

Chem 122 Rybolt Exam 1 Fall 2009 Name _____ (print)
 Numerical constants may be listed below. Other needed information is given in the problem or written on the board or found in the periodic tables you will use during exam. For numerical problems, be sure to **show your work**, include units and circle your final answer. If several choices are given, **circle the correct answer**. Your written answers should be brief and to the point. You can use your own calculator on the exam, but no notes, books, external information, or other electronic devices are to be used. No cell phone is to be used in the Exam room.

$$1 \text{ cal} = 4.184 \text{ J} \quad R = 0.08206 \text{ (L atm/ mol K)} \quad \text{or} \quad R = 8.31 \text{ J/mol K}$$

$$1 \text{ atm} = 760 \text{ torr} = 1.01 \times 10^5 \text{ N/m}^2 \quad 1 \text{ g} = 6.02 \times 10^{23} \text{ amu} \quad ^\circ\text{C} = (^\circ\text{F} - 32)/1.8 \quad \text{K} = ^\circ\text{C} + 273$$

1) An aqueous solution of sodium nitrate $\text{NaNO}_3(\text{aq})$ has a concentration of 0.363 m and a density of 1.0185 g/mL. What is the molarity of this solution? Hint: first find the total grams of solute and solvent in 0.363 mol $\text{NaNO}_3/1.000 \text{ kg H}_2\text{O}$ and then find volume of this mass

2) The vapor pressure of pure water is 24 torr at room temperature. According to Raoult's law if 5.0 moles of sugar are dissolved in 5.0 moles of water then the vapor pressure of the water in the sugar-water mixture should be _____ torr.

3) Vitamin C is polar and vitamin E is nonpolar. Which of these vitamins dissolves in fat and so can build up and be stored in your body?

4) A cloud scatters light which is what makes the cloud appear white. A cloud is most appropriately said to be
 a) a solution of oxygen dissolved in nitrogen b) a solution of water dissolved in air
 c) a colloid made of water droplets suspended in air d) a mixture of methane and nitrogen gas

5) What is the osmotic pressure, $\pi(\text{atm})$, if 2.50 mol of glucose are dissolved in enough water to make 500 mL of solution of glucose(aq) at a temperature of 37°C ?

6) For water the freezing point depression constant is $K_f = -1.86^\circ\text{C}/m$, and therefore the freezing point depression of a 1.613 molal solution of glucose molecules dissolved in water is -3.00°C . Then obviously a 1.613 m solution of CaCl_2 (aq) would likely have a freezing point that is lowered by $\underline{\hspace{1cm}}$ $^\circ\text{C}$

0 -3 -6 -9 -12

7) In the process of burning gasoline to run an automobile and considering the gasoline and oxygen combustion to be the system, then we can say (circle one)

ΔH of the system is positive ΔG of the system is positive ΔS of the universe is positive

8) An organic compound is burned in a bomb calorimeter and gives a temperature rise from 23.4°C to 27.7°C . The heat capacity for the metal container ("bomb") is $2600 \text{ J}/^\circ\text{C}$ and this placed in 1000 grams of water that has a specific heat of $4.184 \text{ J}/(\text{g}^\circ\text{C})$. Therefore, the energy released (kJ) from burning this compound is

9) For the reaction $\text{NH}_4\text{Cl}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$ the enthalpy and entropy changes were found to be $\Delta H = +177 \text{ kJ}$ and $\Delta S = +285 \text{ J/K}$. At a temperature of 900 K , the value for ΔG (kJ) for this reaction is

10) If $\text{NH}_4\text{Cl}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$ has a value $\Delta H = +177 \text{ kJ}$ then the reaction $5\text{NH}_3(\text{g}) + 5\text{HCl}(\text{g}) \rightarrow 5\text{NH}_4\text{Cl}(\text{s})$ has a ΔH value of

11) For a reaction in which no gas is produced or used up, which of the following is true?

