

For 1 – 4:

- Anions
 - Cations
 - Element
 - Isotope
 - atom
- a positive ion
 - an atom of the same element that differs by the number of neutrons
 - cannot be broken down chemically
 - will migrate through the salt bridge to the anode half cell

For 5 – 7:

- calorimeter
 - Geiger counter
 - Burette
 - Funnel
 - Bunsen burner
- used to detect radioactivity
 - used to deliver acids and bases in a titration
 - can be lined with moist filter paper to catch insoluble solids

For 8 – 10:

- Arrhenius acid
- Arrhenius base
- Lewis acid

- Lewis base
- Bronsted-Lowry acid

- yields hydroxide ions as the only negative ions in solution
- electron pair acceptor
- proton donor

For 11 – 14:

- purple solution
 - brown-orange liquid
 - green gas
 - silver-gray liquid
 - yellow-orange when burned in a flame
- potassium permanganate
 - sodium salt
 - chlorine
 - mercury

For 15 – 17:

- E° is positive
 - ΔS is negative
 - ΔG is positive
 - K_{eq} is greater than 1
 - K_a is very large
- indicates a strong acid
 - a reaction is nonspontaneous

- less chaos, disorder, and randomness

For 18 – 21:

- alkali metals
 - alkaline earth metals
 - transition metals
 - halogens
 - noble or inert gases
- group 1
 - group 10
 - contains elements in the solid, liquid, and gas phase
 - will form chlorides with the formula MCl_2

For 22 – 25:

- 1+
 - 1-
 - 0
 - 2+
 - 3+
- oxidation number of O in H_2O_2
 - oxidation number of F in HF
 - oxidation number of O in O_3
 - oxidation number of calcium in calcium phosphate

Q	Statement I	Because	Statement II
26.	methane is defined as a compound	Because	Methane can be broken down chemically
27.	The burning of a piece of paper is a physical change	Because	Once burned, the chemical properties of the paper remain the same
28.	-273 degrees Celsius is also known as absolute zero	Because	$C = K + 273$
29.	The relationship between pressure and volume is considered to be an inverse relationship	Because	As pressure increases on a gas, the volume of the gas will decrease
30.	A liquid can boil at different temperatures	Because	The atmospheric (or surrounding) pressure can vary
31.	Bromine has an atomic mass of 79.9	Because	About 50% of all bromine atoms are ^{79}Br and the other 50% are ^{81}Br
32.	Excited tungsten atoms will give off light energy	Because	As the excited electrons return to their ground state, they emit energy in the form of light
33.	As you go from left to right across the Periodic Table, the elements tend to become more metallic in character	Because	As you go from left to right across the Periodic Table the elements tend to lose electrons
34.	The bonds found in a molecule of N_2 are nonpolar covalent	Because	There is an equal sharing of electrons between the nitrogen atoms
35.	The empirical formula of $C_6H_{12}O_6$ is CH_2O	Because	The empirical formula shows the lowest ratio of the elements present in the molecular formula
36.	A solution of NaCl will conduct electricity	Because	NaCl will not form ions in solution
37.	Increasing the concentration of reactants will cause a reaction to proceed faster	Because	More reactants lowers the activation energy of a reaction
38.	Cl^- is the conjugate base of HCl	Because	A conjugate base is formed once a Bronsted-Lowry acid accepts a proton
39.	$F_2 \rightarrow 2F^- + 2e^-$ is a correctly written half reaction	Because	This half reaction must demonstrate proper conservation of mass and charge
40.	Ethane is considered to be a saturated hydrocarbon	Because	Ethene has a triple bond

- Which of the following would not be attracted or deflected while traveling through an electric field?
 - Gamma ray
 - Beta particle
 - neutron
 - i only
 - ii only
 - i and ii only
 - i and iii only
 - i, ii, and iii

- Which substance below is resonance stabilized by delocalized pi electrons?
 - Benzene
 - Hydrochloric acid
 - Hydrogen gas
 - Methane
 - Potassium bromide

