

$$PV = nRT$$

$$R = 0.0821 \text{ L}\cdot\text{atm}/(\text{mole}\cdot\text{K})$$

$$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$$

$$760 \text{ mm Hg} = 1 \text{ atm}$$

$$1 \text{ torr} = 1 \text{ mm Hg}$$

- (2 points) At a given temperature and pressure, which of the following would be expected to have the greatest molar entropy?
 A) $\text{H}_2\text{O}(s)$ B) $\text{H}_2\text{O}(l)$ C) $\text{H}_2\text{O}(g)$ D) All of these would be expected to have the same molar entropy.
- (2 points) For the following: $\text{NH}_3(g) \rightarrow \text{N}(g) + 3 \text{H}(g)$, one would expect
 A) ΔH° to be negative and ΔS° to be negative. B) ΔH° to be negative and ΔS° to be positive.
 C) ΔH° to be positive and ΔS° to be negative. D) ΔH° to be positive and ΔS° to be positive.
- (2 points) Determine the sign of ΔS° for each of the following:
 I. $\text{C}_6\text{H}_6(s) \rightarrow \text{C}_6\text{H}_6(l)$
 II. $2 \text{SO}_2(g) + \text{O}_2(g) \rightarrow 2 \text{SO}_3(g)$
- (2 points) Determine ΔG° at 298.15K for the reaction
 $2\text{NO}(g) + \text{O}_2(g) \rightarrow 2\text{NO}_2(g)$ $\Delta H^\circ = -114.1 \text{ kJ}$ $\Delta S^\circ = -146.2 \text{ J K}^{-1}$
- (2 points) Circle all of the conditions that always result in a spontaneous (favorable, exergonic) reaction:
 ΔH is negative and ΔS is negative. ΔH is negative and ΔS is positive.
 ΔH is positive and ΔS is negative. ΔH is positive and ΔS is positive.
- (2 points) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains CH_4 , flask B contains CO_2 , flask C contains N_2 . Which flask contains the largest number of molecules?
 A) flask A B) flask B C) flask C D) All flasks contain the same number of molecules.
- (4 points) The volume of 350. mL of gas at 25°C is decreased to 125 mL at constant pressure. What is the final temperature of the gas?
- (4 points) A steel tank has a volume of 438 L and is filled with 0.885 kg of O_2 . Calculate the pressure of O_2 at 21°C .

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- (2 points) At a given temperature and pressure, which of the following would be expected to have the greatest molar entropy?
 A) $\text{H}_2\text{O}(s)$ B) $\text{H}_2\text{O}(l)$ C) $\text{H}_2\text{O}(g)$ D) All of these would be expected to have the same molar entropy.
- (2 points) For the following: $\text{N}(g) + 3 \text{H}(g) \rightarrow \text{NH}_3(g)$, one would expect
 A) ΔH° to be negative and ΔS° to be negative. B) ΔH° to be negative and ΔS° to be positive.
 C) ΔH° to be positive and ΔS° to be negative. D) ΔH° to be positive and ΔS° to be positive.
- (2 points) Determine the sign of ΔS° for each of the following:
 I. $2 \text{SO}_2(g) + \text{O}_2(g) \rightarrow 2 \text{SO}_3(g)$
 II. $\text{C}_6\text{H}_6(s) \rightarrow \text{C}_6\text{H}_6(l)$
- (2 points) Determine ΔG° at 298.15K for the reaction
 $2\text{NO}(g) + \text{O}_2(g) \rightarrow 2\text{NO}_2(g)$ $\Delta H^\circ = -114.1 \text{ kJ}$ $\Delta S^\circ = -146.2 \text{ J K}^{-1}$
- (2 points) Circle all of the conditions that always result in a nonspontaneous (unfavorable, endergonic) reaction:
 ΔH is negative and ΔS is negative. ΔH is negative and ΔS is positive.
 ΔH is positive and ΔS is negative. ΔH is positive and ΔS is positive.
- (2 points) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains CH_4 , flask B contains CO_2 , flask C contains N_2 . Which flask contains the largest number of molecules?
 A) flask A B) flask B C) flask C D) All flasks contain the same number of molecules.
- (4 points) The volume of 402. mL of gas at 22°C is decreased to 112 mL at constant pressure. What is the final temperature of the gas?
- (4 points) A steel tank has a volume of 452 L and is filled with 0.775 kg of O_2 . Calculate the pressure of O_2 at 24°C .