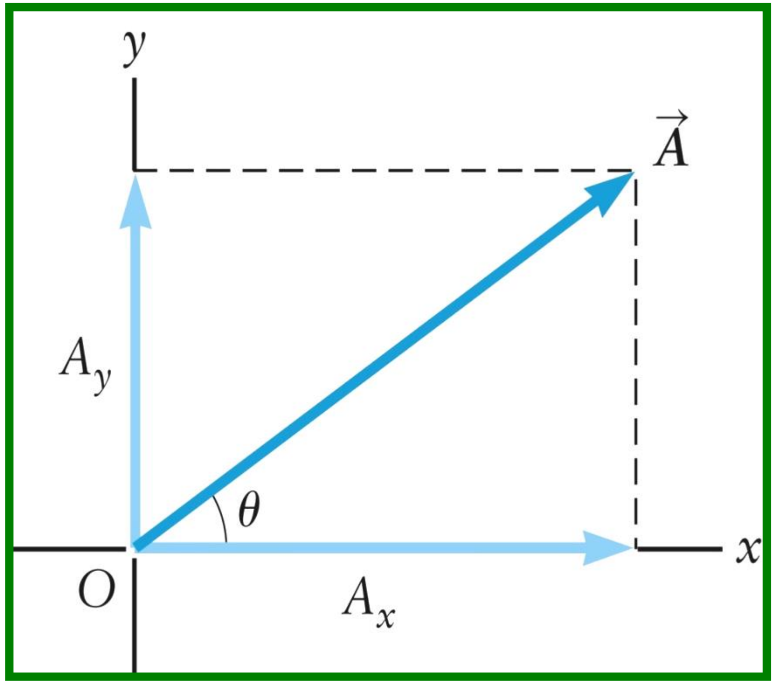
Components of a vector

- The **x-** and **y**-components of a vector are its **projections** along the **x**- and **y**-axes
- Calculation of the **x**- and **y**-components involves trigonometry

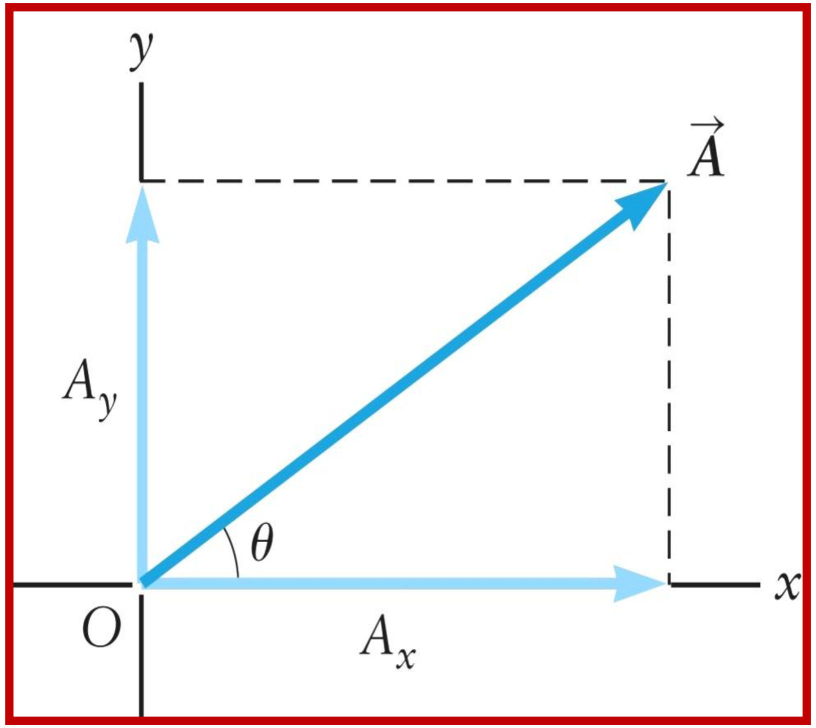
$$A_x = A \cos \theta$$

$$A_y = A \sin \theta$$



Components of a vector

- If we know the components, we can find the vector.
- Use the **Pythagorean Theorem** for the magnitude:



