Nitrogen reacts with hydrogen as shown: $3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -76$ kJ mol^{-1}

10.0 moles of hydrogen was mixed with 5.0 moles of nitrogen. At equilibrium, there was found to be 3.0 moles of ammonia. The total pressure was 2.0 x 10^7 Pa.

a Write an expression for K_p for this equilibrium.

$$K_p = \frac{(p\,NH_3)^2}{(p\,H_2)^3\ x\ (p\,N_2)}$$

b State the units of K_p. **Pa^{-2}**

c Calculate the moles of hydrogen and nitrogen at equilibrium.

hydrogen = **5.5 moles** nitrogen = **3.5 moles**

d Calculate the partial pressure of each gas.

hydrogen = $\frac{5.5}{12.0}\ x\ 2.0\ x\ 10^7 = 9.17\ x\ 10^6\ Pa$

nitrogen = $\frac{3.5}{12.0}\ x\ 2.0\ x\ 10^7 = 5.83\ x\ 10^6\ Pa$

ammonia = $\frac{3.0}{12.0}\ x\ 2.0\ x\ 10^7 = 5.00\ x\ 10^6\ Pa$

e Calculate K_p for this equilibrium.

$$K_p = \frac{(p\,NH_3)^2}{(p\,H_2)^3\ x\ (p\,N_2)} = \frac{(5.00\ x\ 10^6)^2}{(9.17\ x\ 10^6)^3\ x\ (5.83\ x\ 10^6)} = 5.56\ x\ 10^{-15}\ Pa^{-2}$$

f Explain what would happen to the position of the equilibrium and the value of K_p if the total pressure of gases was decreased?

equilibrium position moves left to side with more gas molecules to oppose decrease in pressure
no change in K_p

g Explain what would happen to the position of the equilibrium and the value of K_p if the temperature of gases was decreased?

equilibrium position moves right in exothermic direction to oppose decrease in temperature
K_p increases