

EQUIPOTENTIAL SURFACE

EQUIPOTENTIAL SURFACE_ INTRODUCTION_EXAMPLES-RELATION
BETWEEN ELECTRIC FIELD AND POTENTIAL DIFFERENCE

MEANING OF EQUI DISTANCE:

In The given figure school students are standing for the morning assembly.

In between the lines there are equal distances. ie, all are equi distance from everyone.

Now let us see our topic of equi potential points and surfaces.



EQUI POTENTIAL:

If all the points on a surface are at the **same potential** then it is said to be equi potential surface.

Here are few examples:

In the given figure, consider the two points A and B. They are equi distance from the point charge. So according to the formula

$$V = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$$

If the distance r is the same for the points A and B the potentials are the same.

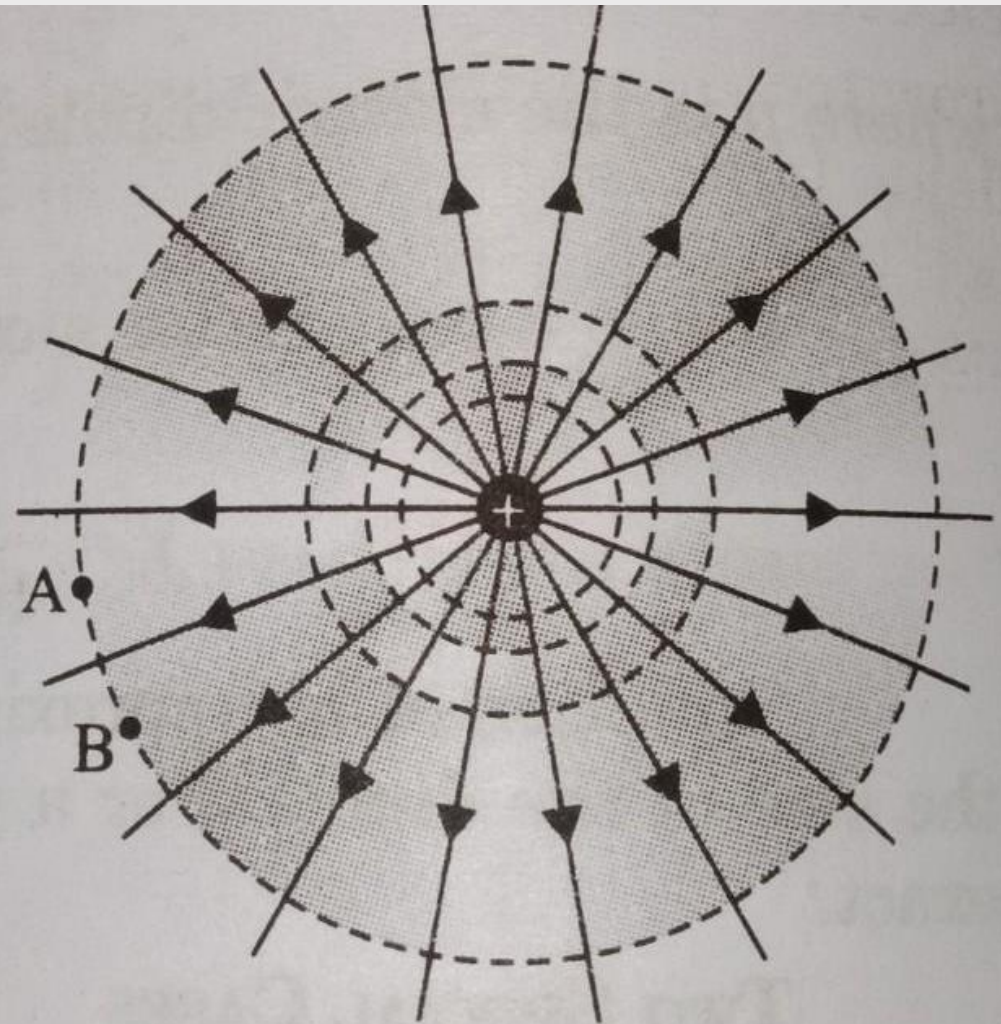


Fig. 3.33. Equipotential surfaces of an isolated point charge in space

PROPERTIES OF EQUIPOTENTIAL SURFACE:

