

Name: _____

June 10, 2014

Chemical Principles I

Exam 2

Some useful information: $K = (^{\circ}\text{C} + 273.15^{\circ}\text{C})\left(\frac{1\text{K}}{1^{\circ}\text{C}}\right)$ $N_{\text{A}} = 6.022 \times 10^{23}$ $PV = nRT$

$R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}$ 1 mm of Hg = 1 torr 1 atm = 760 torr $q = ms\Delta t$ $1\text{J} = 1\text{kg}\cdot\frac{\text{m}^2}{\text{s}^2}$

$\chi_a = \frac{n_a}{n_a + n_b + \dots}$ $P_a = \chi_a P_{\text{total}}$ $M = \frac{dRT}{P}$ $w = -P\Delta V$ $1\text{L}\cdot\text{atm} = 101.325\text{J}$ (exactly)

1. The *distinguishing* characteristic of all electrolyte solutions is that they (2 pt)

- E
- A) contain molecules. B) always contain acids. C) conduct heat.
D) react with other solutions. **E) conduct electricity.**

2. A strong electrolyte is one that _____ completely in solution. (2 pt)

- B
- A) decomposes **B) ionizes** C) disappears D) reacts

3. A weak electrolyte exists predominantly as _____ in solution. (2 pt)

- D
- A) ions B) electrons C) atoms **D) molecules** E) an isotope

4. Identify the following as strong electrolytes (strong), weak electrolytes (weak), or nonelectrolytes (non). (10 pt)

methanol, CH ₃ OH	strong	weak	non
NaBr	strong	weak	non
HF	strong	weak	non
HNO ₃	strong	weak	non
KOH	strong	weak	non

5. A neutralization reaction between an acid and a metal hydroxide produces _____ (2 pt)

- D
- A) sodium hydroxide B) hydrogen gas C) oxygen gas
D) water and a salt E) ammonia

6. Identify the following as strong acids, weak acids, strong bases, or weak bases. (8 pt)

NH ₃	strong acid	weak acid	strong base	<u>weak base</u>
HCl	<u>strong acid</u>	weak acid	strong base	weak base
HNO ₂	strong acid	<u>weak acid</u>	strong base	weak base
LiOH	strong acid	weak acid	<u>strong base</u>	weak base

7. List the formula of any polyprotic acid. (2 pt)



8. What is the molarity of a solution prepared by dissolving 457 grams of sodium nitrate,

85g mol ← NaNO₃, in water to make a total of 2.00 liters of aqueous solution? (5 pt)

- a) 2.69 M b) 9.30 × 10⁻² M c) 1.08 × 10² M d) 2.69 × 10⁻³ M

e) 5.38 M

$$457 \text{ g NaNO}_3 \times \frac{1 \text{ mol NaNO}_3}{85 \text{ g}} / 2.00 \text{ L} = 2.69 \text{ M}$$

9. How many milliliters of a 0.100 molar sulfuric acid, H₂SO₄, solution is needed to make 25.0 milliliters of a 5.00 × 10⁻³ molar solution? (5 pt)

- a) 1.25 mL b) 800 mL c) 8.00 mL d) 125 mL e) 0.125 mL

$$V_i = \frac{M_f V_f}{M_i} = \frac{(25.00 \text{ mL})(5.00 \times 10^{-3} \text{ M})}{0.100 \text{ M}} = 1.25 \text{ mL}$$

10. 34.62 mL of 0.1510 M NaOH was needed to neutralize 50.0 mL of an H₂SO₄ solution.

What is the concentration of the original sulfuric acid solution? (5 pt)

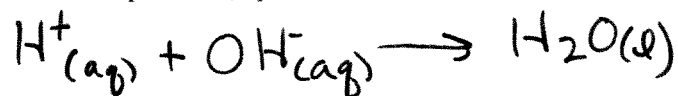
- A) 0.0229 M B) 0.218 M C) 0.0523 M D) 0.209 M E) 0.105 M



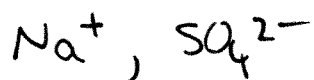
$$\frac{34.62 \text{ mL} \times \frac{\cancel{\text{L}}}{1000 \text{ mL}} \times \frac{0.1510 \text{ mol NaOH}}{\cancel{\text{L}}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol NaOH}}}{\left(50.0 \text{ mL} \times \frac{\cancel{\text{L}}}{1000 \text{ mL}} \right)} = 0.0522 \text{ M}$$

11. For problem 10,

a. write the net ionic equation. (2 pt)



b. identify the spectator ions. (2 pt)



