1.16. Model: Represent the tennis ball as a particle.

Visualize:

The particle falls freely for the three stories under the acceleration of gravity. It strikes the ground and very quickly decelerates to zero (while compressing the ball) then quickly accelerates upward (while the ball decompresses) and finally travels upward with negative acceleration under gravity to zero velocity at a height of two stories. The downward and upward motions of the ball are shown in the figure. The increasing length between the dots during downward motion indicates increasing average velocity or downward acceleration. On the other hand, the decreasing length between the dots during upward motion indicates acceleration in a direction opposite to its motion; that is, in the downward direction.

Assess: For a free-fall motion, acceleration due to gravity is always vertically downward.
1.22. Solve: (a) \( 8 \text{ inches} = 8 \text{ (inch)} \left( \frac{2.54 \text{ cm}}{1 \text{ inch}} \right) \left( \frac{10^{-2} \text{ m}}{1 \text{ cm}} \right) = 0.203 \text{ m} \)

(b) \( 66 \text{ feet/s} = 66 \left( \frac{\text{ feet}}{\text{s}} \right) \left( \frac{12 \text{ inch}}{1 \text{ foot}} \right) \left( \frac{1 \text{ m}}{39.37 \text{ inch}} \right) = 20.1 \text{ m/s} \)

(c) \( 60 \text{ mph} = 60 \left( \frac{\text{ miles}}{\text{hour}} \right) \left( \frac{1.609 \text{ km}}{1 \text{ mile}} \right) \left( \frac{10^3 \text{ m}}{1 \text{ km}} \right) \left( \frac{1 \text{ hour}}{3600 \text{ s}} \right) = 26.8 \text{ m/s} \)

(d) \( 14 \text{ square inches} = 14 \text{ (inches)}^2 \left( \frac{1 \text{ m}}{39.37 \text{ inches}} \right)^2 = 9.03 \times 10^{-3} \text{ square meter} \)
1.30. Solve: (a) $(33.3)^2 = 1.11 \times 10^3$
(b) $33.3 \times 45.1 = 1.50 \times 10^3$
Scientific notation is an easy way to establish significance.
(c) $\sqrt{22.2} - 1.2 = 3.5$
(d) $\frac{1}{44.4} = 0.0225$
1.34. Solve: My barber trims about an inch of hair when I visit him every month for a haircut. The rate of hair growth is

\[
\frac{1 \text{ inch}}{\text{month}} \left( \frac{2.54 \text{ cm}}{1 \text{ inch}} \right) \left( \frac{10^{-2} \text{ m}}{1 \text{ cm}} \right) \left( \frac{1 \text{ month}}{30 \text{ days}} \right) \left( \frac{1 \text{ day}}{24 \text{ hr}} \right) \left( \frac{1 \text{ hr}}{3600 \text{ s}} \right) = 9.8 \times 10^{-9} \text{ m/s}
\]

\[
= 9.8 \times 10^{-9} \left( \frac{\text{m}}{\text{s}} \right) \left( \frac{10^6 \mu\text{m}}{1 \text{ m}} \right) \left( \frac{3600 \text{ s}}{1 \text{ hr}} \right) = 35 \mu\text{m/hr}
\]
1.36. **Model:** Represent the watermelon as a particle for the motion diagram.

**Visualize:**

- **Pictorial representation**
- **Motion diagram**

**Known**

- $y_0 = 10 \text{ m} \quad v_0 = 0$
- $t_0 = 0 \quad a_y = -9.8 \text{ m/s}^2$
- $y_1 = 0$

**Find**

- $v_1$

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Watermelon

$y_1, t_1$

0

Starts

$a_y$

Hits sidewalk
1.54. Solve: (a) A coyote (A) sees a rabbit and begins to run toward it with an acceleration of 3.0 m/s². At the same instant, the rabbit (B) begins to run away from the coyote with an acceleration of 2.0 m/s². The coyote catches the rabbit after running 40 m. How far away was the rabbit when the coyote first saw it?

(b) A coyote (A) sees a rabbit and begins to run toward it with an acceleration of 3.0 m/s². At the same instant, the rabbit (B) begins to run away from the coyote with an acceleration of 2.0 m/s². The coyote catches the rabbit after running 40 m. How far away was the rabbit when the coyote first saw it?

(c) Known
\[ x_{A0} = 0 \]
\[ v_{A0} = 0 \]
\[ t_0 = 0 \]
\[ a_A = 3 \text{ m/s}^2 \]
\[ v_{B0} = 0 \]
\[ a_B = 2 \text{ m/s}^2 \]
\[ v_{A1} = x_{B1} = 40 \text{ m} \]

Find
\[ x_{B0} \]