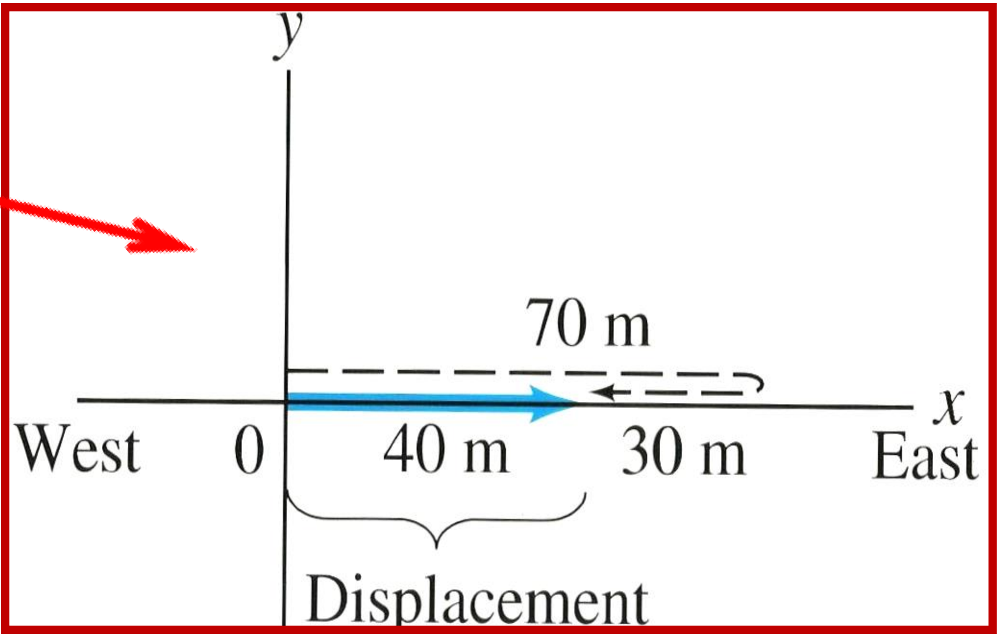
$$A = \sqrt{A_x^2 + A_y^2}$$

- Use the **tan^{-1}** function to find the direction: $\theta = \tan^{-1}\frac{A_y}{A_x}$

Displacement & Distance

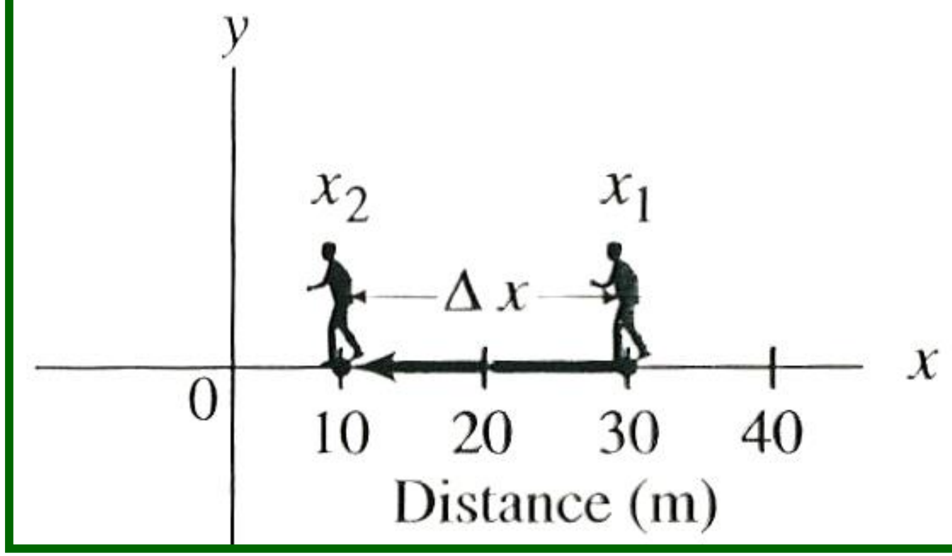
Distance traveled **by an object ≠** ***Displacement*** **of the object!**

Here,
Distance = 100 m.
Displacement
= 40 m East.



- **Displacement ≡ Δx ≡** ***Change in position*** of an object. **Δx** is a **vector** (magnitude & direction).
- **Distance** is a **scalar** (magnitude).

