Semester Final Review U1-U7

U1 *(pg. 14: 1-5, pg. 20: 1-5)*

pg. 14

1. a) The main difference between physical properties and chemical properties is that physical properties can be observed without altering the identity of the substance, whereas chemical properties require the identity to be changed.
   b) An example of a physical property could be color. Although change in color indicates a chemical change, the color of a substance can be observed without chemically changing the identity of the substance. On the other hand, reactivity is a chemical property because it requires a change in identity.
2. a) Physical, doesn't change identity
   b) Physical, doesn't change identity
   c) Changes identity when it burns.
3. Indefinite volume and indefinite shape: gas, definite volume but indefinite shape: liquid, definite volume and definite shape: solid.
4. Mixtures are blends of different types of matter. Pure substances must have a fixed composition.
5. Same, sucrose is always the same molecule.

pg. 20

1. Oxygen, Sulfur, Copper, Silver
2. Fe, N, Ca, Hg
3. Elements in a group are most likely to undergo the same kinds of reactions because they share properties that relate to their valence shell electrons.
4. Metals are lustrous, malleable, ductile, conductive, dense, and have high melting and boiling points (usually solids). Nonmetals are brittle, dull, less reactive, and are usually gaseous and have low melting points. Metalloids are lustrous, brittle, with moderate reactivity and melting/boiling points. Metalloids are usually solids.
5. It would usually be more unreactive because it wouldn't be in a bond. You can determine whether or not it's a metal from its position on the periodic table.

U2 *(pg. 29: 2-4, pg. 40: 3-6, pg. 55: 1-9)*

pg. 29

2. a. Qualitative
   b. Qualitative
   c. Quantitative
3. Hypotheses are testable statements, and theories are generalizations. Theories usually aren't created before hypotheses.
4. Models help explain hypotheses and theories.

pg. 40

3. a. 10.5g = 0.0105kg
   b. 1.57km = 1570m
   c. 3.54µg = 0.00000354g
   d. 3.5mol = 3500000µmol
   e. 1.2L = 1200mL
   f. 358cm^3 = 0.000358m^3
   g. 548.6mL = 548.6cm^3
4. a. 1000000cm^3 / 1m^3
   b. 2.54cm / 1in.
   c. 0.000001g / 1µg
   d. 1000000m / 1Mm
5. a. (d=m/v) -> 1.71g/mL
   b. 7.75g = 1.71g/mL * v, v = 4.53mL
6. No, the student is not performing this calculation. Their conversion factor checks out, but mg should be on the top in order to convert from g to mg.

pg. 55

1. Student A's results are more accurate because they are more evenly distributed around 8.94g/cm^3. Student B's results are more precise because they are closer together.
2. a. 4
   b. 2
   c. 6
   d. 1
   e. 4
3. 2.7

4. a. 52.13g + 1.7502g = 53.88g
   b. 12m * 6.41m = 77m
   c. 16.25g / 5.1442mL = 3.159 g/mL
5. a. 0.0154g + 0.286g = 0.301g = $3.01*10^{-1}$g
   b. 7 023 000 000g - 66 200 000g = 6 956 800 000g = $6.9568*10^{-9}$g
   c. $8.99*10^{-4}$m * $3.57*10^{4}$m = 32.1m = $3.21*10^{1}$m
   d. $2.17*10^{-3}$g / ($5.002*10^{4}$mL) = $0.4338*10^{-7}$g/mL = $4.338*10^{-8}$mL
6. a. $5.6*10^{5}$
   b. $3.34*10^{4}$
   c. $4.120*10^{-4}$
7. a. 215.6g - 110.4g = 105.2g
   b. 105.2g / 114mL = 0.923g/mL
8. (m=dv) -> 19.3g/cm^3 * $5.0*10^{-3}cm^3$ = 0.096g
9. Direct variation can be represented by the equation y=kx. Inverse variation can be represented by the equation k=xy.