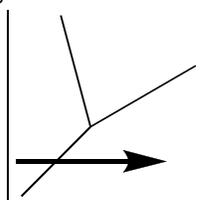
- Which of the following is true about a solution that has $[\text{OH}^-] = 1.0 \times 10^{-6} \text{ M}$?
 - The pH is 8 and the solution is acidic?
 - The $[\text{H}^+] = 1.0 \times 10^{-8} \text{ M}$ and the solution is basic
 - The pH is 6 and the solution is acidic
 - The $[\text{H}^+] = 1.0 \times 10^{-6} \text{ M}$ and the solution is basic
 - The $[\text{H}^+] = 1.0 \times 10^{-14} \text{ M}$ and the solution is neutral

44. What will be the products of the following double replacement reaction?
 $(\text{NH}_4)_3\text{PO}_4 + \text{Ba}(\text{NO}_3)_2 \rightarrow$
- Ammonium nitrate and barium nitrate
 - Barium nitrate and ammonium phosphate
 - Barium phosphate and sodium nitrate
 - Ammonium nitrate and barium phosphate
 - Ammonium nitrate and barium nitrate

45. Which K_a value is that of an acid that is the weakest electrolyte?
- 1.7×10^{-7}
 - 2.7×10^{-8}
 - 6.6×10^{-10}
 - 4.9×10^{-3}
 - 5.2×10^{-4}

46. A student performs a titration using 1.00 M NaOH to find the unknown molarity of a solution of HCl. The student records the data as shown below. What is the molarity of the solution of HCl?

Base: final buret reading	21.05 mL
Base: initial buret reading	6.05 mL
mL of base used	
Acid: final buret reading	44.15 mL
Acid: initial buret reading	14.15 mL
mL of acid used	

- 0.75 M
 - 0.50 M
 - 0.25 M
 - 0.10 M
 - 2.00 M
47. Which of the following is not a synthetic polymer?
- Polyvinyl chloride
 - Plastic
 - Polystyrene
 - Polyethylene
 - cellulose
48. Which process is represented by the arrow on the following phase diagram?
- 
- Evaporation
 - Deposition
 - Condensation
 - Freezing
 - sublimation
49. What is the molar mass of $\text{Ca}_3(\text{PO}_4)_2$?
- 310 g/mol
 - 154 g/mol
 - 67 g/mol
 - 83 g/mol
 - 115 g/mol

50. What is the percent composition of oxygen in $\text{C}_6\text{H}_{12}\text{O}_6$ (molar mass = 180)?
- 25%
 - 33%
 - 40%
 - 53%
 - 75%

51. The following reaction occurs at STP: $2\text{H}_2\text{O}(l) \rightarrow 2\text{H}_2(g) + \text{O}_2(g)$. How many liters of hydrogen gas can be produced by the breakdown of 72 grams of water?
- 5.6 liters
 - 11.2 liters
 - 22.4 liters
 - 44.8 liters
 - 89.6 liters

52. What is the mass-action expression for the following reaction at equilibrium? $2\text{W}(aq) + \text{X}(l) \rightleftharpoons 3\text{Y}(aq) + 2\text{Z}(s)$

$$\frac{[\text{Z}]^2[\text{Y}]^3}{[\text{W}]^2[\text{X}]}$$

$$\frac{[\text{W}]^2[\text{X}]}{[\text{Z}]^2[\text{Y}]^3}$$

$$\frac{[\text{Y}]^3}{[\text{W}]^2}$$

$$\frac{[\text{Z}][\text{Y}]}{[\text{W}][\text{X}]}$$

$$\frac{[\text{W}][\text{X}]}{[\text{Z}][\text{Y}]}$$

53. Which statement best describes the bonding found in formaldehyde, CH_2O ?
- The carbon atom is *sp* hybridized
 - There are three sigma bonds and one pi bond present
 - The bonding gives the molecule a tetrahedral shape
 - The bonds between the atoms are ionic bonds
 - All of the bonds are nonpolar bonds

