

6 • Energy and Chemical Reactions

Station 1 – EXOTHERMIC AND ENDOTHERMIC

Classify each statement as talking about an [EXO]thermic or [ENDO]thermic reaction:

_____ surroundings get hot

_____ PE diagram is uphill

_____ energy is a product

_____ ΔH is positive

_____ reactants have more energy

_____ ΔH is negative

_____ PE diagram is downhill

_____ surroundings get cold

_____ products have more energy

_____ energy is a reactant

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Station 2 – HEAT CALCULATIONS

A 45.0 mL sample of water is heated from 15.0°C to 35.0°C. How many joules of energy have been absorbed by the water? (Show work)

If 5430 J of energy is used to heat 1.25 L of room temperature water (23.0°C), what is the final temperature of the water?

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Station 3 – HOT AND COLD OBJECTS

A 100. gram sample of aluminum (specific heat = $0.900 \text{ J}\cdot\text{g}^{-1}\cdot\text{°C}^{-1}$) in boiling water is added to an insulated cup containing 50.0 grams of water at 5.00°C . What will the final temperature of the mixture be? The specific heat of water is $4.184 \text{ J}\cdot\text{g}^{-1}\cdot\text{°C}^{-1}$.

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Station 4 – WORK, HEAT, AND ENERGY

Determine the change in energy, ΔE , for each system:

A system gives off 25.0 kJ of heat and has 15.0 kJ of work done on it. _____

A system takes in 75.0 kJ of heat and has 25.0 kJ of work done on it. _____

A system does 45.0 kJ of work and loses 80.0 kJ of heat. _____

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Station 5 – HEATS OF FUSION & VAPORIZATION

Knowing that the ΔH_{fus} for water is $6.02 \text{ kJ}\cdot\text{mol}^{-1}$, calculate the following:

How much energy (in kJ) is absorbed by 45.0 g of ice as it melts?

What mass of ice can be melted with 75.0 kJ of energy?

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Station 6 – ΔH FROM DATA

When 10.0 grams of C_5H_{12} is burned, 453 kJ of energy is released.

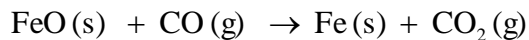
What is the $\Delta H_{\text{combustion}}$ for C_5H_{12} ?

When 10.0 grams of aluminum melts, 3.929 kJ of energy is required. What is the ΔH_{fus} of Al?

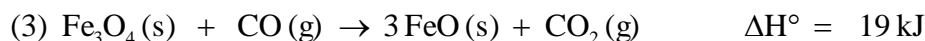
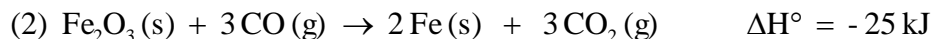
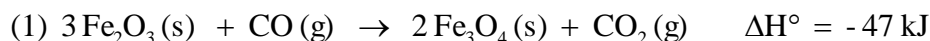
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Station 7 – HESS'S LAW—LONG VERSION

Iron ore can be converted to iron metal with CO gas.



Calculate the standard enthalpy change for this reaction from these reactions of iron oxides with CO:



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Station 8 – HESS'S LAW--SHORTCUT

chemical	$\text{CO}_2(g)$	$\text{H}_2\text{O}(g)$	$\text{C}_5\text{H}_{12}(l)$	$\text{C}_2\text{H}_5\text{OH}(l)$
ΔH_f	$-393.5 \text{ kJ}\cdot\text{mol}^{-1}$	$-241.8 \text{ kJ}\cdot\text{mol}^{-1}$	$-173.1 \text{ kJ}\cdot\text{mol}^{-1}$	$-277.6 \text{ kJ}\cdot\text{mol}^{-1}$

Given the above ΔH_f° 's, calculate the $\Delta H_{\text{combustion}}$ of pentane, C_5H_{12} .

Calculate the $\Delta H_{\text{combustion}}$ of ethyl alcohol, $\text{C}_2\text{H}_5\text{OH}(l)$

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chemical	CO ₂ (g)	H ₂ O(g)	C ₈ H ₁₈ (l)
ΔH_f	-393.5 kJ·mol ⁻¹	-241.8 kJ·mol ⁻¹	??? kJ·mol ⁻¹

Knowing that the ΔH_{combustion} of octane, C₈H₁₈, is -5508.9 kJ·mol⁻¹ calculate the ΔH_f of octane.

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chemical	CO ₂ (g)	H ₂ O(g)	C ₈ H ₁₈ (l)
ΔH_f	-393.5 kJ·mol ⁻¹	-241.8 kJ·mol ⁻¹	??? kJ·mol ⁻¹

Knowing that the ΔH_{combustion} of octane, C₈H₁₈, is -5508.9 kJ·mol⁻¹ calculate the ΔH_f of octane.