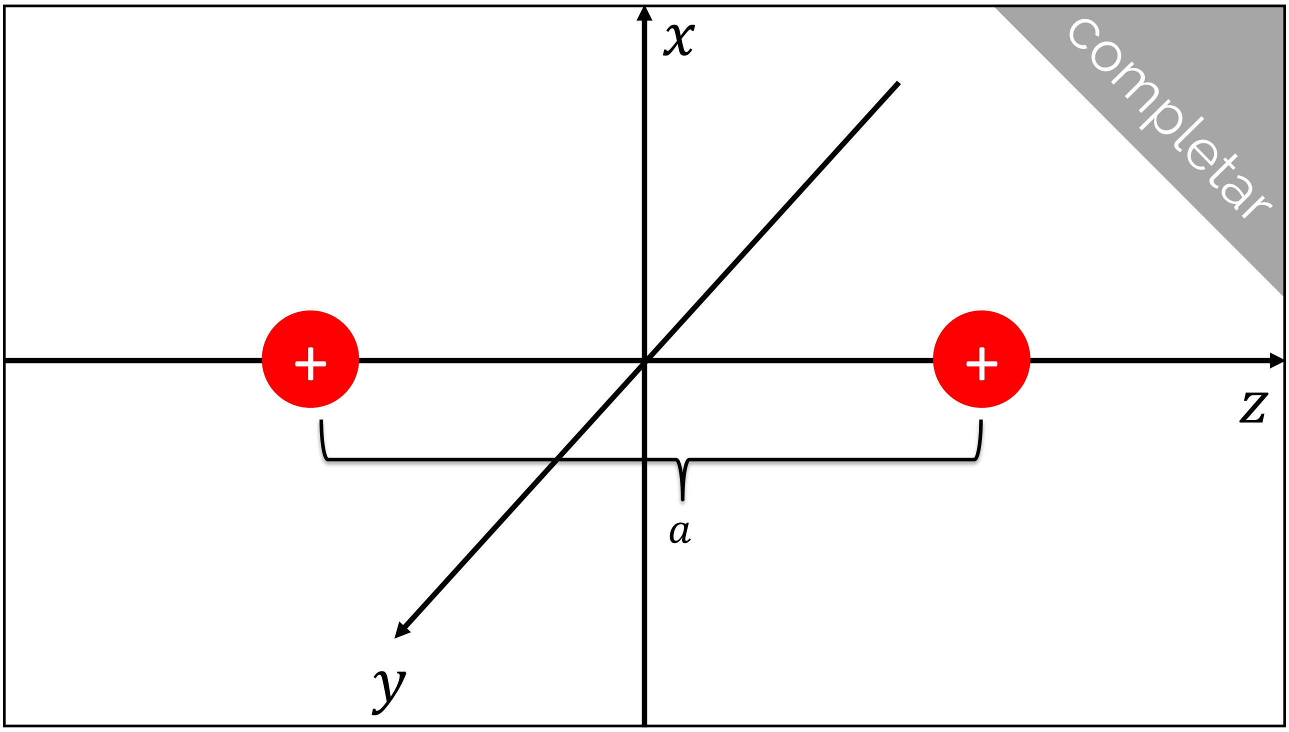
Principio de superposición

cada carga contribuye al campo total
de forma independiente

completar

completar

https://www.geogebra.org/m/jnscmsga



completar

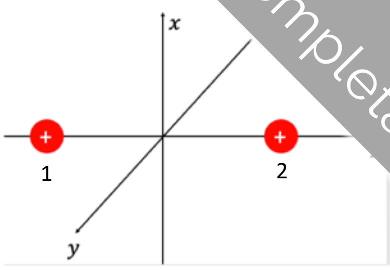
$$\vec{E}(\vec{r}) = \vec{E}_1(\vec{r}) + \vec{E}_2(\vec{r})$$

$$\vec{E}_1(\vec{r}) = \kappa\, q_1 \frac{\vec{r} - \vec{r}_1}{|\vec{r} - \vec{r}_1|^3}$$

$$\vec{E}_2(\vec{r}) = \kappa\, q_2 \frac{\vec{r} - \vec{r}_2}{|\vec{r} - \vec{r}_2|^3}$$

completar

$$\vec{E}_1(\vec{r}) = \kappa\, q_1 \frac{\vec{r} - \vec{r}_1}{|\vec{r} - \vec{r}_1|^3}$$