12. Oxidation is the LOSS of electrons and reduction is the GAIN of electrons. (2 pt)

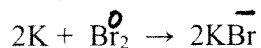
13. The oxidation number of P in P_2O_5 is (3 pt)

- A) +8 B) +7 C) +5 D) -7 E) -8

14. The oxidation number of S in SO_4^{2-} is (3 pt)

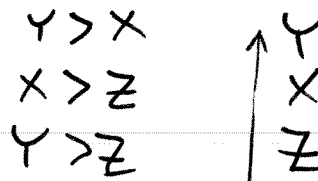
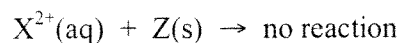
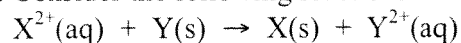
- A) +2 B) -2 C) +4 D) -4 E) +6

15. Considering the following reaction, what is undergoing reduction? (2 pt)



- a) insufficient information to determine
b) K and Br_2 c) K d) Br_2 e) KBr

16. Consider the following reactions:



Write an activity series for the elements X, Y, and Z.

(4 pt)



17. Indicate if the following are soluble or insoluble in water at 25°C? (4 pt)

- | | | |
|--------------------------------------|----------------|------------------|
| a) AgBr | soluble | <u>insoluble</u> |
| b) CaCl ₂ | <u>soluble</u> | insoluble |
| c) Ca(NO ₃) ₂ | <u>soluble</u> | insoluble |
| d) CaCO ₃ | soluble | <u>insoluble</u> |

18. Which of these properties is/are characteristic(s) of gases? (4 pt)

- A) High compressibility *yes*
B) Relatively large distances between molecules *yes*
C) Formation of homogeneous mixtures regardless of the nature of gases *yes*
D) A and B.
E) A, B, and C.

19. At what temperature will a fixed amount of gas with a volume of 175 L at 15°C and 760 mmHg occupy a volume of 198 L at a pressure of 640 mm Hg? (5 pt)

- A) 274°C B) 214°C C) 114°C D) 1°C E) -59°C

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = \frac{(640 \text{ mm Hg})(198 \text{ L})(288 \text{ K})}{(760 \text{ mm Hg})(175 \text{ L})} = 274.1 \text{ K} = 1^\circ \text{C}$$

20. At a temperature of _____ °C, 0.444 mol of CO gas occupies 11.8 L at 889 torr.

- A) 379 B) 73 C) 14 D) 32 E) 106 (5 pt)

$$T = \frac{PV}{nR} = \frac{(889)(11.8 \text{ L})}{(0.444 \text{ mol})(0.08206 \frac{\text{L atm}}{\text{mol K}})} = 378.8 \text{ K} - 273.1 = 106^\circ \text{C}$$

21. The molecular weight of a gas is _____ g/mol if 3.5 g of the gas occupies 2.1 L at STP. (5 pt)

- A) 41 B) 5.5×10^3 C) 37 D) 4.6×10^{-2} E) 2.7×10^{-2}

C
$$M = \frac{dRT}{P} = \frac{\left(\frac{3.5g}{2.1L}\right) \left(0.08206 \frac{L \cdot atm}{mol \cdot K}\right) (273.15 K)}{1.00 atm} = 37.9 \frac{g}{mol}$$

22. A vessel contained N₂, Ar, He, and Ne. The total pressure in the vessel was 987 torr. The partial pressures of nitrogen, argon, and helium were 44.0, 486, and 218 torr, respectively. The partial pressure of neon in the vessel was _____ torr.

- D A) 42.4 B) 521 C) 19.4 D) 239 E) 760 (5 pt)

$$987 \text{ torr} - (44 + 486 + 218) = 239$$

23. Which gas has molecules with the greatest average molecular speed at 25°C? (2 pt)

- A A) CH₄¹⁶ B) Kr⁸⁴ C) N₂²⁸ D) CO₂⁴⁴ E) Ar⁴⁰

24. Deviations from the ideal gas law are greater at (2 pt)

- B A) low temperatures and low pressures. C) high temperatures and high pressures.
B) low temperatures and high pressures. D) high temperatures and low pressures.

25. An exothermic reaction causes the surroundings to (2 pt)

- A A) warm up D) decrease its temperature.
B) become acidic. E) release CO₂.
C) expand.

26. The value of ΔH° for the reaction below is -126 kJ. _____ kJ are released when 2.00 mol of NaOH is formed in the reaction? (5 pt)

- B
$$2 \text{ Na}_2\text{O}_2(s) + 2 \text{ H}_2\text{O}(l) \rightarrow 4 \text{ NaOH}(s) + \text{ O}_2(g)$$

A) 252 B) 63 C) 3.9 D) 7.8 E) -126