**Chemistry 122 Midterm**

**Multiple Choice -** *Identify the choice that best completes the statement or answers the question.*

\_\_\_\_ 1. Which of the following is NOT a form of energy?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | light | c. | heat |
| b. | pressure | d. | electricity |

\_\_\_\_ 2. In an exothermic reaction, the energy stored in the chemical bonds of the reactants is \_\_\_\_.

|  |  |
| --- | --- |
| a. | equal to the energy stored in the bonds of the products |
| b. | greater than the energy stored in the bonds of the products |
| c. | less than the energy stored in the bonds of the products |
| d. | less than the heat released |

\_\_\_\_ 3. How many kilocalories of heat are required to raise the temperature of 225 g of aluminum from 20C to 100C? (specific heat of aluminum = 0.21 )

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 0.59 kcal | c. | 85 kcal |
| b. | 3.8 kcal | d. | none of the above |

\_\_\_\_ 4. How can you describe the specific heat of olive oil if it takes approximately 420 J of heat to raise the temperature of 7 g of olive oil by 30C?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | greater than the specific heat of water | c. | equal to the specific heat of water |
| b. | less than the specific heat of water | d. | Not enough information is given. |

\_\_\_\_ 5. What is the standard heat of reaction for the following reaction?

Zn(*s*) + Cu(*aq*)  Zn(*aq*) + Cu(*s*)

(*H* for Cu = +64.4 kJ/mol; *H* for Zn = –152.4 kJ/mol)

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 216.8 kJ released per mole | c. | 88.0 kJ absorbed per mole |
| b. | 88.0 kJ released per mole | d. | 216.8 kJ absorbed per mole |

\_\_\_\_ 6. What happens to a catalyst in a reaction?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | It is unchanged. | c. | It is incorporated into the reactants. |
| b. | It is incorporated into the products. | d. | It evaporates away. |

\_\_\_\_ 7. At equilibrium, what is the rate of production of reactants compared with the rate of production of products?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | much higher | c. | the same |
| b. | higher | d. | lower |

\_\_\_\_ 8. Consider the reaction N(*g*)  3H(*g*)  2NH(*g*). What is the effect of decreasing the volume on the contained gases?

|  |  |
| --- | --- |
| a. | The reaction shifts toward the product gas. |
| b. | The system reacts by increasing the number of gas molecules. |
| c. | The pressure on the gases decreases momentarily. |
| d. | Ammonia is consumed in the reaction. |

\_\_\_\_ 9. What is the effect of adding more water vapor to the following equilibrium reaction?

CO(g)+ HO(g)  HCO(aq)

|  |  |
| --- | --- |
| a. | More HCO is produced. |
| b. | CO concentration increases. |
| c. | The equilibrium is pushed in the direction of reactants. |
| d. | There is no effect. |

\_\_\_\_ 10. If a reaction has an equilibrium constant just greater than 1, what type of reaction is it?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | irreversible | c. | reversible, favoring products |
| b. | spontaneous | d. | reversible, favoring reactants |

\_\_\_\_ 11. A chunk of ice whose temperature is –20C is added to an insulated cup filled with water at 0C. What happens in the cup?

|  |  |
| --- | --- |
| a. | The ice melts until it reaches the temperature of the water. |
| b. | The water cools until it reaches the temperature of the ice. |
| c. | Some of the water freezes, so the chunk of ice gets larger. |
| d. | none of the above |

\_\_\_\_ 12. Calculate the energy released when 24.8 g NaO reacts in the following reaction.

NaO(*s*) + 2HI(*g*)  2NaI(*s*) + HO(*l*)

*H* = –120.00 kcal

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 0.207 kcal | c. | 48.0 kcal |
| b. | 2.42 kcal | d. | 3.00  10 kcal |

\_\_\_\_ 13. Calculate *H* for the reaction of sulfur dioxide with oxygen.

2SO(*g*) + O(*g*)  2SO(*g*)

(*H*SO(*g*) = –296.8 kJ/mol; *H*SO(*g*) = –395.7 kJ/mol)

|  |  |  |  |
| --- | --- | --- | --- |
| a. | –98.9 kJ | c. | 197.8 kJ |
| b. | –197.8 kJ | d. | Not enough information is given. |

\_\_\_\_ 14. Use LeChatelier’s principle to predict what will happen if the temperature of the following equilibrium system is decreased. The reaction in the forward direction is endothermic.

