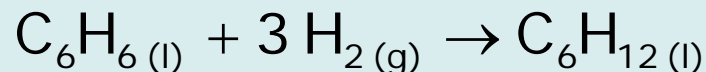
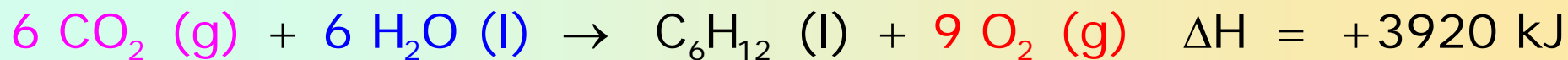
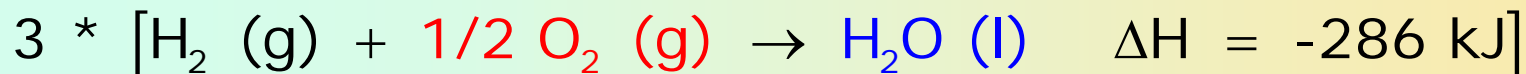


## Enthalpy changes: solutions

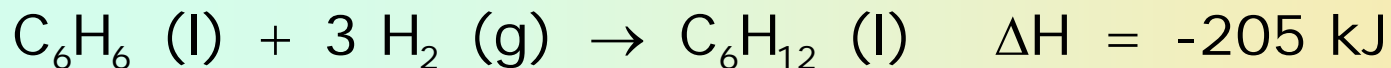
1. Calculate the enthalpy change of hydrogenation of benzene to cyclohexane:



Standard enthalpy changes of combustion in kJ/mol: benzene  $-3267$ ,  
hydrogen  $-286$ , cyclohexane  $-3920$

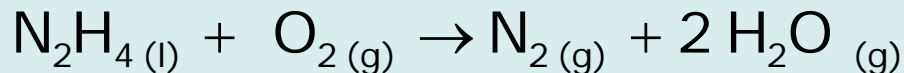


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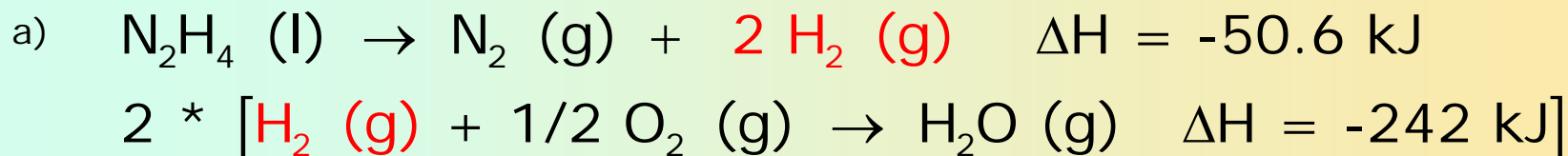
## Enthalpy changes: solutions

2. Hydrazine,  $\text{N}_2\text{H}_4$  (l), is used as a rocket fuel. It burns in oxygen to produce nitrogen and steam:

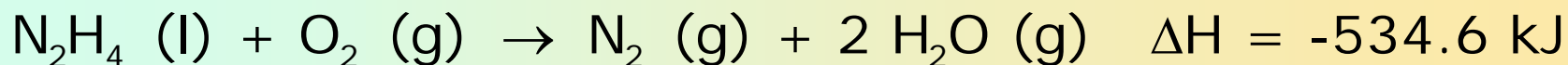


a) Calculate the enthalpy change when 1 mole of hydrazine burns. Standard enthalpy changes of formation (in kJ/mol): hydrazine +50.6,  $\text{H}_2\text{O}$  (g) -242

b) How much heat is evolved if 1 tonne of hydrazine burns completely in this way? (H=1; N=14; 1 tonne=1000 kg)



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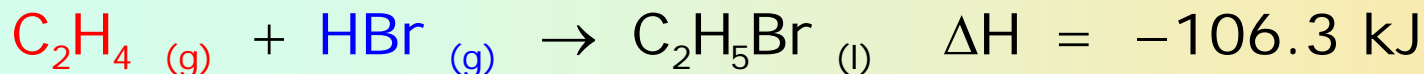
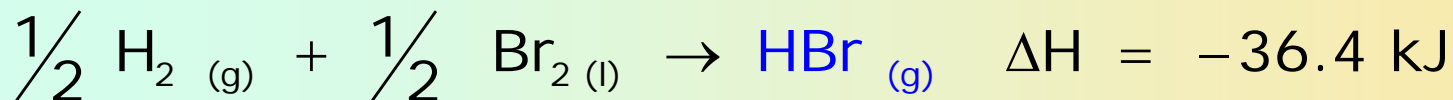
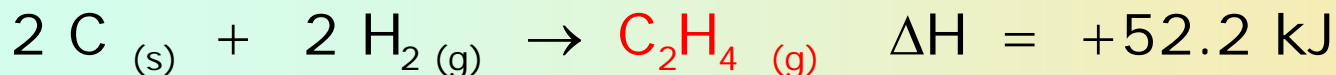
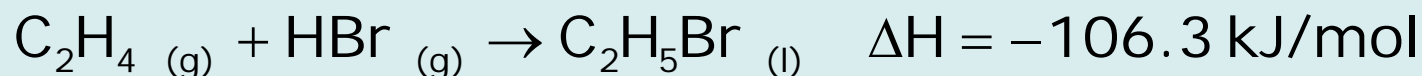
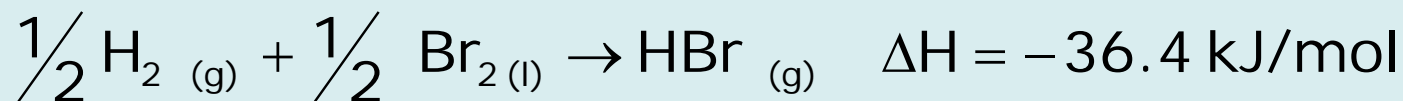
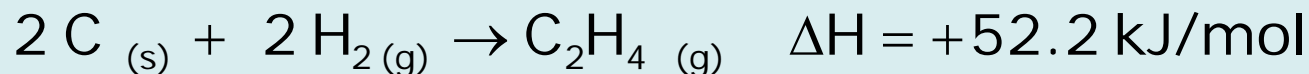
b)

$$M = (2 * 14) + (4 * 1) = 32 \text{ g/mol}$$

$$Q = \frac{-534.6 \text{ kJ}}{1 \text{ mol}} * \frac{1 \text{ mol}}{32 \text{ g}} * 10^6 \text{ g} = -1.67 * 10^7 \text{ kJ}$$

## Enthalpy changes: solutions

3. Calculate the enthalpy change of formation of bromoethane,  $C_2H_5Br_{(l)}$  from the following data



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