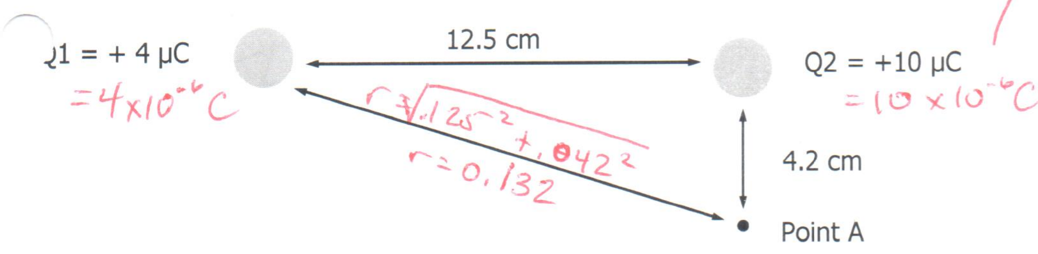
$k = 9E9\ Nm^2/C^2$

Test Review—Electrostatics

Name *Key*



1. What is the magnitude of the electric force between Q1 and Q2 in the diagram above?

$r = 0.125$ m
$Q_1 = 4E{-6}$ C
$Q_2 = 10\times10^{-6}$ C

$F_e = k\frac{Q_1 Q_2}{r^2} = \frac{(9E9)(4E{-6})(10E{-6})}{(0.125)^2}$

23.04 N

2. What is the magnitude of the E-field due to **Q1** at **Point A**?

$E = \frac{kQ}{r^2} = \frac{(9E9)(4E{-6})}{(0.132)^2}$

2.07E6 N/C

3. What is the electric potential at **Point A**?

$V = \frac{kQ_1}{r_1} + \frac{kQ_2}{r_2} = (9E9)\left(\frac{4E{-6}}{0.132} + \frac{10E{-6}}{0.042}\right)$

2.42E6 V

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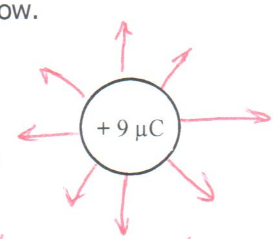
4. Draw the E-field around the charge shown below.



I'm not counting arrows – know that positive charges have arrows drawn from center out, and negative charges are drawn with arrows towards the center.

Note that a larger value charge should have more arrows relative to a weaker charge.

5. A charge of –4 μC exerts an attractive force of 4.20 E 3 N on a second charge that is 35 mm away. What is the magnitude of the second charge?

⊖ $-4E{-6}$ C F_e ← ⊕

$r = 0.035$ m

$F_e = \frac{kQ_1Q_2}{r^2}$

$F_e = \frac{(9E9)(-4E{-6})Q_2}{(0.035)^2} = 4.20E3$

$Q_2 = \frac{(4.20E3)(0.035)^2}{(9E9)(-4E{-6})}$

Note: the value in the calculator comes out negative – it is a positive charge

1.43E-4 C

q electron = -1.6×10^{-19} C

6. At a certain location around a charged particle there is a force of 1.81 E –15 N acting on a magnesium nucleus (Atomic number 12). What is the magnitude of the E-field at that location?

+12e

$Q = (12)(+1.6 \times 10^{-19})$

$Q = 1.92E{-18}$

Q_1 ○ $Q_2 = 1.92E{-18}$C ⊕

$F = 1.81E{-15}$N

$E = \frac{F}{Q} = \frac{1.81E{-15}\text{N}}{1.92E{-18}\text{C}}$

942 N/C

7. What is the electric potential at a point 70 μm from a boron nucleus (Atomic number 5)?

$Q = (5)(1.6E{-19})$

$r = 70E{-6}$ m

$V = \frac{kQ}{r} = \frac{(9E9)(5)(1.6E{-19})}{(70E{-6})}$

1.03E-4 V

8. How close can a proton moving at 1.4 E 7 m / s get to a stationary 45 μC charge before coming to a stop?

$q = 1.6 \times 10^{-19}$ C

$v = 1.4 \times 10^{7}$ m/s

$m = 1.67 \times 10^{-27}$ kg

$q = 45 \times 10^{-6}$ C

$KE = PE_e$

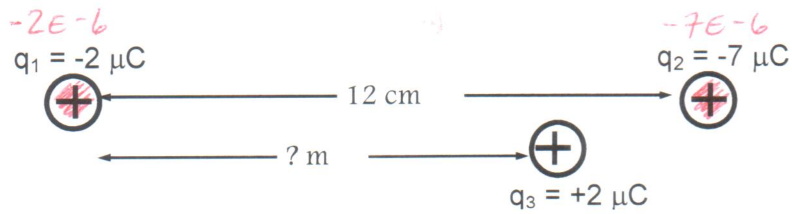
$\frac{1}{2}mv^2 = \frac{kQ_1Q_2}{r}$

$\left(\frac{1}{2}\right)(1.67E{-27})(1.4E7)^2 = \frac{(9E9)(1.6E{-19})(45E{-6})}{r}$

0.396 m

9. Three point charges, q_1, q_2, and q_3 lie along the x-axis as shown in the picture below. How far from q_1 would q_3 need to be placed in order for it to feel no resultant electric force?

$F_{1,3} = \frac{kQ_1Q_3}{r^2}$ → equals → $F_{2,3} = \frac{kQ_2Q_3}{r^2}$



$\frac{kQ_1Q_3}{r_{13}^2} = \frac{kQ_2Q_3}{r_{23}^2}$ $\quad \frac{Q_1}{(r_{13})^2} = \frac{Q_2}{(r_{23})^2}$

$\frac{(-2E{-6})}{x^2} = \frac{(-7E{-6})}{(0.12-x)^2}$

$(+7E{-6})x^2 = (+2E{-6})(0.0144 - 0.24x + x^2)$

$(7E{-6})x^2 = (2.88E{-8}) - (4.8E{-7})(x) + (2E{-6})(x^2)$

$0 = (2.88E{-8}) - (4.8E{-7})(x) - (5E{-6})(x^2)$

Quad form → 0.44 m

Part of the test will be multiple choice part problem solving. You also need to review your notes and the online notes as there will be a number of conceptual problems.