

# Chapter 1: Vectors

Chapter 3 in the textbook



# Lecture Content

- Coordinate systems
- Vectors and scalar quantities
- Properties of vectors
- Components of vectors and unit vectors

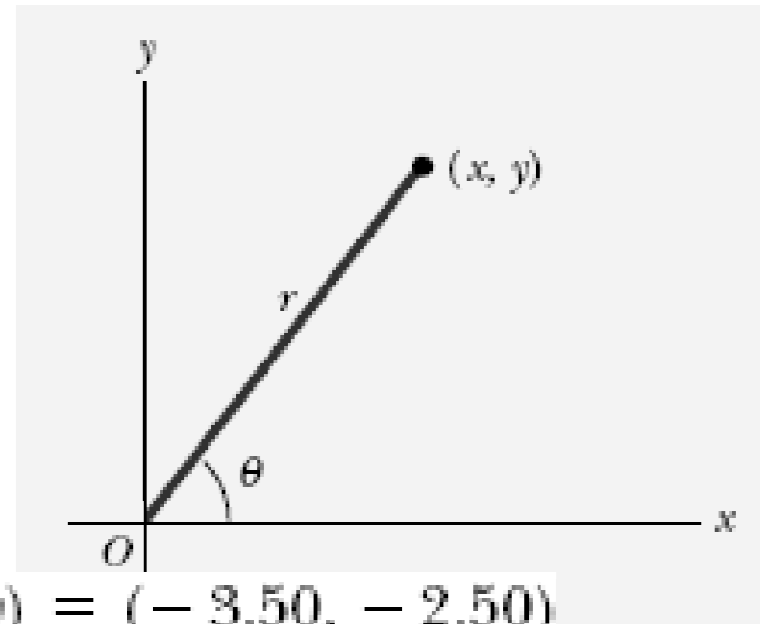
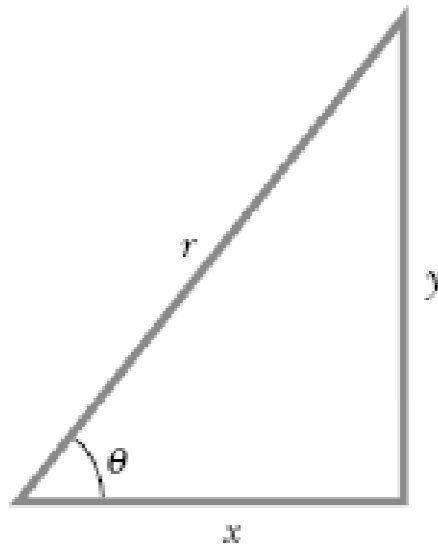
# Coordinate systems

$$\sin \theta = \frac{y}{r}$$

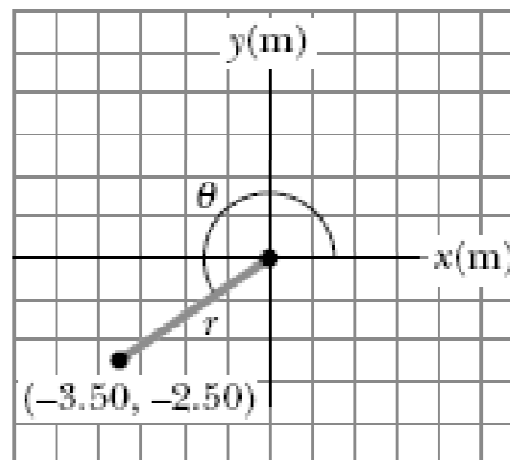
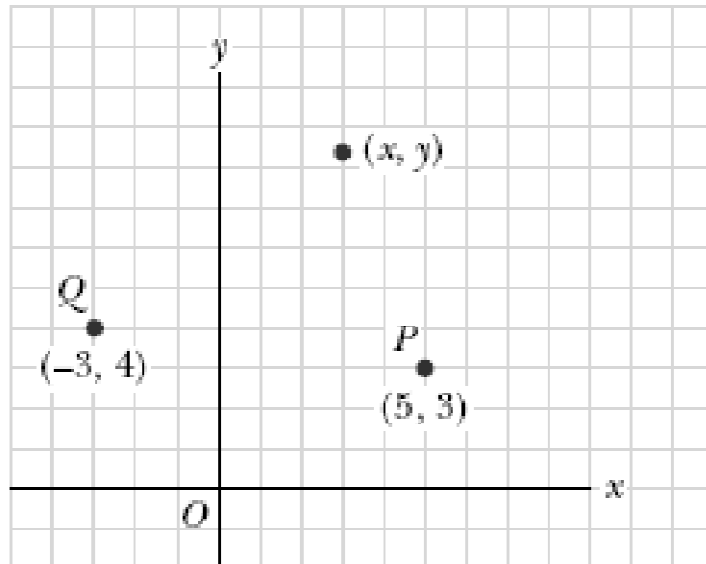
$$\cos \theta = \frac{x}{r}$$

