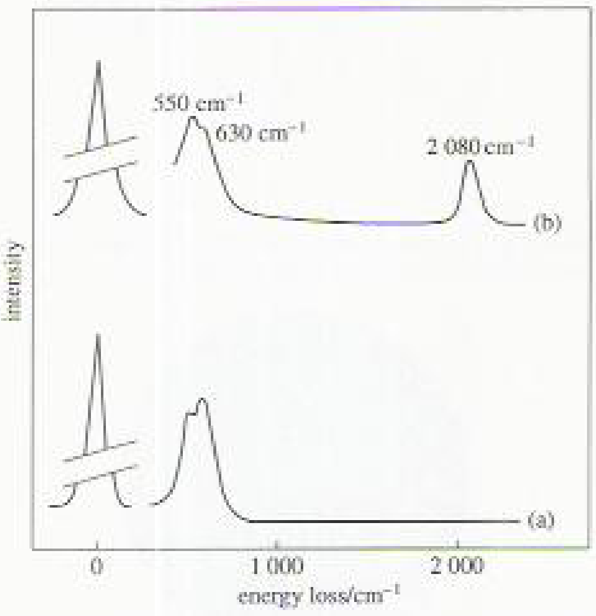

Figure 4.4 The EELS spectra of a W(100) surface exposed to CO at (a) low fractional coverage, and (b) high fractional coverage.

Q4.10 Select from the key the *two* statements that are **incorrect**.

KEY for Q4.10

A X-ray photoelectron spectroscopy is a surface-sensitive technique because the path length of photoelectrons in solids is short.

B The adsorption of atomic oxygen on a nickel surface is expected to increase the work function of the surface.

C In the photoelectron spectrum of a heavy element, three peaks are observed for the 4f subshell, due to the effect of spin–orbit coupling.

D Auger emission occurs during the decay of an ion that has lost an electron from a core level.

E Surfaces that have high Miller indices can be described as terraces of lower index structure, separated by steps.

F The intensities and positions of spots in the LEED pattern of an adsorbate on a surface — for example, the Fe(110)(2 × 1)–H surface — are identical, regardless of whether the adsorbate is located at bridged sites or at top sites.

G The EXAFS technique does not readily distinguish between neighbouring atoms at similar distances from the absorbing atom, if the atomic number of the neighbouring atoms differs only slightly.

H The area of surface sampled by the STM technique can be approximately 10^3 times smaller than that achieved in SAES.

SECTION 5 BLOCKS 7 AND 8 (TMA 04)

Parts A and B of this Section comprise typical problems in the general area of equilibrium electrochemistry. These questions provide valuable practice in using electrode potentials (and/or other kinds of thermodynamic data, if appropriate), and in applying the many terms, conventions, etc. introduced in Block 7. Part C covers important definitions, concepts and results discussed in Block 8; working through these questions will also help you to check your understanding of the way kinetic factors influence the behaviour of practical electrochemical systems.

PART A

The questions in Part A test Objectives 1, 2, 3, 4, 6, 11, 12, 13 and 16 of Block 7.

In answering the questions in Part A, you will need to use the data on a metal X and its compounds given below. Any other information you need should be taken from Block 7 and the S342 *Data Book*.

Where necessary, you should assume that *all* substances (gases, liquids and solutes, including aqueous ions) behave ideally, and that $\Delta H_m^\ominus$ and $\Delta S_m^\ominus$ for the reactions of interest do not vary with temperature.

(a) Thermodynamic data at 298.15 K for the metal X and its oxide

Substance	State	$\Delta H_f^\ominus$ / kJ mol^{-1}	$\Delta G_f^\ominus$ / kJ mol^{-1}	$S^\ominus$ / J K^{-1} mol^{-1}
X	s	0	0	40.9
X_2O_3	s	−1 089.1	−998.3	85.0

(b) At 298.15 K, the standard electrode potential of the (X^{3+}|X) couple is as follows:

$$X^{3+}(aq) + 3e = X(s);\ E^\ominus = -0.55\ V$$

(c) The standard solubility product of the metal(III) hydroxide, $X(OH)_3$, at 298.15 K is:

$$K_{sp}^\ominus(X(OH)_3) = 7.45 \times 10^{-36}$$

Q5.1 What is the value of $\Delta G_f^\ominus(X^{3+}, aq)$/kJ mol^{-1} at 298.15 K? Select from the key the value that is closest to your answer.

KEY for Q5.1

A +159.2	D −53.1
B +83.0	E −83.0
C +53.1	F −159.2

Q5.2 What is the standard electrode potential at 298.15 K of the following couple?

$$X(OH)_3(s) + 3e = X(s) + 3OH^-(aq) \qquad (5.1)$$

Select from the key the value that is closest to your answer.

KEY for Q5.2

A −2.63 V	E −0.14 V
B −1.53 V	F +0.14 V
C −1.38 V	G +1.24 V
D −1.24 V	H +1.53 V