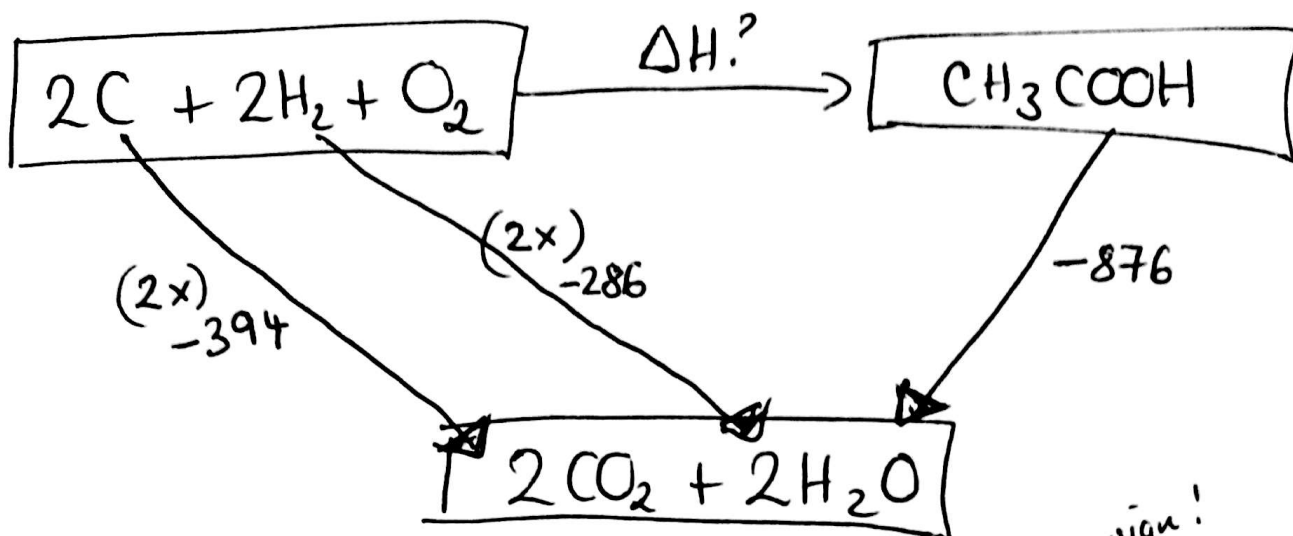


* HESS CYCLE PRACTICE Q'S

Q1

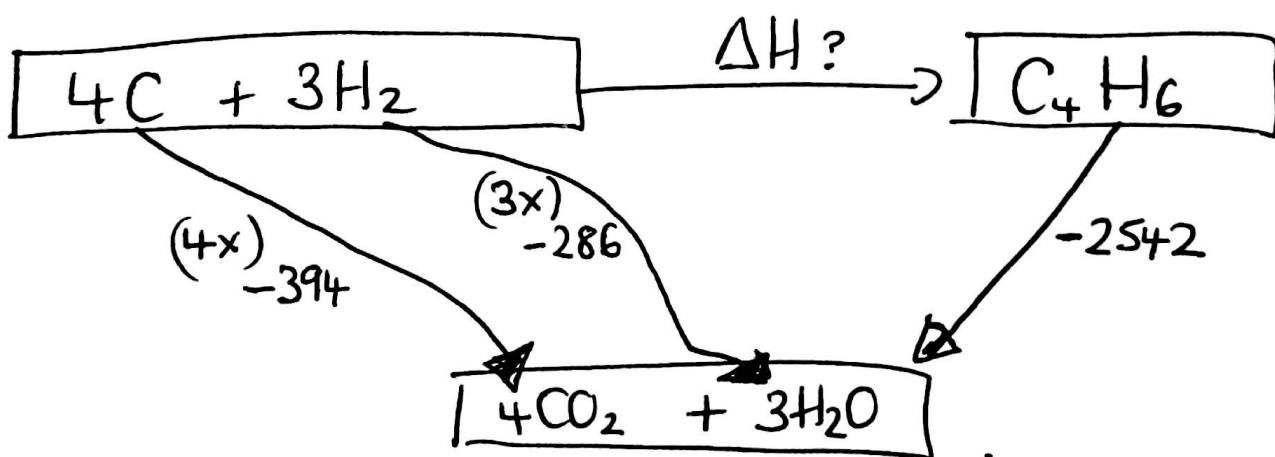


$$\Delta H = [2x - 394] + [2x - 286] - [-876]$$

reverse sign!

