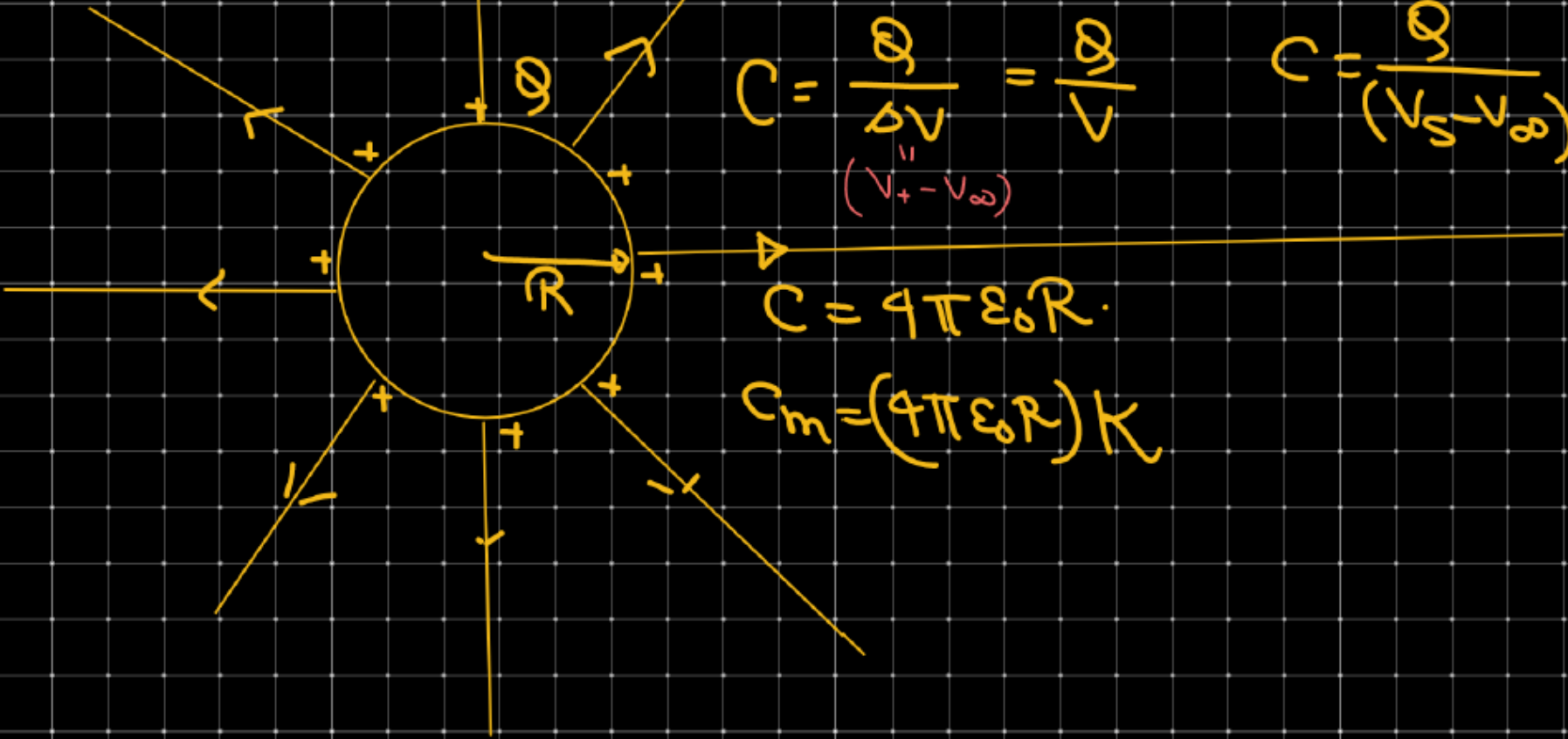
Capacitance of spherical capacitor:



$$C = \frac{Q}{\Delta V} = \frac{Q}{V}$$

$$(V_+ - V_\infty)$$

$$C = \frac{Q}{(V_S - V_\infty)}$$

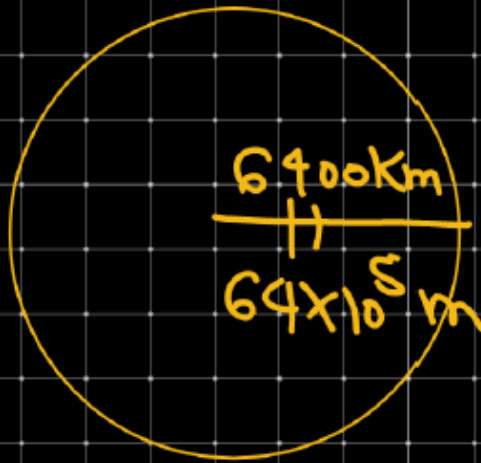
$$C = 4\pi\varepsilon_0 R$$

$$C_m = (4\pi\varepsilon_0 R)K$$

Q1: Capacitance of earth.

$$\frac{1}{4\pi\varepsilon_0} = 10^9 \times 9$$

$$4\pi\varepsilon_0 = \frac{1}{9\times10^9}$$



$$C = 4\pi\varepsilon_0 R$$

$$C = \frac{1}{9\times10^9} \times 6400\times10^3$$

$$C = \frac{64}{9}\times10^{-4}$$

$$C = 7.11\times10^{-4}\,C/Volt$$

$$C = 711\times10^{-6}\,F$$

$$\boxed{C = 711\,\mu F}$$

Capacitance of Concentric Spherical Sphere.

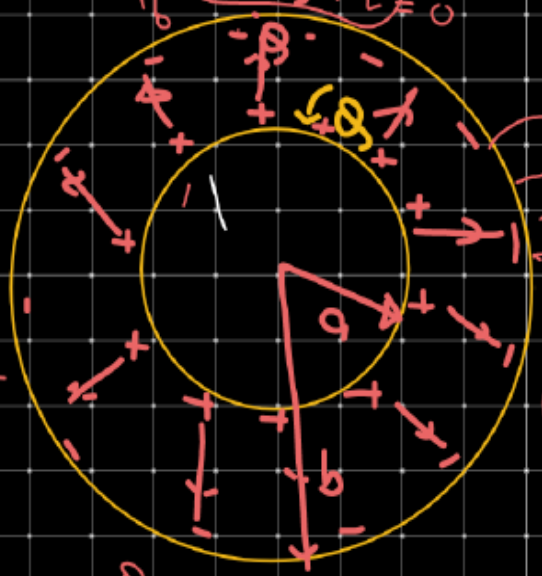
↳ Charge Q given to inner sphere.

↳ Second sphere is earthed

$$V_+ = \frac{KQ}{a} - \frac{Kq}{b}$$

$$V_- = \frac{KQ}{b} - \frac{Kq}{b}$$

$+Q+q=0$



Potential becomes zero

$$\frac{KQ}{b} - \frac{KQ}{b} + \frac{K(Q+q)}{b} = 0$$

$$q = -Q$$

$$C = \frac{Q}{\Delta V}$$

$$C = \frac{Q}{(V_+ - V_-)}$$

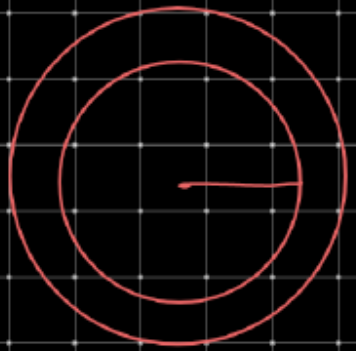
$$C = \frac{Q}{\left(\frac{KQ}{a} - \frac{KQ}{b}\right) - \left(\frac{KQ}{b} - \frac{KQ}{b}\right)}$$

$$= \frac{Q}{KQ\left(\frac{1}{a} - \frac{1}{b}\right)} = \frac{1}{K\left(\frac{b-a}{ab}\right)}$$

$$C = 4\pi\varepsilon_0 \left(\frac{ab}{b-a}\right)$$

$$C = \frac{4\pi\varepsilon_0 ab}{b-a}$$

Find the capacitance of spherical capacitor having inner & outer radii 1m & 1.001m respectively.



