1 Calculate the enthalpy change for this reaction using the enthalpies of formation shown.

 $TiCl_4(s) + 2Mg(s) \rightarrow 2MgCl_2(s) + Ti(s)$ $\Delta_f H / kJ \text{ mol}^{-1} \quad TiCl_4(s) = -912 \quad MgCl_2(s) = -642$ $\Delta H = [Sum \Delta_f H \text{ products}] - [Sum \Delta_f H \text{ reactants}]$ $\Delta H = [2(-642) + 0] - [-912 + 0]$ $\Delta H = -372 \text{ kJ mol}^{-1}$

2 Calculate the enthalpy of combustion of butane, $C_4H_{10}(g)$, given the following data.

 $\Delta_{\rm f} {\rm H \ C_4 H_{10}(g) = -125 \ kJ \ mol^{-1}} \qquad \Delta_{\rm c} {\rm H \ C(s) = -394 \ kJ \ mol^{-1}} \qquad \Delta_{\rm c} {\rm H \ H_2(g) = -286 \ kJ \ mol^{-1}}$ $4C(s) + 5H_2(g) \xrightarrow{-125} C_4 H_{10}(g) \qquad -125 + \Delta_{\rm c} {\rm H} = 4(-394) + 5(-286)$ $4(-394) \qquad \swarrow \Delta_{\rm c} {\rm H} \qquad \Delta_{\rm c} {\rm H} = 4(-394) + 5(-286) + 125$ $4CO_2(g) + 5H_2O(l) \qquad \Delta_{\rm c} {\rm H} = -2881 \ kJ \ mol^{-1}$

3 Ethene reacts with hydrogen as shown: $CH_2=CH_2(g) + H_2(g) \rightarrow CH_3CH_3(g)$ $\Delta H = -99 \text{ kJ mol}^{-1}$ Calculate the bond enthalpy for the C=C bond using this data and the following bond enthalpies.

C-H = 413, H-H = 463, C-C = 348 kJ mol⁻¹

$CH_2=CH_2(g) + H_2(g) \longrightarrow$	CH₃CH₃(g)	-99 + C-C + 6C-H = C=C + 4C-H + H-H
	C=C = C-C + 2C-H - 99 - H-H	
4 C-H	-H / 6 С-H	C=C = 348 + 2(413) - 99 - 463
H-H ◀		$C=C = 612 \text{ kJ mol}^{-1}$

4 1.22 g of propan-1-ol, $C_3H_7OH(I)$, was burned in a spirit burner and used to heat 50.0 g of water in a copper calorimeter. The temperature of the water rose by 52°C. Calculate the enthalpy of combustion of propan-1-ol determined by this experiment. The specific heat capacity of the solution is 4.18 J K⁻¹ g⁻¹.

 $q = mc\Delta T = 50 x 4.18 x 52 = 10868 J = 10.868 kJ$ $moles = \frac{1.22}{60.0} = 0.02033$ $\Delta H = -\frac{q}{mol} = -\frac{10.868}{0.02033} = -535 kJ mol^{-1}$ **ENERGETICS (C)**