Try Yourself 7.5 a

The following reaction have the indicated equilibrium constant at 100^0C:

$2NOBr$ (g) $\leftrightarrows$ $2NO$ (g) $+$ Br_2 (g) $K_c = 0.014$
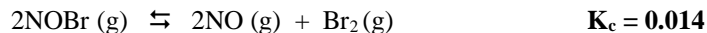
Determine the equilibrium expression, and value for K_c for the following reactions:

a) $2NO$ (g) $+$ Br_2 (g) $\leftrightarrows$ $2NOBr$ (g)

① $2\,NOBr_{(g)} \rightleftharpoons 2\,NO_{(g)} + Br_2(g)$ $K_c = 0.014$

② $2\,NO_{(g)} + Br_2(g) \rightleftharpoons 2\,NOBr_{(g)}$ $K_c = ?$

Equation ② = inverse of eq. ①.

∴ K_c for eq. ② = $\dfrac{1}{K_c \text{ for eq. ①}} = \dfrac{1}{0.014} = 71.429$

b) $4NOBr$ (g) $\leftrightarrows$ $4NO$ (g) $+$ $2Br_2$ (g)

① $2\,NOBr_{(g)} \rightleftharpoons 2\,NO_{(g)} + Br_2(g)$ $K_c = 0.014$

② $4\,NOBr_{(g)} \rightleftharpoons 4\,NO_{(g)} + 2Br_2(g)$ $K_c = ?$

Eq. ② = $\frac{2}{2}$ × eq. ①

∴ K_c for eq. ② = $(K_c \text{ for eq. ①})^2$
                                    $= (0.014)^2$
                                    $= 0.000196$
      or. 1.96×10^{-4}

c)   NOBr (g) ⇆ NO (g) + ½Br₂ (g)