$$\tan \theta = \frac{y}{x}$$

$$r = \sqrt{x^2 + y^2}$$



$$(x, y) = (-3.50, -2.50)$$



$$r = \sqrt{x^2 + y^2} =$$

$$\sqrt{(-3.50 \text{ m})^2 + (-2.50 \text{ m})^2}$$

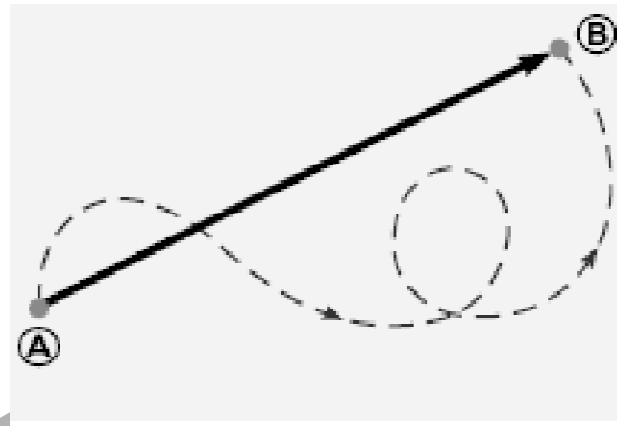
$$4.30 \text{ m}$$

$$\tan \theta = \frac{y}{x} = \frac{-2.50 \text{ m}}{-3.50 \text{ m}} = 0.714$$

$$\theta = 216^\circ$$

# Vector and Scalar quantities

- What to dress? Temperature and unit
- Scalar quantity is specified by a single value with appropriate unit and has no direction. Examples: mass, volume, distance
- What you need for flying a Kite? Wind and direction.
- Vector quantity is completely specified by a number and appropriate unit plus direction. Examples: displacement, velocity



# Vectors

- **A** (bold) is a vector,



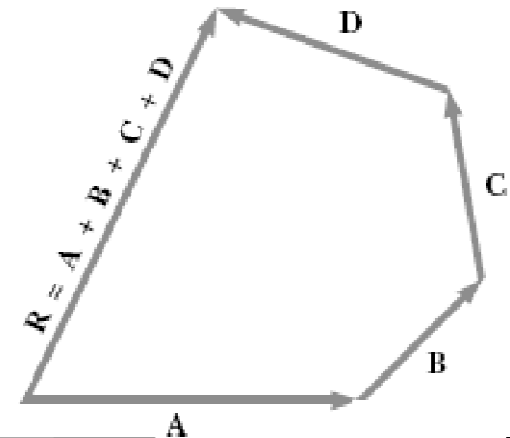
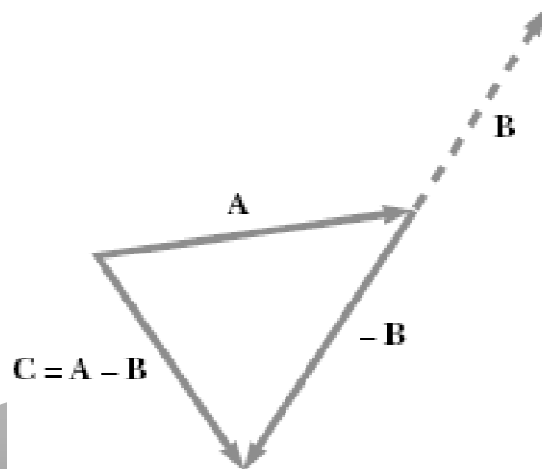
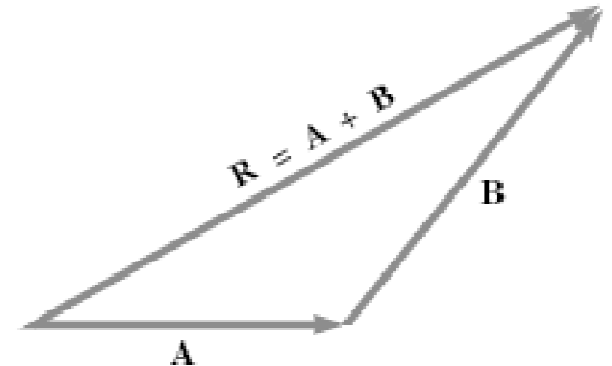
- A is a scalar.

- Two vectors are equal if the magnitude and direction are the same.

