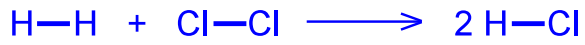
Textbook Page 313 #1ab, 2a, 3

1. (a) $H_2(g) + Cl_2(g) \rightarrow 2\,HCl(g)$



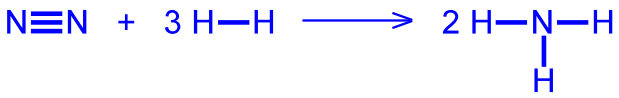
bonds broken: 1 mol H–H @ +432 kJ/mol
1 mol Cl–Cl @ +239 kJ/mol

bonds formed: 2 mol H–Cl @ –427 kJ/mol

$\Delta H \approx 1\ \cancel{mol}(+432\ kJ/\cancel{mol}) + 1\ \cancel{mol}(+239\ kJ/\cancel{mol}) + 2\ \cancel{mol}(-427\ kJ/\cancel{mol})$

$= -183\ kJ$

(b) $N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$



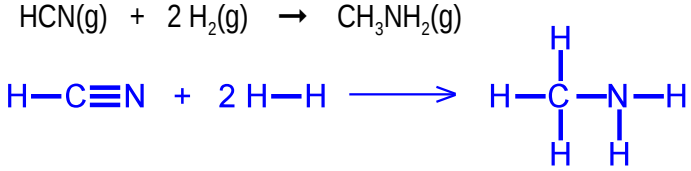
bonds broken: 1 mol N≡N @ +941 kJ/mol
3 mol H–H @ +432 kJ/mol

bonds formed: 6 mol N–H @ –391 kJ/mol

$\Delta H \approx 1\ \cancel{mol}(+941\ kJ/\cancel{mol}) + 3\ \cancel{mol}(+432\ kJ/\cancel{mol}) + 6\ \cancel{mol}(-391\ kJ/\cancel{mol})$

$= -109\ kJ$

2. (a) $HCN(g) + 2\,H_2(g) \rightarrow CH_3NH_2(g)$



bonds broken: 1 mol C–H @ +413 kJ/mol
1 mol C≡N @ +891 kJ/mol
2 mol H–H @ +432 kJ/mol

bonds formed: 3 mol C–H @ –413 kJ/mol
1 mol C–N @ –305 kJ/mol
2 mol N–H @ –391 kJ/mol

$\Delta H \approx 1\ \cancel{mol}(+413\ kJ/\cancel{mol}) + 1\ \cancel{mol}(+891\ kJ/\cancel{mol}) + 2\ \cancel{mol}(+432\ kJ/\cancel{mol}) + 3\ \cancel{mol}(-413\ kJ/\cancel{mol}) + 1\ \cancel{mol}(-305\ kJ/\cancel{mol}) + 2\ \cancel{mol}(-391\ kJ/\cancel{mol})$

$= -158\ kJ$

3. The bond energies are <u>average</u> bond energies and not necessarily the same as the actual bond energies in any given reactant or product.