

Physics 201 Examples 2

Jan 9, 2013

1. The depth of the ocean is sometimes measured in fathoms (1 fathom = 6 feet). Distance on the surface of the ocean is sometimes measured in nautical miles (1 nautical mile = 6076 feet). The water beneath a surface rectangle 1.20 nautical miles by 2.60 nautical miles has a depth of 16.0 fathoms. Find the volume of water (in cubic meters) beneath this rectangle.

$$3.13 \times 10^8 \text{ m}^3$$

2. A bicyclist makes a trip that consists of three parts, each in the same direction (due north) along a straight road. During the first part, she rides for 22 minutes at an average speed of 7.2 m/s. During the second part, she rides for 36 minutes at an average speed of 5.1 m/s. Finally, during the third part, she rides for 8.0 minutes at an average speed of 13 m/s. (a) How far has the bicyclist traveled during the entire trip? (b) What is her average velocity for the trip?

- (a) 27 km
(b) 6.8 m/s

3. A wrecking ball is hanging at rest from a crane when suddenly the cable breaks. The time it takes for the ball to fall halfway to the ground is 1.2 seconds. Find the time it takes for the ball to fall from rest all the way to the ground.

$$1.7 \text{ seconds}$$

4. A police car is traveling at a velocity of 18.0 m/s due north, when a car zooms by at a constant velocity of 42.0 m/s due north. After a reaction time of 0.800 seconds the policeman begins to pursue the speeder with an acceleration of 5.00 m/s². Including the reaction time, how long does it take for the police car to catch up with the speeder?

$$11.1 \text{ s}$$

5. An Olympic long jumper leaves the ground at an angle of 23° and travels through the air for a horizontal distance of 8.7 m before landing. What is the takeoff speed of the jumper?

$$11 \text{ m/s}$$

6. From the top of a tall building, a gun is fired. The bullet leaves the gun at a speed of 340 m/s, parallel to the ground. As Figure 1 shows, the bullet puts a hole in a window of another building and hits the wall that faces the window. Using the data in the drawing, determine the distances D and H , which locate the point where the gun was fired. Assume that the bullet does not slow down as it passes through the window.

$$D = 860 \text{ meters and } H = 32 \text{ meters}$$

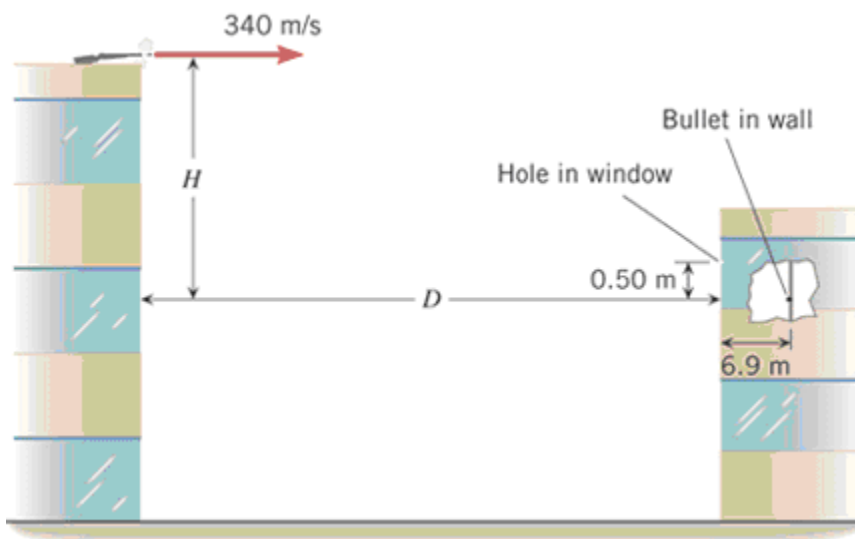


Figure 1: Problem 3.43

7. A golf ball rolls off a horizontal cliff with an initial speed of 11.4 m/s. The ball falls a vertical distance of 15.5 m into a lake below. (a) How much time does

- (a) 1.78 s
(b) 20.8 m/s

the ball spend in the air? (b) What is the speed v of the ball just before it strikes the water?

