

## **Chapter 2: Structure of the Atom**

### **Test Bank**

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#### **MULTIPLE CHOICE**

1. The earliest atomic theory is generally associated with:
  - a. Bohr
  - b. Leucippus
  - c. Democritus
  - d. Dalton

ANS: B

Although his theory was somewhat vague, Leucippus is most often the earliest person associated with atomic theory.

OBJ: 1

2. The word *atom* is derived from the Greek word *atomos*, meaning:
  - a. nuclear
  - b. small
  - c. indivisible
  - d. invisible

ANS: C

The Greek word *atomos* means "indivisible."

OBJ: 1

3. In the early 1800s English chemist John Dalton theorized that:
  - a. elements form compounds
  - b. atoms are unique to each element in size and mass
  - c. a chemical reaction results from atoms being rearranged
  - d. all of the above

ANS: D

As a result of his experiments, John Dalton theorized that elements form compounds, atoms are unique to each element in size and mass, and that a chemical reaction results from atoms being rearranged.

OBJ: 1

4. Discovery of the electron is attributed to:
  - a. Dalton
  - b. Bohr
  - c. Thomson
  - d. Rutherford

ANS: C

Joseph John “J.J.” Thomson determined that the electron was a negatively charged part of the atom.

OBJ: 1

5. The “plum pudding model” is associated with:
- Bohr
  - Rutherford
  - Dalton
  - Thomson

ANS: D

Based on the physical arrangement of raisins in a plum pudding, Thomson described the atom and surrounding negatively charged particles (electrons).

OBJ: 1

6. The earliest atomic theory based on the arrangement of the solar system is attributed to:
- Bohr
  - Rutherford
  - Dalton
  - Thomson

ANS: B

Rutherford developed the theory that the atom consisted of a very dense nucleus with small electrons rotating around, similar to the sun and planets.

OBJ: 1

7. The most commonly known modern atomic theory was developed by:
- Bohr
  - Rutherford
  - Dalton
  - Thomson

ANS: A

Niels Bohr refined Rutherford’s atomic theory, based on the solar system, into the most commonly known atomic theory today.

OBJ: 1

8. The three fundamental particles of the atom are the:
- element, nucleus, and electron
  - electron, nucleus, and proton
  - neutron, electron, and proton
  - nucleus, proton, and neutron

ANS: C

The three fundamental components of the atom are the proton, electron, and neutron.

OBJ: 2

9. The atomic nucleus contains:
- protons and neutrons
  - protons and electrons
  - electrons and neutrons
  - all of the above

ANS: A

The atomic nucleus contains varying amounts of protons and neutrons, depending on the element.

OBJ: 2

10. The component of the nucleus that has a positive charge and mass is the:
- electron
  - neutron
  - proton
  - none of the above

ANS: C

The proton is the part of the nucleus that has a positive charge and mass.

OBJ: 3

11. The component of the nucleus that has mass but no electrical charge is the:
- electron
  - neutron
  - proton
  - none of the above

ANS: B

The neutron is found in the nucleus; it is very similar to the proton but has no electrical charge (neutral).

OBJ: 3

12. The fundamental component of the atom that has the smallest mass is the:
- electron
  - neutron
  - proton
  - none of the above

ANS: A

The electron has significantly less mass than the neutron or proton.

OBJ: 3

13. The mass of an atom is primarily due to the mass of the:
- a. neutrons
  - b. nucleus
  - c. electrons
  - d. protons

ANS: B

The nucleus, consisting of both protons and neutrons, accounts for the majority of the mass of an atom.

OBJ: 3

14. If an atom has more protons than electrons it will:
- a. have a negative charge
  - b. have a positive charge
  - c. be electrically neutral
  - d. have neither a positive nor negative charge

ANS: B

An atom with more protons than electrons will have a positive charge.

OBJ: 3

15. If an atom has more electrons than protons it will:
- a. have a negative charge
  - b. have a positive charge
  - c. be electrically neutral
  - d. have neither a positive nor negative charge

ANS: A

An atom with more electrons than protons will have a negative charge.

OBJ: 3

16. If an atom has the same number of electrons and protons it will:
- a. have a negative charge
  - b. have a positive charge
  - c. be electrically neutral
  - d. none of the above

ANS: C

Having the same number of protons and electrons will result in a neutral atom, having neither a negative nor a positive electrical charge.

