

Thermo Practice Key is at the end

1. Which of these species would you expect to have the highest standard entropy (S°)?

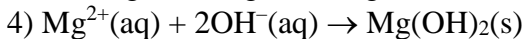
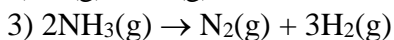
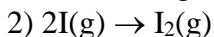
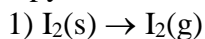
- A) $\text{CH}_4(\text{g})$
- B) $\text{C}_2\text{H}_2(\text{g})$
- C) $\text{C}_2\text{H}_4(\text{g})$
- D) $\text{C}_2\text{H}_6(\text{g})$
- E) $\text{C}_3\text{H}_8(\text{g})$

2. Arrange these compounds in order of increasing standard molar entropy at 25°C :

$\text{C}_3\text{H}_8(\text{g})$, $\text{C}_2\text{H}_4(\text{g})$, $\text{ZnS}(\text{s})$, and $\text{H}_2\text{O}(\text{l})$.

- A) $\text{ZnS}(\text{s}) < \text{H}_2\text{O}(\text{l}) < \text{C}_3\text{H}_8(\text{g}) < \text{C}_2\text{H}_4(\text{g})$
- B) $\text{C}_2\text{H}_4(\text{g}) < \text{H}_2\text{O}(\text{l}) < \text{C}_3\text{H}_8(\text{g}) < \text{NaCl}(\text{s})$
- C) $\text{ZnS}(\text{s}) < \text{C}_3\text{H}_8(\text{g}) < \text{C}_2\text{H}_4(\text{g}) < \text{H}_2\text{O}(\text{l})$
- D) $\text{C}_3\text{H}_8(\text{g}) < \text{C}_2\text{H}_4(\text{g}) < \text{H}_2\text{O}(\text{l}) < \text{ZnS}(\text{s})$
- E) $\text{ZnS}(\text{s}) < \text{H}_2\text{O}(\text{l}) < \text{C}_2\text{H}_4(\text{g}) < \text{C}_3\text{H}_8(\text{g})$

3. Which response includes *all* of the following processes that are accompanied by an *increase* in entropy?



- A) 1, 2
- B) 1, 3
- C) 3, 4
- D) 3
- E) 2, 4

4. Calculate ΔS° at 25°C for the reduction of $\text{PbO}(\text{s})$, $2\text{PbO}(\text{s}) + \text{C}(\text{s}) \rightarrow 2\text{Pb}(\text{s}) + \text{CO}_2(\text{g})$ given these absolute entropies:

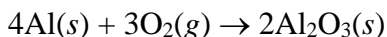
	S° (J/K·mol)
$\text{PbO}(\text{s})$	69.45
$\text{C}(\text{s})$	5.7
$\text{Pb}(\text{s})$	64.89
$\text{CO}_2(\text{g})$	213.6

- 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) $598 \text{ J/K}\cdot\text{mol}$
B) $68.6 \text{ J/K}\cdot\text{mol}$
C) $75.2 \text{ J/K}\cdot\text{mol}$
D) $0.068 \text{ J/K}\cdot\text{mol}$
E) $89.0 \text{ J/K}\cdot\text{mol}$

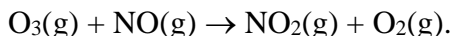
6. Aluminum forms a layer of aluminum oxide when exposed to air which protects the bulk metal from further corrosion.



Calculate ΔG° for this reaction, given that ΔG°_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

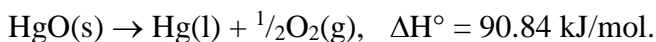
7. Ozone (O_3) in the atmosphere can reaction with nitric oxide (NO):



Calculate the ΔG° for this reaction at 25°C . ($\Delta H^{\circ} = -199 \text{ kJ/mol}$, $\Delta S^{\circ} = -4.1 \text{ J/K}\cdot\text{mol}$)

A) 1020 kJ/mol
B) $-1.22 \times 10^3 \text{ kJ/mol}$
C) $2.00 \times 10^3 \text{ kJ/mol}$
D) $-1.42 \times 10^3 \text{ kJ/mol}$
E) -198 kJ/mol

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



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

$$S^{\circ}(\text{Hg}) = 76.02 \text{ J/K}\cdot\text{mol}$$

$$S^{\circ}(\text{O}_2) = 205.0 \text{ J/K}\cdot\text{mol}$$

$$S^{\circ}(\text{HgO}) = 70.29 \text{ J/K}\cdot\text{mol}$$

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 $\text{SO}_2(\text{g}) + \text{NO}_2(\text{g}) \rightleftharpoons \text{SO}_3(\text{g}) + \text{NO}(\text{g})$.

	ΔG°_f
$\text{SO}_2(\text{g})$	-300.4 kJ/mol
$\text{SO}_3(\text{g})$	-370.4 kJ/mol
$\text{NO}(\text{g})$	86.7 kJ/mol
$\text{NO}_2(\text{g})$	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 ΔG° for the combustion of ethanol vapor, $\text{C}_2\text{H}_5\text{OH}(\text{g})$, at 750°C in oxygen to form carbon dioxide and water vapor. The following data is valid at 25°C:

	ΔH°_f (kJ/mol)	ΔG°_f (kJ/mol)
$\text{C}_2\text{H}_5\text{OH}(\text{g})$	-234.8	-167.9
$\text{O}_2(\text{g})$	0	0
$\text{H}_2\text{O}(\text{g})$	-241.8	-228.6
$\text{CO}_2(\text{g})$	-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