$a = 1m$

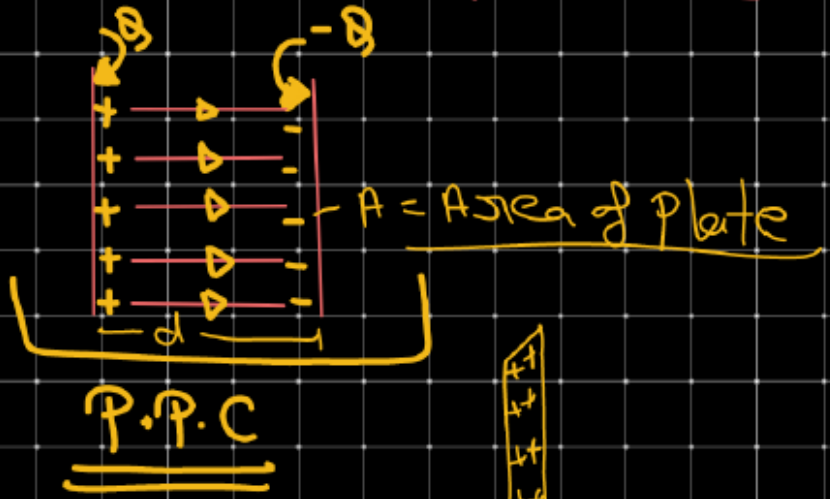
$b = 1.001m$

$$C = 4\pi\varepsilon_0\left(\frac{ab}{b-a}\right)$$

$$C = \frac{1}{9\times10^9}\left(\frac{1\times1.001}{0.001}\right)$$

$$C = 1.1\times10^{-7}F$$

Parallel plate capacitor:

