

## Chapter 02 - Atoms, Molecules, and Ions

1. Which of the following statements is/are postulates of Dalton's atomic theory?

1. Elements are composed of tiny particles called atoms.
  2. No atom is changed into another element in an ordinary chemical reaction.
  3. Compounds are formed when two or more atoms combine.
- a. 1 only
  - b. 2 only
  - c. 3 only
  - d. 1 and 3
  - e. 1, 2, and 3

ANSWER: e

2. J.J. Thomson determined that electrons are small, negatively charged particles by

- a. bombarding gold foil with alpha particles.
- b. exposing photographic plates to radioactive uranium.
- c. deflecting cathode rays with electric and magnetic fields.
- d. converting cathode rays to electron particles using a fluorescent screen.
- e. decomposing neutrons into protons and electrons.

ANSWER: c

3. Which of the following statements is/are CORRECT?

1. A neutron is an uncharged particle with a mass slightly greater than a proton.
  2. The nucleus of an atom has a negative charge.
  3. More than 99.9% of an atom's mass is concentrated in the electron cloud surrounding the nucleus.
- a. 1 only
  - b. 2 only
  - c. 3 only
  - d. 1 and 3
  - e. 1, 2, and 3

ANSWER: a

4. Rank the subatomic particles from least to greatest mass.

- a. electrons = neutrons = protons
- b. electrons = protons < neutrons
- c. electrons < neutrons = protons
- d. electrons < protons < neutrons
- e. electrons < neutrons < protons

ANSWER: d

5. All of the following statements are true EXCEPT

- a. all atoms of a given element have the same mass number.
- b. for any neutral element, the number of electrons is equal to the number of protons.
- c. the mass number is the sum of the number of protons and neutrons.
- d. isotopes of atoms contain the same number of protons but a different number of neutrons.

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e. the atomic number equals the number of protons in an atom.

ANSWER: a

6. All atoms of the same element have the same number of \_\_\_\_\_.

- a. neutrons
- b. protons
- c. protons and neutrons
- d. electrons and neutrons
- e. protons, neutrons, and electrons

ANSWER: b

7. What is the mass number of an argon atom with 22 neutrons?

- a. 2
- b. 18
- c. 22
- d. 40
- e. 39.95

ANSWER: d

8. Which of the following atoms contains the fewest protons?

- a.  $^{232}\text{Th}$
- b.  $^{231}\text{Pa}$
- c.  $^{245}\text{Pu}$
- d.  $^{238}\text{U}$
- e.  $^{232}\text{Pa}$

ANSWER: a

9. How many protons, neutrons, and electrons are in a silver atom with a mass number of 108?

- a. 47 protons, 47 neutrons, 61 electrons
- b. 47 protons, 61 neutrons, 47 electrons
- c. 61 protons, 47 neutrons, 47 electrons
- d. 47 protons, 108 neutrons, 47 electrons
- e. 61 protons, 108 neutrons, 61 electrons

ANSWER: b

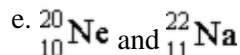
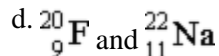
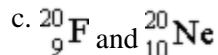
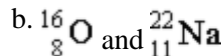
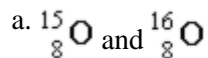
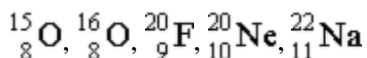
10. F-20, a radioactive isotope of fluorine, has

- a. 9 protons, 10 neutrons, and 1 electron.
- b. 9 protons, 10 neutrons, and 9 electrons.
- c. 9 protons, 11 neutrons, and 9 electrons.
- d. 10 protons, 9 neutrons, and 1 electron.
- e. 10 protons, 10 neutrons, and 10 electrons.

ANSWER: c

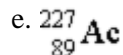
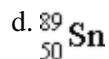
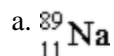
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11. Which two atoms below have the same number of neutrons?



