

► Section 1.3 Questions

Understanding Concepts

- Describe several different conditions under which air resistance is negligible for a falling object.
- Compare and contrast Aristotle's and Galileo's notions of falling objects.
- Determine the landing speed in both metres per second and kilometres per hour for the following situations. Neglect air resistance and assume the object starts from rest.
 - Divers entertain tourists in Acapulco, Mexico, by diving from a cliff 36 m above the water.
 - A stone falls from a bridge, landing in the water 3.2 s later.
- Two high jumpers, one in Java, the other in London, UK, each have an initial velocity of 5.112 m/s [up]. Use the data in **Table 1** to calculate, to four significant digits, the heights each jumper attains.
- During the first minute of blastoff, a space shuttle has an average acceleration of $5g$ (i.e., five times the magnitude of the acceleration due to gravity on the surface of Earth). Calculate the shuttle's speed in metres per second and kilometres per hour after 1.0 min. (These values are approximate.)
- A person throws a golf ball vertically upward. The ball returns to the same level after 2.6 s.
 - How long did the ball rise?
 - Determine the initial velocity of the ball.
 - How long would the ball remain in flight on Mars, where \vec{g} is 3.7 m/s^2 [down], if it were given the same initial velocity?
- In a laboratory experiment, a computer determines that the time for a falling steel ball to travel the final 0.80 m before hitting the floor is 0.087 s. With what velocity does the ball hit the floor?
- A stone is thrown vertically with a velocity of 14 m/s [down] from a bridge.
 - How long will the stone take to reach the water 21 m below?
 - Explain the meaning of both roots of the quadratic equation used to solve this problem.
- A tennis ball and a steel ball are dropped from a high ledge. The tennis ball encounters significant air resistance and eventually reaches terminal speed. The steel ball essentially undergoes free fall.
 - Draw a velocity-time graph comparing the motions of the two balls. Take the downward direction to be positive.
 - Repeat (a) with the upward direction positive.
- A flowerpot is dropped from the balcony of an apartment, 28.5 m above the ground. At a time of 1.00 s after the pot is dropped, a ball is thrown vertically downward from the balcony one storey below, 26.0 m above the ground. The initial velocity of the ball is 12.0 m/s [down]. Does the ball pass the flowerpot before striking the ground? If so, how far above the ground are the two objects when the ball passes the flowerpot?
- Based on your estimates, rank the following objects in order of highest to lowest terminal speed in air: a ping-pong ball, a basketball, a skydiver in a headfirst plunge, a skydiver in a spread-eagle plunge, and a grain of pollen.

Applying Inquiry Skills

- State the number of significant digits, indicate the possible error, and calculate the percent possible error for each of the following measurements:
 - $9.809\ 060 \text{ m/s}^2$
 - 9.8 m/s^2
 - 9.80 m/s^2
 - 9.801 m/s^2
 - $9.8 \times 10^{-6} \text{ m/s}^2$
- How could you use a metre stick, together with one or more of the constant acceleration equations, to determine your lab partner's reaction time? Illustrate your method with an example, including a calculation with plausible numerical values.
 - How would talking on a cell phone affect the results of the reaction time?

Making Connections

- In a group, share responsibility for researching the life and contributions of Aristotle or Galileo. Share your results with other groups in your class.
- There are two different processes of logical thinking. One is called *deductive reasoning*, the other *inductive reasoning*. Use a resource, such as a dictionary or an encyclopedia, to find out more about these types of reasoning.
 - Which process did Aristotle and other ancient scientists use?
 - Which process did Galileo use?
 - Describe other facts you discover about these forms of reasoning.
- Dr. Luis Alvarez has suggested that the extinction of the dinosaurs and numerous other species 65 million years ago was caused by severe temperature drops following the insertion of dust into the atmosphere. The enormous quantities of dust resulted from an asteroid impact in the Yucatán area of what is now Mexico. Research this topic and write a brief report on what you discover.



www.science.nelson.com