University of Louisville **Chem 201 Exam 3** name Key **Dr. Hoyt** **Fall 2013**

Scored grade (instructor use only!) 77 (oops)

1. The following equation is balanced:

$2\ Ag_2O\ (s) \rightarrow 4\ Ag\ (s) + O_2\ (g) \qquad \Delta H^\circ = 62.10\ kJ$

a. [2 pts] What is the correct systematic name of Ag_2O? silver oxide

b. [2] Is the reaction above exothermic or endothermic? endothermic (ΔH is positive)

c. [2] Which element is reduced in the reaction above? Ag ($Ag^+ \rightarrow Ag^\circ$)

d. [3] What is the ΔH° value for the reaction below? other version: $4Ag_{(s)} + O_{2(g)} \rightarrow 2Ag_2O \quad \Delta H = -62$ (reverse of above)

(double of above rxn)

$4\ Ag_2O\ (s) \rightarrow 8\ Ag\ (s) + 2\ O_2\ (g) \qquad \Delta H^\circ = +124.20$ kJ

e. [10] In the box below, write the formation equation (the reaction corresponding to the ΔH^0_f) for Ag_2O (*s*), and give the value of the ΔH^0_f. For full credit, include appropriate phase labels on all species.

reverse and ½ of rxn provided above?

$2\ Ag_{(s)} + \frac{1}{2} O_{2(g)} \rightarrow Ag_2O_{(s)}$

$\Delta H_f^\circ = -31.05$ kJ

8 2

2. [2 each] Three identical 5-L flasks each contain a sample of gas (He, Ne or Ar) at 273 K and 1 atm. For each of the following quantities or values, circle the best choice.

a. greatest density:	He	Ne	(Ar)	all same
b. greatest average kinetic energy:	He	Ne	Ar	(all same)
c. greatest rate of effusion through a valve:	(He)	Ne	Ar	all same
d. greatest average speed of atoms:	(He)	Ne	Ar	all same
e. greatest number of atoms:	He	Ne	Ar	(all same)

3. [6] **41.0 mL of a solution of 0.237 M $Pb(NO_3)_2$ are added to 60.0 mL of a solution of 0.250 M NH_4Cl. How many grams of precipitate can be produced? **SHOW YOUR WORK** in the area below and write your answer in the space provided. (Molar mass of $PbCl_2$ = 278.1, NH_4NO_3 = 80.05)

41.0 mL = 0.0410 L; 60.0 mL = 0.0600 L

$Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow PbCl_{2(s)}$

$0.0410\ L \times \frac{0.237\ mol\ Pb^{2+}}{L} \times \frac{1\ mol\ PbCl_2}{1\ mol\ Pb^{2+}} \times \frac{278.1\ g\ PbCl_2}{mol} = 2.70\ g\ PbCl_2$

$0.0600\ L \times \frac{0.250\ mol\ Cl^-}{L} \times \frac{1\ mol\ PbCl_2}{2\ mol\ Cl^-} \times \frac{278.1\ g\ PbCl_2}{mol} = 2.09\ g\ PbCl_2$ ← Cl^- is limiting

2.09 grams

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4. [6] **A 15.4 L container holds a gas at 38 °C and 2.19 atm. The gas is transferred to a new container of 25.6 L and the new temperature is 87 °C. What is the new pressure (in atm) of the gas? **SHOW YOUR WORK** in the area below and write your answer, rounded appropriately, in the space provided.

1.52 atm

V_1, $311\,K = T_1$, P_1, V_2, $360\,K = T_2$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow P_2 = \frac{P_1V_1T_2}{T_1V_2} = \frac{(2.19\,atm)(15.4\,L)(360\,K)}{(311\,K)(25.6\,L)} = 1.52\,atm$$

(3 sig figs)

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5. [4] **What is the energy (in J) of the n = 2 level of O^{7+}? SHOW YOUR WORK in the area below and write your answer in the space provided.

O^{7+}: 8 p+, 1 e−

-3.49×10^{-17} J

$$E = -2.18\times10^{-18}\,J\left(\frac{8^2}{2^2}\right) = (-2.18\times10^{-18}\,J)(16) = -3.488\times10^{-17} \rightarrow 3\text{ sig figs}$$

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6. [2 each] **Clearly** assign each statement as TRUE or FALSE. If we can't tell which you mean, it's wrong.

True! We are being bombarded with electromagnetic radiation right now, from the lights in this room.

False A photon of red light has a ~~greater~~ smaller frequency than a photon of blue light. greater λ, smaller ν

False Humans can see ~~most~~ very little of the electromagnetic spectrum.

False Electrons in atoms can orbit at any distance and can have any energy. Energy levels are quantized

False The equation to the right can be used to calculate the energy of any electron in an atom. only single-e⁻ species

$$E = -2.18\times10^{-18}\,J\left(\frac{Z^2}{n^2}\right)$$

32 True When an electron in an atom relaxes from n=3 to n=2, a photon is emitted.

False If the temperature of a gas sample rises from 20°C to 40°C, the average kinetic energy of the molecules is ~~doubled~~. only increases by about 7% ↳293K ↳313K

False At a given temperature, all the molecules in a sample of gas have the same kinetic energy. molecules have a range of speeds and kinetic energy values

False All diatomic elements are gases under standard conditions. $I_{2(s)}$, $Br_{2(\ell)}$ (or (s))

False At the same pressure, temperature and volume, all ideal gas samples have the same average molecular velocity. same T, same KE, but the speeds of molecules depend on mass

False Gases behave most ideally at ~~high~~ low pressures and high temperatures.

False At STP, one mole of ~~any substance~~ will occupy a volume of 22.4 L. only works for gases behaving ideally

True Breaking bonds is always an endothermic process.

False Combustion of any substance will yield CO_2 and H_2O as products. only if C & H in reactants

True For an element in its stable state, $\Delta H_f^\circ = 0$ and oxidation number = 0.

False When the temperature of a sample of gas increases, its density decreases. D↓ if V↑, but if V is constant, D is constant.

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