

# Kinematics-Free Fall

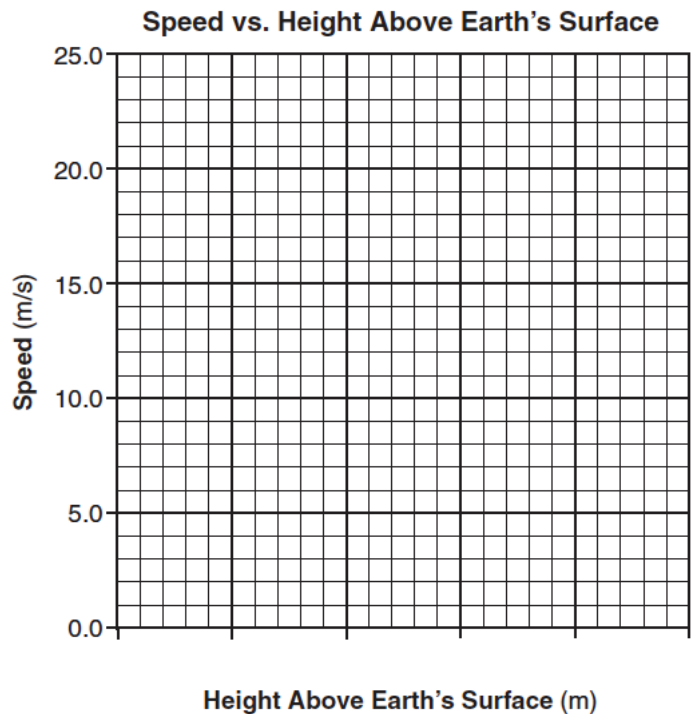
Base your answers to questions 1 through 4 on the information and data table provided.

A 1.00-kilogram mass was dropped from rest from a height of 25 meters above Earth's surface. The speed of the mass was determined at 5-meter intervals and recorded in the data table. Using the information in the data table, construct a graph on the grid, following the directions below.

1. Mark an appropriate scale on the axis labeled "Height Above Earth's Surface (m)."
2. Plot the data points for speed versus height above Earth's surface.
3. Draw the line or curve of best fit.
4. Using your graph, determine the speed of the mass after it has fallen a vertical distance of 12.5 meters.



**Data Table**

Height Above Earth's Surface (m)	Speed (m/s)
25.0	0.0
20.0	9.9
15.0	14.0
10.0	17.1
5.0	19.8
0	22.1



