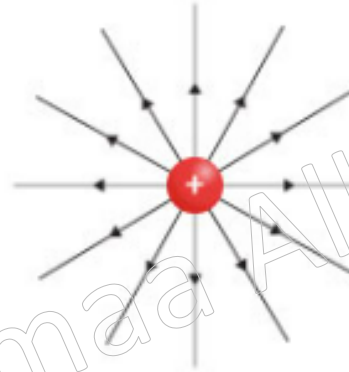


2.1 Definition of electric field

2.2 Field lines

2024-09-22

Vocabulary



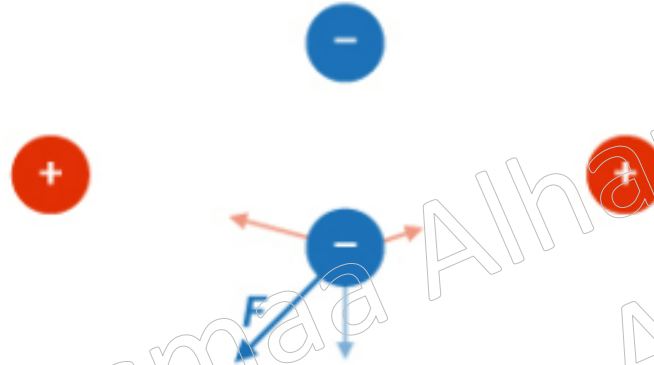
electric field (noun)

a property of every point in space that depends on the charge and distance to nearby electric charges



الحقل الكهربائي

Vocabulary



superposition principle (noun)

the method to add the force from individual charges to find the net force that acts on a charge



مبدأ التراكب

Vocabulary



test charge (noun)

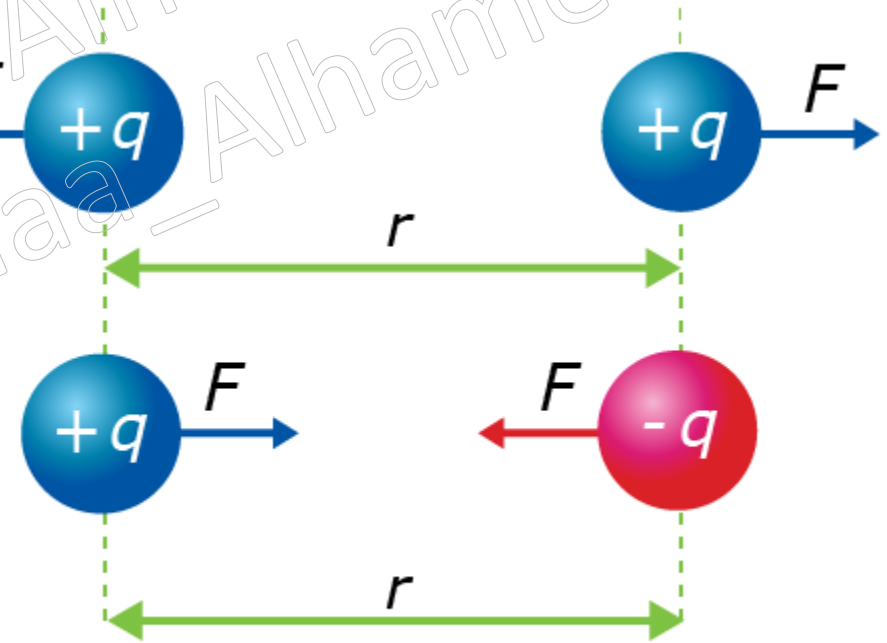
an electrically charged object placed at a specific distance away from another charged object to test the electric force or field



شحنة اختبار

Definition of Electric field:

How do you know
where the charge is
going to go?



Definition of Electric field:

An electric field, $E(r)$, is defined at any point in space, $\vec{r}$, as the net electric force on a charge, divide by that charge.

Mathematically:

$$\vec{E}(\vec{r}) = \frac{\vec{F}(\vec{r})}{q}$$

Where E is the electric field, F is the force on the charge, and q is the test charge.

The units of electric field is (N/C).

