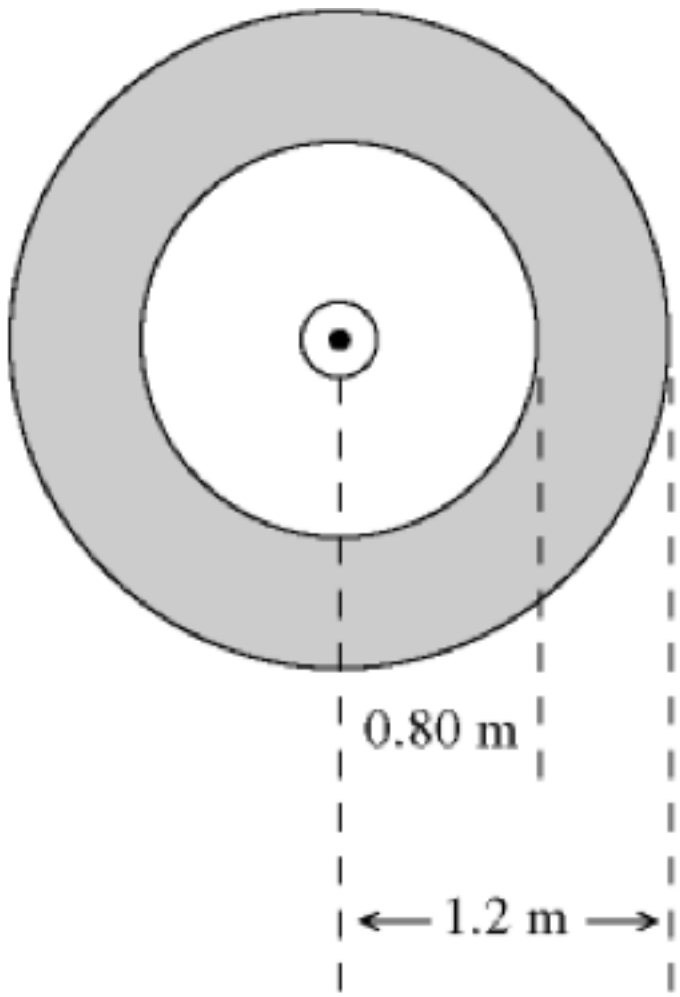
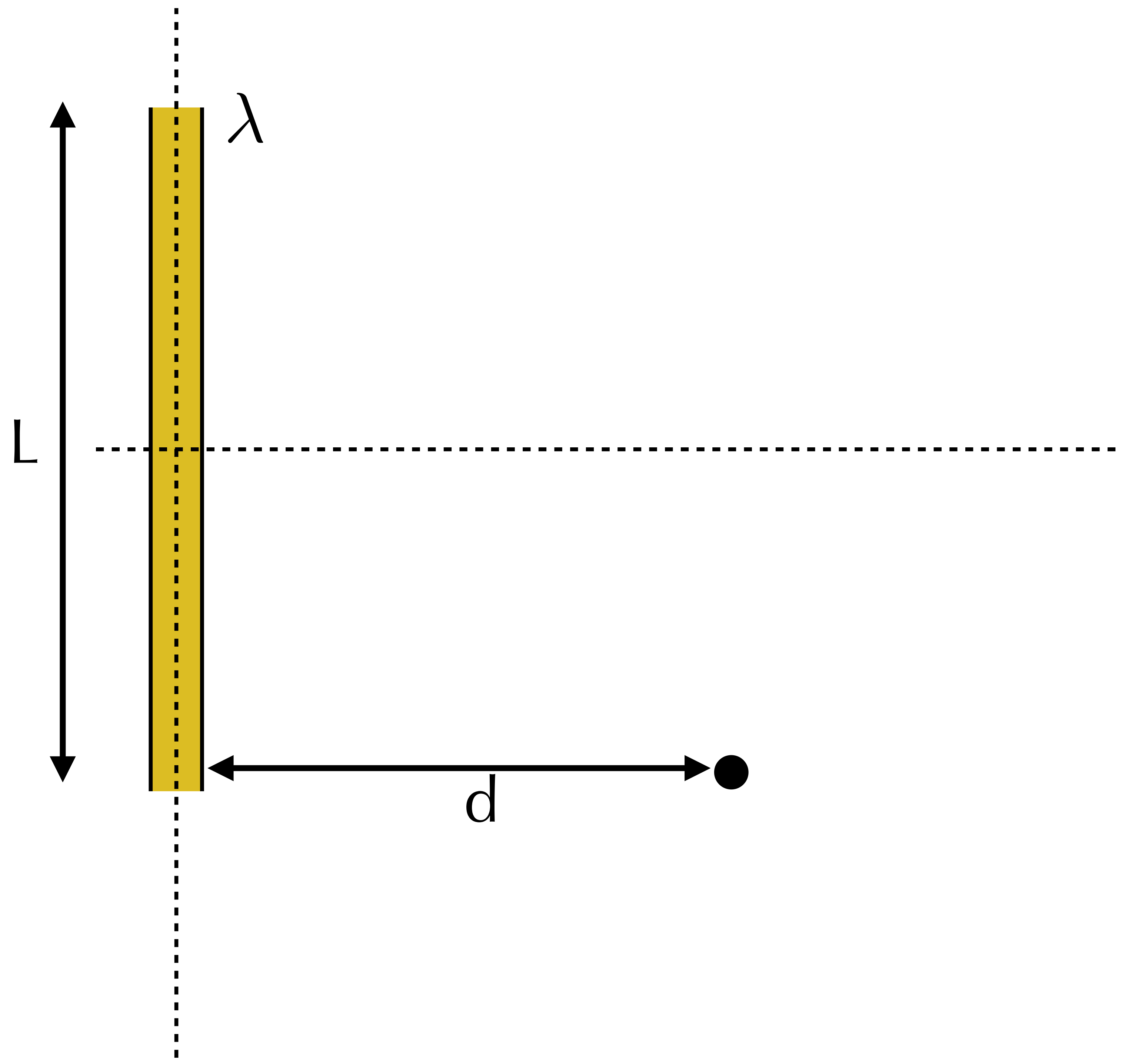
PH 220