54. What is the molarity of a solution that has 29.25 grams of NaCl dissolved to make 1.5 L of a solution?
- 19.5 M
 - 3.0 M
 - 1.75 M
 - 0.33 M
 - 1.0 M

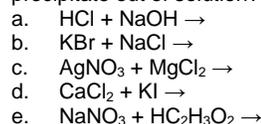
55. A sample of a gas at STP contains 3.01×10^{23} molecules and has a mass of 22.0 grams. This gas is most likely
- CO_2
 - O_2
 - N_2
 - CO
 - NO

56. What is the value of ΔH for the reaction $\text{X} + 2\text{Y} \rightarrow 2\text{Z}$?

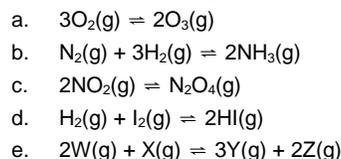


57. Which fraction would be used to find the new volume of a gas at 760 torr under its new pressure at 900 torr if the temperature is kept constant?
- 900 / 760
 - 1.18
 - 760 / 900
 - 658.7 / 798.7
 - 798.7 / 658.7

58. Which of the following aqueous reactions forms a salt that will precipitate out of solution?



59. Which system at equilibrium will not be influenced by a change in pressure?



60. The organic reaction: $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{HCl} + \text{C}_2\text{H}_5\text{Cl}$ is best described as

- a substitution reaction
- an addition reaction
- an esterification
- a dehydration synthesis
- a fermentation

61. Enough $\text{CaSO}_4(s)$ is dissolved in water at 298 K to produce a saturated solution. The concentration of Ca^{2+} ions is found to be 3.0×10^{-3} M. The K_{sp} value for CaSO_4 will be

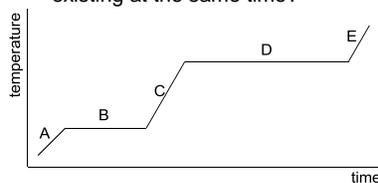
- 6.0×10^{-6}
- 9.0×10^{-6}
- 6.0×10^{-3}
- 9.0×10^{-3}
- 3.0×10^{-3}

62. Which of the following statements is not true about acid rain?

- Acid rain will erode marble statues
- Acid rain can change the pH of lakes and streams
- Acid rain can be formed from carbon dioxide
- Acid rain creates holes in the ozone layer
- Acid rain can be formed from the gases SO_2 and SO_3

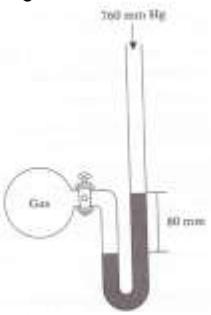
63. Which mole sample of the solids below is best for melting a 500-gram sheet of ice on a sidewalk?
- NaCl
 - CaCl₂
 - KBr
 - AgNO₃
 - NaC₂H₃O₂
64. Given this reaction that occurs in plants: $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$, if 54 grams of water are consumed by the plant, how many grams C₆H₁₂O₆ (molar mass = 180) can be made? Assume an unlimited supply of CO₂.
- 54 g
 - 180 g
 - 540 g
 - 3 g
 - 90 g
65. Which of the following will not be changed by the addition of a catalyst to a reaction at equilibrium?
- The point of equilibrium
 - The heat of reaction, ΔH
 - The potential energy of the products
- i only
 - ii only
 - i and ii only
 - ii and iii only
 - i, ii and iii
66. According to the reaction $\text{Pb}(s) + \text{S}(s) \rightarrow \text{PbS}(s)$, when 20.7 grams of lead are reacted with 6.4 grams of sulfur
- There will be an excess of 20.7 grams of lead
 - The sulfur will be in excess by 3.2 grams
 - The lead and sulfur will react completely without any excess reactants
 - The sulfur will be the limiting factor in the reaction
 - There will be an excess of 10.35 grams of lead
67. Which of the following statements is not part of the kinetic molecular theory?
- The average kinetic energy of gas molecules is proportional to temperature
 - Attractive and repulsive forces are present between gas molecules
 - Collisions between gas molecules are perfectly elastic
 - Gas molecules travel in a continuous, random motion
 - The volume that gas molecules occupy is minimal compared to the volume in which the gas is contained

