

Physics

Free Fall Practice Problems for A2.4

Ignore air friction and use the convention that **down is negative**. $g = 9.8 \text{ m/s}^2$

1.

a-b: A baseball is popped straight up in the air at a velocity of 42.0 m/s

a. What is the greatest height it reaches? (90.0 m)

b. What time does it spend in the air before reaching the same elevation from which it was popped up? (8.57 s)

c-d: A rock is dropped from rest from the top of a cliff and strikes the ground after 2.10 seconds.

c. What is its velocity of impact with the ground? (-20.6 m/s)

d. What is the height of the cliff? (21.6 m)

e. An air rocket is launched from the ground straight up, and on the way down is strikes a light tower that is 16.0 m tall with a downward velocity of 12.0 m/s. What was its initial upward velocity? (+21.4 m/s)

2.

a-b: A soccer ball is kicked straight up from the ground, and reaches a height of 23.0 m before coming back down.

a. What time does it spend in the air (total)? (4.33 s)

b. What was its initial upward velocity leaving the ground? (+21.2 m/s)

c-d: A golf ball is dropped from a cliff and strikes the ground with a downward velocity of 34.0 m/s.

c. How high is the cliff? (59.0 m)

d. What time did it take the ball to strike the ground? (3.47 s)

e. An air rocket is launched straight up at 36.0 m/s. What time elapses between the launch, and the point on the way down where it has a downward velocity of 21.0 m/s? (5.82 s)

3.

a-b: A steel marble is launched straight up from the ground at some velocity, and stays in the air for a total time of 8.20 s before striking the ground again.

a. What was its initial launch velocity? (+40.2 m/s)

b. To what height does the marble rise before going back down again? (82.4 m)

c-d: A hot pocket is dropped from the top of a 52.0 m tall building in Manhattan.

c. What time does it take to reach the sidewalk below? (3.26 s)

d. What is the velocity of impact with the sidewalk? (-31.9 m/s)

e. An air rocket is launched straight upwards at 27.0 m/s. What is its velocity at a time of 4.80 s? (-20.0 m/s)

4.

a-b: A giant lizard jumps straight upwards from the ground at 4.30 m/s.

a. To what height does the lizard rise before going back down again? (0.943 m)

b. What total time does the lizard spend in the air? (0.878 s)

c-d: A frozen blueberry falls from a counter top and strikes the floor with a downward velocity of 4.50 m/s.

c. What is the height of the counter top? (1.03 m)

d. What time does it take the blueberry to strike the ground? (0.459 s)

e. An air rocket is launched straight up with a speed of 31.0 m/s and strikes a 12.0 m tall light tower on the way down. What is the velocity of impact with the light tower? (-26.9 m/s)

5.

a-b: A bowling ball is launched using black powder from a well casing and goes straight up 320. m before coming back down again.

a. For what time does the bowling ball stay in the air? (16.2 s)

b. What was its initial upward velocity of launch? (+79.2 m/s)

c-d: A person falls from a bridge that is 18.0 m above the water.

c. What time does it take them to reach the water? (1.92 s)

d. What is the velocity of impact with the water? (-18.8 m/s)

e. An air rocket is launched straight up and lands on the roof of a building 3.80 s later with a downward velocity of 8.60 m/s. What was its initial velocity of launch from the ground? (+28.6 m/s)