

### Accumulated Change Example: Oil draining from a tank

Oil leaking from a tank flows at an instantaneous rate  $r(t)$  liters per hour. As the tank empties, the flow rate decreases. Values of the rate at two-hour time intervals are shown in the table. Find lower and upper estimates for the total amount of oil that leaked out.

Time $t$ (hours)	0	2	4	6	8	10
Flow Rate $r(t)$ (liters per hour)	8.7	7.6	6.8	6.2	5.7	5.3

Approach: During the first 2 hours (from  $t = 0$  to  $t = 2$ ) the flow rate is between 8.7 and 7.6 liters per hour. Therefore, the amount of oil that flows out is between what would be observed with a constant flow rate of 8.7 and what would be observed with a constant flow rate of 7.6. This gives us:  $15.2 \text{ liters} \leq \text{actual amount of oil} \leq 17.4 \text{ liters}$ . Use the same method to estimate the amount of oil that leaks out in each of the succeeding two hour intervals, and use your results to estimate the total amount of oil that leaked out in the 10 hours represented in the table.