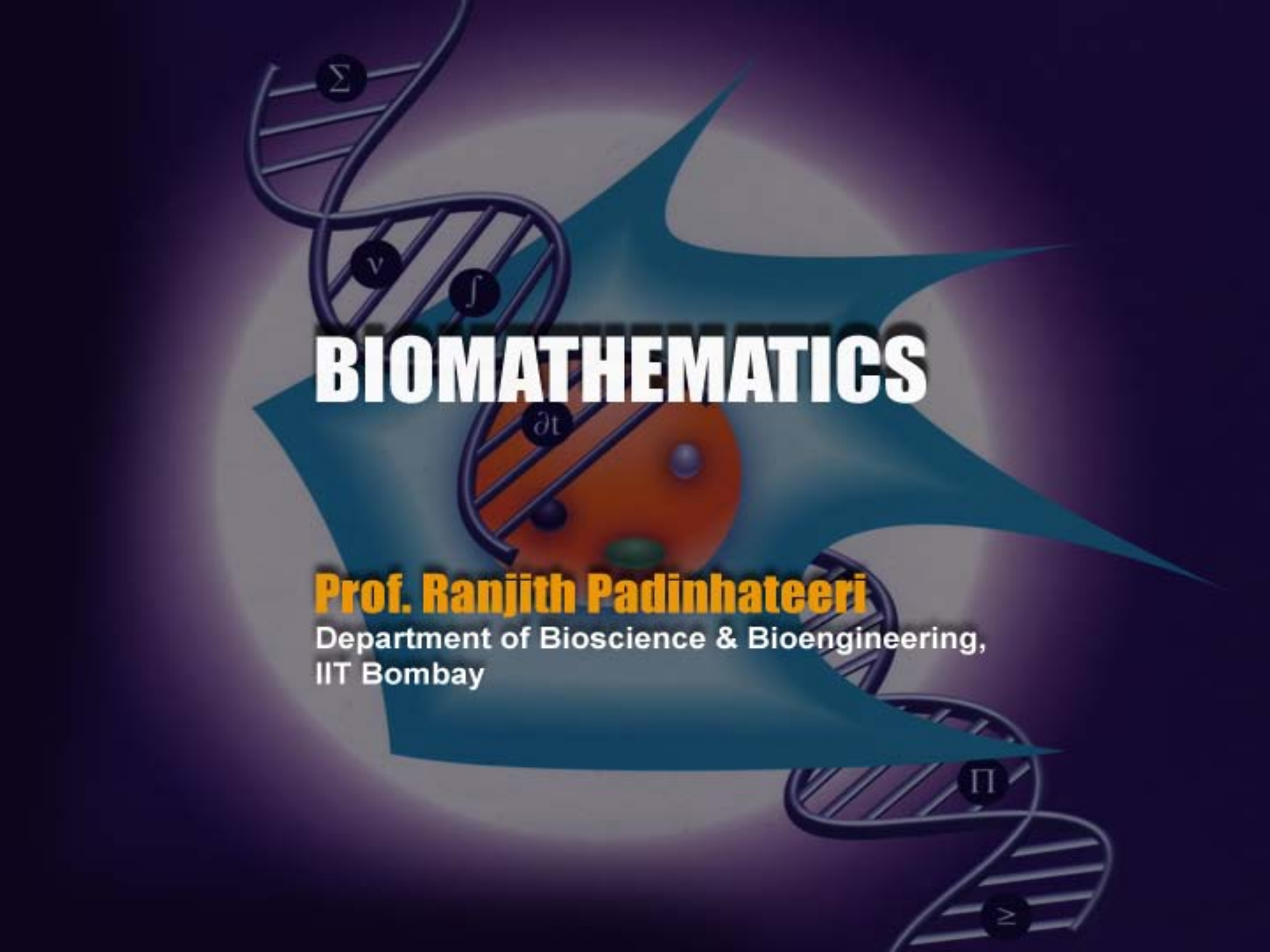

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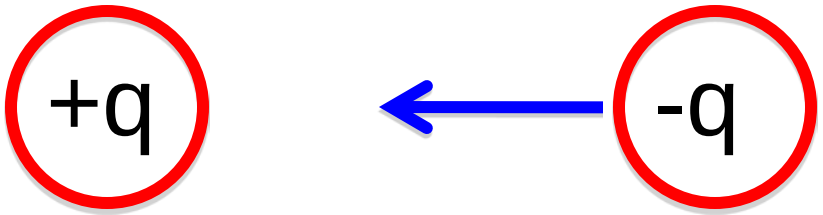
Vectors

