

## Exam IV – Chapters 15 -18

Questions 1-20 are multiple-choice and there is only one correct answer. They are worth 2 points each.

- What nuclear particle has a mass number of zero and an atomic number of -1?  
a. **beta**                      b. gamma                      c. alpha                      d. hydrogen
- When a radioisotope decays by nuclear emission, the nuclear particle  
a. disappears                      b. is a reactant                      c. **is a product**                      d. none of these
- If the half-life for thorium-234 is 24.1 days, how many half-lives have passed after 72.3 days?  
a. 1                      b. 2                      c. **3**                      d. 4
- How many half-lives have passed when only 25% of a radioactive isotope remains?  
a. 1                      b. **2**                      c. 3                      d. 4
- What is the oxidation number for nitrogen in  $N_2O_5$ ?  
a. +10                      b. **+5**                      c. +2                      d. -2
- What is the oxidation number for liquid bromine,  $Br_2(l)$ ?  
a. -1                      b. +1                      c. -2                      d. **0**
- If solid zinc goes from an oxidation number of zero to +2, the solid zinc is  
a. neutral                      b. **oxidized**                      c. reduced                      d. both oxidized and reduced
- A substance that changes color over a specific pH range is a(n)  
a. buffer solution                      b. standard solution                      c. **indicator**                      d. titrant
- An ionic solid that is soluble in water is a  
a. **strong electrolyte**                      b. weak electrolyte                      c. nonelectrolyte                      d. buffer
- A \_\_\_\_\_ is never consumed in a chemical reaction; it only lowers the activation energy.  
a. titrant                      b. electrolyte                      c. **catalyst**                      d. precipitate
- Consider the following reaction:  $H_2O(l) + HClO_4(aq) \rightarrow H_3O^+(aq) + ClO_4^-(aq)$   
Circle the statement that is correct.  
a.  $H_2O(l)$  is an Arrhenius acid but not a Bronsted-Lowry acid  
b.  $H_2O(l)$  is both an Arrhenius acid and a Bronsted-Lowry acid  
c.  $H_2O(l)$  is an Arrhenius base but not a Bronsted-Lowry base  
d.  **$H_2O(l)$  is a Bronsted-Lowry base but not an Arrhenius base**
- Circle the statement that is correct when there is an increase in temperature for a given reaction:  
a. **More reactants have the required activation energy.**  
b. More reactants have the correct collision geometry.  
c. The molecules move slower.  
d. The product molecules collide less often.

13. Circle the statement that is true for a system at equilibrium:
- The concentration of the products is equal to the concentration of the reactants.
  - Products and reactants are being produced and consumed at the same rate.
  - Since the concentration of reactants and products are not changing, everything has stopped.
  - The reactants are completely consumed so only the concentration of the products remains.
14. For the combination reaction:  $4 \text{ Al (s)} + 3 \text{ O}_2 \text{ (g)} \rightarrow 2 \text{ Al}_2\text{O}_3 \text{ (s)}$   
Circle the statement that is correct.
- Al is oxidized so it is the oxidizing agent.
  - Al is reduced so it is the reducing agent.
  - O in  $\text{O}_2$  is oxidized so  $\text{O}_2$  is the oxidizing agent.
  - O in  $\text{O}_2$  is reduced so  $\text{O}_2$  is the oxidizing agent.
15. Which of the following substances is weakly basic?
- maple syrup, pH = 7.0
  - champagne, pH = 1.8
  - baking soda, pH = 8.3
  - oven cleaner, pH = 13.5
16. How many moles of ions are present when solid copper (I) sulfide is placed in water?
- 2 moles of ions are present since copper (I) sulfide is soluble in water.
  - 3 moles of ions are present since copper (I) sulfide is soluble in water.
  - $9.58 \times 10^{25}$  moles of ions are present since copper (I) sulfide is soluble in water.
  - none of the above since copper (I) sulfide is insoluble in water.
17. Circle the statement that is correct regarding an exothermic reaction:
- The energy of the products is lower than the energy of the reactants.
  - The change in enthalpy,  $\Delta H$ , is a positive value.
  - The activation energy is higher than the activation energy for an endothermic reaction.
  - Since energy is released by the reaction, the surroundings feel colder to the touch.
18. An Arrhenius base is a substance that
- releases protons in water
  - releases  $\text{OH}^-$  in water
  - accepts protons in water
  - none of these are correct.
19. The pOH of tomato juice is 9.9. Circle the statement that is correct:
- Since the pH is 9.9, tomato juice is considered weakly basic.
  - Since the pH is 9.9, tomato juice is considered weakly acidic.
  - Since the pH is 4.1, tomato juice is considered weakly basic.
  - Since the pH is 4.1, tomato juice is considered weakly acidic.
20. In an acid-base titration reaction, the titrant is added from a buret into a flask until
- the moles of acid equals the moles of base which is called the equivalence point.
  - the moles of base is slightly greater than the moles of acid as indicated by a pH indicator and is called the end point.
  - the standard solution is titrated until there is none left in the buret.
  - none of these are correct since an acid–base titration can not be performed in a lab.