68. A student is performing an experiment where a blue salt is being heated to dryness in order to determine the percent of water in the salt. Which pieces of laboratory equipment would be used to help determine this percentage?
- A crucible and cover
 - Tongs
 - A triple beam balance
- ii only
 - iii only
 - i and iii only
 - ii and iii only
 - i, ii and iii
69. Which of the following is considered to be a dangerous procedure in the laboratory setting?
- Pouring all liquids, especially acids and bases, over the sink
 - Wearing goggles
 - Pushing glass tubing, thermometers, or glass thistle tubes through a rubber cork
 - Pointing the mouth of a test tube that is being heated away from you and others
 - Knowing where the fire extinguisher and eyewash stations are located
70. Given a 4-gram sample of each H₂(g) and He(g), each in separate containers, which of the following statements is true? (Assume STP)
- The sample of hydrogen gas will occupy 44.8 liters and the sample of helium will contain 6.02×10^{23} molecules
 - The sample of hydrogen gas will occupy 22.4 liters and the sample of helium will contain 3.02×10^{23} molecules
 - The sample of hydrogen gas will occupy 44.8 liters and the sample of helium will contain 1.202×10^{24} molecules
 - The sample of helium will occupy 44.8 liters and the sample of hydrogen gas will contain 6.02×10^{23} molecules
 - None of the above statements is correct
71. The diagram shows a solid being heated from below its freezing point. Which line segment shows the gas and the liquid phases existing at the same time?



- A
- B
- C
- D
- E

72. Which of the following statements is/are correct regarding molecular geometries?
- CH₄ is trigonal pyramidal
 - BF₃ is trigonal planar
 - XeF₆ is tetrahedral
- i only
 - ii only
 - iii only
 - i and iii only
 - i, ii and iii
73. When Uranium-238 undergoes alpha decay and then one beta decay, the resulting isotope is
- Th-234
 - U-234
 - Pa-234
 - Th-230
 - Ra-226
74. Which compound is matched up with its correct name?
- CO—monocarbon monoxide
 - CaF₂—calcium difluoride
 - CCl₄—carbon tetrachloride
 - PCl₃—potassium trichloride
 - TiF₄—tin(IV) fluoride
75. Of the statements below, which best explains why CH₄ is a gas at STP, while C₈H₁₈ is a liquid and C₂₀H₄₂ is a solid?
- C₂₀H₄₂ has the greatest ionic interaction between its molecules
 - C₂₀H₄₂ has a greater amount of hydrogen bonding than CH₄ or C₈H₁₈
 - There is a more dipole-dipole interaction between molecules of greater mass
 - CH₄ has the greatest intermolecular forces while C₂₀H₄₂ has the least
 - There are more Van der Waals (dispersion) forces between nonpolar molecules that are greater in mass
76. Which of the gases listed below would not be collected via water displacement?
- CO₂
 - CH₄
 - O₂
 - NH₃
 - H₂
77. Which scientist and discovery are not correctly paired?
- Millikan / neutron
 - Rutherford / nucleus
 - Charles / relationship between temperature and pressure
 - Curie / radioactivity
 - Mendeleyev / periodic table