Lance Nelson

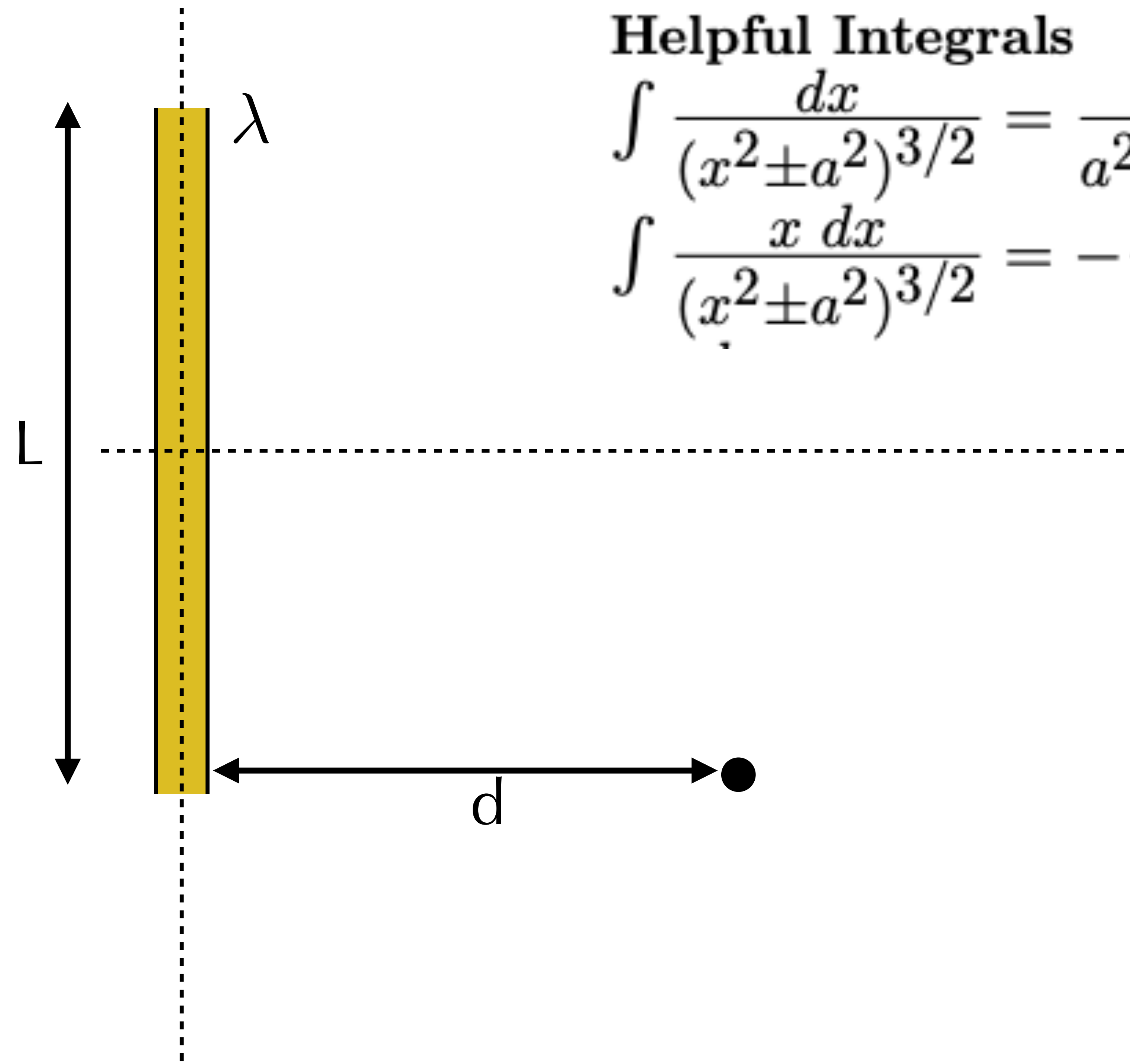
Gauss's Law Practice



E-Field Integration Practice



E-Field Integration Practice



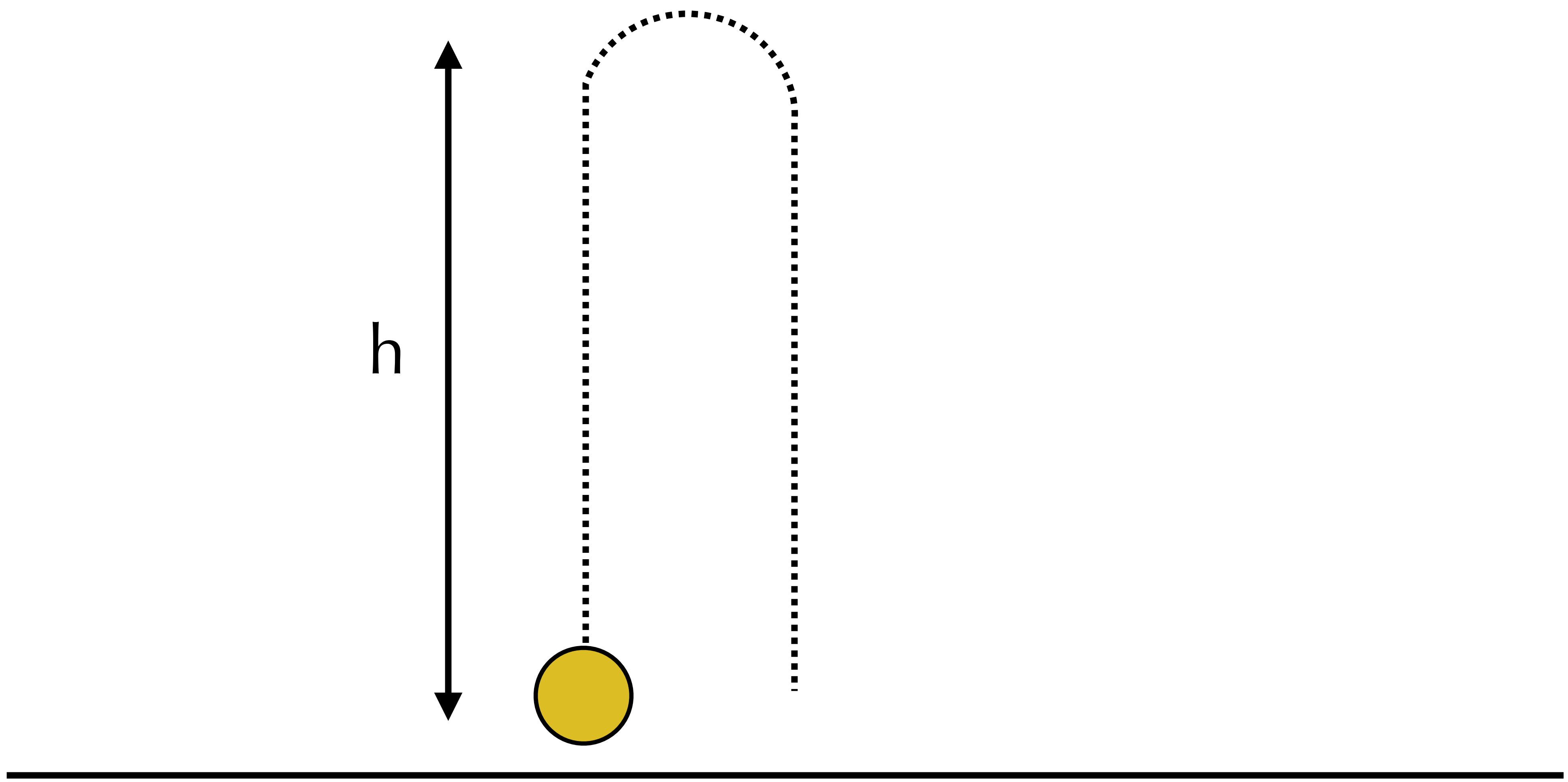
Helpful Integrals

$$\int \frac{dx}{(x^2 \pm a^2)^{3/2}} = \frac{\pm x}{a^2\sqrt{a^2 + x^2}}$$

$$\int \frac{x\,dx}{(x^2 \pm a^2)^{3/2}} = -\frac{1}{\sqrt{x^2 \pm a^2}}$$

Refresher on Work-Energy

Calculate the work done by gravity as the ball travels from the ground to the peak of its motion.



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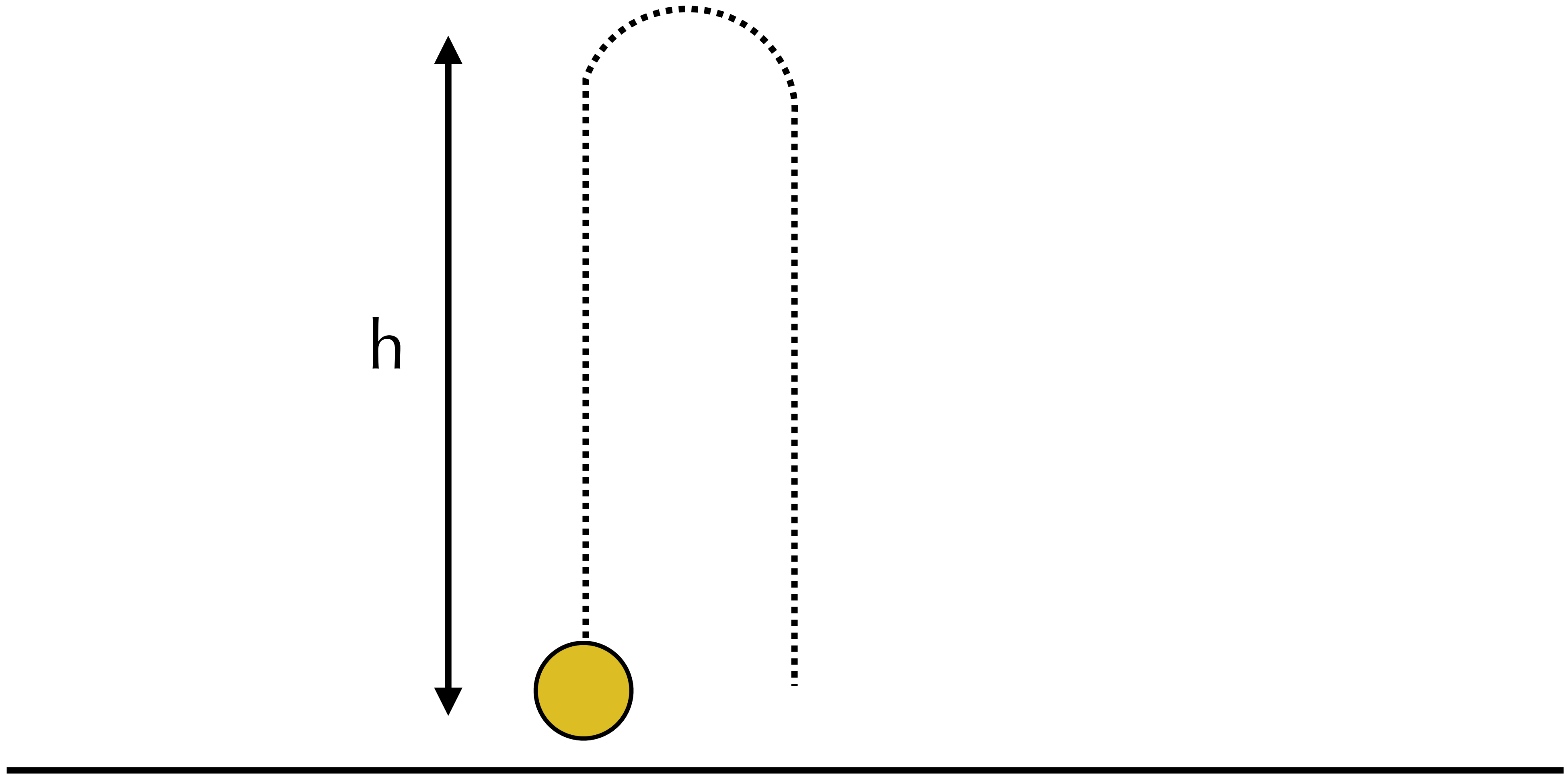
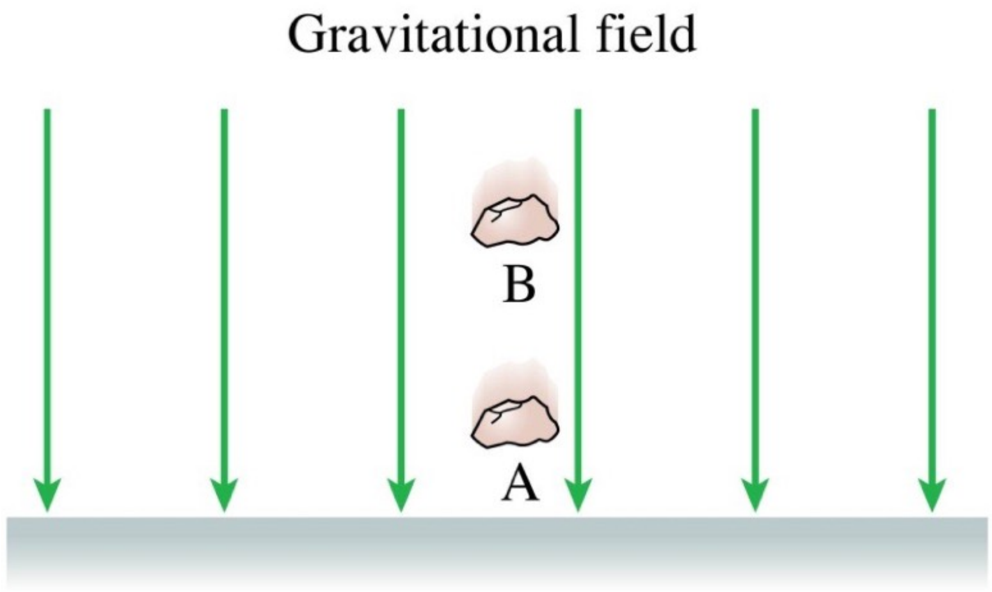
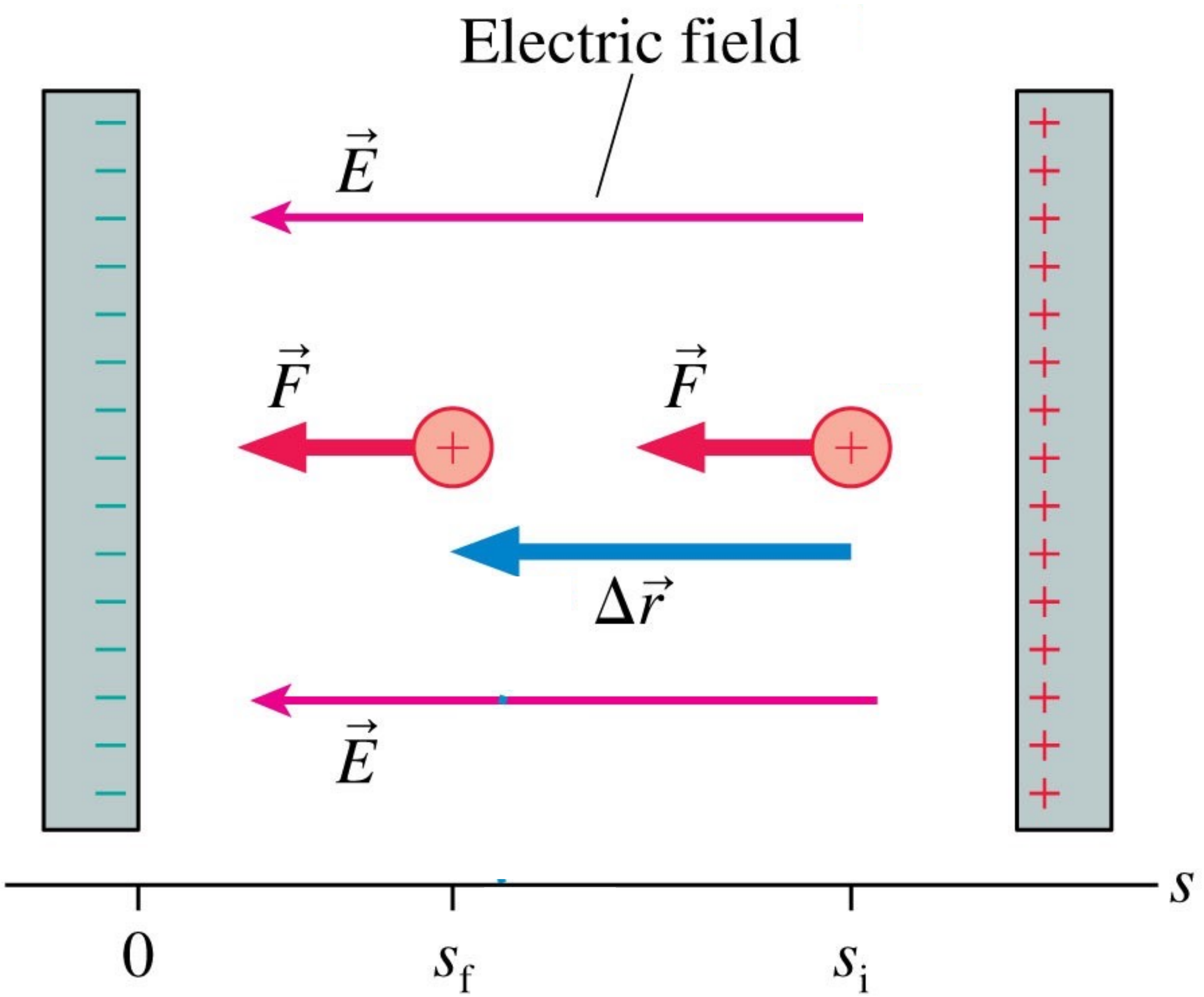


