Distance Traveled Under Constant Acceleration

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?

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 = ½ (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 x 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 x T so T = **6 seconds**. He has fallen d = ½ (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 T so T = **39 seconds**.
D = ½ (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 = ½(12)T^2 so T = **62 seconds**.
Speed = 12 x 62 = **744 feet/sec or 507 mph**.