Definition of Electric field:

You can use the previous equation to calculate the force on the test charge:

$$\vec{E}(\vec{r}) = \frac{\vec{F}(\vec{r})}{q} \quad \vec{F}(\vec{r}) = q\vec{E}(\vec{r})$$

The electric force on a charge at a point is **parallel** or **antiparallel**,
(**depending on the sign of the charge** in question) to the electric field
at that point and proportional to the magnitude of the charge.

Definition of Electric field:

The magnitude of the force is calculated by:

$$F = |q| E$$

The direction of the force on a **positive** charge is along $E(r)$ the direction of the force on a **negative** charge is in the direction opposite to $E(r)$.

Definition of Electric field:

The **superposition principle** for the total electric field, E_t , at any point in space with coordinate $\vec{r}$ due to n electric field sources can be stated as:

$$\vec{E}_t(\vec{r}) = \vec{E}_1(\vec{r}) + \vec{E}_2(\vec{r}) + \cdots + \vec{E}_n(\vec{r})$$

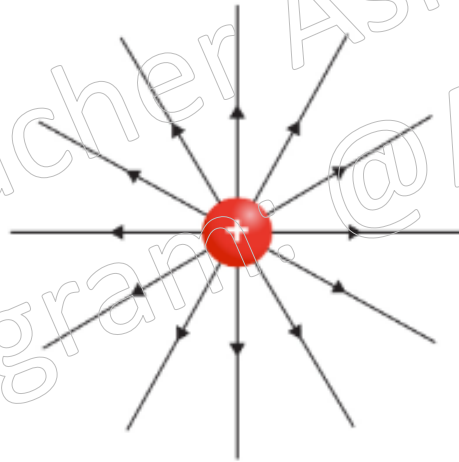
Field lines:

Positive Charges

Negative Charges

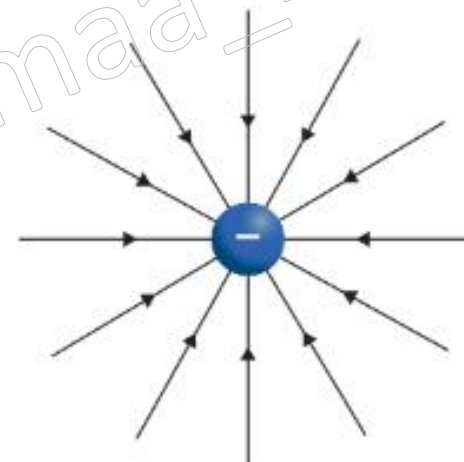
Positive Charges

The field lines **emanate** out of a positive charge.



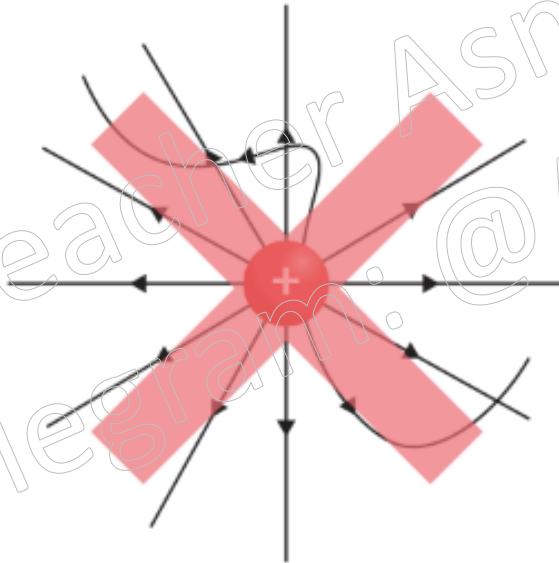
Negative Charges

The field lines **terminate** at a negative charge.