U3 *(pg. 67: 1-2, pg. 72: 1-3, pg. 82: 1-3, pg. 83: 1-6)*

---

pg. 67

1. i. All matter is composed of extremely small particles called atoms.
   ii. Atoms of an element are identical, and atoms of different elements must differ.
   iii. Atoms cannot be divided, created, or destroyed.
   iv. Atoms combine in simple whole-number ratios.
   v. In chemical reactions, atoms are combined, subdivided, and rearranged.
2. iii explains the law of conservation of mass. ii and iv explain the law of definite proportions. iv and v explain the law of multiple proportions.

pg. 72

1. a. Smallest particle of an element that has the element’s properties
   b. Negatively charged subatomic particle in atoms
   c. Center of an atom, has protons and neutrons
   d. Positively charged subatomic particle in atoms
   e. Subatomic particle in an atom without a charge
2. a. Thomson discovered the electron through the cathode ray experiment and came up with the plum pudding model.

b. Millikan discovered the neutron through his oil drop experiment.
c. Rutherford discovered the proton through his gold foil experiment.
3. The protons and neutrons have a mass of 1 and make up the nucleus, the center of the atom. The electrons have an approximate mass of 0 and orbit the nucleus. Protons have a positive 1 charge, electrons have a negative 1 charge, and neutrons don’t have a charge.

pg. 82

1. 1.5010^12 atoms Pb * mol/(6.02210^23 atoms) = 2.49*10^-12 mol Pb
2. 2500 atoms Sn * mol/(6.02210^23 atoms) = 4.210^-23 mol Sn
3. 2.75 mol Al * (6.02210^23 atoms)/mol = 1.6610^24 atoms Al

pg. 83

1. a. Atomic number - number of protons
   b. Mass number - number of protons and neutrons
   c. Relative atomic mass - atomic mass relative to 1/12 the mass of carbon-12
   d. Average atomic mass - average atomic mass in nature
   e. Mole - as many particles as there are in 12g of carbon-12, aka avogadro’s number of particles
   f. Avogadro’s number - 6.022*10^23 - number of particles in one mole of a substance
   g. Molar mass - mass of a mole of a substance
   h. An atom with a different number of neutrons
2. a. Sodium-23 - p+: 11, n0: 12, e-: 11
   b. Calcium-40 - p+: 20, n0: 20, e-: 20
   c. 64_22Cu - p+: 22, n0: 42, e-: 22
   d. 108_47Ag - p+: 47, n0: 61, e-: 47
3. a. 28_14Si, silicon-28
   b. 56_26Fe, iron-56
4. 39.10u, 39.10g
5. a. 2.00 mol N * 14.0067g N / mol N = 28.0g N
   b. 3.0110^23 atoms Cl * 17g Cl / (6.02210^23 atoms Cl) = 8.50g Cl
6. a. 12.15g Mg * mol Mg / 24.305g Mg = 0.4999 mol Mg
   b. 1.5010^23 atoms F * mol/(6.02210^23 atoms) = 0.249 mol F

U4 *(pg. 97: 1-5, pg. 104: 1-3, pg. 116: 1-5)*

---

pg. 97

1. A major shortcoming of Rutherford's model was that it didn't explain the distribution of the electrons.
2. c=λv. c: speed of light, λ: wavelength, v: frequency.
3. a. Electromagnetic radiation is composed of waves of energy.
   b. Wavelength is the minimum length of the wave pattern that repeats itself.
   c. Frequency is wavelengths per second.
   d. A quantum of energy is the minimum amount of energy gained or lost by an atom.
   e. A particle of EMR that carries a quantum of energy.
4. Light acts both as a wave and as a particle. In the double slit experiment, light passes straight through one slit like particles would, but when passing through two slits, the particles interfere with each other and act like waves.
5. Bohr's model of the hydrogen atom has a nucleus in the center, and energy levels on the outside. When a photon is gained, the electron moves further away from the nucleus, and when the proton is lost, light is emitted and the photon falls back down.

pg. 104

1. a. Levels on the Bohr model
   b. Quantum numbers are properties of atoms that relate to their orbitals.
2. a. The four quantum numbers are
   n: Principal quantum number
   ℓ: Angular momentum quantum number
   m: Magnetic quantum number
   m_s: Spin quantum number
3. The principal quantum number indicates the main energy level occupied by the outermost electron.
   The angular momentum quantum number indicates the type of orbital.
   The magnetic quantum number indicates the orientation of the orbital.
   The spin quantum number (+1/2 or -1/2) indicates the spin of the electron.

pg. 116

1. a. An atom's electron configuration is how the electrons are organized.
   b. Aufbau principle, Pauli exclusion principle, Hund's rule.
2. Orbital notation, noble-gas notation, and electron configuration notation.
3. An octet of electrons is 8 electrons. Noble gases contain octets of electrons.
4. a. 1s2 2s2 2p2
   [He] 2s2 2p2

