Chapter 2: Elements of Life and Death: The Chemistry of Elements and Atoms

Multiple Choice

1. What is the function of iron in our diet?
    a. builds strong and healthy bones
    b. boosts the immune system
    c. supports proteins that promote growth of hair and nails
    d. part of the protein that transports oxygen from the lungs to the tissues.
    Answer: d

2. Which element can be found in the center of each heme ring that makes up the protein hemoglobin?
    a. iron
    b. calcium
    c. helium
    d. mercury
    e. sodium
    Answer: a

3. Which of the following is an *intensive physical* property?
    a. mass
    b. temperature
    c. volume
    d. reactivity with oxygen
    e. length
    Answer: b

4. Which of the following is an *extensive physical* property?
    a. temperature
    b. density
    c. mass
    d. color
    e melting point
    Answer: c

5. What is the density of a block of metal with volume 5.25 cm^3 and mass 14.18 g?
    a. 0.37 g/cm^3
    b. 3.70 g/cm^3
    c. 19.43 g/cm^3
    d. 27.00 g/cm^3

e. 2.70 g/cm^3

Answer: e

6. Choose the material that would *sink* in water (density of water = 1.00 g/cm^3).
   a. mass of 25.12 g; volume of 12.76 cm^3
   b. mass of 16.53 g; volume of 47.15 cm^3
   c. mass of 35.00 g; volume of 52.25 cm^3
   d. mass of 8.19 g; volume of 12.15 cm^3
   e. Mass of 115.00 g; volume of 224.35 cm^3

   Answer: a

7. An astronaut weighs 120 pounds on earth. On the moon, where gravity is one-sixth that of the earth, she would weigh
   a. 120 pounds.
   b. 0 pounds.
   c. 180 pounds.
   d. 20 pounds.

   Answer: d

8. A cube has a side measuring 4 cm, and mass of 80 g. The cube has a density of
   a. 1.25 g/cm^3 and would sink in water.
   b. 1.25 g/cm^3 and would float in water.
   c. 0.80 g/cm^3 and would sink in water.
   d. 0.80 g/cm^3 and would float in water.
   e. 20.0 g/cm^3 and would sink in water.

   Answer: a

9 A box of silver-colored coins was found to contain coins having a mass of 3,458 g and, by water displacement, their volume was measured as 329.6 cm^3. Given the following densities, identify what the coins are made of.

   Platinum: 21.45 g/cm^3 Silver: 10.49 g/cm^3

   Zinc: 7.14 g/cm^3 Tin: 7.30 g/cm^3

   Aluminum: 2.70 g/cm^3

   a. Platinum
   b. Silver
   c. Zinc
   d. Tin
   e. Aluminum

   Answer: b

10. Which of the following is a *chemical* change?
    a. Ice cubes melt when removed from the freezer.
    b. Sugar dissolves in water.
    c. Nail polish remover evaporates.
    d. Silver tarnishes.
    e. Eggs are whisked.
    Answer: d

11. Which of the following is a *physical* change?
    a. Food is digested.
    b. Wood is burned in a stove.
    c. Food color is dropped into water to give it color.
    d. Fireworks explode.
    e. A bicycle rusts.
    Answer: c

12. Identify the *homogeneous* mixture.
    a. an egg, before it is cracked
    b. a bowl of cereal and milk
    c. a cup of coffee
    d. a bowl of M&Ms
    e. a blueberry muffin
    Answer: c

13. Identify the *heterogeneous* mixture.
    a. a container of mixed nuts
    b. a bucket of seawater
    c. a jar of mayonnaise
    d. a gallon of milk
    e. a gold bar
    Answer: a

