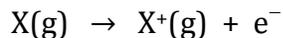October Problem Set

1. Potassium supplements often contain a mixture of potassium citrate, $K_3C_6H_5O_7$, and potassium aspartate, $KC_4H_6O_4N$. If a 100.0 mg tablet of the two compounds contains 35.2 % by mass potassium, how many milligrams of potassium citrate does it contain?

    a) 32.4 mg b) 45.6 mg   c) 50.0 mg   d) 68.0 mg   e) 80.3 mg

2. How many electrons in an atom can have the quantum numbers n = 4 and l = 0?

    a) 1   b) 2 c) 4 d) 8 e) 18

3. Combustion of a 0.200 g sample of a unknown gaseous compound yields 0.606 g CO_2 and 0.310 g H_2O. A 500.00 mL flask weighs 243.12 g when evacuated and 244.28 g when filled with the unknown gas to give a pressure of 0.980 atm at 298 K. What is the molecular formula of the unknown compound?

    a) C_2H_5 b) C_4H_{10} c) C_2H_5O d) C_2H_6O e) C_3H_2O

4. A student accidently prepared a 250.0 mL solution of NaCl with a concentration of 0.150 M, instead of 0.250 M. What volume of water would need to evaporate from the solution to give the desired concentration of 0.250 M?

    a) 0.0250 L   b) 0.0500 L   c) 0.07500 L d) 0.1000 L e) 0.1500 L

5. What is the energy of a mole of photons with wavelength of 656 nm?

    a) 3.03×10^{-19} kJ/mol   b) 3.03×10^{-22} kJ/mol   c) 182 kJ/mol d) 341 kJ/mol e) 2.11×10^{-19} kJ/mol

6. List in order of increasing number of unpaired electrons: S, B, P, Cr, Ar.

    a) Cr < B < P < S < Ar
    b) Ar < P < S <Cr < B
    c) Ar < Cr < S < B < P
    d) P < B < Cr < S < Ar
    e) Ar < B < S < P < Cr

7. The first ionization energy of an element is the energy required to remove one electron from a gaseous atom of that element, that is, it is the energy required for the reaction
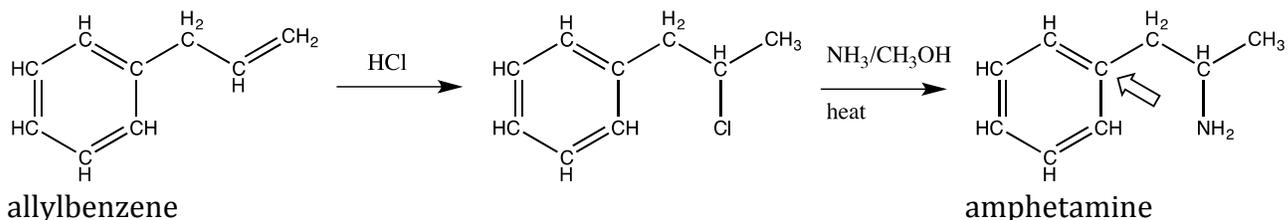
$$X(g) \rightarrow X^+(g) + e^-$$

where X stands for any element. Which of the following elements would you expect to have the lowest first ionization energy?

   a) Na   b) K   c) F   d) Mg   e) Ne

Questions 8 - 13 refer to the reaction and molecules below:

Amphetamine is a stimulant, increasing pulse rate and blood pressure and is an illegal street drug. One method of synthesis for amphetamine is shown in the reaction scheme below where the yield for the first step is 33% and the yield for the second step is 55%.

allylbenzene   amphetamine

8. How many carbon atoms are found in 1.50 g of amphetamine?

   a) 6.68 x 10^{21} atoms   b) 9.88 x 10^{21} atoms   c) 6.01 x 10^{22} atoms
   d) 9.82 x 10^{22} atoms   e) 3.25 x 10^{23} atoms

9. Given the yields of both steps in the reaction scheme , how much allylbenzene should be used to synthesize 1.50 g of amphetamine assuming excess hydrochloric acid and ammonia are present?

   a) 1.31 g   b) 1.50 g   c) 3.97 g   d) 7.22 g   e) 9.12 g

10. Which of the following statements is TRUE?

   a) Allylbenzene is more water-soluble than amphetamine.
   b) Allylbenzene is more soluble in water than in hexanes.
   c) The intramolecular forces between amphetamine molecules include hydrogen bonding and ion-dipole bonding.
   d) The intramolecular forces between allylbenzene molecules include hydrogen bonding and dispersion forces.
   e) None of the above statements are true.

11. Which of the following WHMIS symbols would be best to label hydrochloric acid?

a)   b)   c)   d)   e)

12. How many pi bond electrons are in amphetamine?

a) 0   b) 2   c) 3   d) 6   e) 4

13. What is the best way to describe the geometry about the carbon atom indicated with an arrow in amphetamine?

a) tetrahedral b) T-shaped c) V-shaped d) trigonal planar e) Y-shaped

14. Gas cylinder A has a volume of 10.0 L and contains $He(g)$ at 1.20 atm at 25 °C. Gas cylinder B has a volume of 8.0 L and contains $N_2(g)$ at an unknown pressure at 25 °C. The two cylinders are connected and the gases mixed and the pressure in both cylinders is measured to be 1.35 atm at 25 °C. What was the initial pressure in cylinder B?

a) 1.2 atm   b) 1.4 atm   c) 1.5 atm   d) 1.6 atm   e) 1.8 atm

15. Solutions with a concentration of 0.100 M are made of each of the following compounds. Which will have the lowest freezing point?

a) $MgCl_2$ b) $KClO_3$ c) CH_3CH_2OH d) $CaSO_4$ e) KBr

16. Which term best describes the molecular geometry of BF_3?

a) trigonal planar   b) T-shaped   c) linear   d) tetrahedral
e) trigonal pyramidal

17. When 17.28 mL of a 0.078 M aqueous solution of Na_2SO_4 is combined with 11.30 mL of a 0.20 M aqueous solution of NaCl and 7.84 mL of a 0.26 M aqueous solution of KCl, what is the total concentration of Na^+ in the combined solution?

a) 0.10 M   b) 0.14 M   c) 0.15 M
d) 0.17 M   e) 0.18 M

18. When 2.5 g of a metal chlorate completely decomposes in a 1.00 L evacuated container, the pressure of O_2 is 0.748 atm at 298 K. What is the identity of the metal? Assume the volume of MCl is neglible.

unbalanced reaction: $MClO_3(s) \rightarrow MCl(s) + O_2(g)$

a) Li   b) Na   c) K   d) Rb   e) Cs

19. A volume of 10.00 mL of ethanol, CH_3CH_2OH (density = 0.789 g/mL) is used to make a 100.00 mL aqueous solution with a density of 0.982 g/mL. What is the molarity of the solution?

a) 1.89 M   b) 1.71 M   c) 0.0330 M   d) 0.0931 M   e) 8.30 M

20. Which of the following substances has the highest boiling point?

a) $CH_3CH_2CH_2CH_2CH_2CH_3$ b) H_2 c) CH_4 d) Ne   e) O_2