OBJ: 3

17. When an atom becomes negatively or positively charged it is usually due to a change in the number of:
- a. protons

- b. electrons
- c. neutrons
- d. all of the above

ANS: B

In that there is a weaker bond, the addition or loss of electrons typically produces a charged atom.

OBJ: 3

18. A negative ion is:
- a. an electron
  - b. an atom with more protons than electrons
  - c. an atom with more neutrons than electrons
  - d. an atom with more electrons than protons

ANS: D

A negative ion is a charged atom with more electrons than protons.

OBJ: 3

19. A positive ion is:
- a. a proton
  - b. an atom with more protons than electrons
  - c. an atom with more neutrons than electrons
  - d. an atom with more electrons than protons

ANS: B

A positive ion is a charged atom with more protons than electrons.

OBJ: 3

20. The force that holds the protons and neutrons together in the nucleus is the:
- a. binding energy
  - b. nuclear energy
  - c. atomic energy
  - d. proton/neutron energy

ANS: A

The force that holds the protons and neutrons together in the nucleus is the binding energy.

OBJ: 3

21. If a particle strikes an atom with the same amount of energy as the atom's binding energy:
- a. the atom will become a positive ion
  - b. the atom will become a negative ion
  - c. it can split the atom
  - d. it can fuse the atom

ANS: C

If a particle strikes an atom with the same amount of energy as the atom's binding energy, it can break the atom apart.

OBJ: 3

22. The electrons stay in orbit around the nucleus because of:
- a. their attraction to the protons
  - b. their attraction to the neutrons
  - c. their attraction to the other electrons
  - d. all of the above

ANS: A

The electrons stay in orbit because of their attraction to the positively charged protons in the nucleus.

OBJ: 3

23. The electron binding energy depends on:
- a. how close it is to the nucleus
  - b. how many neutrons there are in the nucleus
  - c. how many protons there are in the nucleus
  - d. A and C

ANS: D

The electron binding energy depends on how close it is to the nucleus and how many protons there are in the nucleus.

OBJ: 3

24. The electron binding energy is stronger when:
- a. there are more protons and the electron is closer to the nucleus
  - b. there are fewer protons and the electron is closer to the nucleus
  - c. there are fewer protons and the electron is farther from the nucleus
  - d. there are more protons and the electron is farther from the nucleus

ANS: A

The electron binding energy is greater when the electron is closer to the nucleus and there are more protons in the nucleus.

OBJ: 3

25. The electron shell closest to the nucleus is lettered:
- a. "E"
  - b. "H"
  - c. "K"
  - d. "M"

ANS: C

The innermost electron shell is the "K" shell.

OBJ: 3

26. The L shell can hold \_\_\_\_\_ electrons.
- a. 1
  - b. 2
  - c. 4
  - d. 8

ANS: D

The L (second) shell can hold  $2 \times 2^2$  electrons, or 8.

OBJ: 3

27. The N shell can hold \_\_\_\_\_ electrons.
- a. 4
  - b. 8
  - c. 32
  - d. 64

ANS: C

The N (fourth) shell can hold  $2 \times 2^4$  electrons, or 32.

OBJ: 3

28. Except for the K shell, the maximum number of electrons that can be in the outermost shell of an atom is:
- a. 4
  - b. 8
  - c. 16
  - d. 32

ANS: B

With the exception of the K shell, no more than 8 electrons can be in the atom's outermost shell.

OBJ: 3

29. If an atom has 15 electrons, which will be the outermost shell?
- a. "L"
  - b. "M"
  - c. "N"
  - d. "O"

ANS: B

With 15 electrons, 2 will fill the K shell, 8 will fill the L shell, and 5 will fill the M shell.

OBJ: 3

30. The number of protons in an atom's nucleus is reflected in its:
- atomic number
  - atomic mass number
  - element
  - compound

ANS: A

The atomic number indicates the number of protons in the nucleus.

OBJ: 4

31. The number of protons and neutrons in the atom's nucleus is the:
- atomic number
  - atomic mass number
  - element
  - compound

ANS: B

The sum of the protons and neutrons in an atom's nucleus is its atomic mass number.

