Quiz Answer Key

Lesson 1

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. When was chemistry first used by humans?
    a. 200 B.C.
    b. 1920s A.D.
    c. Ancient times
    d. 1000 A.D.

2. _____ are subatomic particles located in the nucleus of an atom with a positive charge.
    a. Protons
    b. Neutrons
    c. Electrons
    d. Photons

3. _____ are subatomic particles surrounding the nucleus of an atom with a negative charge.
    a. Protons
    b. Neutrons
    c. Electrons
    d. Photons

4. The two general areas of an atom are _____.
    a. neutrons and protons
    b. the nucleus and electron shells
    c. electrons and protons
    d. protons and orbitals

5. The mass of an object and the weight of an object are always exactly the same.
    a. True
    b. False

6. What is the most basic unit of a chemical element?
    a. Ion
    b. Element
    c. Molecule
    d. Atom

7. A group of atoms bonded together, such as three atoms of oxygen bonding together to form ozone or two atoms of hydrogen and one atom of oxygen bonding together to form water, is called a(n):
    a. ion
    b. element
    c. quartz
    d. compound

8. Which of the following is NOT one of the five main branches of chemistry?
    a. Analytical
    b. Organic
    c. Thermochemistry
    d. Physical

9. Which step of the scientific method is defined as an educated guess?
    a. Purpose
    b. Hypothesis
    c. Conclusion
    d. Analysis

10. Which step of the scientific method involves looking at your results and considering whether your hypothesis was supported or refuted?
    a. Purpose
    b. Hypothesis
    c. Conclusion
    d. Analysis

11. The law of conservation of mass states that:
    a. matter resists change
    b. the mass of an object can grow given enough time and with enough pressure exerted on it
    c. matter cannot be created or destroyed in a chemical reaction but can change forms
    d. all of the above

Lesson 2

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Which of the following is made of matter?
    a. A cell
    b. A desk
    c. A book
    d. All of the above

2. What is a ratio?
    a. The number of times you see a number
    b. The relationship between three amounts
    c. The relationship between any random two values
    d. The comparison of two or more numbers indicating their sizes in relation to each other

3. A conversion factor is:
    a. A ratio that includes the original unit from a quantity and the equivalent value of the new unit
    b. A ratio that includes the original unit from a quantity times 100
    c. A ratio that includes the equivalent value of the new/wanted unit times 100
    d. A unit that is divided by the ratio

4. Which of the following sets of data would be considered quantitative data?
    a. Length, area, and volume
    b. Color, scent, and texture

5. Which is true of qualitative data?
    a. It is primarily concerned with numbers
    b. It describes observations
    c. It has to do with measurements
    d. It describes quality control in chemistry labs

6. 353 grams is equal to how many kilograms?
    a. 0.353 kg
    b. 35.3 kg
    c. 0.00353 kg
    d. 3.53 kg

7. How many liters are in two gallons of milk?
    a. 0.756 L
    b. 21.45 L
    c. 7.57 L
    d. 10.01 L

8. How many grams are in 3.52 moles of carbon?
    a. 42.28 g
    b. 0.29 g
    c. 12.01 g
    d. 3.52 g

9. 62.5° F = ___ K
    a. K = 129
    b. K = 289
    c. K = 79
    d. K = 384

10. 60° C = ___ ° F
    a. **140° F**
    b. 200° F
    c. 47° F
    d. 155° F

Lesson 3

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Accuracy is how close you are to the _____ when measuring.
    a. average
    b. repeated value
    c. **actual value**
    d. value your lab partner has

2. When you get the same measurement value repeatedly, we say your measurements are _____.
    a. accurate
    b. **precise**
    c. inaccurate
    d. verified

3. How many significant digits are in the number 450,000?
    a. **2**
    b. 3
    c. 4
    d. 5

4. How many significant digits are in the number 2.05?
    a. 2
    b. **3**
    c. 4
    d. 5

5. How many significant digits are in the number 1.70?
    a. 2
    b. **3**
    c. 4
    d. 5

6. How do you write 240,000 in scientific notation?
    a. **2.4×10^5**
    b. 2.4×10^{-5}
    c. 240×10^{-4}
    d. 2.40×10^4

7. How do you write 7.78×10^{-7} in standard notation?
    a. 0.0000778
    b. 778
    c. 7,780,000
    d. **0.000000778**

8. What is density?
    a. How big an atom is
    b. How small a molecule is
    c. **How tightly compacted mass is**
    d. How heavy something is

9. Find the density of a bag of pencils with a mass of 1.70 kg and a volume of 0.02800 m^3. Select the answer that uses the correct number of significant digits.
    a. 61 kg/m^3
    b. 60.7 kg/m^3
    c. 60 kg/m^3
    d. 70 kg/m^3

10. How do we solve for mass using the density equation?
    a. D=m/V
    b. **m = DxV**
    c. V = m/D
    d. m = D/V

Lesson 4

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Which scientist was a friend of Einstein and discovered the currently accepted atomic model?
    a. Democritus
    b. Sir Ernest Rutherford
    c. Sir J. J. Thomson
    d. Niels Bohr

2. Which scientist developed the “plum pudding” atomic model?
    a. **Sir J.J. Thomson**
    b. Niels Bohr
    c. Sir Thomas Rutherford
    d. Albert Einstein

3. Who was the Greek philosopher who named the atom?
    a. Socrates
    b. Democritus
    c. Aristotle
    d. Heracles

4. Who developed the first atomic theory in the late 1700s and early 1800s?
    a. **John Dalton**
    b. Niels Bohr
    c. Sir Ernest Rutherford
    d. Albert Einstein

5. The subatomic particle of the atom that is neutral and is responsible for nuclear fission is the _____.
    a. proton
    b. electron
    c. neutron
    d. nucleus

6. According to Bohr's model, which negative subatomic particle is located in orbitals surrounding the nucleus?
    a. **Electrons**
    b. Protons
    c. Neutrons
    d. Orbit particles

7. When water melts from a solid to a liquid this is an example of a chemical change.
    a. True
    b. False

8. Chemical changes are irreversible and result in new products.
    a. True
    b. False

9. Which of the following is NOT an example of a physical property?
    a. Malleability
    b. Oxidation
    c. Ductility
    d. Density

10. Which of the following is NOT an example of a chemical property?
    a. Combustibility
    b. Flammability
    c. Malleability
    d. Color

Lesson 5

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Which scientist, known as the father of the periodic table, left gaps in his version of the periodic table and was able to correctly predict the discovery of other unknown elements?
    a. Newlands
    b. Dalton
    c. Mendeleev
    d. Döbereiner

2. Which scientist first arranged the periodic table by atomic number instead of atomic mass?
    a. Moseley
    b. Dalton
    c. Mendeleev
    d. Lavoisier

3. The number of _____ determines an element's atomic number.
    a. neutrons
    b. atoms
    c. electrons
    d. protons

4. When two atoms of the same element combine, this is an example of a _____ element.
    a. diatomic
    b. polyatomic
    c. monoatomic
    d. none of the above

5. Elements contain multiple types of atoms.
    a. True
    b. False

6. Water is a homogeneous mixture.
    a. True
    b. False

7. Which of the following is an example of a heterogenous mixture?
    a. Trail mix
    b. Air
    c. Copper
    d. Water

8. Suspensions contain large particles, while colloids contain microscopic particles of a substance.
    a. True
    b. False

9. Is saline solution a heterogeneous or homogeneous mixture?
    a. Homogeneous
    b. Heterogeneous

Lesson 6

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Atomic number is defined as _____.
    a. **the number of protons in an element**
    b. the number of neutrons in an element
    c. the number of electrons in an element
    d. the number of ions in an element

2. Carbon-14 is an isotope with how many neutrons?
    a. 6 neutrons
    b. **8 neutrons**
    c. 10 neutrons
    d. 12 neutrons

3. In which group is tin located?
    a. Group 1
    b. Group 5
    c. Group 9
    d. **Group 14**

4. In which period is iron located?
    a. Period 1
    b. Period 2
    c. Period 3
    d. **Period 4**

5. How many valence electrons are in an atom of oxygen?
    a. 2 electrons
    b. 4 electrons
    c. 6 electrons
    d. 8 electrons

6. Which of the following is not a noble gas?
    a. Chlorine
    b. Neon
    c. Argon
    d. Helium

7. Alkali metals are more reactive than alkaline earth metals.
    a. True
    b. False

8. Halogens are less reactive than noble gases.
    a. True
    b. False

9. Which of these elements is the most electronegative?
    a. Barium
    b. Sulfur
    c. Silver
    d. Germanium

10. Which of these elements has the smallest atomic radius?
    a. Manganese
    b. Potassium
    c. Bromine
    d. Copper

11. Which of these elements has the highest electron affinity?
    a. Lithium
    b. Boron
    c. Nitrogen
    d. Fluorine

12. Which of these elements has the lowest ionization energy?
    a. Lead
    b. Radon
    c. Caesium
    d. Barium

13. Hydrogen is a _____.
    a. metal
    b. nonmetal
    c. metalloid

14. Sodium is a _____.
    a. metal
    b. nonmetal
    c. metalloid

15. Boron is a _____.
    a. metal
    b. nonmetal
    c. metalloid

16. Chlorine is a _____.
    a. metal
    b. nonmetal
    c. metalloid

17. Platinum is a _____.
    a. metal
    b. nonmetal
    c. metalloid

Lesson 7

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What does an electron dot structure show?
    a. All electrons in an atom
    b. Only valence electrons in an atom

2. Electron configuration consists of 3 parts.
    a. True
    b. False

3. What does the "3" in $3p^6$ represent?
    a. Orbital shape
    b. Electron number
    c. Energy level
    d. Orientation

4. What does the "p" in $3p^6$ represent?
    a. Orbital shape
    b. Electron number
    c. Energy level
    d. Orientation

5. What does the "6" in $3p^6$ represent?
    a. Orbital shape
    b. Electron number
    c. Energy level
    d. Orientation

6. Which rule or principle states that lower energy orbitals must be filled before higher energy orbitals?
    a. **Aufbau principle**
    b. Pauli exclusion principle
    c. Hund's rule
    d. Heisenberg uncertainty principle

7. Which rules or principle states that when in the same energy level, each sub-orbital must be filled with one electron before any can be filled with a second electron?
    a. Aufbau principle
    b. Pauli exclusion principle
    c. **Hund's rule**
    d. Heisenberg uncertainty principle

8. How many electrons can the d orbital hold?
    a. 2
    b. 6
    c. **10**
    d. 14

9. Which of the following is not true about electrons?
    a. **Largest subatomic particle**
    b. Negatively charged
    c. Located outside the nucleus
    d. Can interact with other atoms' electrons

10. Look at your periodic table and determine which element has a noble gas notation of $[Kr]5s^2 4d^{10} 5p^1$.
    a. Gallium
    b. Krypton
    c. **Indium**
    d. Tin

11. Look at your periodic table and determine how many energy levels a neutral atom of magnesium contains.
    a. Two
    b. Three
    c. Four
    d. Five

12. What do two opposite-facing arrows represent in orbital notation?
    a. Electrons with different energies
    b. Electrons in different orbitals
    c. Electrons with different orientations
    d. Electrons with different spins

Lesson 8: Exam 1

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. All matter has _____ and takes up _____.
    a. velocity, mass
    b. mass, space
    c. weight, volume
    d. velocity, space

2. The variable that you control in an experiment, which causes the change you measure is the:
    a. dependent variable
    b. quantitative variable
    c. independent variable
    d. qualitative variable

3. The study of molecules containing carbon is called:
    a. organic chemistry
    b. inorganic chemistry
    c. biochemistry
    d. physical chemistry

4. What is the logical, step-by-step process used to solve problems in chemistry?
    a. Scientific law
    b. Scientific theory
    c. Scientific process
    d. Scientific method

5. Research for the purpose of solving a specific problem is:
    a. scientific research
    b. basic research
    c. applied research
    d. solution research

6. All chemical reactions involve:
    a. a change in state
    b. a change in energy
    c. magic
    d. an addition of water

7. Which of the following is a quantitative measurement?
    a. The tree is green.
    b. The tree is 15 meters tall.
    c. The tree is an oak tree.
    d. The tree has squirrels in it.

