Thewalt, Jenifer **section 1**

SFU Department of Physics

phys102p – Spring 2004 – Assignment 2
Due Thr, Jan 15, 2004 at 23:59hrs. CAPA ID is **8824**

---

1. [1 pt.] Two point-like particles are placed 39.3cm apart and are given equal and opposite charge. The first particle, of mass 10.3g, has an initial acceleration of 6.05m/s^2 towards the second particle. What is the mass of the second particle if its initial acceleration towards the first is 6.90m/s^2? 9.03 [8.94,9.12] g

2. [1 pt.] What is the magnitude of the charge on each particle? 1.03×10^{-6} [1.02×10^{-6},1.05×10^{-6}] C

3. [1 pt.] What is the initial magnitude of the electric field midway between the two particles? 4.82×10^5 [4.77×10^5,4.87×10^5] N/C

---

4. [2 pt.] Two charges q_1=+5.20nC and q_2=-2.70nC are fixed to a baseline at x_1=0.00m and x_2=+1.00m, respectively. Where on the baseline (relative to x_1) should a third charge of q_3=+0.90nC be placed if it is to experience zero net electrical force? 3.58 [3.54,3.61] m

---

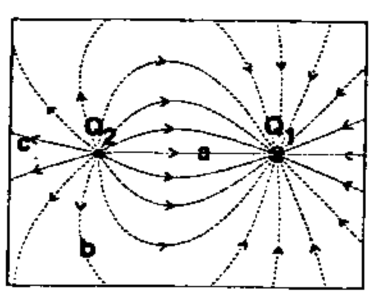
5. [1 pt.] Which of the following statements for electric field lines are true? (Choose all correct answers ex. ABD, CDF).

A) E-field lines do not begin or end in a charge free region (except at "infinity").
B) E-field points inward toward – charges.
C) E-field lines may cross.
D) E-field points outward from + charges.
E) E-field circles clockwise around + charges.
F) A point charge q, released from rest will initially move along an E-field line.
G) E-field circles clockwise around – charges.

ABDF

---

6. [1 pt.] The figure shows the E-field in the plane of two point charges. Give all correct answers in alphabetical order, for example, if A, B and D are correct then input ABD - no spaces, no commas.



A) A – charge placed at 'a' would move right.
B) Q1 is negative.
C) The magnitude of E is the same at 'a' and 'b'.
D) Q1 and Q2 have the same sign.
E) A + charge at 'c' would move left.
F) |Q1| is larger than|Q2|

BEF

---

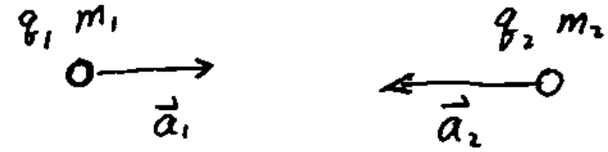
7. [1 pt.] Positive point-charges of +34.0μC are fixed at two of the vertices of an equilateral triangle with sides of 2.20m, located in vacuum. Determine the magnitude of the E-field at the third vertex. 1.09×10^5 [1.08×10^5,1.10×10^5] N/C

8. [1 pt.] Redo the last problem, this time with charges of +34.0μC and -34.0μC at either end of the baseline (creating the field at the remaining vertex). 6.31×10^4 [6.25×10^4,6.38×10^4] N/C

Physics 102.

CAPA set #2 Solutions.

1.



$q_1 =$

$-q_2 = q_1$

$m_1 = 10.3\,g$

$m_2 =$

$r = 39.3\text{ cm} = 0.393\text{ m}.$

$$F_{12} = F_{21} = m_1 a_1 = m_2 a_2 .$$

$$m_2 = \frac{m_1 a_1}{a_2} = \frac{1.03\times10^{-2}\times 6.05}{6.90} = 9.03\times10^{-3}\,\text{Kg} = 9.03\,g .$$

2.

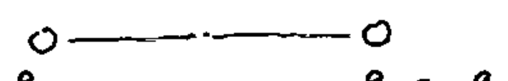
$$F_{12} = m_1 a_1 = \frac{K q_1 q_2}{r^2} = \frac{K q^2}{r^2}$$

$$q^2 = \frac{m_1 a_1 r^2}{K}$$

$$q = r\sqrt{\frac{m_1 a_1}{K}} = 0.393\sqrt{\frac{0.0103\times 6.05}{8.99\times10^9}} = 1.03\times10^{-6}\,C.$$

3.

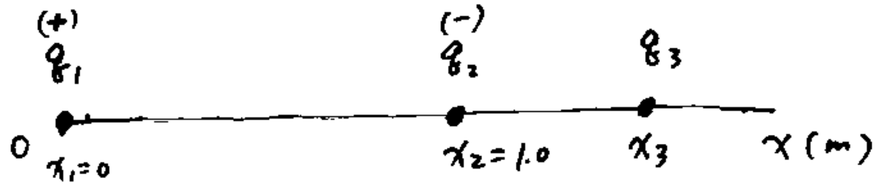
$$E = \frac{K\,2q}{(r/2)^2}$$



$$= \frac{8.99\times10^9\times2\times1.03\times10^{-6}}{\left(\frac{0.393}{2}\right)^2}$$

$$= 4.80\times10^5\ N/C .$$

4.