$$= \underline{\underline{-484 \text{ kJ mol}^{-1} \text{ (exo)}}}$$

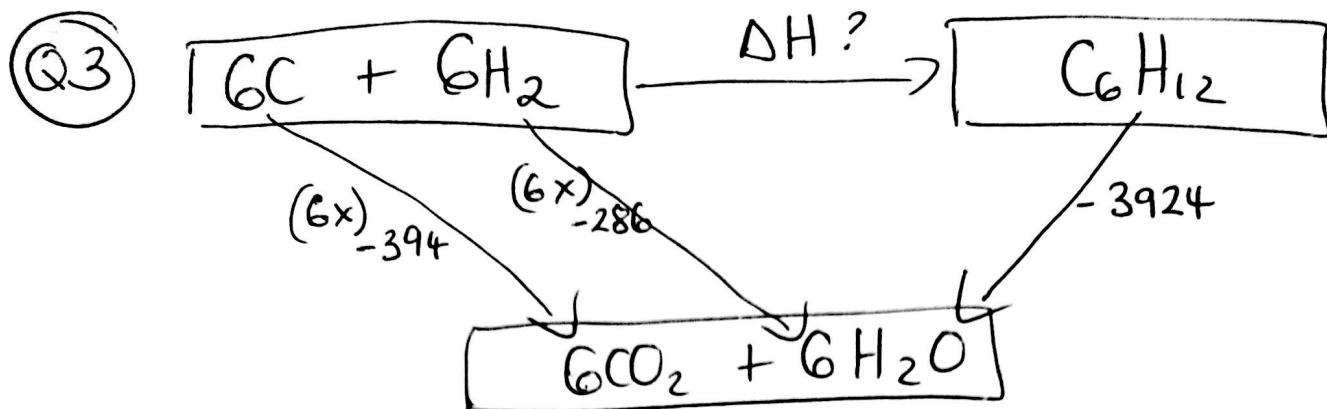
Q2



$$\Delta H = [4x - 394] + [3x - 286] - [-2542]$$

reverse sign

$$= \underline{\underline{+108 \text{ kJ mol}^{-1} \text{ (endo)}}}$$

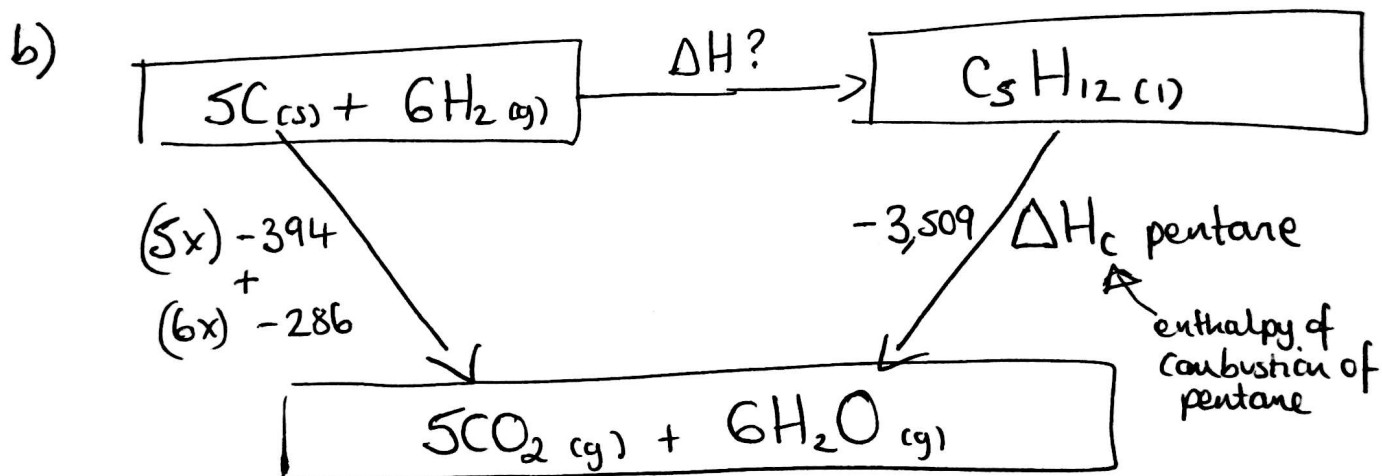


$$\Delta H = [6x - 394] + [6x - 286] - [-3924]$$

$$= \underline{\underline{-156 \text{ kJmol}^{-1} \text{ (exo)}}}$$

Q4 a) $\Delta H_{\text{FORMATION}}$ = the formation of 1 mole of a substance from its elements in their standard states (and if a \ominus is used, the conditions are standard).