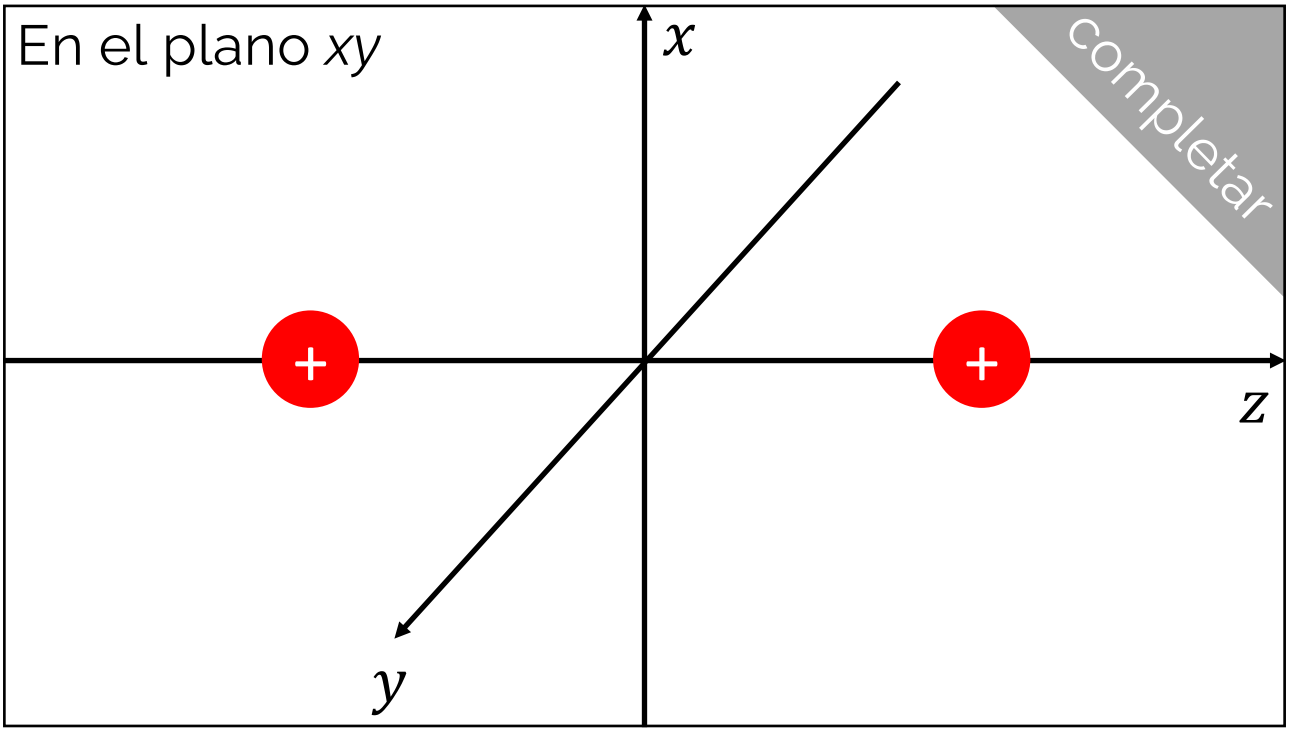
$$\vec{E}(\vec{r}) = \kappa\, q \frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{E}(\vec{r}) = \vec{E}_1(\vec{r}) + \vec{E}_2(\vec{r})$$

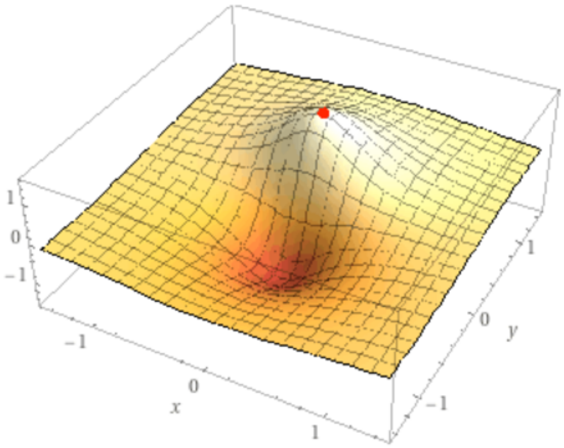
$$E_x(x,y,z) = \kappa\, q \frac{x}{[x^2+y^2+(z+a/2)^2]^{3/2}} + \kappa\, q \frac{x}{[x^2+y^2+(z-a/2)^2]^{3/2}}$$

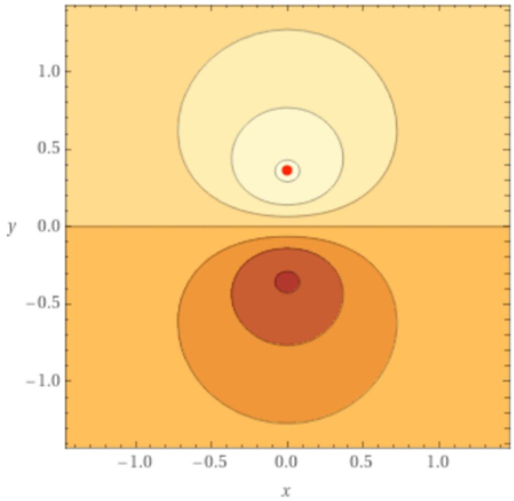
$$E_y(x,y,z) = \kappa\, q \frac{y}{[x^2+y^2+(z+a/2)^2]^{3/2}} + \kappa\, q \frac{y}{[x^2+y^2+(z-a/2)^2]^{3/2}}$$

$$E_z(x,y,z) = \kappa\, q \frac{z+a/2}{[x^2+y^2+(z+a/2)^2]^{3/2}} + \kappa\, q \frac{z-a/2}{[x^2+y^2+(z-a/2)^2]^{3/2}}$$