$$\Delta U_g = -W_g$$

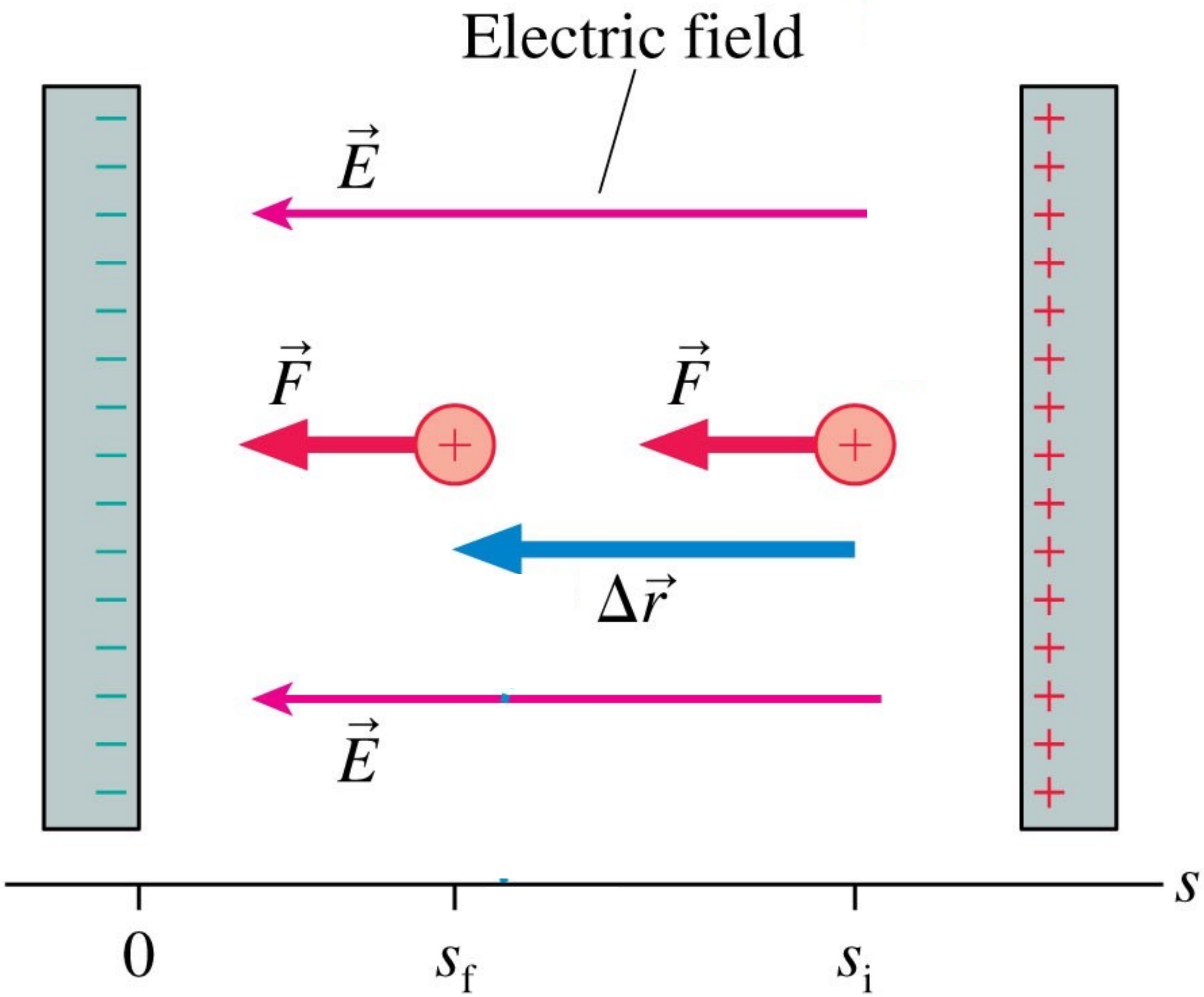
Two rocks have equal mass. Which has more gravitational potential energy?

A. Rock A.
B. Rock B.
C. They have the same potential energy.
D. Both have zero potential energy.



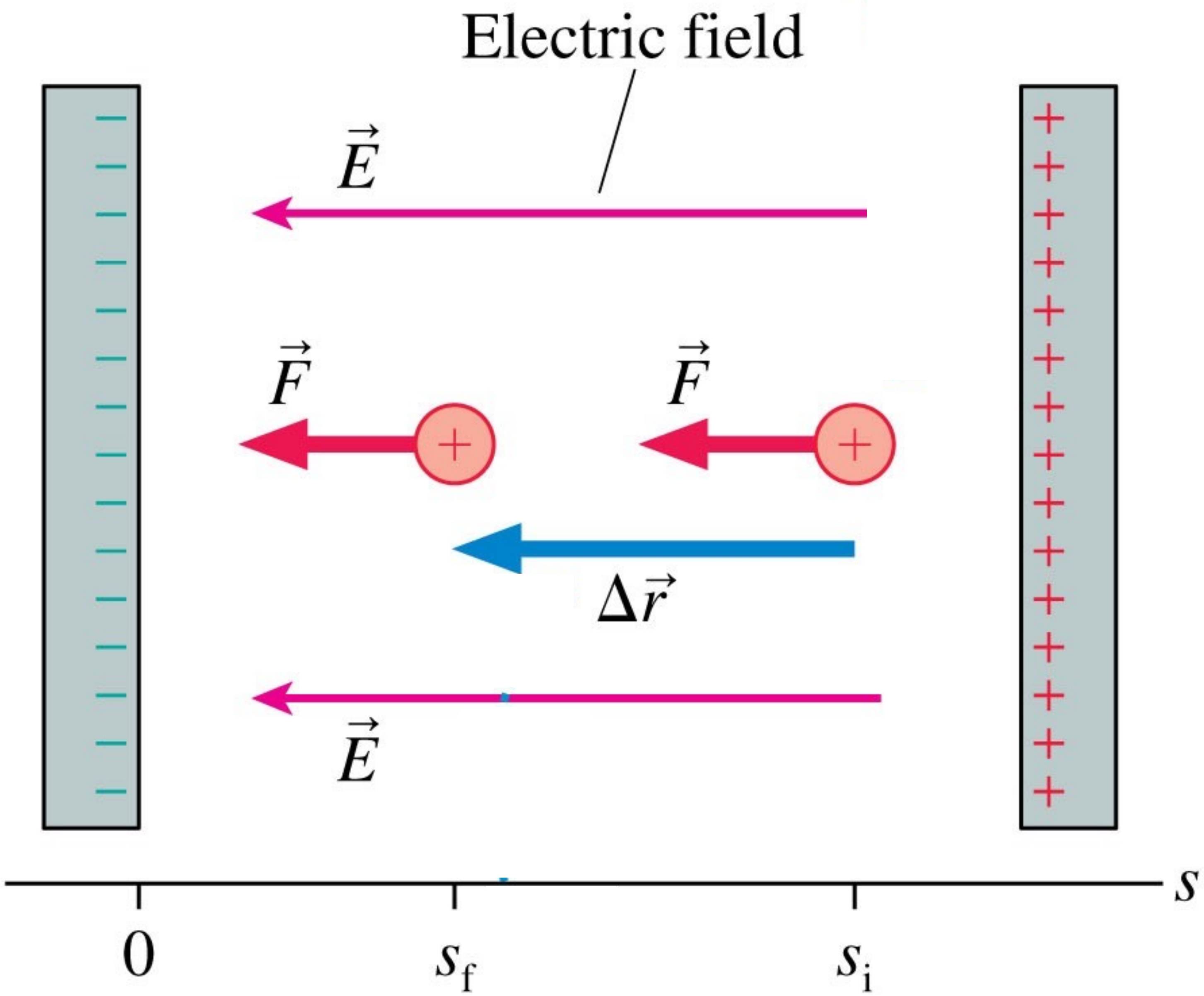


Calculate the work done on the proton!



Calculate the work done on the proton!

$$W = Eq\Delta r$$



Calculate the work done on the proton!

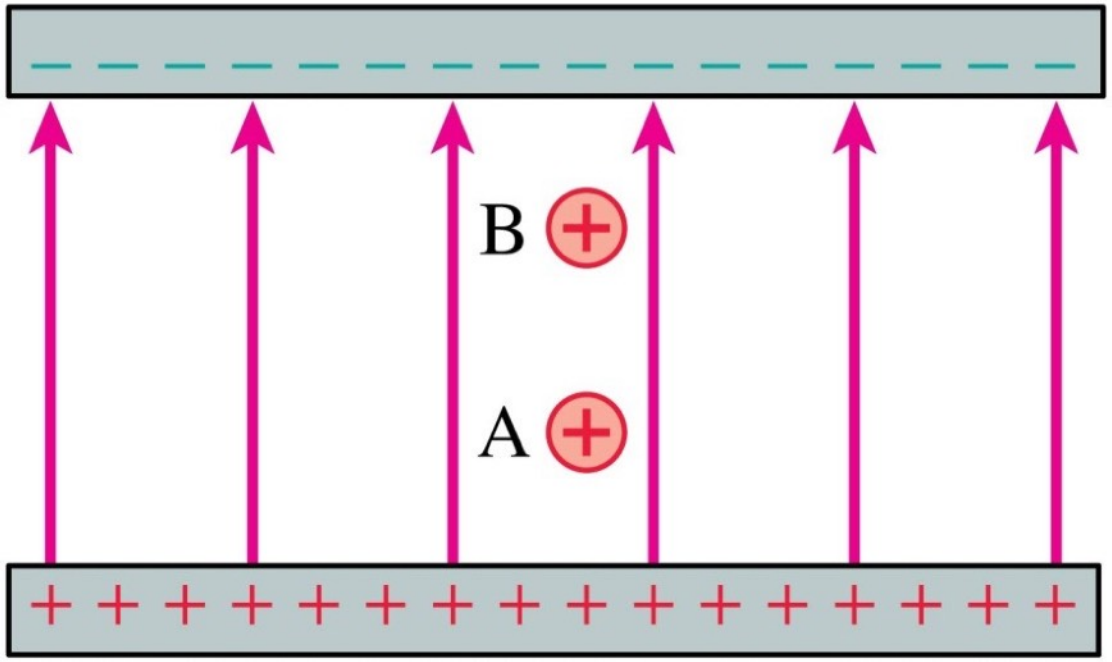
$$W = Eq\Delta r$$

$$\Delta U_{\text{elec}} = -W_{\text{elec}}$$

Two positive charges are equal. Which has more electric potential energy?

Question #43

B. Charge B.
C. They have the same potential energy.
D. Both have zero potential energy.
E. Charge A.



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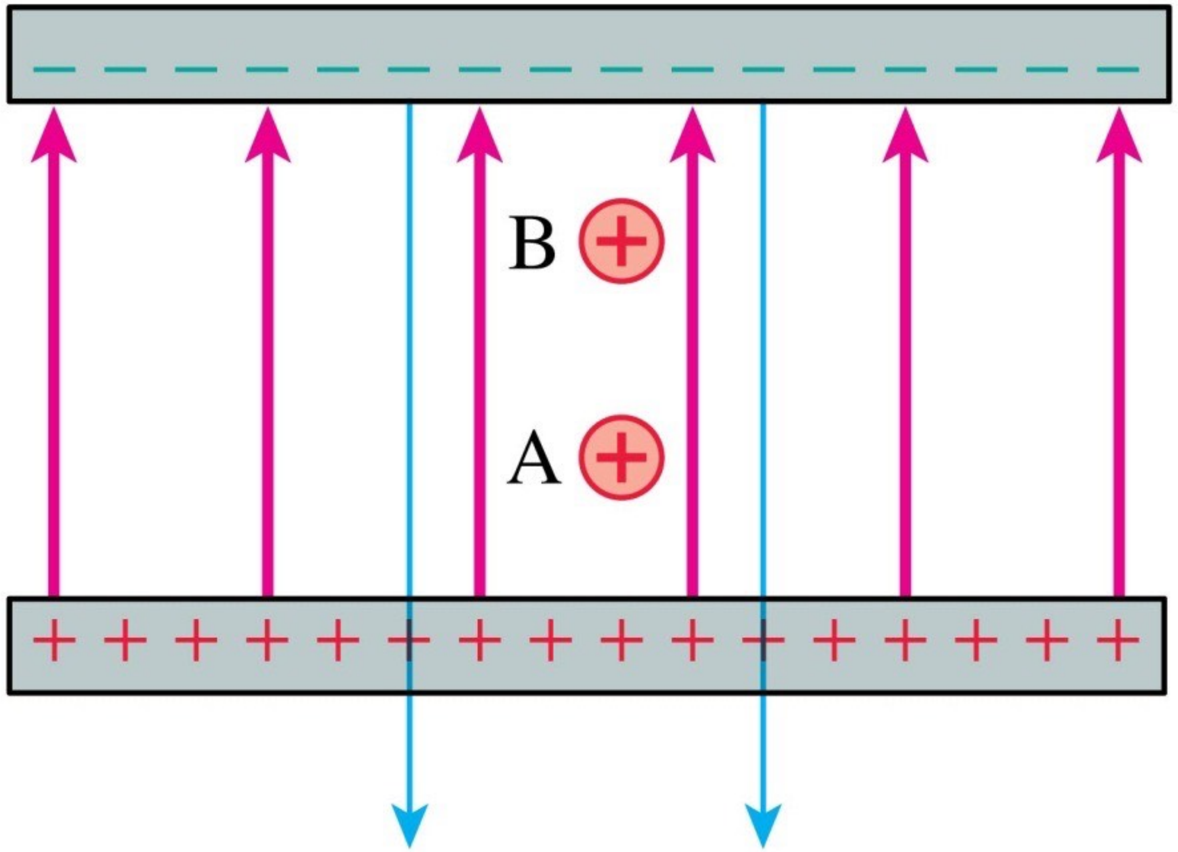

