

EXERCISE - ENERGY CHANGES IN CHEMICAL REACTIONS

1. Classify these reactions as exothermic or endothermic:

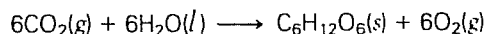
- $\text{energy} + \text{SO}_2(\text{g}) \longrightarrow \text{S}(\text{g}) + \text{O}_2(\text{g})$
- $\text{C}_8\text{H}_{18}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) + \text{energy}$
- $\text{energy} + \text{P}_4\text{O}_{10}(\text{s}) \longrightarrow \text{P}_4(\text{s}) + 5\text{O}_2(\text{g})$
- $\text{Mg}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \longrightarrow \text{MgSO}_4(\text{aq}) + \text{H}_2(\text{g}) + \text{energy}$

2. Which reactions are endothermic?

- $\text{Ba}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow \text{BaO}_2(\text{s}) + \text{energy}$
- $\text{PCl}_3(\text{s}) + \text{Cl}_2(\text{g}) \longrightarrow \text{PCl}_5(\text{s}) + \text{energy}$
- $2\text{Sb}(\text{s}) + 3\text{I}_2(\text{g}) + \text{energy} \longrightarrow 2\text{SbI}_3(\text{s})$
- $\text{C}_3\text{H}_8(\text{g}) + \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$
- $\text{H}_3\text{PO}_4(\text{aq}) + \text{LiOH}(\text{aq}) \longrightarrow \text{Li}_3\text{PO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{energy}$
- $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \longrightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s}) + \text{energy}$
- $\text{CS}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + \text{SO}_2(\text{g}) + \text{energy}$
- $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \longrightarrow \text{NH}_4\text{Cl}(\text{s}) + \text{energy}$
- $\text{CaCO}_3(\text{s}) + \text{energy} \longrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
- $\text{Mg}(\text{s}) + \text{CrCl}_3(\text{aq}) \longrightarrow \text{MgCl}_2(\text{aq}) + \text{Cr}(\text{s}) + \text{energy}$
- $\text{KNO}_3(\text{s}) + \text{energy} \longrightarrow \text{KNO}_2(\text{s}) + \text{O}_2(\text{g})$
- $\text{Pb}(\text{NO}_3)_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \longrightarrow \text{PbSO}_4(\text{s}) + \text{NaNO}_3(\text{aq}) + \text{energy}$
- $\text{HNO}_3(\text{aq}) + \text{LiOH}(\text{aq}) \longrightarrow \text{LiNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{energy}$
- $\text{KBr}(\text{aq}) + \text{AgNO}_3(\text{aq}) \longrightarrow \text{AgBr}(\text{s}) + \text{KNO}_3(\text{aq}) + \text{energy}$

3. Is the melting of ice an endothermic change or an exothermic change?

4. In photosynthesis, plants convert the sun's energy into sugars in the reaction

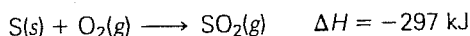


- Is this reaction exothermic or endothermic?
- What is the sign of the ΔH for this reaction?

5. Dry ice is solid carbon dioxide. It does not "melt" but instead turns from a solid into a gas in a process called sublimation.

- Is this change exothermic or endothermic?
- What sign would the ΔH value have?

6. For the following reaction:

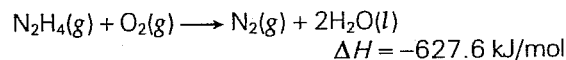


- Is this reaction exothermic or endothermic?
- How does the heat content of 1 mole of SO_2 compare to that of 1 mole of S plus 1 mole of O_2 ?

7. Determine the ΔH for the formation of one mole of each product in each of the following equations.

- $2\text{C}(\text{s}) + 3\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \longrightarrow \text{C}_2\text{H}_5\text{OH}(\text{l}) + 235 \text{ kJ}$
- $2\text{C}(\text{s}) + \text{H}_2(\text{g}) + 227 \text{ kJ} \longrightarrow \text{C}_2\text{H}_2(\text{g})$
- $2\text{Ba}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow 2\text{BaO}(\text{s}) + 1115 \text{ kJ}$
- $\text{I}_2(\text{s}) + \text{Br}_2(\text{l}) + 81.5 \text{ kJ} \longrightarrow 2\text{IBr}(\text{g})$

8. The energy from the combustion of hydrazine, N_2H_4 , is used to power rockets into space in the reaction



How many kilograms of hydrazine would be necessary to produce $1.0 \times 10^8 \text{ kJ}$ of energy?

9. A simple fat molecule has the formula $\text{C}_3\text{H}_5(\text{OH})_2\text{O}-\text{CO}(\text{CH}_2)_2\text{CH}_3$. The heat of reaction when it is combusted to CO_2 and H_2O is 6405 kJ/mol. Find the amount of energy released per gram of fat. Compare it to the amount of energy released when a carbohydrate is burned (15.6 kJ/g). Which provides more energy per gram?

10. The amount of solar radiation received annually in a certain location is about $8.4 \times 10^6 \text{ kJ/m}^2$. How much coke (C) must be burned to carbon dioxide in the following reaction to produce the same amount of energy?

