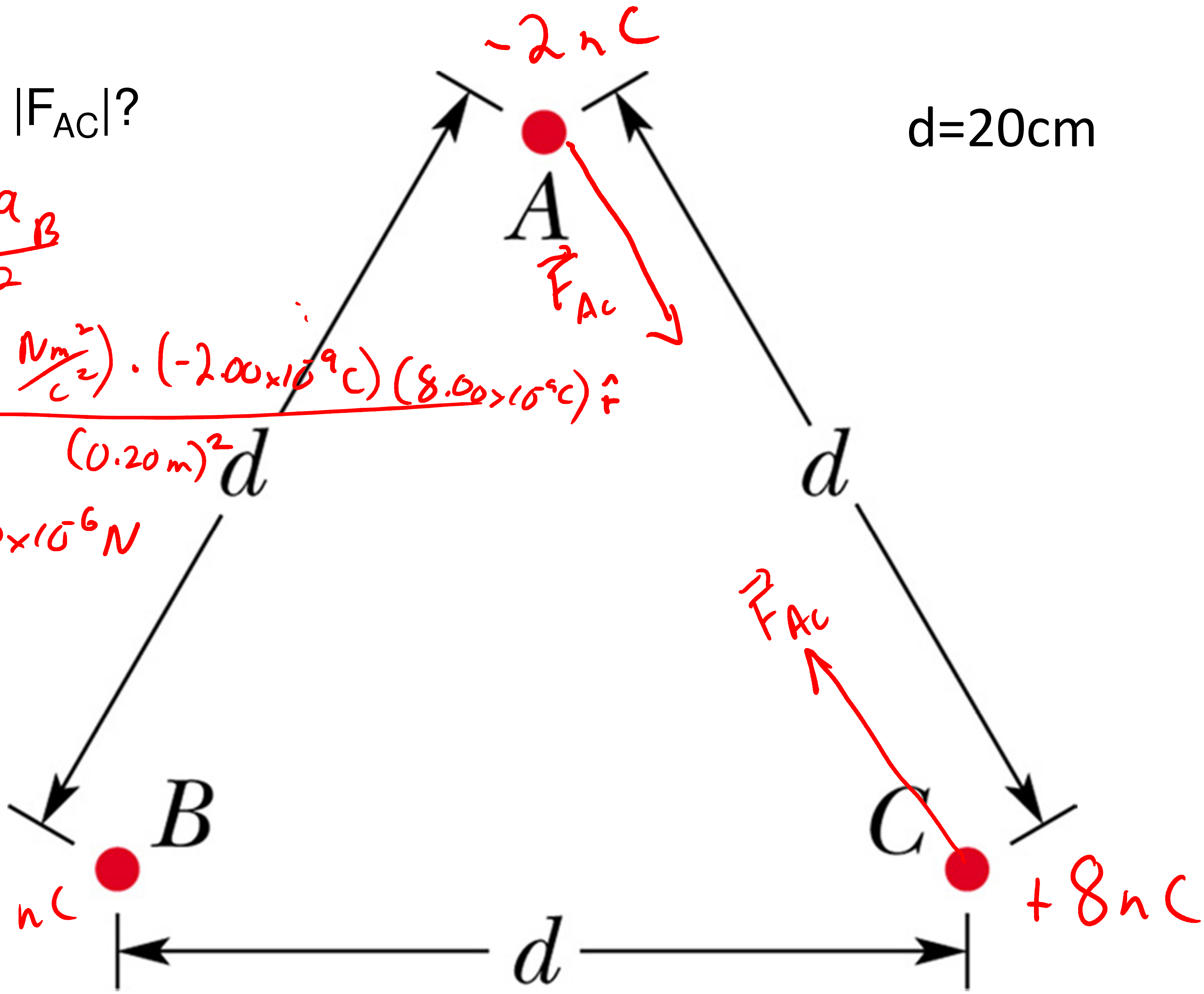
What's $|F_{AC}|$?

d=20cm



$= \frac{k q_A q_B}{r^2}$

$= \frac{(8.99\times10^{9}\ \frac{Nm^2}{C^2})\cdot(-2.00\times10^{-9}C)(8.00\times10^{-9}C)}{(0.20\,m)^2}\hat{r}$

$= 3.60\times10^{-6}\,N$

Connect A and B together momentarily with a wire.
What happens?

q_A was $-2\,nC$ q_B was $-4\,nC$

q_A now? $-3\,nC$

q_B now? $-3\,nC$

Connect B to ground momentarily. What happens?

q_B: $-3\,nC$ to start

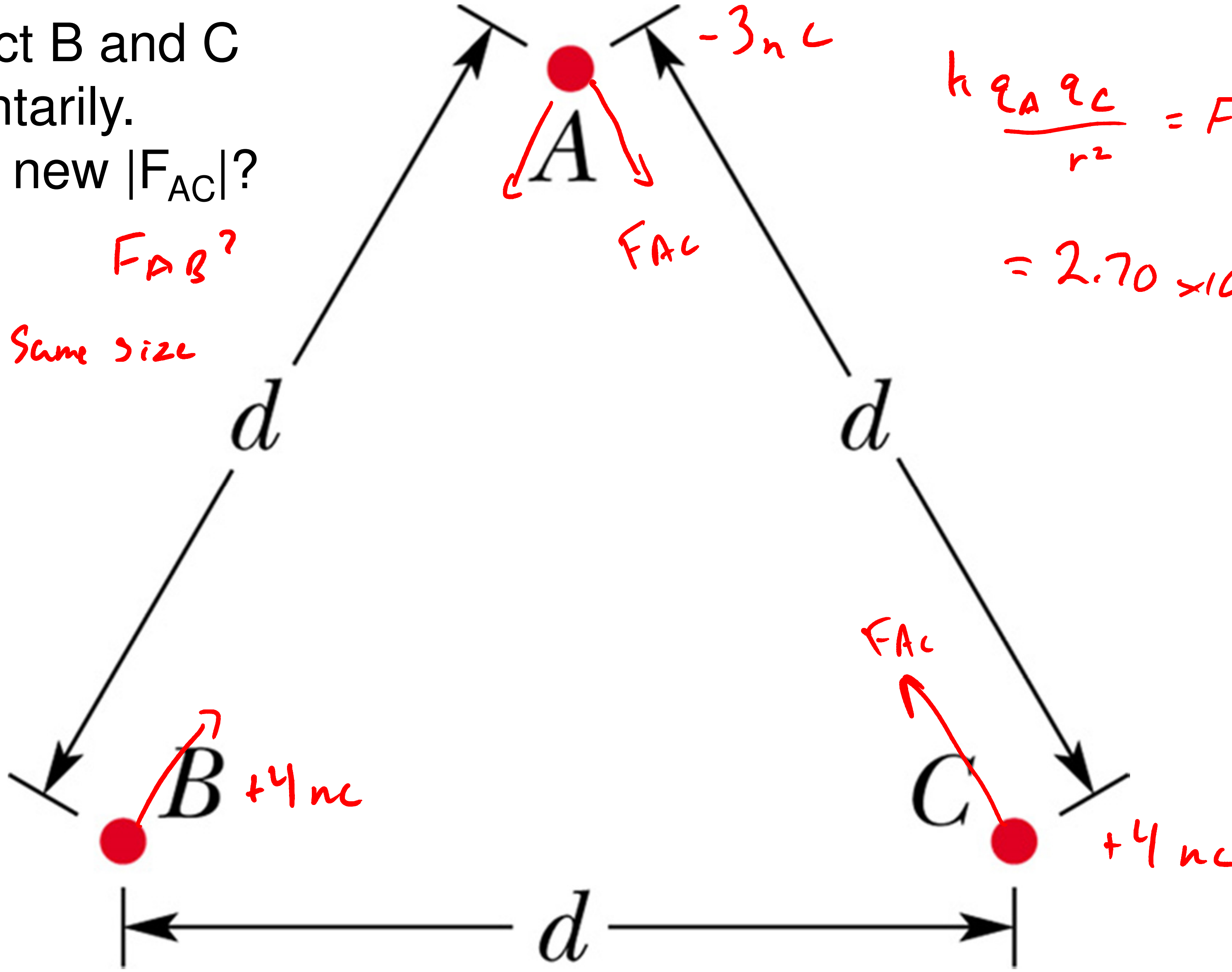
new $q_B = 0$

B was 0, C was +8 nC

Connect B and C momentarily.
What's new $|F_{AC}|$?

F_{AB}?

