

Rectangular Approximation

- 16. Distance Traveled** The table below shows the velocity of a model train engine moving along a track for 10 sec. Estimate the distance traveled by the engine, using 10 subintervals of length 1 with (a) left-endpoint values (LRAM) and (b) right-endpoint values (RRAM). (a) 87 in. = 7.25 ft (b) 87 in. = 7.25 ft

Time (sec)	Velocity (in./sec)	Time (sec)	Velocity (in./sec)
0	0	6	11
1	12	7	6
2	22	8	2
3	10	9	6
4	5	10	0
5	13		

- 17. Distance Traveled Upstream** You are walking along the bank of a tidal river watching the incoming tide carry a bottle upstream. You record the velocity of the flow every 5 minutes for an hour, with the results shown in the table below. About how far upstream does the bottle travel during that hour? Find the (a) LRAM and (b) RRAM estimates using 12 subintervals of length 5. (a) 5220 m (b) 4920 m

Time (min)	Velocity (m/sec)	Time (min)	Velocity (m/sec)
0	1	35	1.2
5	1.2	40	1.0
10	1.7	45	1.8
15	2.0	50	1.5
20	1.8	55	1.2
25	1.6	60	0
30	1.4		

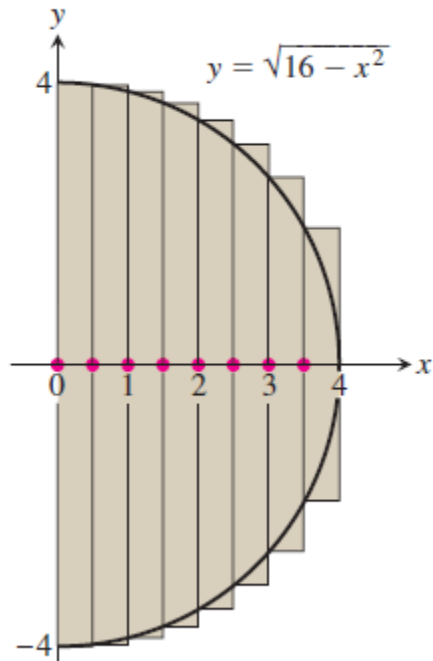
18. **Length of a Road** You and a companion are driving along a twisty stretch of dirt road in a car whose speedometer works but whose odometer (mileage counter) is broken. To find out how long this particular stretch of road is, you record the car's velocity at 10-sec intervals, with the results shown in the table below. (The velocity was converted from mi/h to ft/sec using  $30 \text{ mi/h} = 44 \text{ ft/sec}$ .) Estimate the length of the road by averaging the LRAM and RRAM sums. **3665 ft**

Time (sec)	Velocity (ft/sec)	Time (sec)	Velocity (ft/sec)
0	0	70	15
10	44	80	22
20	15	90	35
30	35	100	44
40	30	110	30
50	44	120	35
60	35		

23. **Volume of Water in a Swimming Pool** A rectangular swimming pool is 30 ft wide and 50 ft long. The table below shows the depth  $h(x)$  of the water at 5-ft intervals from one end of the pool to the other. Estimate the volume of water in the pool using (a) left-endpoint values and (b) right-endpoint values. **(a)  $15,465 \text{ ft}^3$  (b)  $16,515 \text{ ft}^3$**

Position (ft) $x$	Depth (ft) $h(x)$	Position (ft) $x$	Depth (ft) $h(x)$
0	6.0	30	11.5
5	8.2	35	11.9
10	9.1	40	12.3
15	9.9	45	12.7
20	10.5	50	13.0
25	11.0		

20. **Volume of a Solid Hemisphere** To estimate the volume of a solid hemisphere of radius 4, imagine its axis of symmetry to be the interval  $[0, 4]$  on the  $x$ -axis. Partition  $[0, 4]$  into eight subintervals of equal length and approximate the solid with cylinders based on the circular cross sections of the hemisphere perpendicular to the  $x$ -axis at the subintervals' left endpoints. (See the accompanying profile view.)



$$S_8 \approx 146.08406$$

Overestimate, because each rectangle extends beyond the curve.