Marking scheme for AHL Worksheet – Chapter 5

1 **a** $6C(s) + 3H_2(g) \rightarrow C_6H_6(l)$ [1]

b $2C(s) + 2H_2(g) + {}^1/_2O_2(g) \rightarrow CH_3CHO(l)$ [1]

c $3Li(s) + {}^1/_2N_2(g) \rightarrow Li_3N(s)$ [1]

2 **a** $3C(s) + 4H_2(g) \rightarrow CH_3CH_2CH_3(g)$ [1]

$\Delta H_f = 3 \times -394 + 4 \times -286 + 2220$ [1]

$\Delta H_f = -106$ kJ mol^{-1} [1]

b $C(s) + 2H_2(g) + {}^1/_2O_2(g) \rightarrow CH_3OH(l)$ [1]

$\Delta H_f = -394 + 2 \times -286 + 715$ [1]

$\Delta H_f = -251$ kJ mol^{-1} [1]

c $C(s) + H_2(g) + {}^1/_2O_2(g) \rightarrow HCHO(g)$ [1]

$\Delta H_f = -394 - 286 + 561$ [1]

$\Delta H_f = -119$ kJ mol^{-1} [1]

d $2C(s) + 2H_2(g) + O_2(g) \rightarrow CH_3COOH(l)$ [1]

$\Delta H_f = 2 \times -394 + 2 \times -286 + 876$ [1]

$\Delta H_f = -484$ kJ mol^{-1} [1]

3 **a** $C_6H_{12}(l) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ [1]

$\Delta H = (6 \times -394 + 6 \times -286) - (-156)$ [1]

$\Delta H_f = -3924$ kJ mol^{-1} [1]

b $C_6H_5OH(s) + 7O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$ [1]

$\Delta H = (6 \times -394 + 3 \times -286) - (-163)$ [1]

$\Delta H_f = -3059$ kJ mol^{-1} [1]

c $CH_2CHCHCH_2(g) + {}^{11}/_2O_2(g) \rightarrow 4CO_2(g) + 3H_2O(l)$ [1]

$\Delta H = (4 \times -394 + 3 \times -286) - (112)$ [1]

$\Delta H_f = -2546$ kJ mol^{-1} [1]

d $(CH_3)_2O(g) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ [1]

$\Delta H = (2 \times -394 + 3 \times -286) - (-185)$ [1]

$\Delta H_f = -1461$ kJ mol^{-1} [1]

4 **a** $(-246 - 597) - (-297 - 444)$ [1]

-102 kJ mol^{-1} [1]

b $(6 \times -314 + 3 \times -242) - (3 \times 80 + 10 \times -46)$ [1]

-2390 kJ mol^{-1} [1]

5 $-276 = (\Delta H_f + 82) - (230 + 2 \times 90)$ [1]

$\Delta H_f(\text{ClNO}) = +52 \text{ kJ mol}^{-1}$ [1]

6 **a** $Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$ [1]

b $O(g) + e^- \rightarrow O^-(g)$ [1]

c $MgF_2(s) \rightarrow Mg^{2+}(g) + 2F^-(g)$ [1]

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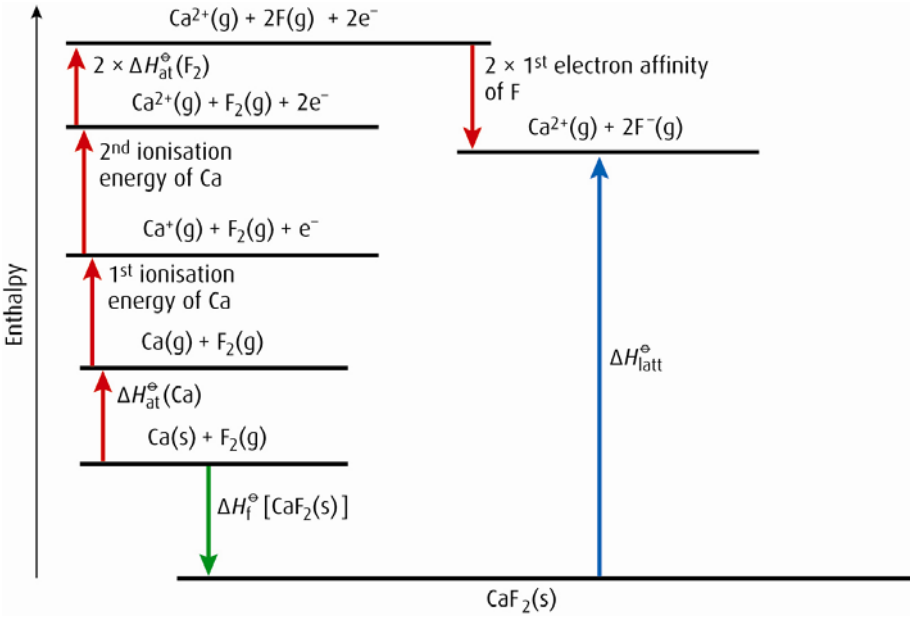

4 marks for all correct, lose 1 mark for each mistake [4]

$\Delta H_{latt} = +1214 + 193 + 590 + 1150 + 2 \times 79 + 2 \times -348$ [1]

$\Delta H_{latt} = 2609 \text{ kJ mol}^{-1}$ [1]

8 Lattice enthalpies for the group 1 fluorides are lower than for the group 2 oxides. [1]

Group 2 oxides contain 2+ and 2– ions as opposed to 1+ and 1– ions in the group 1 fluorides [1]

and there are stronger electrostatic attractions between 2+ and 2– ions, so the lattice enthalpies are higher. [1]

Lattice enthalpy decreases from LiF to NaF to KF and from MgO to CaO to SrO [1]

the size of the positive ions increases [1]

so there are weaker electrostatic attractions between the positive and negative ions. [1]

9 **a** decrease [1]

decrease in number of moles of gas [1]

b increase [1]

increase in number of moles of gas [1]

10 **a** $\Delta S = (308 + 223) - (248 + 167)$ [1]

$\Delta S = 116 \text{ J K}^{-1} \text{ mol}^{-1}$ [1]

b $\Delta S = (192 + 2 \times 188) - (121 + 205)$ [1]

$\Delta S = 242 \text{ J K}^{-1} \text{ mol}^{-1}$ [1]

11 $\Delta G = \Delta H - T\Delta S$ [1]

$$\Delta G = -102 - 298 \times \frac{116}{1000}$$ [1]

$\Delta G = -137 \text{ kJ mol}^{-1}$ [1]

reaction is spontaneous as ΔG is negative [1]

12 **a** $\Delta G^{\ominus} = (2 \times 66) - (2 \times 87)$ [1]

$\Delta G^{\ominus} = -42 \text{ kJ mol}^{-1}$ [1]

b ΔS is negative for this reaction (decrease in number of moles of gas) [1]

as T increases ΔG becomes more positive as $-T\Delta S$ is positive [1]

reaction is less spontaneous at 500 K than at 300 K [1]