

- Nitrogenase, an enzyme present in bacteria on the **root nodules of leguminous plants** such as peas, catalyses the conversion of **atmospheric nitrogen to ammonia**.
- **Uses in industries:**
  - **Petroleum refining** makes intensive use of catalysis for **catalytic cracking** (breaking long-chain hydrocarbons into smaller pieces), naphtha reforming and steam reforming (conversion of hydrocarbons into synthesis gas).
  - **Fuel cells** rely on catalysts for both the anodic and cathodic reactions.
  - Many fine chemicals used in **heavy industries** as well as specialised processes such as **Heck Reaction (2010 Nobel Prize)** that would be prohibitively expensive on a large scale, are prepared cheaply via catalysis.
  - Some of the **large-scale chemicals** including ammonia, nitric acid, sulphuric acid, etc. are produced via catalytic oxidation.
  - **Ziegler-Natta catalysts** are used to make common plastics (or **polymers**) such as polyethylene.
- **Food processing:** One of the most essential applications of catalysis is **hydrogenation** (reaction with hydrogen gas) **of fats** using nickel.
- **Environment: Catalytic converters** typically composed of platinum and rhodium help in breaking down some of the harmful by-products of automobile exhausts.

Until now, **seven Nobel Prizes in Chemistry have been awarded to discoveries in the field of catalysis**. Most enantioselective catalysts until the 21st century were **either enzymes or metal compounds**. While enzymes have to be obtained from **biological sources and do not do well under heat and solvents**, metal catalysts are costly and sometimes **toxic**. Therefore, the discovery of organocatalysts is a pathbreaking success.

**19. Electric mobility offers solutions to the problems associated with climate change, growing fuel prices, and urban transportation issues. Discuss in the context of India. (250 words) 15**

**Approach:**

- Briefly explain the concept of e-mobility.
- Mention the problems related to climate change, growing fuel prices and urban transportation.
- Suggest how e-mobility offers solutions to these problems.
- Conclude accordingly.

**Answer:**

**Electric mobility** is the type of mobility which operates on an **electric motor**, rather than the conventional internal-combustion engine that generates power by burning a mix of fuel and gases. While some electric vehicles (EVs) use lead acid or nickel metal hydride batteries, lithium-ion batteries are used in the modern vehicles.

It is argued that electric mobility is a solution to **various problems faced by India, such as:**

- **Climate change:** According to India Energy Outlook 2021, transportation sector is the third largest emitter of carbon dioxide (greenhouse gas) in India, after power and industry sectors. India is the third-largest global emitter of CO<sub>2</sub>, despite low per capita CO<sub>2</sub> emissions.
- **Growing fuel prices:** India imported over 85% of its oil needs and 53% of its gas demand in 2019-20. Thus, fluctuations in the international crude oil process directly influences fuel prices in India. Recently, the price of Brent Crude crossed \$100 per barrel, which is more than double from last year's price of around \$42.5 per barrel.
- **Urban transportation issues:** The urban population is at risk by directly suffering the impact of **air pollution** caused by conventional vehicles. Also, **noise pollution** is a common problem in urban areas.

**Solutions offered by e-vehicles to these problems:**

- **Reducing greenhouse gas (GHG) emissions:** Shifting to EVs will reduce GHG emissions that get emitted from running a conventional internal combustion engine vehicle. Fully electric vehicles have zero tailpipe emissions. However, even when electricity generation in the power