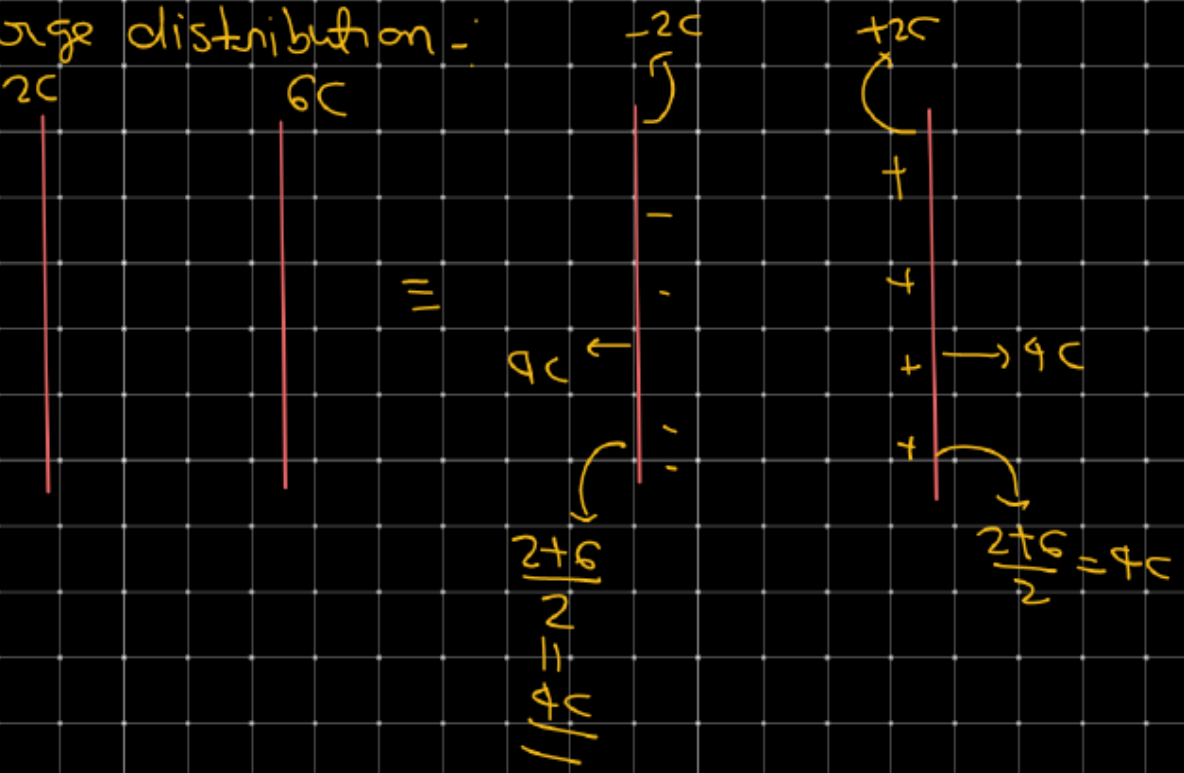


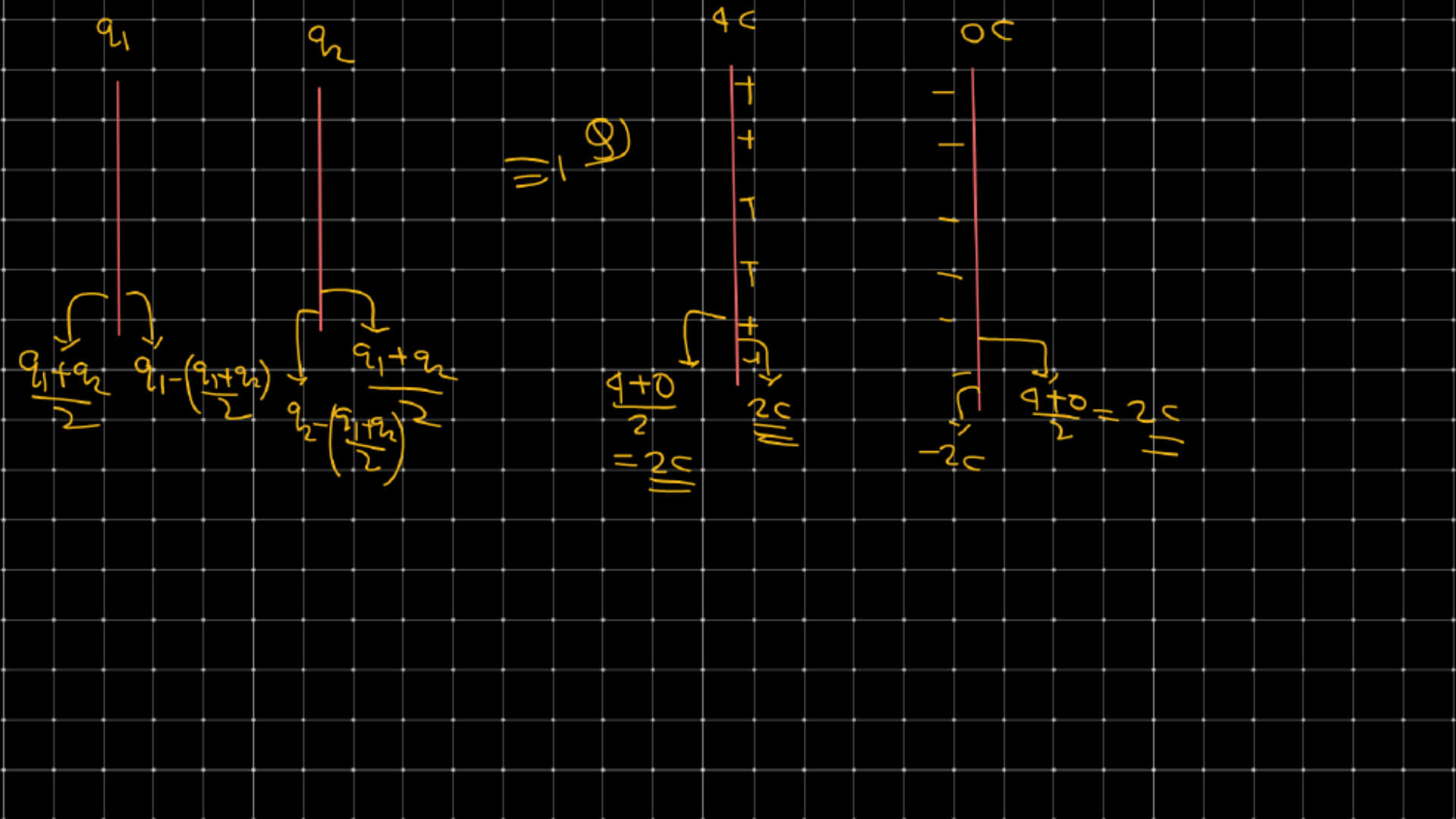
$E_b = \frac{Q}{2A\varepsilon_0}$

$E_a = \frac{Q}{2A\varepsilon_0}$

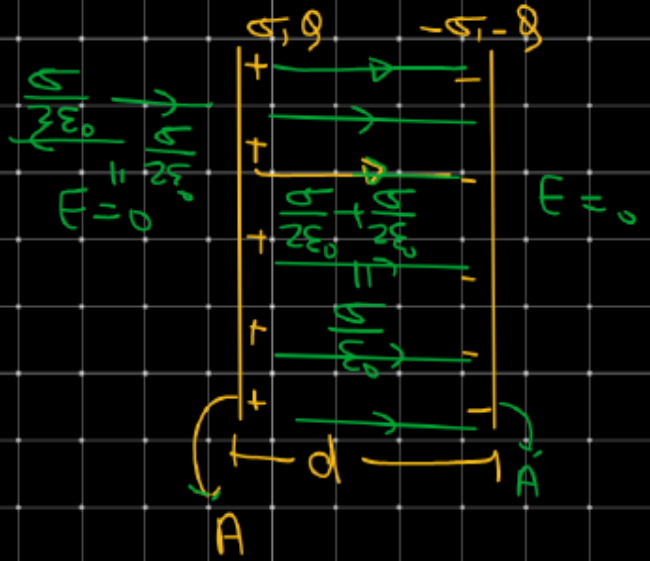
$E_{net} = \frac{Q}{2A\varepsilon_0} + \frac{Q}{2A\varepsilon_0}$

Charge distribution :-




q_1
q_2
$\frac{q_1+q_2}{2}$
$q_1-\left(\frac{q_1+q_2}{2}\right)$
$q_2-\left(\frac{q_1+q_2}{2}\right)$
$\frac{q_1+q_2}{2}$
$\Rightarrow$ (i)
4C
$\frac{q+0}{2}$
$=2C$
2C
0C
-2C
$\frac{q+0}{2}=2C$

Parallel plate Capacitor



$$E = -\frac{dV}{dx}$$

$$-Ed = dV$$

$$V_2 - V_1 = -\frac{\sigma}{\varepsilon_0} \times d$$

$$V_+ - V_- = \frac{\sigma}{\varepsilon_0} d$$

Capacitance of Parallel plate Capacitor

(i) Net electric field inside the capacitor is $\frac{\sigma}{\varepsilon_0} = \frac{Q}{A\varepsilon_0}$ $\left[\sigma = \frac{Q}{A}\right]$