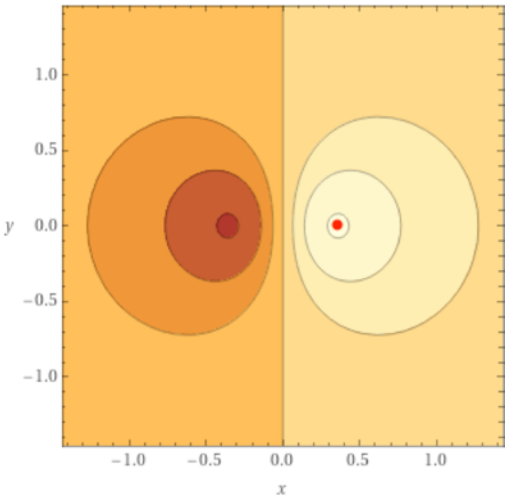
En el plano *xy*, $\boldsymbol{E_y}$



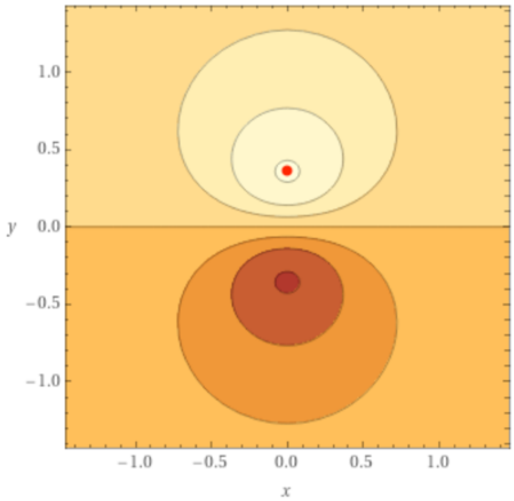


En el plano *xy*, $\boldsymbol{E_z = 0}$

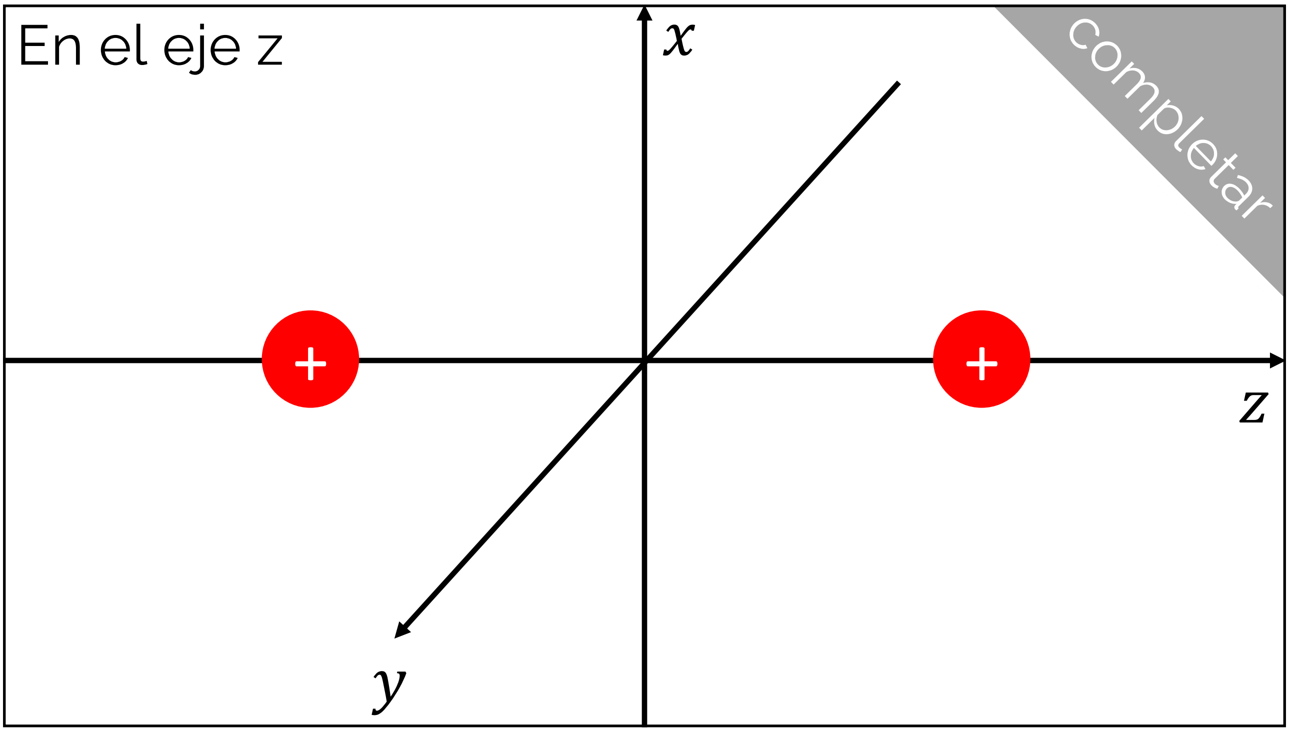
$\boldsymbol{E_x}$



$\boldsymbol{E_y}$



En el eje z



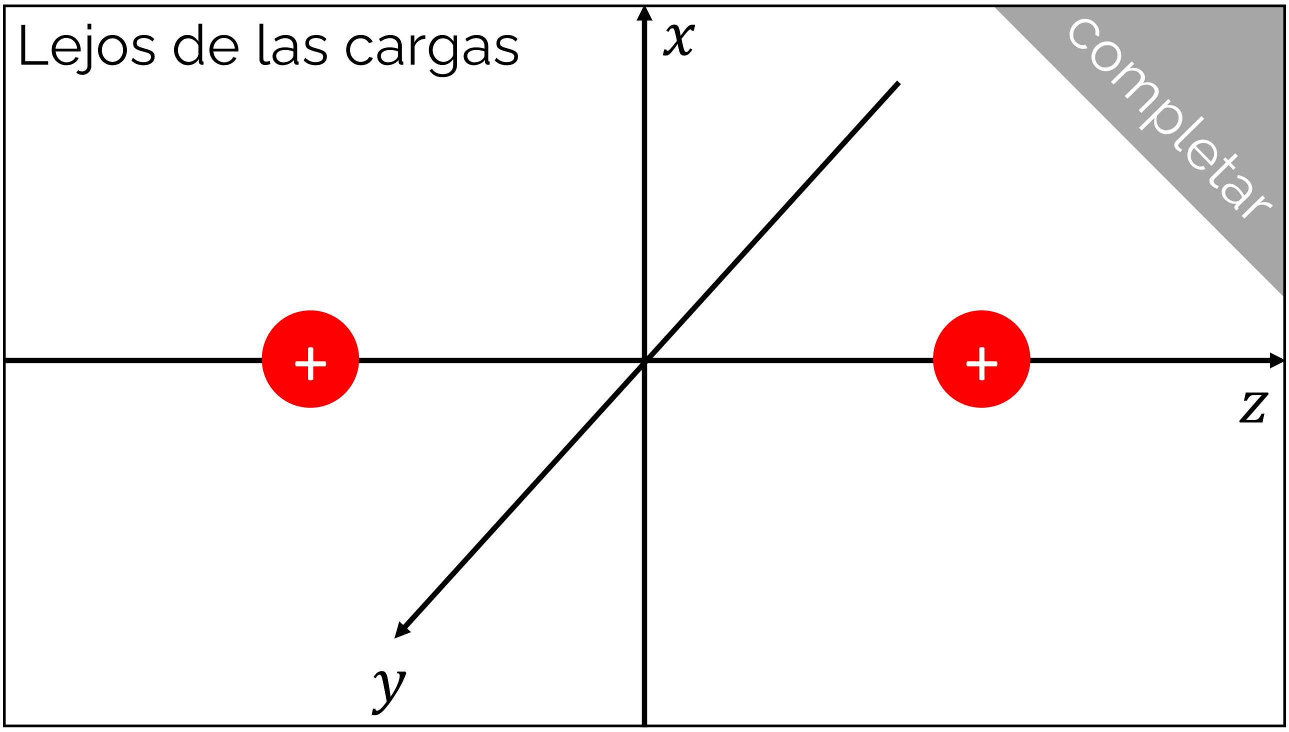
En el eje z, $\boldsymbol{E_x} = \boldsymbol{E_y} = \boldsymbol{0}$

completar

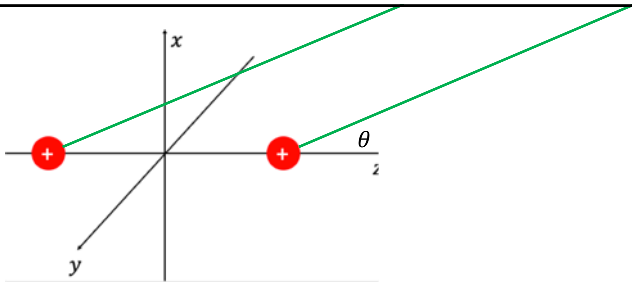
$\boldsymbol{E_z}$

z

Lejos de las cargas



Lejos de las cargas



$$\frac{1}{|\vec{r}-\vec{r}_1|^3} \sim \frac{1}{r^3\left(1-\left(\frac{a}{2r}\right)\cos\theta\right)^3} \sim \frac{1}{r^3}\left(1+\left(\frac{3a}{2r}\right)\cos\theta\right)$$

$$\frac{1}{|\vec{r}-\vec{r}_2|^3} \sim \frac{1}{r^3\left(1+\left(\frac{a}{2r}\right)\cos\theta\right)^3} \sim \frac{1}{r^3}\left(1-\left(\frac{3a}{2r}\right)\cos\theta\right)$$

$$\vec{E}(\vec{r}) = \kappa\, q \frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{E}_1(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1 + \left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r} - \frac{\vec{a}}{2})$$

$$\vec{E}_2(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1 - \left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r} + \frac{\vec{a}}{2})$$

