① Given: $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

ΔH_f° KJ/mol	-74.8	∅	-393.5	-241.8

$\Delta H = ?$

Soln: $\Delta H = \Sigma \Delta H_f^\circ$ prod $- \Sigma \Delta H_f^\circ$ react

$\Sigma \Delta H_{f\,P}^\circ = (1\,mol)(-393.5\,KJ/mol) + (2\,mol)(-241.8\,KJ/mol) = -877.1\,KJ$

$\Sigma \Delta H_{f\,R}^\circ = (1\,mol)(-74.8\,KJ/mol) + 0 = -74.8\,KJ$

$\Delta H = -877.1\,KJ - (-74.8\,KJ)$

$\boxed{\Delta H^\circ = -802.3\,KJ/mol_{rxn}}$

Exothermic

② Given: $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$

ΔH_f° KJ/mol	-1207	-635.5	-393.5

Soln: $\Delta H = \Sigma \Delta H_{f\,P}^\circ - \Sigma \Delta H_{f\,R}^\circ$

$\Sigma \Delta H_{f\,P}^\circ = (1\,mol)(-393.5\,KJ/mol) + (1\,mol)(-635.5\,KJ/mol) = -1029.0\,KJ$

$\Sigma \Delta H_{f\,R}^\circ = (1\,mol)(-1207\,KJ/mol) = -1207\,KJ$

$\Delta H = -1029.0\,KJ - (-1207\,KJ) = \boxed{178\,KJ/mol_{Rxn}}$

③ Given: Cu

$C_p = 0.385\,J/g^\circ C$

$m = 0.020\,Kg = 20.g$

$T_1 = 25^\circ C$

$T_2 = 125^\circ C$

$Q = ?$

$\Delta T = T_2 - T_1$

$= 125^\circ C - 25^\circ$

$= 100.^\circ C$

Soln: $Q = m\,c_p\,\Delta T$

$= (20.g)(0.385\,J/g^\circ C)(100.^\circ C)$

$\boxed{Q = 770\,J}$

(4) Given: H_2O

$C_p = 4.179\ J/g \cdot C^\circ$

$m = 1200g$

$T_1 = 19^\circ C$

$T_2 = ?$

$Q = -10\ KJ = -10{,}000\ J$

Lose ∴ −

Soln: $Q = mc_p\Delta T$

$\Delta T = \frac{Q}{mc_p}$

$= \frac{-10{,}000\ J}{(1200g)(4.179\ J/gC^\circ)}$

$= -1.9^\circ C$

$\Delta T = T_2 - T_1$

$T_2 = \Delta T + T_1$

$= 19^\circ C + -1.9^\circ C$

$\boxed{T_2 = 17^\circ}$

(5) Given:

$$CaCl_{2(s)} \xrightarrow{H_2O} Ca^{2+}_{(aq)} + 2Cl^-_{(aq)}$$

$m_{water} = 100.0g$

$T_1 = 25.1^\circ C$

$m_{CaCl_2(s)\ dissolved} = 10.0g$

$T_2 = 42.7^\circ C$

$C_p = 4.18\ J/g \cdot C^\circ$

$\Delta H_{soln} = ?$ Molar!!

Soln:

$\Delta T = T_2 - T_1 = 42.7^\circ C - 25.1^\circ$

$\Delta T = 17.6^\circ C$

$Q_{soln} = m C_p \Delta T$ mass of soln = water + solute

$= (100.0g + 10.0g)(4.18\ J/gC^\circ)(17.6^\circ C)$

$Q_{soln} = 8092\ J$

$= 8090\ J$

But this is for 10.0g $CaCl_2$

Not 1 mole!

$$\left(\frac{10.0g\ CaCl_2}{1}\right)\left(\frac{1\ mole\ CaCl_2}{110.98g\ CaCl_2}\right) = .0901\ mole\ CaCl_2$$

$\Delta H_{soln} = -Q_{water} / moles\ CaCl_2$

$= -8090\ J / 0.0901$

$= -89800\ J/mole = \boxed{89.8\ KJ/mole}$