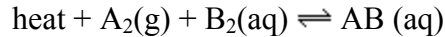NAME_____

Please write your name on the back of the exam too.

Physiological Chemistry I
Exam IV
Dr. Melissa Kelley
November 30, 2007

You have 50 minutes to complete this exam. Provide the one best answer for each, following the instructions given in each section of the exam.

1. Shown below is a general chemical reaction:

$$\text{heat} + A_2(g) + B_2(aq) \rightleftharpoons AB\ (aq)$$

a.) (5 points) Is the reaction exothermic or endothermic?

b) (5 points) Is the reaction endergonic or exergonic? Briefly explain your answer.

c) (10 points) In the space provided draw the free energy diagram for this reaction using free energy on the y-axis and reaction progress on the x-axis. **Clearly** label the activation energy, activated complex, and free energy. State whether the reaction is favorable or unfavorable.

d) (5 points) Write an equilibrium constant expression for the reaction

e) (10 points) Using the following concentrations listed below, calculate the equilibrium constant for the reaction listed above.
A_2= 1.0 M
B_2= 1.5 M
AB = 2.3 M

1

2. (25 points) The pH in our blood is maintained by the following reaction. **For each of the cases listed predict in which direction the equilibrium will shift (right, left, or no change).**

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons HCO_3^- + H^+$$

   a) One of your patients is a firefighter and has been exposed to CO_2 while fighting a fire. What would happen to his blood pH?

   b) One of your patients is dehydrated. Will this person's blood pH decrease or increase?

   c) A student in Dr. Kelley's lab accidentally injects themselves with aluminum hydroxide. Would they suffer from hyperventilation or hypoventilation?

   d) A patient of yours has a kidney disease where they accumulate bicarbonate. Why does this person hypoventilate?

   e) A person in Dr. Kelley's lab accidentally injects themselves with hydrochoric acid. Would their carbon dioxide concentration increase or decrease?

3. (10 points) A student in Dr. Kelley's physiological chemistry class was up all last night studying for today's exam. At midnight this student ate an entire large supreme pizza and 6 candy bars. This increase in food combined with stress about this exam caused the student to have an excess amount of stomach acid (HCl) produced.

How many mL of antacid would this student need to ingest to neutralize a 0.040 L sample of stomach acid (HCl) with a pH of 2.0. The antacid contains 0.1 M $Ca(OH)_2$. A complete answer should include a balanced chemical equation.

Multiple Choice: Select the one best answer for each question. Multiple answers will not be accepted. Each question is worth 3 points.

_____4. Calculate the pH of a 1.00 x 10^{-8} M solution of KOH
    A. 8.0
    B. 6.0
    C. 10.0
    D. 12.0

_____5. Which of the following statements **is correct**?
    A. In an endogonic reaction the energy is absorbed from the reaction, the entropy decreases and the reaction is unfavorable.
    B. In an exergonic reaction the energy is released from the reaction, the entropy increases and the reaction is unfavorable.
    C. In an endogonic reaction the energy is absorbed from the reaction, the entropy decreases and the reaction is favorable.
    D. In an exergonic reaction the energy is absorbed from the reaction, the entropy decreases and the reaction is favorable.

_____6. Which one of the following statements **is not** correct?
    A. Formation of the activated complex requires energy.
    B. Activation energy is the minimum amount of energy needed to produce a reaction.
    C. A catalyst decreases the activation energy.
    D. Energy is released when the products are less stable then the reactants.

_____7. Which of the following represents at decrease in entropy?
    A. Spilling table sugar   C. Scrambling an egg
    B. Ice melting   D. Emptying the dishwasher

_____8. Calculate the H^{+} concentration of a solution with a pH of 5
    A. 1.0 x 10^{-5} M
    B. 5.0 x 10^{-5} M
    C. 3.9 x 10^{-5} M
    D. 1.0 x 10^{-4} M

_____9. Which of the following statements **is not** correct?
    A. A basic solution would have a pH of 9.
    B. Bases increase the [OH^{-}] in water by donating a proton.
    C. Acids increase the [H^{+}] in water by donating a proton.
    D. A pH of 7 is considered neutral.

_____10. Which of the following statements **is correct**?
    A. Decreasing the pH by 3 units will increase the hydrogen ion concentration 1000.
    B. Increasing the pH by 3 units will increase the hydrogen ion concentration by 1000.
    C. Decreasing the pH by 2 units will increase the hydrogen ion concentration by 10.
    D. Decreasing the pH by 2 units will decrease the hydrogen ion concentration by half.

_____11. Which of the following **is not** correct?
   A. A catalyst will increase the rate at which a reaction achieves equilibrium.
   B. The catalyst has no effect on the temperature of a reaction.
   C. A catalyst will alter equilibrium concentrations of the reactants and not the products.
   D. A catalyst will increase the rate at which products are produced.

_____12. Which of the following statements **is not** correct?
   A. A weak acid and its conjugate acid resists changes in pH.
   B. A weak base can slightly dissociate in water.
   C. A strong acid completely dissociates in water.
   D. Neutralization occurs between a strong acid and base.

_____13. A 6.0 g candy sample is completely combusted in a bomb calorimeter. The calorimeter contains 5.55×10^2 g of water, and the reaction increased from 22.0 °C to 32.5 °C. What is the fuel value of the candy sample in nutritional Calories?
   A. 5.55 Calories
   B. 5550 Calories
   C. 35 Calories
   D. 3.5×10^{-2} Calories