1)

$$4\ C(s)\ +\ 5\ H_2(g)\ \xrightarrow{\Delta H_f}\ C_4H_{10}(g)$$

4(−394)
5(−286)   −2877

$$4\ CO_2(g)\ +\ 5\ H_2O(l)$$

$\Delta H_f − 2877\ =\ 4(−394) + 5(−286)$ $\Delta H_f\ =\ 4(−394) + 5(−286) + 2877$

= −129 kJ mol^{-1}

__OR__ $\Delta H\ =$ [Sum of ΔH_c reactants] – [Sum ΔH_c products]

$=$ [4(-394) + 5(-286)] – [−2877]

= −129 kJ mol^{-1}

2) $C_3H_8(g)\ +\ 5\ O_2(g)\ \rightarrow\ 3\ CO_2(g)\ +\ 4\ H_2O(l)$
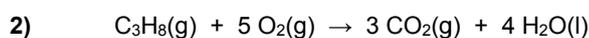
$\Delta H\ =$ [Sum of ΔH_f products] – [Sum ΔH_f reactants]

$=$ [3(-394) + 4(-286)] – [−104]

= −2222 kJ mol^{-1}

3)   Broken   C-C + 6 C-H + 3½ O=O = 348 + 6(412) + 3½(496) = 4556

Made   4 C=O + 6 O-H = 4(743) + 6(463) = 5750
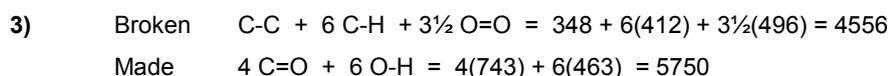
$\Delta H\ =$ [Bond broken] – [Bonds made] = 4556 – 5750 = **-1194 kJ mol^{-1}**

4)

$$3\ C(s)\ +\ 4\ H_2(g)\ +\ ½\ O_2(g)\ \xrightarrow{−318}\ CH_3CH(OH)CH_3(l)$$

3(−394)
4(−286) ΔH_c

$$3\ CO_2(g)\ +\ 4\ H_2O(l)$$
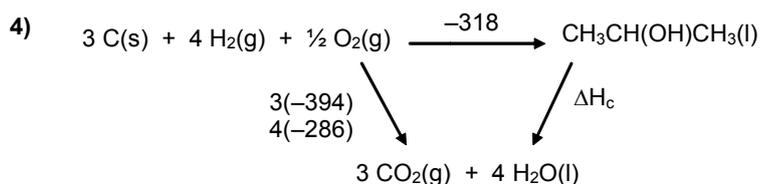
$− 318 + \Delta H_c\ =\ 3(-394) + 4(-286)$ $\Delta H_c\ =\ 3(−394) + 4(−286) + 318$

= −2008 kJ mol^{-1}

__OR__ $\Delta H\ =$ [Sum of ΔH_c reactants] – [Sum ΔH_c products]

$-318\ =$ [3(-394) + 4(-286)] – [ΔH_c]

$\Delta H_c\ =\ 3(-394) + 4(-286) + 318$ **= −2008 kJ mol^{-1}**

5)

$$C(s)\ +\ 2\ Cl_2(g)\ \xrightarrow{\Delta H_f}\ CCl_4(l)$$

715
2(242)   +31
4(338)

$$C(g)\ +\ 4\ Cl(g)$$
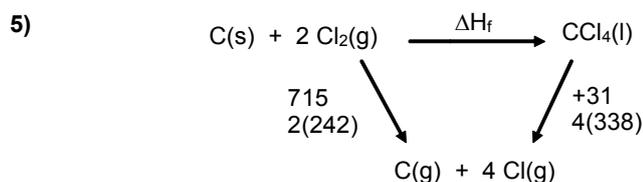
$\Delta H_f + 31 + 4(338)\ =\ 715 + 2(242)$ $\Delta H_f\ =\ 715 + 2(242) – 31 – 4(338)$

= −184 kJ mol^{-1}

6)

$$CH_3CH{=}CH_2(g) \ + \ H_2(g) \ \xrightarrow{\ \Delta H\ } \ CH_3CH_2CH_3(g)$$

−2059
−286   −2220

$$3\ CO_2(g) \ + \ 4\ H_2O(l)$$

$\Delta H - 2220 \ = \ -2059 + -286$ $\Delta H \ = \ -2059 - 286 + 2220$
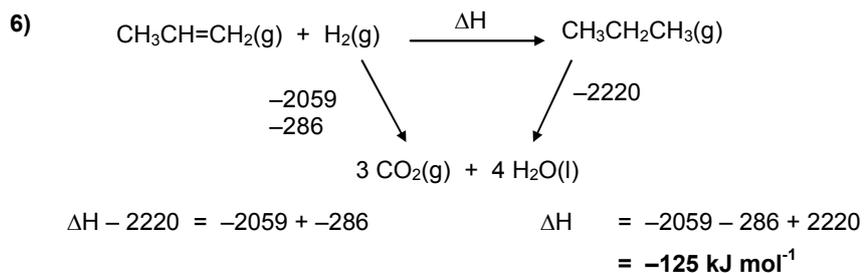
                                               = −125 kJ mol⁻¹

_OR_ $\Delta H \ = \ [\text{Sum of } \Delta H_c \text{ reactants}] - [\text{Sum } \Delta H_c \text{ products}]$

        $= \ [\ -2059 - 286\ ] - [-2220]$

        = −125 kJ mol⁻¹

7) $q \ = \ mc\Delta T$

          $= \ 80 \times 4.18 \times 47.3 \ = \ 15820 \ J \ = \ 15.82 \ kJ$

moles $CH_3COCH_3 \ = \ $ mass $/ \ M_r \ = \ 0.55 \ / \ 58.0 \ = \ 0.00948$

$\Delta H \ = \ q \ / \ $moles $\ = \ -15.82 \ / \ 0.00948$

      = − 1669 kJ mol⁻¹

8) $q \ = \ mc\Delta T$

          $= \ 50 \times 4.18 \times (33.9 - 20.2) \ = \ 2863 \ J \ = \ 2.863 \ kJ$

moles KOH $\ = \ $ conc $\times$ vol (dm³) $\ = \ 2.0 \times 25/1000 \ = \ 0.0500$

moles $HNO_3 \ = \ $ conc $\times$ vol (dm³) $\ = \ 2.0 \times 25/1000 \ = \ 0.0500$

$\Delta H \ = \ q \ / \ $moles $\ = \ -2.863 \ / \ 0.0500$

      = − 57.3 kJ mol⁻¹