The field at x_3 : $\left|\vec{E}_3\right| = E_3 = \dfrac{k q_1}{x_3^2} - \dfrac{k|q_2|}{(x_3 - x_2)^2}$

when q_3 experiences a zero net force,

$$E_3 = 0 \ : \quad \frac{k q_1}{x_3^2} - \frac{k|q_2|}{(x_3 - x_2)^2} = 0 .$$

$$\left(\frac{x_3 - x_2}{x_3}\right)^2 = \frac{|q_2|}{q_1}$$

$$\left(1 - \frac{x_2}{x_3}\right)^2 = \frac{|q_2|}{q_1}$$

$$1 - \frac{x_2}{x_3} = \pm\sqrt{\frac{|q_2|}{q_1}}$$

$$\frac{x_2}{x_3} = 1 \pm \sqrt{0.519} .$$

$$\frac{|q_2|}{q_1} = \frac{2.70\ \text{nC}}{5.20\ \text{nC}} = 0.519$$

$$x_3 = \frac{x_2}{1 + \sqrt{0.519}} = \frac{1.0}{1.720} = 0.581\ \text{m} .$$

Impossible ∵ both q_1 and q_2 will exert a force on q_3 to the right !

OR

$$x_3 = \frac{x_2}{1 - \sqrt{0.519}} = \frac{1.0}{0.279} = 3.58\ \text{m}$$

5. $\vec{E}$-lines begin at $+q$ OR ∞, end at $-q$ OR ∞.

✓ A ∴ $\vec{E}$-lines do not begin in a finite ~~[illegible]~~ charge-free region.

✓ B ∴ $\vec{E}$ field points toward negative charge.

× C $\vec{E}$-lines don't cross. ∵ at any point, the $\vec{E}$ field force on a given charge is ~~[illegible]~~ unique. crossing means there two directions of the force at one point which is not true.

✓ D. $\vec{E}$-lines start from $+q$ OR ∞.

× E. " " " " "

✓ F. $\vec{F} = q\vec{E}$

× G ~~[illegible]~~ $\vec{E}$-lines start and stop at charges.

---

6. BEF.

× A. $\vec{F} = q\vec{E}$. $\vec{E}$ is to the right, but q is negative ∴ $\vec{F}$ is to the left.

✓ B. $\vec{E}$-lines end at Q_1. ⇒ Q_1 is negative.

× C. $\vec{E}$-lines are denser at a than at b. ∴ E is stronger at a.

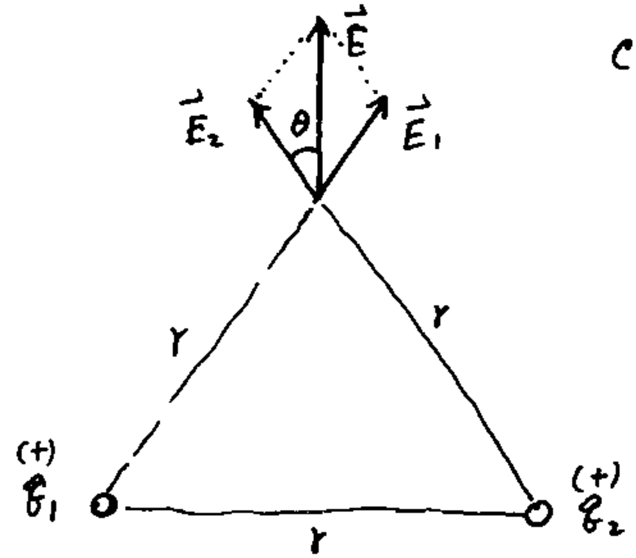
× D $\vec{E}$-lines start from Q_2 but end at Q_1. ∴ $Q_1 = (-)$, $Q_2 = (+)$

✓ E. $\vec{F} = q\vec{E}$.

✓ F. $\vec{E}$-lines are denser near Q_1.

7. $q_1 = q_2 = 34.0\ \mu C$.

$r = 2.20\ m$.



$\vec{E} = \vec{E_1} + \vec{E_2}$

$E = E_1 \cos\theta + E_2 \cos\theta$

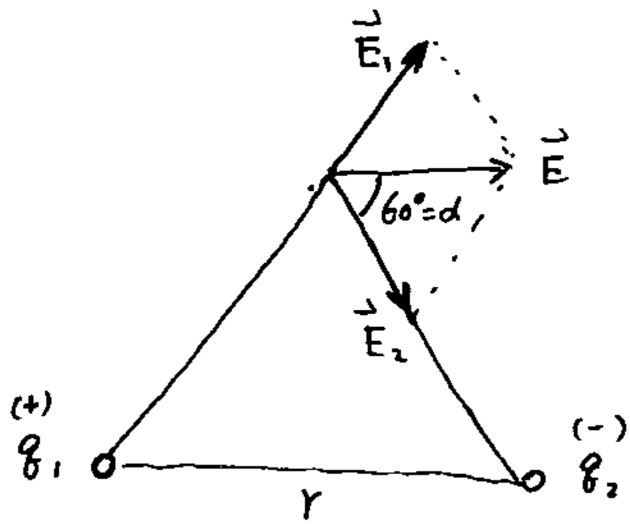
$= 2E_1 \cos\theta$

$= 2 \cdot \frac{K q_1}{r^2} \cos 30°$

$= 2 \times \frac{8.99 \times 10^9 \times 3.4 \times 10^{-5}}{(2.20)^2} \cdot \cos 30° = 1.09 \times 10^5\ N/C$.

8. Now $q_1 = 34.0\ \mu C$

$q_2 = -34.0\ \mu C$.



$\vec{E} = \vec{E_1} + \vec{E_2}$

$|\vec{E}| = E_1 \cos\alpha + E_2 \cos\alpha$

$= 2E_1 \cos\alpha$.

$= 2 \frac{K q_1}{r^2} \cdot \cos 60°$

$= 6.32 \times 10^4\ N/C$.