8. What is the metric unit for the amount of substance?
    a. Grams
    b. Weight
    c. Moles
    d. Pounds

9. How many liters are in 3.56 kiloliters?
    a. 0.00356 L
    b. 3560 L
    c. 0.356 L
    d. 356 L

10. How many grams are in 97.84 centigrams?
    a. 9784 g
    b. 0.9784 g
    c. 9.784 g
    d. 978,400 g

11. Convert 94.3º Fahrenheit to Kelvin.
    a. 307.61 K
    b. 34.6 K
    c. 367.5 K
    d. 201.7 K

12. How many grams of sulfur are in 4.87×10^{23} atoms?
    a. 0.81 g
    b. 0.03 g
    c. 25.94 g
    d. 2.93×10^{47} g

13. True or False: The mass of an object changes depending on its location.
    a. True
    b. False

14. The closeness of a measurement to its true value is a measure of its:
    a. usefulness
    b. precision
    c. accuracy
    d. reproducibility

15. How many significant digits are in 5.0400?
    a. 2
    b. 3
    c. 5
    d. 1

16. How many significant digits are in 0.00320?
    a. 2
    b. 3
    c. 5
    d. 6

17. Calculate 25.4 m x 30.186. Answer in scientific notation and round according to significant digits.
    a. 7.67×10^{2}
    b. 7.67×10^{-2}
    c. 7.6673×10^{2}
    d. 7.6673×10^{-2}

18. What is the density of an object if a 5.03 g sample occupies 3.24 mL of space?
    a. 16.30 g/mL
    b. 0.64 mL/g
    c. 16.3 mLg
    d. 1.55 g/mL

19. What is the mass of an object with a density of $1.37 g/cm^3$ and a volume of $5.24 cm^3$?
    a. 0.26 g
    b. 3.82 g
    c. 7.18 g
    d. 7.17 g

20. What is the percent error of an object you measure in the lab to be 0.229 cm when the actual measurement is 0.225 cm?
    a. **1.78%**
    b. 98.25%
    c. 1.75%
    d. 101.78%

21. What is one way to decrease percent error in an experiment?
    a. Only complete one trial.
    b. Don't find the actual value of your measurement.
    c. **Complete multiple trials and find your average measurement.**
    d. Make up data so your percent error is zero.

22. Which of the following is a chemical change?
    a. Dissolving salt in water
    b. **A bicycle rusting**
    c. Water evaporating from your skin
    d. Sharpening a pencil

23. Which scientist is known as the Father of the Periodic Table?
    a. **Mendeleev**
    b. Chadwick
    c. Dalton
    d. Moseley

24. According to Heisenberg's uncertainty principle, we cannot tell both the _____ and _____ of an electron at the same time.
    a. size, shape
    b. **speed, location**
    c. size, location
    d. speed, shape

25. Which subatomic particle determines the identity of an element?
    a. **Proton**
    b. Neutron
    c. Electron
    d. All of the above

26. Which subatomic particles contribute to the mass number of an element?
    a. Proton and electron
    b. **Proton and neutron**
    c. Electron and neutron
    d. Proton, electron, and neutron

27. Which subatomic particle determines the properties of an element?
    a. Proton
    b. Neutron
    c. **Electron**
    d. All of the above

28. When a substance undergoes a change and remains the same substance after that change, we call that a:
    a. chemical change
    b. subliminal change
    c. physical change
    d. loose change

29. The ability of a substance to be stretched into a wire is called:
    a. malleability
    b. ductility
    c. hardness
    d. conductivity

30. Horizontal rows across the periodic table are called:
    a. groups
    b. families
    c. periods
    d. both a & b

31. Elements with similar properties are found in:
    a. groups
    b. octets
    c. periods
    d. triads

32. What is the unreactive group of elements called?
    a. Metals
    b. Semiconductors
    c. Nonmetals
    d. Noble gases

33. Elements that are good conductors and are ductile and malleable are called:
    a. **metals**
    b. semiconductors
    c. nonmetals
    d. noble gases

34. All elements on the periodic table can be found in nature.
    a. True
    b. **False**

35. A blend of two or more different compounds, each of which retains its own identity and properties, is a(n):
    a. element
    b. compound
    c. **mixture**
    d. nucleus

36. The electronegativity of elements in the same horizontal row _____ as you move from left to right across the periodic table.
    a. **increases**
    b. remains constant
    c. decreases
    d. none of the above

37. What is ionization energy?
    a. The energy it takes to make an atom
    b. **The energy it takes to remove an electron from an atom**
    c. The energy released when a chemical bond forms
    d. The energy released when an atom accepts an electron from another atom

38. The number of valence electrons for a group 16 element is
    a. 2
    b. 6
    c. 8
    d. 16

39. Once an atom has full s and p orbitals in its outer energy level:
    a. it is stable
    b. it has 8 valence electrons
    c. it is unreactive
    d. all of the above

40. Which orbital corresponds with the transition metals on the periodic table?
    a. s
    b. p
    c. d
    d. f

41. No two electrons in the same atom can have the same 4 quantum numbers, according to:
    a. Hund's rule
    b. Aufbau principle
    c. Pauli exclusion principle
    d. quantum theory

42. Lower energy levels are filled before those of higher energy levels, according to:
    a. Hund's rule
    b. Aufbau principle
    c. Pauli exclusion principle
    d. quantum theory

43. Orbitals of equal energy are filled with one electron before any are filled with a second, according to:
    a. **Hund's rule**
    b. Aufbau principle
    c. Pauli exclusion principle
    d. quantum theory

44. Which of the following would you expect to have the largest atomic radius?
    a. Li
    b. K
    c. Na
    d. **Rb**

45. The modern periodic table is arranged in order of increasing atomic:
    a. mass
    b. **number**
    c. size
    d. radius

46. An example of a heterogeneous mixture would be:
    a. sugar
    b. water
    c. water containing dissolved salt
    d. **vegetable soup**

47. Isotopes of the same element have different numbers of:
    a. protons
    b. electrons
    c. **neutrons**
    d. energy levels

48. Which of the following is correct?
    a. Electrons are positively charged
    b. Protons are negatively charged
    c. Neutrons have no charge
    d. Atoms are positively charged

49. Avogadro's number refers to:
    a. the maximum number of electrons that all energy levels can accommodate
    b. the number of atoms or molecules in exactly one mole of a pure substance
    c. the number of protons and neutrons that can fit in the nucleus
    d. the number of avocados needed for guacamole dip

50. The partial orbital notation $\underline{\uparrow\downarrow}$ shows two electrons with:
    a. the same spin
    b. opposite spins
    c. the same energy
    d. different energy

51. P orbitals can hold a maximum of how many electrons?
    a. 2
    b. 10
    c. 3
    d. 6

52. The atomic number of an element is equal to that element's:
    a. number of protons
    b. number of protons + neutrons
    c. molar mass
    d. electronegativity

53. The element with the electron configuration that ends in $5p^6$ is
    a. Kr
    b. Rh
    c. Xe
    d. Sb

54. What is the electron configuration for phosphorus?
    a. $1s^1 1s^2 2s^2 2p^6 3s^2 3p^3$
    b. $1s^2 2s^2 2p^6 3s^2 3p^6$
    c. $1s^2 2p^6 3s^2 3p^6$
    d. $1s^2 2s^2 2p^6 3s^2 3p^3$

55. What causes the color in a flame test lab?
    a. The fire causes a chemical reaction.
    b. The flame heats up the electrons, which jump out of the atom.
    c. The electrons get excited and fall back down, releasing energy.
    d. The fire causes the atom to fall apart, releasing energy.

56. Lemonade is an example of a…
    a. Solution
    b. Colloid
    c. Suspension
    d. Compound

57. A mixture that has to be constantly stirred to keep from settling out is a…
    a. Solution
    b. Colloid
    c. Suspension
    d. Homogeneous mixture

58. The Tyndall effect occurs in this type of mixture:
    a. solution
    b. colloid
    c. suspension
    d. homogeneous mixture

Lesson 9

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. A bond in which electrons are shared unevenly is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. metallic

2. A bond in which electrons are transferred is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. metallic

3. A bond that holds atoms together with a “sea of electrons” is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. metallic

4. A bond in which electrons are shared equally is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. Metallic

5. A bond between a metal and a nonmetal is:
    a. **ionic**
    b. nonpolar covalent
    c. polar covalent
    d. metallic

6. Which is the strongest intermolecular force?
    a. London-dispersion
    b. Dipole-dipole
    c. Ionic
    d. **Hydrogen bond**

7. Which intermolecular force is present in all molecules?
    a. **London-dispersion**
    b. Dipole-dipole
    c. Ionic
    d. Hydrogen bond

8. A molecule that has four of the same atoms bonded to the central atom would be:
    a. bent
    b. **nonpolar**
    c. polar
    d. trigonal planar

9. A molecule that has two atoms bonded to the central atom and no lone pairs would be:
    a. **linear**
    b. bent
    c. trigonal planar
    d. trigonal pyramidal

10. A molecule that has three atoms bonded to the central atom and a lone pair on the central atom would be:
    a. bent
    b. trigonal planar
    c. trigonal pyramidal
    d. tetrahedral

Lesson 10

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What does a coefficient tell you about a compound?
    a. How many atoms there are
    b. How many ions there are
    c. How many molecules there are
    d. How many elements there are

2. How many atoms are in $Fe_2(SO_4)_3$?
    a. Five
    b. 10
    c. 15
    d. 17

3. What is the ratio of **ions** in $2Na_3PO_4$?
    a. 3:1:4
    b. 3:1
    c. 3:4
    d. 6:2:8

4. Which element is present in most polyatomic ions?
    a. Hydrogen
    b. Carbon
    c. Oxygen
    d. Nitrogen

5. Which of the following does NOT have a fixed charge?
    - **a. Copper**
    - b. Aluminum
    - c. Silver
    - d. Calcium

6. What is the chemical formula for barium sulfate?
    - a. Ba_2S_2
    - b. BaS
    - c. $Ba_2(SO_4)_2$
    - **d. $BaSO_4$**

7. What does the Roman numeral (IV) represent?
    - **a. Four**
    - b. Five
    - c. Six
    - d. Nine

8. What is the chemical formula for nickel (III) oxide?
    - a. Ni_3O
    - **b. Ni_2O_3**
    - c. Ni_3O_2
    - d. NiO_3

9. What is the chemical formula for trinitrogen decabromide?
    - a. $N_{10}Br_3$
    - b. $Ni_{10}B_3$
    - **c. N_3Br_{10}**
    - d. Ni_3B_{10}

10. True or false: You should always reduce subscripts when writing the formula for compounds with prefixes.
    a. True
    b. False

Lesson 11

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Which type of compound is $CaCl_2$?
    a. **Fixed charge ionic compound**
    b. Variable charge ionic compound
    c. Molecular compound
    d. Metallic compound

2. Which type of compound is P_2O_4?
    a. Fixed charge ionic compound
    b. Variable charge ionic compound
    c. **Molecular compound**
    d. Metallic compound

3. Roman numerals are always used to name this type of compound:
    a. fixed charge ionic compound
    b. **variable charge ionic compound**
    c. molecular compound
    d. metallic compound

4. Prefixes can be used to name this type of compound:
    a. fixed charge ionic compound
    b. variable charge ionic compound
    c. **molecular compound**
    d. metallic compound

5. What is the name of Li_2S?
    a. Lithium (II) sulfide
    b. Lithium sulfur
    c. Dilithium monosulfide
    d. Lithium sulfide

6. What is the name of H_3P?
    a. Phosphoric acid
    b. Hydrogen (III) phosphide
    c. Hydrophosphoric acid
    d. Trihydrogen phosphide

7. What is the name of Si_2O_7?
    a. Disilicon heptoxide
    b. Silicon (VII) oxide
    c. Silicon oxide
    d. Heptasilicon dioxide

8. What is the name of H_2CO_3?
    a. Dihydrogen carbonate
    b. Hydrogen carbonoxide
    c. Carbonic acid
    d. Hydrocarbonic acid

9. Which of the following is NOT a binary acid?
    a. H_2S
    b. HF
    c. HNO_3
    d. H_3P

10. If the name of an acid ends with -ous, it is a(n):
    a. binary acid
    b. oxyacid containing the most common polyatomic ion
    c. oxyacid with one less oxygen than the most common polyatomic ion
    d. oxyacid without a polyatomic ion

Lesson 12

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. True or False: oxidation numbers for compounds always add up to zero.
    - **a. True**
    - b. False

2. What is the oxidation number for phosphorus in $(PO_3)^{3-}$?
    - a. -2
    - b. -6
    - **c. +3**
    - d. +6

3. What is the percent composition of calcium in $Ca(OH)_2$?
    - a. 45.90%
    - **b. 54.10%**
    - c. 43.19%
    - d. 2.73%

4. What is the percent composition of oxygen in $Ca(OH)_2$?
    - a. 45.90%
    - b. 54.10%
    - **c. 43.19%**
    - d. 2.73%

5. What is the percent composition of hydrogen in $Ca(OH)_2$?
    - a. 45.90%
    - b. 54.10%
    - c. 43.19%
    - **d. 2.73%**

6. Which of the following molecular formulas would NOT have the same empirical formula as the others?
    a. CH_3O
    b. $C_2H_6O_2$
    c. $C_6H_{12}O_6$
    d. $C_5H_{15}O_5$

7. True or false: Empirical formulas provide the same information as molecular formulas.
    a. True
    b. False

8. What is the empirical formula of a compound with 68.40% chromium and 31.60% oxygen?
    a. CrO
    b. CrO_2
    c. Cr_2O_3
    d. Cr_2O_4

