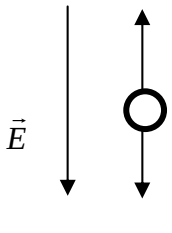
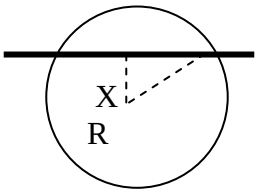
# Solution for Test 1, PHYCS 102 dated 24/10/00

**1a**. 

**( i)** $\vec{E}$ downwards

qE = mg ; q = 9.8 μc




**b. i.** $\Phi = 0$, **ii.** $\Phi = \dfrac{2\lambda\sqrt{x^2+R^2}}{\varepsilon_o}$, **iii.** $\Phi = \dfrac{2\lambda R}{\varepsilon_o}$

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**2a.** $F = K\dfrac{q_1\, q_2}{(0.3)^2} = 10.8\ \mu N$

**b.** $E_1 = K\dfrac{q_1}{(0.5)^2} = 216\ N/C$

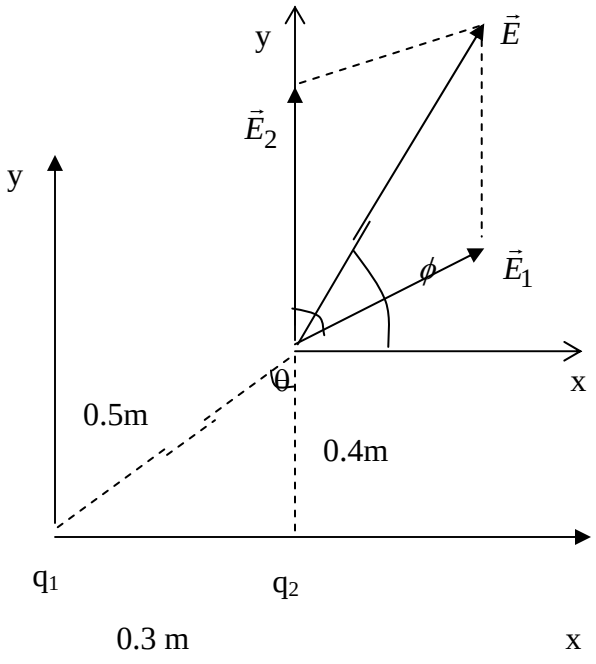
$E_2 = K\dfrac{q_2}{(0.4)^2} = 1012.5\ N/C$

$\sum E_x = E_1\ Sin\,\theta = 129.6\ N/C$

$\sum E_y = E_1 \cos\theta + E_2 = 1185.3\ N/C$

$E = \left[(\sum E_x)^2 + (\sum E_y)^2\right]^{1/2} = 1192.36\ N/C$

$\tan\phi = \sum E_y / \sum E_x = 9.14$, $\phi = 83.7^o$




**c.** $V = K\dfrac{q_1}{(0.5)} + K\dfrac{q_2}{(0.4)} = 513\,V$

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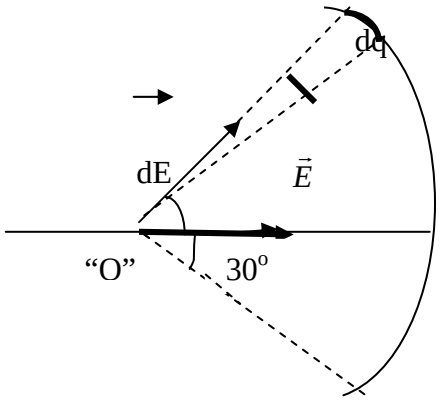
**3.** $dE = K\dfrac{\lambda R d\theta}{R^2}$, $E = \int dE\cos\theta$

$E = \dfrac{K\lambda}{R}\, 2\int_o^{30^o} Cos\ \theta\ d\theta = \dfrac{2K\ \lambda\ Sin\ 30^o}{R}$

$L = R\,\theta = 5\left(60^o\,\dfrac{\pi}{180}\right) = 5.23\ cm \rightarrow E = \dfrac{3KQ}{\pi R^2}$



$$E = \frac{2K\theta \; Sin\, 30^{o}}{L.\,R} = 3.09 \; x\, 10^{7} \text{ N/C}$$ R

**4a.** $E_1 = 0$

$\int E_2 dA \cos\theta = Q/\varepsilon_o$ , $E_2 = KQ/r^2$

$E_3 = 0$

$\int E_4 d\ A \cos\theta = Q/\varepsilon_o$ , $E_2 = K\ (Q - Q + Q/r^2 = K\ /Q\ /r^2$ )

**b.** inner: charge = - Q, $\sigma$ = -Q/4 $\pi$ $a^2$

outer: charge = + Q, $\sigma$ = + Q/4 $\pi$ $b^2$