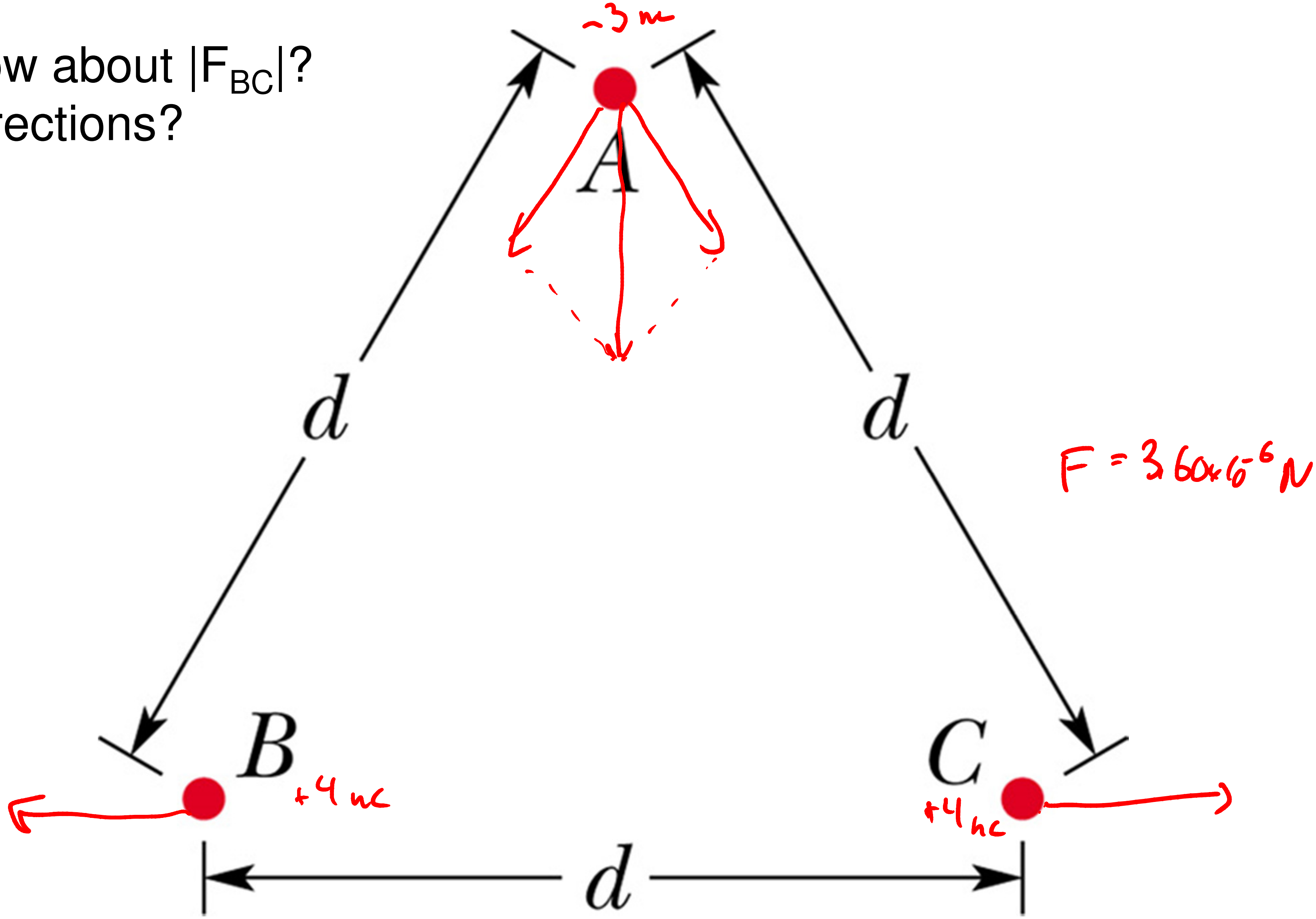
Same size



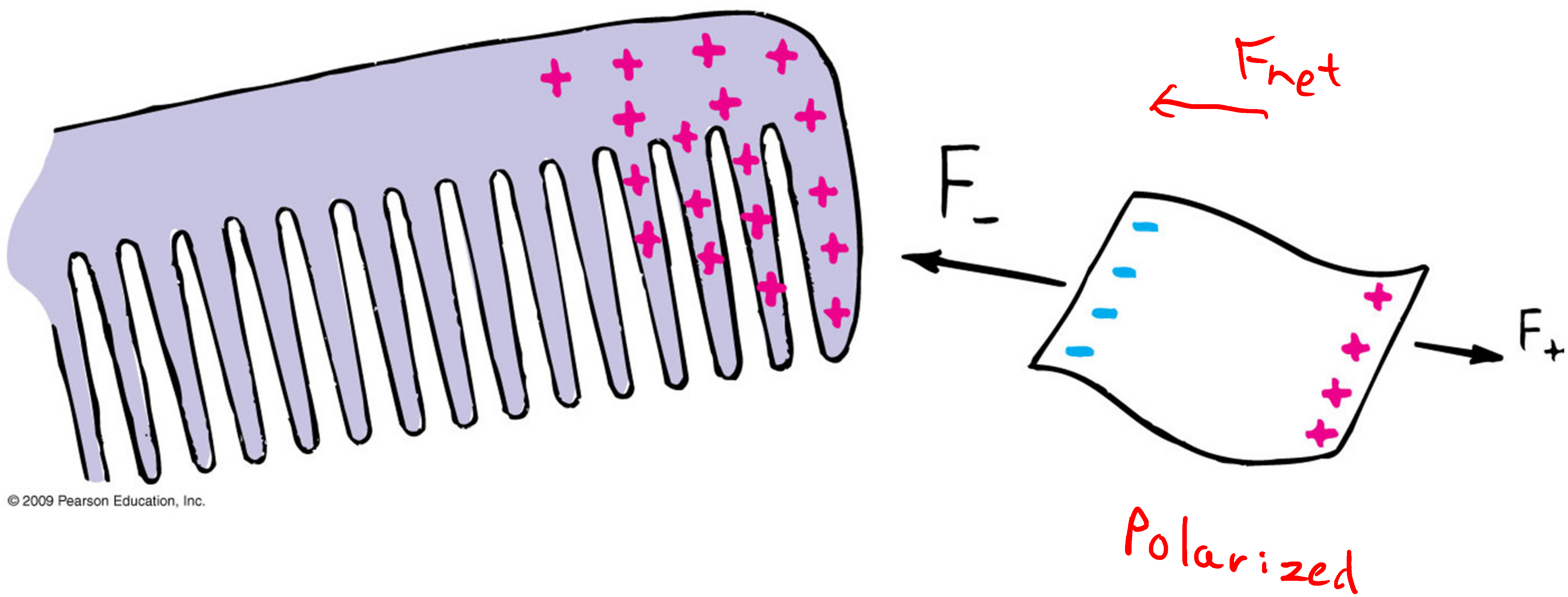
$$k\frac{q_A q_C}{r^2} = F_{AC}$$

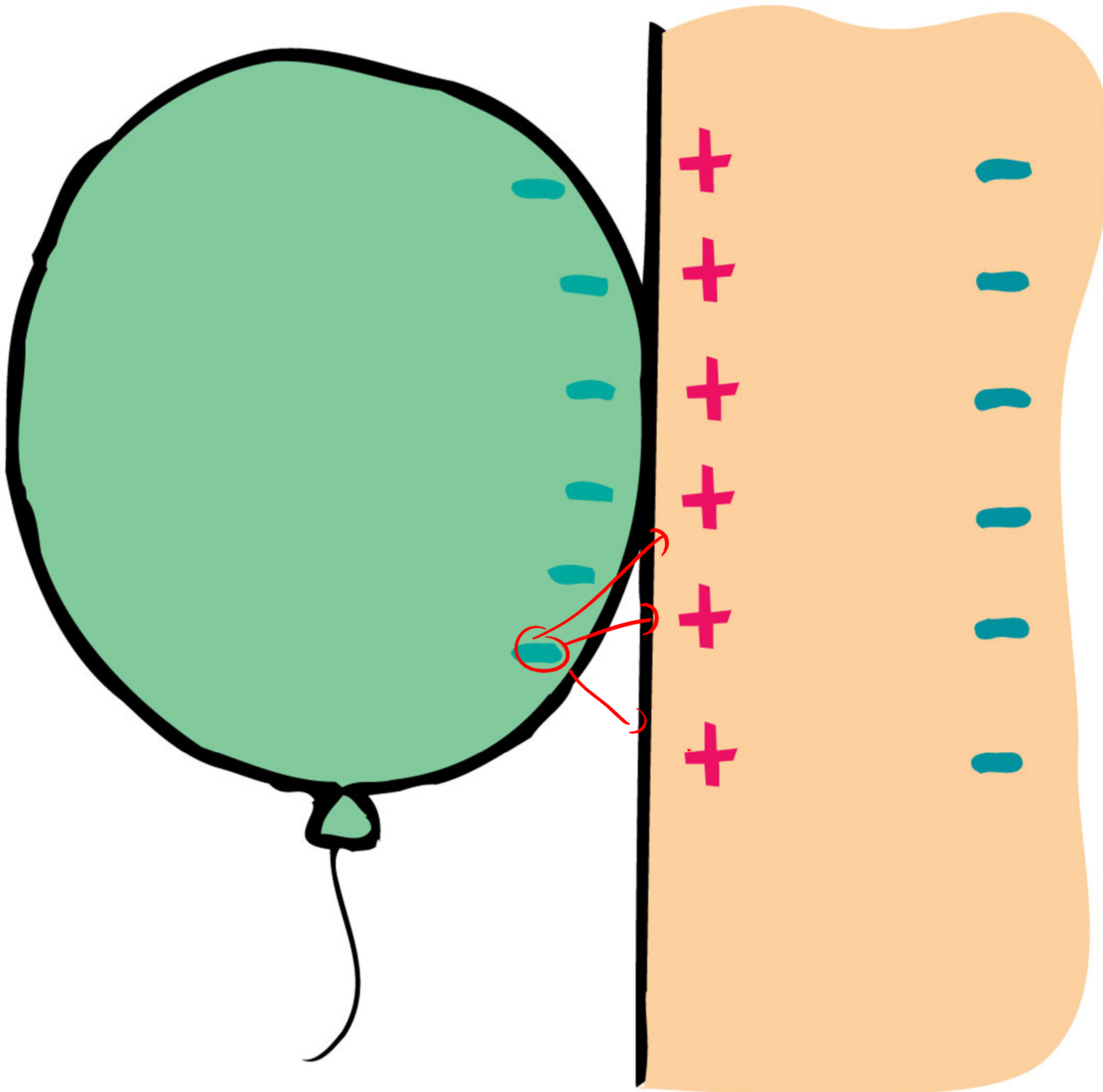
$$= 2.70 \times 10^{-6}\ N$$

How about $|F_{BC}|$?
Directions?



