

CHM 1311

Supplemental Exam

Feb 18- 2009

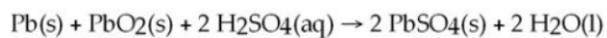
(Prof. Sandro Gambarotta)

Your Name: \_\_\_\_\_ Student #: \_\_\_\_\_

time: 3hours

1. You **MUST DELIVER** the entire booklet (you can take home the scratch paper). The solution key will be posted today on the web.
2. You must respond to all the exercises.
3. Blank pages are at the end.
4. You can keep **ONLY** your textbook but no notes of any kind.
5. No computers are allowed.
6. In order to get partial marks for wrong answers we will need to see your calculations. Summarize them **BRIEFLY** in the space below the text of the exercise

- 1) The chemical reaction occurring during the discharge of a lead storage battery can be represented by the equation:



What mass of lead sulfate would result from the complete reaction of 41.4 g of lead?

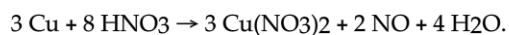
- 2) Given the reaction:



How many moles of  $\text{H}_2\text{SO}_4$  are required to produce 2.0 moles of  $\text{I}_2$ , given the other reactants are in excess?

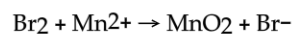
- 3) To measure the volume of an irregularly shaped container filled with water, 1.00 mL of 2.00 M potassium chloride solution is added. After stirring, a 5.00 mL sample was found to contain  $2.54 \times 10^{-2}$  mg of potassium ion. What is the volume of the container?

4) 42.6 g Cu are combined with 84.0 g of HNO<sub>3</sub> according to the reaction:



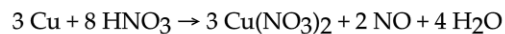
Which reagent is limiting and how many grams of Cu(NO<sub>3</sub>)<sub>2</sub> are produced?

5) Balance the following equation in basic solution and give the sum of the coefficients:



6) What volume of 0.110 M H<sub>2</sub>SO<sub>4</sub> is required to exactly neutralize 10.0 mL of 0.085 M NaOH?

7) A 0.411 g sample of powdered copper mixed with an inert, soluble additive was fully consumed by 23.4 mL of 0.602 M nitric acid, producing copper(II) nitrate, water and nitric oxide (NO) gas. What was the percent copper (by mass) in the sample?



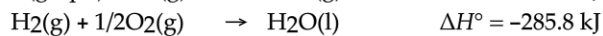
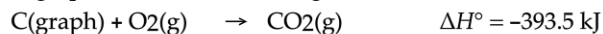
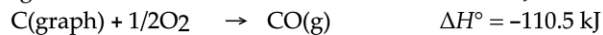
8) A 5.00 L container of unknown gas at 25.0 °C has a pressure of 2.45 atm. The mass of the gas is 32.1 g. What gas is in the container?



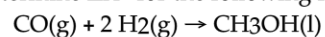
9) A 1.37 L vessel contains He at a temperature of 24.5 °C and a pressure of 205 mmHg. A 721 mL vessel contains Ne at a temperature of 36.2 °C and a pressure of 0.185 atm. Both of these gases are placed in a 2.00 L vessel at 302 K. What is the final pressure (in atm) in the 2.00 L vessel?

10) How much work, in joules, is done when the pressure is suddenly released from 4.56 atm to 1.25 atm on 45.4 g of O<sub>2</sub> at 45 °C?

11) Using the heat of combustion of methanol as -726.6 kJ and the following data:



Determine  $\Delta H^\circ$  for the following reaction:



- 12) Calculate  $\Delta H^\circ_f$  of octane,  $C_8H_{18}(l)$ , given the enthalpy of combustion of octane to  $CO_2(g)$  and  $H_2O(l)$ ,  $-5471$  kJ/mol, and the standard enthalpies of formation of  $CO_2(g)$  and  $H_2O(l)$ ,  $-393.5$  kJ/mol and  $-285.8$  kJ/mol, respectively.
- 13) What is the wavelength of a bullet that is 0.450 g traveling at 2000. m/s?
- 14) What is the orbital designation for the quantum numbers  $n = 2, l = 1$ ?
- 15) Which one of the following set of quantum numbers would not be allowed?
- A)  $n = 3, l = 2, m_l = -1$
  - B)  $n = 3, l = 2, m_l = 1$
  - C)  $n = 3, l = 1, m_l = -1$
  - D)  $n = 3, l = 0, m_l = 0$
  - E)  $n = 3, l = 3, m_l = 1$
- 16) Choose the groups of molecules below in which all the molecules have a net dipole moment.
- A)  $SiHCl_3, O_2, H_2O$
  - B)  $HF, H_2O, N_2$
  - C)  $CCl_4, HCl, NH_3$
  - D)  $HF, H_2C=CH_2, H_2O$
  - E)  $HF, CH_3Cl, H_2O$

