

Questions 1-5 refer to the following information

Reaction 1: $\text{N}_2\text{H}_4(l) + \text{H}_2(g) \rightarrow 2\text{NH}_3(g)$	$\Delta H = ?$
Reaction 2: $\text{N}_2\text{H}_4(l) + \text{CH}_4\text{O}(l) \rightarrow \text{CH}_2\text{O}(g) + \text{N}_2(g) + 3\text{H}_2(g)$	$\Delta H = -37 \text{ kJ/mol}_{\text{rxn}}$
Reaction 3: $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)$	$\Delta H = -46 \text{ kJ/mol}_{\text{rxn}}$
Reaction 4: $\text{CH}_4\text{O}(l) \rightarrow \text{CH}_2\text{O}(g) + \text{H}_2(g)$	$\Delta H = -65 \text{ kJ/mol}_{\text{rxn}}$

1. What is the enthalpy change for reaction 1?

- A. -148 kJ/mol<sub>rxn</sub>
- B. -56 kJ/mol<sub>rxn</sub>
- C. -18 kJ/mol<sub>rxn</sub>
- D. +148 kJ/mol<sub>rxn</sub>

2. If reaction 2 were repeated at a higher temperature, how would the reaction's value for  $\Delta G$  be affected?

- A. It would become more negative because entropy is a driving force behind this reaction.
- B. It would become more positive because the reactant molecules would collide more often.
- C. It would become more negative because the gases will be at a higher pressure.
- D. It will stay the same; temperature does not affect the value for  $\Delta G$ .

3. Under what conditions would reaction 3 be thermodynamically favored?

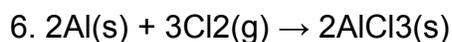
- A. It is always favored.
- B. It is never favored.
- C. It is only favored at low temperatures.
- D. It is only favored at high temperatures.

4. If 64 g of  $\text{CH}_4\text{O}$  were to decompose via reaction 4, approximately how much energy would be released or absorbed?

- A. 65 kJ of energy will be absorbed.
- B. 65 kJ of energy will be released.
- C. 130 kJ of energy will be absorbed.
- D. 130 kJ of energy will be released.

5. A 2.0 L flask holds 0.40 g of helium gas. If the helium is evacuated into a larger container while the temperature is held constant, what will the effect on the entropy of the helium be?

- A. It will remain constant because the number of helium molecules does not change.
- B. It will decrease because the gas will be more ordered in the larger flask.
- C. It will decrease because the molecules will collide with the sides of the larger flask less often than they did in the smaller flask.
- D. It will increase because the gas molecules will be more dispersed in the larger flask.

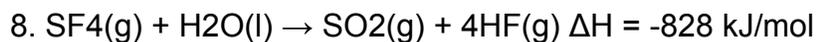


The reaction above is not thermodynamically favored under standard conditions, but it becomes thermodynamically favored as the temperature decreases toward absolute zero. Which of the following is true at standard conditions?

- A.  $\Delta S$  and  $\Delta H$  are both negative.
- B.  $\Delta S$  and  $\Delta H$  are both positive.
- C.  $\Delta S$  is negative, and  $\Delta H$  is positive.
- D.  $\Delta S$  is positive, and  $\Delta H$  is negative.

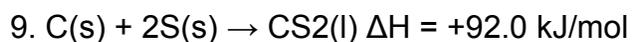
7. 1.50 g of  $\text{NaNO}_3$  is dissolved into 25.0 mL of water, causing the temperature to increase by  $2.2^\circ\text{C}$ . The density of the final solution is found to be 1.02 g/mL. Which of the following expressions will correctly calculate the heat gained by the water as the  $\text{NaNO}_3$  dissolves? Assume the volume of the solution remains unchanged.