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| <p>5. A rock is dropped from a bridge. What happens to the magnitude of the acceleration and the speed of the rock as it falls?</p> <ol style="list-style-type: none"> <li>1. Both acceleration and speed increase.</li> <li>2. Both acceleration and speed remain the same.</li> <li>3. Acceleration increases and speed decreases.</li> <li>4. Acceleration remains the same and speed increases.</li> </ol> <p>6. A rock falls from rest a vertical distance of 0.72 meter to the surface of a planet in 0.63 second. The magnitude of the acceleration due to gravity on the planet is</p> <ol style="list-style-type: none"> <li>1. <math>1.1 \text{ m/s}^2</math></li> <li>2. <math>2.3 \text{ m/s}^2</math></li> <li>3. <math>3.6 \text{ m/s}^2</math></li> <li>4. <math>9.8 \text{ m/s}^2</math></li> </ol> | <p>7. A ball is thrown straight downward with a speed of 0.50 meter per second from a height of 4.0 meters. What is the speed of the ball 0.70 second after it is released? [Neglect friction.]</p> <ol style="list-style-type: none"> <li>1. 0.50 m/s</li> <li>2. 7.4 m/s</li> <li>3. 9.8 m/s</li> <li>4. 15 m/s</li> </ol> <p>8. An astronaut drops a hammer from 2.0 meters above the surface of the moon. If the acceleration due to gravity on the moon is <math>1.62 \text{ m/s}^2</math>, how long will it take for the hammer to fall to the Moon's surface?</p> <ol style="list-style-type: none"> <li>1. 0.62 s</li> <li>2. 1.2 s</li> <li>3. 1.6 s</li> <li>4. 2.5 s</li> </ol> |
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9. An object is dropped from rest and falls freely 20 meters to Earth. When is the speed of the object 9.8 meters per second?
1. during the entire first second of its fall
  2. at the end of its first second of fall
  3. during its entire time of fall
  4. after it had fallen 9.8 meters
10. A ball is thrown vertically upward with an initial velocity of 29.4 meters per second. What is the maximum height reached by the ball? [Neglect friction.]
1. 14.7 m
  2. 29.4 m
  3. 44.1 m
  4. 88.1 m
11. A soccer ball kicked on a level field has an initial vertical velocity component of 15 meters per second. Assuming the ball lands at the same height from which it was kicked, what is the total time the ball is in the air? [Neglect friction.]
1. 0.654 s
  2. 1.53 s
  3. 3.06 s
  4. 6.12 s
12. What is the speed of a 2.5-kilogram mass after it has fallen freely from rest through a distance of 12 meters?
1. 4.8 m/s
  2. 15 m/s
  3. 30 m/s
  4. 43 m/s
13. A baseball dropped from the roof of a tall building takes 3.1 seconds to hit the ground. How tall is the building? [Neglect friction.]
1. 15 m
  2. 30 m
  3. 47 m
  4. 94 m
14. A ball dropped from rest falls freely until it hits the ground with a speed of 20 m/s. The time during which the ball is in free fall is approximately
1. 1 s
  2. 2 s
  3. 0.5 s
  4. 10 s
15. A 25-newton weight falls freely from rest from the roof of a building. What is the total distance the weight falls in the first 1.0 second?
1. 19.6 m
  2. 9.8 m
  3. 4.9 m
  4. 2.5 m
16. A basketball player jumped straight up to grab a rebound. If she was in the air for 0.80 second, how high did she jump?
1. 0.50 m
  2. 0.78 m
  3. 1.2 m
  4. 3.1 m
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17. How far will a brick starting from rest fall freely in 3.0 seconds?
1. 15 m
  2. 29 m
  3. 44 m
  4. 88 m
18. A ball thrown vertically upward reaches a maximum height of 30 meters above the surface of Earth. At its maximum height, the speed of the ball is
1. 0.0 m/s
  2. 3.1 m/s
  3. 9.8 m/s
  4. 24 m/s
19. A rocket initially at rest on the ground lifts off vertically with a constant acceleration of  $2.0 \times 10^1$  meters per second<sup>2</sup>. How long will it take the rocket to reach an altitude of  $9.0 \times 10^3$  meters?
1.  $3.0 \times 10^1$  s
  2.  $4.3 \times 10^1$  s
  3.  $4.5 \times 10^2$  s
  4.  $9.0 \times 10^2$  s
20. Objects in free fall near the surface of Earth accelerate downward at 9.81 meters per second<sup>2</sup>. Explain why a feather does not accelerate at this rate when dropped near the surface of Earth.
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21. A 1.0-kilogram ball is dropped from the roof of a building 40 meters tall. What is the approximate time of fall? [Neglect air resistance.]
1. 2.9 s
  2. 2.0 s
  3. 4.1 s
  4. 8.2 s
22. A 0.25-kilogram baseball is thrown upward with a speed of 30 meters per second. Neglecting friction, the maximum height reached by the baseball is approximately
1. 15 m
  2. 46 m
  3. 74 m
  4. 92 m
23. A rock falls from rest off a high cliff. How far has the rock fallen when its speed is 39.2 meters per second? [Neglect friction.]
1. 19.6 m
  2. 44.1 m
  3. 78.3 m
  4. 123 m
24. An astronaut standing on a platform on the Moon drops a hammer. If the hammer falls 6.0 meters vertically in 2.7 seconds, what is its acceleration?
1.  $1.6 \text{ m/s}^2$
  2.  $2.2 \text{ m/s}^2$
  3.  $4.4 \text{ m/s}^2$
  4.  $9.8 \text{ m/s}^2$