14. Which of the following substances is/are elements?

    I. Air II. Helium III. Carbon monoxide IV. Quartz V. Chlorine

    a. II only
    b. II and V
    c. I and V
    d. I, III, and IV
    e. IV only

Answer: b

15. Which of the following substances is/are compounds?

I. Air II. Helium III. Carbon monoxide IV. Quartz V. Chlorine

a. III only
b. II and V
c. III and IV
d. I, III, and IV
e. IV only

Answer: c

16. Which of the following substances is/are mixtures?

I. Air II. Helium III. Carbon monoxide IV. Quartz V. Chlorine

a. II only
b. II and V
c. I and V
d. I, III, and IV
e. I only

Answer: e

17. Choose the element symbol for the element in period 5, Group 4A.

a. As
b. Zr
c. Sb
d. Sn
e. Nb

Answer: d

18. Which element would you expect to have properties most similar to chlorine?

a. Sulfur, S
b. Astatine, At
c. Argon, Ar
d. Aluminum, Al
e. Sodium, Na

Answer: b

19. Choose the element symbol for the noble gas found in Period 4.

a. Br
b. Kr

c. K
d. Sc
e. Se
Answer: b

20. Elements in the periodic table are arranged according to their
    a. atomic mass.
    b. number of neutrons.
    c. element symbol.
    d. size.
    e. atomic number.
    Answer: e

21. Most of the elements on the periodic table are
    a. artificially made.
    b. lanthanides.
    c. non-metals.
    d. noble gases.
    e. metals.
    Answer: e

22. Dmitri Mendeleev discovered *periodicity* in the elements by noticing what about elements that repeats at regular intervals?
    a. ratios of atoms that combine to form compounds
    b. metallic character
    c. reactivity
    d. a and c
    e. b and c
    Answer: d

23. Although human hair varies in diameter, an average width is 0.00075 m. Change this value to micrometers (μm). One meter = 1×10^6 μm.
    a. 7.5×10^{-2} μm
    b. 7.5×10^{2} μm
    c. 7.5×10^{-10} μm
    d. 7.5×10^{10} μm
    Answer: b

24. An *e. coli* bacterium measures approximately 0.0000005 m in width. Change this value to nanometers (nm). One meter = 1×10^9 nm.

a. 5.0×10^{-16} nm
b. 5.0×10^{16} nm
c. 5.0×10^{-2} nm
d. 5.0×10^{2} nm
Answer: d

25. The distance from the Earth to the Sun is 1.49×10^{11} m. Change this value to kilometers (km). One km = 1×10^{3} m.
    a. 1.49×10^{8} km
    b. 1.49×10^{14} km
    c. 1.49×10^{7} km
    d. 1.49×10^{-3} km
    Answer: a

26. Many bacteria can swim as fast as 50 μm per second. Calculate the distance, in meters, that a bacterium could swim in one day. One meter = 1×10^{6} μm.
    a. 5.0×10^{-4} m
    b. 4.32 m
    c. 4.32×10^{6} m
    d. 5.0×10^{8} m
    e. 1.8×10^{-1} m
    Answer: b

27. The average adult heart beats around 80 times per minute. How many heartbeats does the average adult have over a time span of 60 years?
    a. 2.5×10^{-9} heartbeats
    b. 4.2×10^{7} heartbeats
    c. 2.5×10^{9} heartbeats
    d. 4.2×10^{-7} heartbeats
    Answer: c

28. Which of the following is the best description of the composition of an atom?
    a. protons in the nucleus, electrons in a surrounding space
    b. protons and neutrons in the nucleus, electrons in a surrounding space
    c. neutrons and electrons in the nucleus, protons in a surrounding space
    d. neutrons in the nucleus, protons and electrons in a surrounding space
    e. protons and electrons in the nucleus, neutrons in a surrounding space
    Answer: b

29. Choose the particle that has the *smallest* mass.
    a. proton
    b. neutron
    c. electron
    d. hydrogen atom
    Answer: c

30. Choose the element symbol to replace **X**: ${}^{35}_{17}X$.
    a. Cl
    b. C
    c. Br
    d. Ar
    e. F
    Answer: a