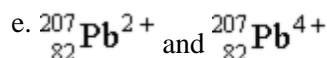
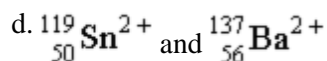
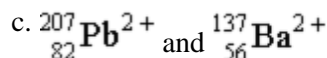
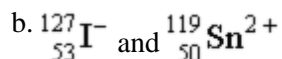
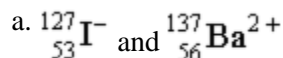
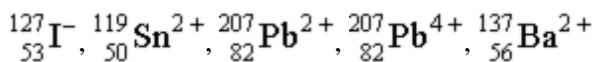
ANSWER: d

12. What is the atomic symbol for an element with 39 protons and 50 neutrons?



ANSWER: c

13. Which two of the ions below have the same number of electrons?



ANSWER: a

14. Two isotopes of a given element will have the same number of \_\_\_\_\_, but a different number of \_\_\_\_\_ in their nucleus.

a. protons, electrons

b. electrons, protons

c. protons, neutrons

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- d. neutrons, protons
- e. electrons, neutrons

ANSWER: c

15. Which of the following are a pair of isotopes?

- a.  ${}_{18}^{40}\text{Ar}$  and  ${}_{19}^{40}\text{K}$
- b.  ${}_{20}^{40}\text{Ca}$  and  ${}_{19}^{40}\text{K}$
- c.  ${}_{18}^{40}\text{Ar}$  and  ${}_{36}^{80}\text{Kr}$
- d.  ${}_{20}^{40}\text{Ca}$  and  ${}_{19}^{39}\text{K}$
- e.  ${}_{20}^{40}\text{Ca}$  and  ${}_{20}^{42}\text{Ca}$

ANSWER: e

16. Which species has 63 neutrons?

- a.  ${}_{48}^{112}\text{Cd}$
- b.  ${}_{49}^{112}\text{In}$
- c.  ${}_{29}^{63}\text{Cu}$
- d.  ${}_{63}^{152}\text{Eu}$

e. none of the above

ANSWER: b

17. Two isotopes of chlorine are found in nature, Cl-35 and Cl-37. The average mass of chlorine is 35.45 amu. The more abundant isotope of Cl has

- a. 17 protons, 17 electrons, and 18 neutrons.
- b. 17 protons, 17 electrons, and 18.45 neutrons.
- c. 17 protons, 17 electrons, and 20 neutrons.
- d. 18 protons, 18 electrons, and 17 neutrons.
- e. 19 protons, 19 electrons, and 16 neutrons.

ANSWER: a

18. What is the identity of  ${}_{25}^{55}\text{X}$ ?

- a. zinc
- b. silver
- c. iridium
- d. cesium
- e. manganese

ANSWER: e

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19. What is the symbol for an element which contains 57 neutrons and has a mass number of 101?

- a. Er
- b. Ru
- c. Md
- d. La
- e. Os

ANSWER: b

20. Rubidium has two naturally occurring isotopes. The average mass of Rb is 85.4678 amu. If 72.15% of Rb is found as Rb-85 (84.9117 amu), what is the mass of the other isotope?

- a. 0.56 amu
- b. 85.68 amu
- c. 86.91 amu
- d. 86.02 amu
- e. 83.47 amu

ANSWER: c

21. Silver has two stable isotopes with masses of 106.90509 amu and 108.9047 amu. The average molar mass of silver is 107.868 amu. What is the percent abundance of each isotope?

- a. 50.0% Ag-107 and 50.0% Ag-109
- b. 51.8% Ag-107 and 48.2% Ag-109
- c. 55.4% Ag-107 and 44.6% Ag-109
- d. 48.2% Ag-107 and 51.8% Ag-109
- e. 44.6% Ag-107 and 55.4% Ag-109

ANSWER: b

22. Gallium has an average atomic mass of 69.7 amu. In a typical sample, 60.4% of Ga exists as Ga-69 (68.9257 amu). What is the identity and the atomic mass of the other isotope?

- a.  ${}^{72}_{31}\text{Ga}$ ; 70.9 amu
- b.  ${}^{70}_{31}\text{Ga}$ ; 70.9 amu
- c.  ${}^{71}_{31}\text{Ga}$ ; 70.9 amu
- d.  ${}^{71}_{31}\text{Ga}$ ; 71.9 amu
- e.  ${}^{72}_{31}\text{Ga}$ ; 71.9 amu

ANSWER: c

23. An element has three naturally occurring isotopes with the following abundances and masses:

abundance	mass (amu)
78.99%	23.985042
10.00%	24.985837

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11.01%

25.982593

Determine the molar mass of the element.

- a. 24.31 g/mol
- b. 24.98 g/mol
- c. 74.95 g/mol
- d. 2431 g/mol
- e. none of the above

ANSWER: a

24. The average molar mass of lithium is 6.941. A sample of lithium consists of two isotopes with masses of 6.01512 amu and 7.01600 amu. Determine the percent abundance of each isotope.