① $2 NOBr_{(g)} \rightleftharpoons 2 NO_{(g)} + Br_{2(g)}$ $K_c = 0.014$

② $NOBr_{(g)} \rightleftharpoons NO_{(g)} + \frac{1}{2} Br_{2(g)}$ $K_c = ?$

$Eq. ② = \frac{1}{2} \times eq. ①$

∴ K_c for eq. 2 $= (K_c$ for eq. 1$)^{1/2}$

$= 0.118$
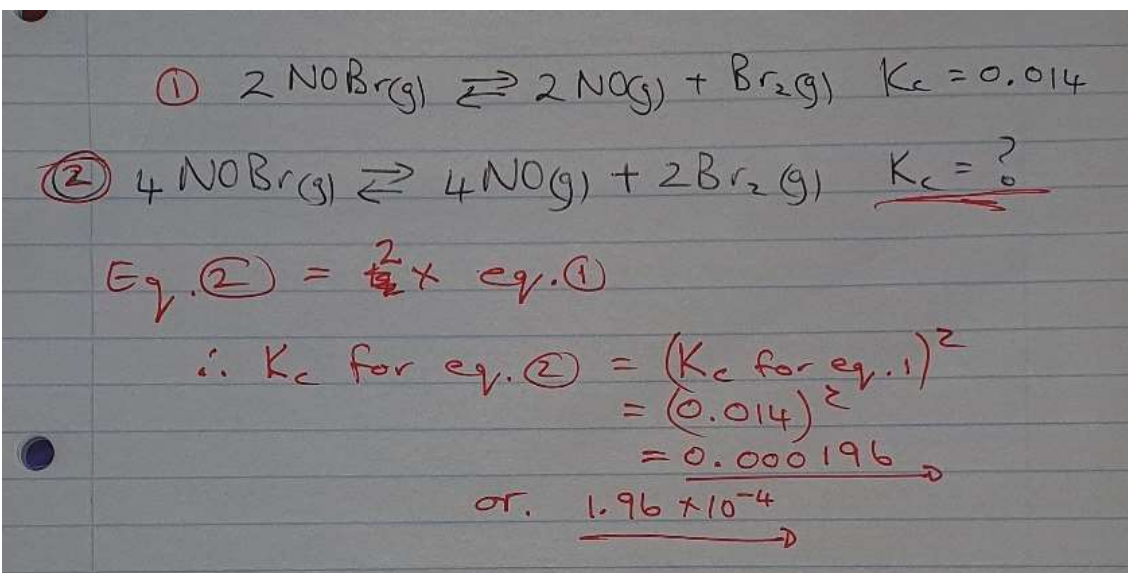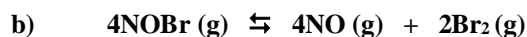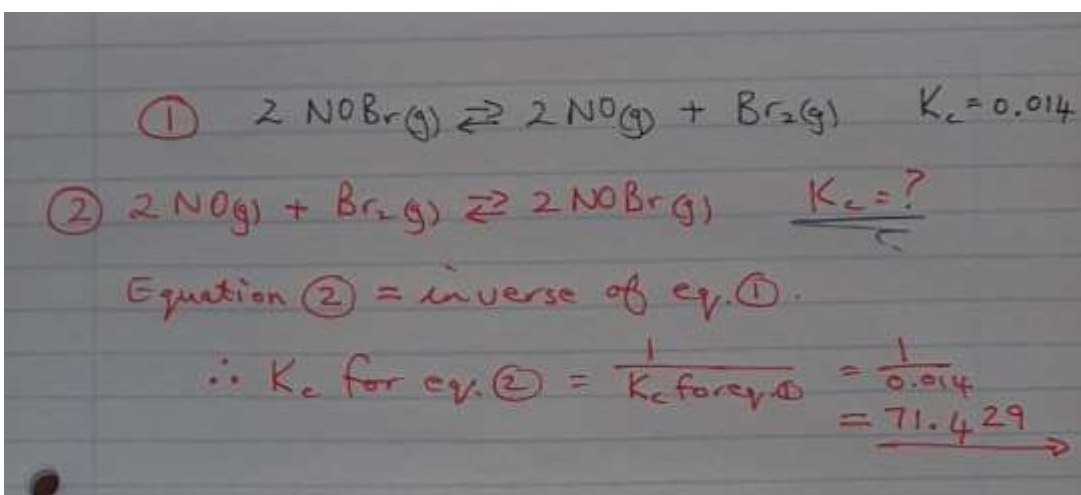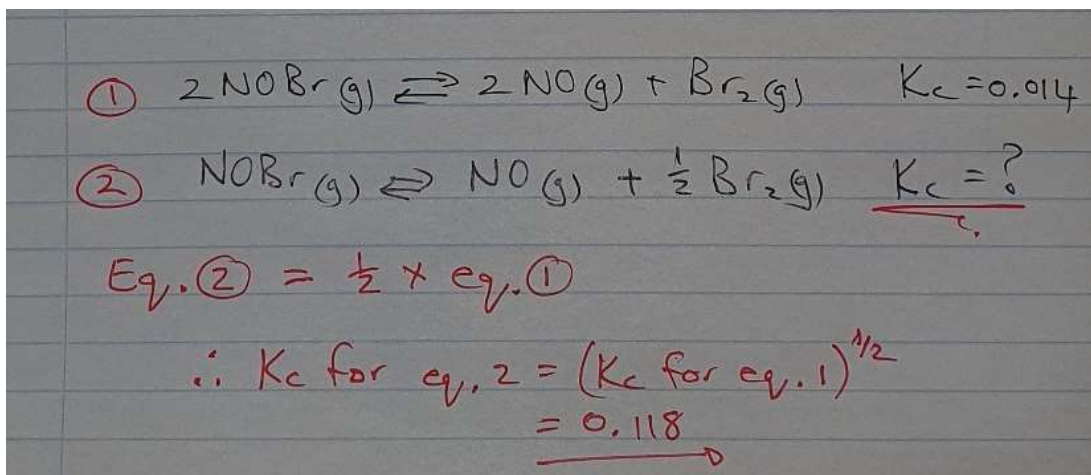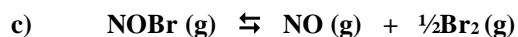
Try Yourself 7.5 b

Given these equilibrium reactions and constants,

(1) $N_2(g) + O_2(g) ⇆ 2NO(g)$ $K_{C1} = 4.3 \times 10^{-25}$

(2) $2NO(g) + O_2(g) ⇆ 2NO_2(g)$ $K_{C2} = 6.4 \times 10^9$
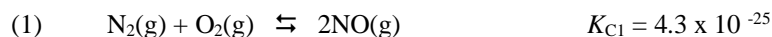
Nitrogen dioxide is a toxic pollutant that contributes to photochemical smog. Calculate the equilibrium constant, K_{C3}, for the overall reaction, given that the K_c's occur at the same temperature.

The overall reaction is:

1) $N_2_{(g)} + O_2_{(g)} \rightleftharpoons 2NO_{(g)}$

2) $2NO_{(g)} + O_2_{(g)} \rightleftharpoons 2NO_2_{(g)}$

Overall: $N_2_{(g)} + 2O_2_{(g)} \rightleftharpoons 2NO_2 _{(g)}$

$K_{overall} = K_1 + K_2$

$= (4.3 \times 10^{-25})(6.4 \times 10^9)$

$= 2.75 \times 10^{-15}$