**Chemistry 122 Practice Midterm 2019**

**Multiple Choice (18 Points)** *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 to the following equilibrium reaction?

CO + HO  HCO

|  |  |
| --- | --- |
| 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. 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 |

\_\_\_\_ 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. In the following diagram, the letter which represents the position of the activated complex is:



|  |  |  |  |
| --- | --- | --- | --- |
| a. | A | d. | D |
| b. | B | e. | E |
| c. | C |

**Short Answer (10 Points)**

 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)

**Problem (30 Points)**

Take out the 2 in 2N2

 

 24. 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)

 25. 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)

 26. 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)

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

 28. Calculate the enthalpy change,  for the vaporization of 200 g of methanol (CH3OH). Hvap = 39.23kJ/mol (3)

**Chemistry 122 Midterm**

**Answer Section**

**MULTIPLE CHOICE**

 1. ANS: B PTS: 1 DIF: L1 REF: p. 505

OBJ: 17.1.1 Explain how energy, heat, and work are related.

 2. ANS: B PTS: 1 DIF: L2 REF: p. 506

OBJ: 17.1.1 Explain how energy, heat, and work are related.

 3. ANS: B PTS: 1 DIF: L1 REF: p. 508

OBJ: 17.1.3 Identify the units used to measure heat transfer.

 4. ANS: B PTS: 1 DIF: L2 REF: p. 509 | p. 510

OBJ: 17.1.3 Identify the units used to measure heat transfer.

 5. ANS: A PTS: 1 DIF: L2 REF: p. 516

OBJ: 17.2.2 Construct thermochemical equations.

 6. ANS: A PTS: 1 DIF: L1 REF: p. 546

OBJ: 18.1.2 Identify four factors that influence the rate of a chemical reaction.

 7. ANS: C PTS: 1 DIF: L1 REF: p. 550

OBJ: 18.2.1 Describe how the amounts of reactants and products change in a chemical system at equilibrium.

 8. ANS: A PTS: 1 DIF: L2 REF: p. 554

OBJ: 18.2.2 Identify three stresses that can change the equilibrium position of a chemical system.

 9. ANS: A PTS: 1 DIF: L2 REF: p. 552 | p. 553

OBJ: 18.2.2 Identify three stresses that can change the equilibrium position of a chemical system.

 10. ANS: C PTS: 1 DIF: L1 REF: p. 556

OBJ: 18.2.3 Explain what the value of Keq indicates about the position of equilibrium.

 11. ANS: C PTS: 1 DIF: L2 REF: p. 512

OBJ: 17.2.1 Describe how calorimeters are used to measure heat flow.

 12. ANS: C PTS: 1 DIF: L2 REF: p. 516

OBJ: 17.2.2 Construct thermochemical equations. | 17.2.3 Solve for enthalpy changes in chemical reactions by using heats of reaction.

 13. ANS: B PTS: 1 DIF: L2 REF: p. 531

OBJ: 17.4.2 Solve for enthalpy changes by using Hess' law or standard heats of formation.

 14. ANS: A PTS: 1

 15. ANS: D PTS: 1

 16. ANS: C PTS: 1 REF: C OBJ: 5.3

STA: EC1.05

 17. ANS: E PTS: 1 REF: K/U OBJ: 6.4

STA: EC1.04

 18. ANS: C PTS: 1 REF: K/U OBJ: 6.4

STA: EC1.05

**SHORT ANSWER**

 19. ANS:

*K* = 

=  8.5

PTS: 1 DIF: L3 REF: p. 556 | p. 557

OBJ: 18.2.3 Explain what the value of Keq indicates about the position of equilibrium.

 20. ANS:

Specific heat =  = 0.14 

PTS: 1 DIF: L2 REF: p. 512

OBJ: 17.2.1 Describe how calorimeters are used to measure heat flow.

 21. ANS:

- since concentration is a factor that affects the rate of reaction, by increasing the concentration of the acid, the reaction rate would be increased

- temperature is another factor that affects the rate of reaction, by increasing the temperature of the reaction, the reaction should proceed at a faster rate

- since surface area of a solid would affect the rate of a reaction, by powdering the magnesium, the rate of the reaction would be increased

- perhaps a catalyst could be added that could speed up the reaction (unknown)

- perhaps using a different acid and/or metal (although this would change the reaction though)

PTS: 1 REF: C OBJ: 6.2 STA: EC1.04

 22. ANS:

- the energy that is required in an "effective collision" is needed to overcome the activation energy of the reaction

- the activation energy is the minimum increase in potential energy of a system required for particles to react

- if this amount of energy is not produced by the collision of the particles, the collision will be ineffective

PTS: 1 REF: K/U OBJ: 6.4 STA: EC1.05

**PROBLEM**



PTS: 1 REF: I OBJ: 7.6 STA: CS2.06

 24. ANS:

|  |  |  |  |
| --- | --- | --- | --- |
| AgC2H3O2(s) <====> | Ag1+(aq) | + | C2H3O21-(aq) |
| initial | 0.45 mol/L |  |  |
| @E | 0.45 mol/L + (negligible) |  |  |

2.5  10-3 = 0.45 

**solubility = 5.6  10-3 mol/L**

PTS: 1 REF: I OBJ: 7.6 STA: CS2.04

 25. ANS:

AgNO3(aq) + NaCl(aq)  AgCl(s) + NaNO3(aq)

[Ag1+] = (0.45 mol/L)(0.045 L) / (0.045 L + 0.085) L

[Cl1-] = (1.35  10-2 mol/L)(0.085 L) / (0.045 L + 0.085) L

**ion product AgCl is [Ag1+][Cl1-] = 1.4  10-3 > Ksp, yes a precipitate forms**

PTS: 1 REF: I OBJ: 7.6 STA: CS2.05

 26. ANS:

i. a. 

 =[(2  –393 kJ) + (4  –242 kJ)] – [2  –638 kJ]

 = –478 kJ

**The heat of reaction for the equation is –478 kJ**

b. Since this is for 2 moles of methanol,

|  |  |
| --- | --- |
|  | = –478 kJ /2 mol |
|  |  |
|  | = –239 kJ/mol |

**The molar heat of combustion of methanol is –239 kJ/mol**

c. Since the value is negative, the reaction is exothermic

ii. 

since q = –

q = 614 kJ

 = 150 C

c= 4.184 kJ/kg0 C



**9.78 kg of water could be heated with 2.57 mol of methanol.**

PTS: 1 REF: I OBJ: 5.5 STA: EC2.05

 27. ANS:

|  |  |
| --- | --- |
| m = | 335 g |
| q = | 2.66 kJ |
| = | 2660 J |
| c = | 4.18 J/(g·ºC) |
| T1 = | 24.5ºC |



**The final temperature of the water would be 26.4ºC.**

PTS: 1 REF: I OBJ: 5.1 STA: EC2.03

 28. ANS:



Find the number of moles of methanol



Then find the enthalpy change



**Since the methanol vaporizes by absorbing heat, the enthalpy change is +244.8 kJ.**

PTS: 1 REF: I OBJ: 5.2 STA: EC2.03