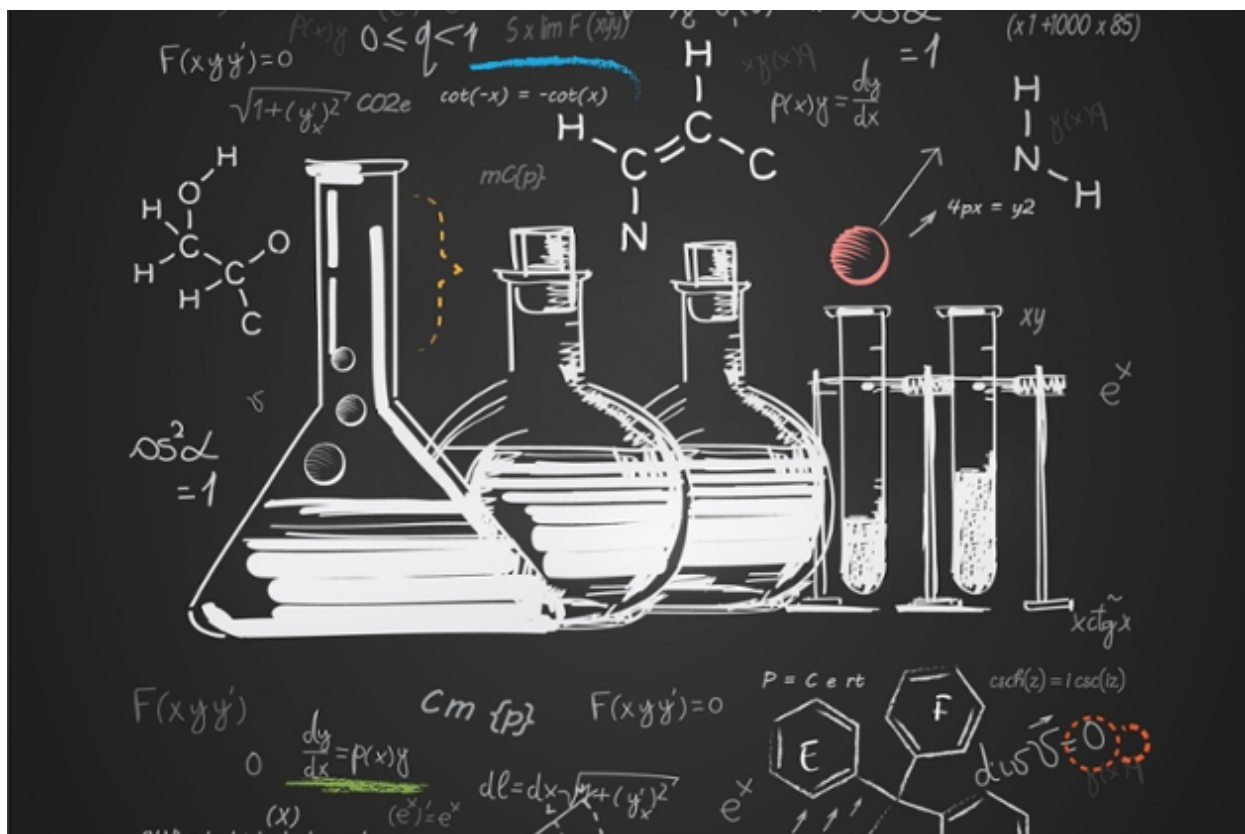


Chemistry Lab

Test 17-18



Name: _____

Score: ____/185 pts

Section I: Reaction Prediction

Write net ionic equations for each of the reactions that follow. Use appropriate ionic and molecular formulas but omit formulas for all ions or molecules that do not take part in a reaction. Write structural formulas for all organic compounds. Equations do not need to be balanced. States are optional. If no reaction occurs, write "no reaction".

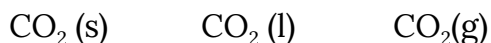
- 1) Crystals of solid sodium chloride are added to water.
- 2) Nitric acid and aqueous sodium hydroxide are mixed.
- 3) Solutions of silver nitrate and sodium chromate are mixed.
- 4) A sample of solid calcium carbonate is heated to a high temperature.
- 5) Small chunks of solid sodium metal are added to water.
- 6) A small piece of zinc metal is submerged in a solution of 1 M hydrochloric acid.
- 7) Silver metal is immersed in lead nitrate solution.
- 8) Hydrogen peroxide solution is added to acidified potassium iodide solution.
- 9) Ethanol is burned in the presence of excess oxygen.
- 10) A solution of acetic acid and propanol is refluxed in the presence of a sulfuric acid catalyst.

Section II: Thermodynamics

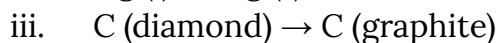
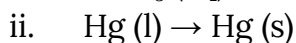
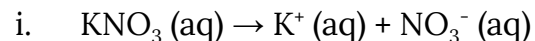
1. This question tests some basic thermodynamic knowledge.

a. State the three laws of thermodynamics below.

b. Which of the following substances have the highest value of S° at 25°C ?
Circle the correct answer.



c. State whether each of the following reactions is spontaneous or not spontaneous at standard temperature and pressure:



d. Identify all of the following which are state functions. Circle the correct answer(s). There may be more than one correct answer.

Heat

Work

Energy

Mass

Entropy

2. Glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, a monosaccharide, is an important energy source that is vital to cell and organ function within our bodies. The heat of combustion of glucose is -2800 kJ/mol . Answer the following questions about the combustion of glucose.

a. Is the combustion of glucose endothermic or exothermic? Circle the correct answer.

