Millikan's Experiment

① $q = \pm Ne$

$8 \times 10^{-8} = N(1.6 \times 10^{-19})$

$N = \boxed{5.0 \times 10^{11}}$

② $q = \pm Ne$

$= +(10^8)(1.6 \times 10^{-19})$

$q = +1.6 \times 10^{-11}\ C$

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

$= \frac{(9 \times 10^9)(1.6 \times 10^{-11})(1.6 \times 10^{-11})}{(1)^2}$

$F_e = \boxed{2.3 \times 10^{-12}\ N}$

③ a) gravity, air resistance

b) they are equal ($\Sigma F = 0$)

④ a) $F_g = F_e$

$1.9 \times 10^{-15} = q(6 \times 10^3)$

$q = \boxed{3.2 \times 10^{-19}\ C}$

b) $q = Ne$

$N = q/e = \frac{3.2 \times 10^{-19}}{1.6 \times 10^{-19}} = \boxed{2}$

⑤ a) $F_g = F_e$

$= qE$

$6.4 \times 10^{-13} = q(4 \times 10^6)$

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

b) $N = \frac{q}{e} = \frac{1.6 \times 10^{-19}}{1.6 \times 10^{-19}} = \boxed{1}$

⑥ $q = \pm Ne$

$= +4(1.6 \times 10^{-19})$

$= +6.4 \times 10^{-19}\ C$

$F_g = F_e$

$= qE$

$6.4 \times 10^{-13} = (6.4 \times 10^{-19})E$

$E = \boxed{1.0 \times 10^6\ N/C}$

⑦ $q = \pm Ne$

$= -(5 \times 10^9)(1.6 \times 10^{-19})$

$q = -8.0 \times 10^{-10}\ C$

$E = \frac{kq}{r^2}$

$= \frac{(9 \times 10^9)(-8 \times 10^{-10})}{(0.5)^2}$

$E = \boxed{-28.8\ N/C}$

Continues on next page

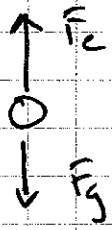
⑦ (continued)

$$V = \frac{kq}{r}$$

$$= \frac{(9\times10^{9})(-8\times10^{-10})}{(0.5)}$$

$$V = \boxed{-14.4\ V}$$

⑧ a)



$$F_e = qE$$

$$= q\frac{\Delta V}{d}$$

$$4.5\times10^{-15} = (6.4\times10^{-19})\frac{\Delta V}{0.05}$$

$$\Delta V = \boxed{351.6\ V}$$

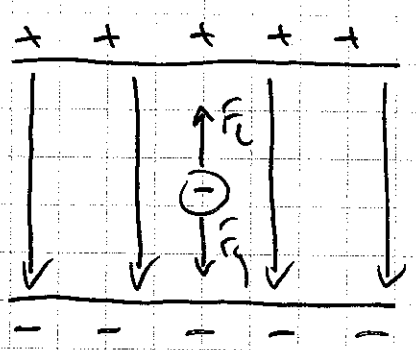
b) $F_g = F_e$

$$mg = F_e$$

$$m(9.8) = 4.5\times10^{-15}$$

$$m = \boxed{4.6\times10^{-16}\ kg}$$

⑨



charge must be negative since $\vec{F}_e$ and $\vec{E}$ are in opposite directions.

$F_e = F_g$

$qE = mg$

$q\frac{\Delta V}{d} = mg$

$q = \frac{mgd}{\Delta V}$

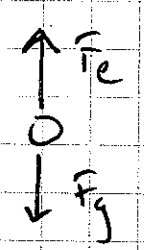
$= \frac{(4.95\times10^{-15})(9.8)(0.01)}{(510)}$

$q = -\boxed{9.5\times10^{-19}\ C}$

$N = -\frac{q}{e} = \frac{9.5\times10^{-19}}{1.6\times10^{-19}} = \boxed{6}$ (charge = 6e)

Since q is negative, it has $\boxed{\text{excess}}$ electrons.

(10)



$$F_e = F_g$$

$$qE = mg$$

$$q = \frac{mg}{E}$$

$$= \frac{(2\times10^{-15})(9.8)}{(100)}$$

$$q = \boxed{1.96\times10^{-16}\ C}$$

$$N = \frac{q}{e} = \frac{1.96\times10^{-16}}{1.6\times10^{-19}} = 1225$$

$$\therefore\ q = \boxed{1225\,e}$$