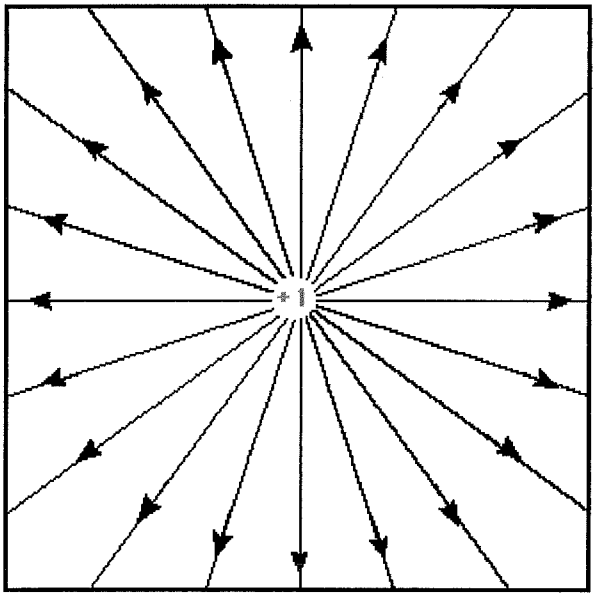
Physics 12
Section 16-7
The Electric Field

1. A field is defined as an area of influence.

2. Electric charges have electric fields around them.



3. Electric fields are studied by using a small positive test charge, q.

4. The strength of the electric field can be determined by:

$$E = F/q$$

F = force (N) on the charge q

q = the small test charge (C)

5. The electric field at any point in space can be determined by the following:

$$E = F/q$$

Substituting in for F

$$F = \frac{kqQ}{r^2}$$

This is Coulomb's Law, the force on the charges q and Q

$$E = \frac{kqQ}{q\ r^2}$$

or

$$E = kQ/r^2$$

Example 16-6 page 487: Calculate the magnitude and direction of the electric field at a point P which is 30cm to the right of a point charge Q = -3.0 x 10-6C

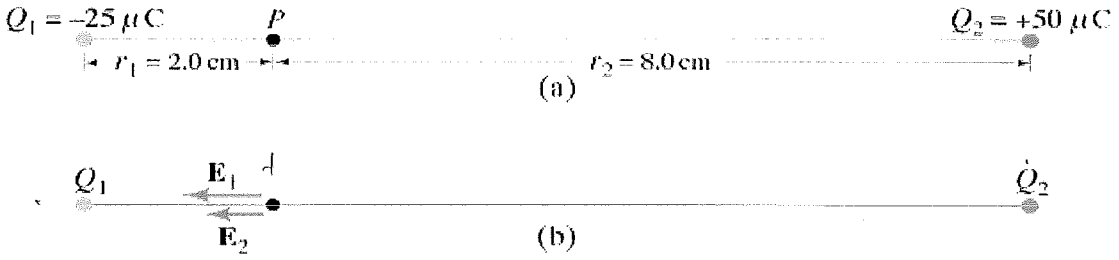
$$E = kQ/r^2$$

$$E = \frac{(9.0 \times 10^9 NM/C^2)(3.0 \times 10^{-6} C)}{(0.30m)^2}$$

$3.0 \times 10^5 N/C$

Note the sign is positive since a positive test charge is attracted to the negative charge.

Example 16-7 page 488: Two point charges are separated by a distance of 10.0cm. One has a charge of -25uC and the other +50uC. What is the direction and magnitude of the electric field at a point P in between them, that is 2.0cm from the negative charge? If an electron is placed at point P, what will its acceleration be initially?



$E = \frac{KQ}{r^2}$ $\quad E_1 = \frac{KQ_1}{(.02m)^2} = \frac{9.0\times10^9 \frac{N\cdot m^2}{C^2} \times 25\times10^{-6}C}{(0.02)^2} = 5.6\times10^8 \frac{N}{C}$

$E_2 = \frac{KQ_2}{(0.08m)^2} = \frac{9.0\times10^9 \frac{N\cdot m^2}{C^2} \times 50\times10^{-6}C}{(0.08m)^2} = 7.0\times10^7 \frac{N}{C}$

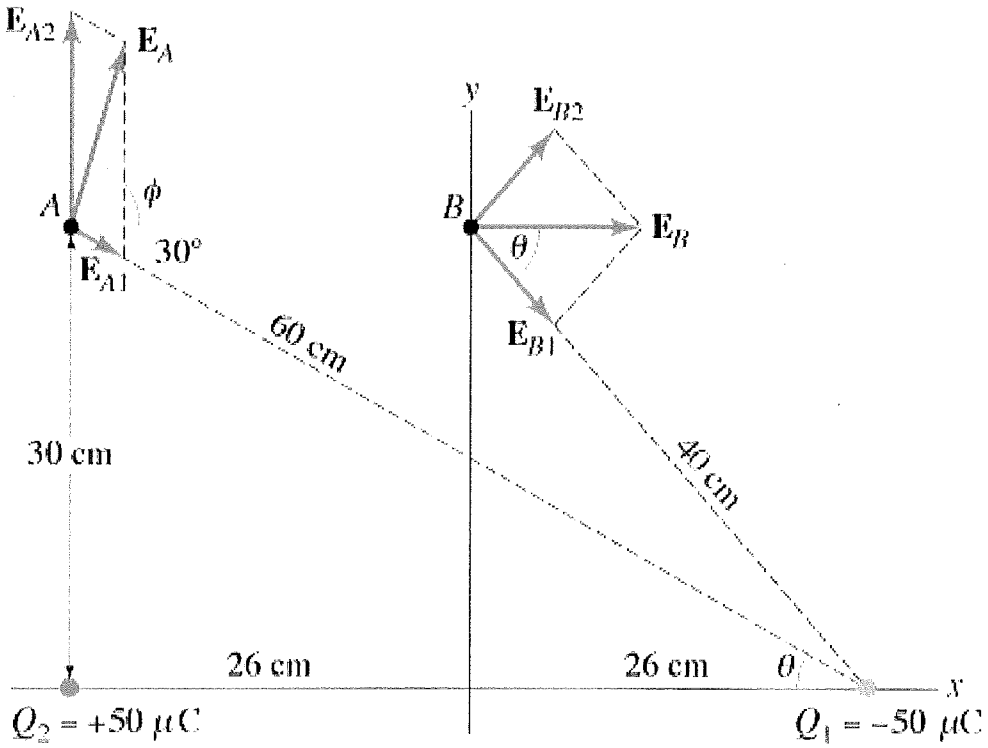
$E_1 + E_2 = 5.6\times10^8 + 7.0\times10^7 = 6.3\times10^8 N/C$

$E = \frac{F}{Q}$ $\quad F = EQ$ $\quad ma = EQ$ $\quad a = \frac{EQ}{m}$

$= \frac{6.3\times10^8 N/C \times 1.6\times10^{-19}C}{9.11\times10^{-31}kg} = 1.1\times10^{20} m/s^2$

E is a vector

Example 16-8 page 489: Calculate the total electric field at point A and at point B due to both charges Q_1 and Q_2.



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