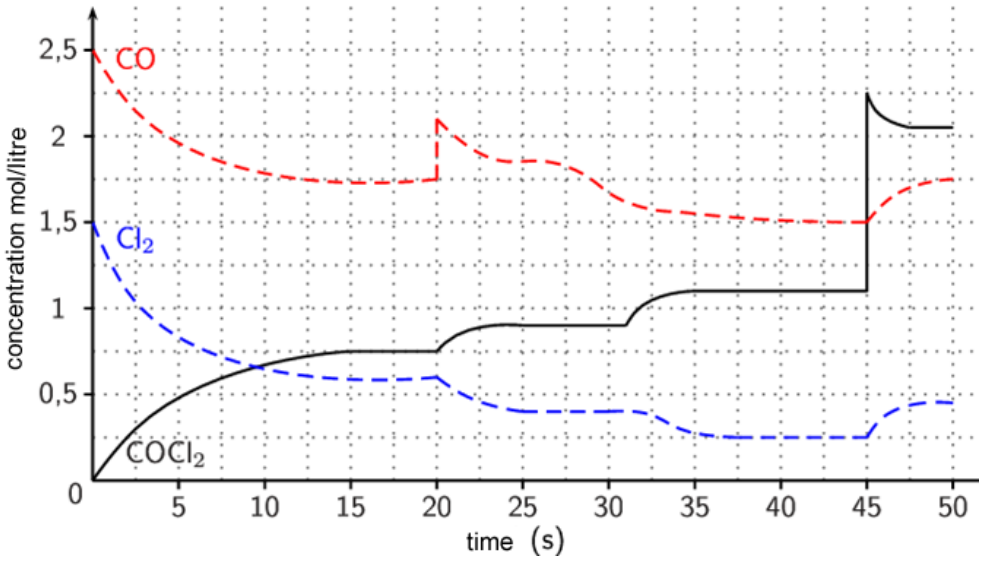
Friday Worksheet **Name: ……**

Chemical equilibrium worksheet 1

1) Consider the graph below of the reaction
$CO(g) + Cl_2(g) <=> COCl_2(g)$



a) How does the rate of the forward and backward reactions compare at the following times
i) 50 s Rates of forward and backward reactions are equal
ii) 5 s Rate of forward reaction is greater than the backward reaction.
iii) 23 s Rate of forward reaction is greater than the backward reaction

b) What happened at t = 20s? Explain how the system responded by referring to Le Chatellier's principle CO is added and the system responds by shifting to the right to partially undo the change.

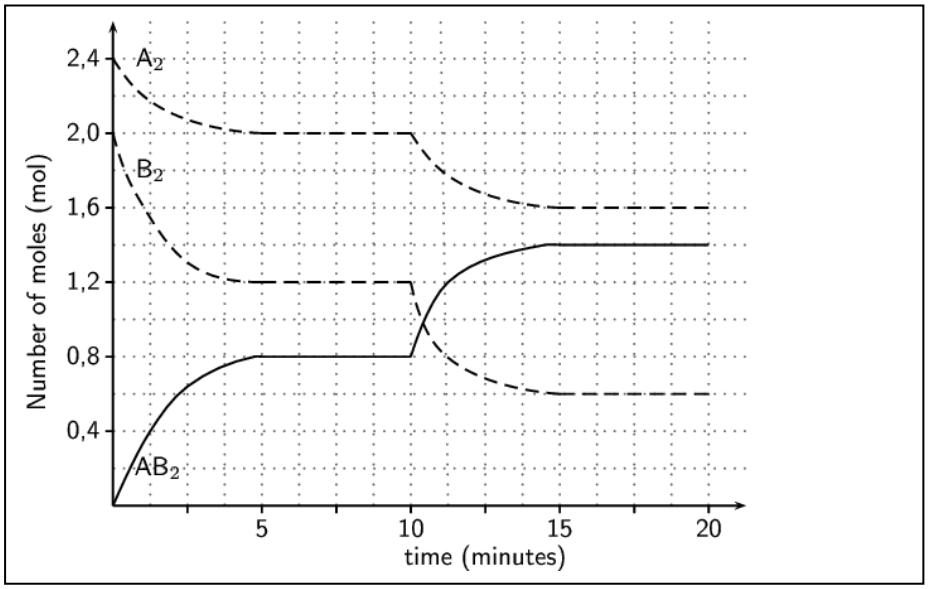
c) Write the equilibrium expression.

$$\frac{[COCl_2]}{[CO\,][Cl_2]}$$

d) Calculate the equilibrium constant at t = 40 s

$$\frac{[1.08]}{[1.50]\,[0.25]} = 2.88M^{-}$$

e) 2.0 mol of Cl_2 is placed in a 2.0 litre vessel along with 3.0 mol of CO gas at a certain temperature. The mixture was allowed to reach equilibrium and then analysed. It was found to contain 1.5 mol of $COCl_2$. Calculate the equilibrium constant .
$[Cl_2] = [0.50/2.0] = 0.25M$, $[CO] = [1.50/2.0 = 0.75M]$ $[COCl_2] = [1.50/2.0] = 0.75M$
$K = 0.75M/0.1875M^2 = 4.0M^{-}$



2) Consider the chemical equilibrium represented by the unbalanced equation

$$A_2(g) + B_2(g) \Leftrightarrow AB_2(g) \quad (+\Delta H).$$

and the graph shown above.

a) How does the rate of the forward and backward reactions compare at the following times

i) 8 min rate forward = rate backward

ii) 20 min rate forward = rate backward

b) What happened at t = 10 min? Explain your answer by referring to Le Chatellier's principle Two possible events

1) Temperature was increased hence driving the endothermic reaction forward to partially undo the change.
2) Since the graph shows number of mol on the y-axis a volume decrease would increase the pressure and drive the equilibrium in the forward direction, direction of least particles, to partially undo the change.

c) Write the equilibrium expression.

$$\frac{[AB_2]^2}{[A_2][B_2]^2}$$

d) Calculate the equilibrium constant at t = 8 min if the reaction occurred in a 1.50 litre vessel

$[AB_2] = 0.80 / 1.50 = 0.533$ M

$[A_2] = 2.0 / 1.5 = 1.33$ M

$[B_2] = 1.2 / 1.50 = 0.80$ M

$K_e = (0.533)^2 / (1.33 \times (0.8)^2) = 0.33$ M^{-}