$\Delta H > \Delta E$ $\Delta H < \Delta E$ $\Delta H = \Delta E$

12) Given the following bond energies C-H 411 kJ/mol , Cl-Cl 240 kJ/mol , and C-Cl 327 kJ/mol , and H-Cl 428 kJ/mol find the enthalpy change for the reaction

$\text{CH}_4(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{CH}_3\text{Cl}(\text{g}) + \text{HCl}(\text{g})$

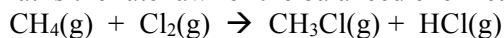
Use the following thermodynamic data for the next two problems

| | CH ₄ | Cl ₂ | CH ₃ Cl | HCl | at 298K |
|-----------------------|-----------------|-----------------|--------------------|-------|---------|
| ΔH_f (kJ/mol) | -74.9 | 0 | -83.7 | -92.3 | |
| S (J/mol K) | 186 | 223 | 234 | 187 | |

13) What is ΔH (kJ) for the reaction $\text{CH}_4(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{CH}_3\text{Cl}(\text{g}) + \text{HCl}(\text{g})$

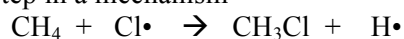
14) What is ΔS (J/K) for the reaction $\text{CH}_4(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{CH}_3\text{Cl}(\text{g}) + \text{HCl}(\text{g})$

15) What is the rate law for the balanced chemical equation



$k [\text{CH}_4][\text{Cl}_2]$ $k [\text{CH}_4][\text{Cl}_2]^2$ cannot determine from information given

16) For a single step in a mechanism



what is the rate law for the production of CH_3Cl in this single step? Rate =

$k[\text{CH}_3\text{Cl}][\text{H}]$ $k [\text{CH}_4][\text{Cl}]$ $k [\text{H}] [\text{Cl}]$ $k [\text{CH}_4]$

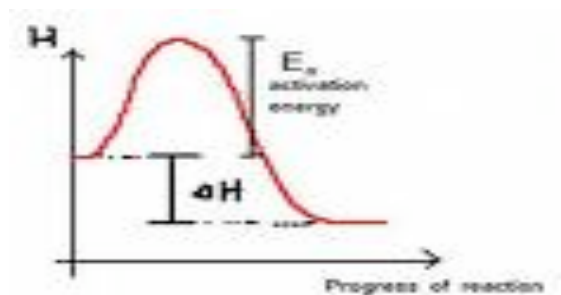
17) Given the following data, determine the order of the reaction with respect to CH_4 :

| | zero | first | second | third |
|-----------------|--------|--------|--------|-------|
| $[\text{CH}_4]$ | 0.039 | 0.082 | 0.081 | |
| $[\text{Cl}_2]$ | 0.020 | 0.021 | 0.041 | |
| initial rate | 0.0060 | 0.0120 | 0.0240 | |

18) Which of the following if plotted versus time should give a straight line plot for a first order reaction involving ethane C_2H_4 ?

$[C_2H_4]$ versus time $\ln [C_2H_4]$ versus time $1/[C_2H_4]$ versus time

19) The potential energy curve shown below is for a reaction occurring with a catalyst. Draw a curve on the same diagram showing how the energy curve would look if the same reaction was run with no catalyst present.



20) Which of the following would have the highest entropy (circle)

$I_2(g)$ $I_2(l)$ $I_2(s)$

21) For the rate law involving a reaction of Br_2 and NO that is described completely by $d[NO]/dt = k [NO]^2$ then if you doubled the initial amount of Br_2 then the reaction will go:

the same speed two times faster four times faster eight times faster

22) Recall the Arrhenius Equation where $k = A e^{-E_a/RT}$. If the reaction of sucrose being converted to glucose and fructose occurs at room temperature $25^\circ C$ with an energy of activation of 107 kJ/mol and a frequency factor of $1.00 \times 10^{15} \text{ s}^{-1}$ and then an enzyme is added that lowers this energy of activation to 35 kJ/mol then how much faster is the rate of the reaction with this biological catalyst present then without it?