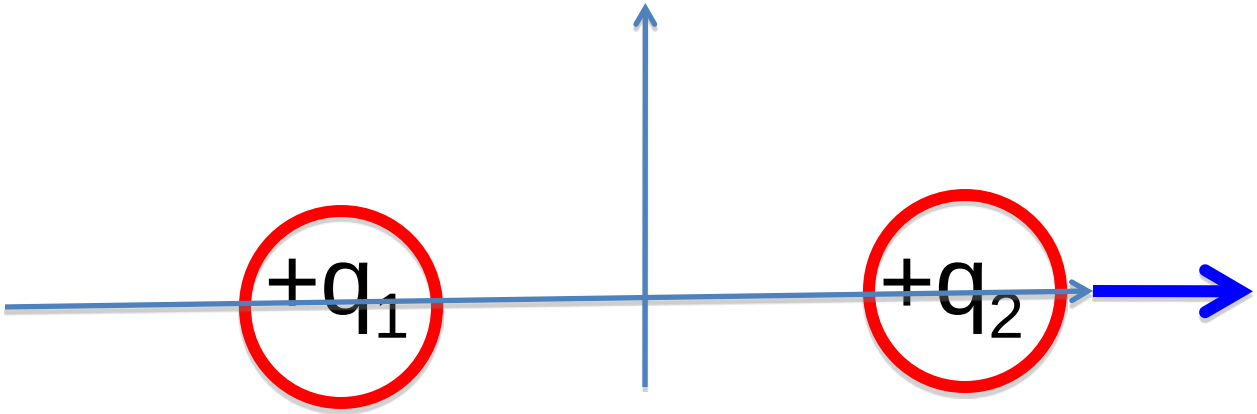
Why should we learn about vectors ?

Two charges attract/repel



$$f = \frac{q^2}{Kr^2}$$

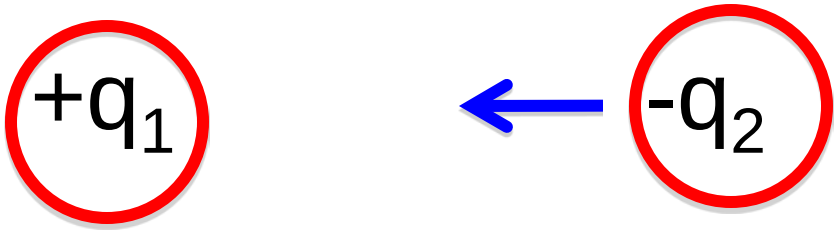
Force on the second charge



$$\vec{f} = \frac{q_1 q_2}{K r^2} \hat{x}$$

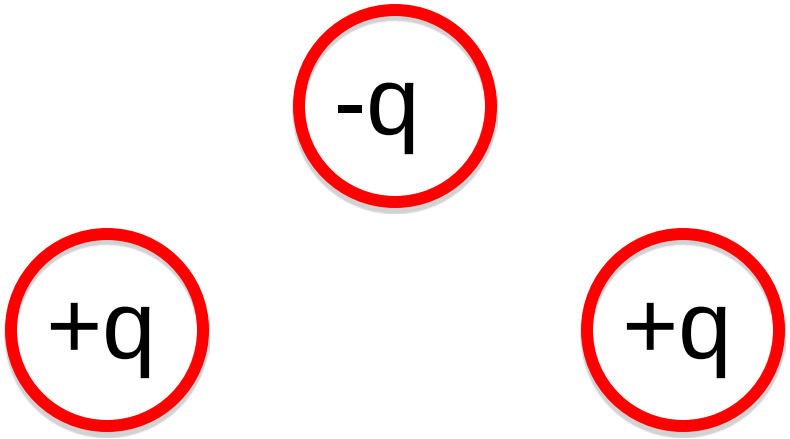
$\hat{x}$: unit vector along X axis $\quad |\hat{x}| = 1$

Force on the second charge



$$\vec{f} = -\frac{q_1 q_2}{Kr^2}\hat{x}$$

Three charges: total force



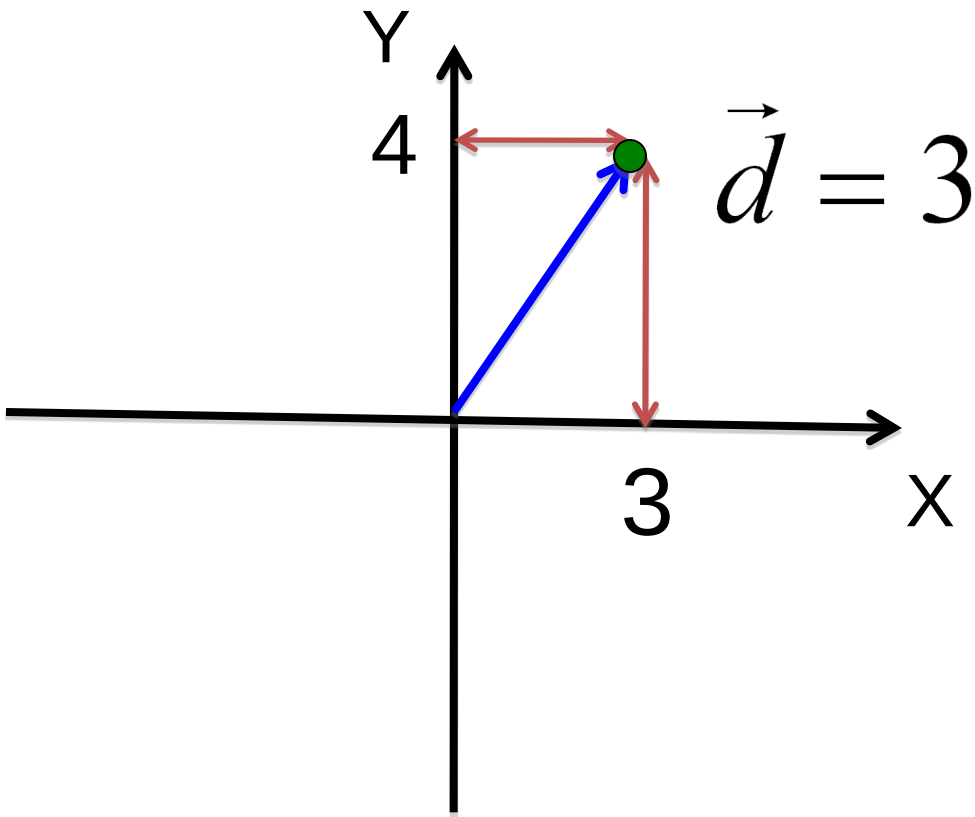
In which direction will the negative charge move ?

