Clicker

- Q_1 has charge +Q
- Q_2 has charge +2Q
- They are separated by d.
- Charge q is a distance a away from Q_1

Is there a place – the value for a -- between Q_1 and Q_2 where the force on ANY charge (positive or negative) is zero?

(a) NO

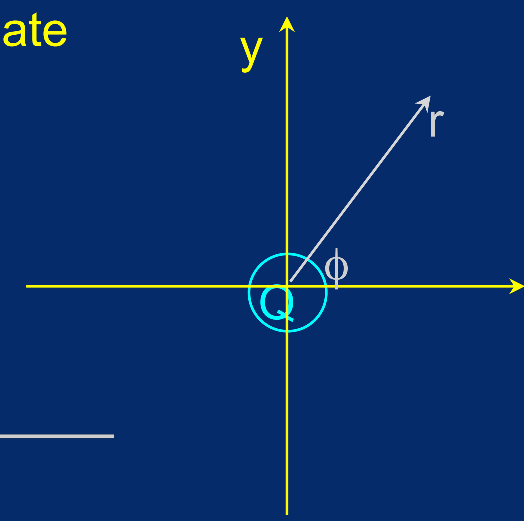
(b) Yes, but I can't find it with all this time pressure.

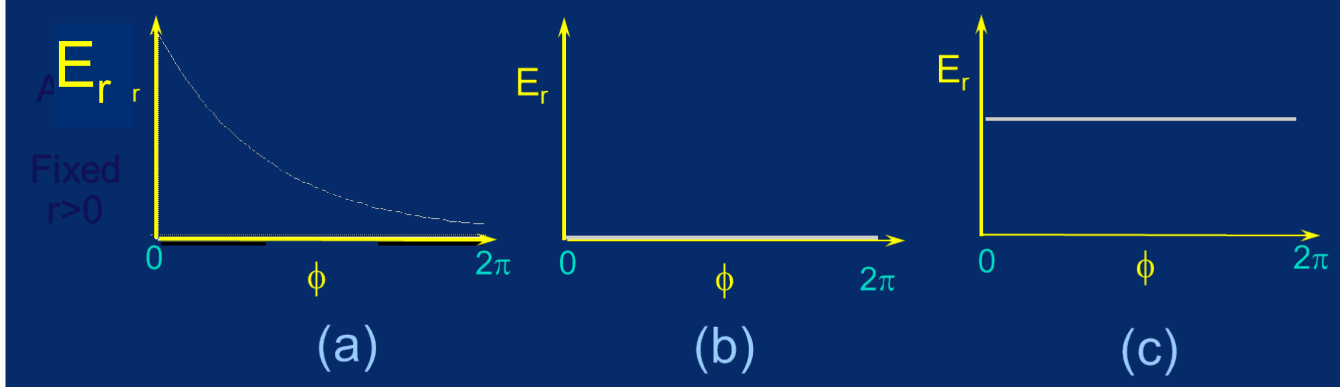
(c) Yes and my answer is _______ from Q_1. I will volunteer to specify if you ask me

Clicker 2-4

Consider a point charge fixed at the origin of a co-ordinate system as shown.

Which of the following graphs best represents the functional dependence of the Electric Field?