- a. 7.49% Li-6 and 92.51% Li-7
- b. 8.45% Li-6 and 91.55% Li-7
- c. 12.49% Li-6 and 87.51% Li-7
- d. 91.55% Li-6 and 8.45% Li-7
- e. 92.51% Li-6 and 7.49% Li-7

ANSWER: a

25. What is the mass (in grams) of a boron atom?

- a. 10.8 g
- b.  $1.80 \times 10^{-23}$  g
- c.  $1.66 \times 10^{-24}$  g
- d.  $5.57 \times 10^{22}$  g
- e.  $1.54 \times 10^{-25}$  g

ANSWER: b

26. Group 1 elements are also known as

- a. alkaline earth metals.
- b. alkali metals.
- c. chalcogens.
- d. halogens.
- e. noble gases.

ANSWER: b

27. How many nonmetallic elements are there in group 13?

- a. 0
- b. 1
- c. 2
- d. 3
- e. 4

ANSWER: a

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28. Identify the halogen from period 4.

- a. Br
- b. I
- c. Kr
- d. Ar
- e. K

ANSWER: a

29. What element is in the fourth period in Group 3A?

- a. Sb
- b. Ga
- c. In
- d. Si
- e. Tl

ANSWER: b

30. Which group of three elements contains a nonmetal, a metal, and a metalloid?

- a. Li, Al, Si
- b. Na, Hg, I
- c. I, Hg, Si
- d. K, O, Br
- e. H, Al, N

ANSWER: c

31. Which three elements are likely to have similar chemical and physical properties?

- a. boron, silicon, and germanium
- b. sodium, magnesium, and aluminum
- c. sodium, potassium, and rubidium
- d. oxygen, sulfur, and chlorine
- e. carbon, nitrogen, and oxygen

ANSWER: c

32. Which group of three elements contains a transition metal, a halogen, and a noble gas?

- a. S, I, Cu
- b. Br, Kr, Ba
- c. Ar, Hg, Rn
- d. Ce, N, He
- e. Cu, I, Xe

ANSWER: e

33. How many elements are contained in period 2?

- a. 3
- b. 8

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- c. 10
- d. 18
- e. 32

ANSWER: b

34. Of the naturally occurring elements in group 14, how many are nonmetals, metalloids, and metals?
- a. 0 nonmetals, 3 metalloids, and 2 metals
  - b. 1 nonmetal, 2 metalloids, and 2 metals
  - c. 2 nonmetals, 2 metalloids, and 1 metal
  - d. 2 nonmetals, 1 metalloid, and 2 metals
  - e. 3 nonmetals, 0 metalloids, and 2 metals

ANSWER: b

35. Which two of the following elements are abundant in the Earth's crust, but missing from the human body: O, Al, Si, Fe, C, N?
- a. O and Fe
  - b. Si and C
  - c. Al and Si
  - d. O and N
  - e. Fe and N

ANSWER: c

36. The formula of ethanol,  $\text{CH}_3\text{CH}_2\text{OH}$ , is an example of a(n)
- a. condensed formula.
  - b. empirical formula.
  - c. structural formula.
  - d. ionic compound formula.
  - e. molecular formula.

ANSWER: a

37. Which element is most likely to form an ion with a  $-2$  charge?
- a. K
  - b. Mg
  - c. P
  - d. Br
  - e. S

ANSWER: e

38. Which atom is most likely to form an ion with a  $+2$  charge?
- a. scandium
  - b. calcium
  - c. aluminum
  - d. oxygen



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e. fluorine

ANSWER: b

39. A strontium ion has \_\_\_\_\_ electrons.

- a. 35
- b. 36
- c. 37
- d. 38
- e. 39

ANSWER: b

40. For a nonmetal in Group 16 of the periodic table, the most common monatomic ion will have a charge of \_\_\_\_\_.

- a. -3
- b. -2
- c. -1
- d. +1
- e. +3

ANSWER: b

41. Identify the ions and their charges in  $\text{Na}_2\text{SO}_4$ .

- a.  $\text{Na}^+$ ,  $\text{SO}_4^-$
- b.  $\text{Na}^+$ ,  $\text{SO}_4^{2-}$
- c.  $\text{Na}^+$ ,  $\text{SO}^{4-}$
- d.  $\text{Na}^{2+}$ ,  $\text{SO}^{4-}$
- e.  $\text{Na}^{2+}$ ,  $\text{SO}_4^{2-}$