Scalars

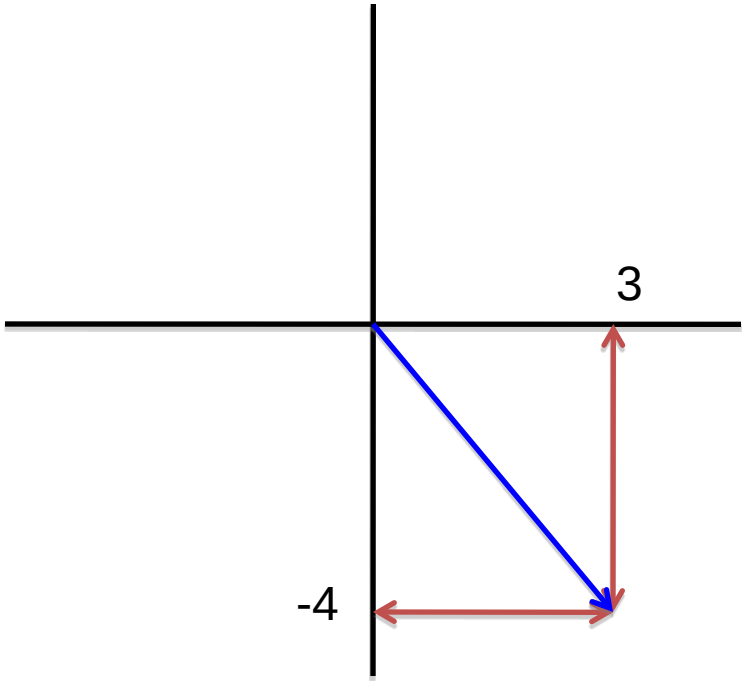
Just numbers representing magnitude.
e.g. Mass, Energy, Temperature etc.

Vectors

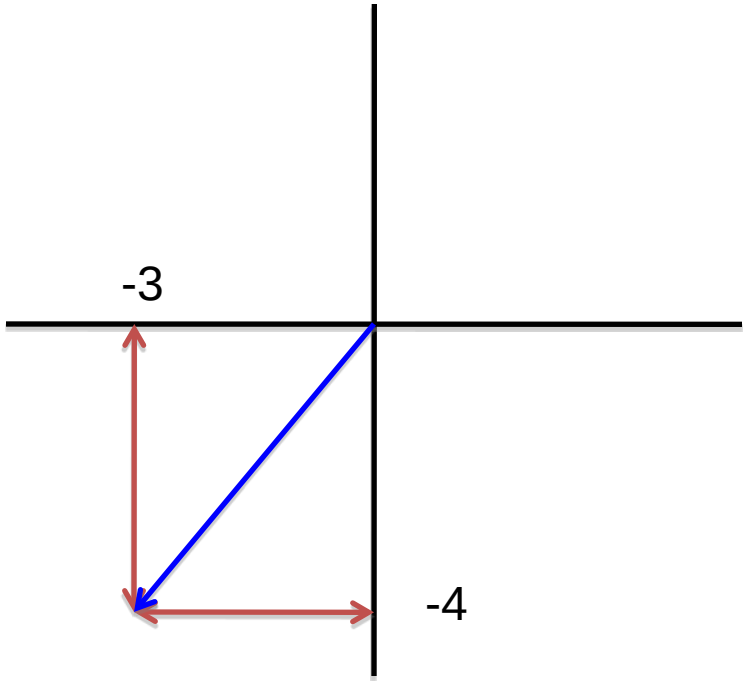
Have magnitude and direction.
e.g. Displacement, Force, Flow etc.



