# Review for Honors Chemistry Final Part I

## UNIT 1: Introduction

1. Identify Laboratory Equipment.
2. Indicate the correct usage of laboratory equipment.
    - (Includes reading said equipment)
3. Identify correct laboratory procedures.
    - (Includes safety rules and regulations)
4. Describe the evolution of chemistry
    - Role of Chinese, Greeks, Arabs, Bacon, Boyle "The Skeptical Chymist", Lavoisier "father of modern chemistry"
5. Define alchemy
6. Sequence, explain, and apply the scientific method. (7 steps)
7. Identify the control, constants, or variables in an experiment
8. Differentiate between the dependent and independent variables.
9. Graph the dependent and independent variable.
10. Define chemistry.
11. Define matter.
12. Differentiate between mass and weight
13. State and apply Lavoisier's Law of Conservation of Mass
14. State the 5 phases of matter.
15. Describe solids, liquids, and gases in terms of volume, shape, and relative movement of particles.
16. Differentiate between an observation and an inference.
17. Differentiate between quantitative and qualitative obervations.
18. Define the 6 base units of the SI system
19. Correctly use and convert among the prefixes
    - G, M, k, da, d, c, m, μ, n, p
20. Identify correct conversion factors.
21. Use the factor-label method for common conversions.
    - Complete squared and cubed conversions in addition to conversions between the English and SI systems.
    - 1 in = 2.54 cm
    - 2.20 lb = 1 kg
22. Differentiate between accuracy and precision.
23. Solve Percent error problems.

24. Identify common derived units (speed, volume, etc.)
    - $1\ dm^3 = 1\ L = 1000\ mL = 1000\ cm^3$
    - density of water = 1 g/mL
25. State the density formula and use it to solve for mass, volume, or density.
26. Determine the number of significant digits in a measurement.
27. Perform calculations (addition, subtraction, multiplication, and division) to the correct number of significant digits.
28. Express numbers in both standard and scientific notation.

# ***UNIT 2: Vocabulary***

29. Define and identify chemical properties.
30. Define and identify intensive and extensive properties.
31. Define and identify physical properties.
32. Define energy.
33. Define and explain the two major classifications of energy.
34. State the relationship between potential and kinetic energy.
35. State and explain the law of conservation of energy.
36. Define and identify physical changes.
37. Define and identify chemical changes.
38. Identify the 5 indicators of a chemical change.
39. Define and explain endothermic and exothermic reactions.
40. Define a phase.
41. Define an interface.
42. Classify matter as homogeneous or heterogeneous.
43. Define and classify matter as either a mixture or a pure substance.
44. Define and classify a pure substance as either an element or a compound.
45. Define and give examples of allotropes.
46. Define and classify matter as either organic or inorganic.
47. Define a homogeneous mixture.
48. Define and identify solute and solvent.
49. Define and give examples of solid, liquid, and gaseous mixtures.
50. Define and identify separation techniques in addition to when it is appropriate to use them.

# ***UNIT 3: Energy***

- 1 calorie = 4.184 J
- 1000 cal = l kcal = 1 Cal (dietary calorie)

51. Explain when the law of conservation of energy can be violated.
52. Explain how a thermometer operates.
53. Use the three main temperature scales, and convert among them.
54. Define and identify absolute zero.
55. Define temperature.
56. Define heat.
57. Explain how heat is transferred between objects of differing temperatures on the sub-microscopic level..
58. Define and explain how Lavoisier's calorimeter operates.
59. Define and explain specific heat.
    - 4.184 J/g°C or 1 cal/g°C for water.
60. Use q = mΔTC to solve for any of the variables in the equation.
61. Use Law of conservation of energy, a calorimeter, and q = mΔTC, to calculate calorimetry problems.
62. Identify and explain the limitations of a calorimeter.
63. Identify and explain the changes of state as matter transforms.
64. Explain changes in potential and kinetic energy as matter transforms.
65. Explain changes in temperature as matter transforms.
66. Define and explain melting (fusion), crystallization, vaporization, and condensation in terms of particles and absorbing or releasing energy.
67. Explain all changes of state as endo- or exothermic.
68. Identify all possible changes of state. (i.e. sublimation, etc.)
69. Compute changes in kinetic and potential energy as matter transforms.
70. Read and interpret heating/cooling curves of pure substances.
71. Construct heating/cooling curves based on data.