FIGURE 2–6 For the displacement $\Delta x = x_2 - x_1 = 10.0\ \text{m} - 30.0\ \text{m}$, the displacement vector points to the left.



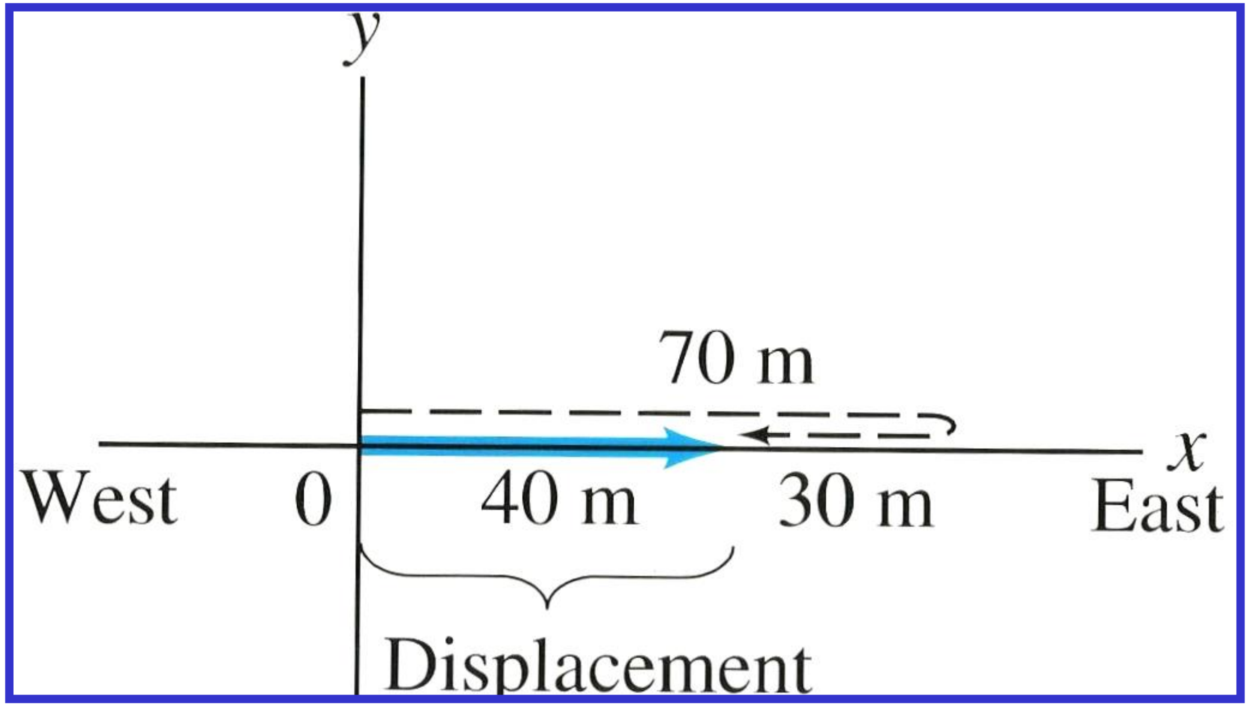
x_1 = 30 m, x_2 = 10 m

Displacement ≡ $\Delta x = x_2 - x_1$ = - 20 m

Average Velocity & Average Speed

Consider the displacement from slide 3.