(ii) $\Delta V = Ed = \frac{\sigma}{\varepsilon_0} \times d = \frac{\sigma d}{\varepsilon_0} = \frac{Q}{A}\frac{d}{\varepsilon_0}$

(iii) $C = \frac{Q}{\Delta V} = \frac{Q}{\frac{Qd}{A\varepsilon_0}} = \frac{A\varepsilon_0}{d}$

$$\boxed{C = \frac{A\varepsilon_0}{d}}$$

Capacitance of parallel plate capacitor

(i) Net Electric field inside the capacitor

$$E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{A\varepsilon_0} \quad \left[\sigma = \frac{Q}{A}\right]$$

(ii) $$\Delta V = Ed = \frac{\sigma}{\varepsilon_0} \times d = \frac{\frac{Q}{A}}{\varepsilon_0} d = \frac{Qd}{A\varepsilon_0}$$

(iii) $$C = \frac{Q}{\Delta V} = \frac{Q}{\frac{Qd}{A\varepsilon_0}} = \frac{A\varepsilon_0}{d}$$

$$\boxed{C = \frac{A\varepsilon_0}{d}}$$

↳ Parallel Plate Capacitor:

Capacitance depends on

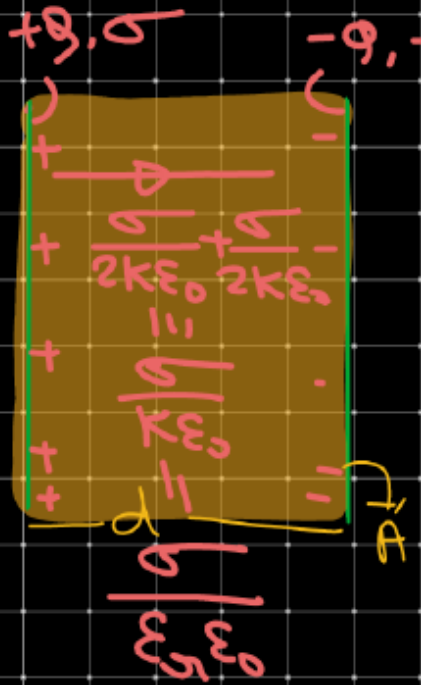
↳ Area of plate.