Endothermic

Exothermic

b. Write out a balanced equation for the combustion of one mole of glucose.

- c. Suppose that you eat 141 grams of a candy whose nutrition label is shown to the right. How much energy, in kilojoules, would be released in your body from glucose in the candy after total combustion of the candy that you consumed? Assume that all sugar in the candy is glucose.

Nutrition Facts	
Serving Size (47g)	
Amount Per Serving	
Calories 130	
	% Daily Values*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Sodium 5.5mg	0%
Total Carbohydrate 47g	16%
Dietary Fiber 0g	0%
Sugars 45g	
Protein 0g	0%

*Percent Daily Values are based on a 2,000 calorie diet.

- d. A scientist is trying to experimentally verify the heat of combustion of glucose using a coffee-cup calorimeter, but to his dismay, his calculated heat of combustion is only -2680 kJ/mol ! After thinking what errors may have caused his experimental value to deviate from the actual value, the scientist concludes that his calorimeter had absorbed some of the heat released from combustion.

This is the scientist's recorded data:

Initial Temperature of Water	25.0°C
Final Temperature of Water	50.0°C
Volume of Water Added	250 mL

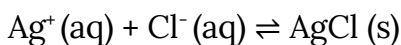
Calculate the value of the calorimeter constant, in $\text{J}/^\circ\text{C}$.

- e. Name two other sources of error that may have contributed to the scientist's inaccurate results.

3. Consider the following thermodynamic data:

Species	ΔH_f° (kJ/mol)	ΔS° (J/K · mol)
Ag ⁺ (aq)	105	73
Cl ⁻ (aq)	-167	57
AgCl (s)	-127	96

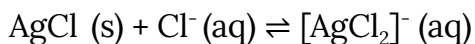
- a. Calculate the value of ΔG for the reaction



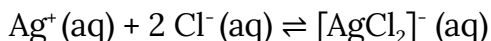
at 298 K.

- b. Explain the sign of ΔG with regard to the reaction (Why does the sign make sense?)

- c. The reaction



Has equilibrium formation constant $K_f = 1.1 \cdot 10^5$ at 298 K. Calculate the value of ΔG at 298 K for the reaction



- d. Draw a complete Born-Haber cycle that can be used to calculate the lattice energy of AgCl. No numeric ΔH values are needed; just make sure that you clearly indicate the reaction that is happening at each step of the cycle.

Section III

Physical Properties

Classify each of the properties below as intrinsic physical properties, extrinsic physical properties, or chemical properties.

1. Density	Intrinsic	Extrinsic	Chemical
2. Charge	Intrinsic	Extrinsic	Chemical
3. Flammability	Intrinsic	Extrinsic	Chemical
4. Temperature	Intrinsic	Extrinsic	Chemical
5. Specific heat	Intrinsic	Extrinsic	Chemical
6. Reactivity	Intrinsic	Extrinsic	Chemical
7. Toxicity	Intrinsic	Extrinsic	Chemical
8. Albedo	Intrinsic	Extrinsic	Chemical
9. Ductility	Intrinsic	Extrinsic	Chemical
10. Malleability	Intrinsic	Extrinsic	Chemical

11. A scientist defines a new property, the “coolness” of materials, to help explain how the material releases force carriers on a quantum level. This property is tested by monitoring the material’s behavior when exposed to various inert gases.
- Would coolness be a physical or chemical property and why?

- b. The scientist also discovers that coolness varies based on the direction of observation. What is the term describing such properties?
12. You want to figure out the thermal conductance of your aluminum pan. After using your 250°C electric stove to heat the pan for 1 second, you calculate that 16.9 kcal of heat has been transferred to your pan. Your aluminum fry pan is initially at 23°C, has a mass of 4.8 kg, an area of 81 cm² and is 0.6 cm thick.
- a. Assuming the pan remains at 23°C during the 1 sec it is heated, What is the thermal conductivity of your pan in (cal · sec⁻¹)/(cm² · °C · cm⁻¹)?
- b. Would Silver have a higher or lower thermal conductivity than aluminum? Rank these 5 materials based on thermal conductivity: Silver, Aluminum, Lead, Gold, Mercury

- c. Rank the same 5 materials based on electrical conductivity and explain the molecular basis for the similarities and differences between the two rankings.

Silver, Aluminum, Lead, Gold, Mercury

- d. While plating you accidentally spill some cooking wine in your orange juice. Explain how you might separate the two liquids.

13. David is trying to find a dense material to wear so he appears massive without looking fat. He is looking into lead as a very dense as well as safe material. Unfortunately, he is too lazy to measure the mass and volume of the lead he has at hand. Fortunately, he searched up information about lead's unit cell on Yahoo answers.

a. Help David find the density of lead in g/cm^3 given that the unit crystal has a face-centered cubic structure and has a side length of 495 pm.

b. David doesn't trust your answer, and decides to measure the lead's mass and volume himself. Use the David gathered to calculate the density of lead, and find the percent error, using your answer from a) as the accepted density of lead.

Initial volume of water	47.0 mL
Volume of water + lead	59.2 mL
Mass of lead	142.3 g

- c. How much lead would David need to appear 20 lbs heavier (use your answer from part A)?
14. It's summertime and you want to design a frozen solid that remains cold and does not melt easily. But first, you decide to examine the melting points of existing materials, to figure out what exactly causes something to have a high melting point.
- Rank the following materials based on melting point:
Butter, methane, ice, NaCl, SO₂
 - Identify the molecular property that causes a substance to have a high melting point and explain why this makes sense.

- c. You choose salts to be your frozen solid because of their high melting points. Why are salts not good candidates for your frozen solid?