In the previous topics on electric potential energy, you know that

$$U = W = (\Delta V)q$$

where ΔV is the potential difference between the points

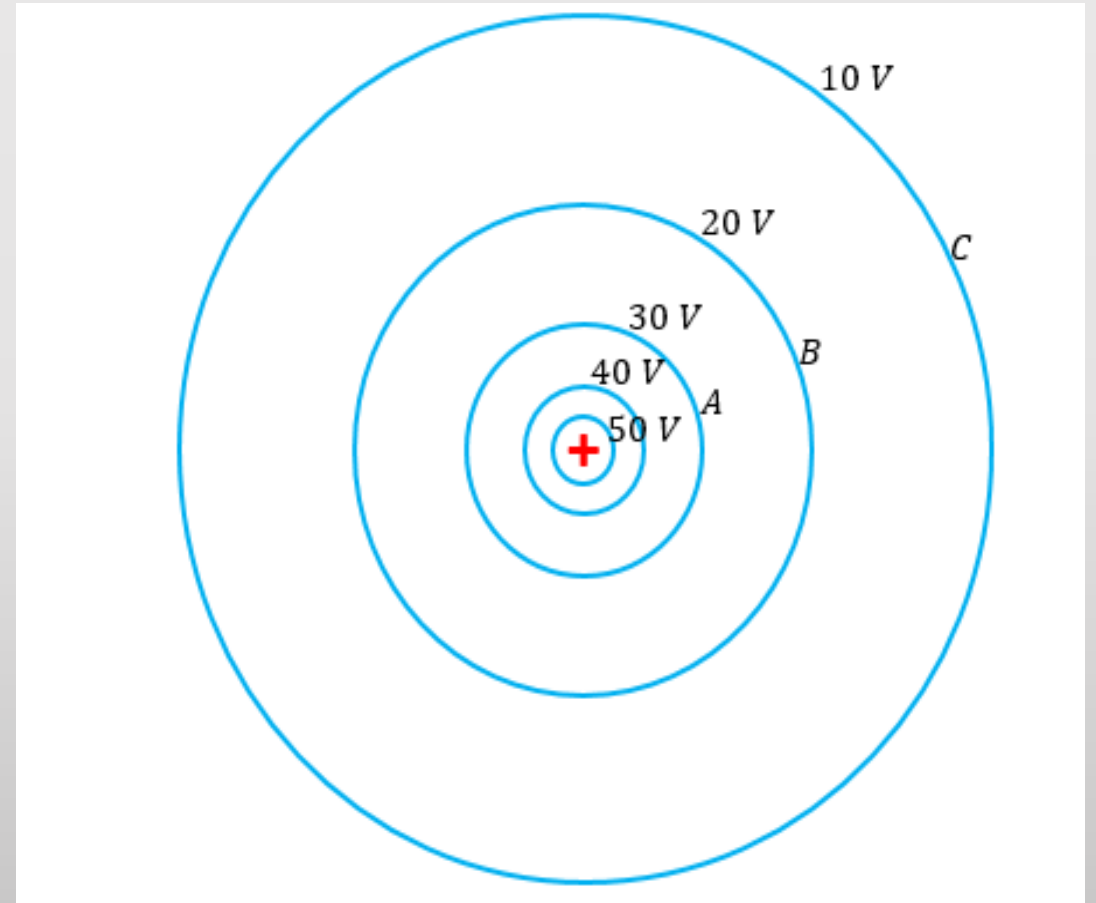
$$A \text{ and } B = (V_B - V_A)$$

$$W = q(V_B - V_A)$$

But in equipotential surface the $V_B = V_A$

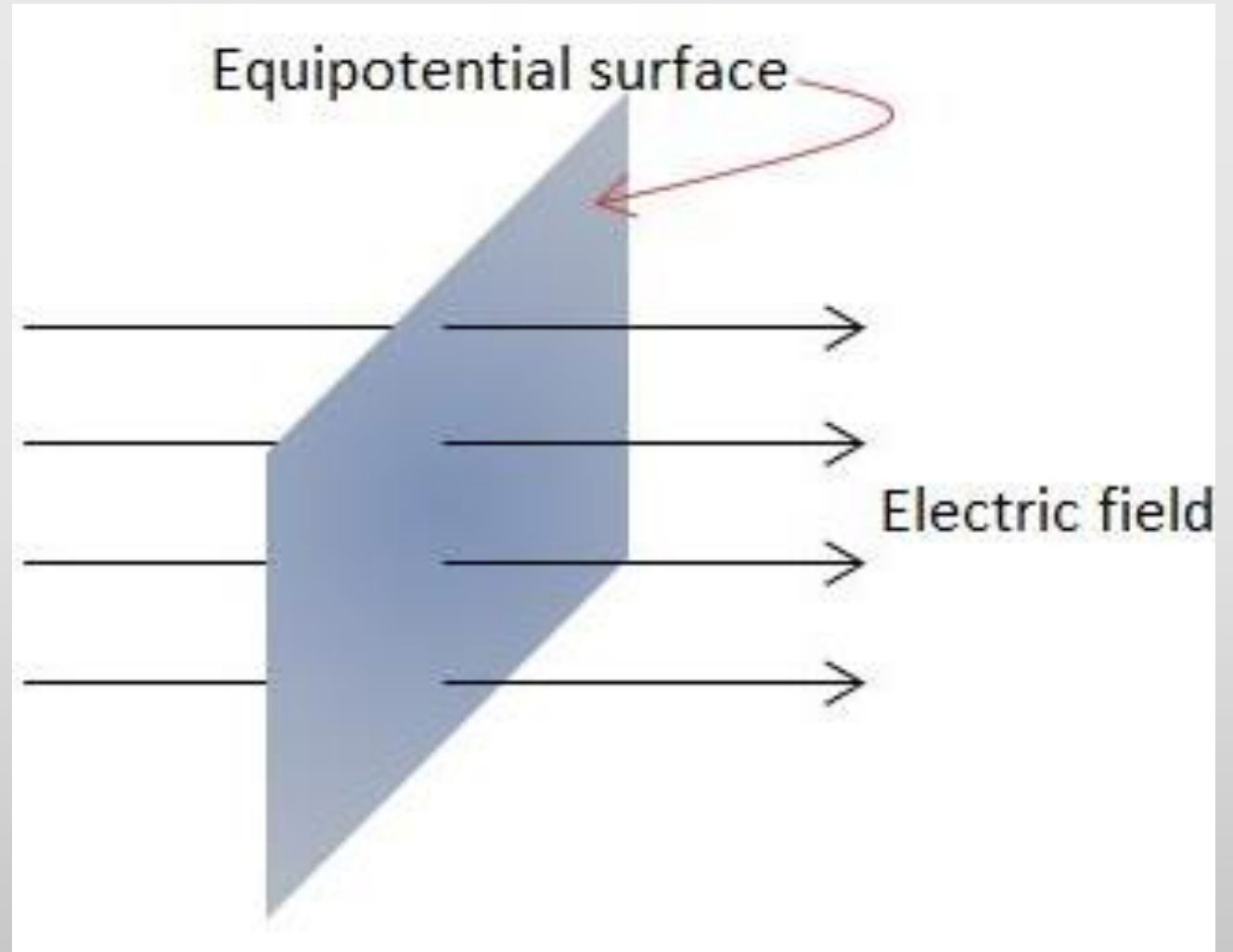
Therefore in an equipotential surface the work done in moving any charge from one point to another is zero.

- In the given figure points A, B and C are lying in different surfaces. So they are not the equipotential points.
- If points are lying on the same circle or Sphere then they are considered to be equipotential points
- For a single charge the equipotential surface is **sphere**



The electric field is normal or perpendicular to the equipotential surface.

Assume if E is not normal there must be a component parallel to the surface. Then work must be done to move any other external charge. This is not correct.



The above figure shows that for the uniform electric field the equipotential surfaces are **planes**.

