Question:

For the reaction equilibrium $2NOBr(g) \leftrightarrow 2NO(g)+Br_2(g)$

If partial pressure of Br_2= P/9 where P is the total pressure, the ratio of K_p/P is?

Solution.

An expression for K_p for the given reaction is the following:

$$K_p = \frac{P_{NO}^2 * P_{Br_2}}{P_{NOBr}^2}$$

According to the chemical reaction in the equilibrium conditions the partial pressure of 2NO will be two times more then the partial pressure of Br_2. It means that partial pressure of 2NO= 2*P/9. From the conditions it is known that the total pressure is P. The partial pressure of 2NOBr in the equilibrium conditions will be 2NOBr = P – 2*P/9 – P/9 = 6*P/9 = 2*P/3

Now we can calculate the constant of equilibrium, K_p:

$$K_p = \frac{P_{NO}^2 * P_{Br_2}}{P_{NOBr}^2} = \frac{(\frac{2*P}{9})^2 * \frac{P}{9}}{(\frac{2*P}{3})^2} = \frac{\frac{4*P^3}{729}}{\frac{4*P^2}{9}} = \frac{P}{81}$$

So K_p/P will be:

$$\frac{K_p}{P} = \frac{\frac{P}{81}}{P} = \frac{1}{81}$$

Answer: $\dfrac{K_p}{P} = \dfrac{1}{81}$