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Chapter 01 – Chemical Foundations

1. Which of the following is NOT a practice that would be employed by a scientist?
   a. testing ideas by experimentation
   b. organizing findings in specific ways
   c. predicting the outcome of an experiment and then not testing the prediction
   d. trying to explain how nature works
   e. making physical models to explain the behavior of matter

ANSWER: c
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

2. Which of the following is NOT normally a part of scientific inquiry?
   a. making observations
   b. philosophizing
   c. suggesting an explanation
   d. testing hypotheses
   e. performing experiments

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

3. Which of the following statements is incorrect?
   a. The scientific method is a way of looking at the world that is different from nonscientific forms of inquiry.
   b. The scientific method does not allow for the use of inferences, and everything must be proven by direct observation.
   c. A theory is a guess about the behavior or properties of matter.
   d. Scientists must isolate and study one variable at a time when performing experiments.
   e. A behavior of matter that has universal validity is called a natural law.

ANSWER: c
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

4. Which of the following observations does NOT relate specifically to the law of definite proportions?
   a. Pure water is composed of the elements oxygen and hydrogen in a mass ratio of 8 to 1.
   b. Any sample of a given compound always contains the same proportions by mass of the component elements.

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c. The mass of the products of a chemical reaction is equal to the mass of the starting materials of the reaction.
d. When a metal reacts with oxygen, the oxygen content of the products is fixed at one or two values.
e. When water is broken down into its elements by electrolysis, elemental oxygen and hydrogen are formed in an 8 to 1 mass ratio.

ANSWER: c
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

5. Which of the following statements regarding fundamental chemical laws is incorrect?
a. John Dalton's experimental results led to the law of conservation of mass.
b. Antoine Lavoisier's experiments showed that the mass of the products of a chemical reaction equals the mass of the reacting substances.
c. When wood is burned, the ashes weigh less than the original wood, but this is not a violation of the law of conservation of matter.
d. John Dalton observed that carbon and oxygen can form two compounds, one of which has twice as much oxygen per gram of carbon as the other.
e. Joseph Proust's findings regarding the composition of various compounds led to the law of definite proportions.

ANSWER: a
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

6. Which of the following statements regarding atoms and atomic theory is incorrect?
a. Elements are made of tiny particles called atoms.
b. The atoms of different elements are different in some fundamental way.
c. Chemical compounds are formed when atoms of different elements combine with each other.
d. An element is a substance that cannot be broken down into simpler substances.
e. By the 1700s, all chemists believed that elements were made of atoms.

ANSWER: e
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.3 - Dalton's Atomic Theory

7. Which of the following statements regarding atoms and atomic theory is incorrect?
a. Antoine Lavoisier discovered that matter is not gained or lost in a chemical reaction.
b. Joseph Proust showed that when elements combine to form new substances, they do so in specific

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mass ratios.

c. According to John Dalton's observations, when water forms, the mass ratio of hydrogen to oxygen is variable.

d. John Dalton's atomic theory stated that all atoms of a given element are identical.

e. John Dalton discovered that in two different compounds of carbon and oxygen, the ratio of oxygen to carbon was two times higher in one compound than the other.

ANSWER: c
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.3 - Dalton's Atomic Theory

8. Which of the following is NOT part of Dalton's atomic theory?

a. Elements are made of tiny particles called atoms.

b. All atoms of a given element are identical to each other.

c. Atoms of one element can be changed to atoms of another element in a chemical reaction.

d. Atoms combine in fixed ratios to form chemical compounds.

e. Chemical reactions involve a reorganization of the atoms in the starting materials.

ANSWER: c
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.3 - Dalton's Atomic Theory

9. Which of the following statements regarding early atomic experiments is incorrect?

a. J. J. Thomson postulated that the "ray" that was observed in cathode ray tubes was a stream of negatively charged particles.

b. J. J. Thomson reasoned that since electrons could be produced from electrodes made of different metals, that all atoms must contain electrons.

c. J. J. Thomson postulated that an atom consists of a diffuse cloud of positive charge with negative electrons randomly embedded in it.

d. Ernest Rutherford's experiment necessitated a revision of Thomson's plum pudding model of the atom.

e. All of these statements are correct.

