



## Harry Potter is NOT average

The Quidditch Championship match between Slytherin and Gryffindor is the social event of Hogwart's school year. Wizards line up at the gate waiting to get the very best viewing seats. The number of wizards in line is modeled by a differentiable function  $L$  for  $0 \leq t \leq 60$  where  $t$  is measured in minutes. Values of  $L(t)$  at various times are given in the table below.

$t$ [minutes]	0	10	25	30	45	60
$L(t)$ [wizards in line]	100	120	160	200	300	500

- (a) Find the average rate of wizards lining up for  $t=0$  to  $t=60$ . Show units.

$$\begin{aligned} \text{AV RATE on } [0, 60] &= \frac{L(60) - L(0)}{60 - 0} \\ &= \frac{20}{3} \frac{\text{WIZARDS}}{\text{MINUTE}} \end{aligned}$$

- (b) Approximate a value for  $L'(20)$ . Show units.

$$\begin{aligned} L'(20) &\approx \frac{L(25) - L(10)}{25 - 10} \\ &= \frac{8}{3} \frac{\text{WIZARDS}}{\text{minute}} \end{aligned}$$

- (c) Use a trapezoid sum to find the value of  $\int_0^{60} L(t) dt$ . Show all the work that

leads to your answer.

$$\int_0^{60} L(t) dt \approx \text{TRAP} \quad \text{TRAP} = \frac{L(0)+L(10)}{2}(10) + \frac{L(10)+L(25)}{2}(15) \\ + \frac{L(25)+L(30)}{2}(5) + \frac{L(30)+L(45)}{2}(15) + \frac{L(45)+L(60)}{2}(15) \\ = 13850 \text{ (WIZARDS)(min)}$$

- (d) Use your solution from part (c) to find the average number of wizards in line for  $0 \leq t \leq 60$  minutes.

$$\frac{1}{60-0} \int_0^{60} L(t) dt \\ \approx 230.833 \text{ WIZARD}$$