Field lines:

Field Lines Never Cross

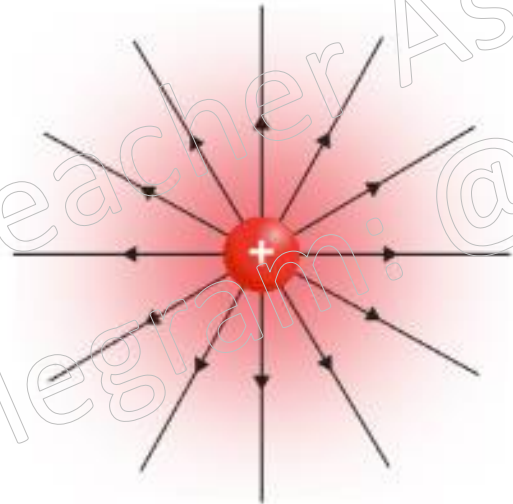


Field Lines Never Cross

- Field lines only go away from or into electric charges. Field lines do not cross over each other.
- A field line represents the electric field vector at each point. If field lines crossed, there would be two electric field vectors at the crossing point. These two vectors would **sum** to make one net electric field vector, removing the crossing point.

Field lines:

Field Line Density



Field Line Density

- The closer field lines are, the stronger the electric field. Right next to a charge, the field is strongest, as shown by the large **density** of field lines.
- The further away field lines are from each other, the weaker the electric field. The field is weakest far away from any charge.

Field lines:

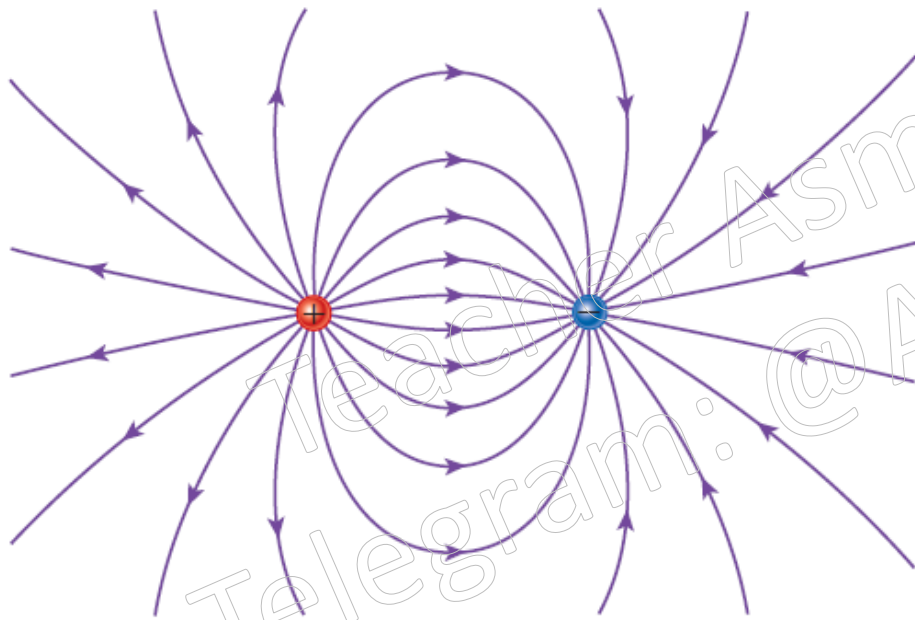


FIGURE 2.7 Electric field lines from two oppositely charged point charges. Each charge has the same magnitude.