~~⊗~~

$$\boxed{5C_{(s)} + 6H_{2(g)} \longrightarrow C_5H_{12(l)}}$$


c)

$$\Delta H? = [5x \Delta H_c C] + [6x \Delta H_c H_2] - [\Delta H_c C_5H_{12}]$$

Enthalpy of formation of PENTANE

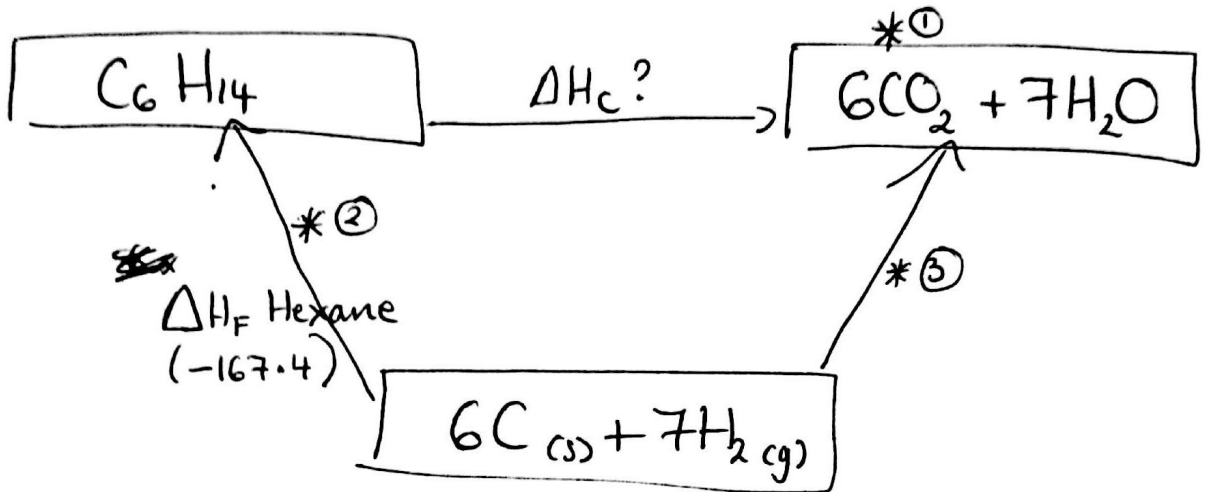
$$= [5x - 394] + [6x - 286] - [-3,509]$$

$$= \underline{\underline{-177 \text{ kJmol}^{-1} \text{ (exo)}}}$$

Q5

$$\begin{aligned} \Delta H_f? &= [4 \times \Delta H_c C] + [5 \times \Delta H_c H_2] - [\Delta H_c \text{ Butane}] \\ &= [4 \times -394] + [5 \times -286] - [-2,877] \\ &= \underline{\underline{-129 \text{ kJmol}^{-1}} \text{ (exo)}} \end{aligned}$$

Q6



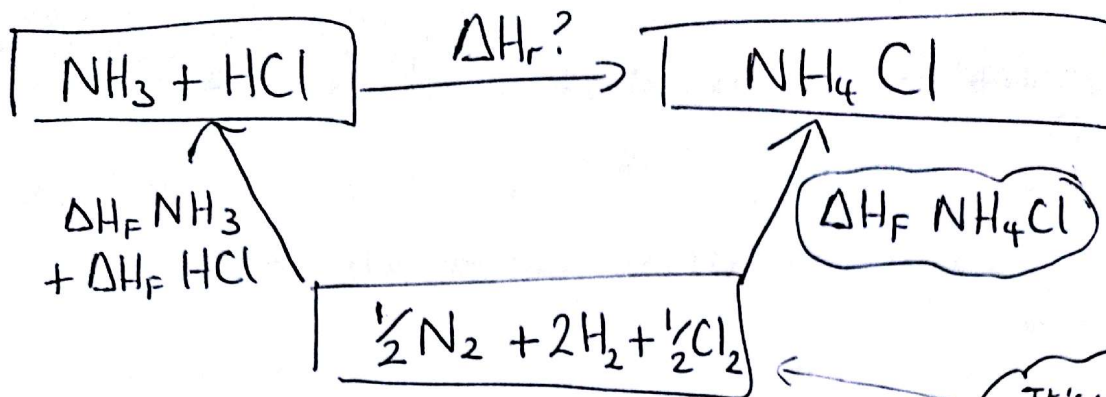
- *① - You know what to put in this box because the question is asking about the enthalpy change of combustion of hexane. Like most hydrocarbons, when you burn hexane (completely) it forms carbon dioxide and water.
- *② - The arrow going up from the bottom box is harder. You need to use the data in the question to guide you here. The only info you have about hexane (C_6H_{14}) is the enthalpy change of formation (ie, enthalpy to form it from its elements $\rightarrow C + H_2$). This means that the bottom box must have the elements in it!
- *③ - This arrow writes itself! It's the combined enthalpies of formation of CO_2 and H_2O .
The arrow represents:

