

AP Physics 1: 2.2 Free Fall

1. A rock is dropped from a building top. The rock takes 3.5 seconds to hit the ground. At what velocity did it strike the floor below? (Answer: 34.3 m/s)

$$\begin{aligned}
 t &= 3.5 & v_x &= v_0 + at \\
 a &= 9.8 & v_x &= 9.8(3.5) = \boxed{34.3 \text{ m/s}} \\
 v_0 &= 0 \\
 v_x &=?
 \end{aligned}$$

2. A can of tuna is dropped from a building. If the can takes 3.2 seconds to strike the ground, what distance did it fall? (Answer: 50.176 m)

$$\begin{aligned}
 t &= 3.2 & x &= v_0 t + \frac{at^2}{2} \\
 v_0 &= 0 \\
 a &= 9.8 & x &= \frac{9t^2}{2} = \frac{9.8(3.2)^2}{2} = \boxed{50.176 \text{ m}} \\
 x &=?
 \end{aligned}$$

3. An engine falls off of an airplane from a height of 2500 m. Ignoring wind resistance, how fast is the thing traveling when it smacks into the turf? (Answer: 221.359 m/s)

$$\begin{aligned}
 x &= 2500 & v_x^2 &= v_0^2 + 2ax \\
 v_0 &= 0 & v_x &= \sqrt{v_0^2 + 2ax} \\
 a &= 9.8 & v_x &= \sqrt{2(9.8)(2500)} = \boxed{221.359 \text{ m/s}} \\
 v_x &=?
 \end{aligned}$$

4. A leg of lamb is dropped from a bridge that is 22.5 m above the river.  
 (a) how fast is it going when it hits the water? (Answer: 21 m/s)

$$\begin{aligned}
 x &= 22.5 & v_x^2 &= v_0^2 + 2ax \\
 a &= 9.8 & v_x &= \sqrt{v_0^2 + 2ax} = \sqrt{2(9.8)(22.5)} = \boxed{21 \text{ m/s}} \\
 v_0 &= 0 \\
 v_x &=?
 \end{aligned}$$

- (b) How long does it take it to hit the water? (Answer: 2.14 sec)

$$\begin{aligned}
 t &=? & v_x &= v_0 + at \\
 t &= \frac{v_x - v_0}{a} = \frac{21 - 0}{9.8} = \boxed{2.14 \text{ sec}}
 \end{aligned}$$

90. A freely falling object is found to be moving downward at 18 m/s. If it continues to fall, two seconds later the object would be moving with a speed of

(A) 8.0 m/s (B) 10 m/s (C) 18 m/s (D) 38 m/s (E) 180 m/s

$$\begin{aligned}
 v_0 &= 18 & v_x &= v_0 + at \\
 t &= 2 & v_x &= 18 + 2(9.8) = 37.6 \text{ m/s} \\
 a &= 9.8 \\
 v_x &=?
 \end{aligned}$$

134. A rock is dropped from the top of a tall tower. Half a second later another rock, twice as massive as the first, is dropped. Ignoring air resistance,

(A) the distance between the rocks increases while both are falling.  
 (B) the acceleration is greater for the more massive rock.  
 (C) the speed of both rocks is constant while they fall.  
 (D) they strike the ground more than half a second apart.  
 (E) they strike the ground with the same kinetic energy.