ANSWER: e
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.4 - Early Atomic Experiments and Models

10. Which of the following statements regarding early atomic experiments is incorrect?

a. J. J. Thomson postulated that the "ray" that was observed in cathode ray tubes was a stream of

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negatively charged particles.

b. Ernest Rutherford was not surprised by the result of his experiment with the metal foil and α-particles.

c. J. J. Thomson postulated that an atom consists of a diffuse cloud of positive charge with negative electrons randomly embedded in it.

d. Ernest Rutherford's experiment necessitated a revision of Thomson's plum pudding model of the atom.

e. Henri Becquerel's discovery of radioactivity was critical to the experiments that helped elucidate the structure of the atom.

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.4 - Early Atomic Experiments and Models

11. The subatomic particles studied by chemists that make up the atom include all of the following except the _____.

a. proton

b. All of these choices are part of the atom.

c. electron

d. neutron

e. phlogiston

ANSWER: e
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

12. In any neutral atom,

a. the number of electrons equals the number of protons.

b. the number of electrons is less than the number of protons.

c. the number of electrons is greater than the number of protons.

d. the number of electrons is equal to the number of neutrons.

e. the number of neutrons is always equal to the number of protons.

ANSWER: a
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

13. Which of the following statements regarding the nucleus of the atom is incorrect?

a. The nucleus is the central core of the atom.

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b. The nucleus contains the electrons and the protons.
c. The nucleus contains most of the mass of the atom.
d. The nucleus contains the neutrons.
e. The nucleus contains the neutrons and protons, as well as most of the mass of the atom.

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

14. The number of _____ determines the identity of an element.
a. electrons
b. protons
c. neutrons
d. neutrons plus protons
e. protons plus electrons

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

15. Consider the element indium, atomic number 49. The nucleus of an atom of indium-112 contains
a. 49 protons, 63 neutrons, 49 electrons.
b. 49 protons, 49 neutrons.
c. 49 protons, 49 alpha particles.
d. 49 protons, 63 neutrons.
e. 49 protons, 112 neutrons.

ANSWER: d
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

16. $^{40}_{20}Ca^{2+}$ has _____.
a. 20 protons, 20 neutrons, and 18 electrons
b. 22 protons, 20 neutrons, and 20 electrons
c. 20 protons, 22 neutrons, and 18 electrons
d. 22 protons, 18 neutrons, and 18 electrons
e. 20 protons, 20 neutrons, and 22 electrons

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ANSWER: a
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

17. Which of the following statements is (are) true?
    a. $^{18}_{8}O$ and $^{19}_{9}$ have the same number of neutrons.
    b. $^{14}_{6}C$ and $^{14}_{7}$ are isotopes of each other because their mass numbers are the same.
    c. $^{18}_{8}O^{2-}$ has the same number of electrons as $^{20}_{10}Ne$.
    d. Two of the statements are true.
    e. All of the statements are true.

ANSWER: e
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

18. A species with 12 protons and 10 electrons is _____.
    a. Ne^{2+}
    b. Ti^{2+}
    c. Mg^{2+}
    d. Mg
    e. Ne^{2-}

ANSWER: c
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

19. The numbers of protons, neutrons, and electrons in $^{39}_{19}K^{+}$ are
    a. 20 p, 19 n, 19 e.
    b. 20 p, 19 n, 20 e.
    c. 19 p, 20 n, 20 e.
    d. 19 p, 20 n, 19 e.
    e. 19 p, 20 n, 18 e.

ANSWER: e
POINTS: 1
QUESTION TYPE: Multiple Choice

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HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

20. An ion is formed
    a. by either adding or subtracting protons from the atom.
    b. by either adding or subtracting electrons from the atom
    c. by either adding or subtracting neutrons from the atom.
    d. all of these are true.
    e. two of these are true.

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

21. All of the following are true EXCEPT
    a. ions are formed by adding electrons to a neutral atom.
    b. ions are formed by changing the number of protons in an atom's nucleus.
    c. ions are formed by removing electrons from a neutral atom.
    d. an ion has a positive or negative charge.
    e. metals tend to form positive ions.

