

THE ENTHALPY GAME ANSWERS!!

Label each situation that represents a increase in enthalpy with endo and each situation that represents a decrease in enthalpy with exo.

1. Exo Change of state from a liquid to a solid
2. Endo An increase in chemical potential energy
3. Exo Formation of CO_2 from its elements
4. Endo mixing ammonium nitrate with water lowers the temperature of the water
5. Exo in a reaction atoms rearrange their position to increase the net attraction for other atoms
6. Exo $\Delta H^\circ = -185 \text{ kJ/mol}$
7. Endo $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
8. Exo an overall increase in bond energy (energy required to overcome a bond)
9. Endo $\Delta H^\circ = 98 \text{ kJ/mol}$
10. Exo free moving atoms combine to form a compound spontaneously
11. Endo change of state from a liquid to a gas
12. Exo exothermic reaction
13. Exo in a closed system (energy can neither enter nor escape) kinetic energy increases
14. Endo $\text{H}_2\text{O}(l) + 10.5 \text{ kcal} \rightarrow \text{H}_2\text{O}(g)$
15. Endo in a reaction net attraction between atoms is lessened
16. Exo $\text{CH}_4 + \frac{3}{2}\text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
17. Endo endothermic reaction
18. Exo a rock falls off a cliff
19. Endo in a closed system potential energy increases
20. Exo mixing $\text{NaOH}(s)$ with water produces heat

21. Exo The assembly of a lattice from free ions
22. Exo The hydration of ions in solution
23. Exo A dissolving process in which the hydration energy is greater than the lattice energy (the interaction between solvent and solute is stronger than the interaction within the lattice structure)
24. Exo $\text{CO} + \text{Cl}_2 \rightarrow \text{COCl}_2$
25. Endo The ionization of magnesium to form Mg^{2+} ($\text{Mg} \Rightarrow \text{Mg}^{2+} + 2\text{e}^-$)
26. Endo The vapourization of $\text{NaCl}(\text{s})$ to form free Na^+ ions and free Cl^- ions (i.e. breaking the lattice energy).
27. ? The formation of a solution of a salt from water and the solid of the salt.

Summary: In the chart list as many different ways that you can determine if enthalpy has increased and list the counter statement for the decrease in enthalpy.

INCREASE IN ENTHALPY (ENDOTHERMIC)	DECREASE IN ENTHALPY (EXOTHERMIC)
endothermic, ↓ in temperature, "eats" heat	exothermic, ↑ in temperature, makes heat
$Q = -$ value	$Q = +$ value
$\Delta H = +$ value	$\Delta H = -$ value
increase in chemical potential energy	decrease in chemical potential energy
decrease in "overall" attractive forces (less attracted)	increase in "overall" attractive forces (more attracted)
increase in distance between particles	decrease in distance between particles
$(\text{s}) \rightarrow (\text{l}) \rightarrow (\text{g})$	$(\text{g}) \rightarrow (\text{l}) \rightarrow (\text{s})$
atomic nuclei experience a net increase in mass - radiation/energy is absorbed (energy becomes mass)	atomic nuclei experience a net decrease in mass - radiation/energy is given off (mass becomes energy)