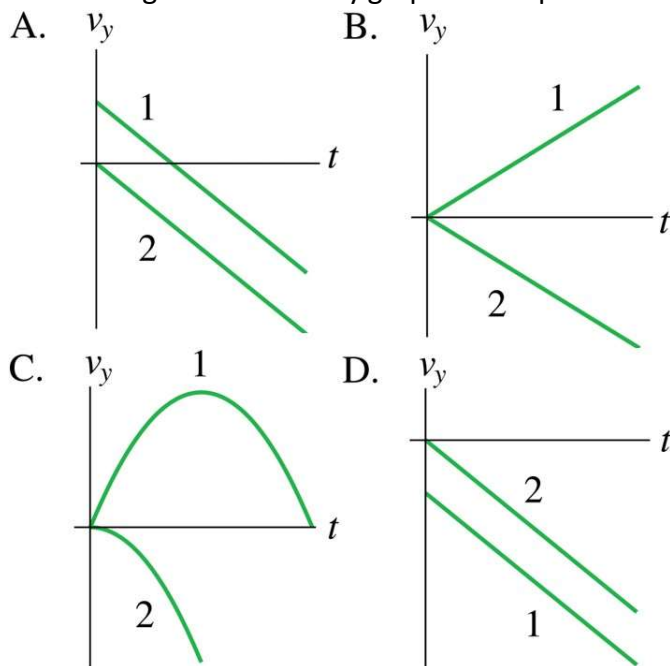


1.6 Free Fall

1. A volcano ejects a chunk of rock straight up at a velocity of $v = 30 \text{ m/s}$. Ignoring air resistance, what will be the velocity v of the rock when it falls back into the volcano's crater?
 - a. $> 30 \text{ m/s}$
 - b. 30 m/s
 - c. 0 m/s
 - d. -30 m/s
 - e. $< -30 \text{ m/s}$
2. A ball is thrown straight up into the air. At each of the following instants, is the ball's acceleration a equal to g , $-g$, 0 , $<g$, or g ?
 - a. Just after leaving your hand?
 - b. At the very top (maximum height)?
 - c. Just before hitting the ground?
3. Chris is holding two softballs while standing on a balcony. He throws ball 1 straight up in the air and, at the same instant, releases his grip on ball 2, letting it drop over the side of the building. Which velocity graph best represents the motion of the two balls?



4. Ball bearings can be made by letting spherical drops of molten metal fall inside a tall tower – called a shot tower – and solidify as they fall.
 - a. If a bearing needs 4.0 s to solidify enough for impact, how high must the tower be?
 - b. What is the bearing's impact velocity?

5. A gannet is a seabird that fishes by diving from a great height. If a gannet hits the water at 32 m/s (which they do), what height did it dive from? Assume that the gannet was motionless before starting its dive?
6. A student at the top of a building of height h throws a ball A straight upward with speed v and throws ball B straight downward with the same initial speed.
 - a. Compare the balls' accelerations, both direction and magnitude, immediately after they leave her hand. Is one acceleration larger than the other? Or are the magnitudes equal?
 - b. Compare the final speeds of the balls as they reach the ground. Is one larger than the other? Or are the magnitudes equal?
7. A football is punted straight up into the air; it hits the ground 5.2 s later.
 - a. What was the greatest height reached by the ball? Assume ball kicked from ground level.
 - b. With what speed did it leave the kicker's foot?
8. Spud Webb, height 5'7", was one of the shortest basketball players to play in the NBA. But he had an impressive vertical leap; he was reputedly able to jump 110 cm off the ground, so he could easily dunk a basketball. For such a leap, what was his "hang time" – the time spent in the air after leaving the ground and before touching down again?
9. Mike jumps out of a tree and lands on a trampoline. The trampoline sags 2 feet before launching Mike back into the air. At the very bottom, where the sag is the greatest, Mike's acceleration is:
 - a. Upward
 - b. Downward
 - c. Zero
10. In an action movie, the villain is rescued from the ocean by grabbing onto the ladder hanging from a helicopter. He is so intent on gripping the ladder that he lets go of his briefcase of counterfeit money when he is 130 m above the water. If the briefcase hits the water 6.0 s later, what was the speed at which the helicopter was ascending?