

Quiz 1 – Week of 10/1/2018 - Solutions

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Name: \_\_\_\_\_

1) (5 Points)

Two identical conducting spheres, one with an initial charge  $+Q$ , the other initially uncharged, are brought into contact.

(a) What is the new charge on each sphere?

A.  $+Q$  or

B.  $+\frac{1}{2}Q$

$+\frac{1}{2}Q$ . Since the spheres are identical, they must share the total charge equally.

(b) While the spheres are in contact, a negatively charged rod is moved close to one sphere, causing it to have a charge of  $+2Q$ . What is the charge on the other sphere?

A.  $-Q$  or

B.  $-2Q$

C. other

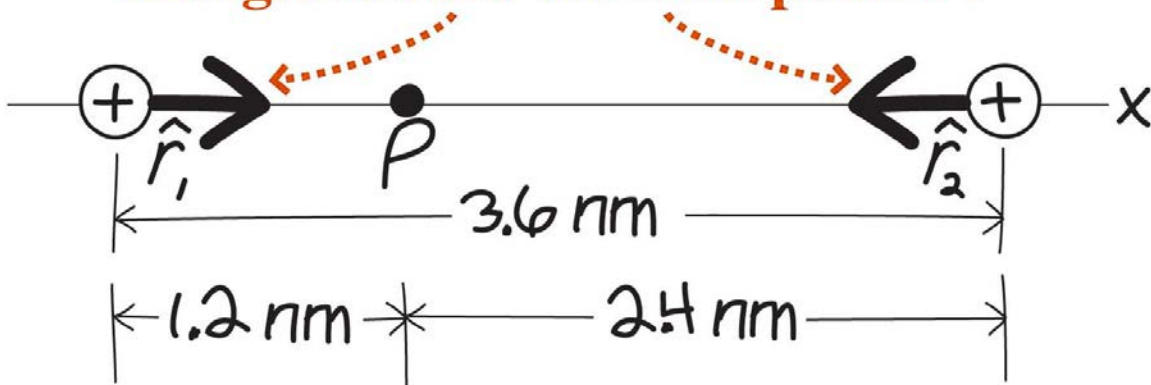
$-Q$ , necessary to satisfy the conservation of charge.

2) (5 Points)

Two protons are 3.6 nm apart. Find the electric field at a point between them, 1.2 nm from one of the protons. Then find the force on an electron at this point.

$$(K = 1/4\pi\epsilon_0 = 9.0 \times 10^9 \text{ N m}^2/\text{C}^2)$$

Unit vectors point *from* the source charges *toward* the field point  $P$ .



$$\vec{E}_P = \frac{kq}{(1.2 \times 10^{-9})^2} \hat{r}_1 + \frac{kq}{(2.4 \times 10^{-9})^2} \hat{r}_2$$

$$= \frac{kq}{(2.4 \times 10^{-9})^2} \left[ 4\hat{i} + (-\hat{i}) \right]$$

$$= \frac{kq}{(2.4 \times 10^{-9})^2} \left[ 3\hat{i} \right]$$

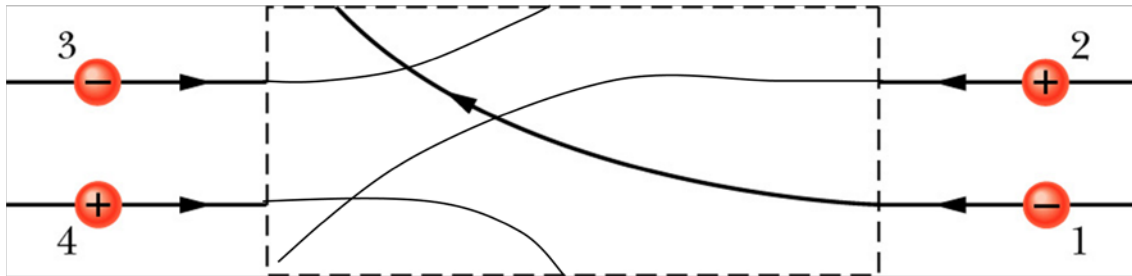
$$= \frac{9 \times 10^9 \times 1.6 \times 10^{-19}}{(2.4 \times 10^{-9})^2} \times 3 \hat{i}$$

$$= 7.5 \times 10^8 \hat{i} \text{ N/C}$$

$$\begin{aligned} \vec{F}_P &= q\vec{E} = -1.6 \times 10^{-19} \vec{E} \\ &= -1.6 \times 10^{-19} \times 7.5 \times 10^8 \hat{i} \\ &= -12 \times 10^{-11} \hat{i} \text{ N} \end{aligned}$$

3) (5 Points)

The figure shows the path of negatively charged particle 1 through a rectangular region of uniform electric field; the particle is deflected towards the top of the page.



Is the field directed

- A. leftward
- B. rightward
- C. upward or
- ☒ D. downward?

Three other charged particles are shown approaching the region of electric field.

Which are deflected towards the top and which towards the bottom?