31. Choose the element symbol to replace **X**: ${}^{14}_{7}X$.
    a. Si
    b. N
    c. O
    d. F
    e. Na
    Answer: b

32. Isotopes of the same element have different numbers of
    a. protons.
    b. neutrons.
    c. electrons.
    d. atoms.
    e. molecules.
    Answer: b

33. How many protons and neutrons are found in Sodium-22?
    a. 22 protons, 22 neutrons
    b. 11 protons, 11 neutrons
    c. 10 protons, 12 neutrons
    d. 22 protons, 11 neutrons
    e. 11 protons, 22 neutrons
    Answer: b

34. How many protons and neutrons are found in Potassium-40?

a. 40 protons, 40 neutrons
b. 20 protons, 20 neutrons
c. 21 protons, 19 neutrons
d. 19 protons, 21 neutrons
e. 19 protons, 40 neutrons
Answer: d

35. How do we find the number of protons in an element?
a. Subtract the mass number from the atomic number.
b. Subtract the atomic number from the mass number.
c. mass number
d. atomic number
e. group number
Answer: d

36. How do we find the number of neutrons in an isotope?
a. Subtract the mass number from the atomic number.
b. Subtract the atomic number from the mass number.
c. atomic number
d. mass number
e. period number
Answer: b

37. An element has three naturally occurring isotopes, as described in the following table. Calculate the relative atomic mass and identify the element.

Isotope	Natural abundance (%)	Relative atomic mass
1	90.48	19.992
2	0.27	20.994
3	9.25	21.991

a. 20.18; neon
b. 20.99; neon
c. 20.17; calcium
d. 20.99; calcium
e. 31.48; sulfur
Answer: a

38. An element has two naturally occurring isotopes, as described in the following table. Calculate the relative atomic mass and identify the element.

Isotope	Natural abundance (%)	Relative atomic mass
1	69.17	62.929

2	30.83	64.928

a. 63.54; europium
b. 63.93; copper
c. 63.54; copper
d. 50.00; vanadium
e. 69.17; gallium

Answer: c

39. Choose the element with 5 valence electrons.
a. cesium
b. vanadium
c. zirconium
d. boron
e. phosphorus

Answer: e

40. Give the number of valence electrons, and the total number of electrons for chlorine.
a. 7 valence; 17 total
b. 5 valence; 17 total
c. 3 valence; 17 total
d. 7 valence; 8 total
e. 5 valence; 8 total

Answer: a

41. Give the number of valence electrons, and the total number of electrons for silicon.
a. 14 valence; 14 total
b. 4 valence; 14 total
c. 3 valence; 14 total
d. 4 valence; 8 total
e. 3 valence; 8 total

Answer: b

42. Give the number of protons and electrons for chloride, the ion formed from chlorine.
a. 18 protons; 17 electrons
b. 17 protons; 19 electrons
c. 17 protons; 17 electrons
d. 17 protons; 18 electrons
e. 18 protons; 16 electrons

Answer: d

43. Give the number of protons and electrons for the ion formed from calcium.
    a. 20 protons; 18 electrons
    b. 18 protons; 20 electrons
    c. 20 protons; 19 electrons
    d. 18 protons; 19 electrons
    e. 22 protons; 20 electrons
    Answer: a

44. Choose the element that would form an ion with a charge of –2.
    a. Sr
    b. Na
    c. Se
    d. Ne
    e. Br
    Answer: c

45. Choose the element that would form an ion with a charge of +1.
    a. F
    b. He
    c. As
    d. K
    e. Be
    Answer: d

46. Choose the best definition of a quantum mechanical orbital.
    a. a circular path that the electron follows around the nucleus
    b. the space around the nucleus where the protons may be found
    c. region of space where there is a high probability of finding an electron
    d. the energy level that an atom's neutrons occupy
    e. region of space where electrons feel the strongest "pull" from the nucleus
    Answer: c

