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## 1. The importance of investigating conditions that affect rate and yield of chemical reactions

Investigating factors which affect rate and yield is extremely important in industry. Industries are required to produce **high yields** of specific products at a **reasonable rate** and at the **lowest cost**. Conditions that produce high yields and / or high rates are often expensive, thus compromises must be made to operate under **optimum (best)** conditions.

## 2. Le Chatelier's Principle and the Haber process.

The **Haber process** is used for the manufacture of **ammonia**.

**Exothermic**

**N<sub>2</sub> (g) + 3 H<sub>2</sub> (g)**

**2 NH<sub>3</sub> (g)**

**#H = - ve**

**Endothermic**

**4 volumes**

**2 volumes**

**Conditions for the reaction.**

### 1. Temperature of 500°C :

- A **high** temperature **increases the rate** of attaining equilibrium.
- The forward reaction is exothermic, therefore a **low** temperature moves the equilibrium to the **right** giving a **higher yield** of ammonia.
- A **medium** temperature is used as a compromise.

### 1. Pressure of 200 atm :

- A high pressure increases the rate of attaining equilibrium
- The forward reaction results in a reduction in volume, therefore a **high** pressure



1. **Catalyst – vanadium (V) oxide :**

- **Increases the rate** of attaining equilibrium.
- The catalyst does **not** affect the position of equilibrium – yield is not affected