

Introduction to Acceleration Problems

Equation: $a = \frac{\Delta v}{t}$ or $a = \frac{v_f - v_i}{t}$

1. A ball rolls down a hill with a constant acceleration of -3 m/s^2 . If it starts from rest, what is its velocity at the end of 4 seconds?

$$-12 \text{ m/s}$$

2. A car starting from rest is accelerated at the constant rate of 3 m/s^2 . What is the velocity at the end of 10 seconds?

$$30 \text{ m/s}$$

3. A car traveling at 25 m/s is brought to rest at a constant rate in 20 sec by applying a brake. What is the constant acceleration?

$$-1.25 \text{ m/s}^2$$

4. What will be the velocity of the car in problem #3 at the end of 17 seconds?

$$-3.75 \text{ m/s}$$

5. What is the acceleration of a plane changing velocity from 140 m/s to 70 m/s in 15 s?

$$-4.7 \text{ m/s}^2$$

6. What was a bicycle's initial velocity if, after accelerating at a constant rate of 2.0 m/s^2 for 30 seconds, the final velocity was 90 m/s ?

$$30 \text{ m/s}$$

Acceleration and Distance Problems

Equations:

$$v = \frac{d}{t} \quad / \quad a = \frac{v_f - v_i}{t} \quad / \quad d = v_0 t + \frac{1}{2} a t^2$$

1. A hot-air balloon is released from rest and attains a velocity of 6 m/s.
 - a. If the balloon has an acceleration of 1.7 m/s^2 then how long did it take to attain a velocity of 6 m/s?

$$3.53 \text{ s}$$

- b. How high did the hot-air balloon travel in that time?

$$10.59 \text{ m}$$

2. A plane flying at a speed of 120 m/s is accelerated uniformly at a rate of 9 m/s^2 .
 - a. What is the plane's speed at the end of 4.5 seconds?

$$160.5 \text{ m/s}$$

- b. What distance has it traveled?

$$631.13 \text{ m}$$

3. An engineer is to design a runway to accommodate airplanes that must gain a speed of 60 m/s before they can take off. These airplanes are capable of being accelerated uniformly at a rate of 1.5 m/s^2 .

- a. What is the expected time to takeoff, assuming the plane starts at rest?

$$40 \text{ s}$$

- b. What must be the minimum runway length?

$$1200 \text{ m}$$

4. A package is dropped from out of the trapdoor on a plane. If the package takes 3.25 seconds to hit the ground...

- a. How high up was the plane if it accelerated towards the ground at -9 m/s^2 ?

$$47.5 \text{ m}$$

- b. With what speed did the package hit the ground?

$$29.25 \text{ m/s}$$