78. Which of the following situations demonstrate(s) an increase in entropy?
- Dissolving a salt into water
 - Sublimation
 - Heating up a liquid
 - i only
 - i and ii only
 - ii and iii only
 - i and iii only
 - i, ii, and iii
79. How many moles of a gas are present in a closed empty soda bottle that has a volume of 2.0 L at 22 °C and a pressure of 1.05 atm?
- $\frac{(0.0820 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})(22 \text{ }^\circ\text{C})}{(1.05 \text{ atm})(2.0 \text{ L})}$
 - $\frac{(0.0820 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})(295 \text{ K})}{(1.05 \text{ atm})(2.0 \text{ L})}$
 - $\frac{(0.0820 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})}{(1.05 \text{ atm})(2.0 \text{ L})}$
 - $\frac{(0.0820 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})(295 \text{ K})}{(0.0820 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})}$
 - $\frac{(0.0820 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})}{(1.05 \text{ atm})(2.0 \text{ L})(295 \text{ K})}$
80. Which set of conditions below guarantees that a reaction will be spontaneous?
- $\Delta H(+)$ and $\Delta S(-)$
 - $\Delta H(-)$ and $\Delta S(+)$
 - $\Delta H(+)$ and $\Delta S(+)$ at low temp
 - $\Delta H(-)$ and $\Delta S(-)$ at high temp
 - $\Delta G(+)$
81. How many moles of electrons are transferred in the following reaction? $\text{Ce}^{3+} + \text{Pb} \rightarrow \text{Ce} + \text{Pb}^{4+}$
- 14
 - 12
 - 7
 - 24
 - 3
82. A gas is confined in the manometer as shown below. The stopcock is then opened and the highest level of mercury inside the tube moved to a level that is 80 mm above its lowest level. What is the pressure of the gas?
- 
- 80 mmHg
 - 160 mmHg
 - 680 mmHg
 - 840 mmHg
 - The pressure cannot be determined
83. Which statement best describes the density and rate of effusion of the following gases? NO_2 C_2H_6 Kr Xe F_2
- Fluorine has the lowest density and the lowest rate of effusion
 - Xenon has the greatest rate of effusion and the lowest density
 - Krypton has the lowest density and the greatest rate of effusion
 - Ethane has the greatest rate of effusion and the lowest density
 - Nitrogen dioxide has the highest density and the greatest rate of effusion
84. Which indicator is correctly paired up with its proper color if it were added to a base?
- Litmus—blue
 - Phenolphthalein—pink
 - Methyl orange—yellow
 - i only
 - ii only
 - iii only
 - i and iii only
 - i, ii and iii
85. Which structure below demonstrates a violation of the octet rule?
- $\text{H}-\text{C}\equiv\text{C}-\text{H}$
 - $\begin{array}{c} \text{O} \\ || \\ \text{H}-\text{C}-\text{H} \end{array}$
 - $\begin{array}{c} \text{O} \\ || \\ \text{HO}-\text{S}-\text{OH} \\ | \\ \text{O} \end{array}$
 - $\begin{array}{c} \text{H}-\text{N}-\text{H} \\ | \\ \text{H} \end{array}$
 - $\begin{array}{c} \text{H}-\text{C}=\text{C}-\text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array}$

ANSWERS:

- | | | | | | | |
|-------|-------|----------|--------|-------|-------|-------|
| 1. B | 14. D | 26. TTCE | 39. FT | 52. C | 65. E | 78. E |
| 2. D | 15. E | 27. FF | 40. TF | 53. B | 66. B | 79. D |
| 3. C | 16. C | 28. TF | 41. D | 54. D | 67. B | 80. B |
| 4. A | 17. B | 29. TTCE | 42. A | 55. A | 68. E | 81. B |
| 5. B | 18. A | 30. TTCE | 43. B | 56. E | 69. C | 82. D |
| 6. C | 19. C | 31. TTCE | 44. D | 57. C | 70. A | 83. D |
| 7. D | 20. D | 32. TTCE | 45. C | 58. C | 71. D | 84. E |
| 8. B | 21. B | 33. FF | 46. B | 59. D | 72. B | 85. C |
| 9. C | 22. B | 34. TTCE | 47. E | 60. A | 73. C | |
| 10. E | 23. B | 35. TTCE | 48. E | 61. B | 74. C | |
| 11. A | 24. C | 36. TF | 49. A | 62. D | 75. E | |
| 12. E | 25. D | 37. TF | 50. D | 63. B | 76. D | |
| 13. C | | 38. TF | 51. E | 64. E | 77. A | |