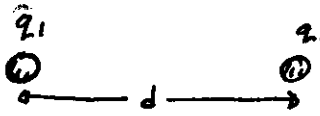
Problem 21-1



$F = k\frac{q_1 q_2}{d^2}$

$F \propto \frac{1}{d^2} \Rightarrow \frac{F_{at\ 6cm}}{F_{at\ 12cm}} = \frac{(12cm)^2}{(6cm)^2} = 4$

$\Rightarrow F_{at\ 12cm} = F_{at\ 6cm}/4 = \frac{20N}{4} = \boxed{5N = F}$

Problem 21-2 $F = k\frac{q_1 q_2}{d^2} = k\frac{q^2}{d^2}$, $q_1 = q_2 = q$, $6cm = .06m$

$\Rightarrow q^2 = \frac{Fd^2}{k} \Rightarrow q = \sqrt{\frac{Fd^2}{k}} = \sqrt{\frac{20 \times (.06)^2}{9 \times 10^9}}$

$\Rightarrow \boxed{q = 2.8 \times 10^{-5}\ Coulombs}$

Problem 21-5

Gravity: $F = G\frac{m_1 m_2}{d^2} = (6.67 \times 10^{-11})\frac{(1.67 \times 10^{-27})(9.1 \times 10^{-31})}{(10^{-10})^2}$

$= 1 \times 10^{-47} N$

Electric: $F = k\frac{q_1 q_2}{d^2} = (9 \times 10^9)\frac{(1.6 \times 10^{-19})(1.6 \times 10^{-19})}{(10^{-10})^2}$

$= 2.3 \times 10^{-8} N$

$F_{electric} / F_{grav} = 2.3 \times 10^{39}$!

Problem 22-2 Current = Voltage / Resistance : $I = V/R$

$\Rightarrow R = V/I \Rightarrow (120V)/20A = \boxed{60\ ohms = R}$

Problem 22-7 Power $\equiv P = VI = (110V)(9A) = 990$ Joules/sec

in one minute # Joules $= (990\ J/s) \times (60s) = \boxed{5.9 \times 10^4\ J}$

Problem 22-8 Current = # Coulombs / sec = I

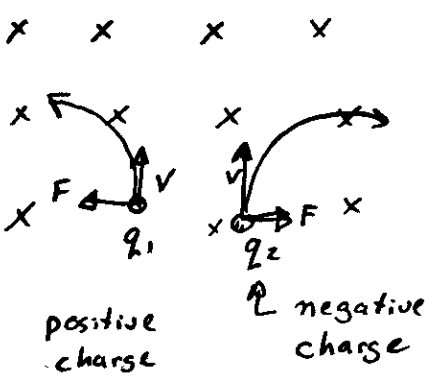
$\Rightarrow Q = \#\ Coulombs = It = (9amps)(1sec) = \boxed{9\ Coulombs = Q}$

Exercise 23-27 An electron at rest.

$\vec{B}$? (a) No. $F = q v_\perp \vec{B}$ if $v = 0$ $F = 0$

(b) yes $F = q\vec{E} = m\vec{a} \Rightarrow \vec{a} = q\vec{E}/m$

Exercise 23-30 The magnetic field $\vec{B}$ is into the paper

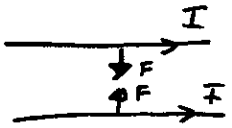


$F = q v_\perp B$

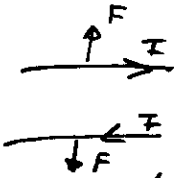
Direction by R.H. Rule

The particles have opposite charge

Exercise 23-40 Yes



attract



repel