Mostly Integer Falling Ball Problems

Throughout this worksheet use g = -10 m/s² for the acceleration due to gravity on earth.

1) A ball is dropped from rest at t = 0 seconds. Neglecting air friction
   a) What is its velocity 4 seconds later?
   b) How far does it fall in the first three seconds?
   c) What is its acceleration after 6 seconds?
   d) How far does it fall from t = 2 seconds to t = 7 seconds?
   e) How much does its velocity change from t = 3 seconds to t = 12 seconds?
   f) What is its average velocity from t = 3 seconds to t = 5 seconds?

2) A stone is thrown upward with an initial velocity of 40 m/s. Neglecting air friction
   b) How long does it take to reach its peak?
   c) How high does it go (at its peak)?
   d) What is its acceleration at the peak
   e) What is its velocity when it hits the ground? How do you know?
   f) What is its displacement from t = 2 seconds to t = 8 seconds?
   g) How much does its velocity change from t = 1 second to t = 5 seconds

3) Is the acceleration of gravity a constant? Why or why not?

4) What is the acceleration of gravity on a planet where a ball falls 15 meters from rest in its first second of fall?

5) If a ball rolls down an incline 2 meters from rest in the first second, how far will it roll in the fourth second (from t = 3 to t = 4)?

6) A ball is thrown upwards from the roof of a building with a speed of 15 m/s just missing the edge of the roof and falling to the ground below. If the ball hits the ground six seconds later, how high is the building? With what speed does the ball hit the ground?

7) Two sisters on the edge of a cliff throw two balls. One throws her ball vertically upward at 15 m/s, and, at exactly the same time, the other sister throws her ball downward at 25 m/s. How long does it take for the balls to be 100 meters apart?

Mostly Integer Falling Ball Problems-KEY

Throughout this worksheet use g = -10 m/s² for the acceleration due to gravity on earth.

1) A ball is dropped from rest at t = 0 seconds. Neglecting air friction
   a) What is its velocity 4 seconds later? $v_f=v_0+a(t)$ = 0 m/s+(-10 m/s²)(4 s) = -40 m/s
   b) How far does it fall in the first three seconds? ?s=-15 m/s(3 s) = -45 m
   c) What is its acceleration after 6 seconds? -10 m/s²
   d) How far does it fall from t = 2 seconds to t = 7 seconds? ?s=-45 m/s(5 s) = -225 m
   e) How much does its velocity change from t = 3 seconds to t = 12 seconds?
      ?v = a(t) = (-10 m/s²)(9 s) = -90 m/s
   f) What is its average velocity from t = 3 seconds to t = 5 seconds?
      [(-30 m/s) + (-50 m/s)]÷2 = -40 m/s

2) A stone is thrown upward with an initial velocity of 40 m/s. Neglecting air friction
   a) How long does it take to reach its peak? 4 sec
   b) How high does it go (at its peak)? ?s= +20 m/s(4 s) = +80 m
   c) What is its acceleration at the peak? -10 m/s²
   d) What is its velocity when it hits the ground? How do you know? -40 m/s, symmetry
   e) What is its displacement from t = 2 seconds to t = 8 seconds?
      ?s= -10 m/s(6 s) = -60 m
   f) How much does its velocity change from t = 1 second to t = 5 seconds
      ?v = a(t) = (-10 m/s²)(4 s) = -40 m/s

3) Is the acceleration of gravity a constant? Why or why not?
No, the acceleration due to gravity changes from planet to planet and from location to location on a planet (albeit only to a relatively small degree).

4) What is the acceleration of gravity on a planet where a ball falls 15 meters from rest in its first second of fall?   -30 m/s²

5) If a ball rolls down an incline 2 meters from rest in the first second, how far will it roll in the fourth second (from t = 3 to t = 4)?
                    Using the law of odd integers: 7 times as far or 14 meters

6) A ball is thrown upwards from the roof of a building with a speed of 15 m/s just missing the edge of the roof and falling to the ground below. If the ball hits the ground six seconds later, how high is the building? With what speed does the ball hit the ground?
      ?s= -15 m/s(6 s) = -90 m $v_f=v_0+a(t)$ = +15 m/s+(-10 m/s²)(6 s) = -45 m/s

7) Two sisters on the edge of a cliff throw two balls. One throws her ball vertically upward at 15 m/s, and, at exactly the same time, the other sister throws her ball downward at 25 m/s. How long does it take for the balls to be 100 meters apart?
         Relative velocity-every second get 40 meters farther apart, so 100 m ÷ 40 m/s = 2.5 s