

AHL Worksheet – Chapter 5

1 Write equations to represent the enthalpy change of formation of the following:

[3]

- a** $\text{C}_6\text{H}_6(\text{l})$
- b** $\text{CH}_3\text{CHO}(\text{l})$
- c** $\text{Li}_3\text{N}(\text{s})$

2 Calculate the enthalpy change of formation of each of the following given the data in the table:

[12]

	$\Delta H_c^\circ / \text{kJ mol}^{-1}$
$\text{C}(\text{s})$	–394
$\text{H}_2(\text{g})$	–286
$\text{CH}_3\text{CH}_2\text{CH}_3(\text{g})$	–2220
$\text{CH}_3\text{OH}(\text{l})$	–715
$\text{HCHO}(\text{g})$	–561
$\text{CH}_3\text{COOH}(\text{l})$	–876

- a** propane, $\text{CH}_3\text{CH}_2\text{CH}_3(\text{g})$
- b** methanol, $\text{CH}_3\text{OH}(\text{l})$
- c** methanal, $\text{HCHO}(\text{g})$
- d** ethanoic acid, $\text{CH}_3\text{COOH}(\text{l})$

3 Calculate the enthalpy change of combustion of each of the following given the data in the table.

[12]

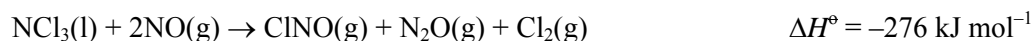
	$\Delta H_f^\circ / \text{kJ mol}^{-1}$
$\text{CO}_2(\text{g})$	–394
$\text{H}_2\text{O}(\text{l})$	–286
$\text{C}_6\text{H}_{12}(\text{l})$	–156
$\text{C}_6\text{H}_5\text{OH}(\text{s})$	–163
$\text{CH}_2\text{CHCHCH}_2(\text{g})$	112
$(\text{CH}_3)_2\text{O}(\text{g})$	–185

- a** cyclohexane, $\text{C}_6\text{H}_{12}(\text{l})$
- b** phenol, $\text{C}_6\text{H}_5\text{OH}(\text{s})$
- c** buta-1,3-diene, $\text{CH}_2\text{CHCHCH}_2(\text{g})$
- d** methoxymethane, $(\text{CH}_3)_2\text{O}(\text{g})$

- 4 Calculate the enthalpy changes for the following reactions given the data in the table.

	$\Delta H_f^\circ / \text{kJ mol}^{-1}$
$\text{SO}_2(\text{g})$	-297
$\text{PCl}_5(\text{s})$	-444
$\text{SOCl}_2(\text{l})$	-246
$\text{Cl}_2\text{O}(\text{g})$	80
$\text{POCl}_3(\text{l})$	-597
$\text{NH}_3(\text{g})$	-46
$\text{NH}_4\text{Cl}(\text{s})$	-314
$\text{H}_2\text{O}(\text{g})$	-242

- a $\text{SO}_2(\text{g}) + \text{PCl}_5(\text{s}) \rightarrow \text{SOCl}_2(\text{l}) + \text{POCl}_3(\text{l})$ [2]
 b $3\text{Cl}_2\text{O}(\text{g}) + 10\text{NH}_3(\text{g}) \rightarrow 2\text{N}_2(\text{g}) + 6\text{NH}_4\text{Cl}(\text{s}) + 3\text{H}_2\text{O}(\text{g})$ [2]
- 5 Use the information below to calculate the enthalpy change of formation of $\text{ClNO}(\text{g})$ [2]



	$\Delta H_f^\circ / \text{kJ mol}^{-1}$
$\text{NCl}_3(\text{l})$	230
$\text{NO}(\text{g})$	90
$\text{N}_2\text{O}(\text{g})$	82

- 6 Write equations to represent the following processes: [3]
 a the second ionisation energy of magnesium
 b the first electron affinity of oxygen
 c the lattice enthalpy of magnesium fluoride
- 7 Construct a Born–Haber cycle showing the formation of calcium fluoride and use it and the data in the table below to predict the lattice enthalpy of calcium fluoride. [6]

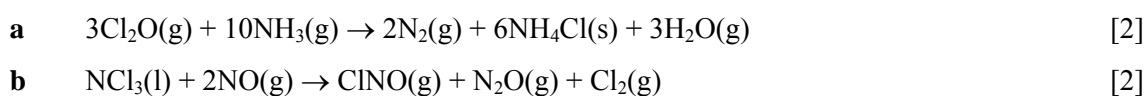
$\Delta H_{\text{at}}(\text{Ca}(\text{s}))$	193 kJ mol^{-1}
$\Delta H_{\text{at}}(\text{F}_2(\text{g}))$	79 kJ mol^{-1}
first ionisation energy (Ca)	590 kJ mol^{-1}
second ionisation energy (Ca)	1150 kJ mol^{-1}
first electron affinity (F)	-348 kJ mol^{-1}
$\Delta H_f(\text{CaF}_2(\text{s}))$	$-1214 \text{ kJ mol}^{-1}$

- 8 State and explain the trends in lattice enthalpy shown in the table below.

[6]

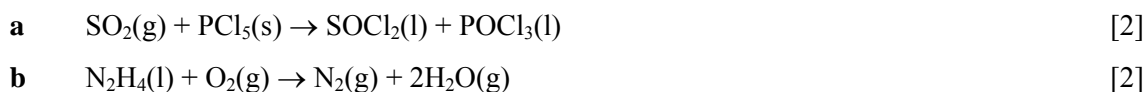
Substance	Lattice enthalpy / kJ mol^{-1}
LiF	1022
NaF	902
KF	801
MgO	3889
CaO	3513
SrO	3310

- 9 Predict, with a reason, whether each of the following reactions involves an increase or decrease in entropy.

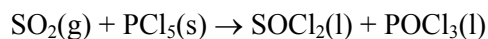


- 10 Use the data in the table to calculate the entropy change for the following reactions:

	$S^\circ / \text{J K}^{-1} \text{mol}^{-1}$
$\text{SO}_2\text{(g)}$	248
$\text{PCl}_5\text{(s)}$	167
$\text{SOCl}_2\text{(l)}$	308
$\text{N}_2\text{H}_4\text{(l)}$	121
$\text{POCl}_3\text{(l)}$	223
$\text{O}_2\text{(g)}$	205
$\text{N}_2\text{(g)}$	192
$\text{H}_2\text{O(g)}$	188

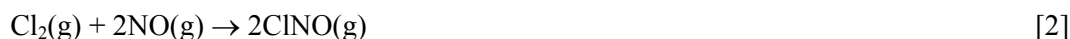


- 11 Use your answers from questions 4 and 10 to predict whether the reaction:



is spontaneous at 298 K. [4]

- 12 a Use the values given in the table to calculate ΔG° for the reaction:



	$\Delta G_f^\circ / \text{kJ mol}^{-1}$
ClNO(g)	66
NO(g)	87

- b Predict whether this reaction will be more spontaneous at 300 K or 500 K. [3]