Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which of the following processes have a $\Delta S > 0$?
   A) lithium fluoride forms from its elements
   B) $2\,HF(g) \rightarrow H_2(g) + F_2(l)$
   C) potassium iodide dissolves in pure water
   D) $2\,NH_3(g) + CO_2(g) \rightarrow NH_2CONH_2(aq) + H_2O(l)$
   E) All of the above processes have a $\Delta S > 0$.

2) Which of the following processes have a $\Delta S < 0$?
   A) carbon dioxide(g) $\rightarrow$ carbon dioxide(s)
   B) methyl alcohol condenses
   C) water freezes
   D) propanol (g, at 555 K) $\rightarrow$ propanol (g, at 400 K)
   E) All of the above processes have a $\Delta S < 0$.

3) Consider the following reaction at constant P. Use the information here to determine the value of ΔS_{surr} at 298
   K. Predict whether or not this reaction will be spontaneous at this temperature.

   $$N_2(g) + 2\,O_2(g) \rightarrow 2\,NO_2(g) \qquad\qquad \Delta H = +66.4\ kJ$$
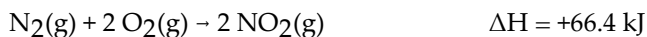
   A) $\Delta S_{surr} = +2656$ kJ/K, reaction is not spontaneous
   B) $\Delta S_{surr} = +223$ J/K, reaction is spontaneous spontaneous
   C) $\Delta S_{surr} = -223$ J/K, reaction is not spontaneous
   D) $\Delta S_{surr} = -66.4$ J/K, reaction is not spontaneous
   E) $\Delta S_{surr} = -66.4$ J/K, it is not possible to predict the spontaneity of this reaction without more information.

4) Place the following in order of decreasing molar entropy at 298 K.

   HF N_2H_4 Ar

   A) $N_2H_4 > Ar > HF$
   B) $Ar > N_2H_4 > HF$
   C) $HF > N_2H_4 > Ar$
   D) $Ar > HF > N_2H_4$
   E) $N_2H_4 > HF > Ar$

5) Place the following in order of decreasing standard molar entropy.

$\quad\quad$ NaF(s) $\quad\quad$ Li$_3$PO$_4$(aq) $\quad\quad$ NaF(aq)

$\quad\quad$ A) NaF(s) > Li$_3$PO$_4$(aq) > NaF(aq)
$\quad\quad$ B) NaF(s) > NaF(aq) > Li$_3$PO$_4$(aq)
$\quad\quad$ C) NaF(aq) > Li$_3$PO$_4$(aq) > NaF(s)
$\quad\quad$ D) NaF(aq) > NaF(s) > Li$_3$PO$_4$(aq)
$\quad\quad$ E) Li$_3$PO$_4$(aq) > NaF(aq) > NaF(s)

6) Which one of the following would be expected to have the lowest standard molar entropy, $S°$, at 25°C?
$\quad\quad$ A) C$_{14}$H$_{30}$(s) $\quad\quad\quad\quad$ B) C$_{10}$H$_{22}$(l) $\quad\quad\quad\quad$ C) C$_{14}$H$_{30}$OH(l) $\quad\quad\quad\quad$ D) C$_{10}$H$_{22}$(s)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

7) Why can't we say that a spontaneous reaction is a fast reaction?

8) Why can endothermic reactions be spontaneous?

$\quad\quad$ **** For the exam, make sure you can calculate for delta G using different methods. Review every example problem in the example packet.**

1) C
2) E
3) C
4) E
5) E
6) D
7) Spontaneity is a thermodynamic quantity that determines if a reaction will occur and to what extent. The speed of a reaction is not related to the spontaneity. A spontaneous reaction can be very slow.
8) Even though an endothermic process requires energy from the surroundings, it can be spontaneous if the disorder (entropy) increase of the process overcomes that energy cost. Overall the entropy of the universe must increase during the process.