$$\vec{d} = 3\hat{x} + 4\hat{y}$$



$$\vec{d} = 3\hat{x} - 4\hat{y}$$



$$\vec{d} = -3\hat{x} - 4\hat{y}$$

In 2D, a vector will be represented by two numbers:

x component and *y* component

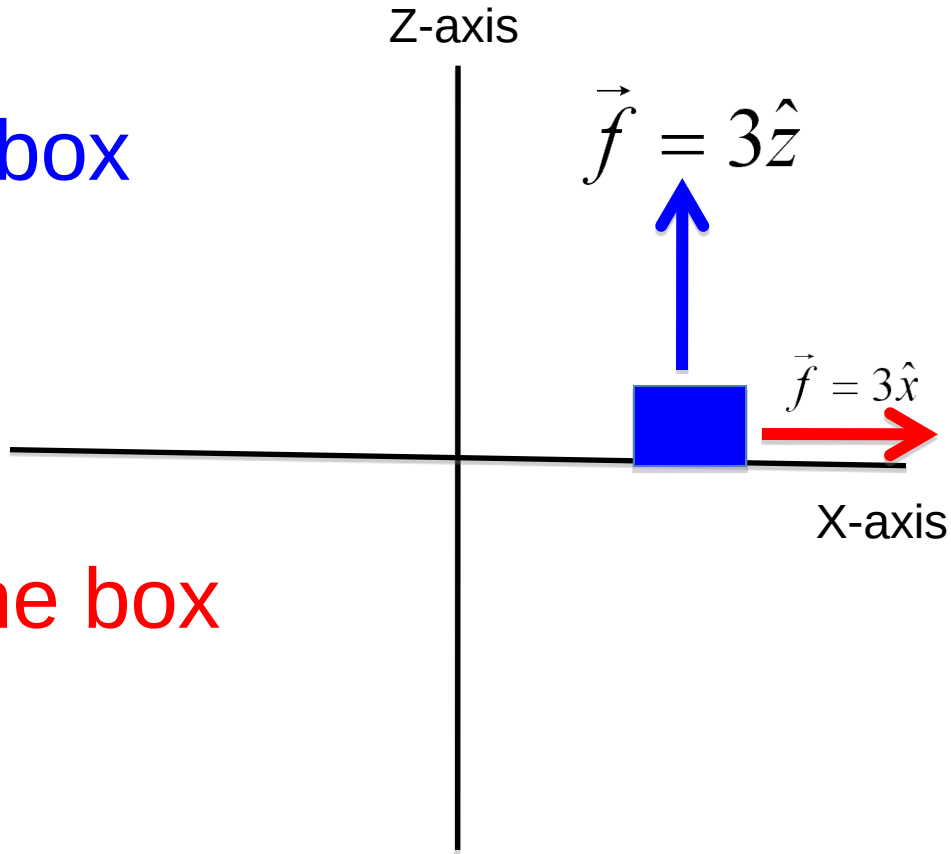
In 3D, a vector will be represented by three numbers:

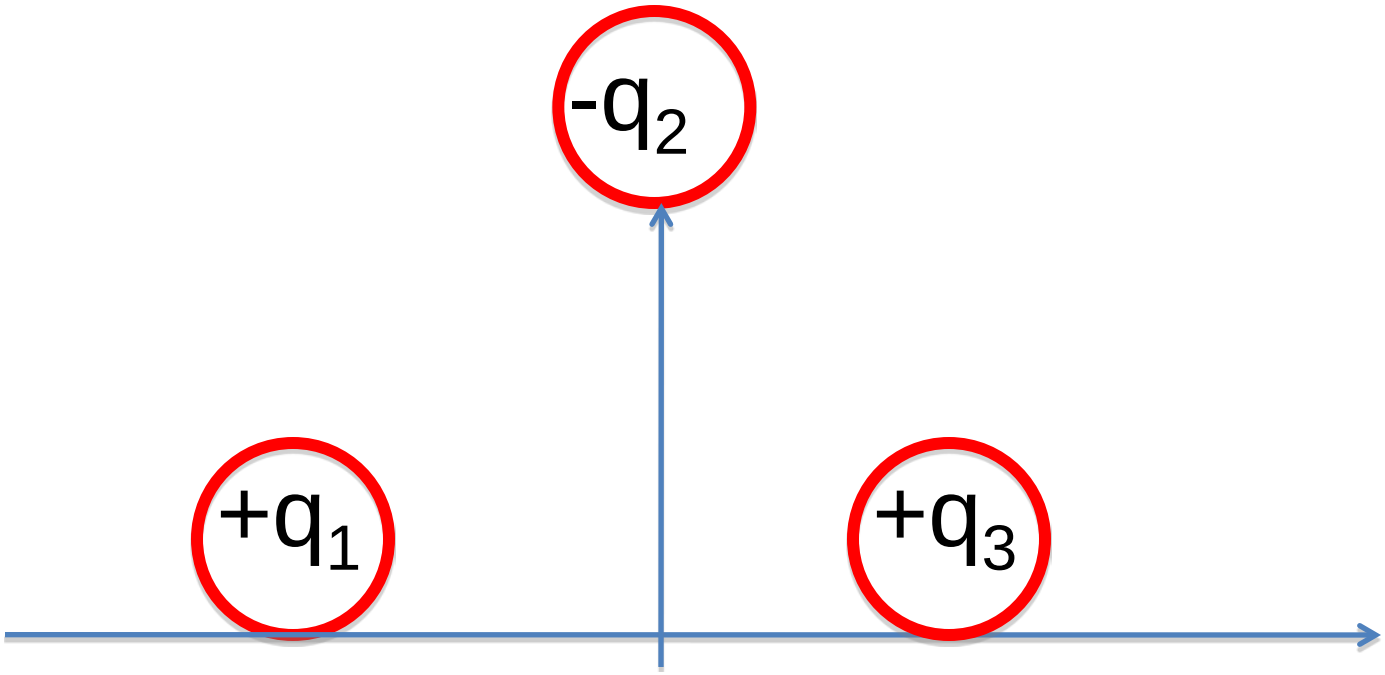
x component, *y* component and z component

