

Dr. Zellmer  
Time: 7 PM Sun.  
40 min

Chemistry 1250  
Spring Semester 2022  
Quiz XII

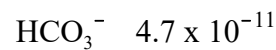
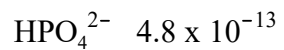
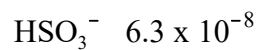
T, R  
April 24, 2022

Name \_\_\_\_\_ Rec. TA/time \_\_\_\_\_

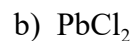
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Show **ALL** your work or **EXPLAIN** to receive full credit.

1. (3 pts) Given the following  $K_a$  values, determine which species is the **strongest base**. **Explain!**

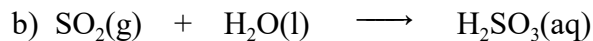
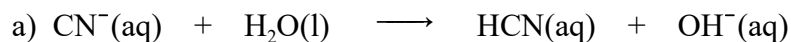


2. (2 pts) Would you expect the following solutions to be acidic, neutral, or basic? **Explain or show work!**



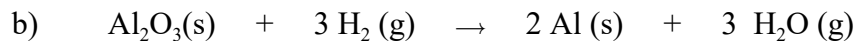
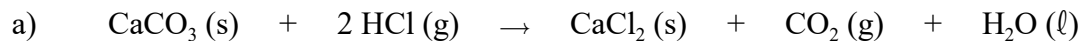
3. (8 pts) What is the **pH** of a 0.30 M  $\text{NaCHO}_2$  solution at  $25^\circ\text{C}$ ? ( $\text{HCHO}_2$ :  $K_a = 1.8 \times 10^{-4}$ , at  $25^\circ\text{C}$ )  
(**Show the ICE table, state any assumptions made and check your percent error.**) **Explain or show work!**

4. (2 pts) Identify the Lewis acid and Lewis base in the following reactions. **Explain!**

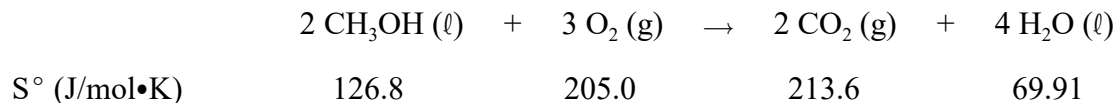


5. (3 pts) Calculate the  $\Delta S$  (J/mol•K) of fusion for a compound which melts at  $-183.0^\circ\text{C}$ . The heat of fusion is 2.86 kJ/mole.

6. (4 pts) Predict the **sign** of  $\Delta S$  of the system **or** if it's **approximately zero** for the following reactions and **explain** your choices.

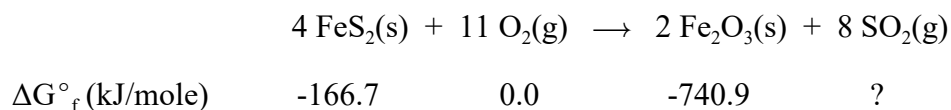


7. (5 pts) Determine the entropy of reaction ( $\Delta S^\circ$ ) (in J/mol-K) for the following reaction at  $25^\circ\text{C}$ .

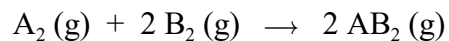


8. (3 pts) Write the reaction for the formation of  $\text{NH}_4\text{NO}_3(\text{s})$  which corresponds to  $\Delta H_f^\circ$  and  $\Delta G_f^\circ$  and explain why you've written it the way you have.

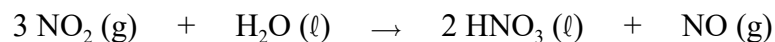
9. (3 pts) Given  $\Delta G^\circ = -3217.4 \text{ kJ/mol}$  and the listed  $\Delta G_f^\circ$  values calculate  $\Delta G_f^\circ$  for  $\text{SO}_2(\text{g})$ .



10. (5 pts) For the following reaction  $\Delta H^\circ$  is  $-150.5 \text{ kJ/mol}$ ,  $\Delta S^\circ$  is  $-293.1 \text{ J/K}\cdot\text{mol}$  at  $25^\circ\text{C}$ . Assuming these don't change with temperature what is the value of  $\Delta G^\circ$  (kJ/mol) at  $141.0^\circ\text{C}$ ?