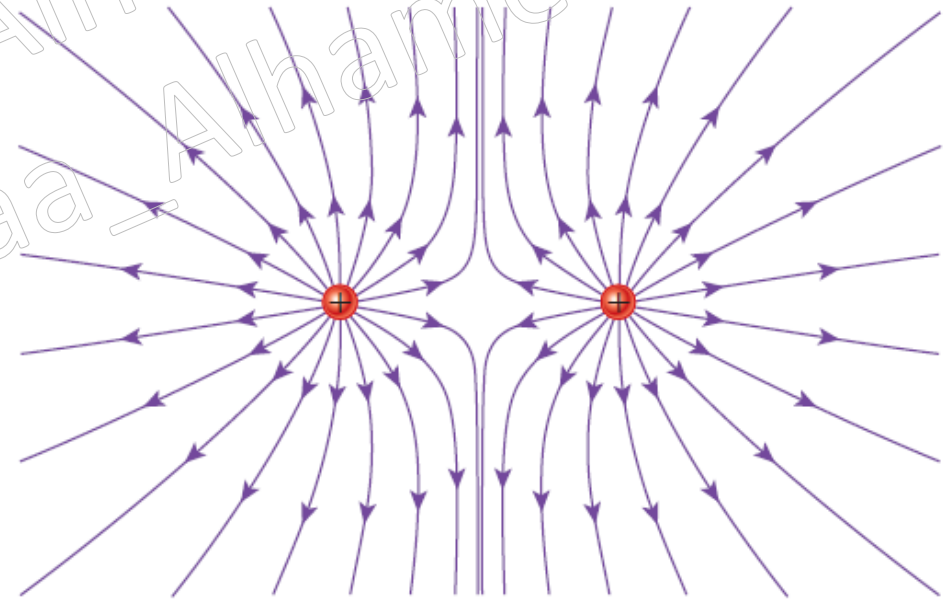


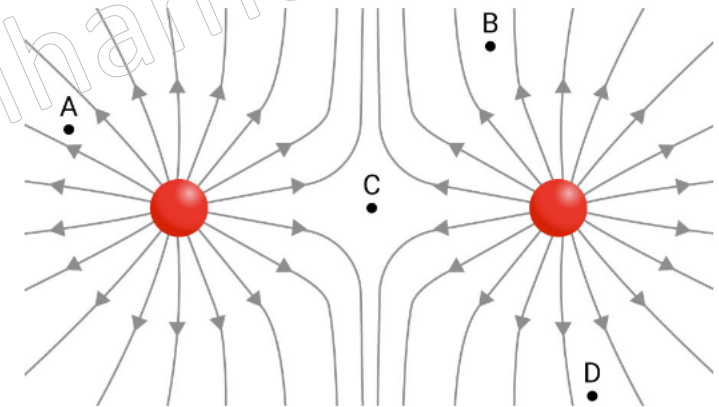
FIGURE 2.8 Electric field lines from two positive point charges with the same magnitude.

Activity:

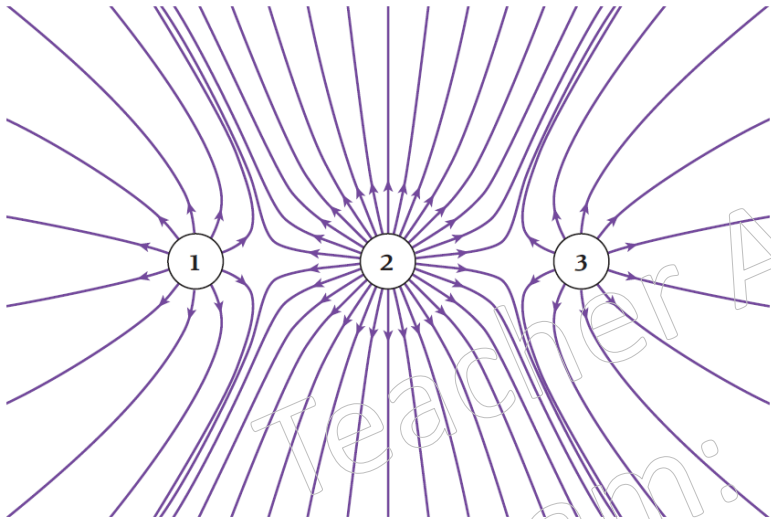
02:00

Select from the drop-down menu the correct answer.

The electric field lines between two charged objects are shown on the right. The charge of the object on the left is , and the charge of the object on the right is . The electric field is strongest at point , and weakest at point .



Practice:



2.11 What are the signs of the charges in the configuration shown in the figure?

- a) Charges 1, 2, and 3 are negative.
- b) Charges 1, 2, and 3 are positive.
- c) Charges 1 and 3 are positive, and 2 is negative.
- d) Charges 1 and 3 are negative, and 2 is positive.
- e) All that can be said is that the charges have the same sign.

Practice:

2.12 Which of the following statements is (are) true?

- a) Electric field lines point inward toward negative charges.
- b) Electric field lines form circles around positive charges.
- c) Electric field lines may cross.
- d) Electric field lines point outward from positive charges.
- e) A positive point charge released from rest will initially accelerate along a tangent to the electric field line at that point.