

Engineering Problem
Solving
ENG1100 - Session 9b

**1-D Motion
Equations**

Session Objectives

- Solve Problems using
 - 1D Motion
 - Spreadsheet calculations

Motion

- Velocity $v = v_o + at$
- Position $x = x_o + v_o t + 1/2 at^2$
 - Where:
 - $v = \text{velocity}$ $v_o =$ initial velocity
 - $a =$ constant acceleration
 - $t =$ time
 - $x =$ position $x_o =$ initial position

Units for Motion Equations

- Velocity $\mathbf{v = v_o + at}$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} * \underline{\hspace{2cm}} \quad (\text{english})$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} * \underline{\hspace{2cm}} \quad (\text{metric})$$

- Position $\mathbf{x = x_o + v_o t + 1/2 at^2}$

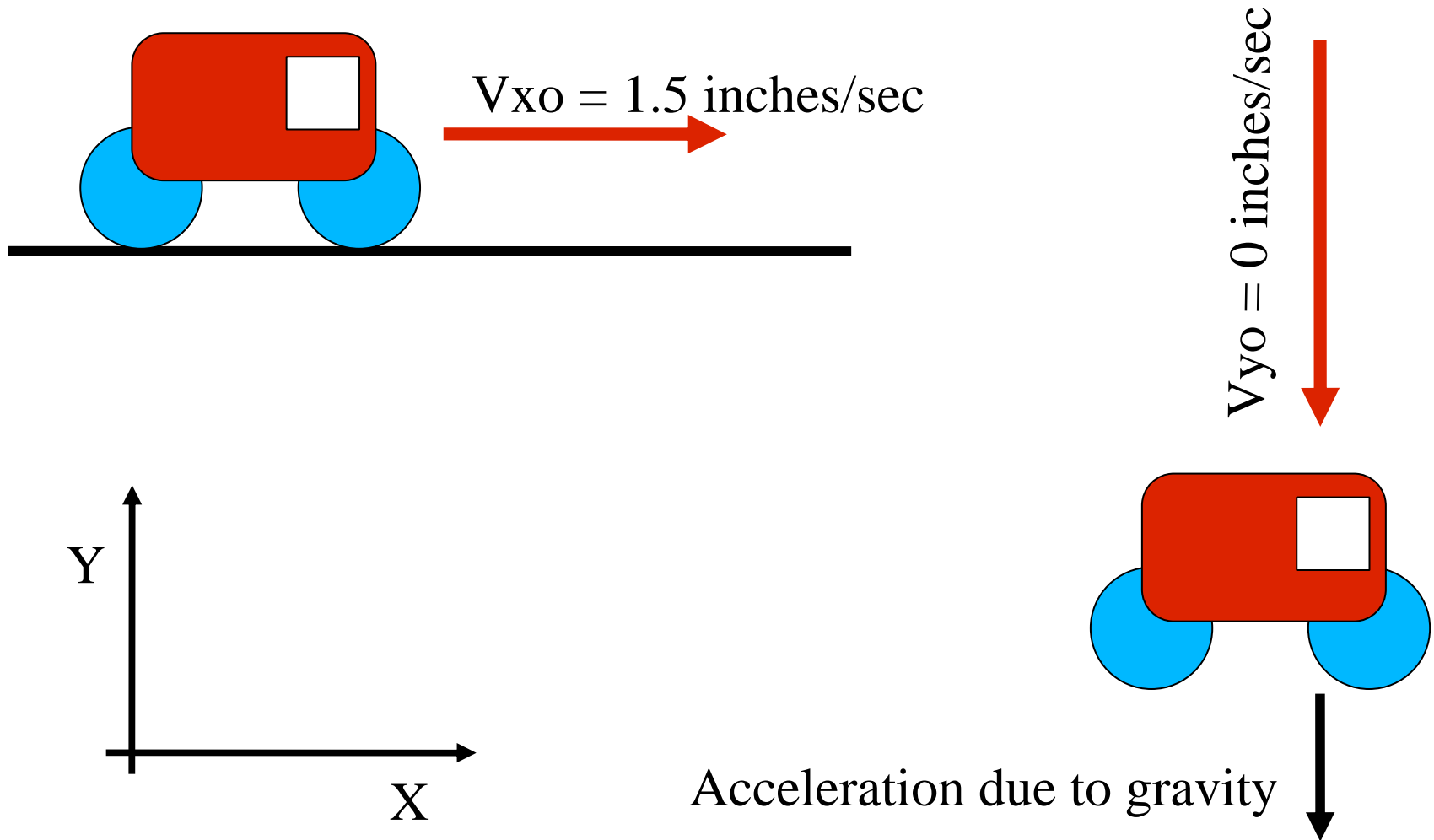
$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} * \underline{\hspace{2cm}} + 1/2 \underline{\hspace{2cm}} * \underline{\hspace{2cm}} \quad (\text{e})$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} * \underline{\hspace{2cm}} + 1/2 \underline{\hspace{2cm}} * \underline{\hspace{2cm}} \quad (\text{m})$$

Position

- $x = x_0 + v_0 t + 1/2 a t^2$
 - *If we assume:*
 - *Constant velocity, $a = 0$*
 - *Starting position is zero, $x_0 = 0$*
 - $x = 0 + v_0 t + 1/2 * 0 * t^2$
 - $x = v_0 t$, *Distance = Rate * Time*
 - $x = 24 \text{ inches}$ & $t = 27 \text{ seconds}$
 - $v_0 = ??$

Direction with Motion Positive and Negative



Directional Equations

X direction

$$x = x_o + v_{x_o}t + 1/2 a_x t^2$$

$$v_x = v_{x_o} + a_x t$$

assume:

$$a_x = \text{constant}$$

$$x_o = 0$$

Y direction

$$y = y_o + v_{y_o}t + 1/2 a_y t^2$$

$$v_y = v_{y_o} + a_y t$$

assume:

$$a_y = \text{gravity}$$

$$y_o = 0$$

Work a motion problem

- Always draw a sketch first
- Add all known info to sketch
- Add equations and positive x & y directions
- What assumptions can you make

REVIEW: Problem Solving Method

- 1) **Problem:** summary of the problem statement
 - a) **Given:** Information/Values Given
 - b) **Diagram:** sketch of the problem including given information
- 2) **Find:** List Unknowns & Variable Names
- 3) **Relationships:** show all your equations & steps as completely as possible
- 4) **Solve:** Check units and equations and **BOX** your final answer

Example Motion Problem....

- A ball is thrown vertically upward at an initial velocity of 15 ft/s. What is the balls maximum height? What time does it reach the maximum height?

Example Motion Problem....

- A ball thrown upward. The thrower catches it 2.8 seconds later. What was the balls initial velocity in m/s? What was the balls maximum height?