$$\begin{aligned} &= [6 \times \Delta H_f CO_2] + [7 \times \Delta H_f H_2O] \\ &= [6 \times -394] + [7 \times -286] = -4366 \text{ kJmol}^{-1} \end{aligned}$$

$$\begin{aligned} \Delta H_c C_6H_{14} &= \overset{\text{reverse sign}}{\leftarrow} [\Delta H_f \text{ Hexane}] + [6 \times \Delta H_f CO_2] + [7 \times \Delta H_f H_2O] \\ &= -[-167.4] + [-4366] \\ &= \underline{\underline{-4,198.6 \text{ kJmol}^{-1}} \text{ (exo)}} \end{aligned}$$

no surprise that's it's a large exo value as you're combusting a HYDROCARBON

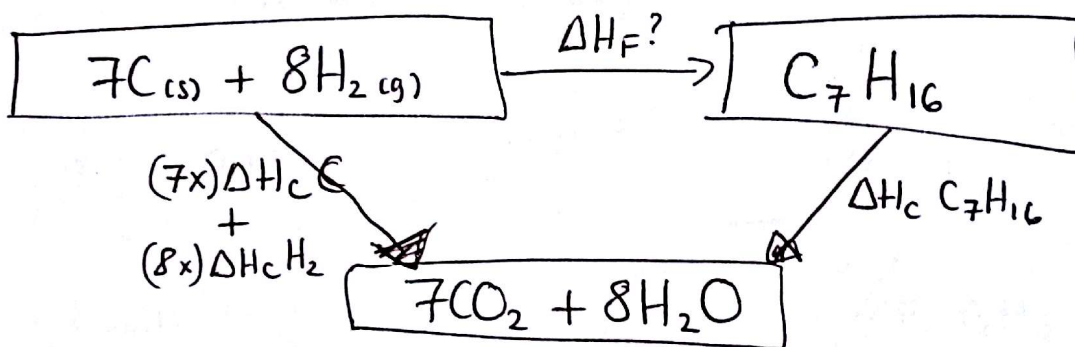
Q7



It's worth keeping these as $\frac{1}{2}$ values, because otherwise you'll have to $\frac{1}{2}$ values at the end.

$$\begin{aligned}\Delta H_r &= -[\Delta H_f \text{NH}_3] - [\Delta H_f \text{HCl}] + \Delta H_f \text{NH}_4\text{Cl} \\ &= -[-46.1] - [-92.3] + [-314.4] \\ &= -176 \text{ kJmol}^{-1} \text{ (exo)}\end{aligned}$$

Q8

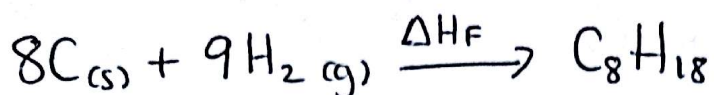


$$\begin{aligned}\Delta H_f \text{C}_7\text{H}_{16} &= (7 \times \Delta H_c \text{C}) + (8 \times \Delta H_c \text{H}_2) - (\Delta H_c \text{C}_7\text{H}_{16}) \\ &= (7 \times -394) + (8 \times -286) - (-4,465.8) \\ &= -580.2 \text{ kJmol}^{-1} \text{ (exo)}\end{aligned}$$

