

Physics

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(Chapter 1) (Electric Charges and Fields)
(Class 12)

Question 1.13:

Figure shows tracks of three charged particles in a uniform electrostatic field. Give the signs of the three charges. Which particle has the highest charge to mass ratio?



Answer 1.13:

Opposite charges attract each other and same charges repel each other. It can be observed that particles 1 and 2 both move towards the positively charged plate and repel away from the negatively charged plate. Hence, these two particles are negatively charged. It can also be observed that particle 3 moves towards the negatively charged plate and repels away from the positively charged plate. Hence, particle 3 is positively charged.

The charge to mass ratio (emf) is directly proportional to the displacement or amount of deflection for a given velocity. Since the deflection of particle 3 is the maximum, it has the highest charge to mass ratio.

Question 1.14:

Consider a uniform electric field $E = 3 \times 10^3 \text{ i N/C}$.

(a) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the yz plane?

(b) What is the flux through the same square if the normal to its plane makes a 60° angle with the x -axis?

Answer 1.14:

(a) Electric field intensity, $E = 3 \times 10^3 \text{ i N/C}$

Magnitude of electric field intensity, $|E| = 3 \times 10^3 \text{ N/C}$

Side of the square, $s = 10 \text{ cm} = 0.1 \text{ m}$

Area of the square, $A = s^2 = 0.01 \text{ m}^2$

The plane of the square is parallel to the y - z plane. Hence, angle between the unit vector normal to the plane and electric field, $\theta = 0^\circ$

Flux (ϕ) through the plane is given by the relation,

$$\phi = |E|A \cos \theta$$

$$= 3 \times 10^3 \times 0.01 \times \cos 0^\circ = 30 \text{ N m}^2/\text{C}$$

(b) Plane makes an angle of 60° with the x -axis. Hence, $\theta = 60^\circ$

Flux, $\phi = |E|A \cos \theta$

$$= 3 \times 10^3 \times 0.01 \times \cos 60^\circ$$

$$= 30 \times \frac{1}{2}$$

$$= 15 \text{ N m}^2/\text{C}$$

Question 1.15:

What is the net flux of the uniform electric field of Exercise 1.14 through a cube of side 20 cm oriented so that its faces are parallel to the coordinate planes?

Answer 1.15:

All the faces of a cube are parallel to the coordinate axes. Therefore, the number of field lines entering the cube is equal to the number of field lines piercing out of the cube. As a result, net flux through the cube is zero.

Solid State Physics Chapter 1 Solutions

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