Suppose that the person walks the whole trip in **70 s.**



Average Speed = (100 m)/(70 s) = 1.4 m/s

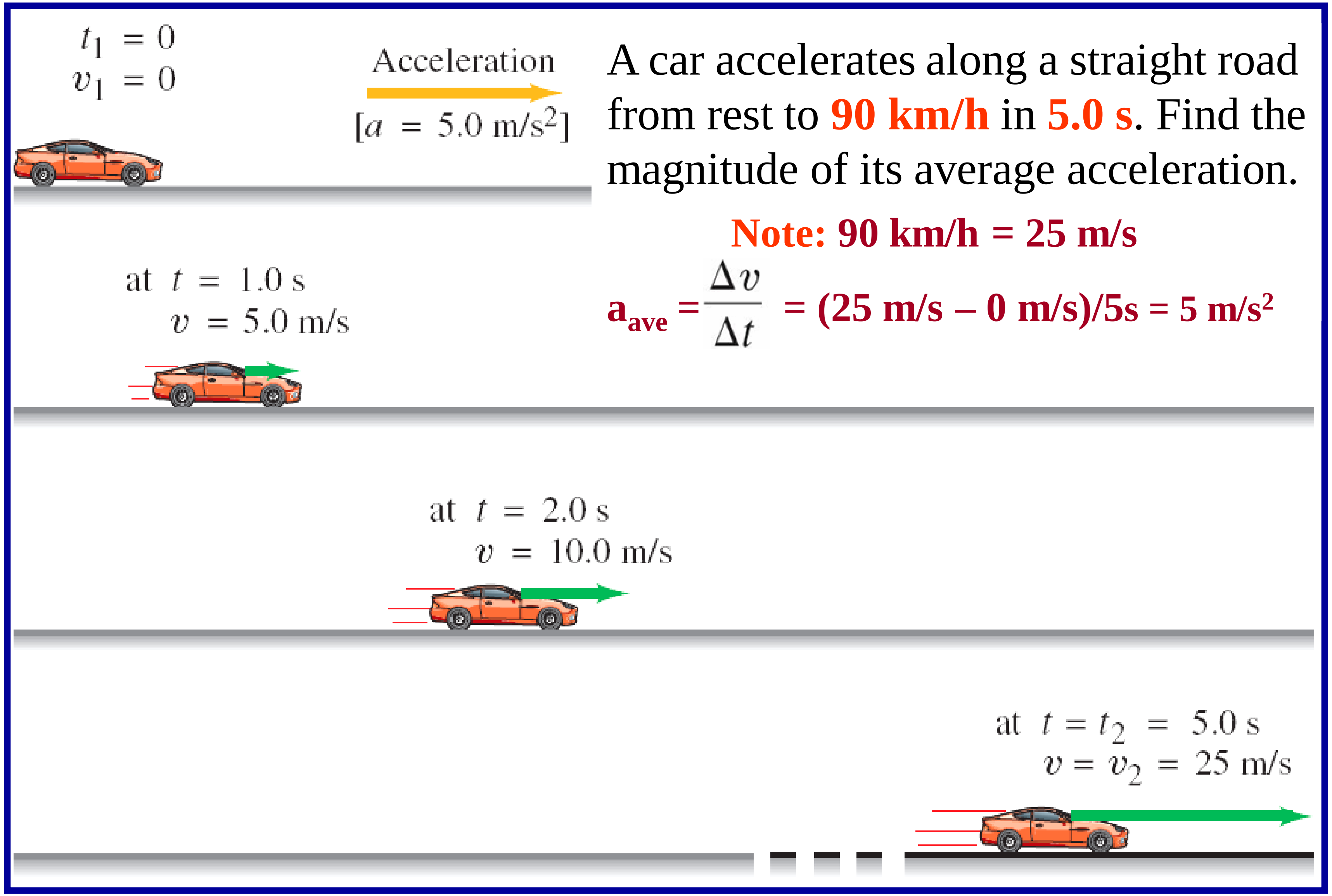
Average Velocity = (40 m)/(70 s) = 0.57 m/s

