

Chemistry 201 – Practice Final

Name Key

Part One: Multiple Choice (60 points)

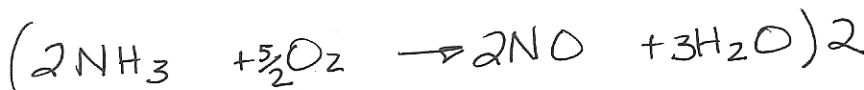
Select the best answer to each question. There is only one correct answer.

1. How many significant figures are in the value: 0.003050?

- a. 7 b. 6 c. 5 **d. 4** e. 3

2. The correct formula for Chromium (IV) Phosphite is:

- a. CrPO₃
b. Cr₃PO₃
c. Cr₂(PO₃)₃
d. Cr₃(PO₃)₄
e. Cr₃(PO₄)₄



3. Ammonia reacts with oxygen gas to produce nitric oxide (NO) and water. In the balanced chemical reaction the coefficient in front of ammonia is:

- a. 2 b. 3 **c. 4** d. 5 e. 6

4. What is the oxidation number of phosphorus in NH₄H₂PO₄?

- a. -3 b. 0 c. +1 d. +3 **e. +5**

5. What volume of 0.2M Na₂CO₃ solution contains 53.0 g of Na₂CO₃?

- a. 0.200 L b. 0.400 L c. 0.500 L d. 1.60 L **e. 2.50 L**

$$\frac{0.5 \text{ mol}}{0.2 \text{ mol/L}}$$

6. A molecular compound contains 92.3% carbon and 7.7% hydrogen by weight. If 0.125 mol of the compound weighs 3.25 g, what is its molecular formula?

- a. CH **b. C₂H₂** c. C₅H₆ d. C₆H₆ e. C₆H₇

$$\begin{array}{r} 48.00 \\ 22.99 \\ 22.99 \\ \hline 12.01 \\ \hline 105.99 \end{array}$$

$$26 \text{ g/mol}$$

7. The formula for perbromic acid is:

- a. HBrO b. HBrO₂ c. HBrO₃ **d. HBrO₄** e. HBr

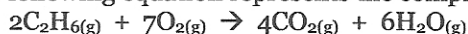
8. At standard conditions (T=273K and P=1.0atm) it was found that 1.17 L of a gas weighed 5.45 g. The gas ~~is~~ could be:

- a. NH₃ b. HNF₂ **c. N₂F₄** d. NH₃

$$\frac{1.17 \text{ L}}{22.4 \text{ L/mol}} = 0.05223 \text{ mol}$$

$$104 \text{ g/mol}$$

9. The following equation represents the complete combustion of ethane:



What is the maximum volume of carbon dioxide that can be obtained from 50.0 L of ethane and 250. L of oxygen assuming constant temperature and pressure?

- a. 25.0 L b. 50.0 L **c. 100. L** d. 150. L e. 200. L

10. If 250 mL of methane, CH₄, effuses through a small hole in 48 s, the time required for the same volume of helium to pass through the hole will be:

- a. 12 s **b. 24 s** c. 48 s d. 96 s e. 192 s

$$\frac{50 \times 4}{2} = 100$$

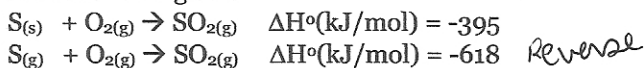
$$\frac{250 \times 4}{7} = 143$$

$$48 = \sqrt{\frac{16.05}{4.00}}$$

11. Calculate the change in enthalpy when 52.0 g of Cr at 25°C and 1 atm pressure is oxidized. The standard heat of formation of Cr₂O_{3(s)} is -1140 kJ/mol. 4Cr_(s) + 3O_{2(g)} → 2Cr₂O_{3(s)}

- a. 1140 kJ b. +1140 kJ **c. -570 kJ** d. +570 kJ e. -285 kJ

12. Given the following data:



find the heat required for the reaction converting solid sulfur to gaseous sulfur.

