1 Which of the statements below concerning thermodynamic sign convention is true:

1. \( w \) is positive when work is done by the system.
2. \( \Delta H \) is negative when heat is added to the system.
3. work is done on the system when \( \Delta V \) is positive.
4. \( \Delta S_{\text{univ}} \) is zero when a reaction is nonspontaneous.
5. \( \Delta H \) is positive in an exothermic reaction.

2. A friend states that living organisms violate the second law of thermodynamics and consequently we exist only as a figment of our imagination. Your best reply would be:

1. as long as the entropy of the surroundings increased while you were being formed, no laws were broken
2. the second lay of thermodynamics applies to chemistry, not biology
3. a first offense of the second law is only a misdemeanor, don’t sweat the small stuff
4. philosophical arguments are exothermic because they generate a lot of hot air

3 Which of the compounds
   I) ammonia, \( \Delta G_f^o = -17 \text{ kJ/mol} \)
   II) calcium carbonate, \( \Delta G_f^o = -1128 \text{ kJ/mol} \)
   III) water, \( \Delta G_f^o = -237 \text{ kJ/mol} \)
   IV) benzene, \( \Delta G_f^o = 124 \text{ kJ/mol} \)
   is/are stable with respect to decomposition into their elements under standard conditions

1. III and IV only
2. I, III and IV only
3. II only
4. I and II only
5. II and III only
6. I, II and III only
7. II, III, and IV only
8. III only
9. Another combination
10. Cannot be determined

4 Calculate the change in entropy of a large pail of water after 1000 J of energy is reversibly removed from the water at 50°C.

1. +3.09 J/K
2. -3.09 J/K.
3. -50J/K
4. +50J/K
5 Calculate the normal boiling point of water given that the standard entropy and enthalpy of vaporization of water is +109 J/K/mol and 40.65 kJ/mol, respectively.

1. 0K
2. 100 K
3. 373 K
4. 405 K
5. 450 K

6 For the reaction \(2\text{H}_2\text{O}(g) \rightarrow 2\text{H}_2(g) + \text{O}_2(g)\) \(\Delta H_f^\circ = 484\) kJ/mol and \(\Delta S_f^\circ = +90\) J/molK. Which statement is true for this reaction?

1. The reaction is driven by the enthalpy.
2. The reaction will be spontaneous at low temperatures.
3. \(\Delta G_f^\circ\) will be negative at high temperatures.
4. The reaction will not be spontaneous at any temperature.
5. \(\Delta G_f^\circ\) will be positive at high temperatures.

7 Consider the following reaction:
\[2\text{H}_2\text{O}(g) \rightarrow 2\text{H}_2(g) + \text{O}_2(g)\]

<table>
<thead>
<tr>
<th></th>
<th>(\Delta H_f^\circ) (kJ/mol)</th>
<th>(S_f^\circ) (J/molK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{H}_2\text{O})</td>
<td>-241.8</td>
<td>188.8</td>
</tr>
<tr>
<td>(\text{H}_2)</td>
<td>0</td>
<td>130.7</td>
</tr>
<tr>
<td>(\text{O}_2)</td>
<td>0</td>
<td>205.1</td>
</tr>
</tbody>
</table>

Calculate \(\Delta G_f^\circ\) for the reactions at 300 K given the formation data above.

1. 457 kJ/mol
2. -457 kJ/mol
3. 510 kJ/mol
4. -214 kJ/mol

8 The entropy of boiling of water is +109.1 J/molK and the enthalpy of boiling of water is +40.6 kJ/mol at 100°C? What is \(\Delta S_{\text{total}}\) for the melting of ice at 100°C?

1. \(\Delta S_{\text{total}} = -109\) J/molK
2. \(\Delta S_{\text{total}} = 0\) J/molK
3. \(\Delta S_{\text{total}} = +109\) J/molK
4. Cannot determine without \(\Delta S_{\text{surr}}\)