B. Charge B.
C. They have the same potential energy.
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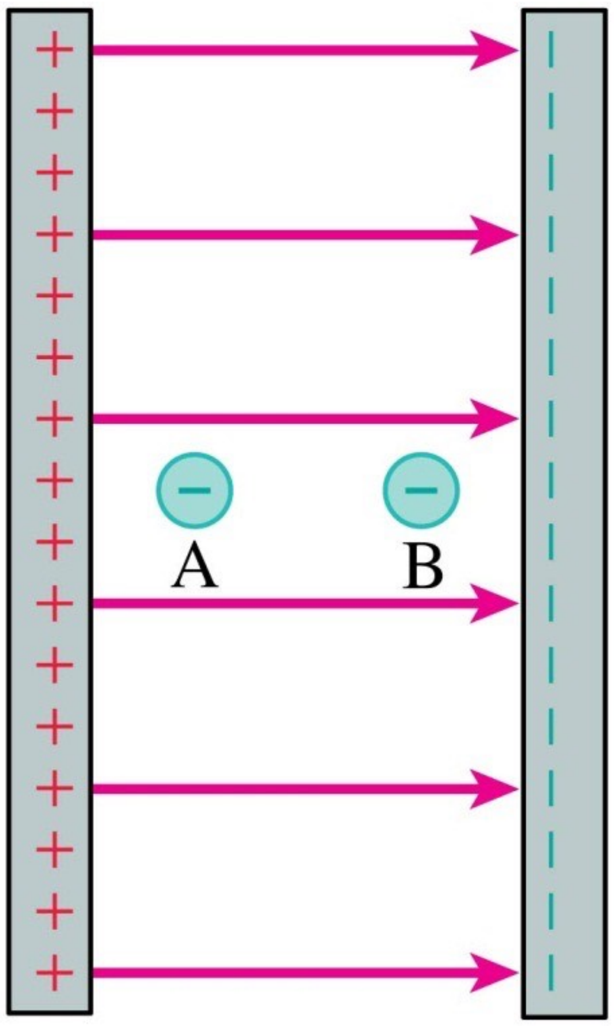
E. Charge A.

Question #44

Two negative charges are equal. Which has more electric potential energy?



A. Charge A.
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Question #44

Two negative charges are equal. Which has more electric potential energy?

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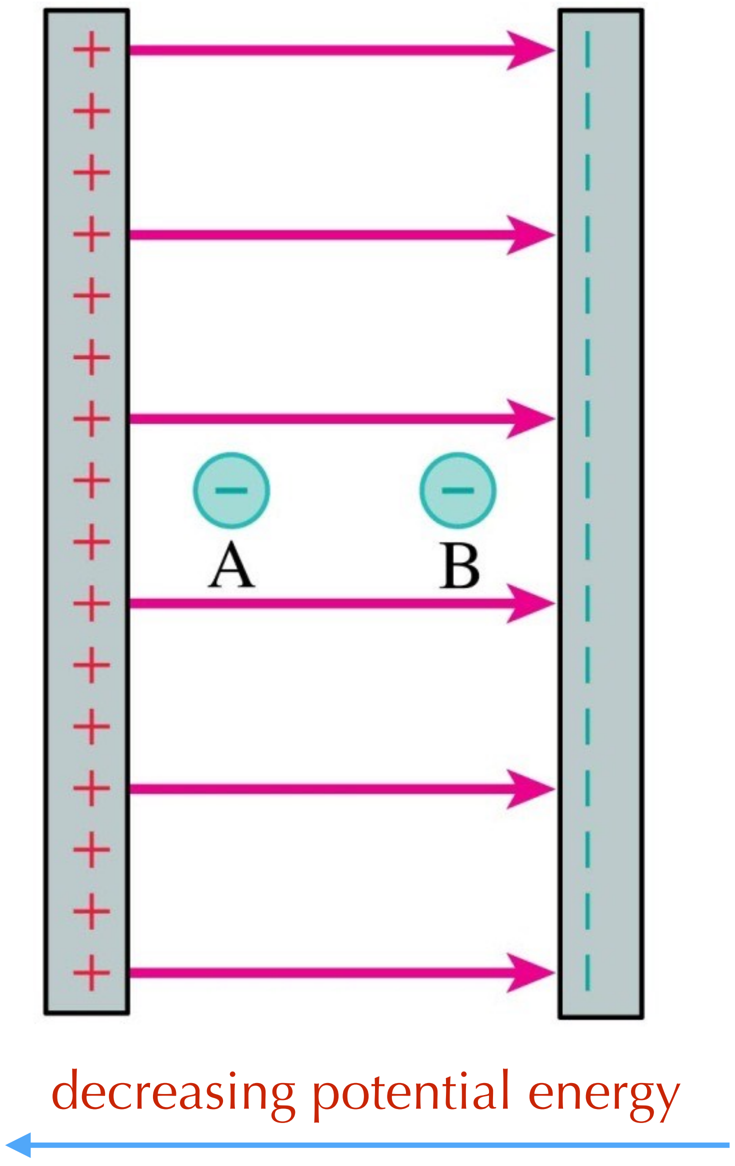
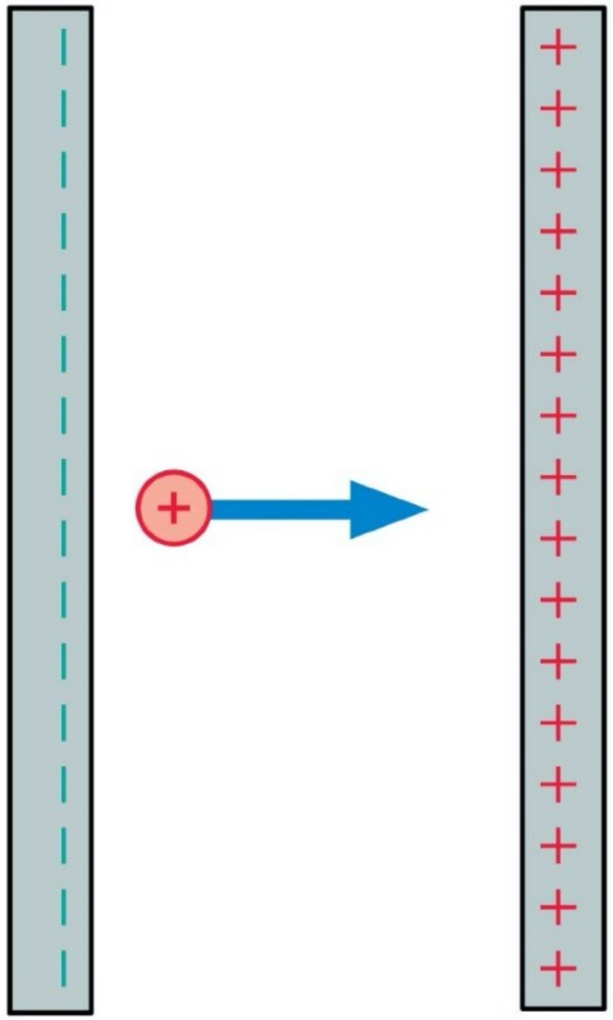