- 17) Draw the Lewis dot formulae for CO, NO and CH<sub>2</sub>PH<sub>3</sub>
- 18) According to principles of VSEPR theory specify the electron pair geometry and hybridization for the species AsCl<sub>5</sub><sup>2-</sup>
- 19) For BeCl<sub>2</sub>, the dipole moment of the molecule, hybridization on the central atom, and number of lone pairs on the central atom are:
- A) away from Be, *sp*<sup>2</sup>, one
  - B) toward Be, *sp*, one
  - C) toward Be, *sp*<sup>2</sup>, none
  - D) none, *sp*<sup>3</sup>, two
  - E) none, *sp*, none
- 20) Choose the *INCORRECT* statement about NH<sub>4</sub><sup>+</sup>.
- A) The hybridization of N is *sp*<sup>3</sup>.
  - B) There are two  $\sigma$  bonds.
  - C) There is one lone pair of electrons on N.
  - D) There are no  $\pi$  bonds.
  - E) The molecule is tetrahedral.
- 21) According to the molecular orbital (M.O.) theory, when two oxygen atoms bond together, their 2*p* orbitals combine to form:
- A) two sigma M.O.'s and two pi M.O.'s
  - B) four pi M.O.'s only
  - C) one sigma and one pi M.O.
  - D) two sigma M.O.'s and four pi M.O.'s
  - E) none of these

22) The octahedral hybrid configuration is composed of which orbital combination?

- A)  $sp^3d^2$       B)  $spd^2$       C)  $sp^2d^3$       D)  $sp^3d$       E)  $sp^3$

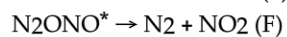
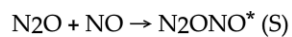
23) For the reaction:  $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$  the rate law is:

$$\frac{\Delta[O_2]}{\Delta t} = k[N_2O_5]$$

At 300 K, the half-life is  $2.50 \times 10^4$  seconds and the activation energy is 103.3 kJ/mol  $O_2$ . At the time when  $N_2O_5$  is being consumed at a rate of  $1.2 \times 10^{-4}$  M/s, what is the rate at which  $NO_2$  is being formed?

24) The reaction  $A + B \rightarrow C + D$  is second order in A and zero order in B. The value of  $k$  is  $0.012 \text{ M}^{-1} \text{ min}^{-1}$ . What is the rate of this reaction when  $[A] = 0.125 \text{ M}$  and  $[B] = 0.435 \text{ M}$ ?

25) What is the rate law for the following mechanism?



- A) Rate =  $k[\text{N}_2\text{O}][\text{NO}]$
- B) Rate =  $k[\text{N}_2][\text{NO}_2]$
- C) Rate =  $k[\text{N}_2\text{ONO}]$
- D) Rate =  $k[\text{NO}]$
- E) Rate =  $k[\text{N}_2\text{O}]$

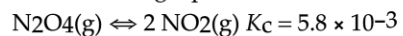
26) For the reaction:  $2\text{NO}_2(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$  concentration - time data are:

t(s)	[NO <sub>2</sub> ]	log[NO <sub>2</sub> ]	$\frac{1}{[\text{NO}_2]}$
0.00	2.000	.300	.500
0.40	1.467	.166	.682
0.80	1.076	.032	.929
1.20	.789	-.103	1.267
1.60	.579	-.237	1.727
2.00	.424	-.373	2.358

What is the order of the reaction with respect to [NO<sub>2</sub>]?

- A) zero
- B) first
- C) third
- D) second
- E) none of these

27) Consider the following equation:



If the initial concentration of  $\text{N}_2\text{O}_4(\text{g}) = 0.040 \text{ M}$  and the initial concentration of  $\text{NO}_2(\text{g})$  is  $0 \text{ M}$ , what is the equilibrium concentration of  $\text{N}_2\text{O}_4(\text{g})$ ?

- A)  $1.9 \times 10^{-2} \text{ M}$
- B)  $3.3 \times 10^{-2} \text{ M}$
- C)  $2.6 \times 10^{-2} \text{ M}$
- D)  $2.3 \times 10^{-6} \text{ M}$
- E)  $1.7 \times 10^{-2} \text{ M}$

28)  $0.272 \text{ g}$  of a monoprotic solid acid ( $\text{mw} = 189 \text{ g/mol}$ ) is dissolved in water to produce  $25.0 \text{ mL}$  of a solution with  $\text{pH} = 4.93$ . Determine the ionization constant of the acid.

- A)  $4.1 \times 10^{-8}$
- B)  $2.4 \times 10^{-9}$
- C)  $2.8 \times 10^{-7}$
- D)  $1.4 \times 10^{-10}$
- E)  $2.1 \times 10^{-4}$

29) What is the pH of a  $0.253 \text{ M}$  solution of ammonium chloride?  $K_b = 1.2 \times 10^{-5}$

- A) 2.7
- B) 11.3
- C) 9.1
- D) 4.9
- E) 9.9