   1s: 1⇂, 2s: 1⇂, 2p: 1 1

   b. 1s2 2s2 2p6

   [He] 2s2 2p6

   1s: 1⇂, 2s: 1⇂, 2p: 1⇂ 1⇂ 1⇂

   c. 1s2 2s2 2p6 3s2 3s4

   [Ne] 3s2 3s4

   1s: 1⇂, 2s: 1⇂, 2p: 1⇂ 1⇂ 1⇂, 3s: 1⇂, 3p: 1⇂ 1 1

5. a. Phosphorus

   b. Potassium

   c. Silicon

   d. Selenium

U5 *(pg. 129: 1-2, pg. 141: 1-5, pg. 156: 1-3)*

pg. 129

1. a. Stanislao Cannizzaro

   b. Dmitri Mendeleev

   c. Henry Moseley

2. Physical and chemical properties are periodic **functions** of their atomic numbers.

pg. 141

1. s, p, d, and f blocks
2. a. Alkali metals

   b. Alkaline earth metals

   c. Transition metals

   d. Halogens

   e. Noble gases

3. The last group can determine the group number.
4. 3d10 4s2 4p3
5. Period 4

   D-block

   Group 9

pg. 156

1. a. Atomic radius decreases across a period and increases down a group. It decreases across a period because it gains protons while the electrons are on the same energy level, pulling the energy level closer. It increases down a group because the increase in the number of energy levels also increases the atomic radius (electrons repel).
   b. First ionization energy increases across a period and decreases down a group. Across a period, the strength of the pull on the farthest electron increases because the electrons are closer to the nucleus. Down a group, it decreases because the electrons are farther away from the nucleus, so they are pulled less.
   c. Electron affinity increases across a period and decreases down a group. Across a period, there is a greater change in energy when electrons are added because more electrons are being added to the same energy level (or new energy level). Down a group, it decreases because the outermost energy level is farther away from the nucleus, so it will be more insignificant.
   d. Ionic radius decreases across a period and increases down a group. It decreases across a period because it gains protons while the electrons are on the same energy level, pulling the energy levels closer. It increases across a group due to the **shielding effect**.
   e. Electronegativity increases across a period, decreases across a group, and is 0 for the noble gases. It increases across a period because as atoms are closer to getting a full octet, they can gain an electron more easily. Noble gases don't have any electronegativity because they already have full octets. Electronegativity decreases across a group because, as the radius increases, it becomes more difficult for the protons in the nucleus to pull the electrons.
2. a. They are more inconsistent.
   b. The reason they are more inconsistent is because they don't all form octets.
3. Group 1: 1, Group 2: 2, Groups 13-18: g-10

U6 *(pg. 167: 1-5, pg. 179: 1-4, pg. 197: 1-6)*

---

pg. 167

1. Covalent bonding is caused by the nuclei of multiple atoms pulling the same electron. Ionic bonding is caused by the difference in ionic charge after the electrons are taken to form an octet.
2. If the electronegativity difference is between 0 and 0.3, it is a nonpolar covalent bond. If it is between 0.3 and 1.7, it is a polar covalent bond. If the difference is greater than 1.7, then it is likely an ionic bond.
3. a. 4.0-1.0=3.0, ionic
   b. 2.5-1.9=0.6, polar covalent
   c. 2.8-2.5=0.3, nonpolar covalent

4. Br & I, Cu & S, Li & F.
5. a. Cu & Cl would have the greater ionic character because the electronegativity difference is greater.

   b. Chlorine has the greater negative charge in Cu & Cl because it is better at pulling electron(s) from copper.

pg. 179

1. a. Bond length is the average distance between two bonded atoms.

