Thermo Practice Key is at the end

1. Which of these species would you expect to have the highest standard entropy (S°)?
   A) $CH_4(g)$
   B) $C_2H_2(g)$
   C) $C_2H_4(g)$
   D) $C_2H_6(g)$
   E) $C_3H_8(g)$

2. Arrange these compounds in order of increasing standard molar entropy at 25°C:
   $C_3H_8(g)$, $C_2H_4(g)$, ZnS(s), and $H_2O(l)$.
   A) $ZnS(s) < H_2O(l) < C_3H_8(g) < C_2H_4(g)$
   B) $C_2H_4(g) < H_2O(l) < C_3H_8(g) < NaCl(s)$
   C) $ZnS(s) < C_3H_8(g) < C_2H_4(g) < H_2O(l)$
   D) $C_3H_8(g) < C_2H_4(g) < H_2O(l) < ZnS(s)$
   E) $ZnS(s) < H_2O(l) < C_2H_4(g) < C_3H_8(g)$

3. Which response includes *all* of the following processes that are accompanied by an *increase* in entropy?
   1) $I_2(s) \rightarrow I_2(g)$
   2) $2I(g) \rightarrow I_2(g)$
   3) $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$
   4) $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$
   A) 1, 2
   B) 1, 3
   C) 3, 4
   D) 3
   E) 2, 4

4. Calculate $\Delta S°$ at 25°C for the reduction of PbO(s), $2PbO(s) + C(s) \rightarrow 2Pb(s) + CO_2(g)$ given these absolute entropies:

	S° (J/K·mol)
PbO(s)	69.45
C(s)	5.7
Pb(s)	64.89
$CO_2(g)$	213.6

   A) +198.8 J/K·mol
   B) +488.0 J/K·mol
   C) +353.6 J/K·mol
   D) –203.3 J/K·mol
   E) +203.3 J/K·mol

5. HI has a normal boiling point of –35.4°C, and its ΔH_{vap} is 21.16 kJ/mol. Calculate the molar entropy of vaporization (ΔS_{vap}).
   A) 598 J/K·mol
   B) 68.6 J/K·mol
   C) 75.2 J/K·mol
   D) 0.068 J/K·mol
   E) 89.0 J/K·mol

6. Aluminum forms a layer of aluminum oxide when exposed to air which protects the bulk metal from further corrosion.

   $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

   Calculate $\Delta G°$ for this reaction, given that $\Delta G°_f$ of aluminum oxide is –1576.4 kJ/mol.
   A) –3152.8 kJ/mol
   B) –1576.4 kJ/mol
   C) –788.2 kJ/mol
   D) 1576.4 kJ/mol
   E) 3152.8 kJ/mol

7. Ozone (O_3) in the atmosphere can reaction with nitric oxide (NO):

   $O_3(g) + NO(g) \rightarrow NO_2(g) + O_2(g)$.

   Calculate the $\Delta G°$ for this reaction at 25°C. ($\Delta H° = –199$ kJ/mol, $\Delta S° = –4.1$ J/K·mol)
   A) 1020 kJ/mol
   B) $–1.22 \times 10^3$ kJ/mol
   C) 2.00×10^3 kJ/mol
   D) $–1.42 \times 10^3$ kJ/mol
   E) –198 kJ/mol

8. The element oxygen was prepared by Joseph Priestley in 1774 by heating mercury(II) oxide:

   $HgO(s) \rightarrow Hg(l) + {}^1/_2O_2(g)$, $\Delta H° = 90.84$ kJ/mol.

   Estimate the temperature at which this reaction will become spontaneous under standard state conditions.

   $S°(Hg) = 76.02$ J/K·mol
   $S°(O_2) = 205.0$ J/K·mol
   $S°(HgO) = 70.29$ J/K·mol

   A) 108 K
   B) 430 K
   C) 620 K
   D) 775 K
   E) 840 K

9. Calculate K_p at 298 K for the reaction $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$.

	$\Delta G°_f$
$SO_2(g)$	–300.4 kJ/mol
$SO_3(g)$	–370.4 kJ/mol
$NO(g)$	86.7 kJ/mol
$NO_2(g)$	51.8 kJ/mol

A) 6.99×10^{-7}
B) 5.71×10^{-8}
C) 14.2
D) 475
E) 1.42×10^{6}

10. Calculate $\Delta G°$ for the combustion of ethanol vapor, $C_2H_5OH(g)$, at 750°C in oxygen to form carbon dioxide and water vapor. The following data is valid at 25°C:

	$\Delta H°_f$ (kJ/mol)	$\Delta G°_f$ (kJ/mol)
$C_2H_5OH(g)$	–234.8	–167.9
$O_2(g)$	0	0
$H_2O(g)$	–241.8	–228.6
$CO_2(g)$	–393.5	–394.4

A) –1407 kJ/mol
B) –2151 kJ/mol
C) –1307 kJ/mol
D) –4486 kJ/mol
E) –1377 kJ/mol

Answer Key

1. E
2. E
3. B
4. A
5. E
6. A
7. E
8. E
9. E
10. E