How do I say that I need to apply 3N force to lift a box?

$$\vec{f} = 3\hat{z}$$ To lift the box

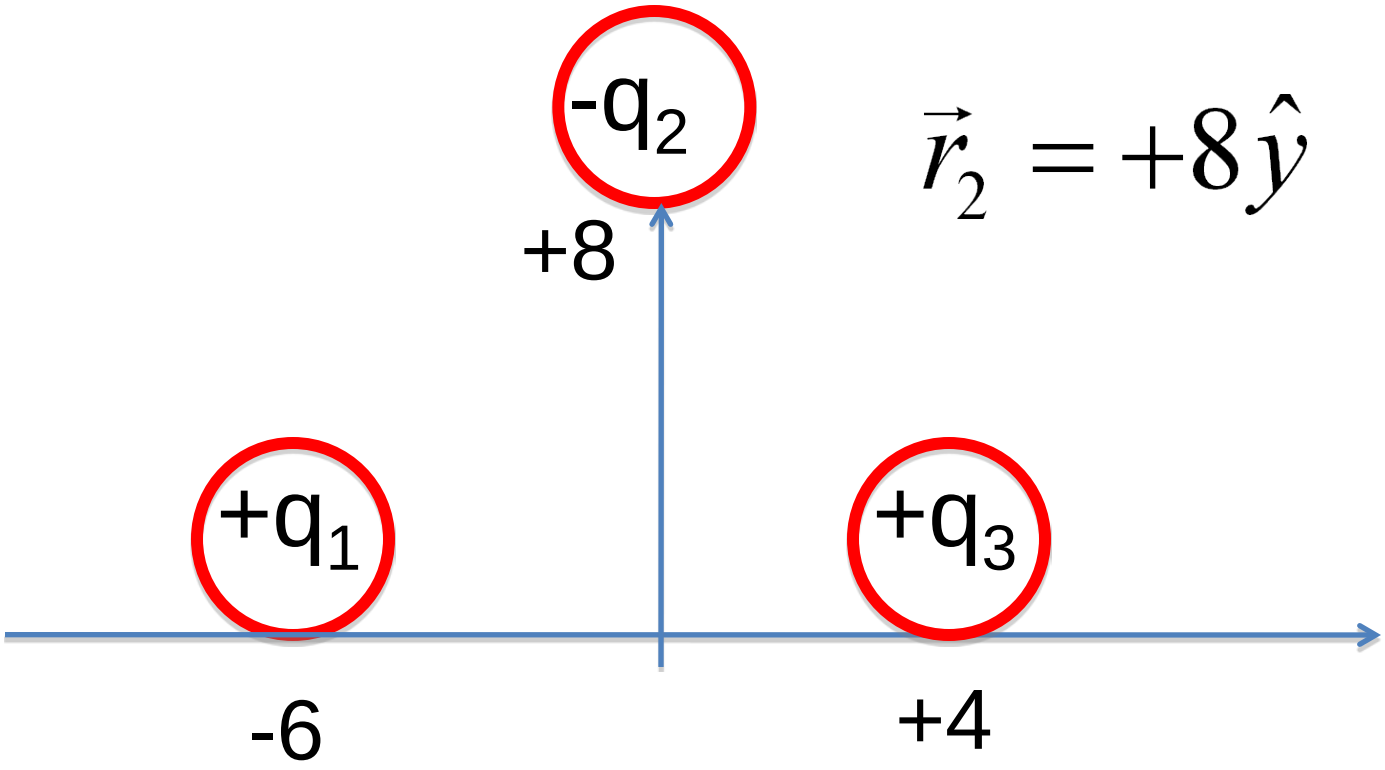
$$\vec{f} = 3\hat{x}$$ To slide the box





Force on the second charge ?