9. What is the molecular formula of a compound with an empirical formula of CH_2O and a molar mass of 180.12 g/mol?
    a. CH_2O
    b. $C_2H_4O_2$
    c. $C_5H_{10}O_5$
    d. $C_6H_{12}O_6$

10. What is the molecular formula of a compound containing 5.9265% hydrogen and 94.0735% oxygen, if the molar mass is 34.01468 g/mol?
    a. H_2O
    b. H_2O_2
    c. H_3O
    d. H_3O_4

Lesson 13

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Why do chemical equations need to be balanced?
    a. To have the same amount of each atom on both sides of the equation
    b. To satisfy the law of conservation of mass
    c. Because matter cannot be created or destroyed
    d. All of the above

2. What needs to be changed in order to balance an equation?
    a. Subscripts
    b. Coefficients
    c. Superscripts
    d. Charges

3. What do letters in parentheses as subscripts tell about a substance?
    a. It is already balanced
    b. The type of reaction
    c. The state of matter
    d. If energy is involved

4. What does aqueous mean?
    a. Melted
    b. Dissolved in water
    c. Changed into water
    d. Changed from liquid to solid

5. In the equation $N_2 + 3\ H_2 \rightarrow 2\ NH_3$, which is/are the reactants?
    - **a. N_2 and H_2**
    - b. NH_3
    - c. N_2 and NH_3
    - d. H_2 and NH_3

6. Which of the following equations is balanced properly?
    - a. $2\ C_3H_3 + O_2 \rightarrow 2\ CO_2 + H_2O$
    - b. $Cl_2 + 2\ KBr \rightarrow KCl + Br_2$
    - c. $3\ H_2O \rightarrow H_2 + 3\ O_2$
    - **d. $2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$**

7. How many atoms of oxygen are on each side of the following equation?
   $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$
    - a. One
    - b. Two
    - c. **Six**
    - d. Four

8. Is the following equation balanced? $2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$
    - a. **Yes**
    - b. No

9. Is the following equation balanced? $NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
    - a. Yes
    - b. **No**

10. If you write the following word equation as a balanced chemical equation, what will the coefficient and symbol for fluorine be?
    Nitrogen triflouride → nitrogen + fluorine
    a. 3 F
    b. 6 F
    c. **3 F_2**
    d. 6 F_2

Lesson 14

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Which type of reaction is the following equation? $2\ Fe + 3\ H_2O \rightarrow Fe_2O_3 + 3H_2$
    a. Synthesis
    b. Decomposition
    c. Single replacement
    d. Double replacement
    e. Combustion

2. Which type of reaction is the following equation? $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$
    a. Synthesis
    b. Decomposition
    c. Single replacement
    d. Double replacement
    e. Combustion

3. Which type of reaction is the following equation? $2\ NaClO_3 \rightarrow 2\ NaCl + 3\ O_2$
    a. Synthesis
    b. Decomposition
    c. Single replacement
    d. Double replacement
    e. Combustion

4. Which type of reaction is the following equation? $CuCl_2 + Na_2S \rightarrow CuS + 2$ NaCl
    a. Synthesis
    b. Decomposition
    c. Single replacement
    d. Double replacement
    e. Combustion

5. Which type of reaction is the following equation? $4\ Li + O_2 \rightarrow 2\ Li_2O$
    a. Synthesis
    b. Decomposition
    c. Single replacement
    d. Double replacement
    e. Combustion

6. Predict the products for the following reaction: $C_7H_{14} + O_2 \rightarrow$
    a. $C_7H_{14}O_2$
    b. $CO + H_2$
    c. $CO_2 + H_2O$
    d. $C + H_2O$

7. Predict the products for the following reaction: $Mg(OH)_2 + H_3PO_4 \rightarrow$
    a. $MgPO_4 + H_3(OH)_2$
    b. $Mg_3(PO_4)_2 + H_2O$
    c. $MgH_3 + PO_4(OH)_2$
    d. $HMg + (OH)_2PO_4$

8. Predict the products for the following reaction: Co^{2+} + NaCl →
    a. **$CoCl_2$ + Na**
    b. NaCo + Cl_2
    c. CoNaCl
    d. Cl_2Co + Na

9. Will the reaction in the previous problem occur?
    a. Yes
    b. No

10. Predict the products for the following reaction: Na + O2 →
    a. NaO_2
    b. NaO
    c. O_2 + Na
    d. Na_2O

Lesson 15: Exam 2

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

Students will need a copy of the periodic table, the electronegativity chart, the chart of common polyatomic ions, and the activity series of metals for this exam.

1. A bond formed by the unequal sharing of electrons is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. metallic

2. A bond formed by the transfer of electrons is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. metallic

3. A bond formed by the equal sharing of electrons is:
    a. ionic
    b. nonpolar covalent
    c. polar covalent
    d. metallic

4. An ionic bond forms from the attraction between large numbers of:
    a. cations and anions
    b. atoms
    c. dipoles
    d. orbitals

5. What type of intermolecular force is found in all molecules?
    a. Hydrogen bond
    b. Dipole-dipole
    c. London-dispersion
    d. Ionic

6. What type of intermolecular force is the strongest?
    a. Hydrogen bond
    b. Dipole-dipole
    c. London-dispersion
    d. Ionic

7. If two elements have an electronegativity difference of 0.2, what type of bond would they form?
    a. Ionic
    b. Polar covalent
    c. Nonpolar covalent
    d. Metallic

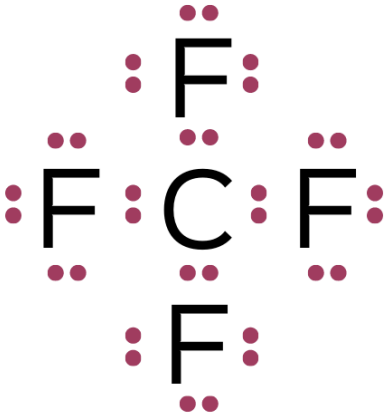
8. If two elements have an electronegativity difference of 1.3, what type of bond would they form?
    a. Ionic
    b. Polar covalent
    c. Nonpolar covalent
    d. Metallic

9. If two elements have an electronegativity difference of 1.9, what type of bond would they form?
    a. **Ionic**
    b. Polar covalent
    c. Nonpolar covalent
    d. Metallic

10. A Lewis structure does NOT show:
    a. **molecular shape**
    b. valence electrons
    c. atoms
    d. bonds

11. When more than one Lewis structure can be drawn, this is called a:
    a. triple bond
    b. **resonance structure**
    c. polyatomic ion
    d. VSPER figure

12. What geometry does this molecule have?

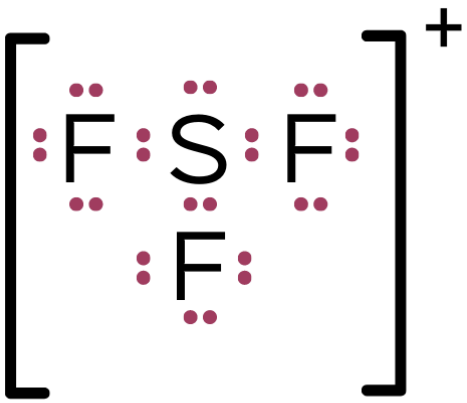


a. Bent
b. Trigonal planar
c. Tetrahedral
d. Trigonal pyramidal

13. Is the molecule in problem 12 polar or nonpolar?

a. Polar
b. Nonpolar

14. What geometry does this molecule have?



a. Bent
b. Trigonal planar
c. Trigonal pyramidal
d. Tetrahedral

15. What types of bonds does the molecule in the previous problem have?

a. Polar covalent
b. Nonpolar covalent
c. Ionic
d. Double

16. Is the molecule in problem 15 polar or nonpolar?

a. Polar
b. Nonpolar

17. If a molecule has a bent shape, is it polar or nonpolar?

a. Polar
b. Nonpolar

18. What does a coefficient tell you about a compound?
    a. The number of atoms
    b. The number of molecules
    c. The number of bonds
    d. The number of ions

19. How many atoms are in $2Na_3PO_4$?
    a. Two
    b. Seven
    c. Eight
    d. Ten
    e. Sixteen

20. What does a Roman numeral tell you about a compound?
    a. The charge of the first element
    b. The charge of the last element
    c. How many molecules there are
    d. How many atoms there are

21. What is the name of Fe_2S_3?
    a. Iron sulfide
    b. Diiron trisulfide
    c. Iron (III) sulfide
    d. Iron (II) sulfide

22. What is the name of HBr?
    a. Hydrogen bromate
    b. Bromic acid
    c. Hydrobromic acid
    d. Hydrobromide

23. What is the name of Ba_3N_2?
    a. **Barium nitride**
    b. Barium (III) nitride
    c. Tribarium nitride
    d. Barium nitrogen

24. What is the name of P_2O_5?
    a. Phosphorus oxide
    b. Pentaphosphorus dioxide
    c. Phosphorus (II) oxide
    d. **Diphosphorus pentoxide**

25. What is the chemical formula for calcium phosphate?
    a. Ca_3P_2
    b. CaP
    c. **$Ca_3(PO_4)_2$**
    d. $CaPO_4$

26. What is the chemical formula for sulfur (VI) oxide?
    a. S_6O_2
    b. S_2O_4
    c. S_3O
    d. **SO_3**

27. What is the formula for triarsenic tetraselenide?
    a. As_4Se_3
    b. **As_3Se_4**
    c. Ar_4S_3
    d. Ar_2Se_7

28. What is the formula for carbonic acid?
    a. H_4C
    b. HCO_3
    c. H_2CO_3
    d. H_2CO_4

29. Which of the following is true about a binary acid?
    a. It only contains two atoms
    b. It contains only two different types of elements
    c. It contains oxygen
    d. It contains a polyatomic ion

30. What is the oxidation number of sulfur in $Al_2(SO_4)_3$?
    a. -2
    b. +3
    c. -5
    d. +6

31. What is the oxidation number of lead in Pb_2O_3?
    a. +2
    b. +3
    c. -6
    d. +6

32. What is the oxidation number of fluorine in CaF_2?
    a. -1
    b. -2
    c. +1
    d. +2

33. In which of the following compounds would hydrogen have an oxidation state of zero?
    a. HI
    b. NaH
    c. $Ca(OH)_2$
    d. NH_4Cl
    e. H_2

34. What is the percent composition of silver in $Ag_2(SO_4)$?
    a. 10.29%
    b. 20.53%
    c. 30.82%
    d. 69.19%

35. What is the percent composition of sulfur in $Ag_2(SO_4)$?
    a. 10.29%
    b. 20.53%
    c. 30.82%
    d. 69.19%

36. What is the percent composition of oxygen in $Ag_2(SO_4)$?
    a. 10.29%
    b. 20.53%
    c. 30.82%
    d. 69.19%

37. What is the empirical formula of a compound containing 47.37% carbon, 10.59% hydrogen, and 42.04% oxygen?
    a. $C_2H_6O_3$
    b. CH_2O
    c. $C_3H_8O_2$
    d. C_2H_4O

38. A compound is found to contain 23.3% magnesium, 30.7% sulfur, and 46.0% oxygen. What is the empirical formula of this compound?
    - **a. $MgSO_3$**
    - b. Mg_2SO_4
    - c. $Mg_2S_2O_3$
    - d. $MgSO_4$

39. A piece of iron ore is found to contain a compound containing 72.3% iron and 27.7% oxygen with a molecular mass of 231.4 g/mol. What is the molecular formula of the compound?
    - a. FeO
    - b. FeO_2
    - c. FeO_3
    - **d. Fe_2O_3**

40. Determine the molecular formula of a compound with an empirical formula of NH_2 and a molar mass of 32.06 g/mol.
    - a. NH_2
    - **b. N_2H_4**
    - c. N_3H_6
    - d. N_4H_8

41. What does (aq) mean as a subscript in a chemical equation?
    - a. The substance is liquid
    - b. The substance is evaporated
    - **c. The substance is dissolved in water**
    - d. The substance is not involved in the reaction

42. How do you balance a chemical equation?
    a. Change the subscripts
    b. Change the coefficients
    c. Change the charges
    d. Change the superscripts

43. In the equation $Cl_2 + 2\ KBr \rightarrow 2\ KCl + Br_2$, which are the reactants?
    a. Cl_2 and KBr
    b. KCl and Br_2
    c. Cl_2 and Br_2
    d. KCl and KBr

44. Which coefficients below would correctly balance the following equation?
    $Al_2(SO_4)_{3(aq)} + KOH_{(aq)} \rightarrow Al(OH)_{3(aq)} + K_2SO_{4(aq)}$
    a. 1, 3, 2, 3
    b. 2, 12, 4, 6
    c. 4, 6, 2, 3
    d. 1, 6, 2, 3