$$\vec{E}(\vec{r}) = \kappa\, q \frac{\vec{r}}{|\vec{r}|^3}$$

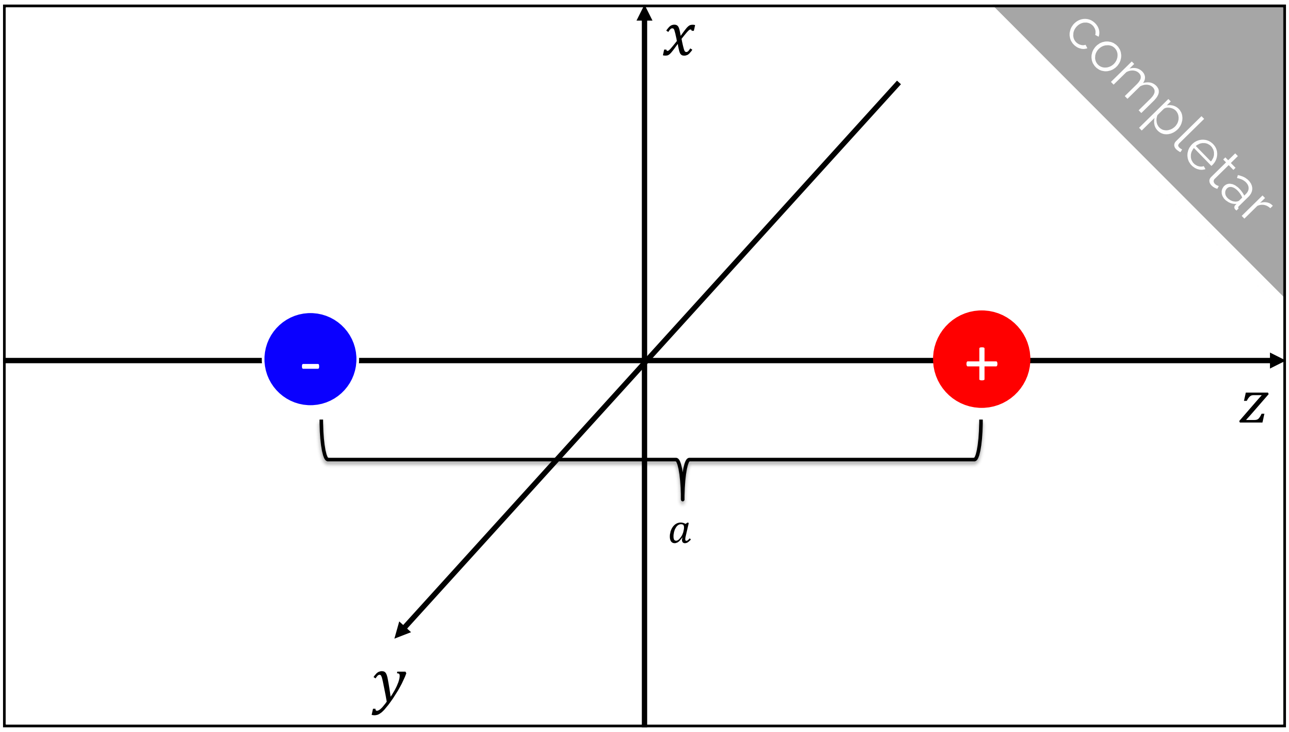
$$\vec{E}_1(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1 + \left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r} - \frac{\vec{a}}{2})$$

$$\vec{E}_2(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1 - \left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r} + \frac{\vec{a}}{2})$$

$$\vec{E}(\vec{r}) \sim \kappa\, 2q \frac{\vec{r}}{|\vec{r}|^3}$$

Dipolo Eléctrico

Dos cargas iguales y opuestas



$$\vec{E}(\vec{r}) = \vec{E}_1(\vec{r}) + \vec{E}_2(\vec{r})$$

$$\vec{E}_1(\vec{r}) = \kappa\, q \frac{\vec{r} - \vec{r}_1}{|\vec{r} - \vec{r}_1|^3}$$

$$\vec{E}_2(\vec{r}) = -\kappa\, q \frac{\vec{r} - \vec{r}_2}{|\vec{r} - \vec{r}_2|^3}$$

