## Physics

## Free Fall Practice Problems for A2.4

Ignore air friction and use the convention that down is negative. $\mathrm{g}=9.8 \mathrm{~m} / \mathrm{s} / \mathrm{s}$
1.
a-b: A baseball is popped straight up in the air at a velocity of $42.0 \mathrm{~m} / \mathrm{s}$
a. What is the greatest height it reaches? $(90.0 \mathrm{~m})$
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 $\mathbf{2 . 1 0}$ seconds.
c. What is its velocity of impact with the ground? $(-20.6 \mathrm{~m} / \mathrm{s})$
d. What is the height of the cliff? $(21.6 \mathrm{~m})$
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 $12.0 \mathrm{~m} / \mathrm{s}$. What was its initial upward velocity? $(+21.4 \mathrm{~m} / \mathrm{s})$
2.
a-b: A soccer ball is kicked straight up from the ground, and reaches a height of $\mathbf{2 3 . 0} \mathbf{~ m}$ 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? ${ }_{(+21.2 \mathrm{~m} / \mathrm{s})}$
c -d: A golf ball is dropped from a cliff and strikes the ground with a downward velocity of $\mathbf{3 4 . 0} \mathbf{~ m} / \mathrm{s}$.
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 $36.0 \mathrm{~m} / \mathrm{s}$. What time elapses between the launch, and the point on the way down where it has a downward velocity of $21.0 \mathrm{~m} / \mathrm{s}$ ? $(5.82 \mathrm{~s})$
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? $(+40.2 \mathrm{~m} / \mathrm{s})$
b. To what height does the marble rise before going back down again? $(82.4 \mathrm{~m})$
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? $(-31.9 \mathrm{~m} / \mathrm{s})$
e. An air rocket is launched straight upwards at $27.0 \mathrm{~m} / \mathrm{s}$. What is its velocity at a time of 4.80 s ? $(-20.0 \mathrm{~m} / \mathrm{s})$
4.
a-b: A giant lizard jumps straight upwards from the ground at $4.30 \mathrm{~m} / \mathrm{s}$.
a. To what height does the lizard rise before going back down again? $(0.943 \mathrm{~m})$
b. What total time does the lizard spend in the air? $(0.878 \mathrm{~s})$
c-d: A frozen blueberry falls from a counter top and strikes the floor with a downward velocity of $4.50 \mathrm{~m} / \mathrm{s}$.
c. What is the height of the counter top? $(1.03 \mathrm{~m})$
d. What time does it take the blueberry to strike the ground? $(0.459 \mathrm{~s})$
e. An air rocket is launched straight up with a speed of $31.0 \mathrm{~m} / \mathrm{s}$ and strikes a 12.0 m tall light tower on the way down. What is the velocity of impact with the light tower? $(-26.9 \mathrm{~m} / \mathrm{s})$
5.
a-b: A bowling ball is launched using black powder from a well casing and goes straight up 320. $\mathbf{m}$ 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? $(+79.2 \mathrm{~m} / \mathrm{s})$
c -d: A person falls from a bridge that is $\mathbf{1 8 . 0} \mathbf{~ m}$ 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? $(-18.8 \mathrm{~m} / \mathrm{s})$
e. An air rocket is launched straight up and lands on the roof of a building $\mathbf{3 . 8 0} \mathrm{s}$ later with a downward velocity of $8.60 \mathrm{~m} / \mathrm{s}$. What was its initial velocity of launch from the ground? $(+28.6 \mathrm{~m} / \mathrm{s})$