ANSWER: b

42. Identify the ions and their charges in  $\text{KH}_2\text{PO}_4$ .

- a.  $\text{K}^+$ ,  $\text{H}^+$ ,  $\text{P}^{3-}$ ,  $\text{O}^{2-}$
- b.  $\text{K}^+$ ,  $\text{H}^{2+}$ ,  $\text{P}^{3-}$ ,  $\text{O}^{8-}$
- c.  $\text{K}^+$ ,  $\text{H}_2^{2+}$ ,  $\text{P}^{-1}$ ,  $\text{O}_4^{-2}$
- d.  $\text{K}^+$ ,  $\text{H}_2\text{PO}_4^-$
- e.  $\text{K}^+$ ,  $\text{H}^{2+}$ ,  $\text{PO}_4^{3-}$

ANSWER: d

43. What is the correct formula for an ionic compound that contains magnesium ions and phosphide ions?

- a.  $\text{MgP}$
- b.  $\text{MgP}_2$
- c.  $\text{Mg}_3\text{P}_2$
- d.  $\text{Mg}_3(\text{PO}_4)_2$

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e.  $\text{Mg}_2\text{P}_3$

ANSWER: c

44. What is the correct formula for an ionic compound that contains aluminum ions and chloride ions?

a.  $\text{AlCl}$

b.  $\text{AlCl}_2$

c.  $\text{AlCl}_3$

d.  $\text{Al}_2\text{Cl}_3$

e.  $\text{Al}_3\text{Cl}_2$

ANSWER: c

45. What are the values for x and y, respectively, in  $\text{Ca}_x\text{H}_y\text{PO}_4$ ?

a. 1 and 2

b. 2 and 1

c. 1 and 3

d. 2 and 2

e. 1 and 1

ANSWER: e

46. Sodium sulfate has the chemical formula  $\text{Na}_2\text{SO}_4$ . Based on this information, the formula for chromium(III) sulfate is \_\_\_\_\_.

a.  $\text{CrSO}_4$

b.  $\text{Cr}(\text{SO}_4)_3$

c.  $\text{Cr}_2(\text{SO}_4)_3$

d.  $\text{Cr}_2\text{SO}_4$

e.  $\text{Cr}_3(\text{SO}_4)_2$

ANSWER: c

47. What is the correct name for  $\text{MnS}$ ?

a. manganese sulfide

b. dimanganese sulfate

c. dimanganese sulfide

d. manganese(II) sulfate

e. manganese(II) sulfide

ANSWER: e

48. What is the correct name for  $\text{K}_3\text{PO}_4$ ?

a. tripotassium phosphate

b. potassium(I) monophosphorus tetraoxide

c. potassium(I) phosphate

d. potassium phosphate

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e. potassium phosphide

ANSWER: d

49. What is the correct name for  $\text{TiCl}_4$ ?

- a. monotitanium tetrachloride
- b. tetrachlorine titanate
- c. titanium tetrachlorine
- d. titanium(IV) tetrachloride
- e. titanium(IV) chloride

ANSWER: e

50. What is the correct name for  $\text{Al}_2\text{O}_3$ ?

- a. alum
- b. aluminum trioxide
- c. aluminum ozinide
- d. aluminum oxide
- e. dialuminum trioxide

ANSWER: d

51. What is the correct formula for aluminum selenide?

- a.  $\text{AlSe}$
- b.  $\text{AlSe}_2$
- c.  $\text{Al}_2\text{Se}$
- d.  $\text{Al}_2\text{Se}_3$
- e.  $\text{Al}_3\text{Se}_2$

ANSWER: d

52. What is the correct formula for iron(II) nitrate?

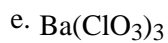
- a.  $\text{Fe}_2(\text{NO}_3)_2$
- b.  $\text{Fe}_2\text{NO}_3$
- c.  $\text{Fe}(\text{NO}_3)_2$
- d.  $\text{Fe}_3\text{N}_2$
- e.  $\text{FeNO}_3$

ANSWER: c

53. What is the correct formula for barium perchlorate?

- a.  $\text{BaClO}_4$
- b.  $\text{BaClO}_3$
- c.  $\text{Ba}(\text{ClO}_4)_2$
- d.  $\text{Ba}(\text{ClO}_3)_2$

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ANSWER: c

54. What is the correct name for  $\text{N}_2\text{O}_3$ ?

- a. nitrogen oxide
- b. nitrogen(II) oxide
- c. nitrogen(III) oxide
- d. trioxygen dinitride
- e. dinitrogen trioxide