11. (13 pts) Given  $\Delta H^\circ = -71.75 \text{ kJ}$  and  $\Delta S^\circ = -268.0 \text{ J/mol}\cdot\text{K}$  for the following reaction at  $25^\circ\text{C}$ ,



a) (2 pts) Calculate the  $\Delta G^\circ$  of the reaction at  $25^\circ\text{C}$ . Is the reaction spontaneous or nonspontaneous at this temperature under standard state conditions? **Show all work and explain.**

b) (4 pts) If the reaction is nonspontaneous, at what temperature would it be spontaneous. If the reaction is spontaneous, at what temperature would it be nonspontaneous. If the reaction will always be spontaneous at all temperatures or never be spontaneous at any temperature state that. **Show ALL work & explain!**

c) (2 pts) What is the equilibrium constant at  $25^\circ\text{C}$ ? **Show all work and explain.**

d) (1 pt) This  $\Delta G^\circ$  and  $K$  corresponds to an equilibrium that is: (choose one from below & explain)

- 1) closer to products
- 2) closer to reactants
- 3) midway between reactants and products (significant amounts of both at equilibrium)

e) (4 pts) Is the reaction spontaneous or nonspontaneous at  $25^\circ\text{C}$  when the pressures of  $\text{NO}_2$  and  $\text{NO}$  are  $2.50 \text{ atm}$  and  $0.50 \text{ atm}$ , respectively? **Show all work and explain.**

## USEFUL INFORMATION

$$R = 0.08206 \text{ L-atm/mol-K} = 8.3145 \text{ J/mol-K}$$

$$K_w = [H_3O^+][OH^-] = 1.0 \times 10^{-14} \quad (\text{at } 25^\circ\text{C})$$

$$pH = -\log[H_3O^+]; \quad pOH = -\log[OH^-]; \quad pK_w = -\log[K_w]$$

$$\text{for } ax^2 + bx + c = 0, \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$S = k \bullet \ln W$$

