

Gateway General Chemistry 125/126/130**Exam 2****October 31, 2006 (8:00-10:00pm)**Name _____ **KEY** _____Section (*circle one*): 601 (Colin) 602 (Brannon) 603 (Mali) 604 (Xiaomu)

The exam has a total of 9 pages including the cover, and a table of heats of formation and a periodic table both of which you may remove. You do not need to turn the table of heats of formation or the periodic table in with your exam. Please neatly show all of your work.

| Page | Questions | Possible points | Score |
|------|-----------|-----------------|-------|
| 2 | 1-5 | 5 | |
| 3 | 6 | 8 | |
| 4 | 7-8 | 8 | |
| 5 | 9-11 | 12 | |
| 6 | 12-14 | 6 | |
| 7 | 15-16 | 6 | |

Total _____/45

Q1-5 (1 point each) Please place the correct letter in the box

1) Which of the following represents a non-polar covalent bond ?

- a. O-O
- b. C-O
- c. NaCl
- d. C-N
- e. C=O

1)
A

2) Which statement concerning the interaction between two atoms is **incorrect**?

- a. If two atoms are widely separated, there is very little attraction between them.
- b. When two atoms are one bond length apart, the valence electrons on one atom are attracted to the nucleus of the other atom.
- c. When two atoms are very close to one another (0.5 \AA apart), repulsion occurs.
- d. A covalent bond occurs when electrons are shared between two nuclei.
- e. As atoms get closer together, their electrons attract each other.

2)
E

3) Which statement about the reaction below is incorrect?



- a. The same quantity of heat is needed for the solid to liquid transformation
- b. The liquid must absorb heat from the surroundings to evaporate.
- c. The reaction is endothermic.
- d. The heat of vaporization is shown.
- e. The ΔH for the gas to liquid transformation has the opposite sign.

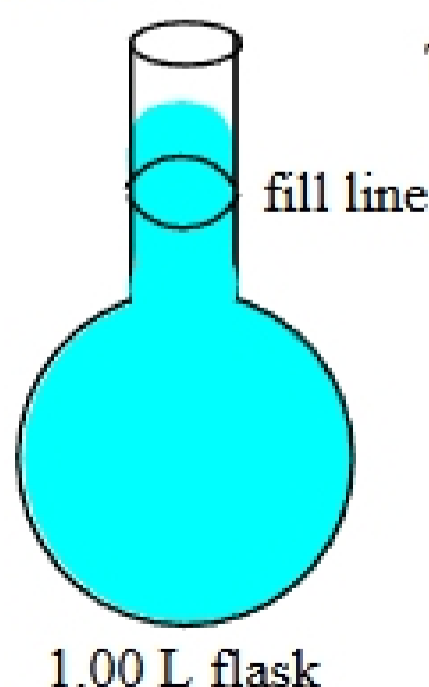
3)
A

4) If you need 300.0 mL of 0.500 M $\text{K}_2\text{Cr}_2\text{O}_7$, which method would you use to prepare this solution?

- a) Dilute 250.0 mL of 0.600 M $\text{K}_2\text{Cr}_2\text{O}_7$ to 300.0 mL.
- b) Add 50.0 mL of water to 250.0 mL of 0.250 M $\text{K}_2\text{Cr}_2\text{O}_7$
- c) Dilute 125.0 mL of 1.00 M $\text{K}_2\text{Cr}_2\text{O}_7$ to 300.0 mL
- d) Add 30.0 mL of 1.50 M $\text{K}_2\text{Cr}_2\text{O}_7$ to 270.0 mL of water
- e) Dilute 150.0 mL of 0.250 M $\text{K}_2\text{Cr}_2\text{O}_7$ to 300.0 mL

4)
A

5) You prepared a NaCl solution by adding 58.44 g of NaCl to a 1-L volumetric flask and then adding water to dissolve it. When you were finished, the final volume in your flask looked like this:



The solution you prepare is:

- a) Greater than 1M because you added more solvent than necessary.
- b) Less than 1M because you added less solvent than necessary
- c) Greater than 1 M because you added less solvent than necessary
- d) Less than 1 M because you added more solvent than necessary.
- e) 1M because the amount of solute, not solvent determines the concentration

5)
D

6) (8 points) The following is an excerpt from a question written into Car and Driver Magazine (May 2006, p20). "...you claim a 12mpg vehicle produces 20,000 pounds of carbon dioxide every 12,000 miles. How do 6200 pounds (1000 gallons at 6.2 pounds per gallon) of fuel excrete 20,000 pounds of pollutant?"

Let's first rephrase the question to make it clearer. A car that gets 12 mpg (miles per gallon) drives 12,000 miles and thus uses 1000 gallons of gasoline. Gasoline weighs 6.2 pounds per gallon, so the car consumed 6200 pounds of gasoline. How did the consumption of 6200 pounds of gasoline result in the creation of 20,000 pounds of pollutant?

a) Write the balanced chemical equation for the burning of gasoline assuming that it is pure octane (C_8H_{18}).



b) What is the ΔH of the reaction you wrote in a) assuming that all products are gases. (A table of heats of formations is available at the end of the exam.)

$$\begin{aligned} \Delta H_{rxn} &= \sum n\Delta H_f^\circ \text{ products} - \sum n\Delta H_f^\circ \text{ reactants} \\ &= [8 \text{ mol } CO_2(-393.5\text{kJ/mol}) + 9\text{mol } H_2O(-241.8\text{kJ/mol})] - [1\text{mol } C_8H_{18}(-249.95\text{kJ/mol}) + 0] \\ &= [-3148 \text{ kJ} + (-2176.2\text{kJ})] - [-249.95\text{kJ}] \\ &= -5074.25 \text{ kJ} \end{aligned}$$

c) The pollutant referred to is CO_2 . How much carbon dioxide in pounds is produced when 6200 pounds of gasoline is burned? (1 lb = 453.59 g)

| | | | | | |
|---------------------|---------------------|-------------------|-------------------|--------------|----------------|
| 6200 lb C_8H_{18} | 453.59g C_8H_{18} | 1 mol C_8H_{18} | 8mol CO_2 | 44g CO_2 | 1 lb CO_2 |
| | 1 lb C_8H_{18} | 114 g C_8H_{18} | 1 mol C_8H_{18} | 1 mol CO_2 | 453.59g CO_2 |

$$= 19143.85 \text{ lb } CO_2 = 19000 \text{ lb } CO_2$$

d) How much energy is given off when 6200 pounds of fuel are burned?

| | | | |
|---------------------|---------------------|-------------------|-------------------|
| 6200 lb C_8H_{18} | 453.59g C_8H_{18} | 1 mol C_8H_{18} | 5074.25 kJ |
| | 1 lb C_8H_{18} | 114 g C_8H_{18} | 1 mol C_8H_{18} |

$$= 1.3 \times 10^8 \text{ kJ}$$