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.5 - Atomic Structure

22. The formula of water, H_2O, suggests
    a. there is twice as much mass of hydrogen as oxygen in each molecule.
    b. there are two hydrogen atoms and one oxygen atom per water molecule.
    c. there is twice as much mass of oxygen as hydrogen in each molecule.
    d. there are two oxygen atoms and one hydrogen atom per water molecule.
    e. none of these are correct.

ANSWER: b
POINTS: 1
QUESTION TYPE: Multiple Choice
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

23. A natural law summarizes what happens in a set of experiments.
    a. True

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b. False

ANSWER: True
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

24. Scientific thinking is useful only for science and has no application in everyday life.
a. True
b. False

ANSWER: False
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

25. A theory (model) is an attempt to explain some aspect of natural behavior.
a. True
b. False

ANSWER: True
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.6 - Models (Theories) Are Explanations of Why Nature Behaves in a Particular Way.

26. The law of conservation of mass is an example of a scientific theory.
a. True
b. False

ANSWER: False
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.6 - Models (Theories) Are Explanations of Why Nature Behaves in a Particular Way.

27. Once a scientific theory (model) is formulated, it can never be changed.
a. True
b. False

ANSWER: False
POINTS: 1
QUESTION TYPE: True / False

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HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.6 - Models (Theories) Are Explanations of Why Nature Behaves in a Particular Way.

28. A natural law is a rule that is enacted by a group of influential scientists.
    a. True
    b. False
ANSWER: False
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

29. The law of conservation of mass states that mass is neither created nor destroyed in a chemical reaction.
    a. True
    b. False
ANSWER: True
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

30. Scientific theories are explanations of natural behavior.
    a. True
    b. False
ANSWER: True
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.6 - Models (Theories) Are Explanations of Why Nature Behaves in a Particular Way.

31. The first “chemist” to perform truly quantitative experiments was J. J. Thomson.
    a. True
    b. False
ANSWER: False
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.3 - Dalton’s Atomic Theory

32. John Dalton’s atomic theory accounted for the existence of different isotopes of elements.

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a. True
b. False

ANSWER: False
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.3 - Dalton's Atomic Theory

33. John Dalton's atomic theory stated that chemical compounds are formed when atoms of different elements combine with each other.

a. True
b. False

ANSWER: True
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.3 - Dalton's Atomic Theory

34. J. J. Thomson reasoned that since electrons could be produced from electrodes made of different metals, then all atoms must contain electrons.

a. True
b. False

ANSWER: True
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.4 - Early Atomic Experiments and Models

35. J. J. Thomson postulated that atoms consist of a diffuse cloud of negative charge.

a. True
b. False

ANSWER: False
POINTS: 1
QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.4 - Early Atomic Experiments and Models

36. Ernest Rutherford proposed the "plum pudding" model of the atom.

a. True
b. False

ANSWER: False
POINTS: 1

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QUESTION TYPE: True / False
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.4 - Early Atomic Experiments and Models

37. The process at the center of scientific inquiry is called the _____.
ANSWER: scientific method
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

38. A _____ is a possible explanation for an observation.
ANSWER: hypothesis
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

39. A natural _____ summarizes what happens in a series of experiments, and a _____ is an attempt to explain why it happens.
ANSWER: law; theory
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.1 - Scientific Method

40. The law of _____ states that mass is neither created nor destroyed in a chemical reaction.
ANSWER: conservation of mass
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

41. The law of _____ states that a given compound always contains exactly the same proportion of elements by mass.
ANSWER: definite proportions
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

42. _____ states that at the same temperature and pressure, equal volumes of different gases contain the same number of particles.

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ANSWER: Avogadro's hypothesis
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

43. The _____ in a chemical formula represent the number of atoms in a particular molecule or formula unit.
ANSWER: subscripts
POINTS: 1
QUESTION TYPE: Subjective Short Answer
HAS VARIABLES: False
LEARNING OBJECTIVES: AF.ZUMD.21.01.2 - Fundamental Laws

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