Grade VII – Ch 8 : Physical and Chemical Changes – Case study

The rustless wonder: A case study on iron pillar of Delhi

The rustless property of the Iron Pillar of Delhi is due to a combination of factors, primarily attributed to the metallurgical composition of the iron used in its construction, as well as environmental conditions. Here are the key reasons behind its rust resistance:

High Purity Iron: The Iron Pillar is made of a type of wrought iron that is exceptionally pure, with an iron content of nearly 99%. This high purity of iron is achieved through a unique smelting process. The absence of impurities, especially sulfur and phosphorus, in the iron contributes to its rust resistance.

Formation of Protective Patina: Over centuries, the Iron Pillar has developed a thin, tightly adhering layer of iron oxides, primarily composed of magnetite (Fe_3O_4). This layer, often referred to as a "patina," serves as a protective barrier against further corrosion. The patina acts as a shield, preventing oxygen and moisture from reaching the underlying iron and causing rust.

Environmental Conditions: The arid and semi-arid climate of Delhi, characterized by low humidity and relatively low rainfall, has played a crucial role in preserving the Iron Pillar. These conditions slow down the corrosion process, making it favorable for the development of a stable and protective patina.

Metallurgical Expertise: The ironworkers of ancient India demonstrated advanced metallurgical knowledge, allowing them to produce high-purity iron and to understand the importance of a pure iron composition in preventing rust. The

craftsmanship and precision in manufacturing the pillar also contributed to its long-term durability.

Design and Shape: The Iron Pillar's design, with a tapering cylindrical shape, contributes to its rust resistance. The absence of corners or edges minimizes areas where corrosion could start, as these areas are more vulnerable to rust.

Chemical Composition of Soil: The soil composition in the specific location where the Iron Pillar is erected may also influence its rust resistance. The soil chemistry can interact with the pillar and either promote or inhibit corrosion.