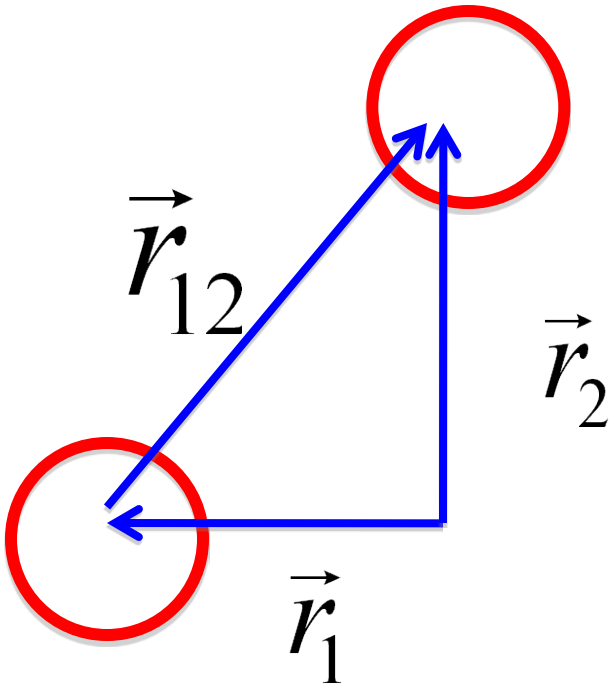
$$\vec{f}_2 = \vec{f}_{21} + \vec{f}_{23}$$



