

SAMPLE PROBLEM E

Final Velocity After Any Displacement

PROBLEM

A person pushing a stroller starts from rest, uniformly accelerating at a rate of 0.500 m/s^2 . What is the velocity of the stroller after it has traveled 4.75 m ?

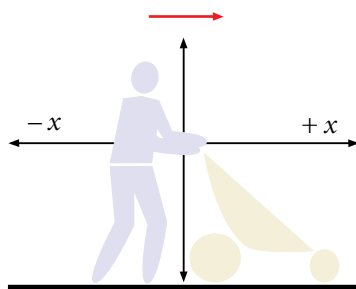
SOLUTION

1. DEFINE

Given: $v_i = 0 \text{ m/s}$ $a = 0.500 \text{ m/s}^2$
 $\Delta x = 4.75 \text{ m}$

Unknown: $v_f = ?$

Diagram:



Choose a coordinate system. The most convenient one has an origin at the initial location of the stroller. The positive direction is to the right.

2. PLAN

Choose an equation or situation:

Because the initial velocity, acceleration, and displacement are known, the final velocity can be found using the following equation:

$$v_f^2 = v_i^2 + 2a\Delta x$$

Rearrange the equation to isolate the unknown:

Take the square root of both sides to isolate v_f .

$$v_f = \pm\sqrt{(v_i)^2 + 2a\Delta x}$$

3. CALCULATE

Substitute the values into the equation and solve:

$$v_f = \pm\sqrt{(0 \text{ m/s})^2 + 2(0.500 \text{ m/s}^2)(4.75 \text{ m})}$$

$$v_f = +2.18 \text{ m/s}$$



Think about the physical situation to determine whether to keep the positive or negative answer from the square root. In this case, the stroller is speeding up because it starts from rest and ends with a speed of 2.18 m/s . An object that is speeding up and has a positive acceleration must have a positive velocity, as shown in **Table 3**. So, the final velocity must be positive.

4. EVALUATE

The stroller's velocity after accelerating for 4.75 m is 2.18 m/s to the right.