

# Charge B in the Middle

Arrangement	Force from Left Charge on B
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+ - +	Left
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- + -	Left
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+ + +	Right
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- - -	Right
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+ + -	Right
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- - +	Right
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+ - -	Left
-------	------

- + +	Left
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# Charge B in the Middle

Charge	Force from Right Charge on B	Result
	Right	Subtract
	Right	Subtract
	Left	Subtract
	Left	Subtract
	Right	Add
	Right	Add
	Left	Add
	Left	Add

## Quick Shortcut

**Charges on the Outside  
(Left & Right)**

**What to Do**

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Same signs (+,+ or -,-)

**Subtract**

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Different signs (+,- or -,  
+)

**Add**

✓ Example: + - + → Outside charges are the same → **Subtract**

✓ Example: + + - → Outside charges are different → **Add**

# 1. Electric Force (Coulomb's Law)

$$F = \frac{k|q_1 q_2|}{r^2}$$

For the **magnitude** of the force, we usually use the **absolute value** (ignore the signs) and then use the signs only to determine the **direction**:

- Like charges (+,+ or -,-) → Repulsion
- Unlike charges (+,-) → Attraction

- ✓ Use signs for direction.
- ✓ Ignore signs when finding magnitude.

## 2. Electric Field Intensity $E$

$$E = \frac{kQ}{r^2}$$

When finding the magnitude:

$$E = \frac{k|Q|}{r^2}$$

The sign of  $Q$  is used to determine the field direction:

- Away from a positive charge
- Toward a negative charge

✓ Ignore sign for magnitude.

✓ Use sign for direction.


### 3. Electric Potential $V$

$$V = \frac{kQ}{r}$$

Here the sign is not ignored.

Examples:

- $Q = +3, \mu C$  gives positive potential.
- $Q = -3, \mu C$  gives negative potential.

 Keep the sign.

## 4. Potential Difference

$$\Delta V = V_B - V_A$$

Since potentials can be positive or negative, the signs must be included.

 Keep the sign.

## 5. Potential Energy

$$U = \frac{kq_1q_2}{r}$$

The signs matter because  $q_1q_2$  may be positive or negative.

- Like charges → Positive  $U$
- Unlike charges → Negative  $U$

✓ Keep the sign.

## 6. Work Done

$$W = q\Delta V$$

The sign of  $q$  and the sign of  $\Delta V$  matter.

 Keep the sign.

## 7. Electric Flux


$$\Phi = EA \cos \theta$$

The sign depends on the angle  $\theta$ , not on whether a charge is positive or negative.

For Gauss's Law:

$$\Phi = \frac{Q_{\text{enclosed}}}{\epsilon_0}$$

the sign of the enclosed charge is kept.


 Keep the sign when using Gauss's law.


# UACE Quick Summary


Quantity	Ignore Charge Sig
Coulomb force (magnitude)	<input checked="" type="checkbox"/> Yes
Electric field intensity (magnitude)	<input checked="" type="checkbox"/> Yes
Direction of force/field	<input type="checkbox"/> No
Electric potential	<input type="checkbox"/> No
Potential difference	<input type="checkbox"/> No
Potential energy	<input type="checkbox"/> No
Work done	<input type="checkbox"/> No
Electric flux (Gauss's law)	<input type="checkbox"/> No


A final shortcut:


Topic	Keep Signs?
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Force magnitude	 Ignore
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Electric field magnitude	 Ignore
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Force direction	 Keep
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Field direction	 Keep
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Potential $V$	 Keep
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Potential energy $U$	 Keep
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Work done $W$	 Keep
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Flux $\Phi$	 Keep
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