Dynamic Nature of Chemical Equilibrium

We know that one important factor affecting reaction rate is reactant concentration. As a reaction begins the reactants are at their maximum concentrations and the forward reaction proceeds at its maximum rate. At this time there are no products and therefore no reverse reaction.

As the forward reaction proceeds, products are being made and so the reverse reaction can begin. This will be slow at first because the concentration of products is low. Gradually the rate of the forward reaction will decrease as the reactants are consumed and, at same time, the rate of the reverse reaction will increase as more products are formed. Eventually the rates of the forward and reverse reactions will become equal. This is when chemical equilibrium is established.

	Forward	**Reverse**
AT START	FAST (maximum concentration)	NIL (no products)
AS TIME PASSES	Becoming slower as reactants are used up.	Becoming faster as products form.
AT EQUILIBRIUM	RATES of forward and reverse reactions equal	

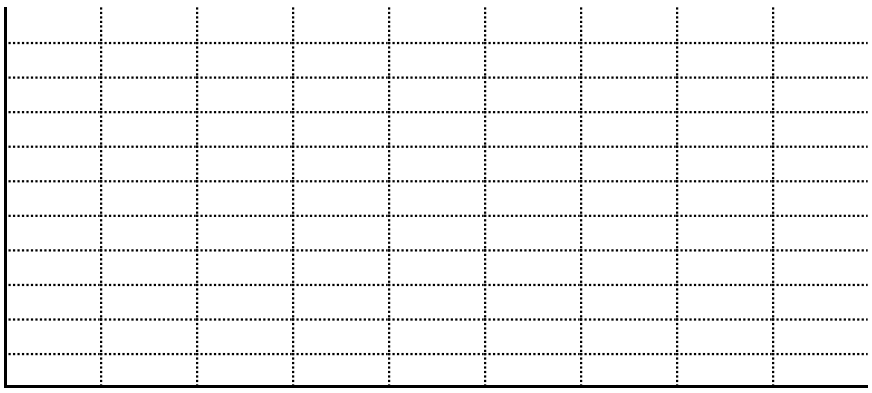
Consider the following equilibrium reaction:

$$Cl_{2(g)} + PCl_{3(g)} \rightleftharpoons PCl_{5(g)}$$

The table below shows concentrations of reactants and products vs time for the above reaction system.

Time (s)	$[Cl_2]$	$[PCl_3]$	$[PCl_5]$
0	1.00	1.00	0.00
20	0.90	0.90	0.10
40	0.80	0.80	0.20
60	0.75	0.75	0.25
80	0.71	0.71	0.29
100	0.71	0.71	0.29
120	0.71	0.71	0.29

Graph the data from the table above.



A) When was equilibrium attained?

B) What would the concentration of Cl_2 be after 20 hours?

C) After 40 s which reaction (forward or reverse) is faster?

D) At 25 s is the forward reaction increasing or decreasing in its rate?

E) At 25 s is the reverse reaction increasing or decreasing in its rate?

F) At 100 s which reaction is faster, forward or reverse?

G) At 100 s which reaction is increasing in rate, the forward or the reverse?

Consider the following equilibrium reaction:

$$N_{2(g)} + 3\ H_{2(g)} \rightleftharpoons 2\ NH_{3(g)}$$

The table below shows concentrations of reactants and products vs time for the above reaction system. Graph the data from the table.

Time (min)	$[N_2]$ mol/L	$[H_2]$ mol/L	$[NH_3]$ mol/L
0.00	2.80	5.00	0.50
1.00	2.50	4.10	1.10
2.00	2.30	3.50	1.50
3.00	2.20	3.20	1.70
4.00	2.10	2.90	1.90
5.00	2.10	2.90	1.90