# ***UNITS 4 & 5: The Atom and Electron Configurations***

72. Describe the history of the atom from Leuccipos and Democritus
    - Define "atomos"
73. Aristotle
74. Alchemy
75. Boyle
76. Lavoisier
77. Proust and his law of definite proportions
78. Dalton and his atomic theory
    - Identify which postulates still hold true today
    - Dalton's law of multiple proportions
    - Describe and identify Dalton's model of the atom
79. Faraday
80. Goldstein
    - canal rays
    - discovered the proton using perforated cathode
81. Becquerel
82. Thomson
    - Describe the CRT experiment
    - Identify the cathode and anode
    - Thomson's model of the atom
83. Rutherford
    - gold foil experiment
    - Rutherford's model of the atom
    - Problem with Rutherford's model
84. Millikan's experiment
    - Oil drop experiment
    - determine the actual charge of the electron
85. Bohr's
    - Spectroscopy
    - model of the atom
    - Problem with Bohr's model
    - Explain how energy is related to electron transitions
    - Ground state versus excited state
    - Quantum leap
    - Light is a fingerprint of element
    - Lyman n = 1 (UV)
    - Balmer n =2 (Visible)
    - Paschen n = 3 (IR)
86. Define and identify fluorescence, phosphorescence, and iridescence
87. Chadwick's discovery of the neutron
88. Schrodinger's quantum mechanical and present day model

89. Define and apply Classical and Quantum Mechanics
    - When does classical physics fail????
90. Electromagnetic spectrum
    - Wavelength
        - Angstrom
    - Crest
    - Trough
    - Amplitude (related to brightness)
    - Node
    - Frequency
        - Hertz
    - Speed of light
    - $c = \lambda\nu$
    - $E = h\nu$
    - $E = hc/\lambda$
    - $m = h/\lambda v$
    - Relationship between frequency, wavelength, and energy
    - Radio waves, radar, microwave, IR, Visible, UV, X-Rays, Gamma rays
91. Max Planck's study of black body radiation
    - Quanta of energy
92. Einstein's photoelectric effect to support Planck
    - Threshold frequency
        - Effect of brightness below the threshold
        - Effects of increasing brightness above threshold
        - Effects of increasing frequency above threshold

93. Use equations to calculate electron transitions.
94. De Broglie's wave-particle duality
    - Why don't we see matter moving in waves???
    - Photons
95. Schrodinger's probability
    - Orbital
96. Heisenberg's Uncertainty principle
97. 4 quantum numbers
    - principal, Azimuthal, magnetic, spin and the characteristics they describe
    - s, p, d, f
    - shapes of orbitals
    - number of orbitals in each sublevel
    - possible values of spin
    - number of electrons in each, orbital, sublevel, and energy level
    - Aufbau Principle
    - Pauli Exclusion Principle

- Hund's Rule
- Degenerate orbitals

98. Write electron configurations (spectroscopic notation) for any element or ion in the ground or excited state
99. Draw orbital diagrams for any element or ion in the ground or excited state
100. Define and identify elements that are paramagnetic, diamagnetic, or ferromagnetic,
101. Deviations from Aufbau's principle (Cu and Cr)
102. Define and identify kernal of atom
103. Define and identify valence level
104. Write the noble gas shortcut for any atom or ion
105. Write the Lewis dot structures for ant atom

