

Kinematics Problems 2

Example 1

A bullet that is shot vertically into the air has an initial velocity of 500 m/s . The acceleration due to gravity is 9.8 m/s^2 [*down*]. How long does it take before the bullet stops rising? How high does the bullet go?

Example 2

A balloon is ascending at a rate of 9.0 m/s and has reached a height of 80 m above the ground when it releases a package. How long does the package take to reach the ground?

Kinematics Worksheet #2

1. A Boeing 747 airliner, initially at rest, undergoes a constant acceleration of 2.3 m/s^2 down the runway for 34 s before it lifts off. How far does it travel down the runway before taking off? (1329.4 m)
2. You are driving your new Saturn Sport coupe at a velocity of 90 km/h , when you suddenly see a cat (meow) step into the road 50 m ahead. You hit the brakes hard to get a maximum deceleration of 7.5 m/s^2 . How far will you go before stopping? Can you avoid hitting the cat? (41.7 m , yes)
3. A person throws a ball upward into the air with an initial velocity of 15 m/s . Calculate
 - a. how high the ball goes. (11.5 m)
 - b. how long the ball is in the air before it comes back to her hand. (3.06 s)
 - c. how much time it takes for the ball to reach its maximum height. (1.53 s)
 - d. the ball's velocity when it returns to the thrower's hand. (-15 m/s)
 - e. at what time the ball passes the 8 m height above the ground. (0.69 s or 2.37 s)
4. A baseball pitcher throws a fastball with a speed of 120 km/h . Estimate the average acceleration of the ball during the throwing motion. It is observed that in throwing the baseball, the pitcher accelerates the ball through a total distance of about 3.5 m from behind his body to the point where it is released. (158.7 m/s^2)
5. A helicopter is ascending vertically with a speed of 6.0 m/s ; at a height of 120 m above the earth, a package is dropped from a window. How much time does it take for the package to reach the ground? (5.60 s)

Note $g = 9.8 \text{ m/s}^2$, therefore, $10g$ would be equivalent to 98 m/s^2 .

6. A person who is properly constrained by a shoulder harness has a good chance of surviving a car collision if the deceleration does not exceed $30g$. Assuming uniform deceleration at this rate, calculate the distance over which the front end of the car must be designed to collapse if a crash occurs at 100 km/h . (1.31 m)
7. Pelicans tuck their wings and free fall straight down when diving for fish. Suppose a pelican starts its dive from a height of 20 m and cannot change its path once committed. If it takes a fish 0.1 s to perform evasive action, at what minimum height must it spot the pelican to escape? Assume the fish is at the surface of the water. (1.93 m)
8. A helicopter descends at 5 m/s and releases a bag. After 2 s ,
 - a. what is the bag's velocity? (24.6 m/s)
 - b. how far has the bag fallen? (29.6 m)