

The graph at the right shows the actual speed of the car at all times.

The lower estimate for the first 2 second interval was 2 seconds times

30 ft/sec which equals 60 ft. This can be represented by the rectangle

shown where the area of the rectangle gives us the distance traveled.

**Draw** in rectangles to show how you calculated the lower

estimate for each of the other intervals.

Notice how the left side of each rectangle touches the graph.

This method of approximating the area under a curve is called

the **Left-Hand Rectangular Approximation Method (LRAM).**

Each interval is called a **partition**.

The graph at the right shows the upper estimate for the first interval.

(2 sec times 36 ft/sec = 72 ft.) The area of therectangle is 2 x 36 = 72.

**Draw** in rectangles to show how you calculated the upper

estimate for each of the other intervals.

Notice how the right side of each rectangle touches the graph.

This method of approximating the area under a curve is called

the **Right-Hand Rectangular Approximation Method (RRAM).**

The approximations we calculated above are known as **Riemann Sums** (named after Georg Riemann). The maximum error in a Riemann Sum is the difference between the lowest estimate and the highest estimate. The accuracy of the approximation can be improved by increasing the number of rectangles.

Example: Find the area between the x-axis and $y=x^{2}$ on the interval [0,3] with partition width of 1.

a. Left-Hand Approximation ( LRAM)

b. Right-Hand Approximation (RRAM)

c. Midpoint Approximation (MRAM)