ANSWER: e

55. What is the correct name for  $\text{PF}_5$ ?

- a. phosphorus pentafluoride
- b. phosphorus(V) fluorine
- c. phosphorofluoride
- d. pentafluorophosphorus
- e. pentafluorophosphate

ANSWER: a

56. What is the correct name for  $\text{CCl}_4$ ?

- a. carbon chlorine
- b. tetracarbon chloride
- c. carbon tetrachloride
- d. carbon(IV) chloride
- e. tetrachlorocarbide

ANSWER: c

57. What is the correct formula for sulfur dichloride?

- a.  $\text{SCl}$
- b.  $\text{SCl}_2$
- c.  $\text{S}_2\text{Cl}$
- d.  $\text{S}_2\text{Cl}_2$
- e.  $\text{S}_4\text{Cl}_2$

ANSWER: b

58. What is the correct formula for potassium dichromate?

- a.  $\text{K}_2\text{Cr}_2\text{O}_7$
- b.  $\text{K}_2(\text{Cr}_2\text{O}_7)_2$
- c.  $\text{K}_2\text{CrO}_4$
- d.  $\text{K}_2(\text{CrO}_4)_2$

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e.  $\text{KCrO}_4$

ANSWER: a

59. What is the formula for hypochlorous acid?

- a.  $\text{HCl}$
- b.  $\text{HClO}$
- c.  $\text{HClO}_2$
- d.  $\text{HClO}_3$
- e.  $\text{HClO}_4$

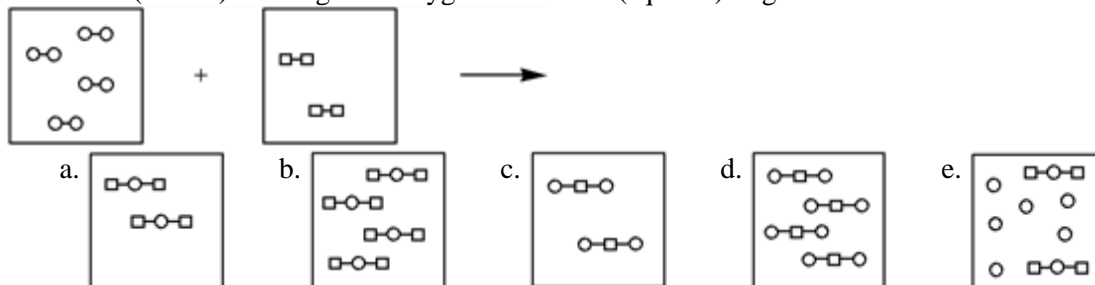
ANSWER: b

60. What is the correct name for  $\text{H}_2\text{SO}_4(\text{aq})$ ?

- a. sulfuric acid
- b. sulfide acid
- c. sulfurous acid
- d. hydrogen sulfate acid
- e. hydrogen sulfide acid

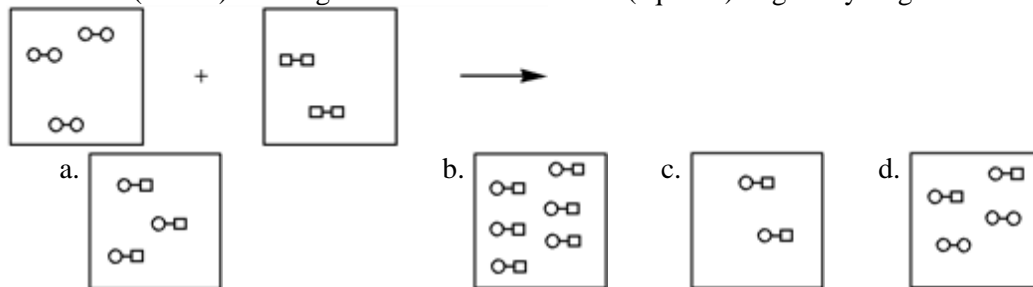
ANSWER: a

61. Using the laws of constant composition and the conservation of mass, complete the molecular picture of hydrogen molecules (circles) reacting with oxygen molecules (squares) to give water.



ANSWER: d

62. Using the laws of constant composition and the conservation of mass, complete the molecular picture of hydrogen molecules (circles) reacting with chlorine molecules (squares) to give hydrogen chloride (HCl).



e. None of these are correct.

ANSWER: e

63. Which of the following is a nonelectrolyte in water?

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

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- a. NaCl
- b. SF<sub>6</sub>
- c. KNO<sub>3</sub>
- d. MgS
- e. NH<sub>4</sub>Cl

ANSWER: b