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



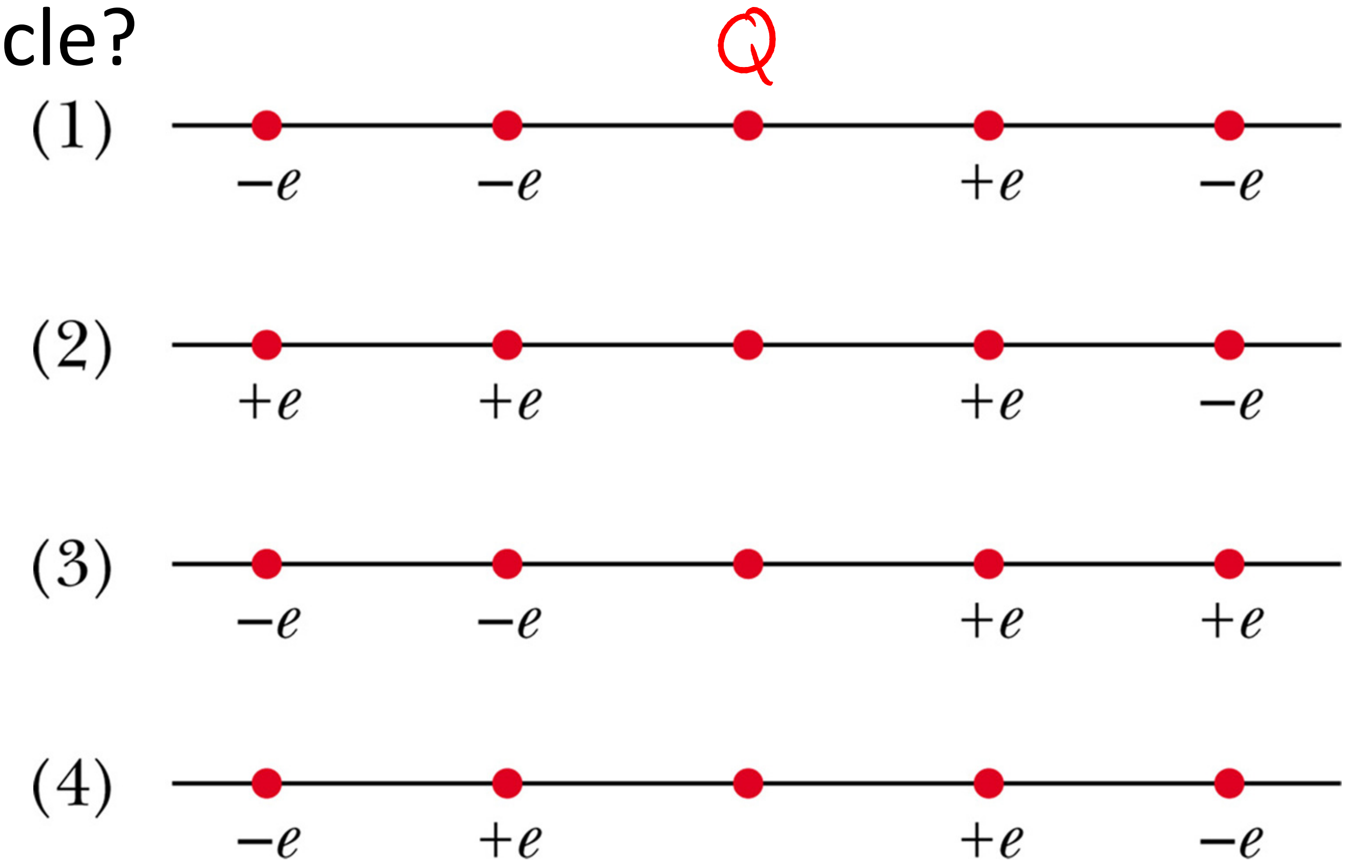


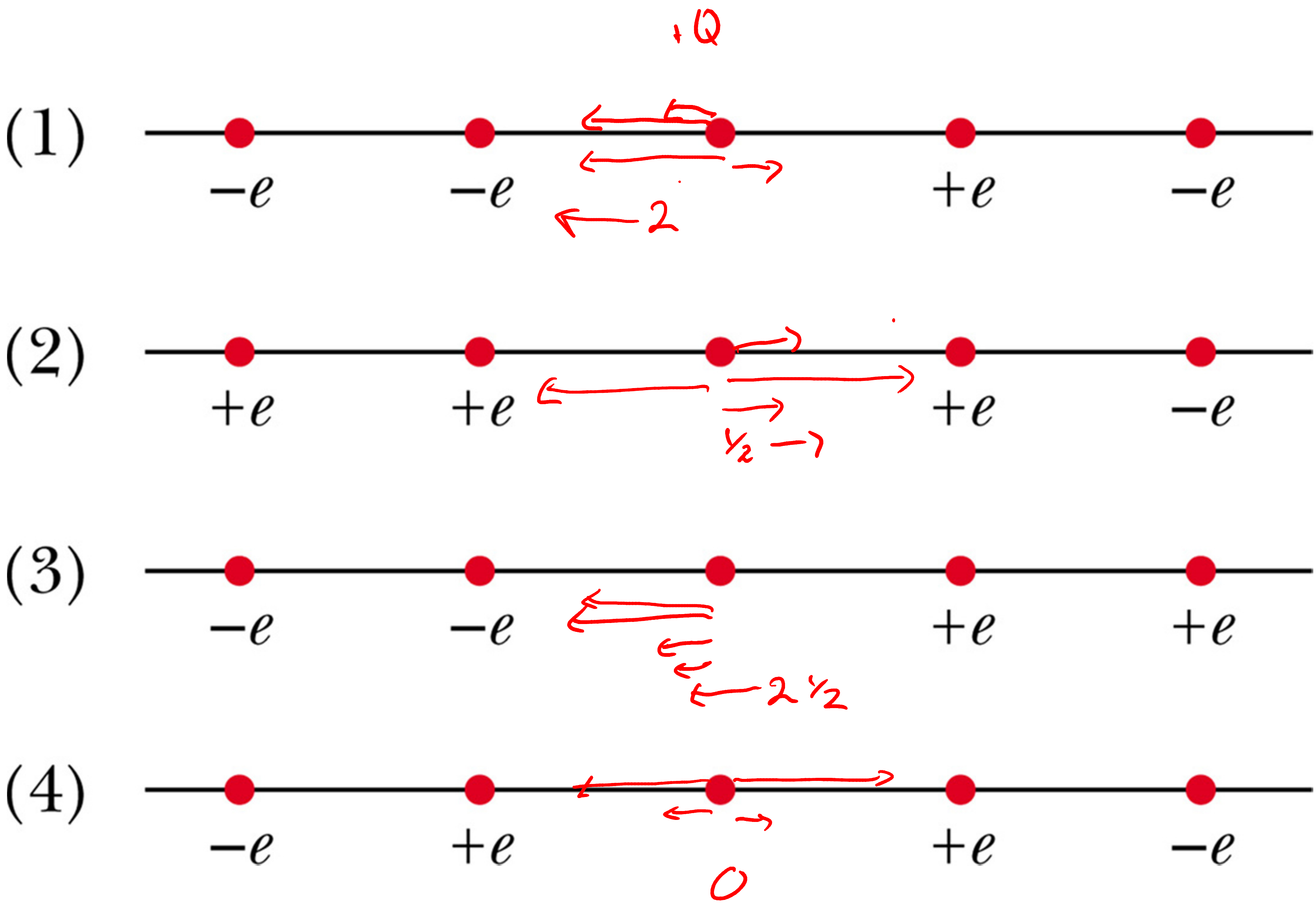
Worksheet that says “page 13” *(ranking forces at point P)*

Worksheet that says “page 14” *(balls hanging from strings*)

(not for clickers, we'll work it out)

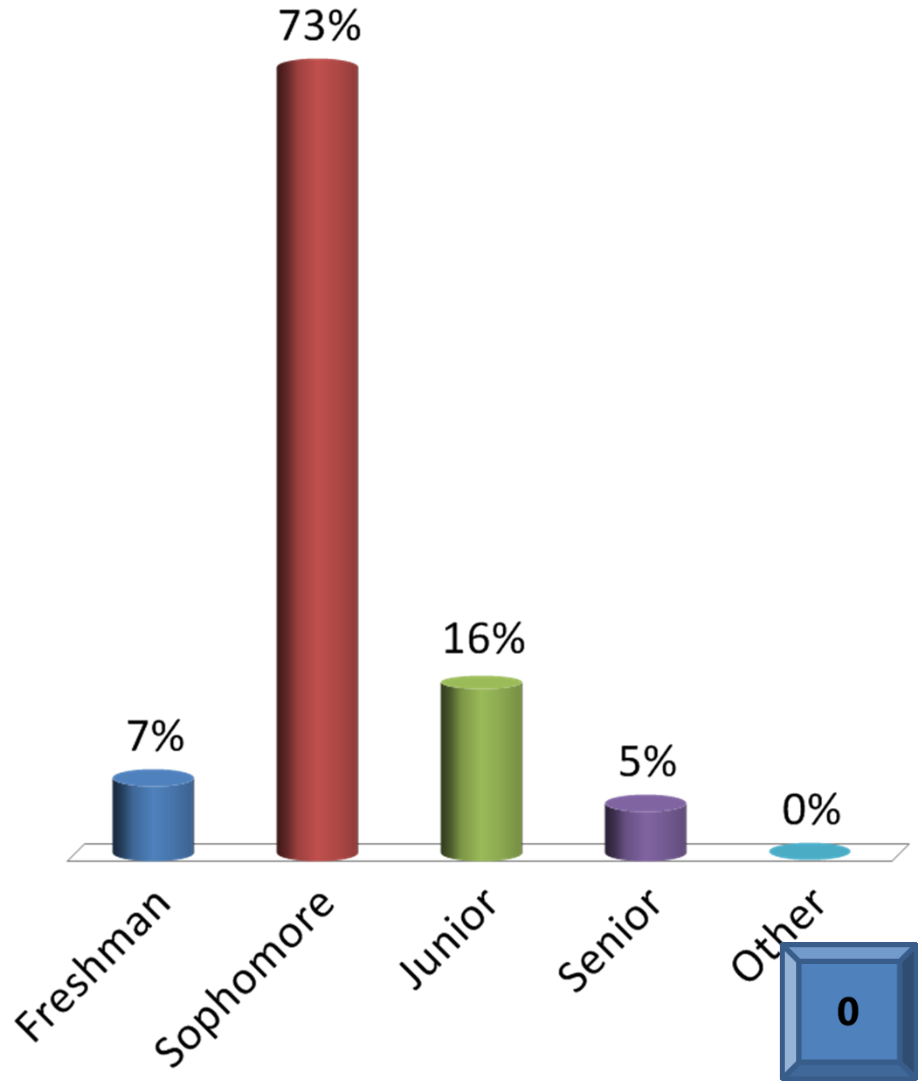
- 5 charged particles, evenly spaced. What's the one with the biggest force on the central particle?