Question #45

A positive charge moves as shown. Its kinetic energy

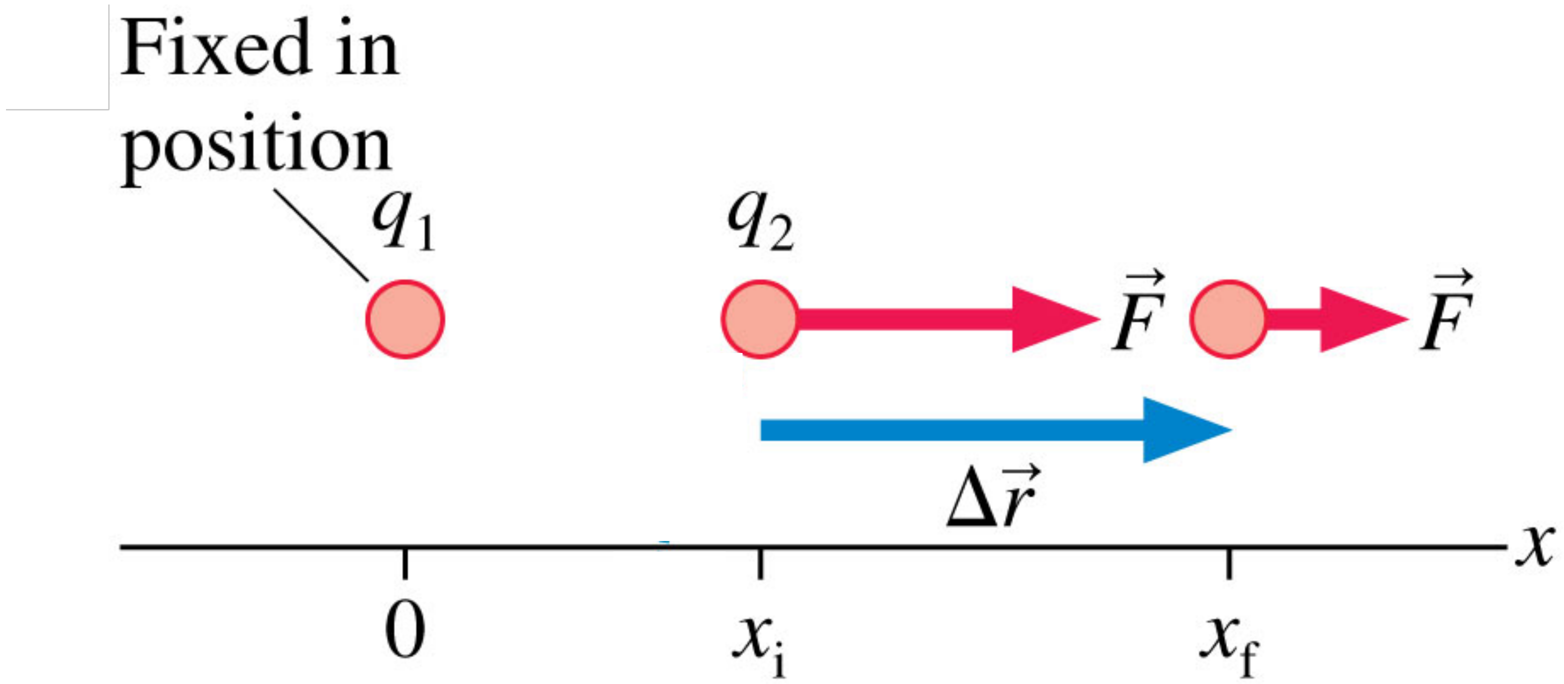


A. Increases.

B. Decreases.

C. Remains constant.

Calculate the work that q_1 does on q_2 as it moves from x_i to x_f



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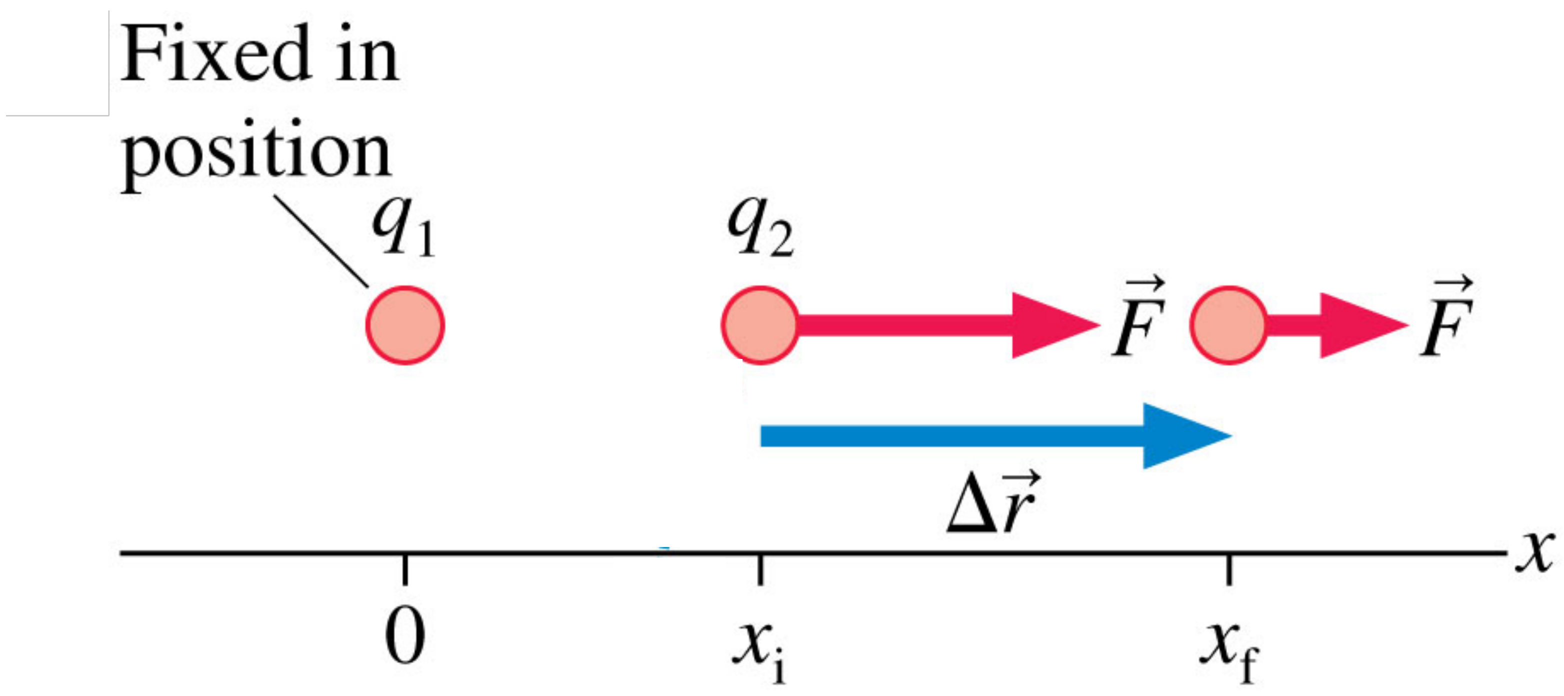
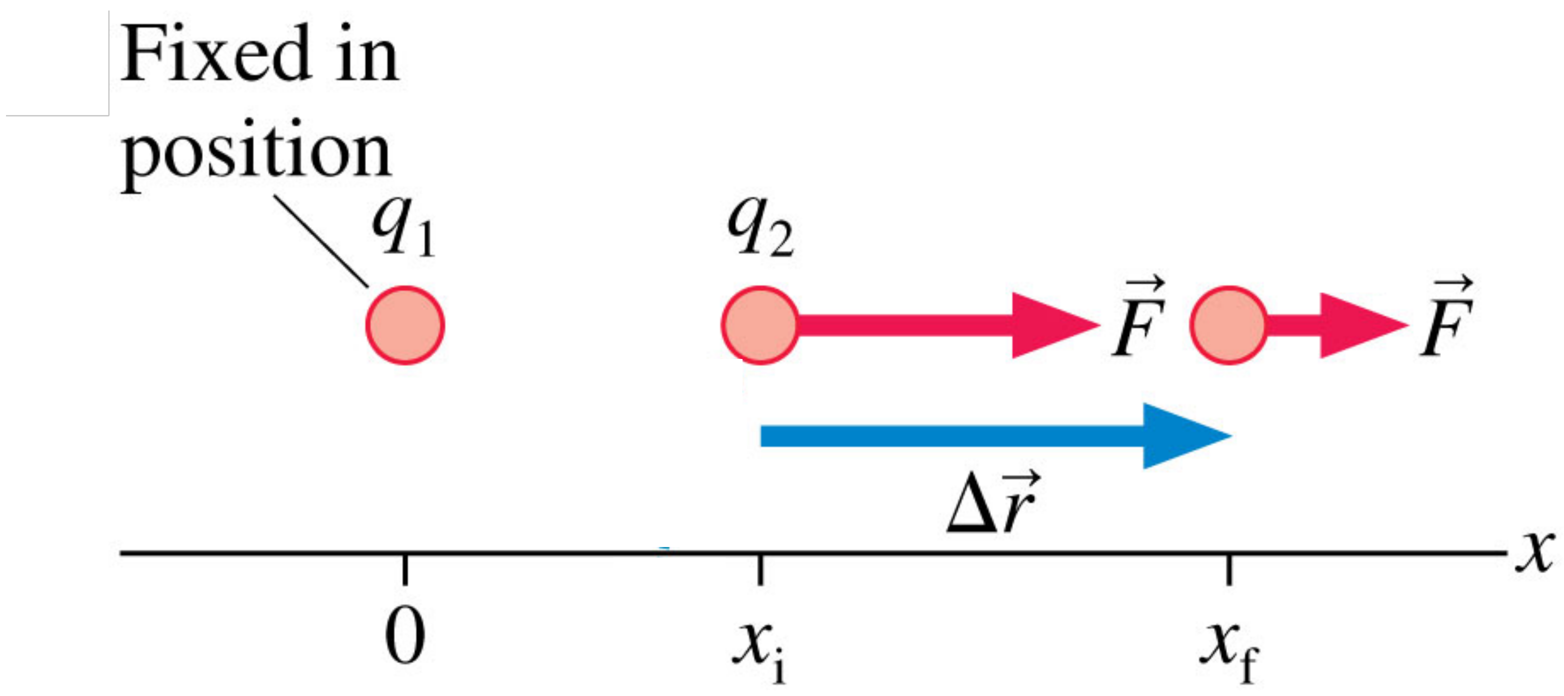


$$W_{elec} = \int_{x_i}^{x_f} F_{1 \text{ on } 2}\, dx = \int_{x_i}^{x_f} \frac{Kq_1q_2}{x^2}\, dx = Kq_1q_2 \frac{-1}{x}\bigg|_{x_i}^{x_f} = -\frac{Kq_1q_2}{x_f} + \frac{Kq_1q_2}{x_i}$$

Calculate the work that q_1 does on q_2 as it moves from x_i to x_f



$$U_{elec} = \frac{Kq_1q_2}{x}$$

$$W_{elec} = \int_{x_i}^{x_f} F_{1\text{ on }2}\,dx = \int_{x_i}^{x_f} \frac{Kq_1q_2}{x^2}\,dx = Kq_1q_2 \frac{-1}{x}\bigg|_{x_i}^{x_f} = -\frac{Kq_1q_2}{x_f} + \frac{Kq_1q_2}{x_i}$$

Two protons are given initial velocities towards each other. In terms of energy, describe the motion.

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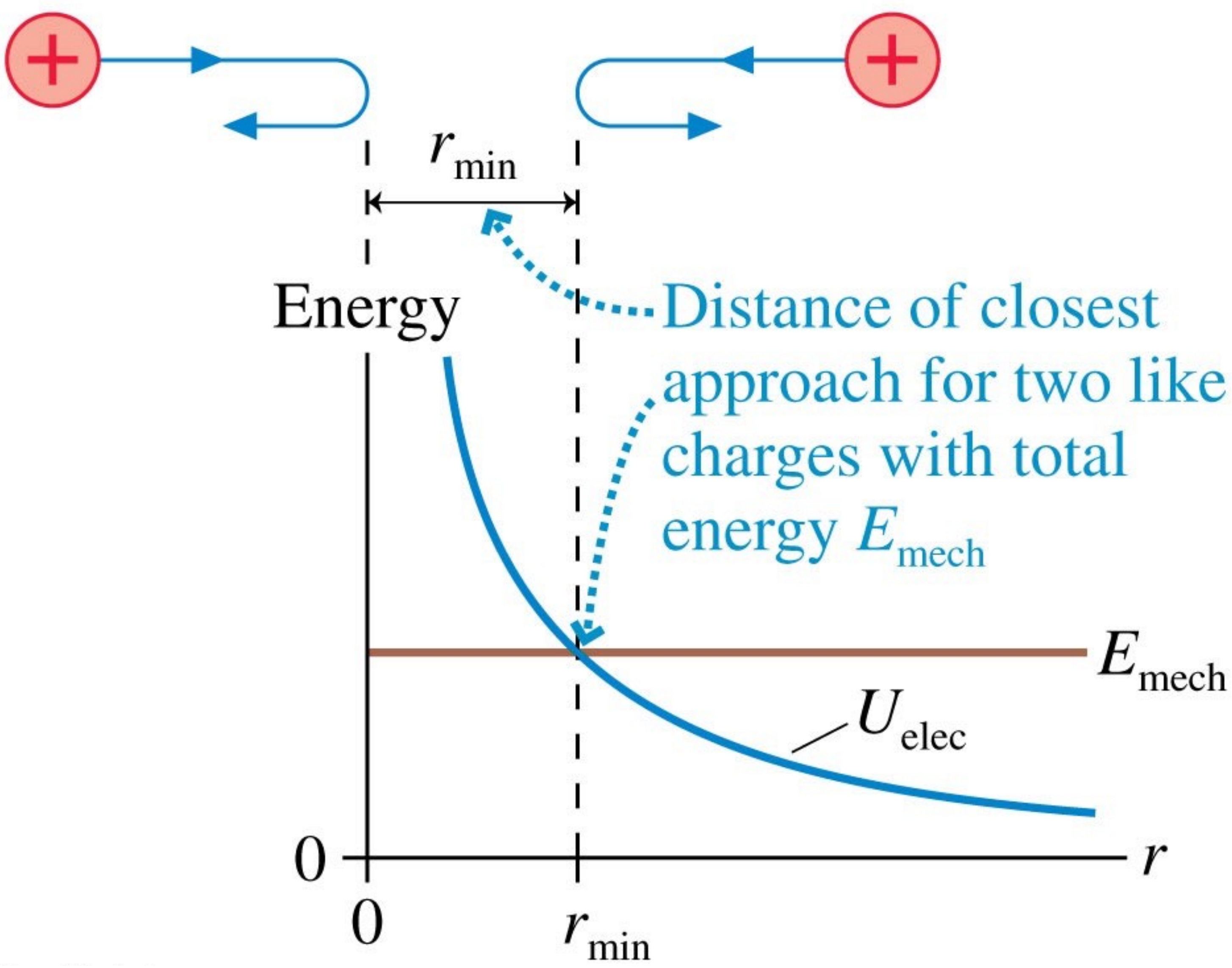
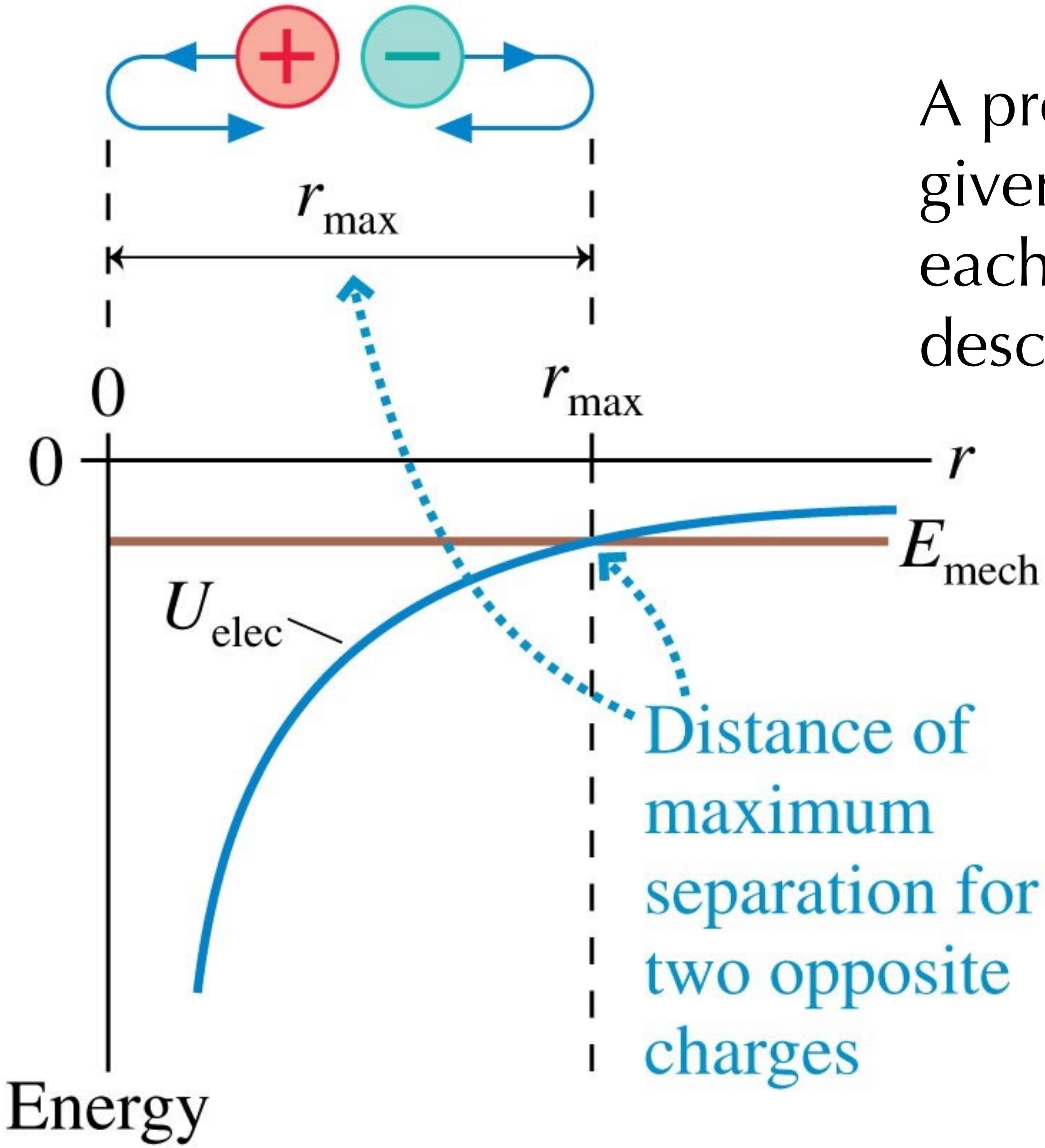