- a. +223 kJ/mol** b. -223 kJ/mol c. -618 kJ/mol d. +618 kJ/mol e. -1013 kJ/mole

13. All of the following salts are soluble EXCEPT:

- a. NaCl **b. AgCl** c. LiCl d. MgCl₂ e. AlCl₃

14. For the reaction that occurs in a lead storage battery:
 $\text{Pb}_{(s)} + \text{PbO}_{2(s)} + 2\text{H}_3\text{O}^+_{(aq)} + 2\text{HSO}_4^-_{(aq)} \rightarrow 2\text{PbSO}_{4(s)} + 4\text{H}_2\text{O}_{(l)}$ the oxidizing agent is:
 a. Pb b. PbO_2 c. H_3O^+ d. HSO_4^- e. PbSO_4
15. When the equation $\text{HBrO}_3 + \text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{Br}_2 + \text{H}_2\text{SO}_4$ is balanced the coefficient for sulfur dioxide is:
 a. 5 b. 4 c. 8 d. 10 e. 17
16. Which group forms oxides of the formula RO?
 a. alkaline earth metals b. chalcogens c. noble gases d. alkali metals e. halogens
17. Which hybridization occurs around the carbons in CHCH (acetylene)?
 a. sp^3 b. sp^2 c. sp d. no hybridization
18. Which of the following molecules is a notable exception to the octet rule?
 a. ammonia b. phosphorus pentachloride c. nitrogen trifluoride d. water
19. Which of the following molecules is polar?
 a. xenon tetrafluoride b. selenium hexachloride c. carbon tetrachloride d. iodine trifluoride
20. All of the following have noble gas electronic configurations except:
 a. As^{3+} b. P^{3-} c. Ca^{2+} d. Br^- e. Kr

Part Two: Short Answer (10 points)

Write your answer in the space provided

1. What is the Pauli Exclusion Principle? Explain. *The Pauli Exclusion Principle states that no two electrons may have the same four quantum numbers, so if two electrons are in the same orbital they must have opposite spins.*

2. What is a redox reaction?
a redox reaction occurs when at least one atom loses electron density and is oxidized and one atom gains electron density and is reduced.

3. What conditions are NOT favorable for ideal gas behavior?
Gases do not behave ideally at low temperatures (sticky collisions) and high pressures (significant volume)

4. What causes emission line spectra?
*electrons
 atoms absorb energy and move to higher energy orbitals. When the electrons return to the ground state, the energy that was absorbed is emitted as light. Any emissions in the visible spectrum are*

5. What is enthalpy? *especially easy to detect.*

Enthalpy is the "heat" lost or gained in a chemical reaction. It is a thermodynamic property.

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Part Three: Problem Solving (30 points)

Solve the following problems. Show your work and circle your final answer.

1. Determine the freezing point of a 0.25 m solution of glucose in water. (K_f for water is $1.86^\circ\text{C}/m$)

$$\Delta T_f = (0.25)(1.86) = 0.465$$

$$\text{F.P. soln} = \underline{\underline{-0.47^\circ\text{C}}}$$

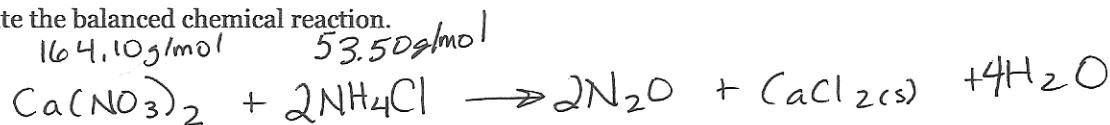
2. A 1.0 g sample of a small protein having a molecular weight of 50,200 g/mol is dissolved in 50.0 mL of water. Calculate the osmotic pressure of the solution in millimeters of mercury at a temperature of 25°C .

$$\begin{aligned} \pi &= MRT \\ 9.7 \times 10^{-3} \text{ atm} &= \left(\frac{1.0 \text{ g} \times \frac{1 \text{ mol}}{50200 \text{ g}}}{0.050 \text{ L}} \right) (0.0821) (298) \\ 7.4 \text{ mm Hg} & \end{aligned}$$

$$1.00 \text{ atm} = 760 \text{ mm Hg}$$

3. Solid calcium nitrate will react with solid ammonium chloride at slightly elevated temperatures to produce nitrous oxide (N_2O) gas and calcium chloride solid and steam (water in gaseous form).

- a. Write the balanced chemical reaction.



- b. What volume of nitrous oxide will be produced at 298K and 1.00 atm if 5.0 grams of solid calcium nitrate are combined with 5.0 grams of solid ammonium chloride?

$$5.0 \text{ g} \times \frac{1 \text{ mol}}{164.10 \text{ g}} \times \frac{2 \text{ N}_2\text{O}}{1 \text{ Ca}(\text{NO}_3)_2} = 0.0609 \checkmark$$

$$5.0 \text{ g} \times \frac{1 \text{ mol}}{53.50 \text{ g}} \times \frac{2 \text{ N}_2\text{O}}{2 \text{ NH}_4\text{Cl}} = 0.09345$$

$$\underline{\underline{1.5 \text{ L}}} = V = \frac{nRT}{P} = \frac{(0.0609)(0.0821)(298)}{(1.00)}$$

Some useful constants

$$N_A = 6.022 \times 10^{23}$$

$$R = 0.0821 \text{ L-atm/mol-K}$$