Q9

P.T.O

Q9 ΔH_f Octane can be represented by the equation Δ



This becomes the 'top line' of the Hess cycle Δ

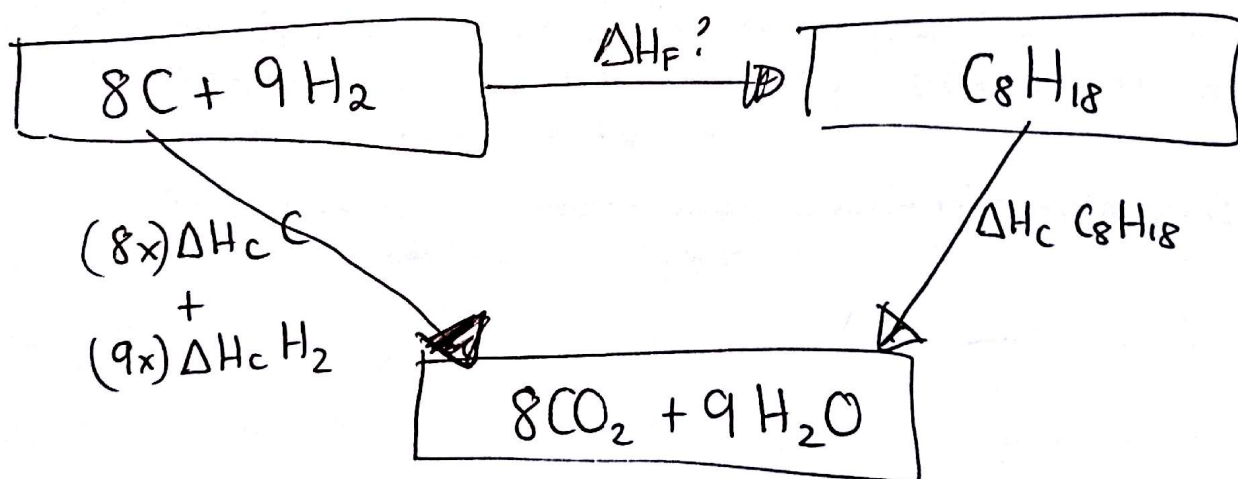


The data in the question guides you how to draw the rest of the cycle! You're looking for ways to link up the 3rd box.

ΔH_c Carbon means burning carbon to form CO_2 .

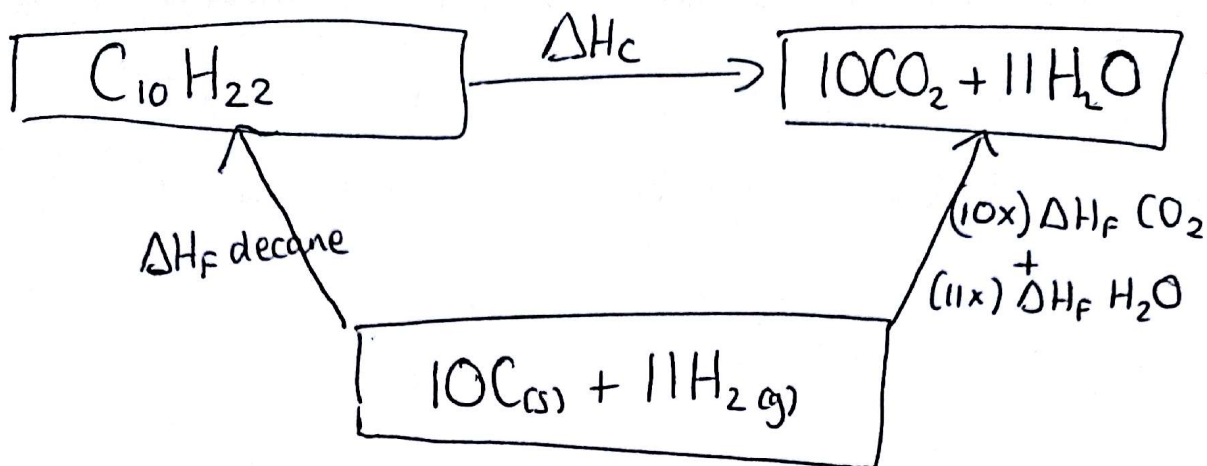
$\Delta H_c H_2$ means burning hydrogen to form H_2O .

ΔH_c octane (hydrocarbon) means burning C_8H_{18} to form $8CO_2 + 9H_2O$
so, the 3rd box must have CO_2 and H_2O in!



$$\begin{aligned} \therefore \Delta H_f? &= [8 \times \Delta H_c C] + [9 \times \Delta H_c H_2] - [\Delta H_c C_8H_{18}] \\ &= [8 \times -394] + [9 \times -286] - [-5,074.9] \\ &= \underline{\underline{-651.1 \text{ kJmol}^{-1} \text{ (exo)}}} \end{aligned}$$

(Q10)



$$\begin{aligned}\Delta H_c \text{ decane} &= -(\Delta H_f \text{ decane}) + (10 \times \Delta H_f CO_2) + (11 \times \Delta H_f H_2O) \\ &= -(-249.4) + (10 \times -394) + (11 \times -286) \\ &= \underline{\underline{-6,791.6 \text{ kJmol}^{-1} \text{ (exo)}}}\end{aligned}$$

* (Note) → with ΔH_c /enthalpy of combustion, you don't have to put the O_2 into the box in the Hess cycle. This is ONLY because the oxygen is included in the definition of ΔH_c and is therefore assumed to be there:

ΔH_c = enthalpy change when 1 mole of substance is burned completely in oxygen.