A mixture of 0.10 mol of NO, 0.050 mol of H2 and 0.10 mol H20 is placed in 1.0 L vessel at 300K. At equilibriuk, [NO]=0.062 M. a) Calculate the equilibrium concentrations of H2, N2 and H2O. b)Calculate Kc.

Solution:

a) The following reaction occurs in vessel:

$2NO(g) + 2H_2(g) = N_2(g) + 2H_2O(g)$

Create a table containing concentration data of each substance before the reaction, during the reaction and after:

	NO	H_2	N_2	H_2O
before	0.10	0.050	-	0.1
change in reaction				
after	0.062			

Difference between initial and eventual concentrations of NO is its change in reaction 0.10 – 0.062 = 0.038. Due to the reaction equation the same quantity of H_2 reacts 0.038.

	NO	H_2	N_2	H_2O
before	0.10	0.050	-	0.1
change in reaction	0.038	0.038		
after	0.062			

Difference between initial concentration of H_2 and its change in reaction is eventual concentration of H_2 0.05 – 0.038 = 0.012.

	NO	H_2	N_2	H_2O
before	0.10	0.050	-	0.1
change in reaction	0.038	0.038		
after	0.062	0.012		

Due to the reaction equation, the quantity of N_2 produced in reaction is two times less than the reaction quantity of NO or H_2 0.038/2 = 0.019. And the same quantity is after the reaction, as N_2 was not present in initial mixture.

	NO	H_2	N_2	H_2O
before	0.10	0.050	-	0.1
change in reaction	0.038	0.038	0.019	
after	0.062	0.012	0.019	

The quantity of water produced in reaction is the same as reaction concentration of H_2 or NO. The concentration of H_2O after the reaction is sum of before and the quantity produced in the reaction:

	NO	H_2	N_2	H_2O
before	0.10	0.050	-	0.1
change in reaction	0.038	0.038	0.019	0.038
after	0.062	0.012	0.019	0.138

The equilibrium concentrations are the same as concentrations after the reaction, so

Answer: $[H_2] = 0.012$ mol/L, $[N_2] = 0.019$ mol/L, $[H_2O] = 0.138$ mol/L.

b) $$K_C = \frac{[N_2]\cdot[H_2O]^2}{[NO]^2\cdot[H_2]^2} = \frac{0.019\cdot 0.138^2}{0.062^2\cdot 0.012^2} = 653.62 \text{ L/mol}$$

Answer: $K_C = 653.62$ L/mol.