

## Riemann Sums - Unequal Widths

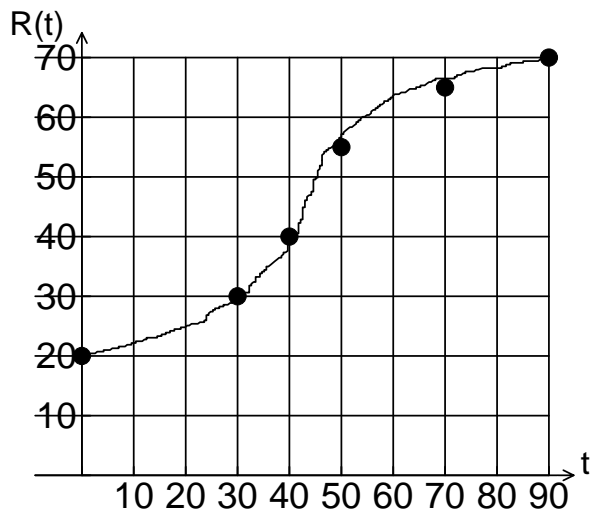
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Let  $f$  be continuous and non-negative on the interval  $[a, b]$ , then a Riemann Sum can be used to find an approximate area of  $f$  under the curve if the widths of the rectangles are unequal by:

1. Area =  $\_\_\_ + \_\_\_ + \_\_\_ + \_\_\_ + \dots$  where  $n$  is # of blanks = # of rectangles
2. Each blank has (ht.)  $(\Delta x)$  of each rectangle where  $(\Delta x)$  is different for each rectangle.
3. The heights are determined by the problem situation (upper, midpt., etc.).

\*\*calc.(FR) The rate of fuel consumption (in gallons per minute) recorded during a plane flight is given by a twice differentiable function  $R$  of time  $t$ , min.



$t$	$R(t)$
0	20
30	30
40	40
50	55
70	65
90	70

1. Approximate the value of the total fuel consumption, using a left Riemann sum with the 5 subintervals indicated in the table above.
  
2. Is this numerical approximation less than the value of the exact area? Explain your reasoning.