1.

(i) Define the term ***standard molar enthalpy change of formation***, $\Delta H_f^{\ominus}$ [1]

(ii) The enthalpy of formation of copper(II) fluoride, CuF_2, can be determined indirectly using a Born-Haber cycle.
Use the data given below to calculate the enthalpy of formation of copper(II) fluoride in kJ mol^{-1}. [4]

Process	$\Delta H^{\ominus}$ / kJ mol^{-1}
$Cu(s) \longrightarrow Cu(g)$	339
$\frac{1}{2}F_2(g) \longrightarrow F(g)$	79
$Cu(g) \longrightarrow Cu^+(g) + e^-$	745
$Cu^+(g) \longrightarrow Cu^{2+}(g) + e^-$	1960
$F(g) + e^- \longrightarrow F^-(g)$	–348
$Cu^{2+}(g) + 2F^-(g) \longrightarrow CuF_2(s)$	–3037

2.

(a) Showing your working, use the data in the table to construct a Born-Haber energy cycle and hence calculate (in kJ mol^{-1}) the standard enthalpy of formation, $\Delta H_f^{\ominus}$, of the ionic solid sodium hydride, NaH.

$$Na(s) + \tfrac{1}{2}H_2(g) \xrightarrow{\Delta H_f^{\ominus}\ NaH} NaH(s)$$

Process	*Enthalpy Change,* $\Delta H^{\ominus}$ / kJ mol^{-1}
$NaH(s) \rightarrow Na^+(g) + H^-(g)$	806
$H_2(g) \rightarrow 2H(g)$	436
$H(g) \rightarrow H^-(g)$	–72
$Na(s) \rightarrow Na(g)$	107
$Na(g) \rightarrow Na^+(g)$	496

[4]

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(b) Giving your reasons, use your answer to part *(a)* to predict the stability of sodium hydride, NaH(s). [1]

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(c) Sodium hydride is a strong *reducing agent*.

(i) Explain the term ***reducing agent***. [1]

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(ii) Sodium hydride, NaH, reacts with water. State the products of this reaction and, by using oxidation numbers, show that sodium hydride is acting as a reducing agent in this reaction. [2]

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