47. The element that plays an important role in forming healthy bones and teeth is
    a. iron.
    b. calcium.
    c. arsenic.
    d. magnesium.
    e. phosphorus.
    Answer: b

48. The risk of contracting this disorder can be reduced by consuming enough calcium at an early age.
    a. anemia
    b. osmosis
    c. tooth decay
    d. ornithosis
    e. osteoporosis
    Answer: e

49. This element is poisonous because of its similarity to an essential element for life.
    a. arsenic
    b. silicon
    c. phosphorus
    d. sulfur
    e. chlorine
    Answer: a

50. Which of these is *not* one of the six building block elements used to make biological molecules?
    a. carbon
    b. hydrogen
    c. phosphorus
    d. magnesium
    e. sulfur
    Answer: d

Short Answer/Fill in the Blank

1. The condition caused by low levels of iron in the body is called _____.
   Answer: anemia

2. Explain the difference between mass and weight.
   Answer: The mass of an object measures the amount of matter it contains. Weight is a measurement of the force exerted on an object by gravity. Mass does not vary with an object's location, while weight does. For example, a person's weight would be different on the moon versus on the Earth's surface, but their mass would remain the same.

3. Use a periodic table and fill in the blanks in the following chart below:

Atomic symbol	Element name	Number of protons	Number of neutrons	Number of electrons	Net charge

		33	42		+3
		16	16	18	
	calcium		22		0
$^{31}_{15}P^{3-}$					–3
$^{197}_{79}Au$					
$^{197}_{79}Au^{3+}$					

Answer:

Atomic symbol	Element name	Number of protons	Number of neutrons	Number of electrons	Net charge
$^{75}_{33}As^{3+}$	**arsenic**	33	42	**33**	+3
$^{32}_{16}S^{2-}$	**sulfur**	16	16	18	**–2**
$^{42}_{20}Ca$	calcium	**20**	22	**20**	0
$^{31}_{15}P^{3-}$	**phosphorus**	**15**	**16**	**18**	–3
$^{197}_{79}Au$	**gold**	**79**	**118**	**79**	**0**
$^{197}_{79}Au^{3+}$	**gold**	**79**	**118**	**76**	**+3**

4. Explain the difference between the mass number, the atomic number, and the relative atomic mass.
   Answer: The mass number applies to a particular isotope and is the sum of protons and neutrons in that isotope. The atomic number is the number of protons in the isotope, which defines the element. The relative atomic mass is a weighted average of all naturally occurring isotopes of an element, weighted according to their natural abundance.

5. Elements with the same number of _____ _____ have the similar chemical properties.
   Answer: valence electrons

6. Give the number of total electrons and valence electrons for the element strontium, Sr.
   Answer: 38 total, 2 valence

7. When the element strontium (Sr) ionizes, would you expect it to gain or lose electrons? How many?
   Answer: Lose two electrons

8. When elements ionize, they gain or lose electrons to resemble the configuration of the nearest _____.
   Answer: noble gas

9. Quantum mechanics describes electrons not as particles but as _____.
   Answer: waves

Matching

Match each of the following elements to its description.

a. mercury (Hg)	_____	A. This element has 5 valence electrons and is a poison that can be found in drinking water.
b. phosphorus (P)	_____	B. Having 8 protons, this element is essential for life.
c. arsenic (As)	_____	C. One of the only elements to exist as a liquid at room temperature, this is a dangerous environmental toxin that accumulates in fish.
d. iron (Fe)	_____	D. This element loses 2 electrons to form a +2 ion; not consuming enough of it can increase risk of osteoporosis.
e. calcium (Ca)	_____	E. This element gains three electrons when forming an ion; it also helps form an essential source of energy for cells.
f. oxygen (O)	_____	F. This is one of the transition elements, and is essential for the function of the protein hemoglobin.

Answer:

a. C
b. E
c. A
d. F
e. D
f. B