ENERGETICS AHL (HL only)

Please ensure that you have also completed the Core (SL & HL) questions

1. The standard enthalpy of combustion, $\Delta H^{\ominus}_c$ of phenol is –3050kJ mol^{-1}.

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

(a) Using section 12 of the data booklet, calculate the standard enthalpy of formation, $\Delta H^{\ominus}_f$, of phenol, $C_6H_5OH(s)$, in kJ mol^{-1}.

[3]

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(b) The standard **entropy** change of formation, $\Delta S^{\ominus}_f$, of phenol is –385 J K^{-1} mol^{-1}. Calculate the Gibbs free energy change, $\Delta G^{\ominus}$, for the formation of phenol at 298K, using section 1 of the data booklet.

[3]

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(c) Determine whether the formation of phenol is spontaneous at 298K, give a reason.

[1]

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2. The standard enthalpy change of reaction is given for the following process:

$C_8H_{18}(g) \rightarrow C_8H_{18}(l)$ $\Delta H^{\ominus} = -41.5 kJ\ mol^{-1}$

The standard entropy, $S^{\ominus}$, of $C_8H_{18}(g)$ is 467 J K^{-1} mol^{-1} and $C_8H_{18}(l)$ is 360 J K^{-1} mol^{-1}.

(a) Calculate the standard entropy change, $\Delta S^{\ominus}$, for the process.

[1]

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(b) Predict and explain the effect of an increase in temperature on the spontaneity of the process. Use section 1 of the data booklet.

[3]

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(c) Using section 1 of the data booklet, calculate the temperature, in °C, at which $\Delta G = 0$ for the process, and state the significance of this temperature.

[3]

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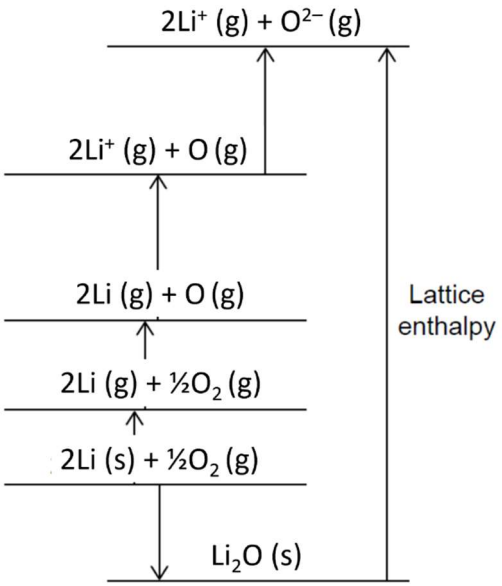
3. The Born-Haber cycle for lithium oxide is shown below, not to scale.



(a) Given that the enthalpy change of atomisation (ΔH_{at}) for lithium is +159 kJ mol^{-1}, and using **section 8** of the data booklet, calculate the enthalpy change for: $2Li (s) \rightarrow 2Li^+ (g)$

[2]

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(b) Given that the enthalpy change of atomisation (ΔH_{at}) for oxygen is +249 kJ mol^{-1}, and using **section 8** of the data booklet, calculate the enthalpy change for: $½O_2 (g) \rightarrow O^{2-} (g)$

[2]

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(c) Given that the enthalpy change of formation (ΔH_f) for Li_2O is –598 kJ mol^{-1} and using your answers in (a) and (b), calculate the lattice enthalpy for Li_2O in kJ mol^{-1}.

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(d) Justify why Na_2O has a lattice enthalpy of lower magnitude (absolute value) than Li_2O.

[1]

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4. Beryllium chloride, $BeCl_2$, is an off-white crystalline solid.

(a) Calculate the molar enthalpy when solid beryllium chloride is dissolved in water, using sections 18 and 20 of the data booklet.

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(b) Using section 1 of the data booklet and your answer in (a), predict and explain whether you might expect beryllium chloride dissolving in water to be a spontaneous process.

[2]

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(c) The theoretical and experimental lattice enthalpies for $BeCl_2$ are considerably different. What does this suggest about the bonding in $BeCl_2$?

[1]

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Total Marks 26 (39 minutes)