For questions 21- 27 , please show all work as needed and answer the question completely.

21. Balance the following nuclear reactions:

a. (6 pts) Uranium-235 decays by alpha emission.

b. (6 pts) Sulfur-32 is produced when a radioactive particle undergoes beta decay.

22. (5 pts) The  $[H^+] = 0.001 \text{ M}$  for a given solution. What is the pH of this solution?

$$\text{pH} = 3$$

(2 pts) The solution is: strongly acidic, strongly basic, **weakly acidic**, weakly basic, neutral? (circle one)

23. The half-life for lead-214 is 27 minutes.

a. (4 pts) How many half-lives have passed after 1 hour and 48 minutes? **4**

b. (4 pts) How much of a 89.5 mg sample of  $^{214}\text{Pb}$  would remain after 1 hour and 48 minutes? **5.59 mg**

24. (6 pts) Circle all of the following compounds that are nonelectrolytes.

NaCl (s)

$\text{Ca}_3(\text{PO}_4)_2$  (s)

**$\text{C}_6\text{H}_{12}\text{O}_6$  (s)**

$\text{KC}_3\text{H}_3\text{O}_2$  (s)

**$\text{I}_2$  (s)**

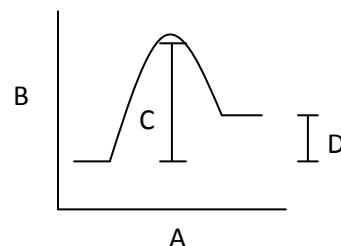
AgCl (s)

25. (9 pts) Answer the following regarding the diagram on the right:

a. This reaction is a(n) **endothermic / exothermic** reaction (circle one)

b. Point C on the diagram is **activation energy**

c. The sign for  $\Delta H$  should be **positive / negative** (circle one)



26. Fill in the blanks for the following oxidation-reduction reaction:



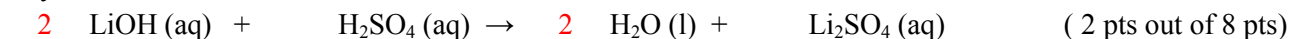
The reagent reduced is **H in HBr** (2 pts)

The reagent oxidized is **Fe** (2 pts)

The reducing agent is **Fe** (2 pts)

The oxidizing agent is **HBr** (2 pts)

27. (8 pts) A student used 25.0 mL of a 2.50 M LiOH solution to titrate 15.0 mL of  $\text{H}_2\text{SO}_4$  to the endpoint. What is the molarity of the sulfuric acid?



$$25.0 \text{ mL} \left( \frac{1 \text{ L}}{1000 \text{ mL}} \right) (2.50 \text{ mol LiOH}) \left( \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol LiOH}} \right) = 0.03125 \text{ mols H}_2\text{SO}_4 / 0.0150 \text{ L} = 2.08 \text{ M H}_2\text{SO}_4$$

**Extra Credit (5 pts):** What is the oxidizing agent in the following reaction? \_\_\_\_\_