A proton and an electron are given initial velocities away from each other. In terms of energy, describe their motion.



A proton and an electron are given initial velocities away from each other. In terms of energy, describe their motion.

Question #46

A positive and a negative charge are released from rest in vacuum. They move toward each other. As they do:

A. A positive potential energy becomes more positive.
B. A positive potential energy becomes less positive.
C. A negative potential energy becomes more negative.
D. A negative potential energy becomes less negative.
E. A positive potential energy becomes a negative potential energy.

Question #46

$$U_{\text{elec}} = \frac{Kq_1q_2}{r}$$

Opposite signs, so U is Negative.

U increases in magnitude as r decreases.

A positive and a negative charge are released from rest in vacuum. They move toward each other. As they do:

A. A positive potential energy becomes more positive.
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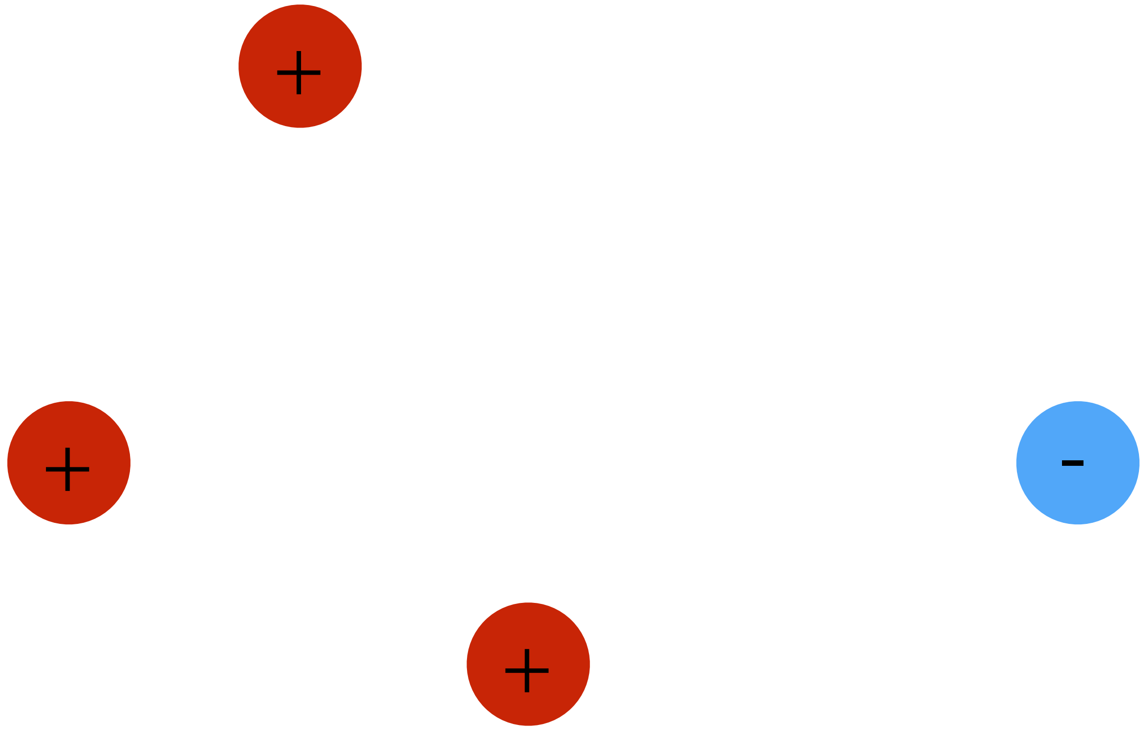
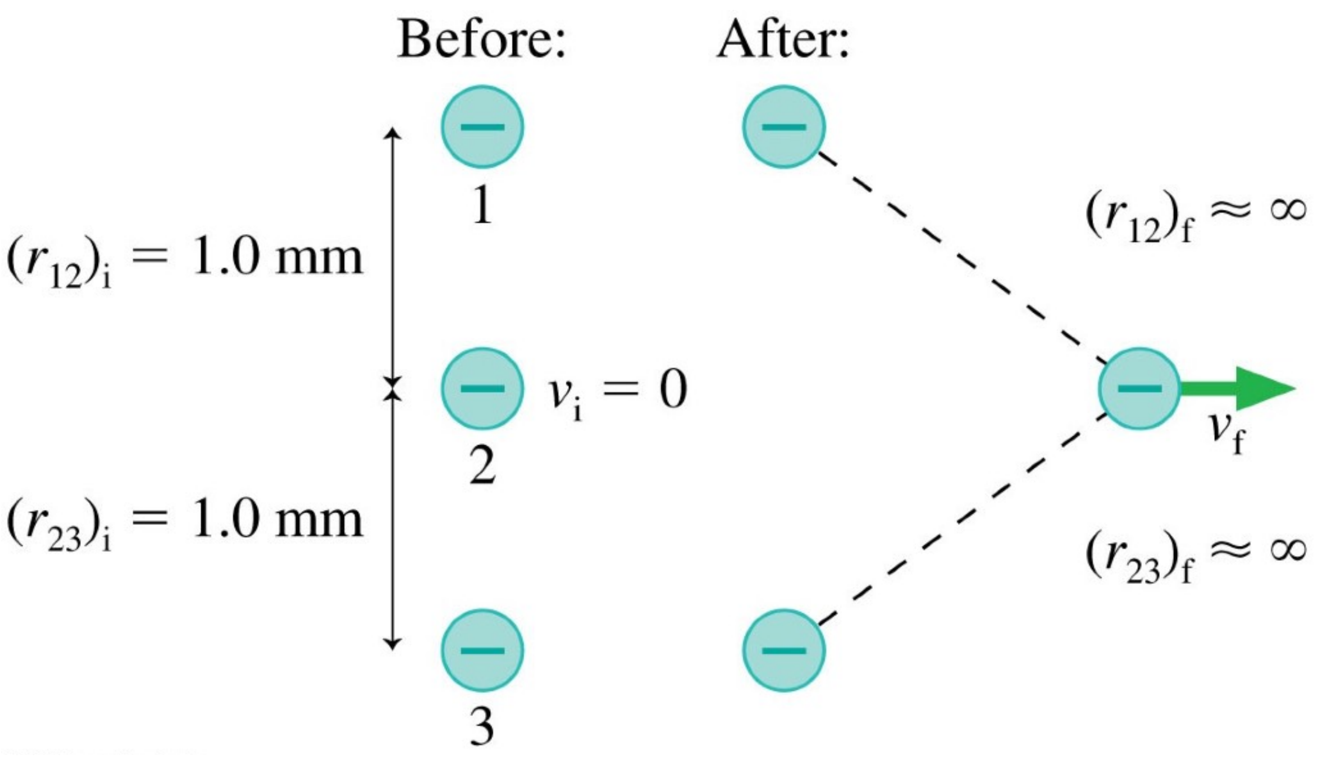
What if there are more than just two charges?



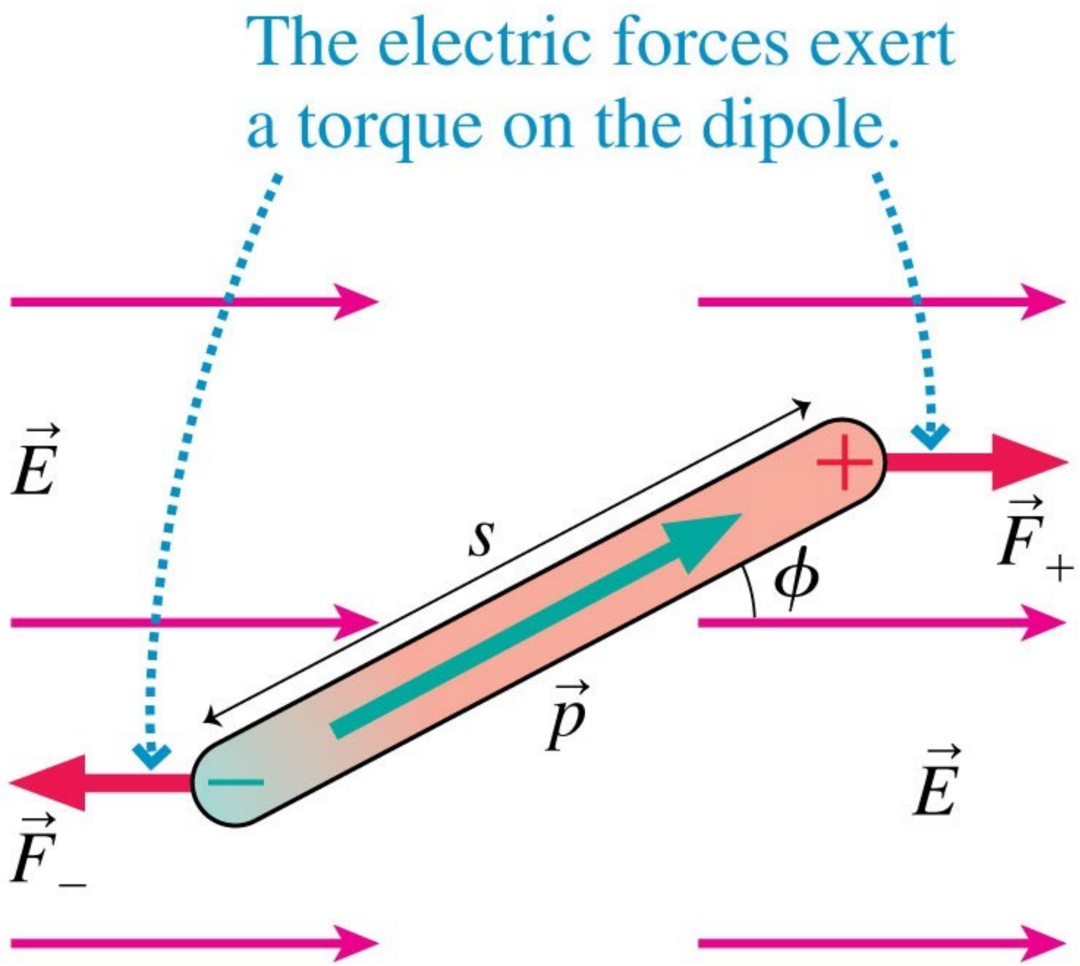
$$U = \sum_{i \neq j} \frac{k q_i q_j}{r_{ij}}$$

Example

Three electrons are spaced 1.0 mm apart on a vertical line. If the center electron is nudged horizontally by a very small distance, what will its speed be when it is very far away?



