Coordinates, Now with More Dimensions....

2D Coordinates

Variables: x (indep), y (dep)

Axes: x-axis $\perp$ y-axis

3D Coordinates

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$\circlearrowleft$

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Continued Comparison

2D Equations

Lines:

$x = 2$ defines

3D Equations

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2D Equations	3D Equations
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Definition: A **vector** is a quantity that has both magnitude and direction, often represented by an arrow. We'll use either $\mathbf{v}$, $\vec{v}$, or $\vec{\mathbf{v}}$.

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- Can have any number of dimensions.

What can we do with vectors?

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Distributive laws:

$(a + b) \cdot \vec{\mathbf{v}} = a \cdot \vec{\mathbf{v}} + b \cdot \vec{\mathbf{v}}$

$c \cdot (\vec{\mathbf{u}} + \vec{\mathbf{v}}) = c \cdot \vec{\mathbf{u}} + c \cdot \vec{\mathbf{v}}$

Grasping the magnitude of the situation

To write a vector in coordinates, place the tail at the origin and find the coordinates of the head.

- $\vec{\mathbf{u}} = \langle 1, 4, 3 \rangle$,
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- $\vec{\mathbf{u}} = \langle 1, 4, 3 \rangle$, then $|\vec{\mathbf{u}}| = \sqrt{1^2 + 4^2 + 3^2} = \sqrt{26}$.
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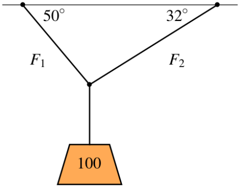
- Example. Unit vector of $\langle 2, -1, -2 \rangle$ is

Vectors are the best way to understand Physics

Example. A 100 lb weight hangs from the ceiling. How much force is held by each rope?



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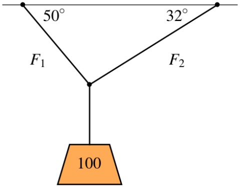

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Answer: The forces must be in equilibrium.

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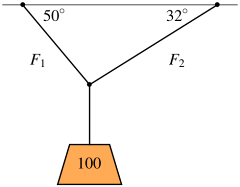

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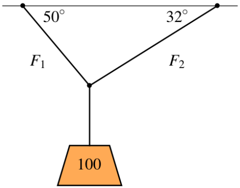

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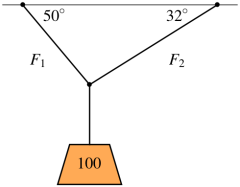

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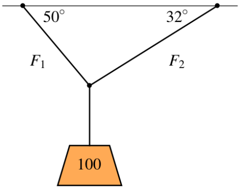

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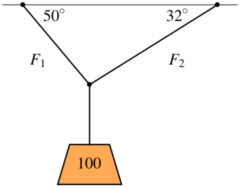

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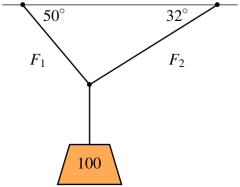

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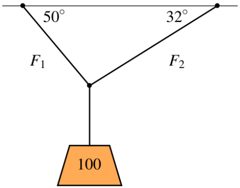

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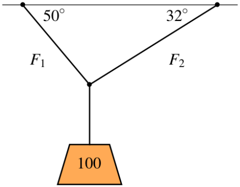

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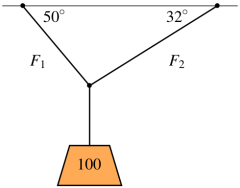

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$$-\cos 50\, F_1 + \cos 32\, F_2 = 0$$

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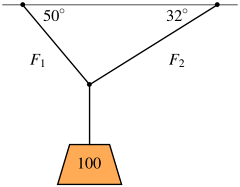

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- Use equilibrium to get a system of equations, solve.

$$-\cos 50\, F_1 + \cos 32\, F_2 = 0 \quad \text{and} \quad \sin 50\, F_1 + \sin 32\, F_2 - 100 = 0$$

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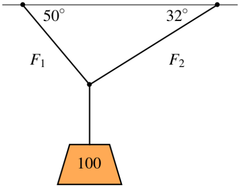

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  - The second force $\vec{\mathbf{F}}_2 = F_2 \langle \underline{\hspace{3cm}} \rangle$
- Use equilibrium to get a system of equations, solve.

$-\cos 50\, F_1 + \cos 32\, F_2 = 0$ and $\sin 50\, F_1 + \sin 32\, F_2 - 100 = 0$

Solving gives $F_1 \approx 85$ lb and $F_2 \approx 65$ lb.