- A.  $(25.0)(4.18)(2.2)$
- B.
- C.
- D.  $(25.0)(1.02)(4.18)(2.2)$



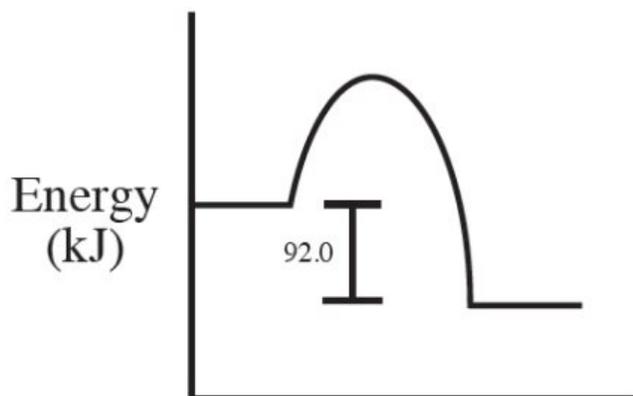
Which of the following statements accurately describes the above reaction?

- A. The entropy of the reactants exceeds that of the products.
- B.  $\text{H}_2\text{O}(\text{l})$  will always be the limiting reagent.
- C. This reaction is never thermodynamically favored.
- D. The temperature of the surroundings will increase as this reaction progresses.

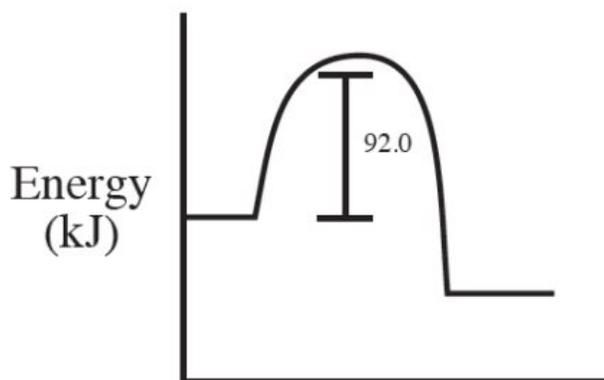


Which of the following energy level diagrams gives an accurate representation of the above reaction?

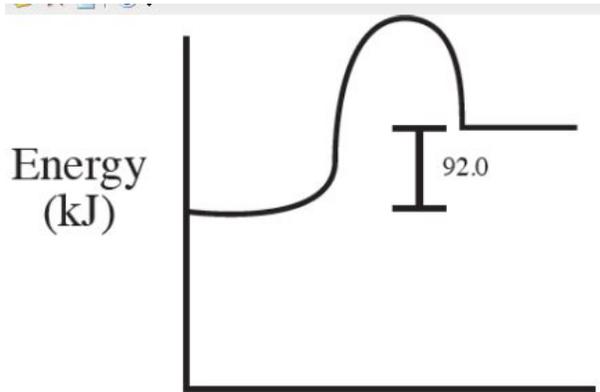
A.



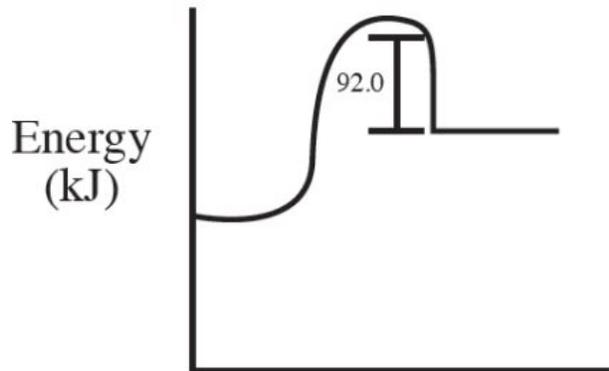
B.



C.



D.



10. A student studies two solutions. Solution A has a volume of 100 mL and is at a temperature of  $25.0^{\circ}\text{C}$ . Solution B has a volume of 1000 mL and is at a temperature of  $22.0^{\circ}\text{C}$ . Which of the following statements must be true regarding both solutions?

- A. Solution A has more heat than solution B.
- B. The specific heat capacity of solution A is greater than that of solution B.
- C. If the solutions were to be mixed, heat would transfer from B to A.
- D. Solution B has more thermal energy than solution A.