8. Due to continental drift, the North American and European continents are drifting apart at an average speed of about 3 cm per year. At this speed, how long (in years) will it take for them to drift apart by another 1500 meters (a little less than a mile)? 50,000 years

9. In 1998, NASA launched *Deep Space I* (DS-1), a spacecraft that successfully flew by the asteroid named 1992 KD (which orbits the sun millions of miles from the earth). The propulsion system of DS-1 worked by ejecting high-speed argon ions out the rear of the engine. The engine slowly increased the velocity of DS-1 by about 9.0 m/s per day. (a) How much time (in days) would it take to increase the velocity of DS-1 by 2700 m/s? (b) What was the acceleration of DS-1 (in m/s²)? (a) 300 days
(b) 1.0×10^{-4} m/s²

10. A cheetah is hunting. Its prey runs for 3.0 seconds at a constant velocity of 9.0 m/s. Starting from rest, what constant acceleration must the cheetah maintain in order to run the same distance as its prey runs in the same time? 6.0 m/s²

11. In a quarter-mile drag race, two cars start simultaneously from rest, and each accelerates at a constant rate until it either reaches its maximum speed or crosses the finish line. Car A has an acceleration of 11.0 m/s² and a maximum speed of 106 m/s. Car B has an acceleration of 11.6 m/s² and a maximum speed of 92.4 m/s. Which car wins the race, and by how many seconds? 0.216 seconds

12. A hot-air balloon is rising upward with a constant speed of 2.50 m/s. When the balloon is 3.00 meters above the ground, the balloonist accidentally drops a compass over the side of the balloon. How much time elapses before the compass hits the ground? 1.08 seconds

13. From her bedroom window a girl drops a water-filled balloon to the ground, 6.0 meters below. If the balloon is released from rest, how long is it in the air? 1.1 seconds

14. A car is traveling at 20.0 m/s, and the driver sees a traffic light turn red. After 0.530 seconds (the reaction time), the driver applies the brakes, and the car decelerates at 7.00 m/s². What is the stopping distance of the car, as measured from the point where the driver first sees the red light? 39.2 meters

15. A jetliner is moving at a speed of 245 m/s. The vertical component of the plane's velocity is 40.6 m/s. Determine the magnitude of the horizontal component of the plane's velocity. 242 m/s

16. A meteoroid is speeding through the atmosphere, traveling east at 18.3 km/s while descending at a rate of 11.5 km/s. What is its speed, in km/s? 21.6 m/s

17. The punter on a football team tries to kick a football so that it stays in the air for a long "hang time". If the ball is kicked with an initial velocity of 25.0 m/s at an angle of 60.0° above the ground, what is the hang time? 4.42 seconds

18. A hot-air balloon is rising straight up with a speed of 3.0 m/s. A ballast bag is released from rest relative to the balloon when it is 9.5 meters above the ground. How much time elapses before the ballast bag hits the ground? 1.7 seconds

19. A quarterback claims that he can throw the football a horizontal distance of 183 meters (200 yards). Furthermore, he claims that he can do this by launching the ball at the relatively low angle of 30.0° above the horizontal. To evaluate this claim, determine the speed with which this quarterback must throw the ball. Assume that the ball is launched and caught at the same vertical level and that air resistance can be ignored. For comparison, a baseball pitcher who can accurately throw a fastball at 45 m/s (100 mph) would be considered exceptional. 45.5 m/s

20. A child operating a radio-controlled model car on a dock accidentally steers it off the edge. The car's displacement 1.1 seconds after leaving the dock has a 3.4 m/s

magnitude of 7.0 meters. What is the car's speed at the instant it drives off the edge of the dock?

21. The lob in tennis is an effective tactic when your opponent is near the net. It consists of lofting the ball over his head, forcing him to move quickly away from the net (see Figure 2). Suppose that you lob the ball with an initial speed of 15.0 m/s, at an angle of 50.0° above the horizontal. At this instant your opponent is 10.0 meters away from the ball. He begins moving away from you 0.30 seconds later, hoping to reach the ball and hit it back at the moment it is 2.10 meters above its launch point. With what minimum average speed must he move? (Ignore the fact that he can stretch, so that his racket can reach the ball before he does.)

5.79 m/s

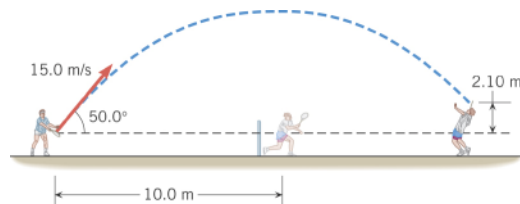


Figure 2: Problem 3.45

22. A volleyball is spiked so that it has an initial velocity of 15 m/s directed downward at an angle of 55° below the horizontal. What is the horizontal component of the ball's velocity when the opposing player fields the ball?

8.6 m/s

23. An object is projected downward at an angle of 30° with the horizontal from the top of a building 170 meters high. Its initial speed is 40 m/s. (a) How long will it take to hit the ground? (b) How far from the starting point will it strike? (c) At what angle with the horizontal will it strike?

- (a) 4.2 seconds
- (b) 150 meters
- (c) 60°