106. Define and identify atoms and ions
107. Define and identify isotopes (nuclides).
108. Define and identify atomic number.
109. Define the three nuclides of hydrogen.
110. Define and identify nucleons
111. Define and identify mass number.
112. Calculate number of neutrons from mass number and atomic number.
113. Utilize isotopic notation
114. Count total electrons for atoms and ions.
115. Define particles that contribute to the mass of the atom.
116. Define relative ratios of mass of subatomic particles.
117. Define location of subatomic particles
118. Define amu
119. Define average atomic mass
120. Compute average atomic mass from abundance data

## ***Unit 6: The Periodic Table***

121. Define and identify groups
122. Define and identify periods
123. Define and identify metals, nonmetal, and metalloids
124. Identify properties of metals, nonmetals, and metalloids
    - (i.e. luster, sectility, etc.)
125. Identify the families of elements
126. Identify the Lanthanide and Actinide series.
127. Use the Roman numerals and/or the modern system to identify groups.
128. Describe the first 4 elements
129. J.J. Berzelius
    - Created symbols of elements
130. Johann Dobereiner and law of triads
131. John Newlands and his law of octaves
132. Dmitri Mendeleev "father of periodic table" and his predictions
133. Meyer

134. Early Periodic Law and its problems
135. Henry Moseley and his solution
136. Modern Periodic Law

## ***Unit 7: Formulae and Nomenclature***

137. Define and identify molecular, empirical, and structural formulas
138. Define, identify, and write structural formulas in both expanded and condensed form
139. Define and identify binary and ternary compounds
140. Define and identify molecule and formula unit
141. Define and Identify the seven diatomic elements.
142. Define, identify, and use oxidation numbers.
143. Define and identify monatomic and polyatomic ions.
144. Define and identify oxyanions.
145. Define and identify polyatomic ions: *per- -ate, -ate, -ite- and hypo- -ite.*
146. Define and identify acid anions (bi-, hydrogen, dihydrogen)
147. Write formulas for and name ionic compounds using oxidation numbers.
148. Name metals with multiple oxidation numbers with roman numerals (stock method) or latin roots and suffixes (-ic and –ous)
149. Write formulas for and name covalent compounds using prefixes.
150. Write formulas for covalent compounds using roman numerals.
151. Write common names for $H_2O$, $CH_4$, and $NH_3$.
152. Write formulas for and name acids
153. Write formulas for and name hydrates.

219. Define and identify Gibbs free energy.
220. Calculate $\Delta G^\circ_{rxn}$ from data table.
221. Calculate $\Delta G^\circ_{rxn} = \Delta H^\circ - T\Delta S^\circ$
    - T must be in Kelvin
    - Watch units!!!!!
222. Identify reactions as spontaneous or nonspontaneous.
223. Relate enthalpy and entropy to spontaneity
    - Always, never, sometimes

## *Unit 12: Periodic Trends*

224. Define periodic trend.
225. Identify trend of metallic character.
226. Identify most reactive metal.
227. Define and identify radii of atoms and ions.
228. Define and identify radius trend in both groups and periods.
229. Identify causes of aforementioned trend.
230. Define and identify nuclear charge.
231. Define trend of ion size for both the metals and nonmetals.
232. Identify abnormalities in atomic radius trends.
233. Relate size of ions to size of parent atoms for both metals and nonmetals.
234. Define isoelectronic.
235. Relate sizes of isoelectronic species.
236. Predict oxidation numbers for any element and justify your answer.
237. Identify most stable (common) form of ions.
238. Define and identify ionization energy.
239. Define and identify I.E. trend in both groups and periods.
240. Identify causes of aforementioned trend.
241. Identify abnormities in I.E. trend.
242. Define and identify multiple I.E.
    i. Relate values to loss of electrons.
243. Define and identify electron affinity.
244. Define and identify E.A. trend in both groups and periods.
245. Identify causes of aforementioned trend.
246. Identify abnormalities in E.A. trend.
247. Define and identify Electronegativity.
248. Define and identify E.N. trend in both groups and periods.
249. Identify causes of aforementioned trend.
250. Identify abnormalities in E.N. trend.
251. Identify element with highest E.N.
252. Identify most reactive nonmetal.