Free Fall

1

Falling Objects

- **Gravity acts on all falling objects.**
- **Gravity is not dependent on mass.**
- **When an object is dropped, its initial velocity is 0 m/s.**
- **Down is considered to be in the negative direction. Up is positive.**
- **When an object is thrown down, its initial velocity will be negative.**
- **When an object is falling downward, its displacement will be negative.**
- **Acceleration due to gravity is -9.80 m/s^2**
- **Gravity varies slightly with on the surface of the Earth, but we use the average of –9.80 m/s^2.**
- **Whenever an object is dropped on Earth, we can use –9.80 m/s^2 as the acceleration for that object.**

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The Equations

- **When acceleration is constant, we can find other information about the object's motion using the following equations:**

$$v = v_o + at \qquad v^2 = v_0^2 + 2a\Delta x$$

$$\Delta x = v_o t + \frac{1}{2} a t^2$$

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Practice Problem #1

- **A rock is dropped from the edge of a bridge 42 m above a river. How long will it take the rock to hit the river?**

$\Delta x = V_0 t + \frac{1}{2} A t^2$

$-42 = 0(t) + \frac{1}{2}(-9.8)t^2$

$-42 = -4.9\,t^2$

$\frac{-42}{-4.9} = t^2$

$8.57 = t^2$

$2.93\text{s} = t$

V	
V_o	0
a	-9.8
t	
Δx	-42

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Practice Problem #2

- **You throw a stone down with a velocity of 18.0 m/s from bridge. When it hits the ground it is traveling at a speed of 43.6 m/s.**
  - **What is the height of the bridge?**

$V^2 = V_0^2 + 2a\Delta x$

$(-43.6)^2 = (-18)^2 + 2(-9.8)\Delta x$

$1900.96 = 324 + (-19.6)\Delta x$

$1576.96 = (-19.6)\Delta x$

$-80.5 = \Delta x$

HEIGHT $= |\Delta x| = 80.5\text{ m}$

  - **How long does it take to hit the ground?**

$V = V_0 + At$

$-43.6 = -18 + (-9.8)t$

$-25.6 = -9.8t$

$2.61\text{ s} = t$

V	-43.6
V_0	-18
a	-9.8
t	
Δx	

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Practice Problem #3

- **A student drops a ball from the top the school. It takes 1.75 seconds to hit the ground.**
  - **What is the velocity of the ball just before it hits the ground?**

$V = V_0 + At$

$V = 0 + (-9.8)(1.75)$

$V = -17.15\text{ m/s}$

  - **What is the height of the school?**

$\Delta x = V_0 t + \frac{1}{2}At^2$

$\Delta x = 0(1.75) + \frac{1}{2}(-9.8)(1.75)^2$

$\Delta x = -15\text{ m}$

HEIGHT $= |\Delta x| = 15\text{ m}$

V	
V_0	0
a	-9.8
t	1.75
Δx	

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