Clicker 3-1

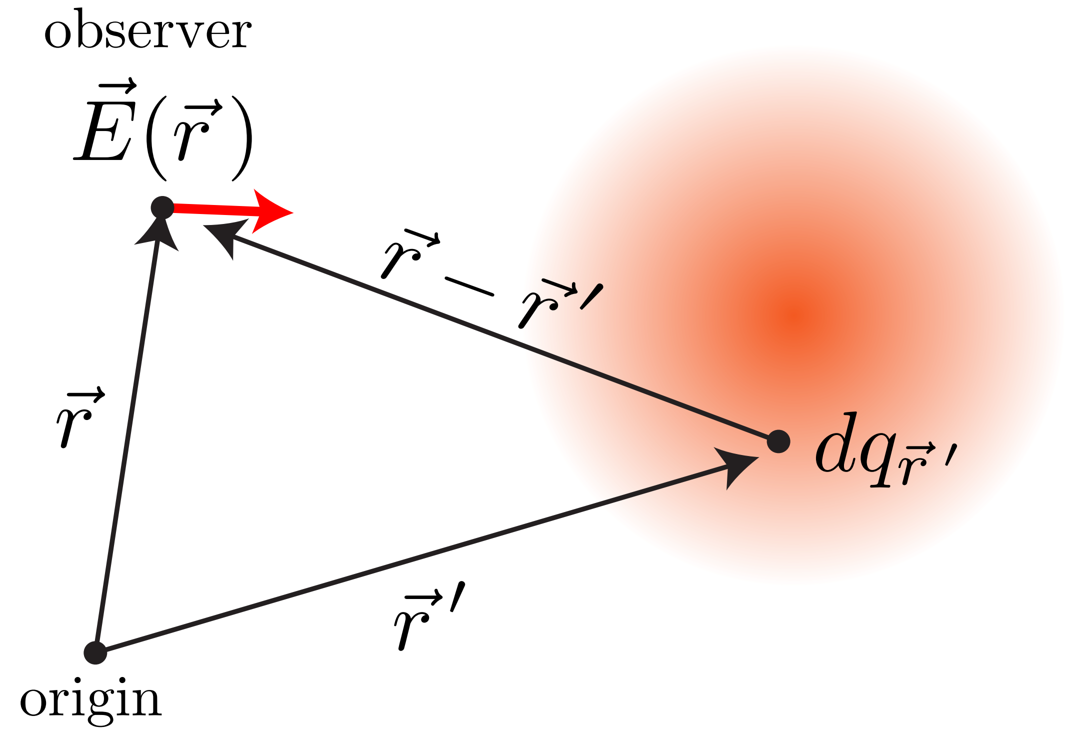
E field from a charge distribution

- **Electric Field** from a collection of charges:

$$\vec{E}(\vec{r}_0) = \sum_{j \neq 0} \frac{k\ q_j}{r_{j,0}^2} \hat{r}_{j,0}$$

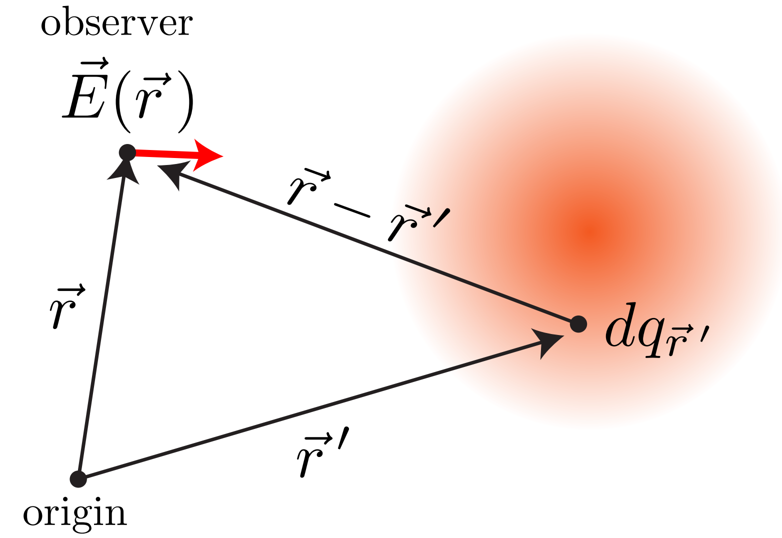
- **Electric Field** from a continuous charge distribution:

$$\vec{E}(\vec{r}) = \int \frac{k\ dq}{r^2} \hat{r}$$



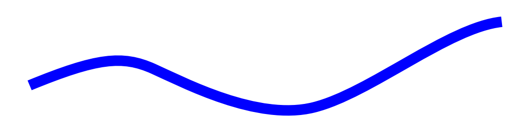
E field from a charge distribution

$$\vec{E}(\vec{r}) = \int \frac{k\ dq}{r^2}\hat{r}$$



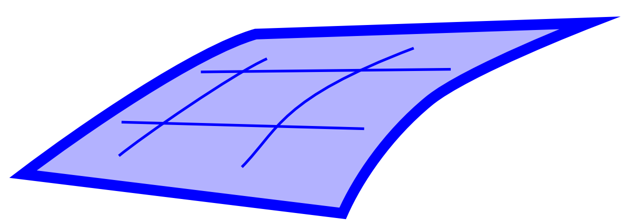
- **Electric Field** from a 1D source: [λ] = C/m[1]

$$dq_{\vec{r}\,'} \to d\ell\, \lambda(\vec{r}\,')$$



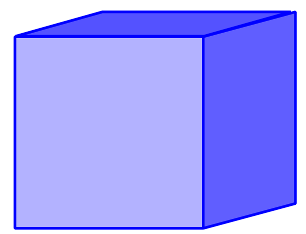
- **Electric Field** from a 2D source: [σ] = C/m[2]

$$dq_{\vec{r}\,'} \to d^2x\, \sigma(\vec{r}\,')$$



- **Electric Field** from a 3D source: [ρ] = C/m[3]