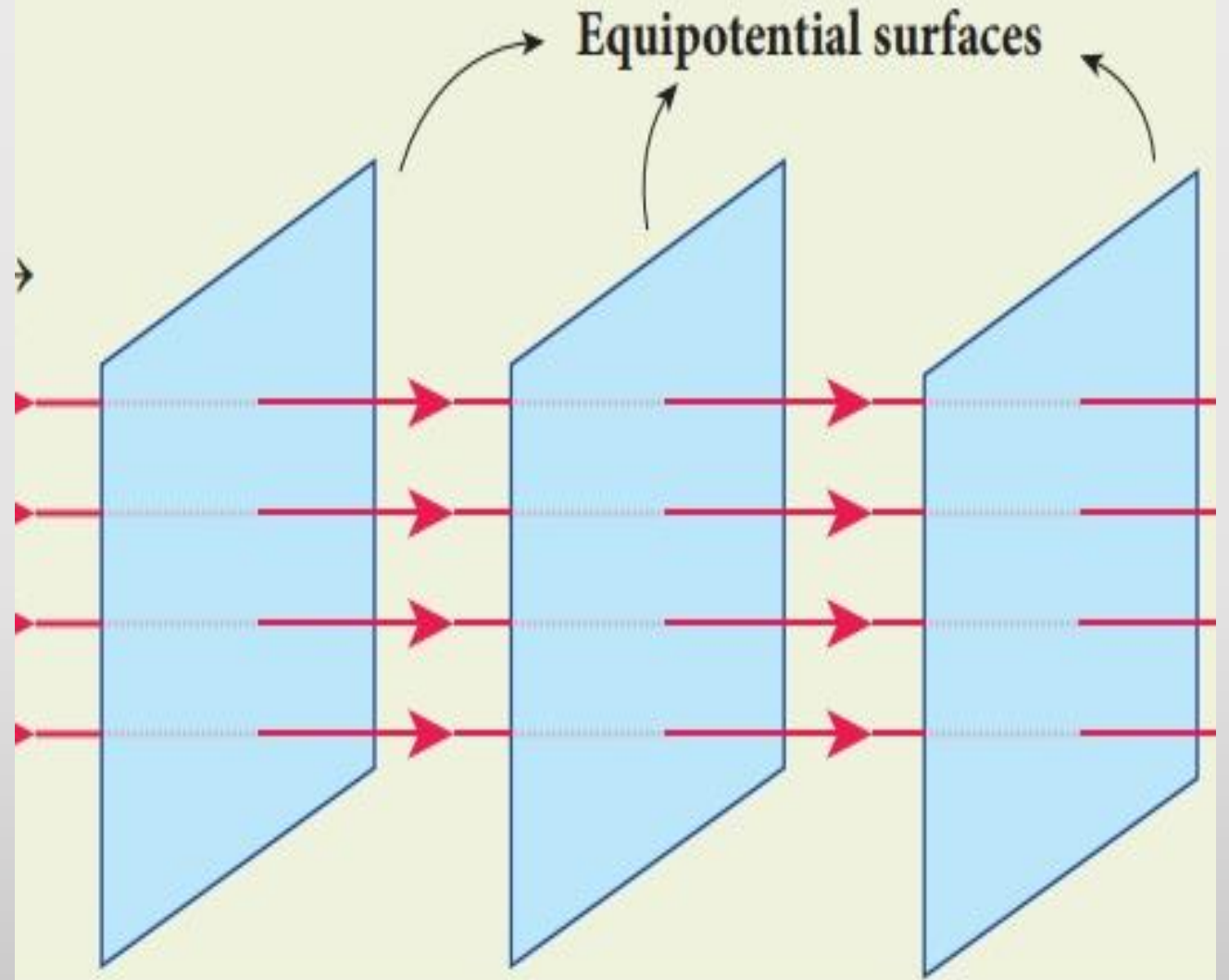
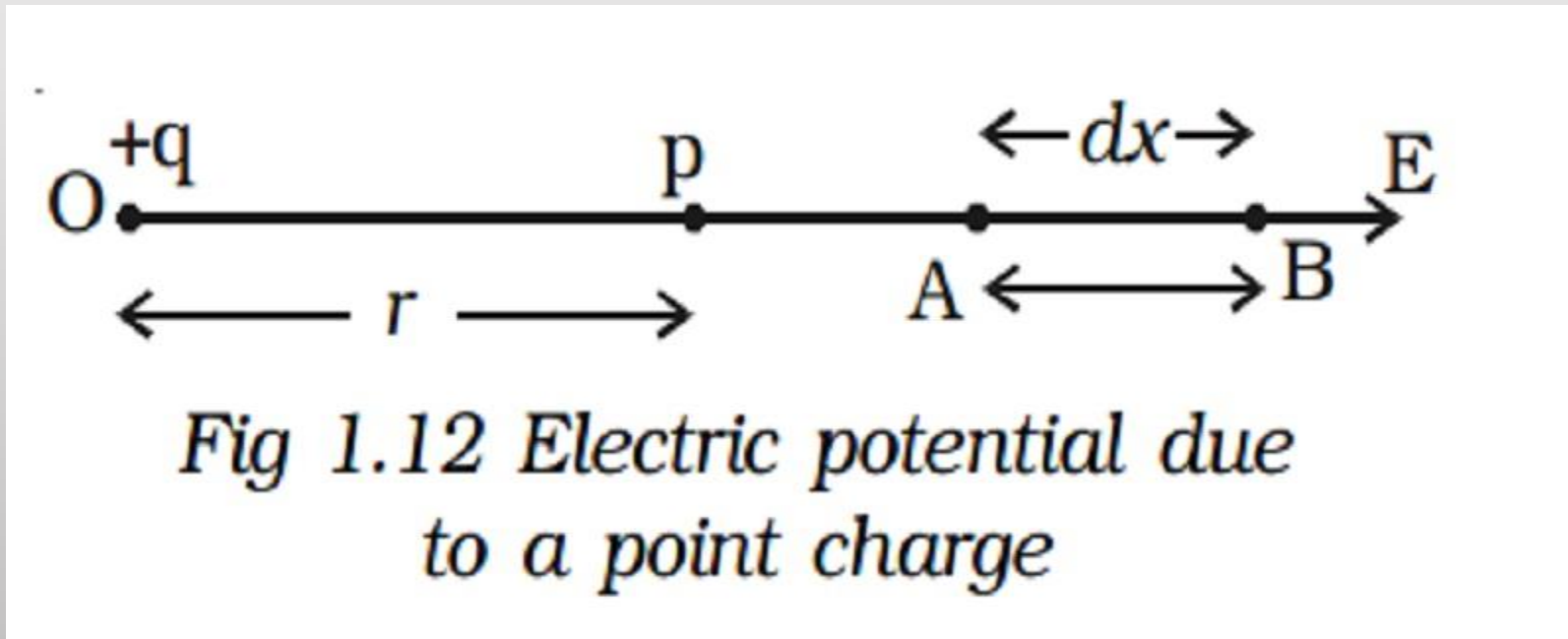


