PART C

The questions in Part C test Objectives 1 and 3 of Block 1.

The questions in Part C are concerned with the following gas-phase reaction:

$$2A(g) + B(g) = 2C(g) + D(g) \qquad (2.5)$$

Q2.11 According to reaction 2.5, if the reactants are mixed in stoichiometric proportions, what is the maximum theoretical equilibrium yield of substance C? Select from the key the range of values within which your answer lies.

KEY for Q2.11

A 0–15%
B 15–30%
C 30–45%
D 45–60%
E 60–75%
F 75–90%
G 90–100%

Q2.12 Suppose now that the equilibrium yield, y, of substance C is defined as $y = p(C)/p_{tot}$, where $p(C)$ is the partial pressure of C at equilibrium, and p_{tot} is the total pressure. If the reactants are mixed in stoichiometric proportions, select from the key the correct expression for the equilibrium constant K_p of reaction 2.5.

KEY for Q2.12

A $K_p = \dfrac{27y^3}{(1-3y)^3}$

B $K_p = \dfrac{27y^3}{2(1-3y)^3}$

C $K_p = \dfrac{27y^3}{2(1-\frac{3}{2}y)^3}$

D $K_p = \dfrac{27y^3}{8(1-\frac{3}{2}y)^3}$

E $K_p = \dfrac{8(1-\frac{3}{2}y)^3}{27y^3}$

F $K_p = \dfrac{2(1-\frac{3}{2}y)^3}{27y^3}$

G $K_p = \dfrac{2(1-3y)^3}{27y^3}$

H $K_p = \dfrac{(1-3y)^3}{27y^3}$

PART D

The questions in Part D test Objectives 1, 3, 4, 6, 12, 13 and 14 of Block 2.

Q2.13 to Q2.17 At temperatures in the range 500–650 K, the thermal decomposition of nitrogen dioxide, NO_2, yields nitric oxide, NO, and oxygen, O_2, according to the following time-independent stoichiometry:

$$2NO_2(g) = 2NO(g) + O_2(g) \qquad (2.6)$$

Under these conditions, the experimental rate equation for reaction 2.6 has the form:

$$J = k_R[NO_2]^2$$

The rate constants for reaction 2.6 at 523 K and 573 K are given in the following Table:

T/K	k_R/dm^3 mol^{-1} s^{-1}
523	0.056
573	0.54

Q2.13 to Q2.15 Assign each of the statements in Q2.13–Q2.15 to *one* of the categories in the key for Q2.13 to Q2.15.

KEY for Q2.13 to Q2.15

A The statement must be true.
B The statement must be false.
C The statement *could* be true, but it is not necessarily true.

Q2.13 The rate of reaction 2.6 is given by the following expression:

$$J = d[NO_2]/dt$$

Q2.14 At temperatures in the range 500–650 K, the thermal decomposition of nitrogen dioxide is a bimolecular reaction.

Q2.15 If reaction 2.6 takes place in a vessel of fixed volume at a temperature of 523 K, a plot of $1/p_{tot}$ against time will be a straight line, where p_{tot} is the total pressure in the vessel.

Q2.16 If the initial pressure of NO_2 is 20 kPa in a vessel of fixed volume at 573 K, how long will it take before the *total* pressure in the vessel reaches a value of 25 kPa? (You may assume that the gases behave ideally.) Select from the key the value that is closest to your answer.

KEY for Q2.16

A 205 s
B 221 s
C 410 s
D 441 s
E 819 s
F 882 s
G 1 544 s
H 3 088 s

Q2.17 What is the value of the Arrhenius activation energy for reaction 2.6? Select from the key the value that is closest to your answer.

KEY for Q2.17

A 1 kJ mol^{-1}
B 5 kJ mol^{-1}
C 14 kJ mol^{-1}
D 31 kJ mol^{-1}
E 58 kJ mol^{-1}
F 113 kJ mol^{-1}
G 480 kJ mol^{-1}