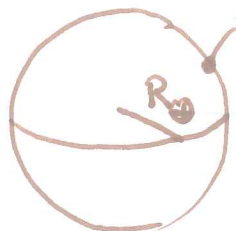


## TODAY IS JUST EXAMPLES.

WHAT IS THE CAPACITANCE OF THE EARTH (TO 1 SIGNIFICANT FIGURE)?



$$V = \frac{q}{4\pi\epsilon_0 R_{\oplus}} \Rightarrow C = \frac{q}{V} = 4\pi\epsilon_0 R_{\oplus}$$

$$\epsilon_0 = 9 \times 10^{-12} \text{ F/m}$$

$$R_{\oplus} = 6 \times 10^6 \text{ m}$$

$$4\pi = 12$$

$$C \approx 9 \cdot 6 \cdot 12 \times 10^{-6} \text{ F} = \boxed{600 \text{ } \mu\text{F}}$$

YOU CAN GET THAT AT DIGI-KEY FOR \$4.

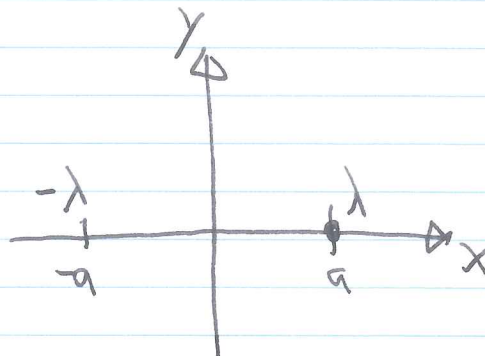
EXAMPLE

FIND THE EQUIPOTENTIAL SURFACES OF TWO PARALLEL LINE CHARGES.

$$V = \lambda \ln\left(\sqrt{(x-a)^2 + y^2}\right) - \lambda \ln\left(\sqrt{(x+a)^2 + y^2}\right)$$

(LEAVING OUT SOME CONSTANT FACTORS)

$$= \lambda \ln \left[ \frac{\sqrt{(x-a)^2 + y^2}}{\sqrt{(x+a)^2 + y^2}} \right]$$



EQUIPOTENTIALS MUST SATISFY THE EQUATION

$$\sqrt{(x-a)^2 + y^2} = C \sqrt{(x+a)^2 + y^2}$$

$$(1-C)x^2 - (1+C)2ax + (1-C)a^2 + (1-C)y^2 = 0$$

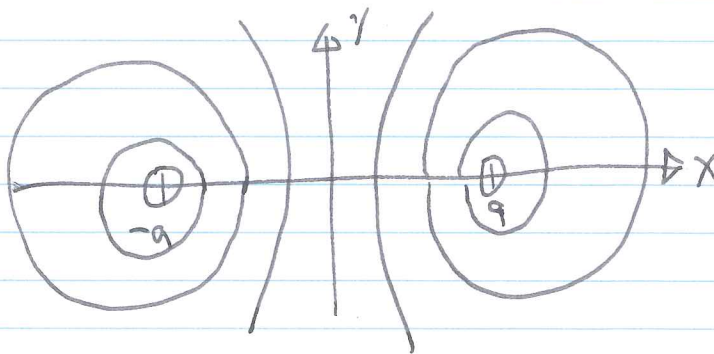
$$x^2 - 2ax \frac{(1+C)}{(1-C)} + a^2 + y^2 = 0$$

COMPLETE THE SQUARE!

$$\left[ x - a \frac{(1+C)}{(1-C)} \right]^2 - a^2 \frac{(1+C)^2}{(1-C)^2} + a^2 + y^2 = 0$$

THESE SURFACES ARE <sup>CIRCULAR</sup> CYLINDERS OF RADIUS  $R = a \sqrt{\frac{(1+C)^2}{(1-C)^2} - 1}$

CENTERED AT  $x = a \frac{(1+C)}{(1-C)}$ .



PERIODIC POTENTIALS CAN BE USEFUL IN PHYSICS FOR MODELING SOLID SYSTEMS SUCH AS CRYSTALS.

3

EXAMPLE

$$\text{LET } V = V_0 \cos(kx) \cos(ky) \cos(kz).$$

- (a) FIND THE CHARGE DISTRIBUTION.
- (b) FIND THE MEAN CONFIGURATIONAL ENERGY PER UNIT VOLUME (HINT: INTEGRATE OVER ONE PERIOD IN  $x$ ,  $y$ , AND  $z$ )