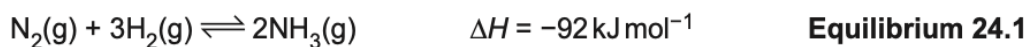


AS Level Chemistry A
H032/01 Breadth in chemistry

Question Set 21

1. This question is about ammonia, NH_3 .

(a) In industry, ammonia is made from nitrogen and hydrogen. This is a reversible reaction, as shown in **equilibrium 24.1** below.



(i) Explain how Le Chatelier's principle can be used to predict the conditions of temperature and pressure for a maximum **equilibrium** yield of ammonia

① a) i) decreasing the temperature would increase the yield of ammonia [4] because the forward reaction is exothermic, so the equilibrium would move to the right in order to increase the temperature, according to Le Chatelier's principle (oppose the change in conditions).

increasing the pressure would increase the yield of ammonia because there are less moles of gas on the right (2 moles on the right vs 4 moles on the left) so the equilibrium would move to the right in order to decrease the pressure i.e. oppose the change in conditions.

(ii) Using certain conditions, **equilibrium 24.1** has the equilibrium concentrations in the table.

Substance	Equilibrium concentration / mol dm^{-3}
$\text{N}_2(\text{g})$	1.25
$\text{H}_2(\text{g})$	2.75
$\text{NH}_3(\text{g})$	0.862

Calculate the numerical value for K_c for **equilibrium 24.1** under these conditions.

Give your answer to an appropriate number of significant figures and in standard form.

ii)
$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} \rightarrow \frac{(\text{mol dm}^{-3})^2}{(\text{mol dm}^{-3})(\text{mol dm}^{-3})^3} \xrightarrow{\text{cancelling out top and bottom}} \frac{1}{(\text{mol dm}^{-3})^2} \rightarrow (\text{mol dm}^{-3})^{-2}$$

$$K_c = \frac{(0.862)^2}{(1.25)(2.75)^3} = 0.0285829 = 2.86 \times 10^{-2} \text{ mol}^{-2} \text{ dm}^6$$

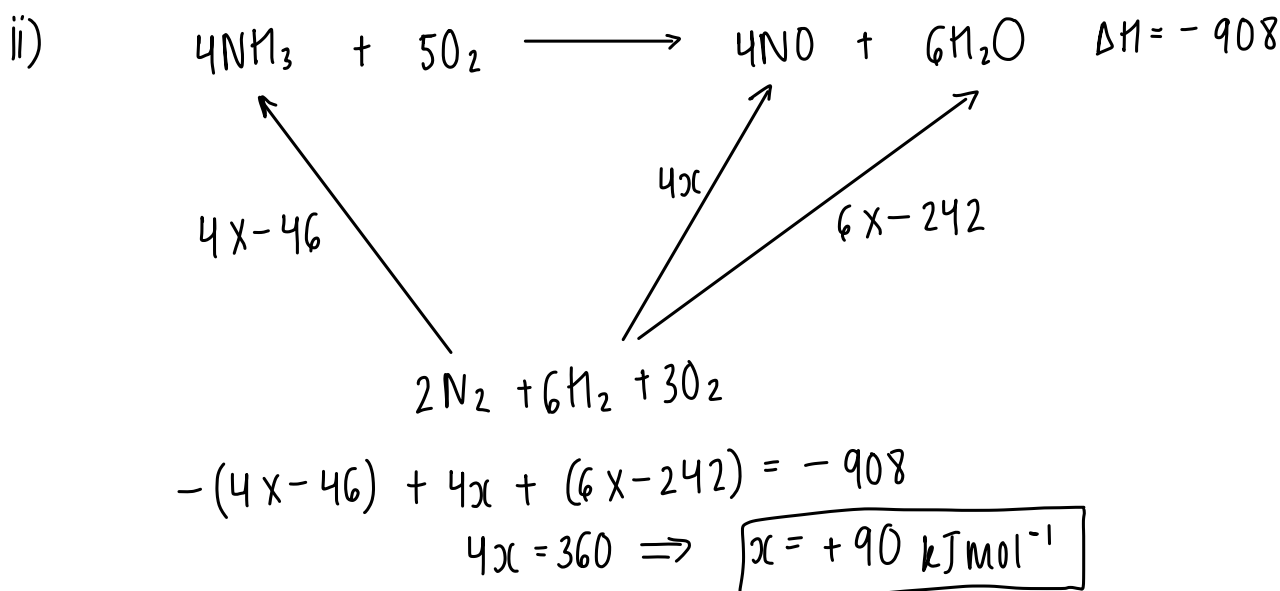
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increasing the pressure would increase the yield of ammonia because there are less moles of gas on the right (2 moles on the right vs 4 moles on the left) so the equilibrium would move to the right in order to decrease the pressure i.e. oppose the change in conditions.

ii)
$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \xrightarrow{\text{cancelling out top and bottom}} \frac{(mol\ dm^{-3})^2}{(mol\ dm^{-3})(mol\ dm^{-3})^3} \rightarrow \frac{1}{(mol\ dm^{-3})^2}$$

$$K_c = \frac{(0.862)^2}{(1.25)(2.75)^3} = 0.0285829 = 2.86 \times 10^{-2} mol^{-2} dm^6$$

$(mol\ dm^{-3})^{-2}$



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