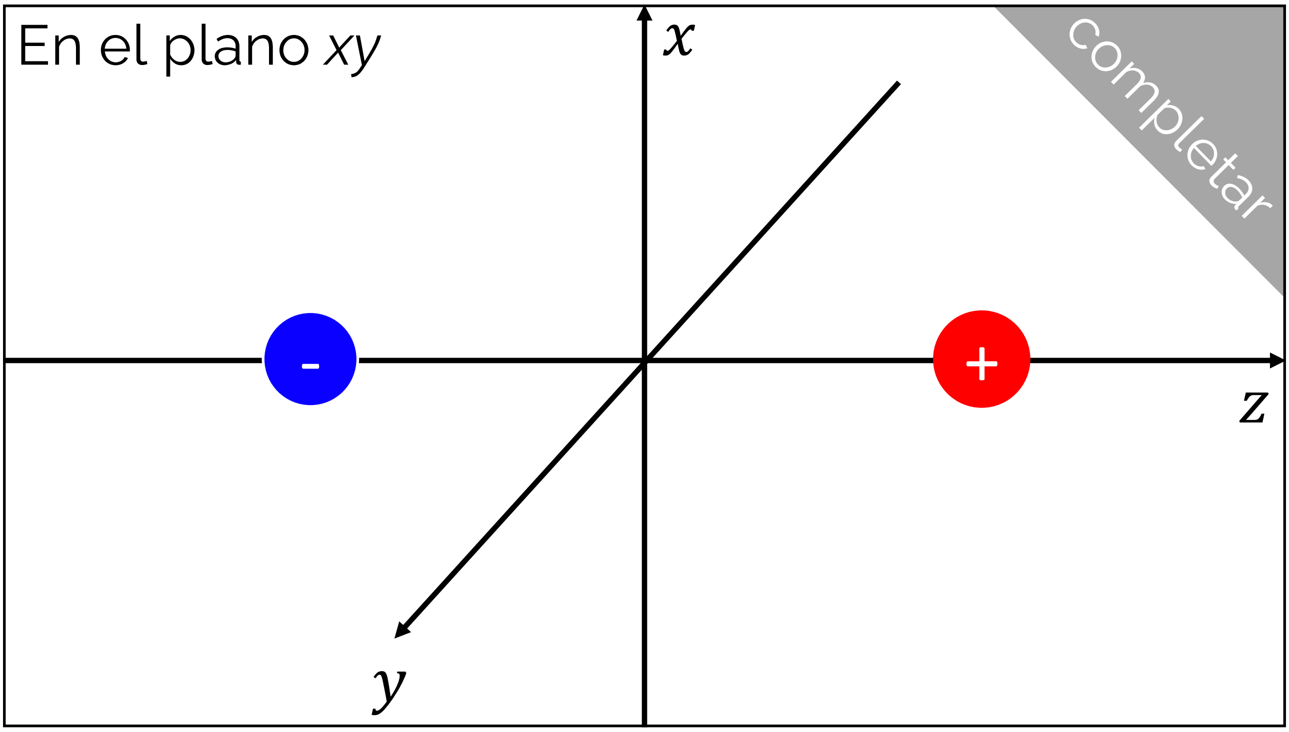
$$\vec{E}(\vec{r}) = \kappa\, q \frac{\vec{r}}{|\vec{r}|^3}$$

$$E_x(x,y,z) = \kappa\, q \frac{x}{[x^2 + y^2 + (z + a/2)^2]^{3/2}} - \kappa\, q \frac{x}{[x^2 + y^2 + (z - a/2)^2]^{3/2}}$$

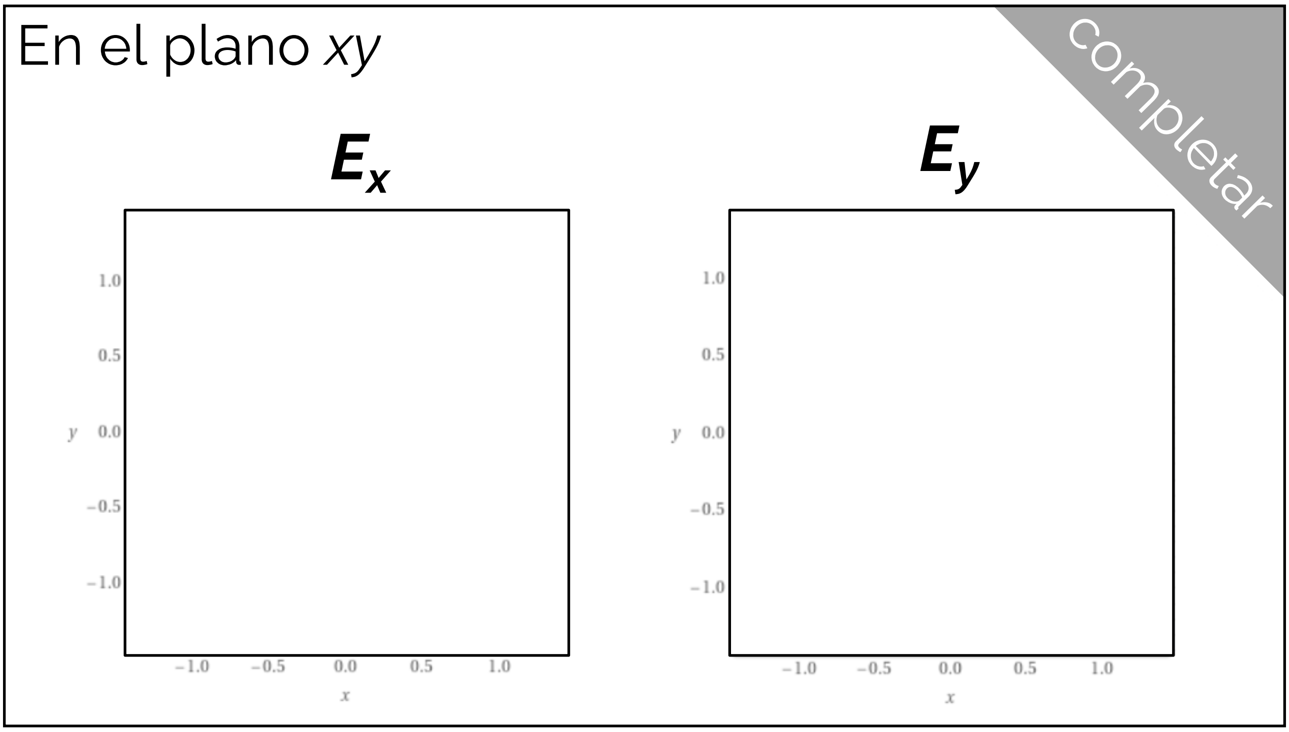
$$E_y(x,y,z) = \kappa\, q \frac{y}{[x^2 + y^2 + (z + a/2)^2]^{3/2}} - \kappa\, q \frac{y}{[x^2 + y^2 + (z - a/2)^2]^{3/2}}$$