Figure 1.29 Equipotential surface for uniform electric field

RELATION BETWEEN ELECTRIC FIELD AND POTENTIAL DIFFERENCE:

Consider a point charge $+q$. Around this an electric field is created. So if I want to move a unit positive charge I have to do some work against the electric field.



As per the definition, the work done in moving the unit positive charge through a distance dx is given by,
 $dW = dV = -E dx$

$$E = -\frac{dV}{dx}$$

So the electric field is the negative gradient of potential difference.

Already you know the unit of E as NC^{-1} . Now from the above expression you can derive the unit of E as Vm^{-1}

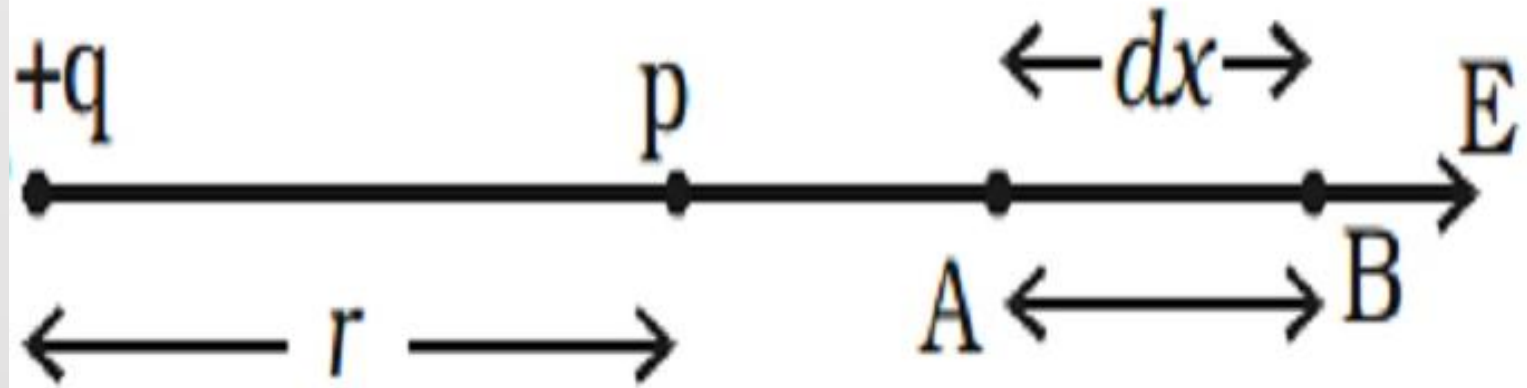


Fig 1.12 Electric potential due to a point charge