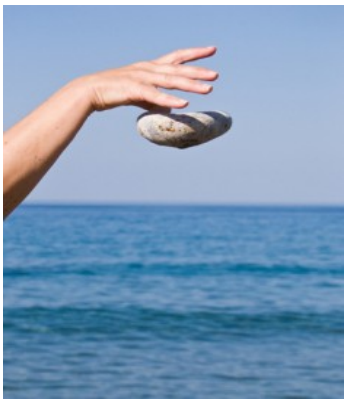

One of the simplest kinds of motion that were first studied carefully is that of falling. Unless supported, a body will fall to the ground under the influence of gravity. But the falling does not happen smoothly. Instead, the speed of the body increases in proportion to the elapsed time. This is called acceleration.

Near Earth's surface, the speed of a body increases 32 feet/sec (9.8 meters/sec) for every elapsed second. This is usually written as an acceleration of 32 feet/sec/sec or 32 feet/sec^2. (also 9.8 meters/sec^2) A simple formula gives you the speed of the object after an elapsed time of T seconds:

$S = 32\ T$ in feet/sec

If instead of just dropping the object, you threw it downwards at a speed of 12 feet/sec (3 meters/sec) you could write the formula as:

$S = 12 + 32T$ feet/sec

In general you could also write this by replacing the selected speed of 12 feet/sec, with a fill-in speed of S_0 to get

$S = S_0 + 32T$ feet/sec.

Problem 1 – On Earth, a ball is dropped from an airplane. If the initial speed was 0 feet/sec, how many seconds did it take to reach a speed of 130 miles per hour, which is called the Terminal Velocity? (130 mph = 192 feet/sec)

Problem 2 – On Mars, the acceleration of gravity is only 12 feet/sec^2. A rock is dropped from the edge of the huge canyon called Valles Marineris and falls 20,000 to the canyon floor. If the impact speed was measured to be 700 feet/sec (480 mph) how long did it take to impact the canyon floor?

Problem 3 – Two astronauts standing on the surface of two different objects in the solar system want to decide which object is the largest in mass. The first astronaut drops a hammer off a cliff that is exactly 5000 feet tall and measures the impact speed with a radar gun to get 100 feet/sec. It takes 8 seconds for the hammer to hit the bottom. The second astronaut drops an identical hammer off a cliff that is only 500 feet tall and also measures the impact speed at 150 feet/sec, but he accidentally gave the object a release speed of 5 feet/sec. It takes 29 seconds for the hammer to reach the ground. They can't re-do the experiments, but given this information what are the accelerations of gravity on the two bodies and which one has the highest mass?

Problem 1 – On Earth, a ball is dropped from an airplane. If the initial speed was 0 feet/sec, how many seconds did it take to reach a speed of 130 miles per hour, which is called the Terminal Velocity? (130 mph = 192 feet/sec)

Answer: 192 = 32T, so T = **6 seconds**.

Problem 2 – On Mars, the acceleration of gravity is only 12 feet/sec^2. A rock is dropped from the edge of the huge canyon called Valles Marineris and falls 20,000 to the canyon floor. If the impact speed was measured to be 700 feet/sec (480 mph) how long did it take to impact the canyon floor?

Answer: 700 = 12T, so T = **58 seconds**.

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Answer: Astronaut 1. 100 = A1 x T1 T1 = 8 seconds, so A1 = 100/8 = 12 feet/sec^2.

Astronaut 2: 150 = 5 + A2 T2 T2 = 29 sec, so A2 = (150-5)/29 = 5 feet/sec^2

The acceleration measured by the second astronaut is much lower than for the first astronaut, so the first astronaut is standing on the more-massive objects. In fact, Astronaut 1 is on Mars and Astronaut 2 is on the moon!