Chemistry 141 Name

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Exam 2a retest April 15, 2009

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Percent

Formulas

|  |  |  |
| --- | --- | --- |
| Kinetic energy = ½ mv2  w = -PΔV  w=dxF  C = q/ΔT  E = mc2 | PV = nRT  Ptotal = P1+P2+P3+…  P1=X1\*Ptotal  Ptotal = P1 + P2 + P3 + …  u = (3RT/MW)½ | HΨ=EΨ  E = nhν  M1V1 = M2V2  Psoln = (Psolv)(Xsolv)  Rate ∝ (MW)-½ |



Constants

|  |  |
| --- | --- |
| h = 6.626 x 10-34 J sec  c= 2.9979 x 108 m/sec  NA = 6.022 x 1023/mol  1 kcal = 4.184 kJ  K = oC + 273.16 | mass electron = 9.109 x 10-31 kg  Standard Temperature and Pressure = 0oC and 1 atm  R = 0.0821 L atm/mol K= 8.314 J/K mol= 1.987 cal.mol K = 62.4 L torr/mol K  760 torr = 760 mm Hg =1.00 atm =101 kPa = 4.6 psi =30 in Hg |
| Specific heat Al 0.902 J/g K  Specific heat Cu 0.385 J/g K | Specific heat water = 4.184 J/g K  ΔHvaporization (H2O) = 2260 J/g |

1. (10 points) The specific heat of aluminum is 0.902 J/g oC. When a 65.0 g aluminum statue is heated to 450.0 oC and dropped into a 55.0 g of water at 38.5oC, all of the heat lost by the aluminum is gained by the water. If the heat of vaporization of water is 2260 J/g, how many grams of water will evaporate? (Assume the water is well mixed and the temperature of the water rises uniformly.)

q aluminum cooling to 100oC = q water warming to 100oC + q water evaporating

2.8 g of water will evaporate!

1. (10 points) Enormous numbers of microwave photons are needed to warm macroscopic samples of matter. A portion of soup containing 225 g of water is heated in a microwave oven from 20.0oC to 98oC, with radiation of wavelength 1.35 x 10-2 m. How many photons are absorbed by the water in the soup?

heat required to heat soup to 98o

1. (10 points) Calculate ΔHrxn for 2 NOCl(g) 🡪 N2(g) + O2(g) + Cl2(g) using the reactions below:

½ N2(g) + ½ O2(g) 🡪 NO(g) ΔHrxn = +90.3 kJ

NO(g) + ½ Cl2(g) 🡪 NOCl(g) ΔHrxn = −38.6 kJ

2 [ NOCl(g) 🡪 NO(g) + ½ Cl2(g) ] Hrxn = 2(+38.6 kJ)= +77.2 kJ

2 [NO(g) 🡪 ½ N2(g) + ½ O2(g) ] Hrxn = 2 (−90.3 kJ) = −180.6 kJ

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2 NOCl(g) 🡪 N2(g) + O2(g) + Cl2(g) Hrxn = −103.4 kJ

1. (20 points) The ionization energy of krypton is 1351 kJ/mol.
   1. What is the energy required to eject one electron from an atom of krypton?
   2. What is the frequency of light required to just eject an electron from an atom of krypton?
   3. What is the wavelength of this light?
   4. What frequency of light would be required to eject an electron with a kinetic energy of 6.8 x 10-19 J?

energy of light

= ionization energy + kinetic energy

= 2.243 x 10-18J + 6.8 x 10-19 J = 2.92 x 10-18 J

1. (10 points) It took 6.52 minutes for 1.0 L of helium to effuse through a porous barrier. How long will it take for 1.0 L of N2 gas to effuse under identical conditions?

X = 17.3 min

2.46 min if upside down ½ credit

1. (10 points) Use the following equation and heats of formation to calculate the ΔHfo for heat of formation of ZnS(s)

2 ZnS(s) + 3 O2(g) 🡪 2 ZnO(s) + 2 SO2(g) ΔH = -878.2 kJ

|  |  |
| --- | --- |
| substance | ΔHfo (kJ/mol) |
| ZnO(s) | -348.3 |
| SO2(g) | -296.8 |
| SO3(g) | -395.7 |

1. (20 points) A sample of an unknown metal was reacted with 175.0 g of hydrochloric acid in a calorimeter.
   1. If a 1.342 g sample of the metal caused the temperature of the calorimeter and its contents to rise from 22.4oC to 81.2oC, calculate the heat of reaction per g for the metal. (The acid solution has a specific heat of 4.168 J/g K, and the calorimeter has a heat capacity of 46.3 J/K.)
   2. The hydrogen gas from the experiment above was collected in a 452 mL at 35.0oC and 731 torr pressure, how many moles of hydrogen were collected?
   3. What is the molar mass of the metal? (Previous experiments have shown the metal to form a chloride of the formula MCl3.)

M + 3 HCl 🡪 MCl3 + 3/2 H2

* 1. Calculate the molar heat of reaction of the metal.