Bungee jumping has become a popular but dangerous sport. It also shows how the acceleration of gravity is connected to the total distance traveled during the fall. The distance traveled is given by the formula

\[ D = \frac{1}{2} g T^2 \]

Where \( g \) is the acceleration of gravity in meters/sec\(^2\), \( D \) is the distance in meters, and \( T \) is the elapsed time in seconds. For locations near the surface of Earth, \( g = 9.8 \) meters/sec\(^2\) (32 feet/sec\(^2\)).

**Problem 1** - A confused Daredevil jumps from a plane at an altitude of 15,000 feet. How long does it take for the Daredevil to land if there is no air friction to slow him down?

**Problem 2** – How fast would the Daredevil be traveling at the moment of impact if \( S = 32T \)?

**Problem 3** – Once he reaches 130 mph (190 feet/sec), called the terminal velocity, his free-fall speed stops increasing. How soon after he jumps does he reach terminal velocity, and how far has he fallen from the plane?

**Problem 4** - In 2012, Felix Baumgartner jumped from a high-altitude balloon at an altitude of 24 miles (127,000 feet), landing safely on the ground after 4 minutes and 19 seconds. With little atmosphere friction, he reached a maximum speed of 844 mph (1240 feet/sec). How long after he jumped did he reach this speed, and how high above the ground was he at that time?

**Problem 5** – On Mars, the Valles Marineris canyon is 23,000 feet deep. If the acceleration of gravity is 12 feet/sec\(^2\), how long would it take a rock to fall into the canyon and how fast is it traveling when it hits bottom?

Space Math  http://spacemath.gsfc.nasa.gov
**Problem 1** - A confused Daredevil jumps from a plane at an altitude of 15,000 feet. How long does it take for the Daredevil to land if there is no air friction to slow him down?

Answer: \(15,000 = \frac{1}{2} (32) T^2\), so \(T^2 = 937\) and so \(T = 31\) seconds.

**Problem 2** – How fast would the Daredevil be traveling at the moment of impact if \(S = 32T\)?

Answer: \(S = 32 \times 31 = 992\) feet/second or 676 miles/hour!

**Problem 3** – Once he reaches 130 mph (190 feet/sec), called the terminal velocity, his free-fall speed stops increasing. How soon after he jumps does he reach terminal velocity, and how far has he fallen from the plane?

Answer: \(190 = 32 \times T\) so \(T = 6\) seconds. He has fallen \(d = \frac{1}{2} (32)(6)^2 = 576\) feet.

**Problem 4** - In 2012, Felix Baumgartner jumped from a high-altitude balloon at an altitude of 24 miles (127,000 feet), landing safely on the ground after 4 minutes and 19 seconds. With little atmosphere friction, he reached a maximum speed of 844 mph (1240 feet/sec). How long after he jumped did he reach this speed, and how high above the ground was he at that time?

Answer: \(1240 = 32 \times T\) so \(T = 39\) seconds. 
\(D = \frac{1}{2} (32) (39)^2 = 24,336\) feet, so \(127,000 - 24333 = 102,700\) feet from the ground.

**Problem 5** – On Mars, the Valles Marineris canyon is 23,000 feet deep. If the acceleration of gravity is 12 feet/sec\(^2\), how long would it take a rock to fall into the canyon and how fast is it traveling when it hits bottom?

Answer: \(23,000 = \frac{1}{2}(12)T^2\) so \(T = 62\) seconds. 
Speed = \(12 \times 62 = 744\) feet/sec or 507 mph.