OBJ: 4

32. The simplest form of the substances that form matter is the:
- atomic number
  - atomic mass number
  - element
  - compound

ANS: C

The element, such as hydrogen or oxygen, is the simplest form of substances that form matter.

OBJ: 4

33. Two or more atoms that bond together form a(n):
- atomic number
  - atomic mass number
  - element
  - compound

ANS: D

More than one atom bonded together, such as two atoms of H and one of O (H<sub>2</sub>O), form a compound.

OBJ: 4

34. In a neutral atom, the atomic number indicates the number of:
- protons
  - neutrons
  - electrons



d. A and C

ANS: D

In a neutral atom, the atomic number indicates the number of protons (by definition) but also the number of electrons (which are equal to the number of protons).

OBJ: 4

35. An atom of helium ( ${}^4_2\text{He}$ ) has:
- a. two protons
  - b. four protons
  - c. four neutrons
  - d. four electrons

ANS: A

The atomic number, the number of protons, is the lower number, two.

OBJ: 4

36. An atom of oxygen ( ${}^{16}_8\text{O}$ ) has:
- a. eight protons
  - b. eight neutrons
  - c. eight electrons
  - d. all of the above

ANS: D

The atomic mass number (16) less the atomic number (number of protons—8) equals the number of neutrons (8). The number of electrons equals the number of protons (8).

OBJ: 4

37. How many neutrons does  ${}^7_3\text{Li}$  (lithium) have?
- a. 3
  - b. 4
  - c. 7
  - d. 10

ANS: B

Subtracting the atomic number (3) from the atomic mass number (7) determines the number of neutrons (4).

OBJ: 4

38. How many electrons does a neutral atom of carbon ( ${}^{12}_6\text{C}$ ) have?
- a. 3
  - b. 6
  - c. 12
  - d. 18

ANS: B

A neutral atom has the same number of protons and electrons, in this case 6.

OBJ: 4

39. For the chemical element sodium ( $^{22}_{11}\text{Na}$ ), the atomic number is:
- eleven
  - twenty two
  - thirty three
  - none of the above

ANS: A

The atomic number, number of protons in the nucleus, is the lower number, 11.

OBJ: 4

40. For the chemical element sodium ( $^{22}_{11}\text{Na}$ ), the atomic mass number is:
- 11
  - 22
  - 33
  - none of the above

ANS: B

The atomic mass number, which equals the number of protons and neutrons in the nucleus, is the upper number, 22.

OBJ: 4

41. Atoms with the same number of protons but different number of neutrons are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: A

As isotope is an atom that has the same number of protons but different number of neutrons as compared with the element.

OBJ: 4

42. Atoms with the same atomic number but different atomic mass numbers are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: A

Having the same atomic number (number of protons) and different atomic mass number (number of neutrons are different) results in an atom being classified as an isotope.

OBJ: 4

43. Atoms with the same number of neutrons but different number of protons are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: B

An isotone has the same number of neutrons but different number of protons.

OBJ: 4

44. Atoms with different number of protons but the same combined number of protons and neutrons are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: C

An isobar has a different number of protons but the atomic mass number (protons and neutrons) is the same.

OBJ: 4

45. Atoms with different atomic numbers but the same atomic mass numbers are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: C

Isobars have different number of protons (atomic number) but the atomic mass number (protons and neutrons) is the same.

OBJ: 4

46. Atoms with the same atomic number and atomic mass number but have different energy within their nuclei are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: D

The isomer has the same number of protons and neutrons but the energy level within the nucleus is different.

OBJ: 4

47.  $^{23}_{11}\text{Na}$  is an \_\_\_\_\_ of  $^{22}_{11}\text{Na}$ .
- isotopes
  - isotones
  - isobars
  - isomers

ANS: A

$^{23}_{11}\text{Na}$  is an isotope of  $^{22}_{11}\text{Na}$  because it has the same number of protons (11) and different number of neutrons, as seen in the increased atomic mass number.

OBJ: 4

48.  $^{131}_{53}\text{I}$  and  $^{132}_{54}\text{Xe}$  are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: B

$^{131}_{53}\text{I}$  and  $^{132}_{54}\text{Xe}$  are isotones because they have the same number of neutrons ( $131 - 53 = 132 - 54$ ) but different number of protons (53 vs. 54).