$$\vec{r}_2 = +8\,\hat{y}$$

$$\vec{r}_1 = -6\,\hat{x}$$

$$\vec{r}_3 = +4\,\hat{x}$$



$$\vec{r}_1 = -6\hat{x}$$

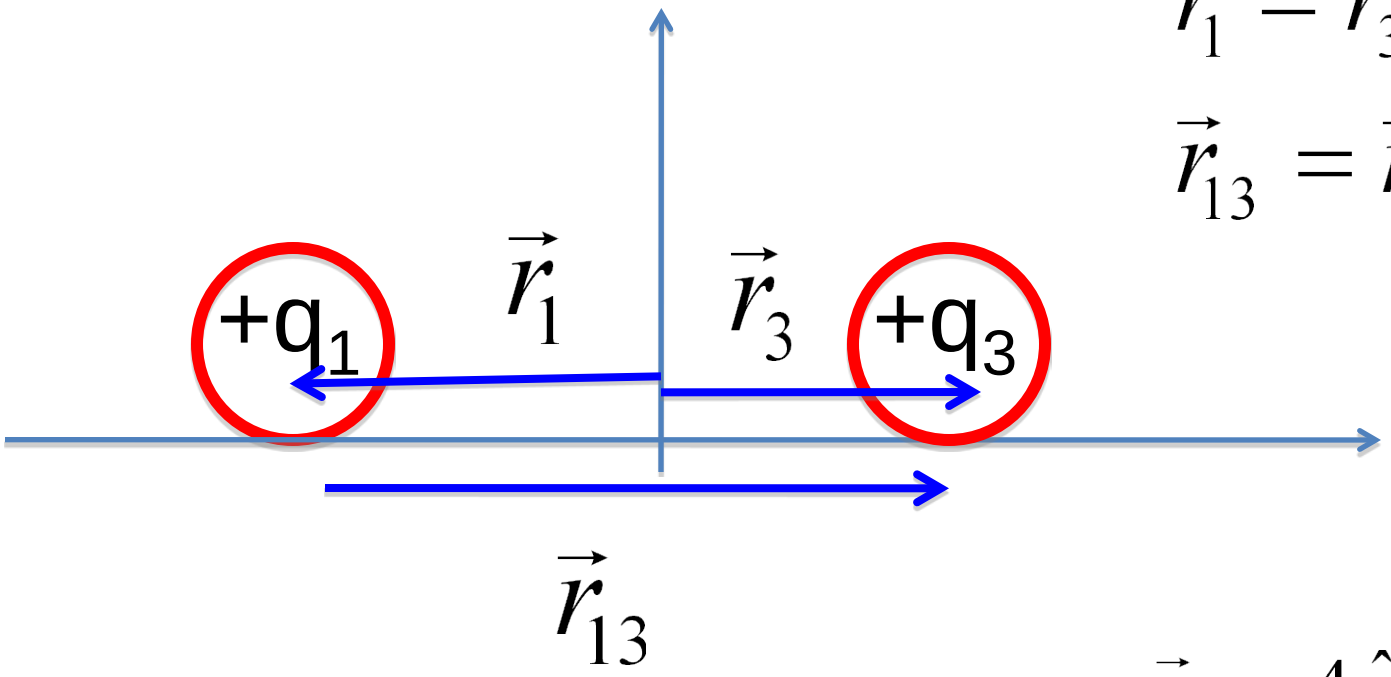
$$\vec{r}_2 = +8\hat{y}$$

$$\vec{r}_1 + \vec{r}_{12} = \vec{r}_2$$

$$\vec{r}_{12} = \vec{r}_2 - \vec{r}_1$$

$$\vec{r}_{12} = 8\hat{y} - (-6\hat{x})$$

$$\vec{r}_{12} = 8\hat{y} + 6\hat{x}$$

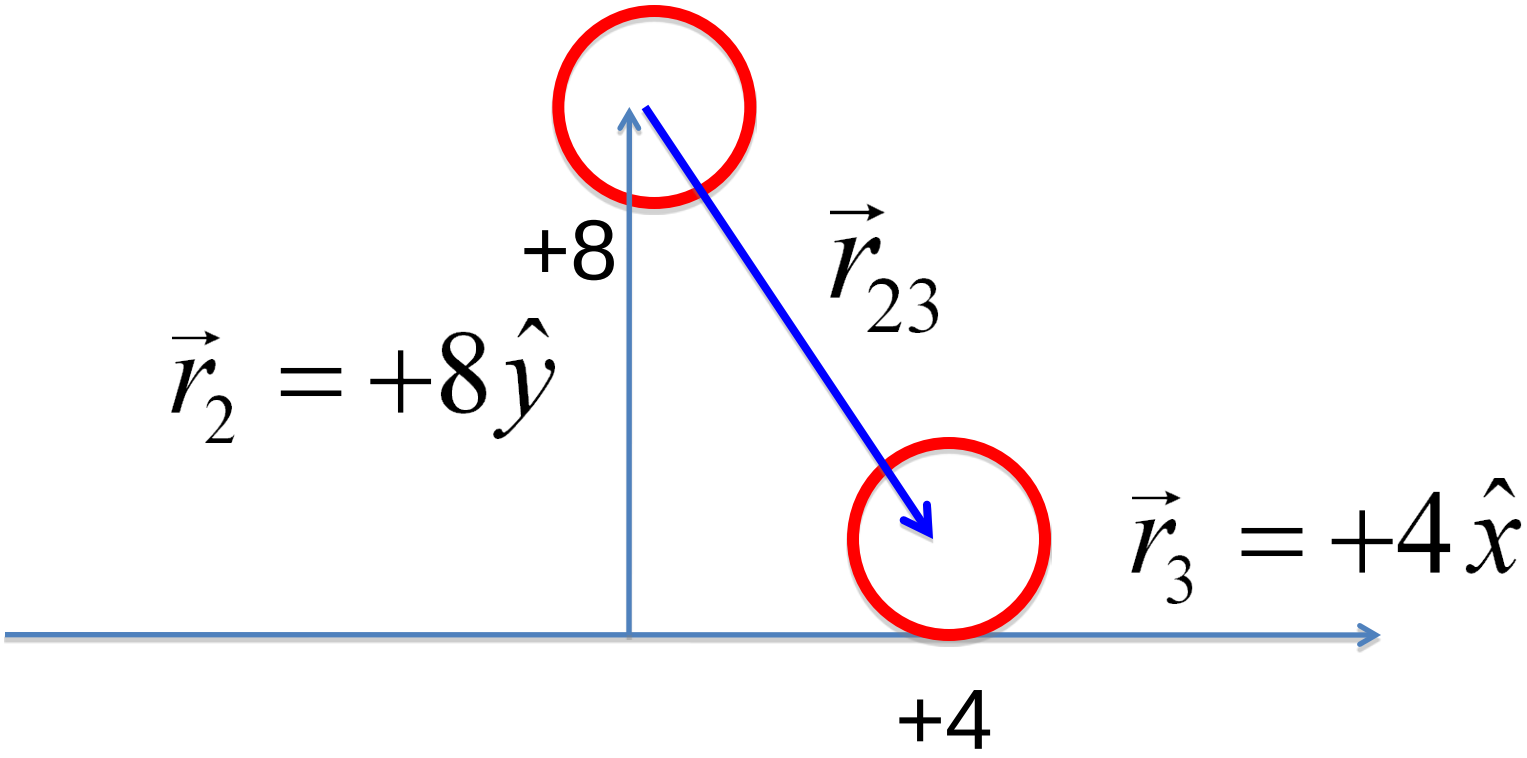


$$\vec{r}_1 = \vec{r}_3 - \vec{r}_{13}$$

$$\vec{r}_{13} = \vec{r}_3 - \vec{r}_1$$

$$\vec{r}_{13} = 4\hat{x} - (-6\hat{x})$$

$$\vec{r}_{13} = 10\hat{x}$$