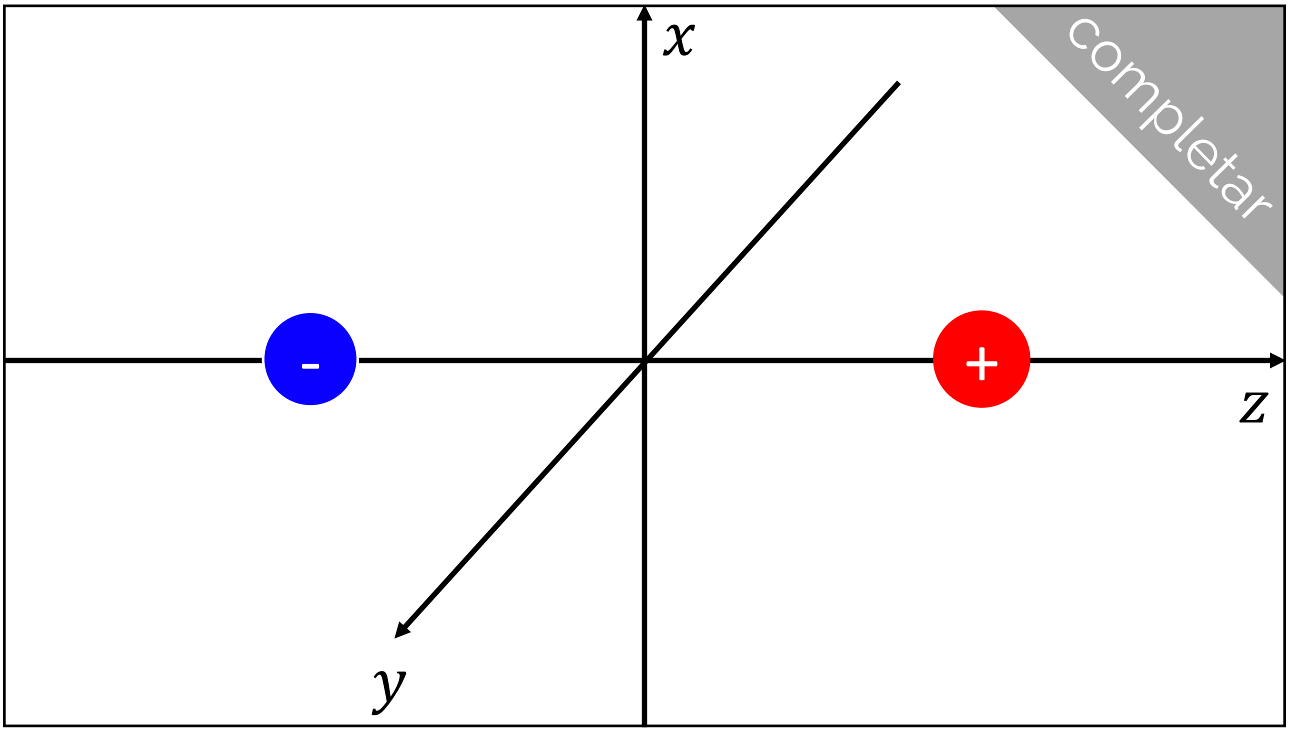
$$E_z(x,y,z) = \kappa\, q \frac{z + a/2}{[x^2 + y^2 + (z + a/2)^2]^{3/2}} - \kappa\, q \frac{z - a/2}{[x^2 + y^2 + (z - a/2)^2]^{3/2}}$$

