At 11:30 AM EST, NASA successfully launched the Ares 1-X rocket from Cape Canaveral. The top image is an artists illustration of the launch and the bottom photo shows the actual launch from Pad 39B. The flight reached the target sub-orbital altitude of 150,000 feet. The next launch will be in March 2014 of Ares 1-Y. (Images courtesy NASA)

The first half of the flight just before the rocket reached its peak altitude was powered by the first stage. Once the first stage was jettisoned 150 seconds after launch, the capsule traveled under its own inertia under the influence of Earth's gravity. The capsule reached a maximum altitude of 28 miles (45 km) at a point 40 miles (64 km) downrange from the launch pad, traveling at a horizontal speed of 4000 mph (6400 km/hr). We can approximate the capsule's path by a portion of a parabolic arc.

The time that it takes a body to fall to the ground is given by

$$H = \frac{1}{2} g T^2$$

where H is the altitude in meters, T is the time in seconds and g is the acceleration of gravity given by g = 9.8 meters/sec^2.

Problem 1 - To two significant figures, how many seconds did it take the Ares 1-X capsule to fall from an altitude of 45 kilometers?

Problem 2 - At the horizontal speed that the capsule was traveling, and to two significant figures, how far from the launch pad did it come to earth if the capsule reached its maximum altitude 64 kilometers downrange from the launch pad?

Problem 1 - To two significant figures, how many seconds did it take the Ares 1-X capsule to fall from an altitude of 45 kilometers?

Answer: H = 45 kilometers or 45,000 meters
g = 9.8 meters/sec^2

And $$H = \frac{1}{2} g T^2$$

So solving for T we get

$$T = \sqrt{\frac{2H}{g}}$$

$$T = \sqrt{\frac{2x45000}{9.8}}$$

$$T = \sqrt{9184}$$

T = 95.833
T = 96 seconds to 2 significant figures.

Problem 2 - At the horizontal speed that the capsule was traveling, and to two significant figures, how far from the launch pad did it come to earth if the capsule reached its maximum altitude 64 kilometers downrange from the launch pad?

Answer: The time taken was 96 seconds which is 96 sec x (1 hour/3600 sec) = 0.027 hours. Then V = 6,400 km/hour and the initial distance was 40 kilometers, so in 96 seconds, the capsule lands

X = x0 + VT

X = 64 km + (6400 km/hr) x (0.027 hours)

X = 237 kilometers (or 147 miles) downrange

To 2 significant figures, this becomes 240 kilometers or 150 miles downrange from the launch pad.