19)

Force that the electron experiences -- always in the opposite direction of the electric field because an electron is NEGATIVE

Electric Field -- generated by some other charge(s); it always points in the direction of a force that would act on a POSITIVE charge.

$$\vec{E} = \frac{\vec{F}}{q} = \frac{8.0 \times 10^{-16}}{1.6 \times 10^{-19}} = \boxed{5000\ N/C}$$

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

$F = 8.0 \times 10^{-16}\ N$

The E-Field points in the opposite direction as the force acting on the electron.

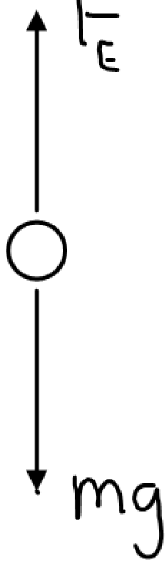
21) $$E_{\text{DUE TO POINT CHARGE } Q} = \frac{F}{q} = \frac{\frac{kQ\cancel{q}}{r^2}}{\cancel{q}} = \frac{kQ}{r^2}$$

HERE, q WOULD BE A SMALL CHARGE BEING PUSHED/PULLED BY Q IF IT EXISTED.

$$E = \frac{kQ}{r^2} = \left(9\times10^{9}\right)\frac{\text{N}\cdot\cancel{\text{m}^2}}{\cancel{\text{C}^2}}\,\frac{\left(13.0\times10^{-6}\right)\cancel{\text{C}}}{12^2\ \cancel{\text{m}^2}} = \boxed{813\ \text{N/C}}$$

POINTED UPWARD BECAUSE A $+q$ WOULD BE REPELLED BY Q WHICH IS POSITIVE AS WELL.

23)



$$E = \frac{F_E}{q} \Rightarrow F_E = Eq$$

$$\Sigma F = m\cancel{a}^{\,0} = 0$$

$$F_E - mg = 0$$

$$Eq - mg = 0$$

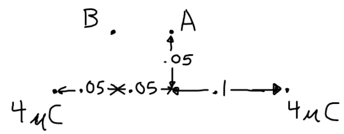
$$Eq = mg$$

$$E = \frac{mg}{q} = \frac{(1.67\times10^{-27})(9.8)}{1.6\times10^{-19}} = \boxed{1.023\times10^{-7}\ \text{N/C}}$$

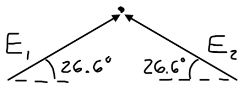
It's a proton so the E-field must be pointed up.

25) In general, when you wish to find the net electric field at a given point in space due to multiple Q's, draw a simple diagram similar to a FBD only you will be showing E-fields with arrows instead of showing forces. You will find the net E-fields as you would find net forces, breaking E-fields into x and y-components when necessary and addinig appropriately.

$E_{\text{POINT CHARGE}} = \frac{kQ}{r^2}$



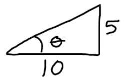
@ A:



$E_1 = E_2 = \frac{kQ}{r^2}$

$= \frac{(9\times10^9)(4\times10^{-6})}{(\sqrt{.1^2+.05^2})^2}$

$= 2.88\times10^6$ N/C



$\tan\theta = \frac{5}{10}$

$\theta = \tan^{-1}(\frac{5}{10}) = 26.6°$

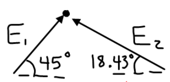
$\Sigma E_x = 0$ (X-COMPONENTS WILL CANCEL).

$\Sigma E_y = E_1 \sin 26.6° + E_2 \sin 26.6°$

$= 2.88\times10^6 \sin 26.6 + 2.88\times10^6 \sin 26.6 = \boxed{2.58\times10^6 \text{ N/C}}$

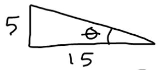
STRAIGHT UP, IN + Y DIRECTION

@ B:



$E_1 = \frac{kQ}{r^2} = \frac{(9\times10^9)(4\times10^{-6})}{(\sqrt{.15^2+.05^2})^2} = 1.44\times10^6$ N/C

$E_2 = \frac{kQ}{r^2} = \frac{(9\times10^9)(4\times10^{-6})}{(\sqrt{.05^2+.05^2})^2} = 7.2\times10^6$ N/C

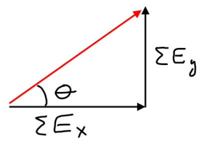


$\tan\theta = \frac{5}{15}$

$\theta = \tan^{-1}(\frac{5}{15}) = 18.43°$

$\Sigma E_x = E_2 \cos 45° - E_1 \cos 18.43° = 3.73\times10^6$ N/C

$\Sigma E_y = E_2 \sin 45° + E_1 \sin 18.43° = 5.55\times10^6$ N/C



$E = \sqrt{(3.73\times10^6)^2 + (5.55\times10^6)^2}$

$= \boxed{6.69\times10^6 \text{ N/C}}$

$\theta = \tan^{-1}\left(\frac{\Sigma E_y}{\Sigma E_x}\right) = \boxed{56.1° \text{ AS SHOWN}}$

30) $\circ \longrightarrow F_E$

$$\Sigma F = ma$$

$$F_E = ma$$

$$Eq = ma$$

$$\frac{Eq}{m} = a = \frac{(2200\ \text{N/C})(1.6\times10^{-19}\ \text{C})}{9.11\times10^{-31}\ \text{kg}} = \boxed{3.86\times10^{14}\ \text{m/s}^2}$$

Note: this acceleration rate will not be sustained -- it would quickly reach and exceed the speed of light which is not possible. As its speed increases, its mass will be measured to increase as well reducing its acceleration and preventing its speed from exceeding the speed of light.

It will be accelerating in the opposite direction as the E-field since the electron has a negative charge