Example: Average Acceleration

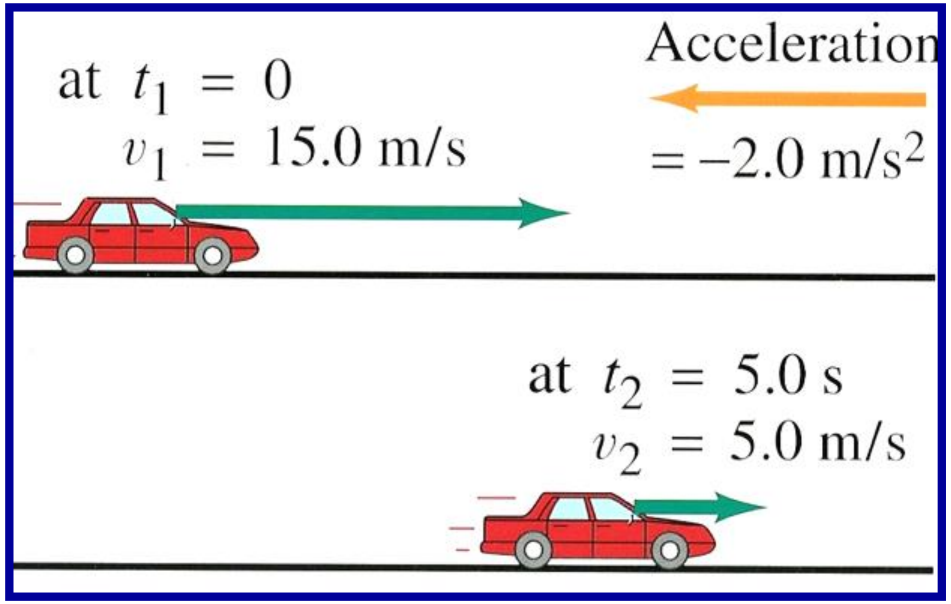
A car accelerates along a straight road from rest to **90 km/h** in **5.0 s**. Find the magnitude of its average acceleration.

Note: 90 km/h = 25 m/s

$$\mathbf{a_{ave}} = \frac{\Delta v}{\Delta t} = \mathbf{(25\ m/s - 0\ m/s)/5s = 5\ m/s^2}$$



Example: A slowing down car

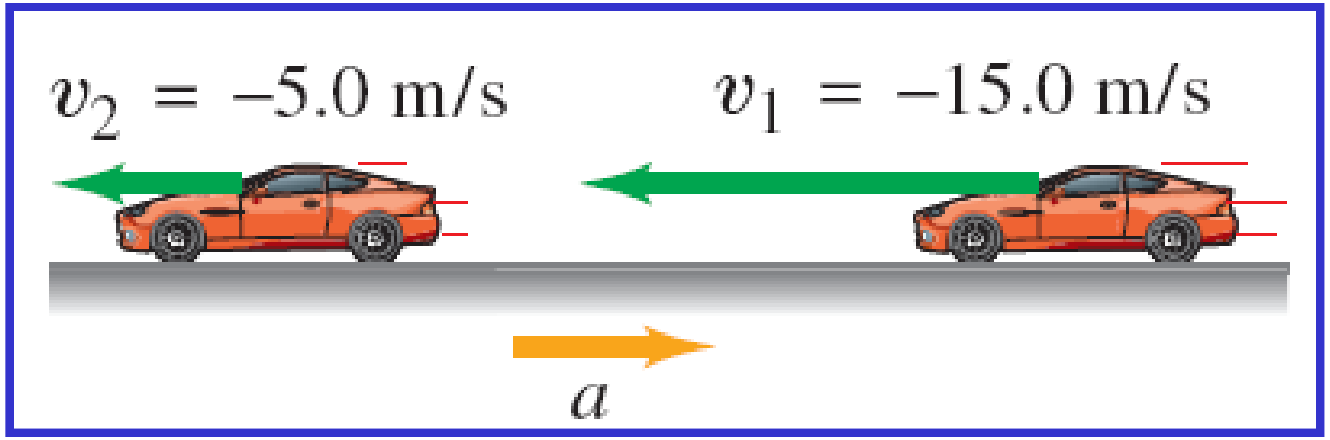


A car moves to the right on a straight highway (positive **x-axis**). Calculate the car's average acceleration.

$$\mathbf{a} = \frac{\Delta v}{\Delta t} = (v_2 - v_1)/(t_2 - t_1) = (5 \text{ m/s} - 15 \text{ m/s})/(5\text{s} - 0\text{s})$$

$$\mathbf{a = -2.0\ m/s^2}$$

Deceleration



The same car is moving to the left instead of to the right. **We still assume positive x is to the right.** The car is "decelerating" & the initial & final velocities are same as before. Calculate the average acceleration now.

$$a = \frac{v_2 - v_1}{\Delta t} = \frac{-5.0\text{ m/s} - (-15.0\text{ m/s})}{5.0\text{ s}}$$

$$= \frac{-5.0\text{ m/s} + 15.0\text{ m/s}}{5.0\text{ s}} = +2.0\text{ m/s}.$$

Deceleration is a **misleading** term!