45. Aluminum chloride and bubbles of hydrogen gas are produced when metallic aluminum is placed in hydrochloric acid. What is the balanced equation for this reaction?
    a. $H + AlCl \rightarrow Al + HCl$
    b. $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$
    c. $Al + HCl_3 \rightarrow AlCl_3 + H$
    d. $Al + 2HCl \rightarrow AlCl_2 + H_2$

46. Will the reaction in problem 45 occur?
    a. Yes
    b. No

47. When potassium hydroxide and barium chloride react, potassium chloride and barium hydroxide are formed. The balanced equation for this reaction is:
    a. KH + BaCl → KCl + BaH
    b. KOH + BaCl → KCl + BaOH
    c. $2KOH + BaCl_2$ $2KCl + Ba(OH)_2$
    d. KOH + BaCl2 → K+ BaOH
    e. $2KOH + 2BaCl_2 \rightarrow 2KCl_2 + 2Ba(OH)_2$

48. Write a balanced equation to represent the decomposition of lead (IV) oxide into its constituent elements.
    a. $PbO_2 \rightarrow Pb + 2O$
    b. $PbO_2 \rightarrow Pb + O_2$
    c. $Pb_2O \rightarrow 2Pb + O$
    d. $PbO \rightarrow Pb + O_2$
    e. $2PbO \rightarrow 2Pb + O_2$

49. The equation $H_3PO_4 + 3KOH \rightarrow K_3PO_4 + 3H_2O$ is an example of which type of reaction?
    a. Single replacement
    b. Double replacement
    c. Combustion
    d. Synthesis
    e. Decomposition

50. The equation $2NO + O_2 \rightarrow 2NO_2$ is an example of which type of reaction?
    a. Single replacement
    b. Double replacement
    c. Combustion
    d. Synthesis
    e. Decomposition

51. The equation $2\ AlPO_4 + 3\ Mg \rightarrow 2\ Al + Mg_3(PO4)_2$ is an example of which type of reaction?
    a. **Single replacement**
    b. Double replacement
    c. Combustion
    d. Synthesis
    e. Decomposition

52. The equation $CaCO_3 \rightarrow CaO + CO_2$ is an example of which type of reaction?
    a. Single replacement
    b. Double replacement
    c. Combustion
    d. Synthesis
    e. **Decomposition**

53. The equation $C_{10}H_8 + 12\ O_2 \rightarrow 10\ CO_2 + 4\ H_2O$ is an example of which type of reaction?
    a. Single replacement
    b. Double replacement
    c. **Combustion**
    d. Synthesis
    e. Decomposition

54. What are the products when these reactants combine? $HCl + Mg(OH)_2 \rightarrow$
    a. $H(OH)_2 + ClMg$
    b. $MgH + Cl(OH)_2$
    c. **$MgCl_2 + H_2O$**
    d. $MgCl + H_2O$

55. What are the products when these reactants combine? $Li + N_2 \rightarrow$

a. LiN_2
b. Li_3N
c. Li_2N
d. $N_2 + Li$

56. What are the products when these reactants combine? $Na + MgCl_2 \rightarrow$

a. $NaMg + Cl_2$
b. $NaCl_2 + Mg$
c. $MgCl_2 + Na$
d. NaCl + Mg

57. What are the products when these reactants combine? $C_6H_{10}O3 + O_2 \rightarrow$

a. $CO_2 + H_2O$
b. $C_6H_{10}O_5$
c. $H_6H_{10} + O_2$
d. $C_6O_2 + H_{10}O_3$

Lesson 16

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. How many moles of $KBrO_3$ are required to prepare 0.0700 moles of Br_2 according to the reaction: $KBrO_3 + 5KBr + 6HNO_3 \rightarrow 6KNO_3 + 3Br_2 + 3H_2O$
   a. **0.0233**
   b. 0.0732
   c. 0.220
   d. 0.210

2. Calculate the mass of hydrogen formed when 25 grams of aluminum reacts with excess hydrochloric acid: $2Al + 6HCl \rightarrow Al_2Cl_6 + 3H_2$
   a. 0.41 g
   b. 1.22 g
   c. 1.83 g
   d. **2.81 g**

3. Given the following equation, how many grams of NaCl can be produced from 4.2 moles of Cl_2: $2\ Na + Cl_2 \rightarrow 2\ NaCl$?
   a. 8.41 g
   b. 245.40 g
   c. **490.90 g**
   d. 54.89 g

4. Using the following equation, what is the mole ratio of carbon monoxide reacting to the amount of carbon dioxide being produced: $3\ CO + Fe_2O_3 \rightarrow 2\ Fe + 3\ CO_2$
    a. 2:1
    b. **3:3**
    c. 3:1
    d. 3:2

5. The limiting reactant for a reaction can change based on the amount of each reactant you start with.
    a. **True**
    b. False

6. To get from one substance to another using stoichiometry, you have to go through grams.
    a. True
    b. **False**

7. What is the limiting reactant if 20.0 grams of O_2 react with 30.0 grams of H_2 according to the following reaction: $2\ H_2 + O_2 \rightarrow 2\ H_2O$?
    a. H_2
    b. **O_2**
    c. Both a and b
    d. H_2O

8. How much of the excess reactant is left over after the reaction in problem 7?
    a. **27.47 g**
    b. 2.53 g
    c. 22.53 g
    d. 7.47 g

9. What is the theoretical yield of water in the reaction in number 7?
    a. 27.47 g
    b. 2.53 g
    c. **22.53 g**
    d. 7.47 g

10. If the actual yield of water in the reaction from problem 7 is 21.24 g, what is the percent yield for the reaction?
    a. 85.73%
    b. 89.62%
    c. 91.41%
    d. **94.27%**

Lesson 17

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Liquids diffuse more slowly than gases because:
    a. liquids cannot be compressed
    b. liquids are always at lower temperatures than gases
    c. **the intermolecular forces between particles cause them to move slower**
    d. of magic

2. Solids have all of the following properties except:
    a. **Fluidity**
    b. definite shape
    c. high density
    d. definite volume

3. What is the change of state directly from a gas to a solid?
    a. Sublimation
    b. **Deposition**
    c. Solidification
    d. Condensation

4. What substance has properties of both a liquid and a solid?
    a. Crystalline solid
    b. Solid-liquid
    c. Hard liquid
    d. **Amorphous solid**

5. What is the change of state directly from a solid to a gas?
    a. **Sublimation**
    b. Deposition
    c. Vaporization
    d. Melting

6. What is the amount of energy required to change one mole of solid into a liquid?
    a. Molar heat of vaporization
    b. **Molar heat of fusion**
    c. Molar heat of solidification
    d. Molar heat of melting

7. What is the state of matter with definite volume and indefinite shape?
    a. Solid
    b. **Liquid**
    c. Gas
    d. Fluid

8. What is the process of gas particles moving through a tiny opening?
    a. Flowing
    b. Diffusion
    c. **Effusion**
    d. Kinetic movement

9. Which of the following is NOT an assumption of the kinetic-molecular theory?
    a. Particles are always in motion
    b. Collisions between particles are elastic collisions
    c. The temperature of a gas depends on the average kinetic energy of the particles
    d. **Gas particles have forces of attraction between them**

10. How much energy would it take to melt 2.53 g of water?
    a. **0.84 kJ**
    b. 0.48 kJ
    c. 5.72 kJ
    d. 5.27 kJ

Lesson 18

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. Equilibrium is characterized by:
    a. **opposing processes occurring at equal rates**
    b. an open system
    c. net change in the amount of substance in one phase
    d. changes in physical states

2. Which statement regarding water is true?
    a. Liquid water is less dense than solid water.
    b. Only covalent bonds are broken when ice melts.
    c. Energy must be given off in order to break down the crystal lattice of ice to a liquid.
    d. **All of these statements are false.**

3. Which of the following statements is NOT true about the triple point on a phase diagram?
    a. The point at which the solid, liquid, and gaseous phases for a substance coexist.
    b. The triple point for a substance occurs at a specific temperature and pressure.
    c. **The triple point exists at a single temperature and is independent of pressure.**
    d. The system must be enclosed so that no vapor can escape.

4. In which reaction will the equilibrium shift to the left when the pressure on the system is increased?
    a. $2\ Mg_{(s)} + O_{2(g)} \leftrightarrow MgO_{(s)}$
    b. $CaCO_{3(s)} \leftrightarrow CaO_{(s)} + CO_{2(g)}$
    c. $2\ H_{2(g)} + O_{2(g)} \leftrightarrow 2\ H_2O_{(g)}$
    d. $C_{(s)} + O_{2(g)} \leftrightarrow CO_{2(g)}$

5. The critical point on a phase diagram is the point above which only a solid can exist.
    a. True
    b. False

6. Volatile liquids evaporate easily because of their low vapor pressures.
    a. True
    b. False

7. The chemical equilibrium of a reversible reaction is *not* influenced by:
    a. temperature
    b. pressure
    c. catalyst
    d. concentration

8. Le Chatelier's principle states that if a chemical system at equilibrium is stressed,
    a. the system will adjust to increase the stress
    b. the system will adjust to reduce the stress
    c. the system will not adjust
    d. the reverse reaction will be favored

9. In an exothermic reaction at equilibrium, if heat is removed, which way will the equilibrium shift?
    a. **To the right**
    b. To the left
    c. To the middle
    d. It won't shift

10. For the reaction $SO_{2(g)} + O_{2(g)} <-> SO_{3(g)}$, if the equilibrium shifts to the right, the concentration of $O_{2(g)}$ will _____.
    a. increase
    b. **decrease**
    c. stay the same
    d. double

Lesson 19

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. This law relates pressure to temperature:
    a. Dalton's law
    b. Boyle's law
    c. Charles's law
    d. Gay-Lussac's law

2. This law relates volume to temperature:
    a. Dalton's law
    b. Boyle's law
    c. Charles's law
    d. Gay-Lussac's law

3. This law involves the pressures of a mixture of gases:
    a. Dalton's law
    b. Boyle's law
    c. Charles's law
    d. Gay-Lussac's law

4. This law relates pressure to volume:
    a. Dalton's law
    b. Boyle's law
    c. Charles's law
    d. Gay-Lussac's law

5. A mixture of hydrogen, nitrogen, and water vapor has a total pressure of 864 mmHg. The partial pressure of hydrogen is 220 mmHg, and that of nitrogen is 410 mmHg. What is the partial pressure of water vapor?
    a. **234 mmHg**
    b. 2.64 mmHg
    c. 1.37 mmHg
    d. 1490 mmHg

6. A gas is in an environment that has a volume of 16.8 L and a pressure of 3.2 atm. If the volume changes to 10.6 L, what will be the new pressure?
    a. 2.02 Pa
    b. 2.02 atm
    c. **5.07 atm**
    d. 5.07 L

7. The pressure of a gas is changed from 500 kPa to 250 kPa. What would you expect the new temperature to be if the initial temperature is 200 K?
    a. **100 K**
    b. 250 K
    c. 400 K
    d. 500 K

8. If a gas with a pressure of 6 atmospheres is cooled from 500 K to 250 K, then what is its final pressure if the volume does not change?
    a. **3 atm**
    b. 9 atm
    c. 0.5 atm
    d. 12 atm

9. To convert from degrees C to K, you would:
    a. subtract 273
    b. add 273
    c. divide by 2
    d. multiply by 2

10. Standard temperature and pressure (STP) refers to which conditions?
    a. 0^{o} C and 1 KPa
    b. 100 K and 1 mm Hg
    c. 0 K and 1 atm
    d. 273 K and 1 atm

Lesson 20

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. If 10 L of O_2 at 273 K and 1 atm is compressed to a 7 L container at 250 K, what is the new pressure?
    - **a. 1.31 atm**
    - b. 0.76 atm
    - c. 9.16 atm
    - d. 6.07 atm

2. A weather balloon has a volume of 105 L at 0.97 atm when the temperature is 318 K. What is the volume at 293 K and 1.05 atm?
    - a. 3.13 L
    - **b. 89.37 L**
    - c. 93.81 L
    - d. 0.32 L

3. One way to increase pressure on a gas is to:
    - a. decrease temperature
    - b. increase volume
    - **c. increase the number of gas particles**
    - d. lower the kinetic energy of the gas particles

4. In the ideal gas law, which variable represents the gas constant?
    - a. P
    - b. n
    - c. V
    - **d. R**

5. Determine the number of moles in a container of gas at STP with a volume of 99.2 L.
    a. 22.4 moles
    b. 2222.08 moles
    c. 4.43 moles
    d. 76.8 moles

6. In order to solve gas law calculations, temperatures must be in:
    a. Fahrenheit
    b. Kelvin
    c. Celsius
    d. It doesn't matter

7. A 0.33 mole sample of $CaCO_{3(s)}$ is placed in a 1 L evacuated flask, which is then sealed and heated. What is the pressure of the flask at 300 K?
    a. 8.13 atm
    b. 2.01 atm
    c. 4.12 atm
    d. 16.34 atm