↳ distance b/w Plate

↳ medium.

↳ does not depends on

↳ Q, E, V=



(i) If we medium b/w PPC.

$E_{med} = \frac{E_{air}}{K} = \frac{\sigma}{\varepsilon_0 K}$

$\Delta V = \frac{\sigma}{\varepsilon_0 K} \times d = \frac{\sigma d}{A\varepsilon_0 K}$

$C_m = \frac{Q}{\Delta V} = \frac{\varepsilon_0 K A}{d}$

$C_m = K C_{air}$

5

$C = ?$

$$C = \frac{A\varepsilon_0\varepsilon_r}{d}$$

$$\boxed{C = \frac{A\varepsilon_0 K}{d}}$$

$$C = \frac{1 \times 8.85 \times 10^{-12} \times 10}{1 \times 10^{-3}}$$

$$\boxed{C = 8.85 \times 10^{-8}\ F}$$

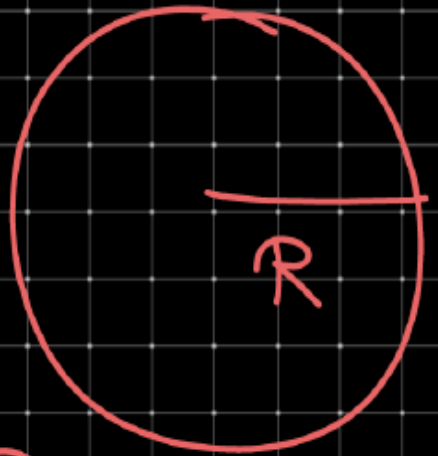
82) The earth has Volume V & Surface A. then its Capacitance would be.

(a) $4\pi\varepsilon_0 \frac{A}{V}$.

(b) $4\pi\varepsilon_0 \frac{V}{A}$.

(c) $12\pi\varepsilon_0 \frac{V}{A}$.

(d) $12\pi\varepsilon_0 \frac{A}{V}$.



$C = 4\pi\varepsilon_0 R$

$V = \frac{4}{3}\pi R^3$

$A = 4\pi R^2$

$\frac{V}{A} = \frac{R}{3} \Rightarrow R = 3\frac{V}{A}$

$C = 4\pi\varepsilon_0 \left[\frac{3V}{A}\right]$

$$\boxed{C = \frac{12\pi\varepsilon_0 V}{A}}$$

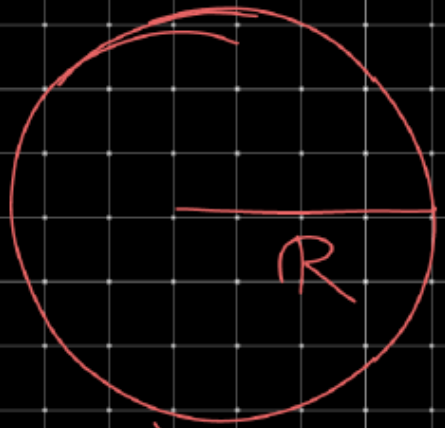
93) Maximum Circumference of a Sphere is 2m then its Capacitance in water would be. [$K_{water} = 81$]

(a) 27.65 PF

(b) 2866 PF

(c) 236.5 PF

(d) 2385 PF.



$2\pi R = 2m$

$R = \frac{1}{\pi} m$

$C = (4\pi\varepsilon_0 R)\varepsilon_r$

$= 4\pi\varepsilon_0 R K$

$C = (4\pi\varepsilon_0 R)K$

$= 4 \times \pi \times 8.85 \times 10^{-12} \times \frac{1}{\pi} \times 81$

$C = 4 \times 8.85 \times 81 \times 10^{-12}$

8) To increase the charge on the plate of capacitor implies to

(a) decrease the potential difference b/w the plate ✗

(b) ↓se the Capacitance of capacitor

(c) ↑se the " " "

(d) ↑se the P.D b/w the plate

$$E = \frac{\sigma}{A\varepsilon_0}$$

$$\Delta V = \frac{\sigma d}{A\varepsilon_0}$$

$$C = \frac{A\varepsilon_0\varepsilon_r}{d}$$