

Readings of the power being used at a given time are taken at hourly intervals at an electric substation. The units of power are in kilowatts (kW) and the hourly readings over a 12-hour period are shown below.

$t$ (hours)	0	1	2	3	4	5	6	7	8	9	10	11	12
$f(t)$ (kW)	900	1200	1300	1200	1000	850	1200	1000	1100	1400	1400	1700	1500

- a) Using a left sum approximation with 4 equally spaced subintervals, approximate the power usage from time  $t = 4$  to  $t = 12$ .
- b) Using a right sum approximation with 4 equally spaced subintervals, approximate the power usage from time  $t = 4$  to  $t = 12$ .
- c) Using a midpoint approximation with 4 equally spaced subintervals, approximate the power usage from time  $t = 4$  to  $t = 12$ .

### AP Riemann Problems

$x$	1	3	5	7	9
$h(x)$	2	3	3	4	5

1. Using the table of values shown above for the continuous function  $h(x)$ , which of the following is the approximation of the area under the curve  $h(x)$  using left sum with 4 equal subintervals?

(A) 34      (B) 30      (C) 28      (D) 27      (E) 24

2. Using the table of values shown above for the continuous function  $h(x)$ , which of the following is the approximation of the area under the curve  $h(x)$  using right sum with 4 equal subintervals?

(A) 34      (B) 30      (C) 28      (D) 27      (E) 24

3. Using the table of values shown above for the continuous function  $h(x)$ , which of the following is the approximation of the area under the curve  $h(x)$  using midpoint sum with 2 equal subintervals?

(A) 34      (B) 30      (C) 28      (D) 27      (E) 24

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4. A function  $f$  is continuous on  $[1,5]$  and some of the values of  $f$  are shown below:

$x$	1	4	5
$f(x)$	7	$b$	2

If the right Riemann sum is 17, then the value of  $b$  is:

(A)  $-4$       (B) 0      (C) 3      (D) 4.25      (E) 5