$$dq_{\vec{r}\,'} \to d^3x\, \rho(\vec{r}\,')$$



Dipole E-field

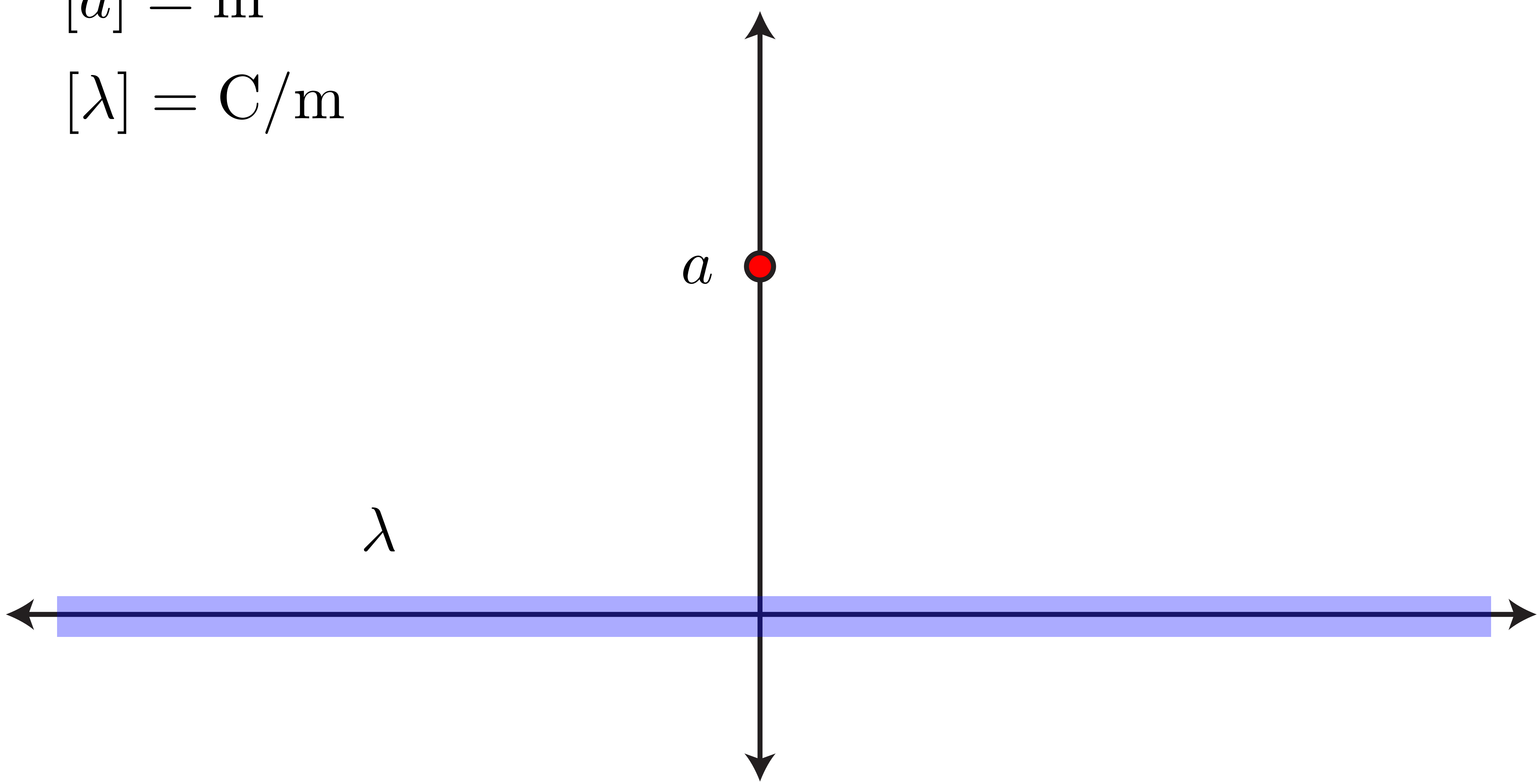
Line charge

2 positive charges

E field from a line charge

$[a] = \mathrm{m}$

$[\lambda] = \mathrm{C/m}$



Setup the integral…

$$\vec{E}(\vec{r}) = \int \frac{k\ dq}{r^2}\hat{r} = 2k\int_0^{\infty} \frac{\lambda}{r^2}dx = 2k\int_0^{\pi/2} \frac{\lambda\ r\cos(\theta)}{r^2}d\theta = 2k\int_0^{\pi/2} \frac{\lambda\ \cos^2(\theta)}{a}d\theta = \frac{2k\lambda}{a}$$

Gaus’s Law

E field from a dipoles