+Q
(1)
−e −e +e −e
2
(2)
+e +e +e −e
1/2
(3)
−e −e +e +e
2 1/2
(4)
−e +e +e −e
0

What year are you in?

1. Freshman
2. Sophomore
3. Junior
4. Senior
5. Other



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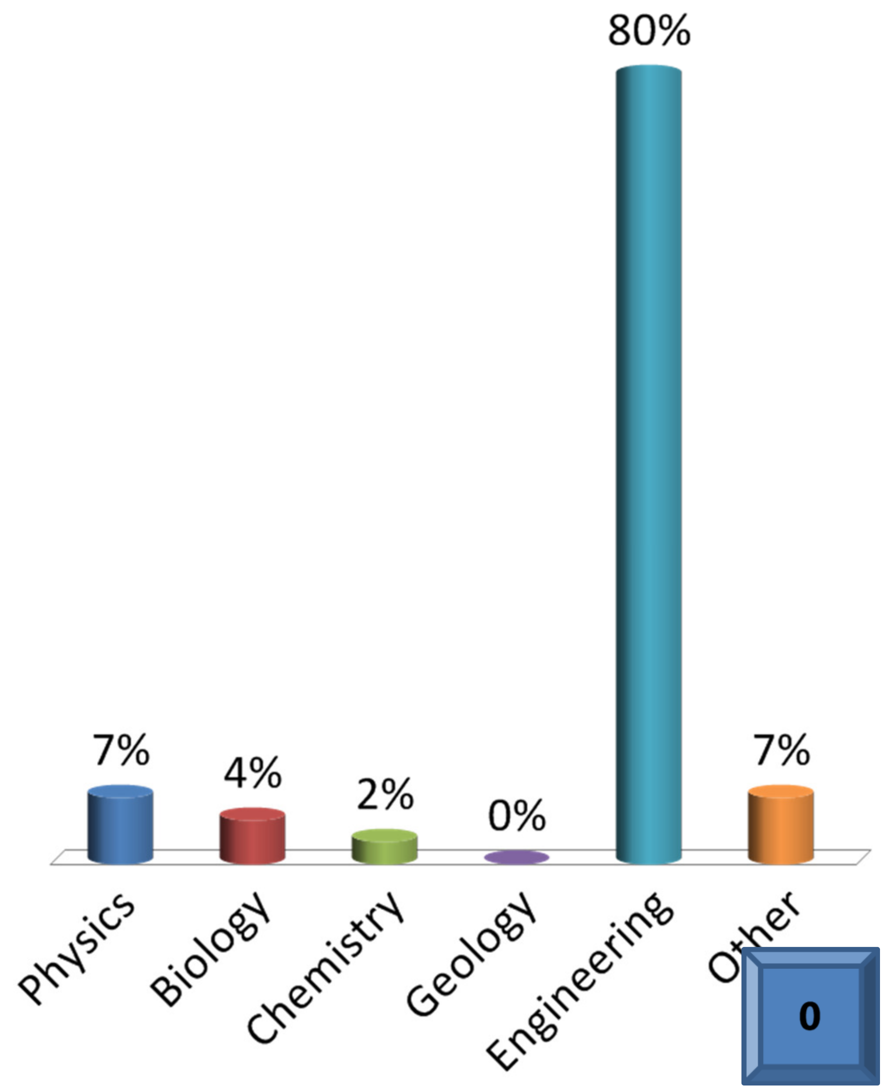
0

What is your Major?

1. Physics
2. Biology
3. Chemistry
4. Geology
5. Engineering
6. Other



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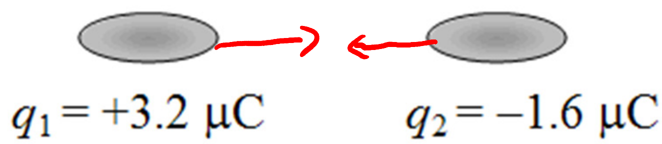
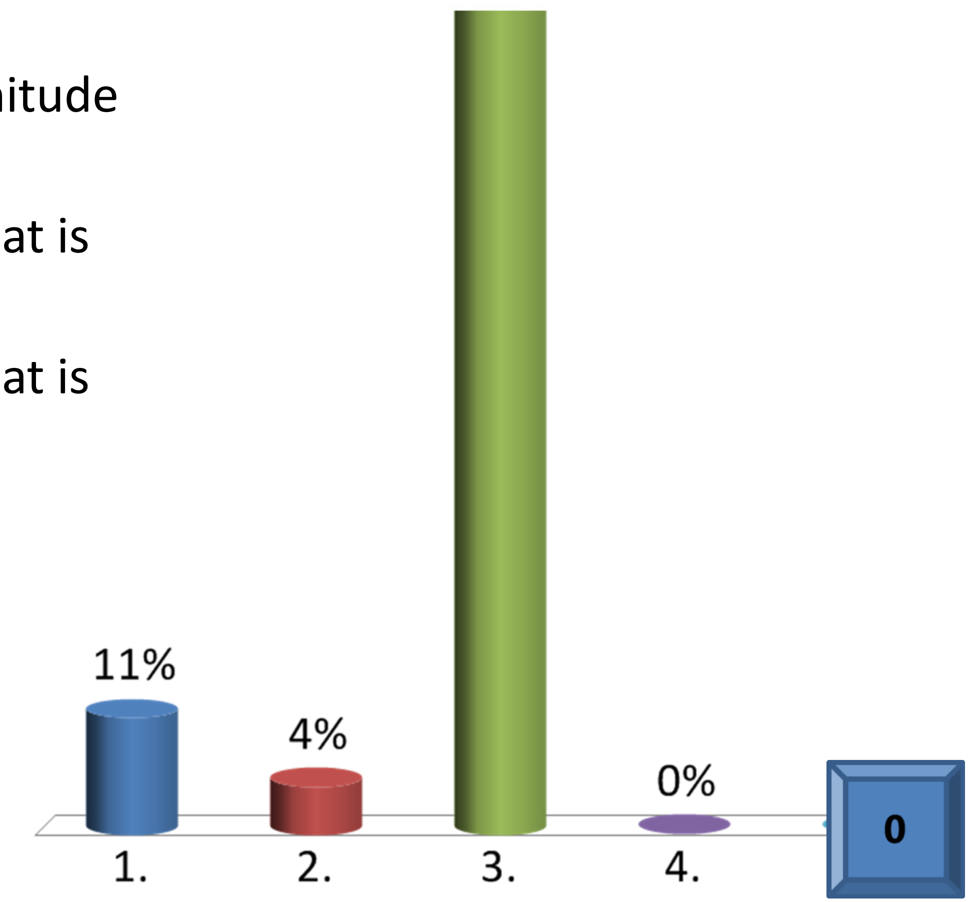
Consider the two charges shown in the drawing. Which of the following statements correctly describes the magnitude of the electric force acting on the two charges? $F_E = \frac{kq_1q_2}{r^2}$

1. The force on q_1 has a magnitude that is twice that of the force on q_2.
2. The force on q_2 has a magnitude that is twice that of the force on q_1.
3. ✓ The force on q_1 has the same magnitude as that of the force on q_2.
4. The force on q_2 has a magnitude that is four times that of the force on q_1.
5. The force on q_1 has a magnitude that is four times that of the force on q_2.





