

More Uniformly Accelerated Motion

Name:

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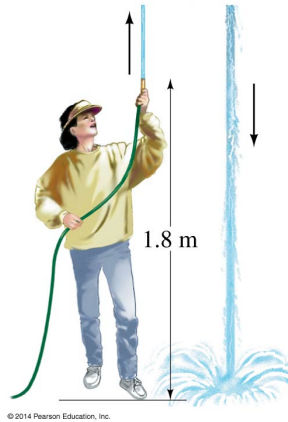
1. Consider the following combinations of signs and values for the velocity and acceleration of a particle with respect to a one-dimensional x -axis:

| | Velocity | Acceleration |
|----|-----------------|---------------------|
| a) | Positive | Positive |
| b) | Positive | Negative |
| c) | Positive | Zero |
| d) | Negative | Positive |
| e) | Negative | Negative |
| f) | Negative | Zero |
| g) | Zero | Positive |
| h) | Zero | Negative |

Describe what the particle is doing in each case and give a real-life example for an automobile on an east–west one-dimensional axis, with east considered the positive direction.

- A car slows down from a speed of 60 km/h to rest in 4.00 s. How far did it travel in that time?
- A car travelling at 90 km/h strikes a tree. The front end of the car compresses and the driver comes to rest after travelling 0.80 m. What was the average acceleration of the driver during the collision? Express the answer in terms of “ g ’s,” where $1.00\ g = 9.80\ \text{m/s}^2$.
- A foul ball is hit straight up into the air with a speed of about 25 m/s.
 - How high does it go?
 - How long is it in the air?
- A helicopter is ascending vertically with a speed of 5.40 m/s. At a height of 105 m above the Earth, a package is dropped from the helicopter. At what speed does the package impact the ground?
- A light plane must reach a speed of 30 m/s for takeoff. How long a runway is needed if the acceleration is a constant $3.0\ \text{m/s}^2$.
- A ballplayer catches a ball 3.3 s after throwing it vertically upward. With what speed did he throw it, and what height did it reach?

8. Suppose you adjust your garden hose nozzle for a fast stream of water. You point the nozzle vertically upward at a height of 1.8 m above the ground. When you quickly turn off the nozzle, you hear the water striking the ground next to you for another 2.5 s. What is the water speed as it leaves the nozzle?



9. A rocket rises vertically, from rest, with an acceleration of 3.2 m/s^2 until it runs out of fuel at an altitude of 775 m. After this point, its acceleration is that of gravity, downward.
- What is the velocity of the rocket when it runs out of fuel?
 - How long does it take to reach this point?
 - What maximum altitude does the rocket reach?
 - How much time (total) does it take to reach maximum altitude?
 - With what velocity does it strike the Earth?
 - How long (total) is it in the air?
10. A rock is thrown upwards with a speed of 20 m/s from the top of a 100 m high cliff. It reaches a maximum height and then falls to the base of the cliff.
- How long does it take to hit the ground? Solve using two (or more) different methods.
 - At what other velocity could the rock be thrown to hit the ground at the same speed?
 - Over which one-second interval of the rock's flight does it have the least displacement (i.e. the change in position from the beginning of the time interval to the position one second later is the least)?
11. Adin runs past Brad at a constant speed of 4.0 m/s. Five seconds after Adin passes him, Brad remembers that he needs to tell him a message so he accelerates uniformly towards Adin at 0.80 m/s^2 . After how much time since Adin passed Brad will Brad be able to catch up Adin?
12. A couple of mischievous students are dropping old physics textbooks off the tops of cliffs.
- Matthew drops a textbook off a 300 m high cliff. How long will it be until he hears the textbook hit the ground? (The speed of sound in air is 343 m/s.)
 - Connor drops a textbook off a cliff and hears the textbook hit the ground 6.35 s later. How high is the cliff?