   b. Bond energy is the energy required to break a bond.
2. Chemical compounds will generally try to form an octet of electrons in its highest occupied energy level
3. a. 1

   b. 2

   c. 3
4.

```
a)  ..    ..
  : I   : Br :
    ..    ..

b)        ..
        : H   :

    ..    ..    ..
  : H   : C   : Br :
    ..    ..    ..
        : H   :
          ..

c)  ..                ..
  : H   : C::: C    : Cl :
    ..                ..

d)        ..
        : Cl :

    ..    ..    ..
  : Cl  : Si  : Cl :
    ..    ..    ..
        : Cl :
          ..

e)  ..    ..    ..
```

```
  : F  : O  : F  :
    ..   ..   ..
```

pg. 197

1. VSEPR theory
2.

```
a) Linear
     ..         ..
   : O :: S :: O  :
     ..         ..

b) Tetrahedral
           ..
         : I  :
     ..    ..   ..
   : I  : C  : I  :
     ..    ..   ..
         : I  :
           ..

c) Trigonal planar
           ..
         : Cl :
     ..    ..   ..
   : Cl : B  : Cl :
     ..         ..
```

3. Lone pairs and bonds on the central atom.
4. We didn't do hybridization.
5. Hydrogen bond forces are the strongest intermolecular forces and contribute to the high boiling point of water.
6. Boiling points can be used to test the strength of intermolecular forces. When something is boiling, the pulling forces between the molecules have been overcome.

U7 *(pg. 219: 2-4, pg. 223: 1, pg. 232: 1-6, pg. 237: 1-4)*

pg. 219

2. a. AlBr3
   b. Na2O
   c. MgI2
   d. PbO
   e. SnI2
   f. Fe2S3
   g. Cu(NO3)2
   h. (NH4)2SO4
3. a. Sodium iodide
   b. Magnesium sulfide
   c. Calcium oxide
   d. Potassium sulfide
   e. Copper(I) bromide
   f. Iron(II) chloride
4. a. NaOH
   b. Pb(NO3)2
   c. FeSO4
   d. P2O3
   e. CSe2
   f. HC2H3O2
   g. HClO3
   h. H2SO3

pg. 223

1. We did not do oxidation numbers.

pg. 232

1. formula mass: 2*(14.007u N)+8*(1.008u H)+(12.011u C)+3*(15.999u O) = 96.086u (NH4)2CO3
   molar mass: 96.086g (NH4)2CO3
2. 2 mol N
   8 mol H
   1 mol C
   3 mol O
3. formula mass: 2*(55.845u Fe)+3*(32.06u S)+12*(15.999u O) = 399.86u Fe2(SO4)3
   3.25mol Fe2(SO4)3 * 399.86u Fe2(SO4)3 = 1299.54g Fe2(SO4)3

4. formula mass: 9*(12.011u C)+8*(1.008u H)+4*(15.999u O) = 180.159u C9H8O4
   100.0mg C9H8O4 * 1g/1000mg / (180.159g/mol C9H8O4) * *6.02210^23 molecules/mol = 3.343*10^20 molecules aspirin
5. formula mass: 2*(14.007u N)+8*(1.008u H)+(12.011u C)+3*(15.999u O) = 96.086u (NH4)2CO3
   2*(14.007u N) / 96.086u (NH4)2CO3 = 29.155% N
   8*(1.008u H) / 96.086u (NH4)2CO3 = 8.392% H
   (12.011u C) / 96.086u (NH4)2CO3 = 12.500% C
   3*(15.999u O) / 96.086u (NH4)2CO3 = 49.952% O
6. CuSO4 formula mass: (63.55u Cu)+(32.06u S)+4*(16.00u O) = 159.61u CuSO4
   H2O formula mass: 2*(1.01u H)+(16.00u O) = 18.02u H2O
   n = (58.55 / 18.02) / (103.75u CuSO4 / 159.60u CuSO4) ~= 5
   5.0 moles H2O

pg. 237

1. 36.48% Na * mol/22.99g = 0.01587mol Na
   25.41% S * mol/32.06g = 0.007926mol S
   38.11% O * mol/16.00g = 0.02382mol O
   Na2SO3
2. 53.70% Fe * mol/55.845g = 0.009616mol Fe
   46.30% S * mol/32.06g = 0.01444mol S
   n ~= 1.5
   Fe2S3
3. 1.04g K / (39.098g K / mol K) = 0.0266mol K
   0.70g Cr / (51.996g Cr / mol Cr) = 0.013mol Cr
   0.86g O / (16.00g O / mol O) = 0.054mol O
   K2CrO4
4. 4.04g N * (mol N / 14.01g N) = 0.288mol N
   11.46g O * (mol O / 16.00g O) = 0.7162mol O
   N2O5
   empirical formula mass: *214.01g N + 5*16.00g O = 108.02g N2O5
   n = 108.0g/108.02g = 1
   N2O5