

SL & HL Questions on Equilibrium

1. Distinguish between dynamic equilibrium and static equilibrium.

2. Explain why wet clothes that are hung on a washing line dry best

- in bright sunshine.
- on a windy day.
- when the general humidity in the air is low.



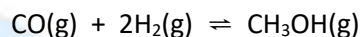
3. When ethanoic acid and ethanol are mixed in a closed container in the presence of sulfuric acid (which acts as a catalyst) water and ethyl ethanoate are formed.



The reaction can be followed and the concentration of the products slowly increases. After about one week the concentrations of all the reactants and products are found to be constant.

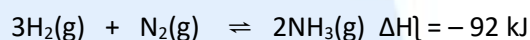
- Explain why the concentrations of the products increase initially but then remain constant.
- State and explain how the value of the reaction quotient, Q will change during the week after the ethanoic acid and ethanol are mixed.
- Suggest why the sulfuric acid speeds up the reaction but has no effect on the final concentrations of the reactants and products.
- The value for the equilibrium constant is 4 at 298 K. If equal amounts of ethanoic acid and ethanol are added initially in a closed container at 298 K and the temperature kept constant what can be deduced about the composition of the reaction mixture after one week has passed.

4. Carbon monoxide reacts with hydrogen at 500 K to form gaseous methanol. The equation for the reaction is:



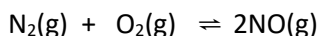
- i. Write the equilibrium expression for this reaction.
- ii. The value of K_c for this reaction is 14.5 at 500 K. What information does this give about the position of equilibrium and the approximate relative concentrations of the reactants and product in the equilibrium mixture?

5. Hydrogen and nitrogen react under certain conditions to form ammonia:



- i. The value for K_c is 152 at 500 K. Explain why the value is lower at higher temperatures and deduce the effect that a higher temperature has on the yield of ammonia.
- ii. Explain why increasing the pressure increases the yield of ammonia.
- iii. Many text books state that the iron used as the catalyst is *finely divided* (or powdered). Explain why the iron is in this form.

6. In the high temperatures reached in an internal combustion engine the nitrogen and oxygen in the air can combine to form nitrogen(II) oxide:



The value for the equilibrium constant, K_c , is 1.7×10^{-3} at 2300 K.

- i. Write the equilibrium expression for this reaction.
- ii. Explain the effect that increasing the pressure will have on the position of equilibrium.
- iii. This reaction is endothermic. Explain the effect that increasing the temperature above 2300 K will have on:
 - (a) the yield of nitrogen(II) oxide.
 - (b) the rate of the reaction.
 - (c) the value of the equilibrium constant, K_c .

