Chemistry 30: Unit 2 – Thermochemistry ***Name:***
Outcome 2 – Practice Quiz ***Mark: / 10***

1. A reaction done in a bomb calorimeter involves the reaction of sodium metal and chlorine gas. 200 mL of water in the calorimeter has an initial temperature of 24.6°C and the final temperature is 28.4 °C.
   a. What mass of sodium would be required to react to cause this temperature change? [2 marks] (Start by writing the reaction occurring)

$\Delta_r H$: $\Delta_r H_m = -411.2\ kJ/mol$, $n = ?$

Q: $m = 200\ g$, $c = 4.19\ J/g\cdot°C$, $\Delta t = 3.8°C$

$\Delta_r H = Q$

$n\,\Delta_r H_m = mc\Delta t$

$n\,(411200\ J/mol) = (200\ g)(4.19\ J/g\cdot°C)(3.8°C)$

$n = 0.007744...\ mol$

$m = nM$

$= 0.17803...\ g$

$= 0.18\ g$

   b. Write a chemical equation representing the reaction occurring in the bomb, including energy as a term in the equation.

$2Na_{(s)} + 1Cl_{2(g)} \rightarrow 2NaCl_{(s)} + 822.4\ kJ$ ~~$\Delta_r H_m$~~

2. Use Hess's Law and the 3 reactions provided below to calculate the molar enthalpy for the combustion of propene. **Assume liquid water is produced**. [2 marks]

flip 1. $\Delta_f H°_m = -285.8\ kJ/mol$ $H2O_{(l)}$ $\quad H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)} \quad \Delta_r H = -285.8\ kJ$

flip 2. $C_3H_{8(g)} \rightarrow C_3H_{6(g)} + H_{2(g)} \quad \Delta_r H° = +124.0\ kJ$

3. $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ ~~$+2222.0\ kJ$~~ $\quad \Delta_r H = -2222.0\ kJ$

$1C_3H_6 + \frac{9}{2}O_{2(g)} \rightarrow 3CO_{2(g)} + 3H_2O_{(l)} \quad \Delta_r H = -2060.2\ kJ$

~~$H_2O_{(l)}$~~ $\rightarrow H_{2(g)} + \frac{1}{2}O_{2(g)} \quad \Delta_r H = +285.8\ kJ$

$C_3H_{6(g)} + H_{2(g)} \rightarrow$ ~~$C_3H_{8(g)}$~~ $\quad \Delta_r H = -124.0\ kJ$

~~$C_3H_{8(g)}$~~ $+ \frac{9}{2}O_{2(g)} \rightarrow 3CO_{2(g)} + 3H_2O_{(l)} \quad \Delta_r H = -2222.0\ kJ$

$\Delta_r H_{m_c} = -2060.2\ kJ/mol$
C_3H_6

$$2\,C_2H_{2(g)} + 5\,O_{2(g)} \rightarrow 4\,CO_{2(g)} + 2\,H_2O_{(g)}$$

3. a. Use the information above to calculate the molar enthalpy of combustion for ethyne. [1 mark]

$\Delta_r H = [(4\text{ mol} \times -393.5\text{ kJ/mol}) + (2\text{ mol})(-241.8\text{ kJ/mol})] - [(2\text{ mol})(+227.4\text{ kJ/mol})]$

$\Delta_r H = -2512.4\text{ kJ}$

$\Delta_r H_m\ (C_2H_2) = \dfrac{-2512.4\text{ kJ}}{2\text{ mol}} = -1256.2\text{ kJ/mol}$

b. Calculate the enthalpy change for the combustion of 10.5 g of ethyne. [2 marks]

$\Delta_r H\ (10.5\text{ g } C_2H_2) = n\,\Delta_r H_m = \left(\dfrac{10.5\text{ g}}{26.04\text{ g/mol}}\right)(-1256.2\text{ kJ/mol}) = -506.53\ldots\text{ kJ}$

$= -507\text{ kJ}$

c. Draw a potential energy diagram for the combustion of ethyne. (2 marks)