8. Why would O_2 effuse faster than CO_2 in the same room?
    a. Because O_2 has more energy
    b. Because oxygen has a higher temperature
    c. Because CO_2 has a greater molar mass
    d. They will effuse at the same rate because the temperature is fixed

9. The rate of effusion of water vapor is 0.391 mol/s and the rate of effusion of propane is 0.251 mol/s at the same temperature and pressure. What is the molar mass of propane?
    a. **43.73 g/mol**
    b. 0.37 g/mol
    c. 28.32 g/mol
    d. 6.63 g/mol

10. Lighter molecules have a _____ rate of effusion.
    a. slower
    b. **faster**
    c. constant
    d. none of the above

Lesson 21

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. A blend of two or more compounds that are physically combined would be a(n):
    a. pure substance
    b. mixture
    c. element
    d. nonelectrolyte

2. The substance dissolved in a homogeneous mixture is called a:
    a. solution
    b. colloid
    c. solute
    d. solvent

3. A substance that does not dissolve in a polar solvent is:
    a. nonpolar
    b. polar
    c. ionic
    d. miscible

4. The solubility of gases _____ as temperature increases.
    a. increases
    b. decreases
    c. remains the same
    d. all of the above

5. A water solution that conducts electricity would be identified as a(n):
    a. Tyndall effect
    b. immiscible
    c. nonelectrolyte
    d. electrolyte

6. Which of the following is NOT a colligative property?
    a. Boiling point elevation
    b. Freezing point depression
    c. Density
    d. Vapor pressure lowering

7. Which of the following does NOT increase the rate at which a solid dissolves in water?
    a. Heating the solution
    b. Using large pieces of the solid
    c. Crushing the solid
    d. Stirring the solution

8. A solution containing more solute than it should have at that temperature is a(n):
    a. saturated solution
    b. unsaturated solution
    c. supersaturated solution
    d. hypersaturated solution

9. Changes in pressure affect the solubility of which types of solutes?
    a. Gas
    b. Solid
    c. Liquid
    d. Charged

10. What is the molarity of a solution made from 8.210 g K_2CrO_4 dissolved in enough water to make a 0.50L solution?
    a. .12 M
    b. .08 M
    c. .04 M
    d. .16 M

Lesson 22

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. An ion that does not take part in a chemical reaction is called a:
    - **a. spectator ion**
    - b. soluble ion
    - c. negative ion
    - d. colligative ion

2. When a solid is formed from the combination of two liquids is called a(n):
    - a. aqueous
    - **b. precipitate**
    - c. sulfide
    - d. molal

3. Solutions that have water as a solvent:
    - **a. aqueous**
    - b. precipitate
    - c. sulfide
    - d. molal

4. Which of the following is always a product of ionization?
    - a. OH^-
    - b. H^+
    - c. NO_3^-
    - **d. H_3O^+**

5. When soluble ionic compounds are placed in water, they:
    a. ionize
    b. dissociate
    c. precipitate
    d. melt

6. When barium nitrate and potassium phosphate react, what compound is the precipitate?
    a. $Ba(NO_3)_2$
    b. K_3PO_4
    c. $Ba_3(PO_4)_2$
    d. KNO_3

7. When barium nitrate and potassium phosphate react, which of the following is a spectator ion?
    a. Ba^{2+}
    b. K^+
    c. SO_4^{2-}
    d. H_3O^+

8. When sodium hydroxide and iron (II) chloride react, which of the following is the precipitate?
    a. NaOH
    b. $FeCl_2$
    c. NaCl
    d. $Fe(OH)_2$

9. When sodium hydroxide and iron (II) chloride react, which of the following is a spectator ion?
    - **a. Na^+**
    - b. Fe^{2+}
    - c. OH^-
    - d. H_3O^+

10. Which of the following is NOT a sign of a chemical change?
    - a. Release or absorption of energy
    - b. Formation of a solid
    - **c. Formation of a liquid**
    - d. Formation of a gas

Lesson 23

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. A substance that does not ionize completely and produces H_3O^+:
    a. Strong acid
    b. Weak acid
    c. Strong base
    d. Weak base

2. An acid composed of hydrogen and only one other element:
    a. Binary acid
    b. Oxyacid
    c. Monoprotic acid
    d. Weak acid

3. An acid that can donate only one proton per molecule:
    a. Binary acid
    b. Oxyacid
    c. Monoprotic acid
    d. Weak acid

4. The ion that is formed after a base has accepted a proton:
    a. Bronsted-Lowry acid
    b. Bronsted-Lowry base
    c. Conjugate acid
    d. Conjugate base

5. Any substance that can react as either an acid or a base:
    a. Polyprotic
    b. Conjugate
    c. Weak
    d. Amphoteric

6. The strength of an acid is determined by the extent to which it _____ in water.
    a. dissociates
    b. ionizes
    c. reacts
    d. dissolves

7. A substance that completely dissociates to form OH^- ions:
    a. Strong acid
    b. Weak acid
    c. Strong base
    d. Weak base

8. A Bronsted-Lowry base does which of the following?
    a. Donates an electron pair
    b. Accepts a proton
    c. Forms OH^-
    d. Donates a proton

9. A Lewis base does which of the following?
    a. Donates an electron pair
    b. Accepts a proton
    c. Forms OH-
    d. Donates a proton

10. H_3PO_4 could be classified as all of the following EXCEPT:
    a. polyprotic acid
    b. oxyacid
    c. arrhenius acid
    d. binary acid

Lesson 24

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. In a titration, this is when an indicator changes color.
    a. Transition interval
    b. Neutralization point
    c. End point
    d. Standard point

2. A solution is neutral if:
    a. it contains no H_3O^+ ions
    b. it contains no ionized water molecules
    c. it contains no H_3O^+ or OH^- ions
    d. H_3O^+ and OH^- ions are equal

3. A neutralization reaction produces:
    a. H_3O^+
    b. OH^-
    c. a salt and water
    d. a weak acid and a strong base

4. If the $[H_3O^+]$ of a solution is 2.5×10^{-5} M, calculate its pH.
    a. 2.50
    b. 4.60
    c. 5.40
    d. 8.20

5. If the pH of a solution is 9.82, calculate the $[H_3O^+]$.
    a. **1.51×10^{-10} M**
    b. 2.12×10^{-8} M
    c. 9.82×10^{-10} M
    d. 1.51×10^{-8} M

6. If the $[OH^-]$ of a solution is 1.0×10^{-11} M, calculate the $[H_3O+]$
    a. 2.0×10^{-2} M
    b. 1.0×10^{-4} M
    c. 2.0×10^{-11} M
    d. **1.0×10^{-3} M**

7. If the molarity of the acid H_2SO_4 is 3.4×10^{-3} M, what is its $[H_3O^+]$?
    a. 2.94×10^{-12} M
    b. 3.4×10^{-3} M
    c. **6.8×10^{-3} M**
    d. 1.47×10^{-12} M

8. Which of the following does NOT occur when potassium hydroxide is combined with sulfuric acid?
    a. Water is formed.
    b. It is a neutralization reaction.
    c. K_2SO_4 is a product.
    d. **H_3O^+ is formed.**

9. Which of the following is a correctly balanced equation for the reaction in number 8?
    a. $KOH + H_2SO_4 \rightarrow H_2O + K_2SO_4$
    b. **$H_2SO_4 + 2\ KOH \rightarrow K_2SO_4 + 2\ H_2O$**
    c. $KOH + H_2SO_4 \rightarrow H_3O^+ + K_2SO_4$
    d. $H_2SO_4 + 2\ KOH \rightarrow K_2SO_4 + 2\ H_3O^+$

10. What is the main purpose of a titration?
    a. **To find an unknown molarity of a solution**
    b. To find the volume of a solution needed to neutralize another solution
    c. To prepare a neutral solution
    d. To see an indicator change colors

Lesson 25: Exam 3

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. This deals with the mass relationships of elements in compounds:
    a. reaction stoichiometry
    b. composition stoichiometry
    c. quantum stoichiometry
    d. kinetic molecular theory

2. The substance that is completely used up in a reaction is identified as the:
    a. limiting reactant
    b. excess reactant
    c. theoretical yield
    d. precipitate

3. When the reaction $S_{(s)} + O_{2(g)} \rightarrow SO_{3(g)}$ is correctly balanced, what is the mole ratio of sulfur to oxygen molecules?
    a. 1:1
    b. 1:2
    c. 1:3
    d. 2:3

4. If 6.30 g of sulfur are reacted with 10.00 g of oxygen in number 3, what is the limiting reactant?
    a. Sulfur
    b. Oxygen
    c. Sulfur (III) oxide
    d. None of the above

5. How much of the excess reactant would be left over for the reaction in problem 4?
    a. 0.82 g
    b. 5.48 g
    c. 0.57 g
    d. 9.43 g

6. What is the theoretical yield in problem 4?
    a. 16.64 g
    b. 15.73 g
    c. 9.43 g
    d. 6.67 g

7. If the actual yield of SO_3 in an experiment is 14.87 g, what is the percentage yield?
    a. 40.08%
    b. 56.67%
    c. 94.53%
    d. 100.00%

8. Gasses have all of the following properties except:
    a. fluidity
    b. indefinite shape
    c. indefinite volume
    d. high density

9. What is the spontaneous mixing of particles of two or more substances?
    a. Diffusion
    b. Effusion
    c. Elastic collisions
    d. Kinetic movement

10. The behavior of a real gas is closest to an ideal gas at:
    a. high temperature and high volume
    b. high temperature and low pressure
    c. low temperature and high pressure
    d. low temperature and high volume

11. What is the amount of energy needed to change one mole of liquid into a gas?
    a. Molar heat of fusion
    b. Molar heat of condensation
    c. Molar heat of vaporization
    d. Molar heat of melting

12. How much energy would it take to melt 4.23 g of water (the molar heat of fusion of water is 6.009 kJ/mol)?
    a. 0.70 kJ
    b. 1.41 kJ
    c. 12.69 kJ
    d. 25.41 kJ

13. The kinetic-molecular theory is based on the idea that particles of matter are always:
    a. immersed
    b. in motion
    c. volatile
    d. amorphous

14. According to the kinetic-molecular theory, all gasses:
    a. are made up of tiny particles
    b. have elastic collisions
    c. are in constant, random motion
    d. all of the above

15. The point on a phase diagram where all three states of matter can exist at the same time is called the:
    a. critical point
    b. normal point
    c. triple point
    d. phase point

16. The point on a phase diagram above which only a gas can exist is known as the:
    a. critical point
    b. normal point
    c. triple point
    d. phase point

17. Which is the weakest intermolecular force, present in all molecules?
    a. Hydrogen bond
    b. Dipole-dipole
    c. Covalent
    d. London-dispersion

18. The three states of matter of a particular substance, in order of intermolecular forces from greatest to least, are:
    a. **solid, liquid, gas**
    b. gas, solid, liquid
    c. solid, gas, liquid
    d. gas, liquid, solid

19. Which of the following is true about water?
    a. Solid water is less dense than liquid water.
    b. Ice requires a lot of energy to melt.
    c. Water is a polar molecule with polar covalent bonds.
    d. **All of the above are true.**

20. When two opposing changes occur at equal rates in the same closed system, the system is said to be:
    a. balanced
    b. **in dynamic equilibrium**
    c. volatile
    d. Unstable

21. In a system at equilibrium, $N_{2(g)} + 3\ H_{2(g)} \leftrightarrow 2\ NH_{3(g)}$ + heat, which reaction will be favored when the temperature is increased?
    a. Forward
    b. **Reverse**
    c. Both
    d. Neither

22. What will happen to the amount of N_2 in problem 21?
    a. **Increase**
    b. Decrease
    c. Remain the same
    d. Be removed

23. If the pressure of the system in problem 21 is increased, which reaction will be favored?
    a. **Forward**
    b. Reverse
    c. Both
    d. Neither

24. A meteorological balloon contains 250.0 L of helium at 22 ^{o}C and 0.97 atm of pressure. What volume would occupy the balloon at a higher altitude with a temperature of -52 ^{o}C and a pressure of .750 atm?
    a. 766.61 L
    b. 57.17 L
    c. **241.63 L**
    d. 472.98 L

25. How many moles of helium gas would it take to fill a balloon with a volume of 7.5 L when the temperature is 32 ^{o}C and the atmospheric pressure is .98 atm?
    a. 2.80 mol He
    b. 485.42 mol He
    c. 3.41 mol He
    d. **0.29 mol He**

26. A student has stored 100.0 mL of neon gas over water on a day when the temperature is 27 °C. The barometer in the room reads 99.10 kPa. What is the pressure of the neon gas?
    a. 102.67 kPa
    b. 95.53 kPa
    c. 72.4 kPa
    d. 33.03 kPa

27. Which of the following increases the rate at which a solid dissolves in water?
    a. Cooling the solution
    b. Using large pieces of the solid
    c. Stirring the solution
    d. Adding pressure to the solution

