11.5) USING $P = bk^l q^m a^n c^p$ AND DIMENSIONAL ANALYSIS, DERIVE

$$P = \frac{2kq^2a^2}{3c^3} \qquad (11.1)$$

LOOK AT UNITS:

$P = b k^l q^m a^n c^p$

- c — SPEED OF LIGHT $\sim \frac{m}{s}$
- a — ACCELERATION $\sim \frac{m}{s^2}$
- q — CHARGE $\sim$ C (COULOMBS)
- k — COULOMB CONSTANT $\sim \frac{N \cdot m^2}{C^2}$
- b — CONSTANT, NO UNITS

THUS

$$P = b\left(\frac{N \cdot m^2}{C^2}\right)^l (C)^m \left(\frac{m}{s^2}\right)^n \left(\frac{m}{s}\right)^p$$

$$P \sim N^l m^{2l+n+p} C^{-2l+m} s^{-2n-p}$$

POWER IS IN WATTS

$$\Rightarrow P \sim \frac{J}{s} \sim \frac{N \cdot m}{s} = N^1 m^1 s^{-1}$$

EQUATING THE POWER ON THE UNITS

$N:\ l = 1$

$m:\ 2l + n + p = 1 \Rightarrow 2 + n + p = 1 \Rightarrow n + p = -1$

$s:\ -2n - p = -1 \Rightarrow n + (n+p) = 1 \Rightarrow n = 2$

$\quad '' \Rightarrow 4 + p = 1 \Rightarrow p = -3$

$C:\ -2l + m = 0 \Rightarrow -2 + m = 0 \Rightarrow m = 2$

THUS

$$P = bk^l q^m a^n c^p = bkq^2a^2c^{-3} = \boxed{\frac{bkq^2a^2}{c^3} = P}$$

WHERE $b = \frac{2}{3}$ SO IT'S WITHIN A CONSTANT