Freefall

(Take $g = -9.8 \, m/s^2$ unless otherwise stated.)

1. A ball is dropped from rest. What is its velocity after 1.0 s?

2. A ball is dropped from rest. How far does it fall in 1.0 s?

3. A physics student drops a textbook from rest. If it takes 2.1 s to hit the ground, from what height did it fall?

4. A ball is dropped from a height of 20.0 m. What is its impact velocity when it reaches the ground?

5. A flowerpot falls from a windowsill 36.0 m above the sidewalk. What is its velocity when it strikes the ground?

6. A flowerpot falls from a windowsill 36.0 m above the sidewalk. How long does it take to reach the ground?

7. A brick is thrown straight downward at 25.0 m/s from the roof of a building. If it strikes the ground in 2.0 s, how tall is the building?

8. An object is thrown straight downward at 10.0 m/s. What is its velocity after 3.0 s?

9. A ball is thrown upward at 20.0 m/s. What is its velocity after 3.0 s?

10. A ball is thrown upward at 36.0 m/s. How long before it returns to the ground?

11. A tennis ball is thrown straight upward. If it rises to a maximum height of 99.0 m, what was its initial velocity?

12. A ball is thrown upward at 15.0 m/s. How much time does it take to reach its maximum height?

13. A bullet is shot vertically upward. If the bullet's total time in the air is 10.0 s, what was its initial velocity?

14. A ball is thrown upward at 30.0 m/s.
    (a) How high is it after 2.0 s?
    (b) What is its velocity at that instant?

15. A ball is thrown upward at 20.0 m/s from a 10.0 m balcony. What is its displacement after 3.0 s?

16. A ball is thrown upward at 25.0 m/s from the top of a 15.0 m building.
    (a) Calculate the speed of the ball when it strikes the ground.
    (b) State whether the final velocity is upward or downward.
    (c) Calculate the time it takes for the ball to reach the ground.

17. A toy rocket is launched straight upward with an acceleration of 10.0 m/s² for 3.0 s. After its fuel is used up, it continues upward under the influence of gravity. How high does the rocket go?

18. An object is thrown upward with 40.0 m/s from the top of a 50.0 m building. What maximum height above the ground does it reach?

19. A ball is thrown upward at 20.0 m/s from a balcony 60.0 m above the ground.
    (a) Determine the speed of the ball when it passes a height of 80.0 m.
    (b) Explain why the ball passes this point twice.
    (c) Find the time at which the ball first passes 80.0 m (on the way up).
    (d) Use the same formula to find the time when it passes 80.0 m again (on the way down).

20. A ball is thrown upward at 25.0 m/s from ground level.
    (a) Calculate the speed of the ball when it is at a height of 20.0 m.
    (b) Determine the time when the ball passes 20.0 m on the way up.
    (c) Find the time when the ball passes 20.0 m on the way down.
    (d) How much total time does the ball spend above 20.0 m?