W1.09

Vertical Kinematics: 1D Freefall
(9/18/03)

1. An object is dropped from rest. (a) What is its acceleration at the end of the fifth second? (b) What is its acceleration at the end of the sixth second? (c) What is its acceleration at <u>any</u> time while it is falling.

2. A ball is thrown straight up. (a) By how much does the <u>velocity</u> change each second? (b) After the ball reaches the top and begins to return back down, by how much does the <u>velocity</u> change each second?

3. A ball is thrown straight up. What will be the instantaneous velocity at the top of its path?

4. An object is thrown upwards. (a) What is its acceleration as it travels upwards? (b) What is its acceleration when it reaches its highest point (were its speed is zero)? (c) What is its acceleration as it falls downwards?

5. An object is thrown upwards at 15.0 m/s. (a) What will be its speed when it returns to its starting position? (b) What will be its velocity when it returns to its starting position?

6. You cast a stone upwards. Which takes longer, the time for the stone to travel from your hand to the peak (top of its arc), or the time it takes for the stone to fall from the peak back to your hand? Explain your answer.

7. A ball is thrown vertically upwards and is caught by the thrower after 5.0 seconds. (a) How long did the ball take to reach its peak? (b) How high did the ball travel?

8. An arrow is shot straight up into the air with a speed of 35 m/s. (a) How high does it go? (b) How long is it in the air?

9. A ball is thrown upwards. The ball has a velocity of +6.0 m/s (6m/s up) when it is at a height of 12.0 meters above where it was thrown. How long did it take the ball to reach that point?

10. Two pennies are simultaneously thrown down a well. The first penny is thrown with a velocity of –4.5 m/s (downward at 4.5 m/s]. The second penny is thrown downward at 6.5 meters per second. If the well is 54 m deep, what is the time interval between when the pennies hit? {Hint: find the times for each]

11. A rock climber, together with her first-aid kit, are descending a vertical rope at a steady rate of 1.9 m/s. The strap holding the first-aid kit to her pack breaks and the kit is "released". After 2.5 sec, the kit hits the ground. How high above the ground was the first-aid kit when the strap broke? [Hint: v_0?0 m/s]

12. A helicopter is traveling straight upwards at 6.5 m/s. When the helicopter is 85 meters above the ground, the pilot mistakenly lets go of his coffee mug out the window. How long does it take for the mug to hit the ground? [Hint: see above problem]

13) The acceleration of gravity on the moon is 1.7 m/s² (downward). If you can throw a ball upwards a distance of 15.0 meters on Earth, how high could you throw it on the moon? [Hint: 2 problems-1 on earth & 1 on moon]

14) A person, staring through a 1.2 meter tall window, sees a penny fall by the window, taking 0.10 seconds to pass. The person knows that the bottom of the window is 14.8 meters above the ground. How tall is the building if the penny was dropped from the roof?

15) A boy wants to throw a can straight up and then hit it with a second can. He wants the collision to occur 4.0 meters above the throwing point. In addition, he knows that the time he needs between throws is 3.0 seconds. Assuming he throws both cans with the same speed, what must the initial speed be?

Vertical Kinematics: 1D Freefall-KEY
(9/18/03)

1) An object is dropped from rest. (a) What is its acceleration at the end of the fifth second? (b) What is its acceleration at the end of the sixth second? (c) What is its acceleration at <u>any</u> time while it is falling.
<p style="text-align:center">(a) –10 m/s²   (b) –10 m/s²   (c) –10 m/s²</p>

2) A ball is thrown straight up. (a) By how much does the <u>velocity</u> change each second? (b) After the ball reaches the top and begins to return back down, by how much does the <u>velocity</u> change each second?
<p style="text-align:center">(a) –10 m/s "way up-loses 10 m/s"   (b) –10 m/s "way down-gains 10 m/s"</p>

3) A ball is thrown straight up. What will be the instantaneous velocity at the top of its path?
<p style="text-align:center">0 m/s</p>

4) An object is thrown upwards. (a) What is its acceleration as it travels upwards? (b) What is its acceleration when it reaches its highest point (were its speed is zero)? (c) What is its acceleration as it falls downwards?
<p style="text-align:center">(a) –10 m/s²   (b) –10 m/s²   (c) –10 m/s²</p>

5) An object is thrown upwards at 15.0 m/s. (a) What will be its speed when it returns to its starting position? (b) What will be its velocity when it returns to its starting position?
<p style="text-align:center">(a) 15 m/s   (b) either down at 10 m/s or -10 m/s</p>

6) You cast a stone upwards. Which takes longer, the time for the stone to travel from your hand to the peak (top of its arc), or the time it takes for the stone to fall from the peak back to your hand? Explain your answer.
<p style="text-align:center">Same time: since t=?v/a and the ?v up is the same as ?v down</p>

7) A ball is thrown vertically upwards and is caught by the thrower after 5.0 seconds. (a) How long did the ball take to reach its peak? (b) How high did the ball travel?
<p style="text-align:center">(a) 2.5 sec   (b) 31.25 m</p>

8) An arrow is shot straight up into the air with a speed of 35 m/s. (a) How high does it go? (b) How long is it in the air?
<p style="text-align:center">(a) 61.25 m   (b) 7 sec</p>

9) A ball is thrown upwards. The ball has a velocity of +6.0 m/s (6m/s up) when it is at a height of 12.0 meters above where it was thrown. How long did it take the ball to reach that point?
<p style="text-align:center">1.06 sec [note: v_0=16.6 m/s]</p>

10) Two pennies are simultaneously thrown down a well. The first penny is thrown with a velocity of –4.5 m/s (downward at 4.5 m/s]. The second penny is thrown downward at 6.5 meters per second. If the well is 54 m deep, what is the time interval between when the pennies hit? {Hint: find the times for each]
<p style="text-align:center">0.16 sec [1st penny v_f=-33.17 m/s so t=2.86 sec & 2nd penny v_f=-33.5 m/s so t=2.7 sec]</p>

11) A rock climber, together with her first-aid kit, are descending a vertical rope at a steady rate of 1.9 m/s. The strap holding the first-aid kit to her pack breaks and the kit is "released". After 2.5 sec, the kit hits the ground. How high above the ground was the first-aid kit when the strap broke? [Hint: v_0?0 m/s]
<p style="text-align:center">36m (?s=-36m)</p>

12) A helicopter is traveling straight upwards at 6.5 m/s. When the helicopter is 85 meters above the ground, the pilot mistakenly lets go of his coffee mug out the window. How long does it take for the mug to hit the ground? [Hint: see above problem]
<p style="text-align:center">4.8 sec (note: v_f= -41.74 m/s)</p>

13) The acceleration of gravity on the moon is 1.7 m/s² (downward). If you can throw a ball upwards a distance of 15.0 meters on Earth, how high could you throw it on the moon? [Hint: 2 problems-1 on earth & 1 on moon]
<p style="text-align:center">88.23 meters (v_0=17.32 m/s)</p>

14) A person, staring through a 1.2 meter tall window, sees a penny fall by the window, taking 0.10 seconds to pass. The person knows that the bottom of the window is 14.8 meters above the ground. How tall is the building if the penny was dropped from the roof?
<p style="text-align:center">22.6125 meters [6.6125 m + 1.2 m + 14.8m]</p>

15) A boy wants to throw a can straight up and then hit it with a second can. He wants the collision to occur 4.0 meters above the throwing point. In addition, he knows that the time he needs between throws is 3.0 seconds. Assuming he throws both cans with the same speed, what must the initial speed be?
<p style="text-align:center">17.46 m/s</p>