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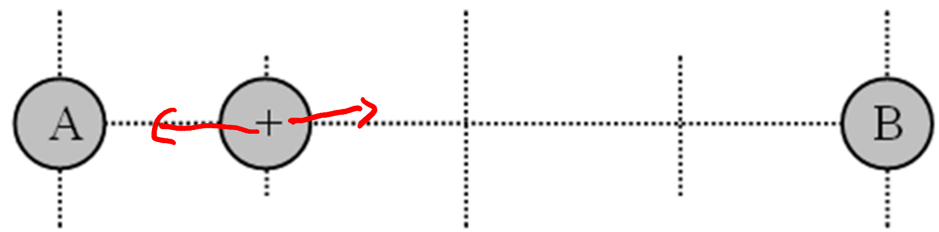
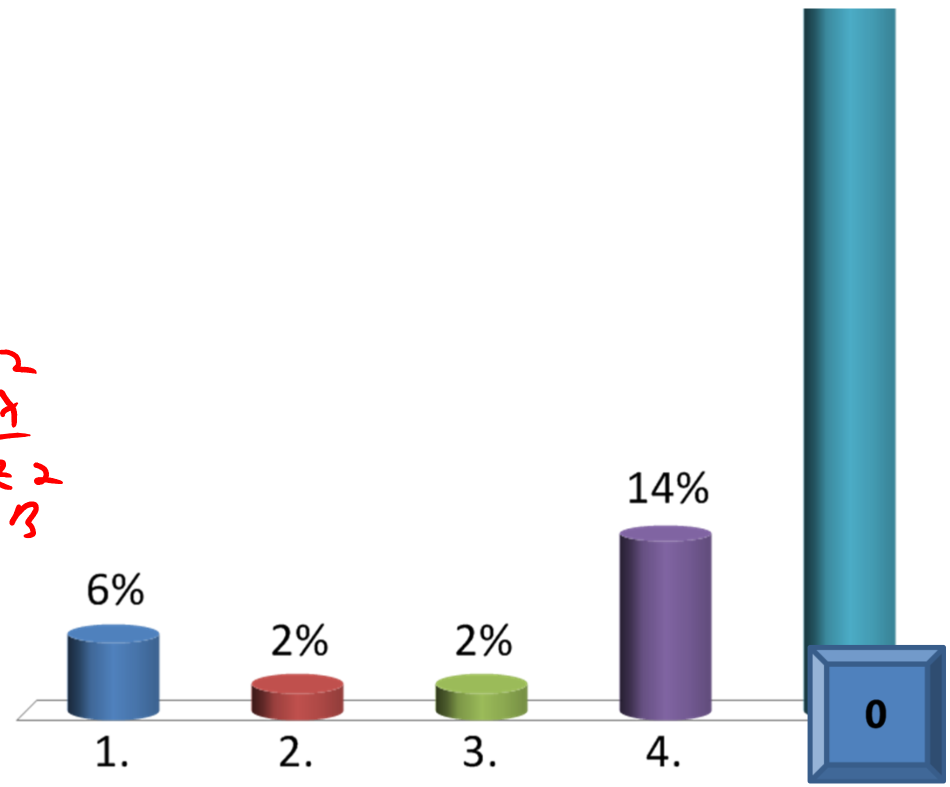
As shown in the drawing, a positively charged particle remains stationary between particles A and B. The positively charged particle is one-quarter the distance between the two other particles, as shown. What can be concluded from the situation?



1. The charge on A is 4x B's.
2. The charge on A is 16x B's
3. The charge on A is ½ B's
4. The charge on A is ¼ B's
5. ✓ The charge on A is 1/9th B's

$F_A = F_B$

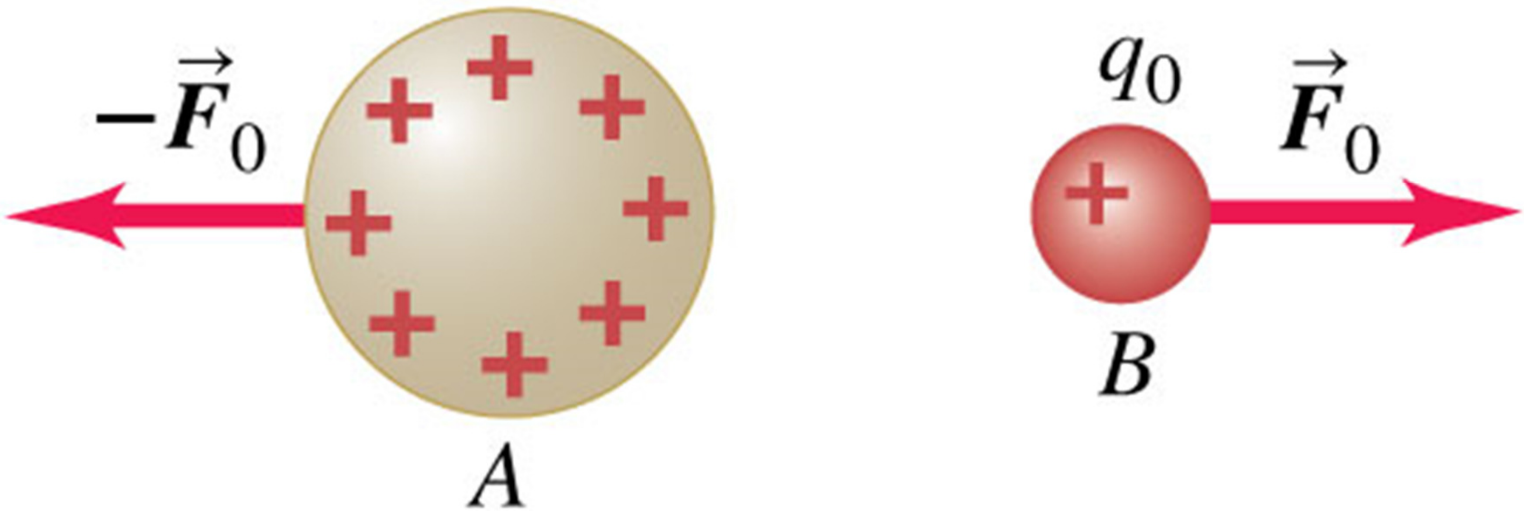
$\frac{k q_A q_+}{r_A^2} = \frac{k q_B q_+}{r_B^2}$ $\qquad \frac{q_A}{q_B} = \frac{r_A^2}{r_B^2}$

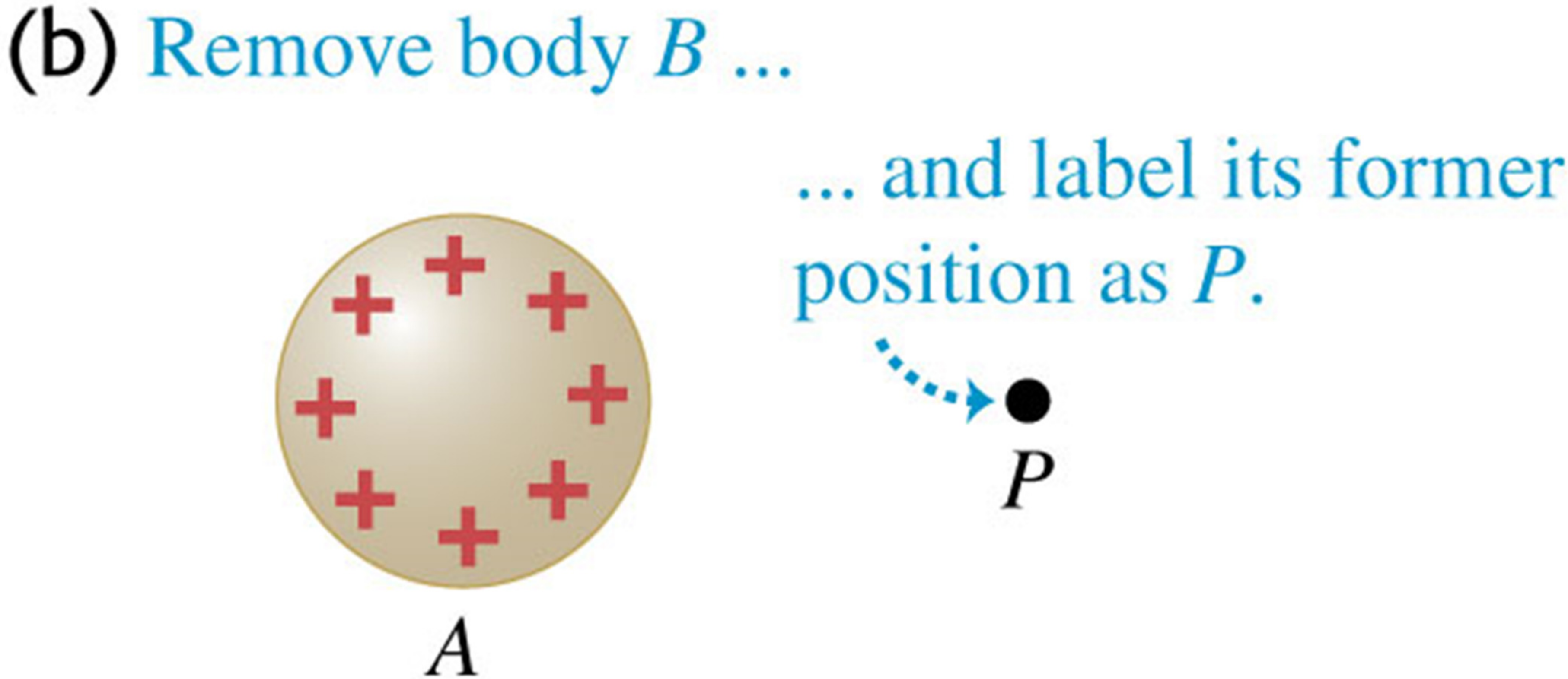


What we know so far…

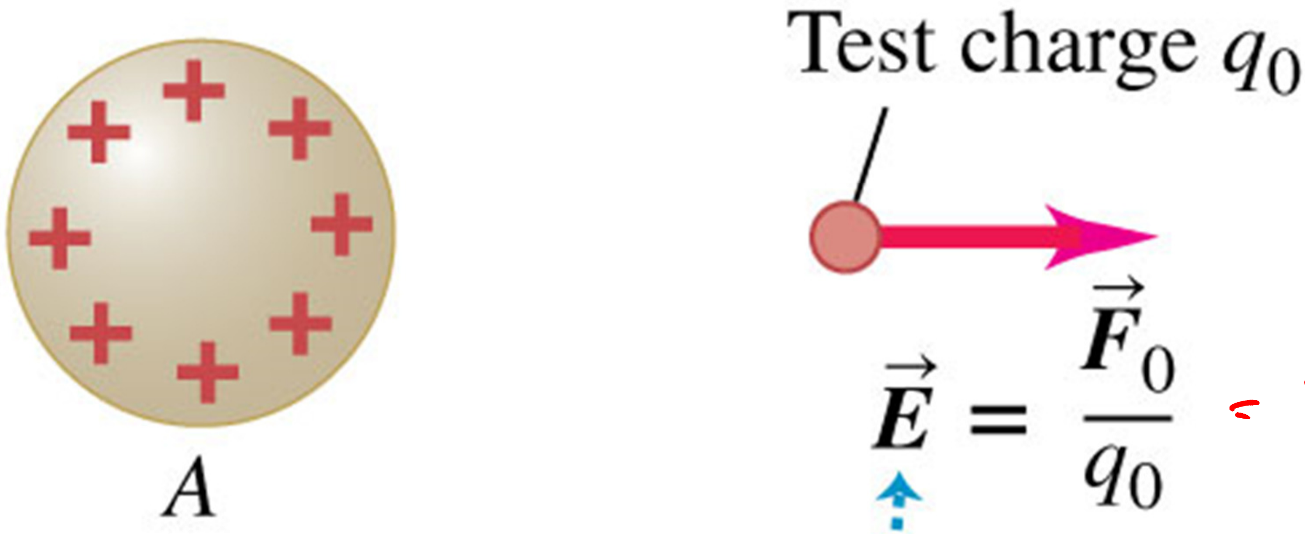
- Like charges repel, opposites attract. With what force? Coulomb's Law.
- Charge is conserved, comes in electron-sized chunks.
- Charge can move in conductors, is stuck in place in insulators.