28. A colligative property is one that depends on:
    a. both the number and identity of particles in a solution
    b. only the number of particles in a solution
    c. only the identity of particles in a solution
    d. none of the above

29. Which of the following is not a colligative property?
    a. Electrical conductivity
    b. Boiling point elevation
    c. Freezing point depression
    d. Vapor pressure lowering

30. How many moles of ions are produced when $Fe_3(PO_4)_2$ dissociates in water?
    a. 2
    b. 3
    c. 5
    d. 13

31. What is the solid called that's formed from the combination of two liquids?
    a. **Precipitate**
    b. Aqueous
    c. Sulfide
    d. Molal

32. The solubility of a solute depends on:
    a. the nature of the solute
    b. the nature of the solvent
    c. the temperature
    d. **all of the above**

33. Henry's law states that the solubility of a gas in a liquid is:
    a. **directly proportional to the partial pressure of the gas**
    b. inversely proportional to the temperature of the gas
    c. directly proportional to the pressure and temperature of the gas
    d. inversely proportional to the volume of the gas

34. Compounds whose water solutions conduct electric current:
    a. are nonpolar
    b. **dissociate**
    c. do not dissolve in the water
    d. decompose in water

35. Liquid solutes and solvents that do not dissolve in each other are called:
    a. soluble
    b. insoluble
    c. miscible
    d. **immiscible**

36. What would be the molarity of a solution containing 7.00 g KOH in a 500 mL solution?
    a. 0.01 M
    b. 0.06 M
    c. 0.25 M
    d. 14.00 M

37. A solution containing less than the full amount of solute possible in a solution is:
    a. saturated
    b. unsaturated
    c. supersaturated
    d. none of the above

38. A solution whose solute and solvent are both solid metals is a(n):
    a. aqueous
    b. heterogeneous
    c. alloy
    d. colloid

39. When barium chloride reacts with potassium phosphate, what is the precipitate?
    a. $BaPO_4$
    b. KCl
    c. $Ba_3(PO_4)_2$
    d. KCl_2

40. When potassium nitrate and magnesium sulfate are combined, what is the precipitate?
    a. $MgSO_4$
    b. $Mg(NO_3)_2$
    c. K_2SO_4
    d. None of the above

41. Which of the following is not a property of bases?
    a. Ionizes in water
    b. Turns litmus paper blue
    c. Has a high pH
    d. Forms OH^- ions in water

42. What always forms when a substance ionizes in water?
    a. H_2O
    b. OH^-
    c. H_3O^+
    d. Salt

43. Which of the following is always true about Bronsted-Lowry acids?
    a. They donate protons
    b. They accept electrons
    c. They form H_3O^+
    d. None of the above

44. Which of the following is always true about Arrhenius bases?
    a. They accept protons
    b. They donate electrons
    c. They form OH^-
    d. None of the above

45. Which of the following is true about weak acids?
    a. They dissociate completely
    b. They dissociate, but not completely
    c. They ionize completely
    d. They ionize, but not completely

46. When hydrochloric acid is put in water, which is the Bronsted-Lowry base?
    a. HCl
    b. H_2O
    c. H_3O^+
    d. Cl^-

47. Which is the conjugate base in the prior question?
    a. HCl
    b. H_2O
    c. H_3O^+
    d. Cl^-

48. Is HCl an Arrhenius acid in problem 47?
    a. Yes, because it donates a proton
    b. No, because it does not donate a proton
    c. Yes, because it forms H_3O^+
    d. No, because it does not form OH^-

49. If a 2.71×10^{-3} M solution of H_3PO_4 ionizes in water, what is $[H_3O^+]$?
    a. 2.71×10^{-3} M
    b. 5.42×10^{-3} M
    c. 8.13×10^{-3} M
    d. 3.69×10^{-12} M

50. What is the [OH-] for the solution in the previous question?

a. 1.85×10^{-12} M

b. 1.23×10^{-12} M

c. 2.71×10^{-3} M

d. 3.69×10^{-12} M

Lesson 26

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. The study of the changes in heat energy in a chemical reaction is called:
    a. chemistry
    b. Hess's Law
    c. temperature
    d. thermochemistry

2. The measure of the average kinetic energy of the particles in a sample of matter is:
    a. heat
    b. temperature
    c. joule
    d. specific heat

3. The sum total of the kinetic energies of the particles in a sample of matter is:
    a. heat
    b. temperature
    c. joule
    d. specific heat

4. The amount of heat energy required to raise the temperature of one gram of a substance by one degree Celsius or one Kelvin is:
    a. joule
    b. temperature
    c. enthalpy change
    d. specific heat

5. Compounds with high positive values of enthalpy of formation are:
    a. very stable compounds
    b. typically unstable
    c. very unstable compounds
    d. sometimes stable and sometimes unstable

6. If we refer to H_2O in its standard state, it would be a:
    a. solid
    b. liquid
    c. gas
    d. plasma

7. A device used to measure the heat released or absorbed in a chemical or physical change is called a:
    a. thermometer
    b. barometer
    c. calorimeter
    d. joule

8. A reaction with a negative enthalpy change would be:
    a. exothermic
    b. endothermic
    c. thermochemical
    d. decomposition

9. If a reaction has a ΔH of 87.9 J, the heat energy would go on which side of the equation?
    a. Products
    b. Reactants
    c. Both
    d. Impossible to tell

10. What is the specific heat of a substance if it takes 70.2 J to raise a 34g sample from 283K to 284K?
    a. 1.07 J/gK
    b. 2.06 J/gK
    c. 1193.4 J/gK
    d. 2386.80 J/gK

Lesson 27

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. The measure of the degree of randomness of the particles in a system is known as:
    a. enthalpy
    b. entropy
    c. Gibbs free energy
    d. specific heat

2. Nature favors reactions that:
    a. are endothermic
    b. have a positive Gibbs free energy
    c. have a high entropy
    d. All of the above

3. The state of matter that has the lowest entropy is:
    a. solid
    b. liquid
    c. gas
    d. They are all the same

4. The enthalpy change that occurs in a reaction is due to:
    a. the amount of energy needed to break bonds
    b. the amount of energy released when bonds form
    c. the difference in enthalpies of the products and reactants
    d. All of the above

5. A negative enthalpy and negative entropy would be spontaneous:
    a. always
    b. at high temperatures
    c. at low temperatures
    d. never

6. A negative enthalpy and positive entropy would be spontaneous:
    a. always
    b. at high temperatures
    c. at low temperatures
    d. never

7. A positive enthalpy and negative entropy would be spontaneous:
    a. always
    b. at high temperatures
    c. at low temperatures
    d. never

8. A positive enthalpy and positive entropy would be spontaneous:
    a. always
    b. at high temperatures
    c. at low temperatures
    d. never

9. Calculate the Gibbs free energy for a reaction with an enthalpy change of -76 kJ/mol and an entropy change of -0.117 kJ/mol K at a temperature of 298.15 K.
    a. -110.88 kJ/mol
    b. -41.12 kJ/mol
    c. 110.88 kJ/mol
    d. 41.14 kJ/mol

10. Which of the following describes the reaction in the previous question?
    a. **Spontaneous**
    b. Not spontaneous
    c. Will occur quickly
    d. None of the above

Lesson 28

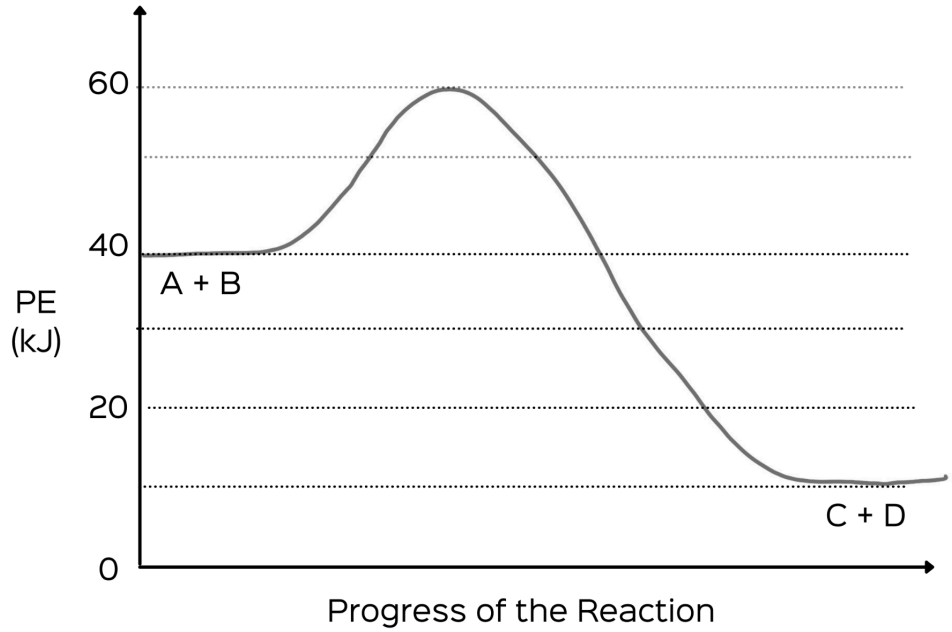
*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. A transitional structure that results from an effective collision is called a(n):
    a. intermediate
    b. activation energy
    c. activated complex
    d. catalyst

2. Which of the following is true about an activated complex?
    a. Old bonds break
    b. Valence electrons merge
    c. New bonds form
    d. All of the above

3. Which of the following is not a factor that influences the rate of a reaction?
    a. Temperature
    b. Surface area
    c. Pressure
    d. Concentration

Use the graph below to answer the following questions.



4. What is the potential energy of the reactants for the forward reaction?
    a. 10 kJ
    b. 30 kJ
    c. 40 kJ
    d. 60 kJ

5. What is the potential energy of the products for the forward reaction?
    a. 10 kJ
    b. 30 kJ
    c. 40 kJ
    d. 60 kJ

6. What is the potential energy of the activated complex?
    a. 20 kJ
    b. 30 kJ
    c. 40 kJ
    d. 60 kJ

7. What is the value for the enthalpy of reaction for the forward reaction?
    a. 20 kJ
    b. -20 kJ
    c. 30 kJ
    d. -30 kJ

8. What type of reaction is this?
    a. Endothermic
    b. Exothermic
    c. Synthesis
    d. Decomposition

9. What is the activation energy for the forward reaction?
    a. 20 kJ
    b. 40 kJ
    c. 50 kJ
    d. 60 kJ

10. What is the activation energy for the reverse reaction?
    a. 20 kJ
    b. 40 kJ
    c. 50 kJ
    d. 60 kJ

11. What is the enthalpy of reaction for the reverse reaction?
    a. 20 kJ
    b. -20 kJ
    c. 30 kJ
    d. -30 kJ

Lesson 29

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What is the equilibrium constant for this reaction 41.8 kJ + 2 $SO_{2(g)}$ + $O_{2(g)}$ ⇌ 2 $SO_{3(g)}$ if [SO_2] = 1.5 M, [O_2] = 4.0 M, and [SO_3] = 3.0 M.
    a. 0.50
    b. 0.85
    c. 1.00
    d. 1.50

2. Based on the value of K for problem 1, which reaction is favored?
    a. Forward
    b. Reverse
    c. Neither
    d. All of the above

3. Which of the following is true if the concentration of O_2 increases for the reaction in problem 1?
    a. The forward reaction is favored.
    b. The amount of SO_2 will increase.
    c. The amount of SO_3 will decrease.
    d. The reverse reaction is favored.

4. Which of the following is true if the concentration of SO_3 is increased for the reaction in problem 1?
    a. The forward reaction is favored.
    b. The temperature on the system will decrease.
    c. The amount of O_2 will decrease.
    d. The reverse reaction is favored.

5. Which of the following is true if the temperature on the system is decreased in problem 1?
    a. The forward reaction is favored.
    b. The equilibrium will shift to the left.
    c. The pressure on the system will increase.
    d. The amount of O_2 will decrease.

6. Which of the following is true if the pressure on the system is increased in problem 1?
    a. There will be no effect.
    b. The equilibrium will shift to the right.
    c. The reverse reaction will be favored.
    d. The amount of SO_2 will increase.

7. Which change will not put a stress on a system at equilibrium?
    a. Increase in temperature
    b. Decrease in pressure
    c. Increase in concentration
    d. Addition of a catalyst

8. What does a K value of less than 1 mean?
    a. The forward reaction is favored.
    b. The reverse reaction is favored.
    c. Neither reaction is favored.
    d. All of the above.

9. What does ⇄ mean?
    a. The concentration of reactants is higher than the concentration of products.
    b. The concentration of products is higher than the concentration of reactants.
    c. The equilibrium lies to the left.
    d. None of the above.

10. Which of the following would be included in an equilibrium expression?
    a. Solid calcium chloride
    b. Liquid water
    c. Gaseous oxygen
    d. None of these would be included.

