

Chemistry 100
Homework Problem Set # 5
Due Wednesday, October 8

1. These bases dissolve in water. Write a chemical equation that shows the release of hydroxide ions as each dissolves.

(a) KOH

(b) Ba(OH)₂

(c) NH₂CH₃

2. Write a neutralization reaction for the reaction of KOH with HBr.

3. Write a neutralization reaction for the reaction of KOH with H₃PO₄, an acid with three acidic protons.

4. Fill in the following table. Each row corresponds to a different solution.

pH	[H ₃ O ⁺]	[OH ⁻]	acidic or basic?	more H ₃ O ⁺ or OH ⁻ ?
7.6				
	1×10^{-6}			
		1×10^{-5}		

5. What are the chemical components of:

(a) the atmosphere

(b) industrial smog

(c) photochemical smog

(d) acid rain

6. Identify the primary sources of the following pollutants:

(a) Carbon monoxide

(b) Nitrogen oxides

(c) Sulfur oxides

(d) Tropospheric ozone

7. Explain why rain is naturally acidic, but not all rain is classified as "acid rain."

8. What are the necessary ingredients for the formation of photochemical smog?

9. Assume that coal can be represented by the formula $C_{135}H_{96}O_9NS$.

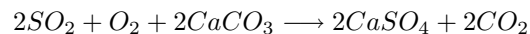
(a) What is the percent of nitrogen by mass in coal?

(b) What is the percent of sulfur by mass in coal?

(c) If 1 ton of coal was burned completely, what mass of nitrogen in NO would be produced? Assume that all of the nitrogen in the coal is converted to NO.

- (d) In 2007, the United States burned about 1.05 billion tons of coal for electric power production.¹ Using the % sulfur by mass you calculated in (b), calculate the tons of sulfur dioxide that were emitted assuming all the sulfur was converted to SO₂.

10. Calculate the mass of CaCO₃ (in tons) necessary to react completely with 1.00 ton of SO₂ according to the reaction shown below.



11. The following are the six criteria air pollutants regulated by the EPA:

- CO, carbon monoxide
- O₃, ozone
- NO_x (NO and NO₂), nitrogen oxides
- SO₂ sulfur dioxide
- lead
- particulates

Choose two of these and describe the harmful properties of each.

¹Source: *U.S. Coal Supply and Demand: 2007 Review*, U.S. Department of Energy, Energy Information Administration. Available online: <http://www.eia.doe.gov/cneaf/coal/page/special/feature.html> (accessed September 30, 2008)

12. Write out the full electron configurations of atoms of the following elements: *example: Si: $1s^2 2s^2 2p^6 3s^2 3p^2$*

(a) Ca

(b) Ar

(c) N

(d) Rb

(e) Ti

(f) Se

(g) Mg

(h) Al

13. Write out the electron configurations of atoms of the following elements using the noble gas notation:

example: Si: $[Ne]3s^2 3p^2$

(a) Ca

(d) Se

(b) Rb

(e) Mg

(c) Ti

(f) Al

14. Indicate the number of:

(a) subshells in energy shell 3

(b) maximum electrons in energy shell 3

(c) maximum electrons in the 2p subshell

(d) maximum electrons in the 3d subshell

(e) maximum electrons in one 3p orbital

(f) orbitals in the 5p subshell

(g) orbitals in the 3s subshell