- Adding vectors

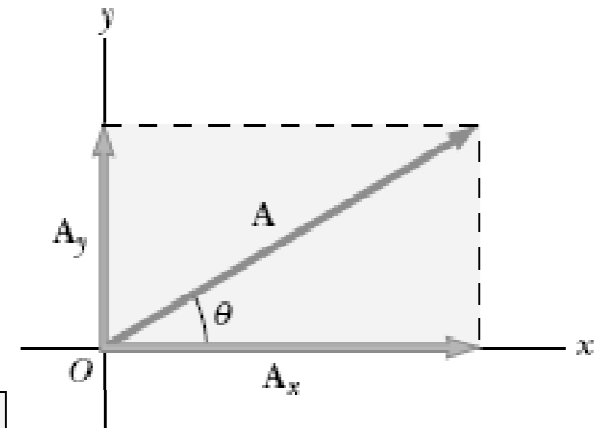
- Negative of a vector

- Vector subtraction

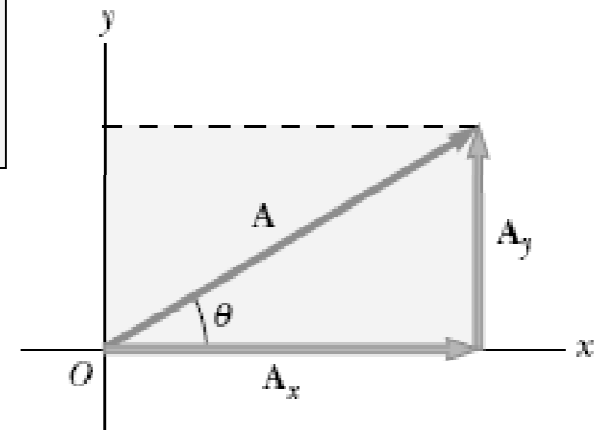


# Unit vectors

- Multiplying vector by a constant.
- Projection (components) of vector
- Why projection is important? Accuracy, 3D,

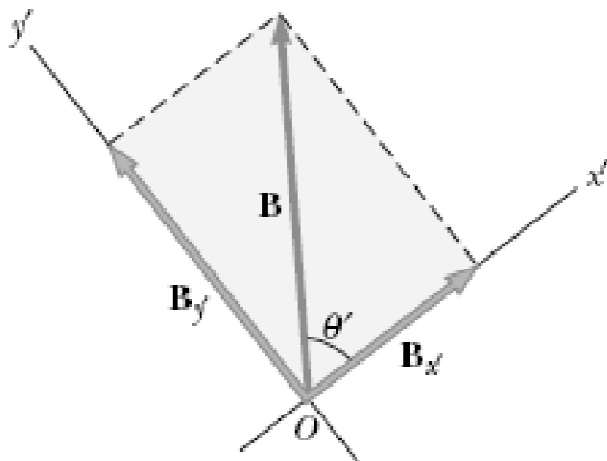


(a)



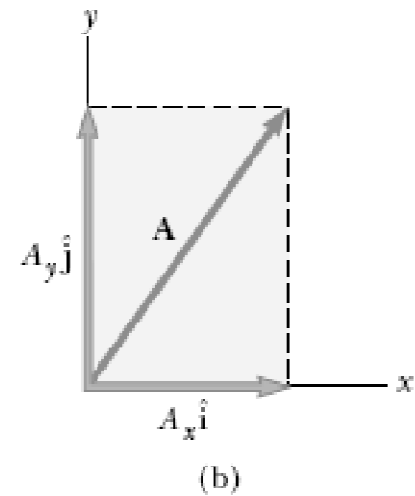
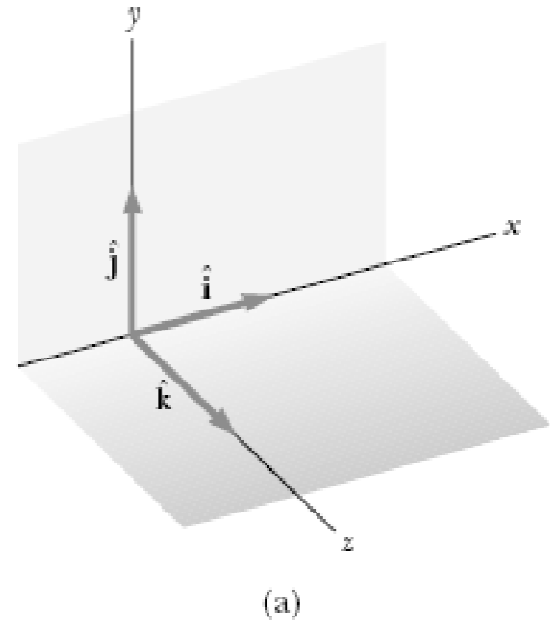
(b)

$y$	
$A_x$ negative	$A_x$ positive
$A_y$ positive	$A_y$ positive
$x$	
$A_x$ negative	$A_x$ positive
$A_y$ negative	$A_y$ negative



# Unit vectors

- Unit vectors in x, y, z coordinate are  $\hat{i}$ ,  $\hat{j}$ ,  $\hat{k}$



More details will be followed