Lesson 30

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. When writing an equation for K_a, which of the following is always ignored?
    a. The acid
    b. The base
    c. The water
    d. The ions

2. What can be determined from the acid ionization constant?
    a. The strength of the acid
    b. The pH of the acid
    c. All properties of the acid
    d. The solubility of the acid

3. Which of the following happens in cation hydrolysis?
    a. Water molecules react with negative ions
    b. Water molecules react with positive ions
    c. Positive and negative ions react together
    d. All of the above

4. Which of the following happens in anion hydrolysis?
    a. Water molecules react with negative ions
    b. Water molecules react with positive ions
    c. Positive and negative ions react together
    d. All of the above

5. K_{sp} calculations apply to substances that are _____.
    a. completely soluble
    b. slightly soluble
    c. completely insoluble
    d. All of the above

6. Which of the following is the correct K_a expression for when carbonic acid ionizes to form the hydronium and bicarbonate ions?
    a. $K_a = ([H_2CO_3][H_2O])/([H_3O^+][HCO_3^-])$
    b. $K_a = ([H_3O^+][HCO_3^-])/([H_2CO_3][H_2O])$
    c. $K_a = [H_2CO_3]/([H_3O^+][HCO_3^-])$
    d. $K_a = ([H_3O^+][HCO_3^-])/[H_2CO_3]$

7. If $[H_2CO_3]$ = 4.8 M, and [H3O+] and [HCO3-] = .20 M, calculate K_a for the equation in #6.
    a. $K_a = 1.20x10^2$
    b. $K_a = 1.92x10^{-1}$
    c. $K_a = 8.33x10^{-3}$
    d. $K_a = 4.61x10^0$

8. Which of the following is the correct K_{sp} expression for when magnesium hydroxide dissociates?
    a. $K_{sp} = [Mg^{2+}][OH^-]$
    b. $K_{sp} = [Mg^{2+}][OH^-]^2$
    c. $K_{sp} = [Mg^{2+}]^2[OH^-]$
    d. $K_{sp} = ([Mg^{2+}][OH^-]^2)/[Mg(OH)_2]$

9. If the solubility of magnesium hydroxide is 9.0×10^{-4} g/100g H_2O, what is the solubility in mol/L?
    a. 9.0×10^{-4} mol/L
    b. 3.08×10^{-4} mol/L
    c. 1.54×10^{-4} mol/L
    d. 2.18×10^{-2} mol/L

10. What is the value of $K_{sp,}$ given the information from problems 8 and 9?
    a. $K_{sp} = 3.65 \times 10^{-12}$
    b. $K_{sp} = 4.74 \times 10^{-8}$
    c. $K_{sp} = 7.30 \times 10^{-12}$
    d. $K_{sp} = 1.46 \times 10^{-11}$

Lesson 31

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What is the oxidation number for $O_{2(g)}$?
    - **a. 0**
    - b. -2
    - c. +2
    - d. -4

2. What is the oxidation number for oxygen in $Cu_3(PO_4)_2$?
    - a. 0
    - **b. -2**
    - c. -8
    - d. +2

3. What is the oxidation number for phosphorus in $Cu_3(PO_4)_2$?
    - a. -3
    - b. 0
    - **c. +5**
    - d. +8

4. What is the oxidation number for copper in $Cu_3(PO_4)_2$?
    - a. 0
    - **b. +2**
    - c. +3
    - d. +6

5. In a redox reaction, which of the following is true for the substance that is oxidized?
    a. It gains electrons
    b. It becomes more negative
    c. It loses electrons
    d. It does not change oxidation states

6. In a redox reaction, which of the following is true for the substance that is reduced?
    a. It becomes more negative
    b. It becomes more positive
    c. It loses electrons
    d. It does not change oxidation states

7. In the equation $Ag^{+}_{(aq)} + H_3As_{(aq)} \rightarrow Ag_{(s)} + H_3(AsO_4)_{(aq)}$, which substance is oxidized?
    a. Ag
    b. H
    c. O
    d. As

8. In the equation $Ag^{+}_{(aq)} + H_3As_{(aq)} \rightarrow Ag_{(s)} + H_3(AsO_4)_{(aq)}$, which substance is reduced?
    a. Ag
    b. H
    c. O
    d. As

9. In the equation $Ag^{+}_{(aq)} + H_3As_{(aq)} \rightarrow Ag_{(s)} + H_3(AsO_4)_{(aq)}$, how many water molecules would be added to the oxidation half reaction to balance it by mass?
    a. 1
    b. 2
    c. 4
    d. 8

10. In the equation $Ag^{+}_{(aq)} + H_3As_{(aq)} \rightarrow Ag_{(s)} + H_3(AsO_4)_{(aq)}$, what would be the final coefficient for $Ag_{(s)}$ in the balanced chemical equation?
    a. 1
    b. 2
    c. 4
    d. 8

Lesson 32

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What happens in a voltaic cell?
    a. Electricity causes a redox reaction
    b. A redox reaction produces electrical energy
    c. Electrons flow from the cathode to the anode
    d. Redox reactions do not occur

2. What happens in an electrolytic cell?
    a. Electricity causes a redox reaction
    b. A redox reaction produces electrical energy
    c. Electrons flow from the anode to the cathode
    d. Redox reactions do not occur

3. What process occurs at the anode?
    a. Electrochemistry
    b. Heat
    c. Reduction
    d. Oxidation

4. What process occurs at the cathode?
    a. Electrochemistry
    b. Heat
    c. Reduction
    d. Oxidation

5. Which of the following would be the correct cell notation for the reaction in which $Cu_{(s)}$ forms the $Cu^{2+}_{(aq)}$ ion and $Ag^{+}_{(aq)}$ forms $Ag_{(s)}$?
    a. $Cu_{(s)} \mid Cu^{2+}_{(aq)} \mid\mid Ag_{(s)} \mid Ag^{+}_{(aq)}$
    b. $Ag_{(s)} \mid Cu_{(s)} \mid\mid Ag^{+}_{(aq)} \mid Ag_{(s)}$
    c. $Cu^{2+}_{(aq)} \mid Ag_{(s)} \mid\mid Cu_{(s)} \mid Ag^{+}_{(aq)}$
    d. $Cu_{(s)} \mid Cu^{2+}_{(aq)} \mid\mid Ag^{+}_{(aq)} \mid Ag_{(s)}$

6. For the reaction in problem 5, which substance is the cathode?
    a. $Cu_{(s)}$
    b. $Cu^{2+}_{(aq)}$
    c. $Ag_{(s)}$
    d. $Ag^{+}_{(aq)}$

7. For the reaction in problem 5, which substance is the anode?
    a. $Cu_{(s)}$
    b. $Cu^{2+}_{(aq)}$
    c. $Ag_{(s)}$
    d. $Ag^{+}_{(aq)}$

8. Given that $E^0 = +.34V$ for copper and $E^0 = +.80V$ for silver, what would be the E^0_{cell} for the reaction in problem 5?
    a. +1.14 V
    b. -1.14 V
    c. +.46 V
    d. -.46 V

9. In which way do electrons flow in a voltaic cell?
    a. From anode to cathode
    b. From cathode to anode
    c. From anode electrolyte to cathode electrolyte
    d. From cathode electrolyte to anode electrolyte

10. What is the internal circuit in an electrolytic cell?
    a. The flow of electrons through a wire
    b. The flow of negative ions through a porous barrier
    c. The flow of positive ions through a porous barrier
    d. The flow of positive ions from anode to cathode

Lesson 33

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What is the nuclear symbol for potassium-40?
    a. ${}^{40}_{19}P$
    b. ${}^{19}_{40}P$
    c. ${}^{40}_{19}K$
    d. ${}^{19}_{40}K$

2. What is the total mass of protons in potassium-40?
    a. 1.007276 amu
    b. 19.138244 amu
    c. 0.0104234 amu
    d. 19.164635 amu

3. What is the total mass of electrons in potassium-40?
    a. 0.0005486 amu
    b. 19.138244 amu
    c. 0.0104234 amu
    d. 19.164635 amu

4. How many neutrons are in potassium-40?
    a. 40
    b. 21
    c. 19
    d. 10

5. What is the total mass of neutrons in potassium-40?
    a. 1.008665 amu
    b. 21.152796 amu
    c. 0.0115206 amu
    d. 21.181965 amu

6. What is the mass defect for potassium-40 in amu?
    a. 0.3666244 amu
    b. 40.3306324 amu
    c. 39.988011 amu
    d. 5.1203551 amu

7. What is the mass defect for potassium-40 in kg?
    a. 0.3426214 kg
    b. $3.0821357 \times 10^{-13}$ kg
    c. $6.0877982 \times 10^{-27}$ kg
    d. 5.120305512 x 10-11 kg

8. What is the nuclear binding energy for potassium-40 in J/atom?
    a. $5.4790184 \times 10^{-10}$ J/atom
    b. $1.28733512 \times 10^{-12}$ J/atom
    c. $3.08015732 \times 10^{-13}$ J/atom
    d. $5.689228347 \times 10^{-28}$ J/atom

9. What is the nuclear binding energy for potassium-40 in J/mol?
    a. 5.12×10^{11} J/mol
    b. 1.28×10^{12} J/mol
    c. 3.30×10^{14} J/mol
    d. 5.68×10^{28} J/mol

10. What is the nuclear binding energy for potassium-40 in J/nucleon?
    a. 5.12×10^{-11} J/nucleon
    b. 1.37×10^{-11} J/nucleon
    c. 3.08×10^{-13} J/nucleon
    d. 5.68×10^{-28} J/nucleon

Lesson 34

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. The stability of a nucleus is most affected by the
    a. Number of neutrons
    b. Number of protons
    c. Number of electrons
    d. Ratio of neutrons to protons

2. What name matches this symbol: ${}^{4}_{2}He$?
    a. Alpha particle
    b. Beta particle
    c. Positron
    d. Gamma ray

3. What name matches this symbol: γ?
    a. Alpha particle
    b. Beta particle
    c. Positron
    d. Gamma ray

4. What name matches this symbol: ${}^{0}_{-1}\beta$?
    a. Alpha particle
    b. Beta particle
    c. Positron
    d. Gamma ray

5. What name matches this symbol: ${}^{0}_{+1}\beta$?
    a. Alpha particle
    b. Beta particle
    c. Positron
    d. Gamma ray

6. When titanium-210 undergoes electron capture, what product is formed?
    a. Scandium-210
    b. Vanadium-210
    c. Scandium-211
    d. Vanadium-211

7. When caesium-129 undergoes alpha and gamma decay, what other product is formed?
    a. Antimony-127
    b. Tantalum-133
    c. Iodine-125
    d. Lanthanum-131

8. How many half-lives does it take for 1/32 of a substance to remain?
    a. 3
    b. 4
    c. 5
    d. 6

9. If the half-life of a sample of radon-222 is 3.8 days, how long will it take for 1/32 of the sample to remain?
    a. 11.4 days
    b. 15.2 days
    c. 19.0 days
    d. 22.8 days

10. The half-life of an isotope is 30.0 seconds. In a 1000 gram sample, what mass of this isotope remains after 2 minutes?
    a. 31.25 g
    b. 62.50 g
    c. 125 g
    d. 250 g

Lesson 35: Exam 4

*Correct answers are highlighted in **red and bold**. Each question is worth 1 point.*

1. What is the study of the changes in heat energy that accompany chemical reactions and physical changes?
    a. Electrochemistry
    b. Entropy
    c. Thermochemistry
    d. Nuclear chemistry

2. What is a calorimeter?
    a. A device used to measure heat changes in a reaction
    b. A substance added to increase the rate of a reaction
    c. A device used to measure the temperature of a substance
    d. A substance added to add heat to a reaction

3. A reaction with a positive enthalpy change is:
    a. exothermic
    b. endothermic
    c. thermochemical
    d. decomposition

4. If a reaction has a ΔH of 273.5 kJ, the heat energy would go on which side of the equation?
    a. Products
    b. Reactants
    c. Both
    d. Impossible to tell

5. What is the specific heat of a 70 gram sample of material that absorbed 862.4 J as it was heated from 281 K to 313 K?
    a. 8.45 J/gK
    b. 2.60 J/gK
    c. 1.89 J/gK
    d. 0.39 J/gK

6. Calculate the enthalpy change for the following reaction.

    $2\ CuSO_4 \rightarrow 2\ CuO_{(s)} + SO_{2(g)} + S_{(s)}$

    a. 317.30 kJ
    b. -317.30 kJ
    c. 931.40 kJ
    d. - 931.40 kJ

7. Which of the following would not increase the rate at which a reaction occurs?
    a. Increasing the temperature of the reaction
    b. Crushing the reactants
    c. Adding a catalyst
    d. Decreasing the concentration of the reactants

