Chapter 1, Section 1: Preview Activity

Preview Activity 1.1.1. Suppose that the height s of a ball at time t (in seconds) is given in feet by the formula
$$s(t) = 64 - 16(t - 1)^2.$$

a. Construct a graph of $y = s(t)$ on the time interval $0 \leq t \leq 3$. Label at least six distinct points on the graph, including the three points showing when the ball was released, when the ball reaches its highest point, and when the ball lands.

b. Describe the behavior of the ball on the time interval $0 < t < 1$ and on time interval $1 < t < 3$. What occurs at the instant $t = 1$?

c. Consider the expression

$$AV_{[0.5,1]} = \frac{s(1) - s(0.5)}{1 - 0.5}.$$

Compute the value of $AV_{[0.5,1]}$. What does this value measure on the graph? What does this value tell us about the motion of the ball? In particular, what are the units on $AV_{[0.5,1]}$?
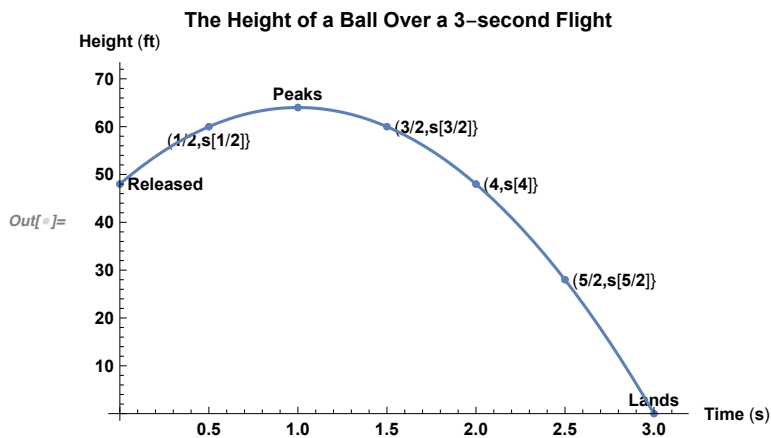
a. Graph, with labelled points:

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In[ ]:= s[t_] := 64 - 16 (t - 1) ^ 2
     p1 = Plot[s[t], {t, 0, 3}];
     points = Table[{t, s[t]}, {t, 0, 3, 0.5}];
     p2 = ListPlot[points, PlotStyle → Large];
     p3 = ListPlot[{
         Labeled[points[[1]], "Released", Right],
         Labeled[points[[2]], "(1/2,s[1/2]}", Bottom],
         Labeled[points[[3]], "Peaks", Top],
         Labeled[points[[4]], "(3/2,s[3/2]}", Right],
         Labeled[points[[5]], "(4,s[4]}", Right],
         Labeled[points[[6]], "(5/2,s[5/2]}", Right],
         Labeled[points[[7]], "Lands", Top]
       }];
     Show[p3, p2, p1, PlotLabel → "The Height of a Ball Over a 3-second Flight",
      AxesLabel → {"Time (s)", "Height (ft)"}]
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b. Description of behavior:

1. On the interval [0,1), the ball is flying up to its peak.

2. At t=1, it hits its peak.

3. On the interval (1,3], the ball is dropping until it hits the ground at t=3.

c. Graph, with labelled points:

In[ ]:= AV = $\left(s[1] - s[0.5]\right) / \left(1 - 0.5\right)$

Out[ ]= 8.

Q: Compute the value of AV[0.5,1]. What does this value measure on the graph? What does this value tell us about the motion of the ball? In particular, what are the units on AV[0.5,1]?

A: the value is 8ft/s. If you compute its value, you should automatically include the units!:) What it tells us about the motion of the ball is that its "AV" -- average velocity -- over the interval [0.5,1] is 8 feet per second. It's actually the slope of the secant line, joining the points on the graph at times 0.5 and 1 second.

In[ ]:= p3 = Plot$\left[s[0.5] + AV\left(t - 0.5\right), \{t, 0, 1.5\}\right]$;
Show[p1, p2, p3]

Out[ ]=