Difficulty: M

97. For each of the following names, write down the corresponding formula, including charge where appropriate (atomic numbers and mass numbers are not required):

a. zinc ion

b. nitrite ion

c. carbonic acid

d. cyanide ion

Ans: a.  $\text{Zn}^{2+}$

b.  $\text{NO}_2^-$

c.  $\text{H}_2\text{CO}_3$

d.  $\text{CN}^-$

Difficulty: M

98. Calculate the molecular masses of the following:

a.  $\text{Cl}_2$

b.  $\text{H}_2\text{O}_2$

c.  $(\text{NH}_4)_2\text{SO}_4$

d.  $\text{Ba}(\text{NO}_3)_2$

Ans: a. 70.90 amu

b. 34.02 amu

c. 132.2 amu

d. 261.3 amu

Difficulty: E

99. In nature, some elements exist as molecules, while others do not.

Ans: True Difficulty: E

100. Modern studies have shown that the Law of Multiple Proportions is not valid.

Ans: False Difficulty: M

101. Atoms of one element cannot be converted to another element by any known method.

Ans: False Difficulty: E

Chapter 2: The Components of Matter

102. The mass of a neutron is equal to the mass of a proton plus the mass of an electron.  
Ans: False Difficulty: E
103. All neutral atoms of tin have 50 protons and 50 electrons.  
Ans: True Difficulty: E
104. Copper (Cu) is a transition metal.  
Ans: True Difficulty: E
105. Lead (Pb) is a main-group element.  
Ans: True Difficulty: E
106. Ionic compounds may carry a net positive or negative charge.  
Ans: False Difficulty: E
107. When an alkali metal combines with a non-metal, a covalent bond is normally formed.  
Ans: False Difficulty: E
108. The molecular formula of a compound provides more information than its structural formula.  
Ans: False Difficulty: E
109. The formula  $C_9H_{20}$  is an empirical formula.  
Ans: True Difficulty: E