8. Determine the ΔH for the following reaction, given the information below:

    $8\ H_{2(g)} + 7\ C_{(s)} \rightarrow\ C_7H_{16(l)}$

    $H_{2(g)} + ½\ O_{2(g)} \rightarrow H_2O_{(l)}$ ΔH = -285.8 kJ/mol
    $CO_{2(g)} \rightarrow C_{(s)} + O_{2(g)}$ ΔH = 393.5 kJ/mol
    $7\ CO_{2(g)} + 8\ H_2O_{(l)} \rightarrow C_7H_{16(l)} + 11\ O_{2(g)}$ ΔH = 4816.0 kJ/mol

    a. ΔH = -224.90 kJ/mol
    b. ΔH = 17.60 kJ/mol
    c. ΔH = 184.60 kJ/mol
    d. ΔH = -778.20 kJ/mol

9. What does entropy measure?
    a. The amount of heat in a reaction
    b. The spontaneity of a reaction
    c. The degree of randomness in a system
    d. None of the above

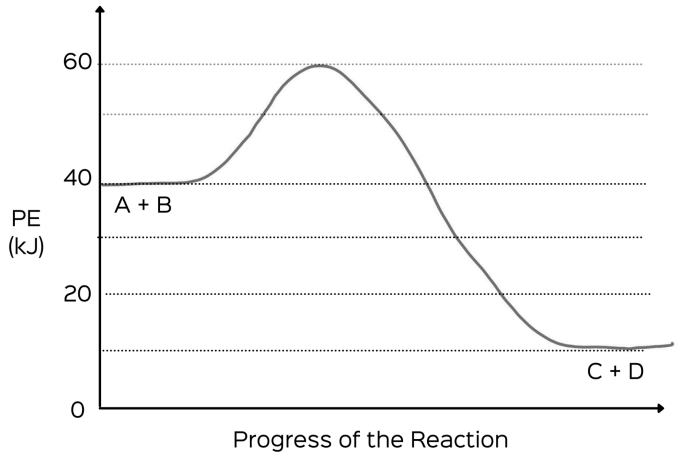
10. Which state of matter has the highest entropy?
    a. Liquid
    b. Gas
    c. Solid
    d. They are all the same

11. Nature favors reactions that:
    a. are exothermic
    b. have a negative Gibbs free energy
    c. have a high entropy
    d. All of the above

12. Calculate the Gibbs free energy at 420 K for a reaction in which the enthalpy change is +35 kJ/mol and entropy change is 1,500 J/molK.
    a. -367.5 kJ/mol
    b. -595.0 kJ/mol
    c. 367.5 kJ/mol
    d. 595.0 kJ/mol

13. Is the reaction in problem 12 spontaneous? Why or why not?
    a. Yes, it has a positive ΔG value
    b. Yes, it has a negative ΔG value
    c. No, it has a positive ΔG value
    d. No, it has a negative ΔG value

Use the graph below to answer the following questions.



14. What is the potential energy of the reactants?
    a. 10 kJ
    b. 20 kJ
    c. 40 kJ
    d. 60 kJ

15. What is the potential energy of the products?
    a. 10 kJ
    b. 20 kJ
    c. 40 kJ
    d. 60 kJ

16. What type of reaction is this?
    a. Endothermic
    b. Exothermic
    c. Decomposition
    d. None of the above

17. What is the potential energy of the activated complex?
    a. 10 kJ
    b. 20 kJ
    c. 40 kJ
    d. 60 kJ

18. What is the activation energy for this reaction?
    a. 20 kJ
    b. 40 kJ
    c. 50 kJ
    d. 60 kJ

19. What is the enthalpy change for this reaction?
    a. 30 kJ
    b. -30 kJ
    c. 50 kJ
    d. -50 kJ

20. In the following equation, which reaction is favored in terms of enthalpy?
    $C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(l)} + 136.9\ kJ$
    a. Forward
    b. Reverse
    c. Both
    d. Neither

21. A chemical reaction in which the products can react to re-form the reactants is:
    a. exothermic
    b. buffer
    c. chemical equilibrium
    d. reversible

22. This states that if a system is subjected to a stress, the equilibrium will be shifted in the direction that tends to relieve the stress.
    a. Chemical equilibrium
    b. Buffer
    c. LeChatelier's principle
    d. Reversible reaction

23. When the rate of the forward reaction equals the rate of the reverse reaction, a system is:
    a. endothermic
    b. at equilibrium
    c. exothermic
    d. a buffer

24. A solution that resists changes in pH is called:
    a. endothermic
    b. exothermic
    c. water
    d. Buffer

25. Which of the following is the correct equilibrium expression for the following reaction?

    $N_{2(g)} + 3\ H_{2(g)} \rightleftharpoons 2\ NH_{3(g)} + 92\ kJ$

    a. $[NH_3]^2/([N_2][H_2]^3)$
    b. $([N_2][H_2]^2)/[NH_3]^2$
    c. $[NH_3]/([N_2][H_2])$
    d. $([N_2][H_2])/[NH_3]$

26. For the equation in problem 25, what is the value of K if $[NH_3] = 1.5x10^{-6}$ M, $[N_2] = 1.0x10^{-2}$ M, and $[H_2] = 2.8x10^{-3}$ M?
    a. 9.76×10^{1} M
    b. 1.87×10^{-1} M
    c. 1.02×10^{-2} M
    d. 2.87×10^{-5} M

27. Which reaction in problem 25 is endothermic?
    a. Forward
    b. Reverse
    c. Neither
    d. Both

28. Which reaction in problem 25 is favored if extra $N_{2(g)}$ is added?
    a. Forward
    b. Reverse
    c. Neither
    d. Both

29. Which reaction in problem 25 is favored if the temperature of the system is decreased?
    a. Forward
    b. Reverse
    c. Neither
    d. Both

30. Which change will not put a stress on a system at equilibrium?
    a. Increase in temperature
    b. Decrease in pressure
    c. Increase in concentration
    d. Addition of a catalyst

31. What does $\rightleftarrows$ mean?
    a. **The concentration of reactants is higher than the concentration of products.**
    b. The concentration of products is higher than the concentration of reactants.
    c. The equilibrium lies to the right.
    d. None of the above

32. Which of the following is the correct K_a expression for when hydrochloric acid ionizes in water?
    a. $K_a = [HCl][H_2O]/[H_3O^+][Cl^-]$
    b. $K_a = [H_3O^+][Cl^-]/[HCl][H_2O]$
    c. **$K_a = [H_3O^+][Cl^-]/[HCl]$**
    d. $K_a = [HCl]/[H_3O^+][Cl^-]$

33. What is the value of the acid ionization constant for the reaction in problem 32 if [HCl] = 5.3 M, $[H_3O^+] = [Cl^-]$ = .45 M, and $[H_2O]$ = 2.5 M?
    a. 2.62×10^{1} M
    b. **3.82×10^{-2} M**
    c. 1.53×10^{-2} M
    d. 3.40×10^{-2} M

34. Which of the following is the correct K_{sp} expression for when calcium hydroxide dissociates?
    a. $K_{sp} = [Ca^{2+}][OH^-]$
    b. **$K_{sp} = [Ca^{2+}][OH^-]^2$**
    c. $K_{sp} = [Ca^{2+}]^2[OH^-]$
    d. $K_{sp} = ([Ca^{2+}][OH^-]^2)/[Ca(OH)_2]$

35. If the solubility of calcium hydroxide is 8.0×10^{-4} g/100g H_2O, what is the solubility in mol/L?
    - **a. 1.08×10^{-4} mol/L**
    - b. 2.16×10^{-4} mol/L
    - c. 8.0×10^{-4} mol/L
    - d. 1.60×10^{-4} mol/L

36. Given the information from problems 34 and 35, what is the value of $K_{sp,}$?
    - a. $K_{sp} = 1.08 \times 10^{-12}$
    - b. $K_{sp} = 2.16 \times 10^{-12}$
    - **c. $K_{sp} = 5.04 \times 10^{-12}$**
    - d. $K_{sp} = 9.72 \times 10^{-12}$

37. Which of the following is true for redox reactions?
    - **a. Both mass and charge are conserved**
    - b. Neither mass nor charge are conserved
    - c. Only mass is conserved
    - d. Only charge is conserved

38. In the following reaction, which substance is oxidized?

    $HNO_{3(l)} + H_3(PO_3)_{(l)} \rightarrow H_3(PO_4)_{(l)} + NO_{(g)}$
    - a. Hydrogen
    - b. Oxygen
    - **c. Phosphorus**
    - d. Nitrogen

39. Which substance is reduced in the reaction for problem 38?
    - a. Hydrogen
    - b. Oxygen
    - c. Phosphorus
    - **d. Nitrogen**

40. How many water molecules must be added to balance the reduction half-reaction for problem 38?
    a. Zero
    b. One
    c. Two
    d. Four

41. How many electrons must be added to balance the charge of the oxidation half-reaction for problem 38?
    a. One
    b. Two
    c. Three
    d. Four

42. What is the coefficient for H_3PO_4 in the balanced redox reaction for problem 38?
    a. 1
    b. 2
    c. 3
    d. 4

43. An electrochemical cell is also known as this type of cell when it produces electrical energy:
    a. Hydrogen
    b. Redox
    c. Electrolytic
    d. Voltaic

44. The process in which metal is deposited on a surface by a nonspontaneous redox reaction is called:
    a. reversible
    b. electroplating
    c. a cathode
    d. an internal circuit

45. When a rechargeable battery is being recharged, the battery acts as a(n):
    a. electrochemical cell
    b. voltaic cell
    c. electrolytic cell
    d. brain cell

46. In a voltaic cell where the electrodes are Ni and Hg_2 metals, which is the anode?

Standard Reduction Potentials

Half reaction	E^o(V)
$Li^+ + e^- \rightarrow Li$	-3.05
$Ca^{2+} + 2e^- \rightarrow Ca$	-2.87
$Al^{3+} + 3e^- \rightarrow Al$	-1.66
$Mn^{2+} + 2e^- \rightarrow Mn$	-1.19
$Cr^{3+} + 3e^- \rightarrow Cr$	-0.74
$Fe^{2+} + 2e^- \rightarrow Fe$	-0.44
$Ni^{2+} + 2e^- \rightarrow Ni$	-0.25
$Sn^{2+} + 2e^- \rightarrow Sn$	-0.14
$Hg_2^{2+} + 2e^- \rightarrow Hg$	+0.79

a. **Ni**
b. Hg_2
c. Both
d. Neither

47. What process occurs at the mercury electrode in the cell for problem 46?
    a. Oxidation
    b. Reduction
    c. Electrolysis
    d. Electroplating

48. What is the E^0 cell for the cell in problem 46?
    a. -1.04 V
    b. -.60 V
    c. +1.04 V
    d. +.60 V

The following information may be useful as you complete the following mass defect problems:

Proton mass = 1.007276 amu Speed of light = 3.00×10^8 m/s $E= mc^2$

Electron mass = 0.0005486 amu 1 mol = 6.022×10^{23} atoms

Neutron mass = 1.008665 amu 1 amu = 1.6605×10^{-27} kg

49. What is the mass defect for fluorine-19 if the actual mass is 18.99840 amu?
    a. 0.1586714 amu
    b. 0.2437654 amu
    c. 0.2819026 amu
    d. 0.4546832 amu

50. What is the nuclear binding energy for problem 49 in J/atom?
    a. $1.473652981 \times 10^{-11}$ J/atom
    b. $1.876329173 \times 10^{-11}$ J/atom
    c. $2.141864939 \times 10^{-11}$ J/atom
    d. $2.371264737 \times 10^{-11}$ J/atom

51. What is the nuclear binding energy for problem 49 in J/mol?
    a. 1.21×10^{13} J/mol
    b. 1.43×10^{13} J/mol
    c. 1.82×10^{13} J/mol
    d. 2.15×10^{13} J/mol

52. What is the nuclear binding energy for problem 49 in J/nucleon?
    a. 1.25×10^{-12} J/nucleon
    b. 1.34×10^{-12} J/nucleon
    c. 1.76×10^{-12} J/nucleon
    d. 2.15×10^{-12} J/nucleon

53. What nuclide forms when carbon-12 undergoes positron emission?
    a. Carbon-11
    b. Boron-12
    c. Nitrogen-12
    d. Helium-4

54. What nuclide forms when caesium-129 undergoes alpha decay?
    a. Tantalum-131
    b. Lanthanum-133
    c. Antimony-127
    d. Iodine-125

55. What nuclide forms when titanium-210 undergoes electron capture?
    a. Titanium-211
    b. Vanadium-210
    c. Scandium-210
    d. Chromium-211

56. A 208 g sample of sodium-24 decays to 13g within 60 hours. What is the half-life of this isotope?
    a. 60 hours
    b. 30 hours
    c. 15 hours
    d. 7.5 hours

57. The half-life of chromium-48 is 21.6 hours. How much of a 360 g sample will remain after 108 hours?
    a. 11.25 g
    b. 22.5 g
    c. 45 g
    d. 90 g