

Energy of Reactions Worksheet

1. Complete the chart by placing each option in the correct column.

General Rule	Endergonic	Exergonic
Energy input or energy released?		
Anabolic or catabolic?		
Increasing complexity or decreasing complexity?		
Change in G positive or negative?		
Spontaneous or non-spontaneous?		
Molecule complexity greatest in product or reactant?		
ATP coupled process, or ATP produced?		
Greater energy in the reactants or products?		
Dehydration or hydrolysis?		
Photosynthesis or respiration?		
ATP formed, or ADP + P?		
Entropy increased or decreased?		
High energy bonds formed, or broken?		
Decomposition or synthesis?		
Energy of reactants vs products same or different?		
Atoms of reactant vs products same or different?		

Gibbs Free Energy

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

- Free Energy (ΔG)
- Enthalpy (ΔH) – kJ (kilojoules)/mol
- Entropy (ΔS) – J/K (joules/kelvin)
- Temperature – K (standard temperature is 298K (25°C))
- $-\Delta G$ values are exergonic & spontaneous
- ΔG values are endergonic & non-spontaneous
- *Remember to convert joules to kilojoules before providing a final answer*

2. Free Energy Practice Problems

Determine the Free Energy & Spontaneity for each scenario

Reaction	Δ enthalpy (kJ/mol)	Δ entropy (J/K)	Δ Free Energy (kJ/mol)	Ender- or exergonic? Spontaneous or not?
A + B \rightarrow AB	+12	-5		
CD \rightarrow C + D	-32	+25		
CH ₄ + 2O ₂ \rightarrow CO ₂ + 2H ₂ O	-890	-243		
N ₂ + 3H ₂ \rightarrow 2NH ₃	-92	-199		
Hydrolyzing ATP \rightarrow ADP + P _i	-	-	-0.31	
Phosphorylation of Glucose (glucose + P _i)	-	-	+14	
2COCl ₂ + H ₂ O \rightarrow CO ₂ + 2HCl ***	-223	+284		

***Phosgene, COCl₂, was used as a weaponized gas during World War I. It reacts with moisture in the lungs to produce HCl, which causes the lungs to fill with fluid, leading to death. Use the energy values above, at a body temp of 37°C (310K) to see if this reaction is spontaneous or not.

Name _____ Period _____ Date _____

Work Page