|   | IA                        | IIA                       | IIIB                      | IVB                       | VB                        | VIB                      | VIIIB                     | VIIIB                     | IB                        | IIB                       | IIIA                      | IVA                       | VA                        | VIA                       | VIIA                      | VIIIA                     |                           |                           |
|---|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| 1 | 1.008<br><b>H</b><br>1    |                           |                           |                           |                           |                          |                           |                           |                           |                           |                           |                           |                           |                           |                           | 4.003<br><b>He</b><br>2   |                           |                           |
| 2 | 6.941<br><b>Li</b><br>3   | 9.012<br><b>Be</b><br>4   |                           |                           |                           |                          |                           |                           |                           |                           | 10.811<br><b>B</b><br>5   | 12.011<br><b>C</b><br>6   | 14.007<br><b>N</b><br>7   | 15.999<br><b>O</b><br>8   | 18.998<br><b>F</b><br>9   | 20.179<br><b>Ne</b><br>10 |                           |                           |
| 3 | 22.990<br><b>Na</b><br>11 | 24.305<br><b>Mg</b><br>12 |                           |                           |                           |                          |                           |                           |                           |                           | 26.98<br><b>Al</b><br>13  | 28.09<br><b>Si</b><br>14  | 30.974<br><b>P</b><br>15  | 32.06<br><b>S</b><br>16   | 35.453<br><b>Cl</b><br>17 | 39.948<br><b>Ar</b><br>18 |                           |                           |
| 4 | 39.098<br><b>K</b><br>19  | 40.08<br><b>Ca</b><br>20  | 44.96<br><b>Sc</b><br>21  | 47.88<br><b>Ti</b><br>22  | 50.94<br><b>V</b><br>23   | 52.00<br><b>Cr</b><br>24 | 54.94<br><b>Mn</b><br>25  | 55.85<br><b>Fe</b><br>26  | 58.93<br><b>Co</b><br>27  | 58.69<br><b>Ni</b><br>28  | 63.546<br><b>Cu</b><br>29 | 65.38<br><b>Zn</b><br>30  | 69.72<br><b>Ga</b><br>31  | 72.59<br><b>Ge</b><br>32  | 74.92<br><b>As</b><br>33  | 78.96<br><b>Se</b><br>34  | 79.904<br><b>Br</b><br>35 | 83.80<br><b>Kr</b><br>36  |
| 5 | 85.47<br><b>Rb</b><br>37  | 87.62<br><b>Sr</b><br>38  | 88.91<br><b>Y</b><br>39   | 91.22<br><b>Zr</b><br>40  | 92.91<br><b>Nb</b><br>41  | 95.94<br><b>Mo</b><br>42 | 98<br><b>Tc</b><br>43     | 101.07<br><b>Ru</b><br>44 | 102.91<br><b>Rh</b><br>45 | 106.42<br><b>Pd</b><br>46 | 107.87<br><b>Ag</b><br>47 | 112.41<br><b>Cd</b><br>48 | 114.82<br><b>In</b><br>49 | 118.69<br><b>Sn</b><br>50 | 121.75<br><b>Sb</b><br>51 | 127.60<br><b>Te</b><br>52 | 126.90<br><b>I</b><br>53  | 131.39<br><b>Xe</b><br>54 |
| 6 | 132.91<br><b>Cs</b><br>55 | 137.33<br><b>Ba</b><br>56 | 138.91<br><b>La</b><br>57 | 178.39<br><b>Hf</b><br>72 | 180.95<br><b>Ta</b><br>73 | 183.85<br><b>W</b><br>74 | 186.21<br><b>Re</b><br>75 | 190.23<br><b>Os</b><br>76 | 192.22<br><b>Ir</b><br>77 | 195.08<br><b>Pt</b><br>78 | 196.97<br><b>Au</b><br>79 | 200.59<br><b>Hg</b><br>80 | 204.38<br><b>Tl</b><br>81 | 207.2<br><b>Pb</b><br>82  | 208.98<br><b>Bi</b><br>83 | 209<br><b>Po</b><br>84    | 210<br><b>At</b><br>85    | 222<br><b>Rn</b><br>86    |
| 7 | 223<br><b>Fr</b><br>87    | 226.03<br><b>Ra</b><br>88 | 227.03<br><b>Ac</b><br>89 | 261<br><b>Rf</b><br>104   | 262<br><b>Ha</b><br>105   | 263<br><b>Sg</b><br>106  | 262<br><b>Ns</b><br>107   | 265<br><b>Hs</b><br>108   | 266<br><b>Mt</b><br>109   | 269<br><b>110</b>         | 272<br><b>111</b>         | 277<br><b>112</b>         |                           |                           |                           |                           |                           |                           |

|                   |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |                           |
|-------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Lanthanide Series | 140.12<br><b>Ce</b><br>58 | 140.91<br><b>Pr</b><br>59 | 144.24<br><b>Nd</b><br>60 | 145<br><b>Pm</b><br>61    | 150.36<br><b>Sm</b><br>62 | 151.96<br><b>Eu</b><br>63 | 157.25<br><b>Gd</b><br>64 | 158.93<br><b>Tb</b><br>65 | 162.50<br><b>Dy</b><br>66 | 164.93<br><b>Ho</b><br>67 | 167.26<br><b>Er</b><br>68 | 168.93<br><b>Tm</b><br>69 | 173.04<br><b>Yb</b><br>70 | 173.04<br><b>Lu</b><br>71 |
| Actinide Series   | 232.04<br><b>Th</b><br>90 | 231.04<br><b>Pa</b><br>91 | 238.03<br><b>U</b><br>92  | 237.05<br><b>Np</b><br>93 | <b>Pu</b><br>94           | <b>Am</b><br>95           | <b>Cm</b><br>96           | <b>Bk</b><br>97           | <b>Cf</b><br>98           | <b>Es</b><br>99           | <b>Fm</b><br>100          | <b>Md</b><br>101          | <b>No</b><br>102          | <b>Lr</b><br>103          |

A PERIODIC CHART OF THE ELEMENTS  
(Based on <sup>12</sup>C)