

Recitation 3 Worksheet Thermodynamics

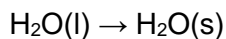
Name:

UGA ID:

Instructions:

- Please enter your first and last name as it appears on the eLC roster (do not use a nickname).
- Your UGA myID is a combination of letters and numbers (example: mine is sre13137). **Do not use your 81x number.**
- If you have a printer, print the worksheet, write your answers on the template showing your work where appropriate, convert it to a PDF and Upload this worksheet to Gradescope by 11:59 p.m. on Tuesday, September 22. You do not need to upload anything to eLC.
- If you do not have a printer, type your answers in the boxes and write your work on separate sheets of paper and convert your work to a PD. Upload the PDF of your work to eLC in the Dropbox. Then upload the worksheet template to Gradescope by 11:59 p.m. on Tuesday, September 22.

1. For the example, identify the signs for enthalpy and entropy.



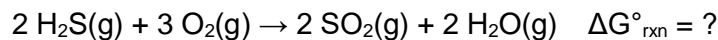
- A. a negative ΔH and a negative ΔS
- B. a positive ΔH and a negative ΔS
- C. a negative ΔH and a positive ΔS
- D. a positive ΔH and a positive ΔS
- E. It is not possible to determine without more information.

2. Place the substances in order of increasing entropy at 298 K.



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3. Calculate the $\Delta G^\circ_{\text{rxn}}$ using the following information.

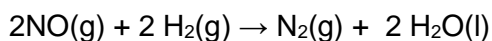


kJ

4. For a given reaction, $\Delta H = + 29.9 \text{ kJ/mol}$ and $\Delta S = + 57.0 \text{ J/K}\cdot\text{mol}$. The reaction is spontaneous _____. (Assume that ΔH and ΔS do not vary with temperature).

- A. at $T < 525 \text{ K}$
- B. at $T > 525 \text{ K}$
- C. at $T > 298 \text{ K}$
- D. at $T < 298 \text{ K}$
- E. at all temperatures

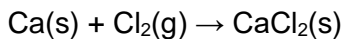
5. Calculate $\Delta S^\circ_{\text{rxn}}$ for the following reaction. The S° for each species is shown below the reaction.



$S^\circ (\text{J/mol}\cdot\text{K})$	210.8	130.7	191.6	69.9
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J/mol·K

6. The value of ΔG° at 221.0°C for the formation of calcium chloride from its constituent elements is _____ kJ/mol.



At 25.0°C for this reaction, ΔH° is -795.8 kJ/mol , ΔG° is -748.1 kJ/mol , and ΔS° is -159.8 J/K .

kJ/mol

7. Determine $\Delta G^\circ_{\text{rxn}}$ for the following reaction at 378 K .



$\Delta H^\circ = +179.2 \text{ kJ}$

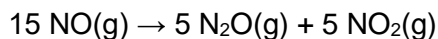
$\Delta S^\circ = +160.2 \text{ J/K}$

kJ/mol

8. Given the following equation,

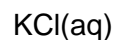


Calculate $\Delta G^\circ_{\text{rxn}}$ for the following reaction.



kJ

9. Place the following in order of decreasing standard molar entropy.



I

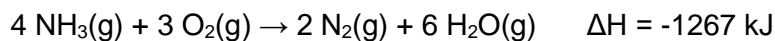
II

III

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10. Consider the following reaction at constant P. Use the information here to determine the value of ΔS_{surr} at 398 K. Predict whether or not this reaction will be spontaneous at this temperature.

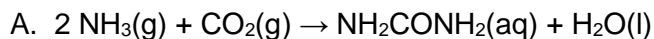


$\Delta S_{\text{surr}} =$

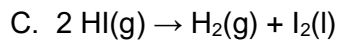
kJ/K,

The reaction is

11. Which of the following processes have a $\Delta S > 0$?



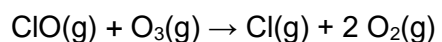
B. lithium fluoride forms from its elements



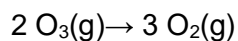
D. lithium chloride dissolves in pure water

E. All of the above processes have a $\Delta S > 0$.

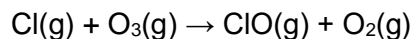
12. Use Hess's law to calculate $\Delta G^\circ_{\text{rxn}}$ using the following information.



$$\Delta G^\circ_{\text{rxn}} = ?$$



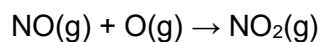
$$\Delta G^\circ_{\text{rxn}} = +489.6 \text{ kJ}$$



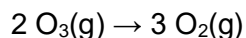
$$\Delta G^\circ_{\text{rxn}} = -34.5 \text{ kJ}$$

kJ

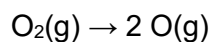
13. Use Hess's law to calculate $\Delta G^\circ_{\text{rxn}}$ using the following information.



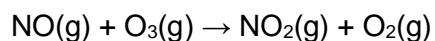
$$\Delta G^\circ_{\text{rxn}} = ?$$



$$\Delta G^\circ_{\text{rxn}} = +489.6 \text{ kJ}$$



$$\Delta G^\circ_{\text{rxn}} = +463.4 \text{ kJ}$$



$$\Delta G^\circ_{\text{rxn}} = -199.5 \text{ kJ}$$

kJ

14. Consider a reaction that has a negative ΔH and a negative ΔS . Which of the following statements is TRUE?

- A. This reaction will be spontaneous only at low temperatures.
- B. This reaction will be spontaneous at all temperatures.
- C. This reaction will be nonspontaneous at all temperatures.
- D. This reaction will be nonspontaneous only at low temperatures.
- E. It is not possible to determine without more information.

15. The reaction $2 \text{H}_2\text{O}(g) + \text{CO}_2(g) \rightarrow \text{CH}_4(g) + 2 \text{CO}_2(g)$ is nonspontaneous at 25 °C. The addition of a catalyst will (decrease, increase, not change) the rate of reaction

and (decrease, increase, not change) the spontaneity of the reaction.

16. Acetylene, C_2H_2 , has a standard enthalpy of formation, $\Delta H^\circ = 226.7 \text{ kJ/mol}$, and a standard entropy change for its formation from its elements, $\Delta S^\circ = 58.8 \text{ J/K}\cdot\text{mol}$. The standard free energy of formation of acetylene is

kJ/mol.