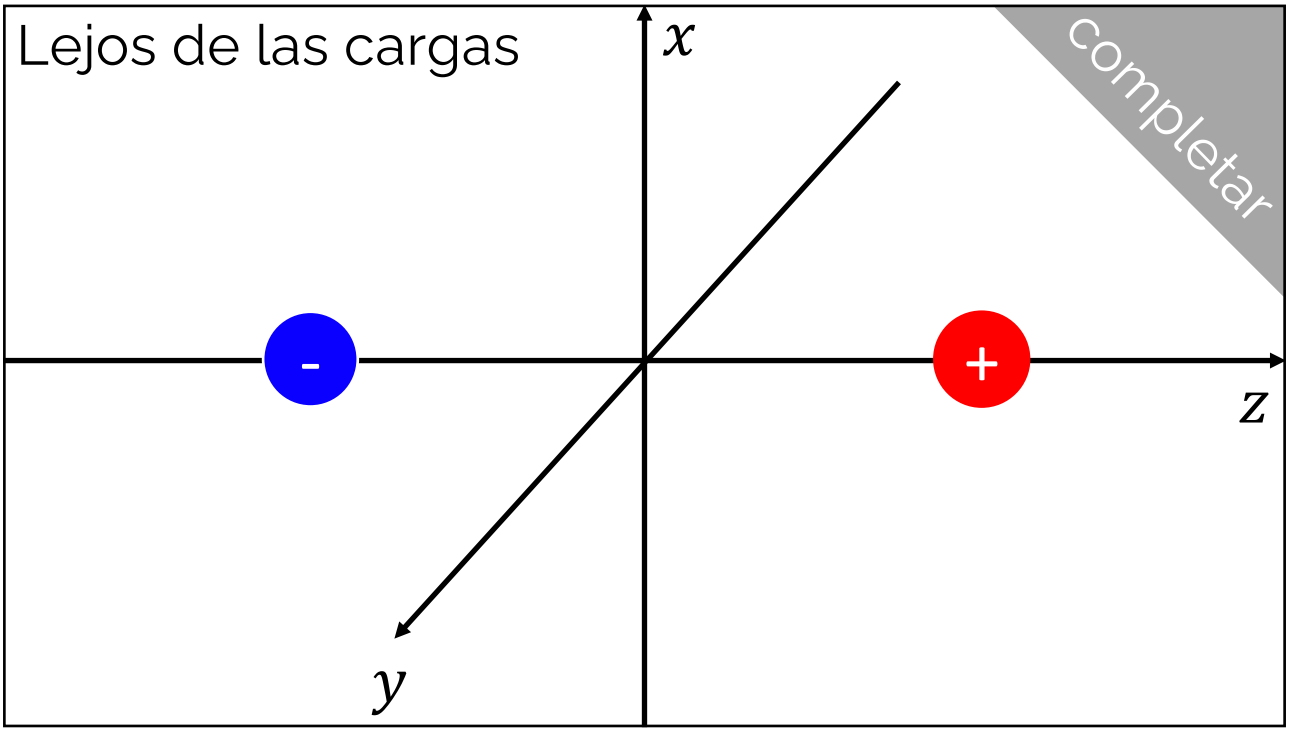
En el plano *xy*



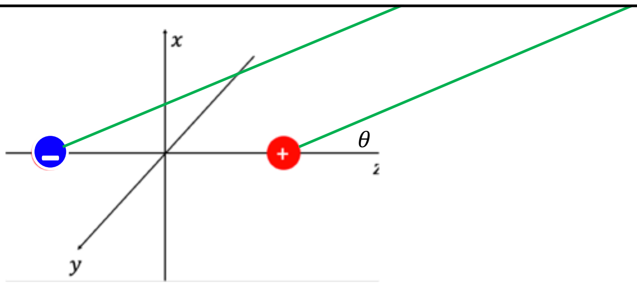
En el plano *xy*




x
completar
-
+
z
y


Lejos de las cargas
x
completar
-
+
z
y

Lejos de las cargas



$$\frac{1}{|\vec{r}-\vec{r}_1|^3} \sim \frac{1}{r^3\left(1-\left(\frac{a}{2r}\right)\cos\theta\right)^3} \sim \frac{1}{r^3}\left(1+\left(\frac{3a}{2r}\right)\cos\theta\right)$$

$$\frac{1}{|\vec{r}-\vec{r}_2|^3} \sim \frac{1}{r^3\left(1+\left(\frac{a}{2r}\right)\cos\theta\right)^3} \sim \frac{1}{r^3}\left(1-\left(\frac{3a}{2r}\right)\cos\theta\right)$$

$$\vec{E}(\vec{r}) = \kappa\, q \frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{E}_1(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1+\left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r}-\frac{\vec{a}}{2})$$

$$\vec{E}_2(\vec{r}) = -\,\kappa\, q \frac{1}{r^3}\left(1-\left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r}+\frac{\vec{a}}{2})$$

$$\vec{E}(\vec{r}) = \kappa\, q \frac{\vec{r}}{|\vec{r}|^3}$$

$$\vec{E}_1(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1 + \left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r} - \frac{\vec{a}}{2})$$

$$\vec{E}_2(\vec{r}) = \kappa\, q \frac{1}{r^3}\left(1 - \left(\frac{3a}{2r}\right)\cos\theta\right)(\vec{r} + \frac{\vec{a}}{2})$$

$$\vec{E}(\vec{r}) \sim \kappa\, qa \frac{1}{r^3}\left[3\cos\theta\frac{\vec{r}}{r} - \frac{\vec{a}}{a}\right]$$

$$\vec{E}(\vec{r}) \sim \kappa\, qa \frac{1}{r^3}\left[3\cos\theta\frac{\vec{r}}{r} - \frac{\vec{a}}{a}\right]$$

El momento dipolar $\vec{p} = q\vec{a}$

$$\vec{E}(\vec{r}) \sim \frac{\kappa}{r^3}\left[3(\vec{p}\hat{r})\hat{r} - \vec{p}\right]$$

python

https://colab.research.google.com/drive/1_A6jdLKgB8P7sumXWFLvbWnEILFEf2lk?usp=sharing