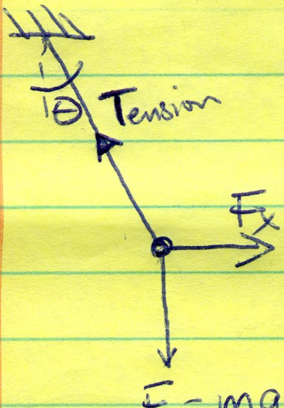
1)



$$F_x = \frac{K|q_1||q_2|}{r^2}$$

$$F_y = mg$$

$$F_x = \frac{\left(8.99\times10^9 \frac{Nm^2}{C^2}\right)(0.6\times10^{-6}C)(0.9\times10^{-6}C)}{(0.15m)^2}$$

$$\boxed{F_x = 0.216N}$$

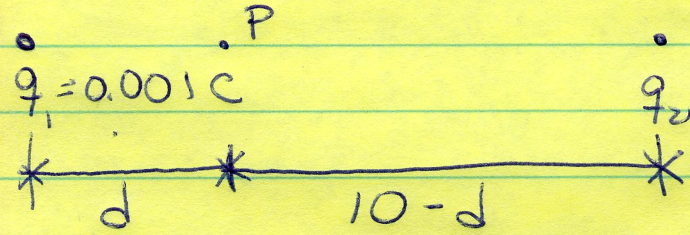
$$F_y = (0.08\,kg)(9.81\,m/s^2) = 0.785N$$

$$\boxed{F_y = 0.785N}$$

$$T = \sqrt{(0.216)^2 + (0.785)^2} \qquad \boxed{T = 0.814N} \checkmark$$

$$\tan\theta = \frac{F_x}{F_y} \qquad \theta = \tan^{-1}\left(\frac{0.216}{0.785}\right) \qquad \boxed{\theta = 15.4^\circ} \checkmark$$

2) $E = \frac{Kq}{r^2}$



the net electric field is zero when

$$\frac{Kq_1}{d^2} = \frac{Kq_2}{(10-d)^2}$$

$$\frac{0.001}{d^2} = \frac{0.003}{(10-d)^2}$$

$$(10-d)^2 = \frac{0.003}{0.001}d^2$$

$$100 - 20d + d^2 = 3d^2$$

$$0 = 2d^2 + 20d - 100$$

$$0 = d^2 + 10d - 50$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-10 \pm \sqrt{10^2 - 4(1)(-50)}}{2(1)}$$

$$x = \frac{-10 \pm \sqrt{300}}{2}$$

$$\boxed{x_1 = 3.66m} \checkmark \qquad x_2 = ~~-13.66m~~$$

SOLUTION 1

3) $P = IV$

$I = P/V$

$I = \frac{60W}{12V}$

$I = 5A$

$\text{current} = \frac{\text{charge}}{\text{time}}$

$\text{charge} = (\text{current})(\text{time})$

$q = (5A)(3600 \text{ seconds})$

$q = 18{,}000\ C$

SOLUTION 2

$\text{Power} = \frac{\text{Energy}}{\text{time}}$

$\text{Energy} = (\text{Power})(\text{time})$

$\text{Energy} = (60\ W)(3600 \text{ seconds})$

$\text{Energy} = 2.2 \times 10^{5}\ J$

$\text{Energy} = qV$

$q = \frac{\text{Energy}}{V} = \frac{2.2 \times 10^{5}\ J}{12\ V}$

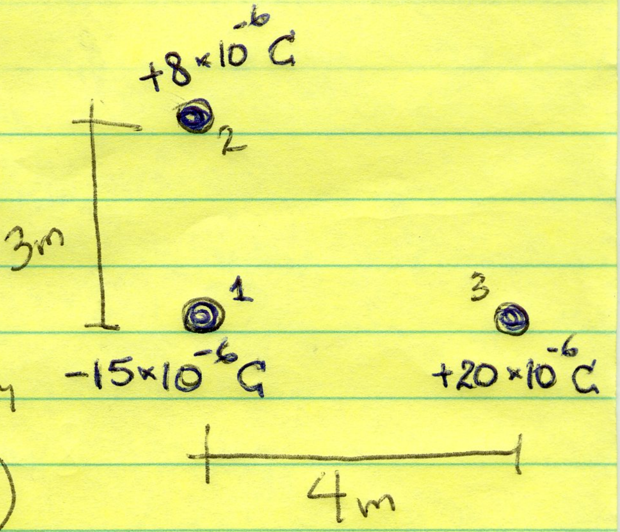
$q = 18{,}000\ C$

the charge of an electron $= 1.6 \times 10^{-19}\ C$

$\#e^- = 18{,}000\ C \left(\frac{1 \text{ electron}}{1.6 \times 10^{-19}\ C}\right) = \boxed{1.1 \times 10^{23} \text{ electrons}}$

$V = K\frac{q}{r}$

4) $W = EPE = qV$



move charge #1 → no energy required

↳ the voltage produced by other 2 charges = 0 ↓ far away

$EPE_1 = 0$

voltage in point 2

$$V_2 = \frac{Kq_1}{r_{12}} = \frac{(8.99\times10^{9})(-15\times10^{-6})}{3}$$

$V = -44950$ Volts

when charge #2 is placed

$$EPE_2 = q_2V_2 = (8\times10^{-6})(-44950) = \boxed{-0.36\,J}$$

in corner

#3 → V_3 = sum of potentials due to the other 2 charges already in place

$$V_3 = \frac{Kq_1}{r_{13}} + \frac{Kq_2}{r_{23}} = 19500 \text{ Volts}$$

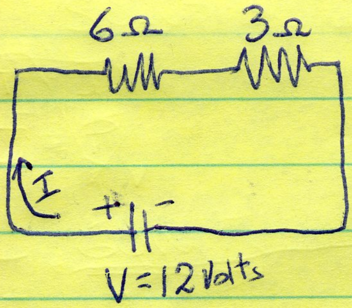
$$EPE_3 = q_3V_3 = q_3\left(\frac{Kq_1}{r_{13}} + \frac{Kq_2}{r_{23}}\right)$$

$$EPE_3 = (20\times10^{-6})(8.99\times10^{9})\left(\frac{-15\times10^{-6}}{4} + \frac{8\times10^{-6}}{5}\right) = \boxed{-0.39\,J}$$

Total Potential Energy = 0 − .36 J − 0.39 J

$$\boxed{= -0.75\,J}$$

5)



equivalent resistance $R_S = 6\Omega + 3\Omega = 9\Omega$

$V = IR$

a) $I = V/R \quad I = \frac{12V}{9\Omega}$ current $\boxed{I = 1.33A}$

b) $P = IV \quad V = IR$

$\downarrow$

$P = I^2R$

in 6Ω $\quad P_1 = (1.33A)^2(6\Omega) = \boxed{10.6 \text{ watts}}$

in 3Ω $\quad P_2 = (1.33A)^2(3\Omega) = \boxed{5.3 \text{ watts}}$

total Power $= P_1 + P_2 = \boxed{15.9 \text{ watts}}$

or $P_T = (1.33A)^2(9\Omega) = \boxed{15.9 \text{ watts}}$