OBJ: 4

49.  $^7_3\text{Li}$  and  $^7_4\text{Be}$  are:
- isotopes
  - isotones
  - isobars
  - isomers

ANS: C

$^7_3\text{Li}$  and  $^7_4\text{Be}$  are isobars because they have the same atomic mass numbers (7) but different numbers of protons (3 vs. 4).

OBJ: 4

50. The periodic table of elements classifies by period and group. The period is the:
- row
  - column
  - group
  - type of element

ANS: A

The periodic table of elements includes seven periods, the rows of the table.

OBJ: 4

51. The periodic table of elements classifies by period and group. The group is the:
- row
  - column
  - period
  - type of element

ANS: B

The periodic table of elements includes eight groups, the columns of the table.

OBJ: 4

52. Atoms in each period have the same number of:
- electrons in the outermost shell
  - atomic mass number
  - electrons
  - electron shells

ANS: D

Atoms in each period have the same number of electron shells.

OBJ: 4

53. Atoms in each group have the same number of:
- electrons in the outermost shell
  - atomic mass number
  - electrons
  - electron shells

ANS: A

Atoms in each period have the same number of electrons in the outermost shell, increasing from left to right.

OBJ: 4

54. A compound consists of:
- at least two molecules
  - at least two elements
  - at least two different materials
  - all of the above

ANS: B

A compound is a molecule that consists of atoms of at least two different elements.

OBJ: 5

55. When the bond between two atoms is due to their sharing an outer-shell electron, this is called a:
- molecular bond
  - ionic bond

- c. compounding bond
- d. covalent bond

ANS: D

Covalent bonding is based on atoms sharing an outer-shell electron.

OBJ: 5

56. When the bond between two atoms is due to one atom giving up an electron and the other atom gaining an electron, it is called a:
- a. molecular bond
  - b. ionic bond
  - c. compounding bond
  - d. covalent bond

ANS: B

Ionic bonding is based on one atom giving up an electron (becoming a positive ion) and the other gaining an electron (becoming a negative ion) and then being attracted to each other.

OBJ: 5

#### TRUE/FALSE

1. The electrons rotate around the nucleus at a single energy level.

- A. True
- B. False

ANS: F

The electrons rotate around the nucleus at different energy levels, based on their distance from the nucleus.

OBJ: 2

2. Electron shells are the hard coating around the electron.

- A. True
- B. False

ANS: F

Electron shells are the defined energy levels around the atomic nucleus.

OBJ: 3

3. Each electron shell has a specific limit to the amounts of electrons it can hold.

- A. True
- B. False

ANS: T

There is a specific limit to how many electrons each shell can hold.

OBJ: 3

4. The outermost shell of an atom can hold fewer than 8 electrons.

A. True

B. False

ANS: T

Although there can be no more than 8 electrons in the outermost shell, there can be fewer than 8.

OBJ: 3

5. Each element has an unchanging number of protons.

A. True

B. False

ANS: T

Each element (H, O, C, etc.) has an unchanging number of protons.

OBJ: 4

6. Elements can only occur naturally.

A. True

B. False

ANS: F

Although there are 92 naturally occurring elements, more than a dozen have been created artificially.

OBJ: 4

7. The atoms of the elements at the top of the periodic table of elements are the most complex.

A. True

B. False

ANS: F

The atoms at the elements at the bottom of the table have more electron shells and are more complex.

OBJ: 4

8. In the middle of the periodic table of elements there are elements that don't fit exactly into one of the eight groups.
- A. True
  - B. False

ANS: T

The inner transitional metals, located in the middle of the table, do not fit into the eight groups.

OBJ: 4

9. All compounds are molecules and all molecules are compounds.
- A. True
  - B. False

ANS: F

All compounds are molecules, containing atoms of at least two elements, but not all molecules are compounds, occurring when multiple atoms of the same element combine.

OBJ: 5

10. An ionic bond results in an electrically charged molecule or compound.
- A. True
  - B. False

ANS: F

An ionic bond is the result of two charged atoms being attracted to each other, creating a neutral molecule or compound.

OBJ: 5