(a) *A* and *B* exert electric forces on each other.




(b) Remove body B ...
... and label its former position as P.
P
A

(c) Body A sets up an electric field $\vec{E}$ at point P.



$$\vec{E} = \frac{\vec{F}_0}{q_0} = \frac{k q_A}{r^2}\hat{r}$$

$$\vec{F}_0 = \frac{k q_A q_0}{r^2}\hat{r}$$

$\vec{E}$ is the force per unit charge exerted by A on a test charge at P.

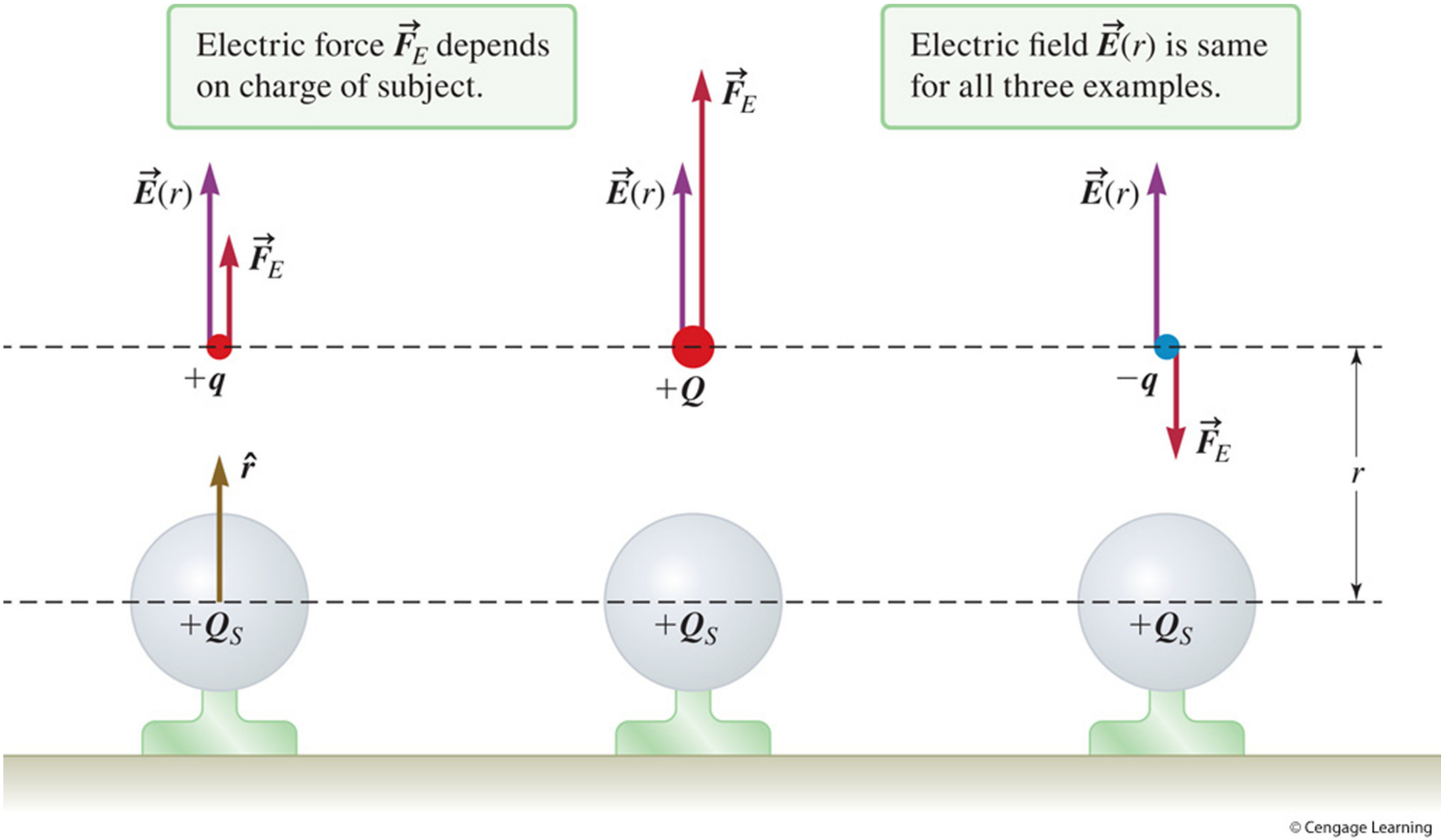

Electric force $\vec{F}_E$ depends on charge of subject.
Electric field $\vec{E}(r)$ is same for all three examples.
$\vec{E}(r)$
$\vec{F}_E$
$+q$
$\hat{r}$
$+Q_S$
$\vec{E}(r)$
$\vec{F}_E$
$+Q$
$+Q_S$
$\vec{E}(r)$
$-q$
$\vec{F}_E$
$+Q_S$
r
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Fig.24.2

