KEY for Q4.5

A The overall rate of reaction can be written as

$$r = -\frac{\mathrm{d}p_{\mathrm{A}}}{\mathrm{d}t} = 2\frac{\mathrm{d}p_{\mathrm{C}}}{\mathrm{d}t}$$

B According to the mechanism,

$$-\frac{\mathrm{d}p_{\mathrm{A}}}{\mathrm{d}t} = k_1 p_{\mathrm{A}}$$

C According to the mechanism,

$$-\frac{\mathrm{d}p_{\mathrm{B}}}{\mathrm{d}t} = k_2 p_{\mathrm{B}} \theta_{\mathrm{A}}$$

D According to the mechanism, the rate of change of 'concentration' of adsorbed A with time can be expressed as:

$$\text{rate} = k_1 p_{\mathrm{A}}(1 - \theta_{\mathrm{A}})$$

E In the steady state, the amount of adsorbed A will be zero.

F According to the mechanism,

$$\frac{\mathrm{d}p_{\mathrm{C}}}{\mathrm{d}t} = 2k_2 p_{\mathrm{B}} \theta_{\mathrm{A}}$$

G According to the mechanism, if the initial partial pressure of A is kept at a fixed value, then the initial rate of reaction should be independent of the initial partial pressure of B.

PART C

The questions in Part C test Objectives 1, 2, 3, 5, 6, 9, 10, 11 and 12 of Block 6.

Q4.6 Figure 4.1 is the X-ray photoelectron spectrum of a sample of gold (Au) foil. Using the information in Appendix 1 of Block 6, suggest the identity of the elements that emit the photoelectrons giving rise to the four peaks A to D. Select from the key *three* elements that you can identify.

KEY for Q4.6

A C	E Al
B N	F Si
C O	G Ag
D Na	H Au

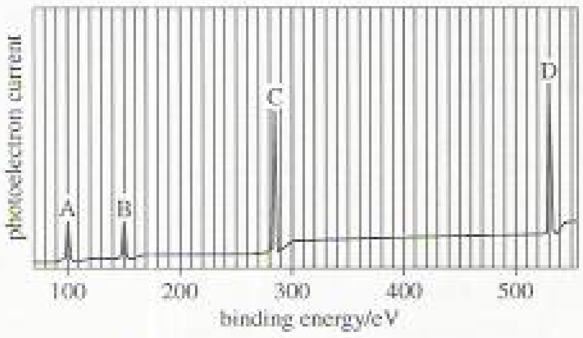

Figure 4.1 The X-ray photoelectron spectrum of a sample of gold (Au) foil.

Q4.7 Figure 4.2 shows the real unit mesh of a clean *bcc*(110) surface. Figure 4.3 is the LEED pattern of an adsorbate on this surface. Assuming that the sample was orientated in the conventional way, select from the key the notation that correctly describes the adsorbate real mesh.

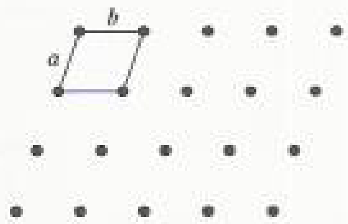

Figure 4.2 Lattice point representation of a clean *bcc*(110) surface, showing the conventional unit mesh.

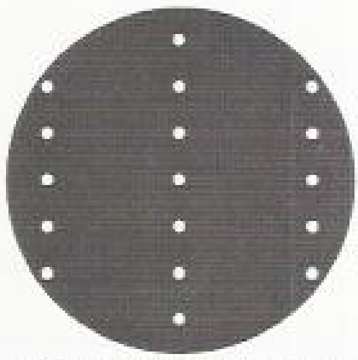

Figure 4.3 Schematic representation of the LEED pattern for a particular adsorbate structure on a *bcc*(110) substrate.

KEY for Q4.7

A *bcc*(110)(2 × 1)	D *bcc*(110)(3 × 1)
B *bcc*(110)(1 × 2)	E *bcc*(110)(3 × 2)
C *bcc*(110)(1 × 3)	F *bcc*(110)(3 × 3)

Q4.8 Exposure of the (111) surface of a crystal of the *fcc* metal silver to bromine leads to the adsorbate structure that is described as Ag(111)(3 × 3)–Br. Given that the unit cell parameter for silver is $a_0 = 0.409\,\mathrm{nm}$, calculate the surface density of bromine atoms on this surface. Select from the key the value that is closest to your answer.

KEY for Q4.8

A $4.4 \times 10^{19}\,\mathrm{m^{-2}}$	E $1.5 \times 10^{9}\,\mathrm{m^{-2}}$
B $1.5 \times 10^{18}\,\mathrm{m^{-2}}$	F $4.5 \times 10^{9}\,\mathrm{m^{-2}}$
C $4.5 \times 10^{18}\,\mathrm{m^{-2}}$	G $1.2 \times 10^{7}\,\mathrm{m^{-2}}$
D $1.2 \times 10^{16}\,\mathrm{m^{-2}}$	

Q4.9 The EELS spectra of a W(100) surface exposed to CO at (a) low fractional coverage and (b) high fractional coverage are shown in Figure 4.4 (*overleaf*). From the information given in Block 6 about the nature of CO adsorption, interpret these spectra, and then select the *one* **correct** response from the key.

KEY for Q4.9

A Dissociative adsorption at all coverages; linearly bonded at high fractional coverage.

B Linearly bonded at all coverages; dissociative adsorption at high fractional coverage.

C Dissociative adsorption at low fractional coverage; bridge bonded at high fractional coverage.

D Bridge bonded at low fractional coverage; dissociative adsorption at high fractional coverage.

E Linearly bonded at low fractional coverage; bridge bonded at high fractional coverage.

F Bridge bonded at low fractional coverage; linearly bonded at high fractional coverage.