Q2.1 For which of the reactions would you expect the value of $\Delta G_m^\ominus$ to become more positive (or less negative) with increasing temperature?

Q2.2 For which of the reactions would you expect the standard equilibrium constant, $K^\ominus$, to *decrease* with increasing temperature?

Q2.3 For which of the reactions would you expect the value of $\Delta G_m^\ominus$ to change sign at some temperature as the temperature is increased from 0 K?

Q2.4 For which of the reactions would you expect the standard equilibrium constant, $K^\ominus$, to be greater than unity at *all* temperatures?

Q2.5 For which of the reactions will the units of $K^\ominus$ be the same as those of K_p?

Q2.6 At a fixed temperature, for which of the reactions would you expect an increase in total pressure to increase the equilibrium yield of products? (Assume that all species are in the gas phase, as shown in equations 2.1–2.3.)

PART B

The questions in Part B test your ability to use tables of thermodynamic data.

In answering the questions in Part B, you will need to use the information in Table 2.1. This table provides you with thermodynamic data for a metal M and some of its compounds. *Where appropriate*, you may assume that $\Delta H_m^\ominus$ and $\Delta S_m^\ominus$ for the reactions of interest do not vary with temperature. Any other thermodynamic data that you need should be taken from the S342 *Data Book*.

Q2.7 What is the value of $\Delta H_f^\ominus(M(NO_3)_2,s)$/kJ mol^{-1} at 298.15 K? Select from the key the value that is closest to your answer.

KEY for Q2.7

A −58.0	E −298.6
B −180.3	F −314.0
C −196.0	G −329.7
D −211.4	H −452.0

Q2.8 What is the value of $\Delta G_f^\ominus(M^{2+}, aq)$/kJ mol^{-1} at 298.15 K? Select from the key the value that is closest to your answer.

KEY for Q2.8

A +0.3	E −77.6
B −38.6	F −97.7
C −54.1	G −113.2
D −74.2	H −152.1

Q2.9 and Q2.10 These questions are concerned with the following reaction:

$$MS(s) + 2HCl(g) = MCl_2 + H_2S(g) \qquad (2.4)$$

The metal chloride, MCl_2, melts at 841 K, with a standard enthalpy of fusion $\Delta H_{fus}^\ominus = 30.1$ kJ mol^{-1}, and boils at 1 234 K, with a standard enthalpy of vaporization $\Delta H_{vap}^\ominus = 123.8$ kJ mol^{-1}. The metal sulfide, MS, sublimes (goes directly from solid to gas) at 1 653 K.

To answer these questions you should assume that the metal chloride, MCl_2, is entirely in the solid phase at 600 K, and entirely in the gas phase at 1 300 K, but that the sulfide, MS, is completely solid at both temperatures.

Q2.9 What is the value of $\Delta G_m^\ominus$/kJ mol^{-1} for reaction 2.4 at 600 K? Select from the key the value that is closest to your answer.

KEY for Q2.9

A −228.6	E −87.4
B −136.3	F −30.6
C −100.8	G +4.9
D −95.1	H +46.1

Q2.10 What is the value of $\Delta H_m^\ominus$/kJ mol^{-1} for reaction 2.4 at 1 300 K? Select from the key the value that is closest to your answer.

KEY for Q2.10

A −311.9	E −4.1
B −219.6	F +28.0
C −158.0	G +88.2
D −65.7	H +219.6

Table 2.1 Thermodynamic data at 298.15 K for the metal M and some of its compounds

Substance	State	$\Delta H_f^\ominus$ / kJ mol^{-1}	$\Delta G_f^\ominus$ / kJ mol^{-1}	$S^\ominus$ / J K^{-1} mol^{-1}
M	s	0	0	51.8
M^{2+}	aq	−75.9		−73.2
MCl_2	s	−391.5	−343.9	115.3
$M(NO_3)_2$	s		−255.0	197.9
MS	s	−161.9	−156.3	64.9