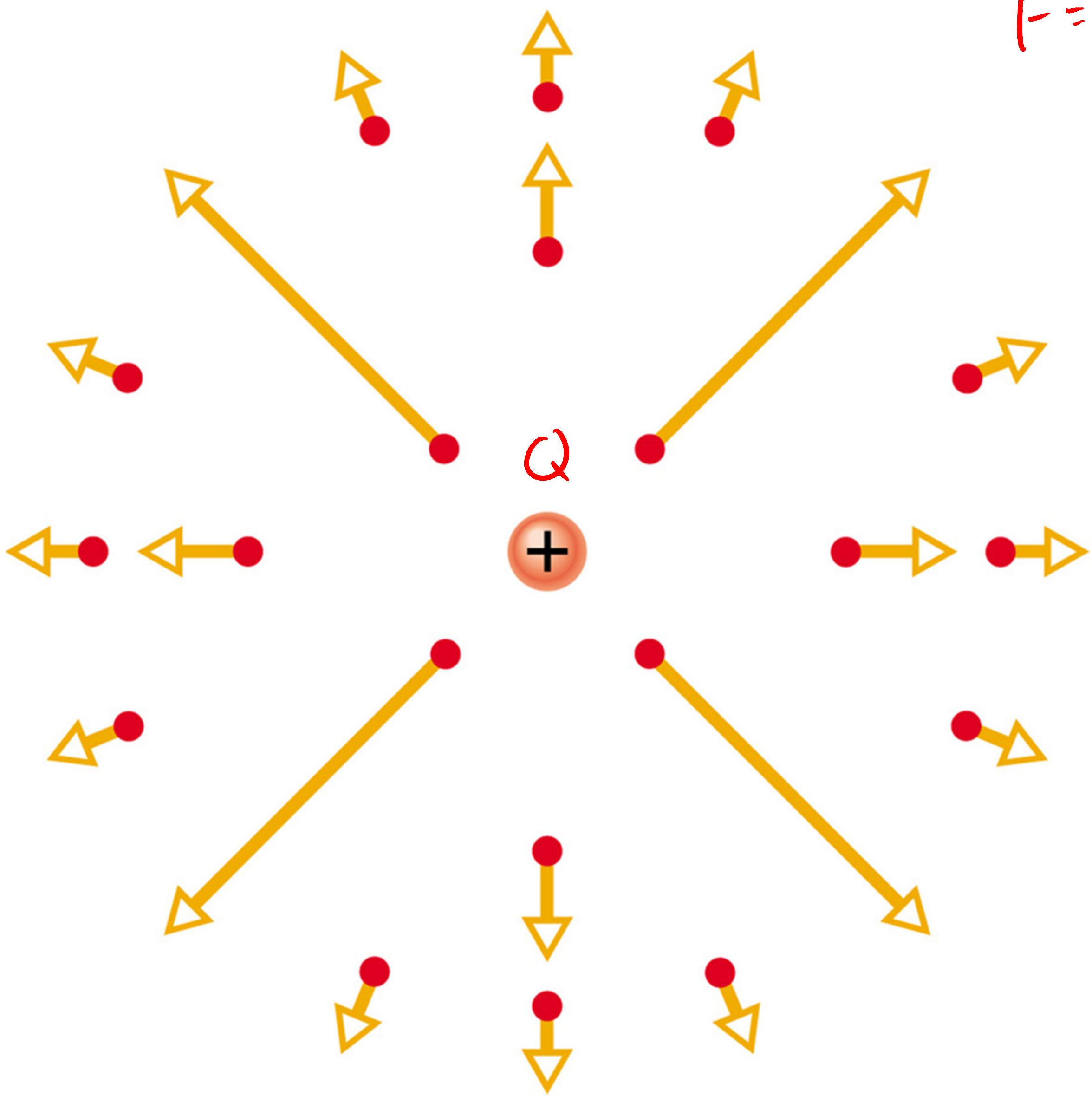
Electric Field N/C

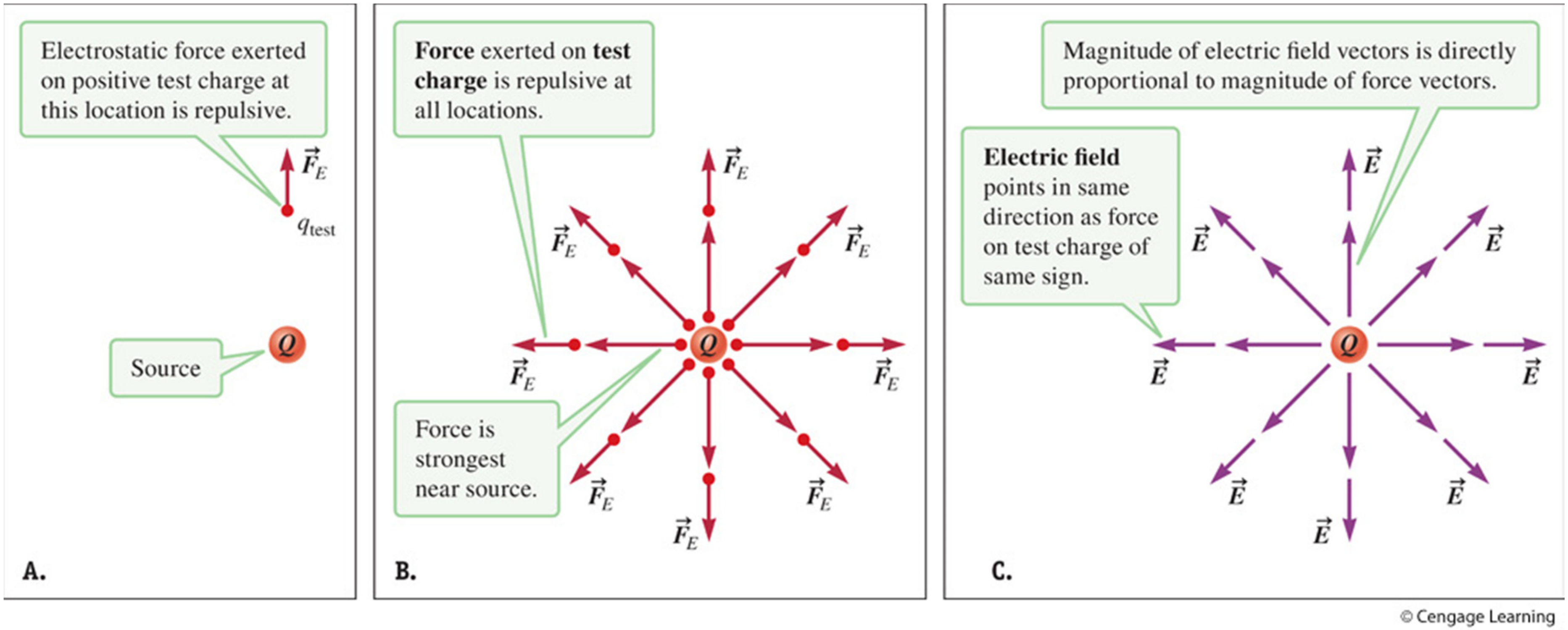
$$\frac{\vec{F}}{q_0} = \vec{E}$$

$$\vec{F} = \vec{E}\,\text{"}q\text{"}$$

$$\vec{F} = \frac{k\,Q\,q_0}{r^2}\,\hat{r}$$

$$\vec{E} = \frac{kQ}{r^2}\,\hat{r}$$





Electrostatic force exerted on positive test charge at this location is repulsive.
$\vec{F}_E$
q_{test}
Source
Q
A.
Force exerted on **test charge** is repulsive at all locations.
Force is strongest near source.
B.
Magnitude of electric field vectors is directly proportional to magnitude of force vectors.
Electric field points in same direction as force on test charge of same sign.
$\vec{E}$
C.
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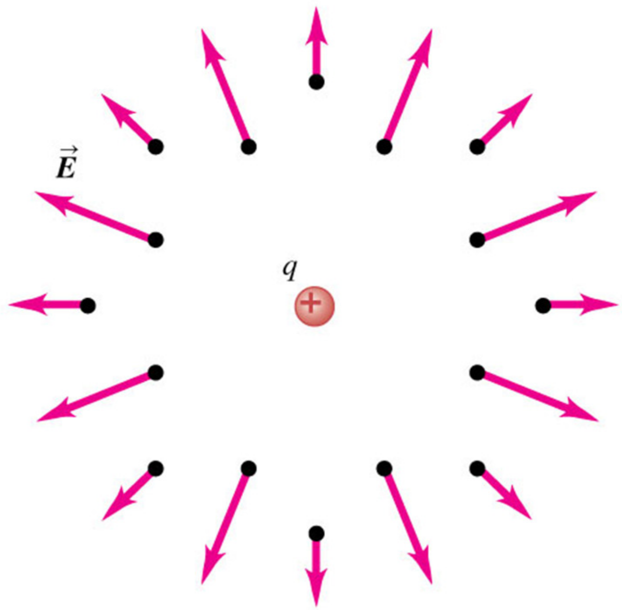
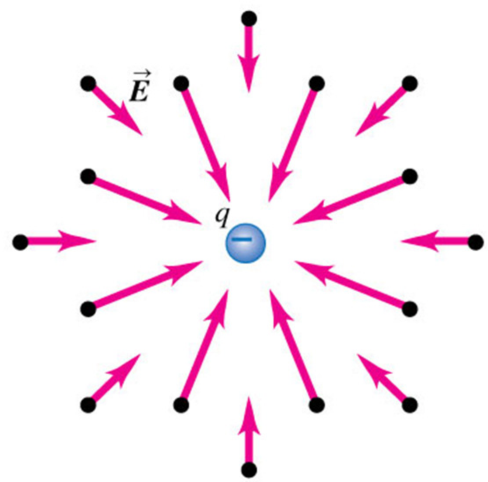
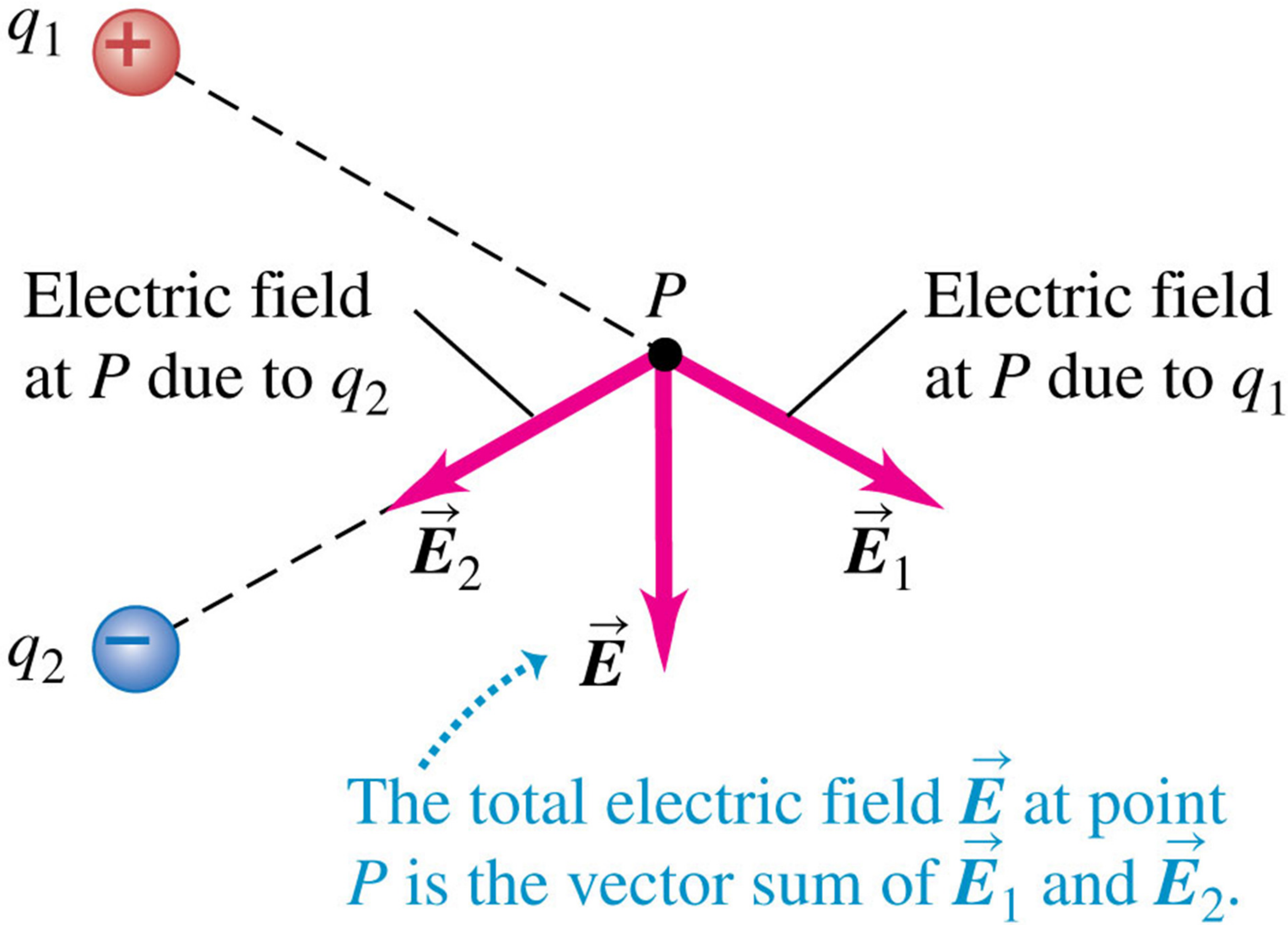
Fig.24.4