Potential Energy of a dipole in a uniform field



linear motion

$$dW = F_s ds$$

rotational motion

$$dW = \tau d\phi$$

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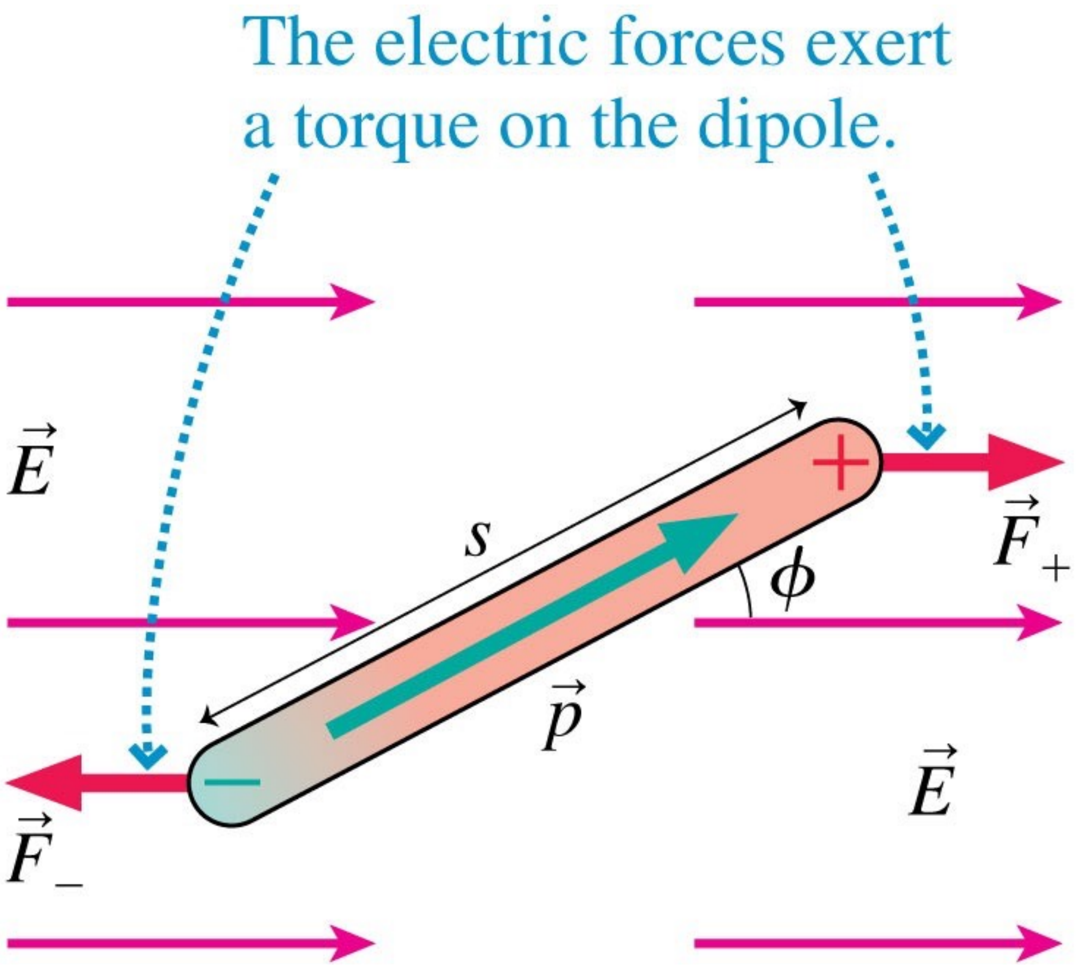

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$$= -pE \sin\phi d\phi$$

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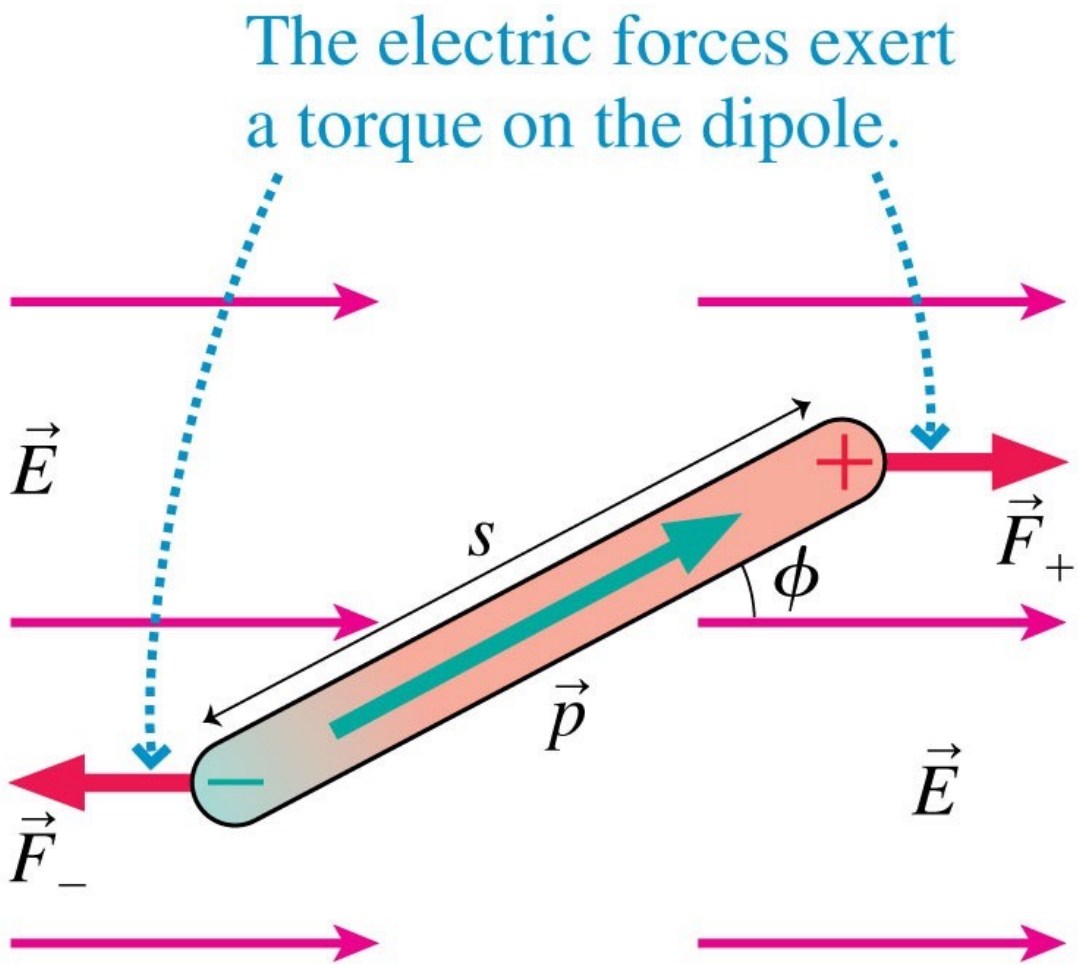

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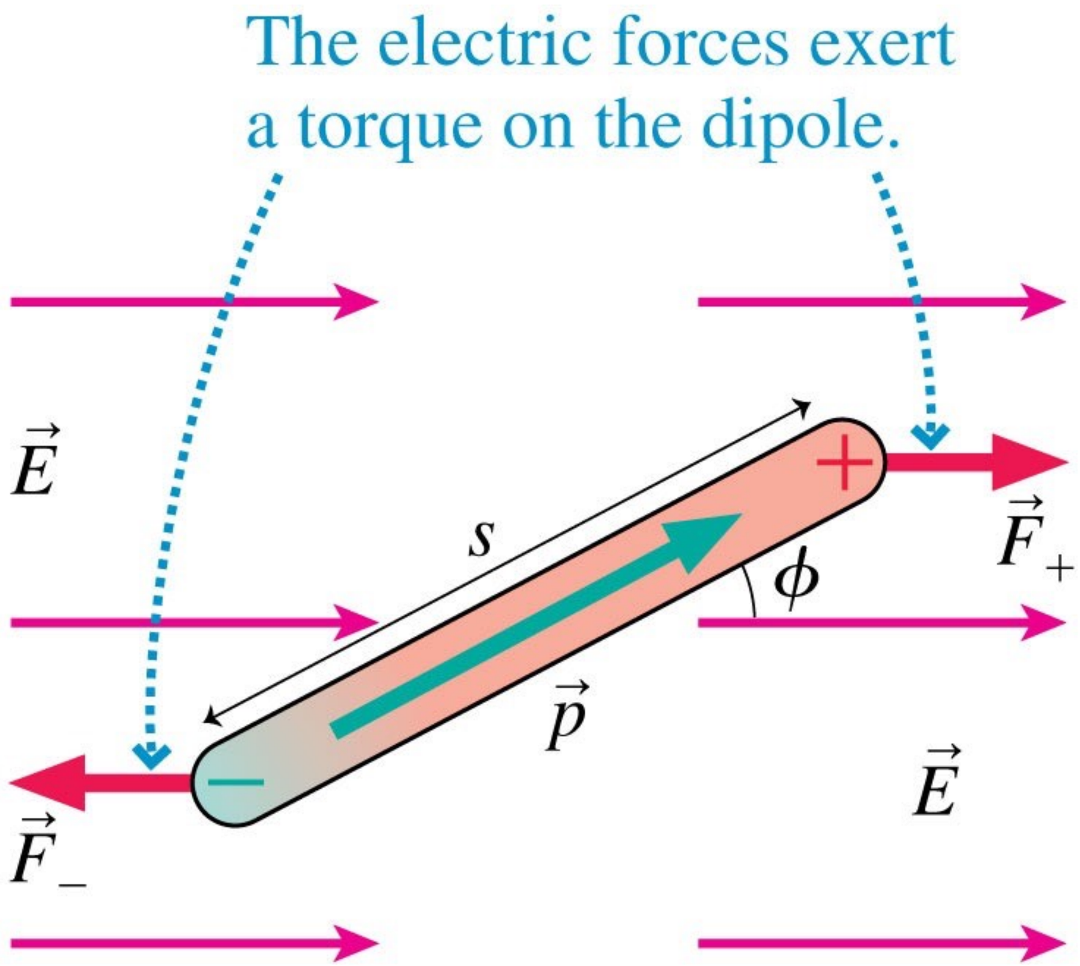

