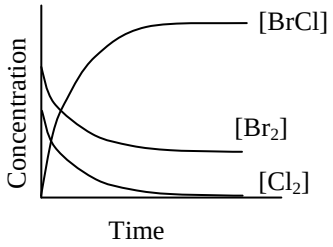
Marks 4

- In the reaction of Cl_2 with Br_2 in CCl_4 solution, BrCl forms according to the equation:

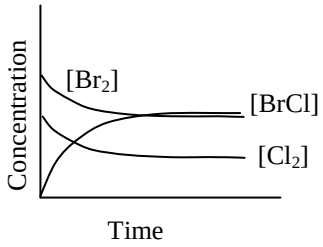
$$Br_2 + Cl_2 \rightarrow 2BrCl \qquad K_c = 2$$

With initial concentrations of $[Br_2] = 0.6$ M, $[Cl_2] = 0.4$ M and $[BrCl] = 0.0$ M, which of the following concentration versus time graphs represents this reaction? Explain why you rejected each of the other three graphs.

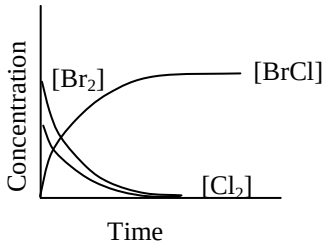
(a)



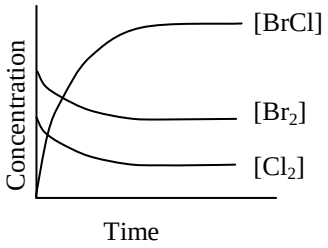
(b)



(c)



(d)



Graph B is correct.

Graph A has $[Cl_2]$ tending to zero and graph C has both $[Cl_2]$ and $[Br_2]$ tending to zero. As $K_c = 2$, the reaction does not go anywhere near to completion.

In Graph C, the rates of change of $[Br_2]$ and $[Cl_2]$ are different. The chemical reaction shows that these react with a 1 : 1 stoichiometry and so their concentrations should decrease at the same rate.

As the initial concentration of $[Cl_2] > [Br_2]$ and these react with a 1 : 1 stoichiometry, $[Cl_2]$ is the limiting reagent. The maximum value of [BrCl] is limited by the initial $[Cl_2]$. As $[Cl_2]_{initial} = 0.4$ M and the chemical equation shows that 2BrCl are made from each Cl_2, $[BrCl]_{final} = 0.8$ M. In graph D, [BrCl] is larger than $2 \times [Cl_2]_{initial}$ so this graph can also be ruled out.