PHYSICS — Electrostatics (Electric Field Lines + Electric Flux)

Electric Field Lines

- Electric field lines are imaginary lines that show the direction and strength of an electric field created by charges.
- They always start from positive charges and end at negative charges.
- The closer these field lines are, the stronger the electric field at that point.
- Field lines never cross each other because that would mean two directions for the field at the same spot, which is impossible.
- These lines are always perpendicular to the surface of a conductor or charge.
- For two like charges, the lines repel and bend away from each other. For opposite charges, lines run straight from positive to negative, showing attraction.
- Tangents drawn at any point on a field line show the direction of the electric field at that point.

Electric Flux

- Electric flux measures how many electric field lines pass through a given surface. You can think of it as the number of field "arrows" that go through a window.
- The formula for electric flux is:

$$\Phi = E \times A \times \cos\ \theta$$

where $E$is the electric field strength, $A$is the area through which the field lines pass, and $\theta$is the angle between the field and the surface's perpendicular (normal).

- If the field is perpendicular to the surface ($\theta = 0°$), flux is maximum. If parallel ($\theta = 90°$), flux is zero.
- Electric flux helps us quantify the effect of electric fields on surfaces and is foundational to Gauss's Law, which relates flux through a closed surface to the charge it encloses.

Charge Distribution (Revision & Simple Numerical Examples)

- The electric field due to a point charge is given by:

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

where $q$is the charge and $r$is the distance from the charge.

- Example: For a pair of equal opposite charges a small distance apart (a dipole), the fields at points closer to one charge are stronger, showing distinct field line patterns and regions where the net field cancels out.

CHEMISTRY — Solid State (Unit Cell Parameters + Packing)

Types of Unit Cells

- **Simple Cubic (SC):** Atoms only at the 8 corners of the cube.
- **Body-Centered Cubic (BCC):** Atoms at the corners plus one atom at the cube center.
- **Face-Centered Cubic (FCC):** Atoms at the corners plus one at the center of each of the 6 faces.

Unit Cell Parameters and Radius Relation

- The unit cell edge length $a$and atomic radius $r$relation depends on structure:
  - SC: atoms touch along the edges → $a = 2r$
  - BCC: atoms touch along the body diagonal → $a = \frac{4r}{\sqrt{3}}$
  - FCC: atoms touch along the face diagonal → $a = \frac{4r}{\sqrt{2}} = 2\sqrt{2}r$

Packing and Coordination

- Coordination number is how many nearest neighbors each atom touches.
  - SC coordination number = 6
  - BCC coordination number = 8
  - FCC coordination number = 12
- Packing efficiency describes the percentage volume occupied by atoms in the unit cell. FCC has the highest efficiency, followed by BCC, and then SC (which is least efficient).

MATHS — Relations & Functions (Part 2)

Equivalence Relations

- A relation is an equivalence relation if it satisfies three properties:
  - **Reflexive:** Every element relates to itself (e.g., $a \sim a$).
  - **Symmetric:** If $a$relates to b, then $b$relates to a.
  - **Transitive:** If $a$relates to $b$and $b$relates to c, then $a$relates to c.
- Such relations partition sets into groups called equivalence classes where elements are considered equivalent.

Function Basics, Domain & Codomain

- A function assigns exactly one output to every input.
- **Domain:** The set of all possible inputs (x-values).

- **Codomain:** The set of all possible outputs, including those not necessarily produced.
- **Range:** The actual set of outputs produced by the function.
- **Vertical Line Test:** A test on graphs; if a vertical line crosses the curve more than once anywhere, the curve is not a function because it assigns multiple outputs to an input.

Example Problems

- Practice problems in NCERT Ex 1.3 help you learn to identify domain, range, and check if relations meet equivalence properties or function criteria.