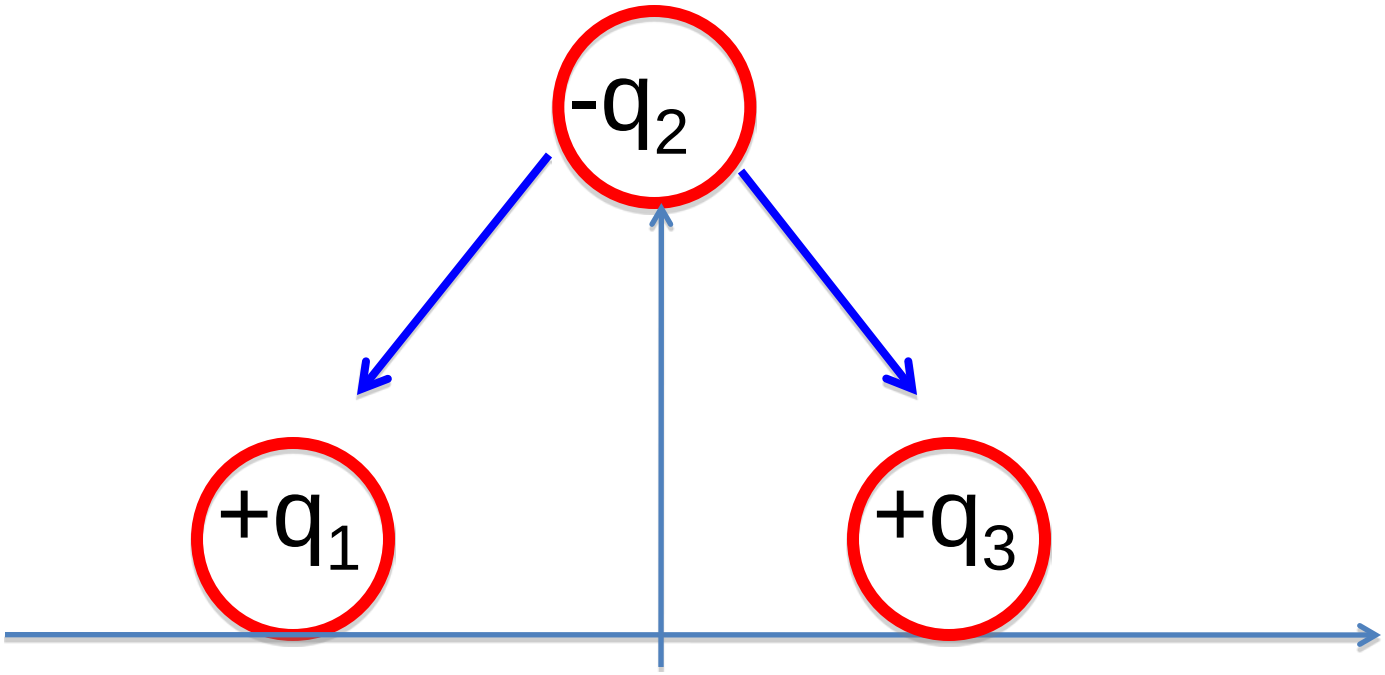


$$\vec{r}_{23} = \vec{r}_3 - \vec{r}_2$$

$$\vec{r}_{23} = 4\hat{x} - 8\hat{y}$$

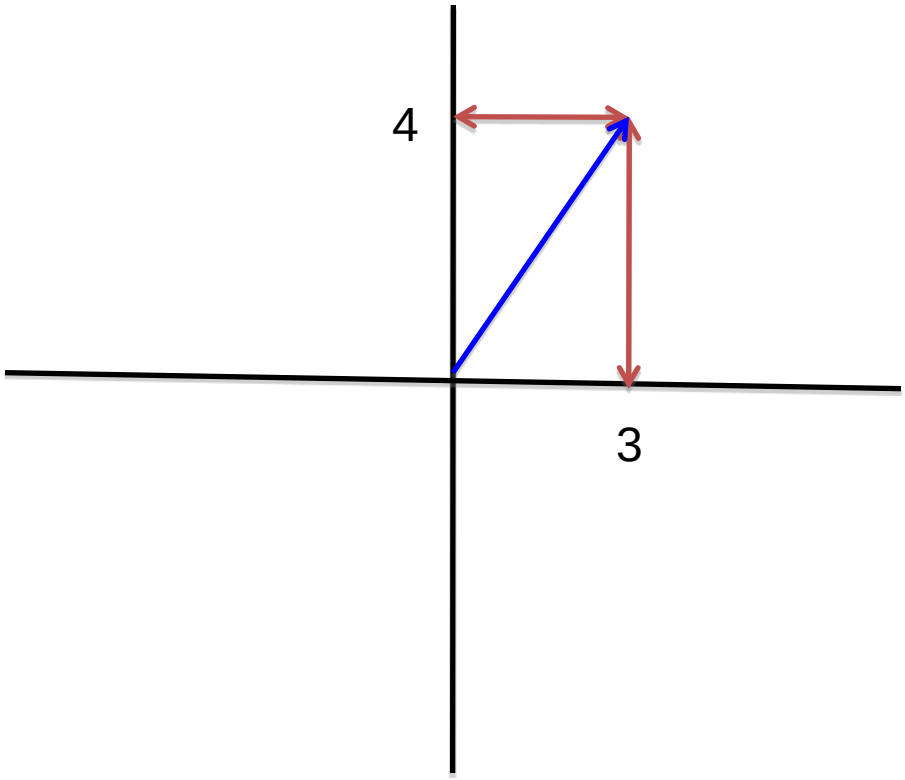
Summary

- Many physical quantities that we deal with are vectors
- Vectors have a magnitude and direction
- Vector addition



Force on the second charge due to 1 ?

We saw that two numbers specify a vector in 2D e.g. position of a particle.



Plane polar co-ordinate

We can represent the same using a distance and an angle.

$$x = r\cos\theta$$

$$y = r\sin\theta$$