Exam 2

# Part 1: Multiple Choice (2 points each)

## Directions: Please circle the *best* answer for each of the following questions.

1. Assuming ideal behavior, which of these gas samples will have the greatest volume at STP?
2. 1 g of H2
3. 1 g of Ar
4. 1 g of O2
5. all of the above
6. not enough information
7. Which of the following is true of the internal energy of a system and its surroundings during an energy exchange with a negative ∆Esys?
8. The internal energy of both the system and the surroundings increases.
9. The internal energy of the system increases and the internal energy of the surroundings decreases.
10. The internal energy of both the system and the surroundings decreases.
11. The internal energy of the system decreases and the internal energy of the surroundings increases.
12. none of the above
13. What is a photon?
    1. A packet of light.
    2. A packet of force.
    3. The smallest particle.
    4. The way of any interaction.
    5. Charge transporting particle.
14. Which one of the following is not used to describe the condition of a gas?
    1. polarity
    2. number of moles
    3. temperature
    4. volume
    5. pressure
15. Which statement is true about kinetic molecular theory?
    1. A single particle does not move in a straight line.
    2. The size of the particle is large compared to the volume.
    3. The collisions of particles with one another is completely elastic.
    4. The average kinetic energy of a particle is not proportional to the temperature.
    5. none of the above
16. A sun burn is caused by overexpose to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ radiation.
    1. ultraviolet
    2. gamma
    3. microwave
    4. x-ray
    5. radio
17. What value of the angular momentum quantum number, l, is represented by a d orbital?
    1. 0
    2. 1
    3. 2
    4. 3
    5. 4
18. How many electrons does an f orbital contain?
    1. 2
    2. 6
    3. 7
    4. 10
    5. 14
19. Two aqueous solutions are both at room temperature and are then mixed in a coffee cup calorimeter. The reaction causes the temperature of the resulting solution to fall below room temperature. Which of the following statements is true?
    1. The products have a lower potential energy than the reactants.
    2. This type of experiment will provide data to calculate ∆Erxn.
    3. The reaction is exothermic.
    4. Energy is leaving the system during the reaction.
    5. none of the above; all statements are true.
20. Which rule(s) about lab safety is true?
    1. If a small piece of matter is lodged in the tip of a pipet, buret, or eye dropper, it is acceptable to blow the piece out with your mouth.
    2. If a chemical smells good, it must taste good and therefore it can be eaten.
    3. Eye protect is needed while you are reading or writing in the lab if other students are still performing their experiments.
    4. If a glass drops and shatters, you should immediately pick up all large pieces with unprotected hands.
    5. You should deeply inhale all chemicals at the opening of the reagent bottle to smell it.

# Part 2: Short Answer

## Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work.

1. In constructing a barometer, what advantage is there in choosing a dense liquid (3 points)?
2. Determine the total volume of all gases (at STP) formed when 50.0 mL of TNT, C3H5(NO3)3, density = 1.60 g/mL and molar mass = 227.10 g/mol, react according to the following reaction (10 points):

4 C3H5(NO3)3 (l) 🡪 6 N2 (g) + O2 (g) + 12 CO2 (g) + 10 H2O (g)

You either get question 3 or 4

1. A gas bottle contains 0.250 mol of gas at 730 mm Hg pressure. If the final pressure is 1.15 atm, how many moles of gas were added to the bottle (6 points)?
2. A gas bottle contains 0.1571 mol of gas at 727.1 torr pressure. If the final pressure is 0.9754 atm, how many moles of gas were added to the bottle (6 points)?

You either get question 5 or 6

1. What is the volume of 9.783 x 1023 atoms of kypton at 9.25 atm and 239 °C (5 points)?
2. What is the volume of 3.711 x 1023 atoms of argon at 5.741 atm and 133.2 °C (5 points)?

You either get question 7 or 8

1. A system releases 673 kJ of heat and does 115 kJ of work on the surroundings. What is the change in internal energy of the system (3 points)?
2. A system absorbs 673 kJ of heat and does 115 kJ of work on the surroundings. What is the change in internal energy of the system (3 points)?
3. How is Hess’ Law consistent with the law of conservation of energy (3 points)?
4. A sample of an unknown metal was reacted with 150.0 g of hydrochloric acid in a calorimeter (16 points).
   1. If a 2.744 g sample of the metal caused the temperature of the calorimeter and its contents to rise from 22.4oC to 61.2oC, calculate the heat of reaction per g for the metal. (The acid solution has a specific heat of 4.168 J/g K, and the calorimeter has a heat capacity of 39.2J/K.)
   2. The hydrogen gas from the experiment above was collected in a 397 mL at 30.0oC and 731 torr pressure, how many moles of hydrogen were collected?
   3. What is the molar mass of the metal? (Previous experiments have shown the metal to form a chloride of the formula MCl3. Write a balanced chemical reaction and determine how many moles of the metal reacted.)
   4. Calculate the molar heat of reaction of the metal.

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| --- | --- |
| Substance | ∆H°f (kJ/mol) |
| CH4 (g) | -75 |
| CHCl3 (g) | -134 |
| Cl2 (g) | 0 |
| HCl (g) | -92 |

1. Use the information provided to determine ∆H°rxn for the following reaction (5 points):

CH4 (g) + 3 Cl2 (g) 🡪 CHCl3 (g) + 3 HCl (g) ∆H°rxn = ?

You either get question 12 or 13

1. A laser pulse has a wavelength of 505 nm (10 points).
   1. What is the frequency of the laser pulse?
   2. What is the energy of the photon?
   3. It contains 4.40 mJ of energy. How many photons are in the laser pulse?
2. An x-ray has a wavelength of 1.5 × 10-2 nm (8 points).
3. What is the frequency?
4. What is the energy, in joules, associated with a photon of this frequency?
5. What would be the energy of a mole of such photons?
6. An electron in the n = 7 level of the hydrogen atom relaxes to a lower energy level, emitting light of 1005 nm. What is the value of n for the level to which the electron relaxed? RH = 1.097 x 10-2 nm-1 (4 points).
7. Why are the various forms of radiant energy called electromagnetic radiation (3 points)?
8. Why don’t we observe the wavelength of everyday macroscopic objects (3 points)?
9. How does the concept of an orbit in the Bohr model of the hydrogen atom differ from the concept of an orbital in quantum theory (4 points)?
10. What is the photoelectric effect (2 points)?
11. Complete the following statements (4 points):
12. The quantum number, n, describes the \_\_\_\_\_\_\_\_\_\_and \_\_\_\_\_\_\_\_\_\_ of an atomic orbital.
13. The shape of an atomic orbital is given by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
14. When n = 5, the possible values of l are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
15. When ℓ is 2, what are the possible values of mℓ? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_