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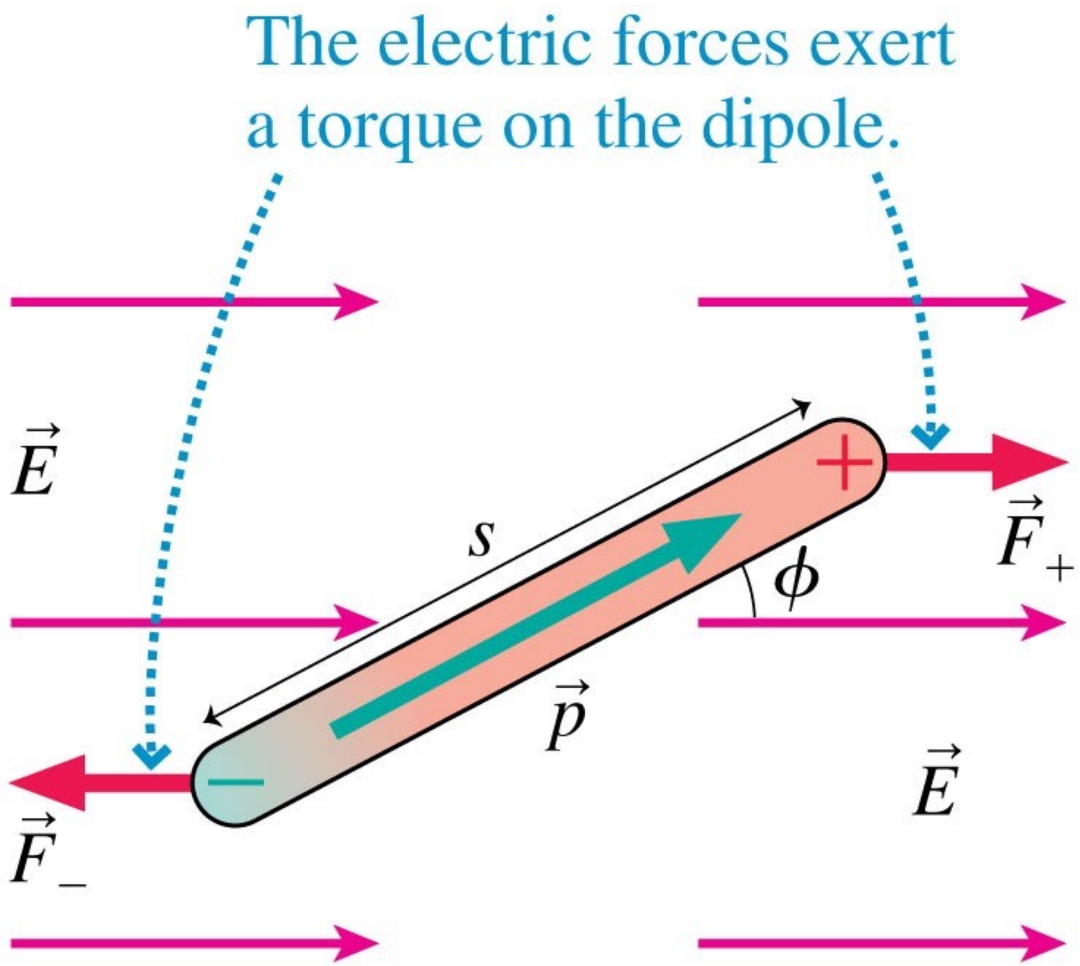

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$$= pE \cos\phi_f - pE \cos\phi_i$$

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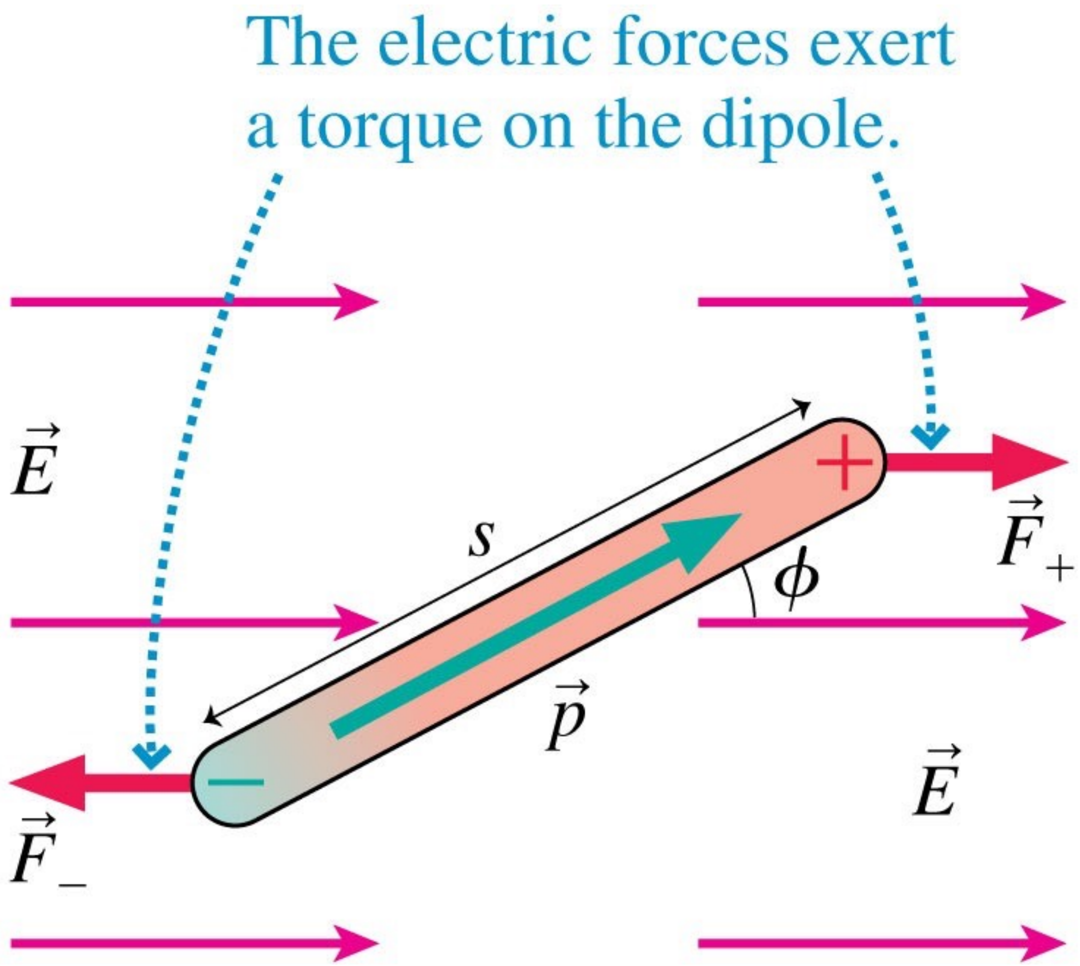

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$$U_{\text{dipole}} = -\vec{p} \cdot \vec{E}$$

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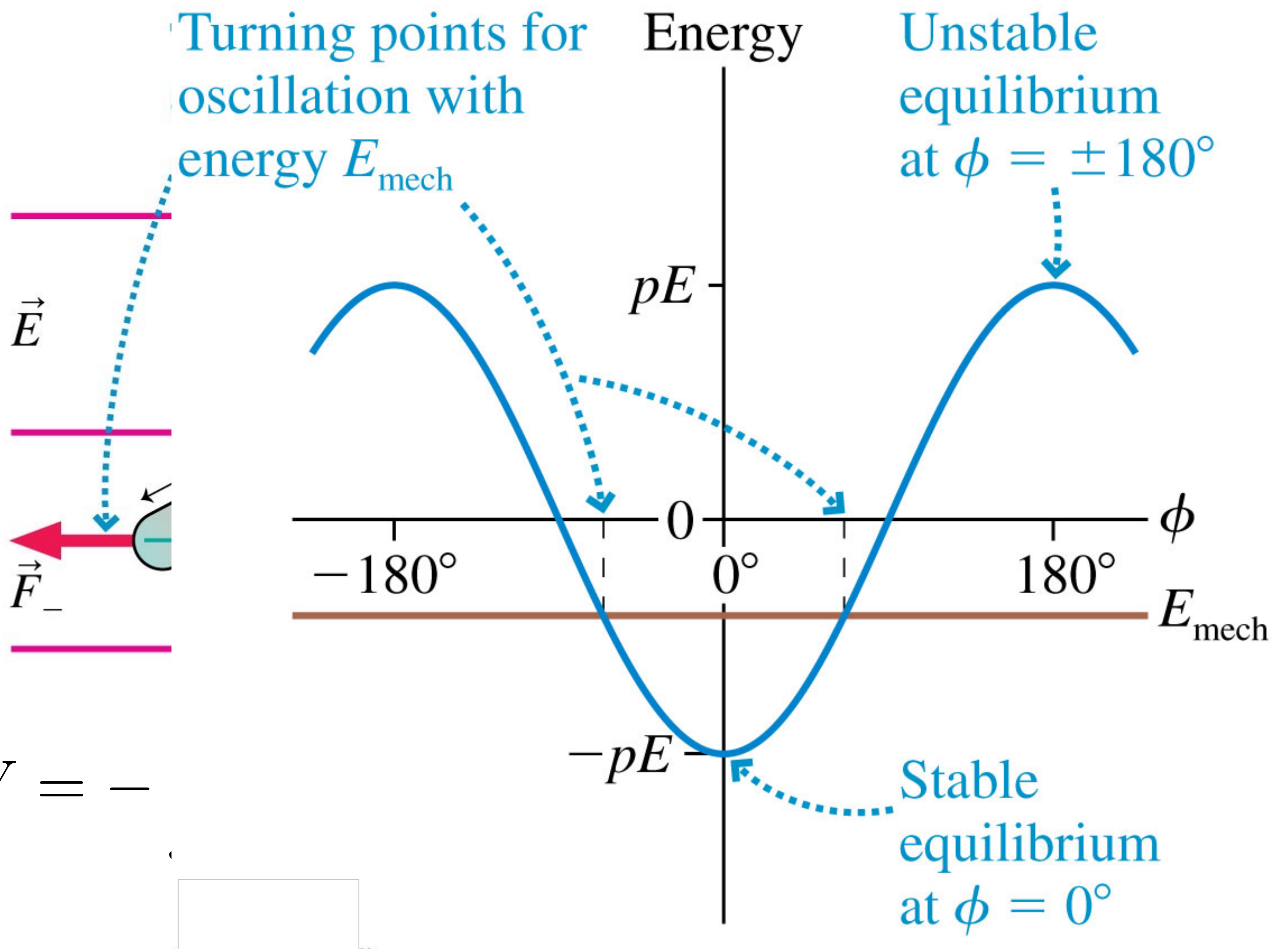

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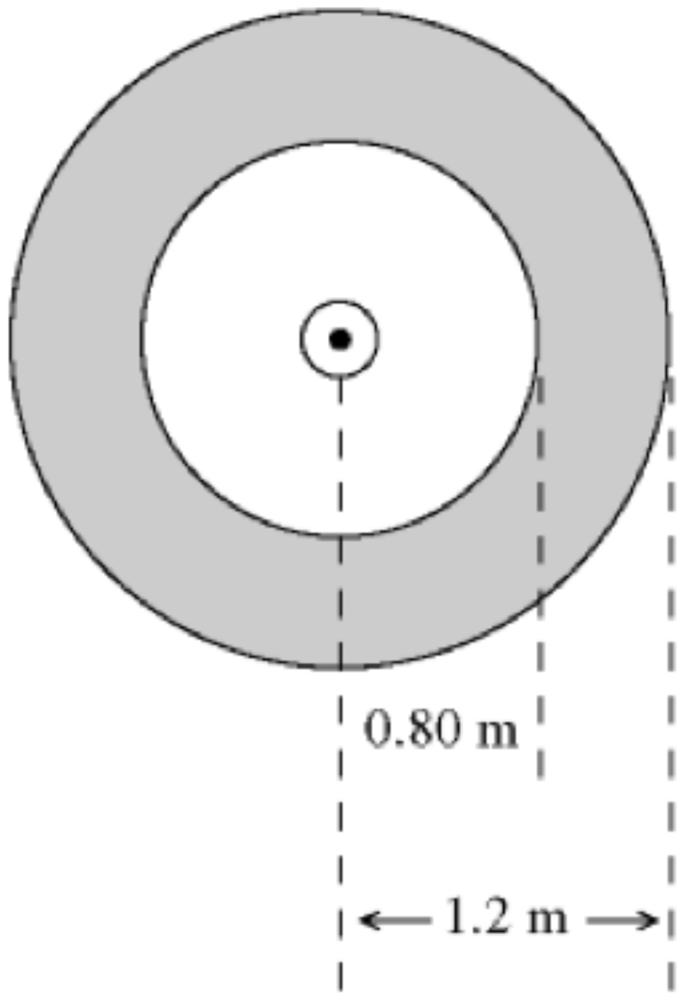
$E \sin\phi d\phi$

$W = -$

$= pE\cos\phi_f - pE\cos\phi_i$

$U_{\text{dipole}} = -\vec{p}\cdot\vec{E}$


0.80 m
1.2 m