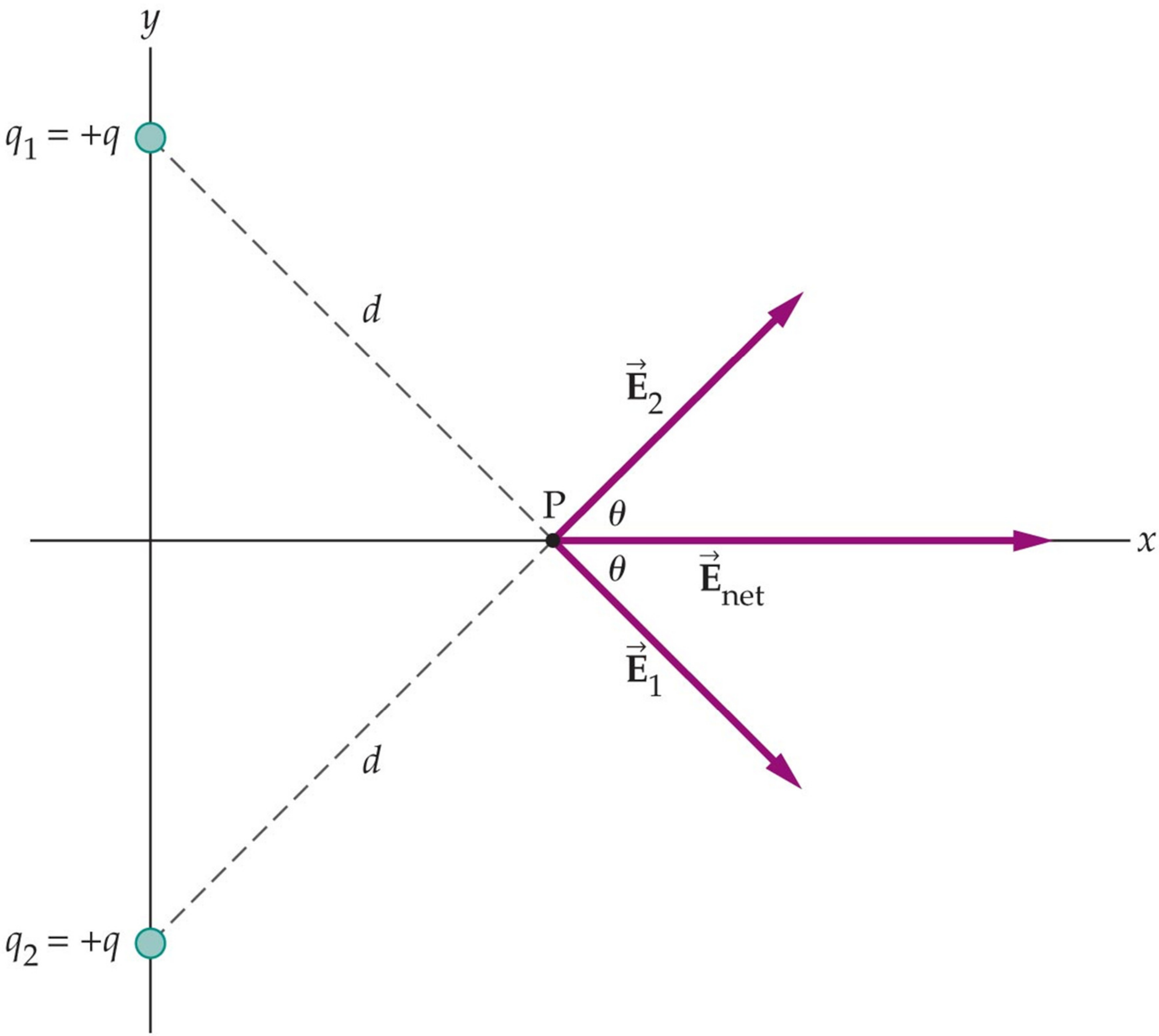
(a) The field produced by a positive point charge points *away from* the charge.



(b) The field produced by a negative point charge points *toward* the charge.

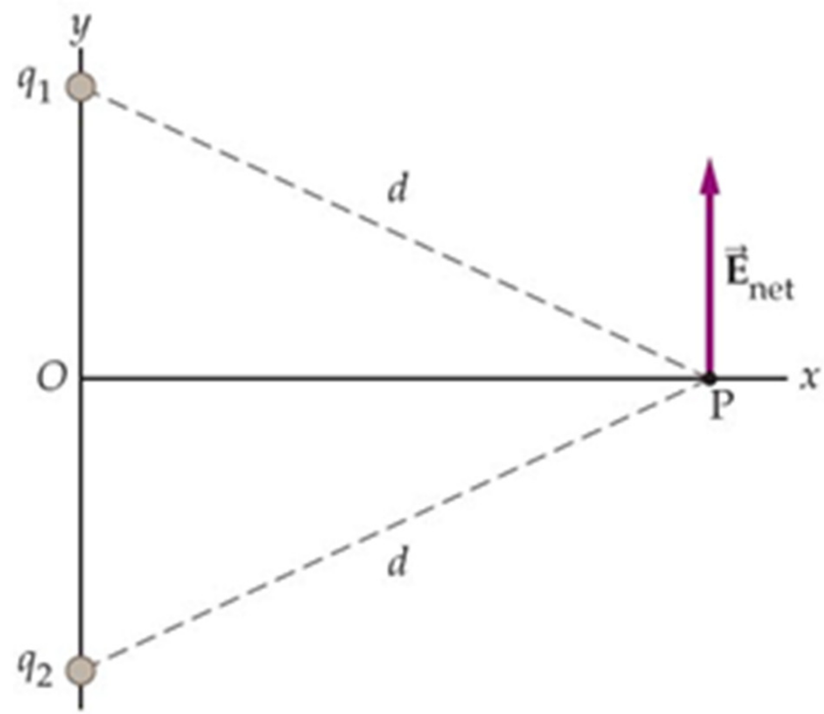


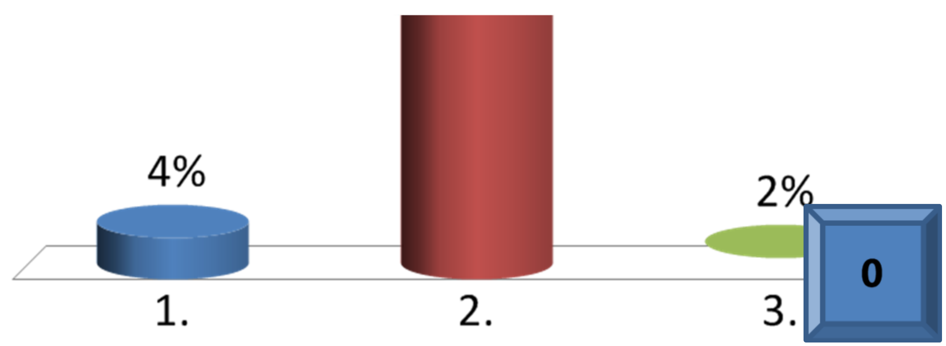

q_1
q_2
P
Electric field at P due to q_2
Electric field at P due to q_1
$\vec{E}_2$
$\vec{E}_1$
$\vec{E}$
The total electric field $\vec{E}$ at point P is the vector sum of $\vec{E}_1$ and $\vec{E}_2$.


y
$q_1 = +q$
d
$\vec{E}_2$
P
θ
x
θ
$\vec{E}_{net}$
$\vec{E}_1$
d
$q_2 = +q$

Two charges (q_1 & q_2) have equal magnitudes and are placed as shown in this figure. The net electric field at point P is vertically upward. Do we conclude:

1. That q_1 is positive and q_2 is negative.
2. That q_1 is negative and q_2 is positive.
3. That q_1 and q_2 both have the same sign





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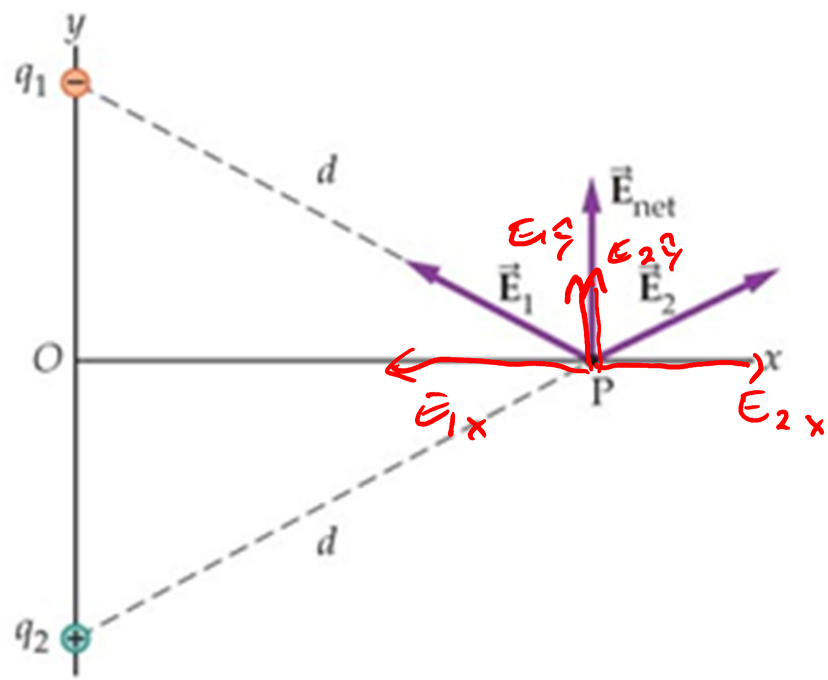
$$\vec{E} = \frac{kq}{|r^2|}\hat{r}$$

$$\vec{F} = \vec{E} \cdot Q$$

$$N = \frac{N}{C}\, C$$



$$E_{net} = 2(E_{1y})$$

Worksheet that says “page 24” *(describe electric field…)*

Worksheet that says “page 25” *(calculate the electric field…)*