Co(H2O)62+(aq) + 4Cl-(aq)  CoCl42-(aq) + 6H2O(l)

|  |  |  |  |
| --- | --- | --- | --- |
| a. | The equilibrium will shift to the left | d. | The concentration of chloride ions will decrease |
| b. | The equilibrium solution will become more purple | e. | There will be no change |
| c. | The equilibrium will shift to the right |

\_\_\_\_ 15. Which chemical equation has the following expression for its equilibrium constant?

Keq = 

|  |  |  |  |
| --- | --- | --- | --- |
| a. | Ni2+(g) + Co(s)  Ni(s) + Co2+(g) | d. | Ni(s) + Co2+(g)  Ni2+(g) + Co(s)  |
| b. | Ni(s) + Co(s)  Ni2+(g) + Co2+(g) | e. | Ni2+(g) + Co2+(g)  NiCo4+(s) |
| c. | Ni2+(g) + Co2+(g)  NiCo4+(s) |

\_\_\_\_ 16. What is the Ksp of PbCl2 if, in a saturated solution of this salt, [Cl1-(aq)] = 0.032mol/L?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | 5.1 x 10-4 | d. | 1.6 x 10-5 |
| b. | 4.8 x 10-3 | e. | 6.2 x 10-2 |
| c. | 3.9 x 10-5 |

\_\_\_\_ 17. Ineffective collisions are collisions that involve particles

|  |  |
| --- | --- |
| a. | without enough energy to react |
| b. | with the wrong orientation |
| c. | that rebound from the collision unchanged |
| d. | that cannot react |
| e. | all of the above |

\_\_\_\_ 18. Which statement concerning the accompanying diagram is true?



|  |  |
| --- | --- |
| a. | H is positive |
| b. | the system is endothermic |
| c. | the system releases heat to the surroundings |
| d. | the heat content of the reactants is less than the heat content of the products |
| e. | the enthalpy of the products is greater than the enthalpy of reactants |

**Short Answer**

 19. Calculate the value of *K* for the following reaction at equilibrium. (2)

2NClO(*g*)  2NO(*g*) + Cl(*g*)

An analysis of the equilibrium mixture in a 1-L flask gives the following results: NClO, 2.2 mol; NO, 8.8 mol; Cl, 0.53 mol

 20. It takes 185 calories of energy to raise the temperature of 50.0 g of mercury by 110C. What is the specific heat of mercury? Express your answer in J/g•oC (2)

 21. Describe three ways in which the rate of the following reaction, , could be increased. (3)

 22. Why is a certain amount of energy required within an effective collision? If you need to draw an activation energy curve to better illustrate your points, please do so.(3)

 23. Use the information below to calculate *H* for the following reaction.

|  |  |  |
| --- | --- | --- |
| 2NO(*g*)  NO(*g*) |  |  |
| 2N(*g*) + 2O(*g*)  2NO(*g*) | *H* = 67.7 kJ |  |
| N(*g*) + 2O(*g*)  NO(*g*) |   | *H* = 9.7 kJ |

 24. Calculate the concentration of silver ions, in g/L when the solubility product constant of AgI is 1 x 10. (3)

**Problem**

 25. What is the solubility, in mol/L, of AgC2H3O2 in a 0.45 mol/L solution of AgNO3 if the Ksp of AgC2H3O2 is2.5  10-3? (4)

 26. If 335 g of water at 24.5ºC absorbed 2.66 kJ of energy, what is the final temperature of the water? (4)

 27. If 45 mL of a 0.45 mol/L solution of AgNO3 was mixed with 85 mL of a 1.35  10-2 mol/L solution of NaCl, would a precipitate form? Calculate the ion product for the potential precipitate. The Ksp of AgCl(s) is 1.8  10-10. (4)

 28. Calculate the enthalpy change,  for the vaporization of 200 g of methanol (CH3OH). Hvap = 43.5kJ/mol (3)

 29. The combustion of methanol is shown by the following equation:



i. Given the data which follows:

a. Find the heat of reaction for the equation above. (2)

b. State the molar heat of combustion of methanol. (2)

c. State whether the reaction is endothermic or exothermic. (1)



ii. What mass of water could be heated from 20.00 C to 35.00 C by the burning of 2.57 mol of methanol? ()? (3)