1A
1 of 2

1. People enter a line for an escalator at a rate modeled by the function $r$ given by

$$r(t) = \begin{cases} 44\left(\frac{t}{100}\right)^3\left(1 - \frac{t}{300}\right)^7 & \text{for } 0 \le t \le 300 \\ 0 & \text{for } t > 300, \end{cases}$$

where $r(t)$ is measured in people per second and $t$ is measured in seconds. As people get on the escalator, they exit the line at a constant rate of 0.7 person per second. There are 20 people in line at time $t = 0$.

(a) How many people enter the line for the escalator during the time interval $0 \le t \le 300$ ?

$$\int_0^{300} 44\left(\frac{t}{100}\right)^3\left(1 - \frac{t}{300}\right)^7 dt = \boxed{270}$$

(b) During the time interval $0 \le t \le 300$, there are always people in line for the escalator. How many people are in line at time $t = 300$ ?

$.7(300) = 210$

$20 + 270 = 290$

$290 - 210 = \boxed{80}$





Continue question 1 on page 5.

1A
2 of 2

(c) For $t > 300$, what is the first time $t$ that there are no people in line for the escalator?

$(t-300)(.7)-80=0$

$.7t-210-80=0$

$.7t=+290$

$\boxed{t=414.286s}$

(d) For $0 \le t \le 300$, at what time $t$ is the number of people in line a minimum? To the nearest whole number, find the number of people in line at this time. Justify your answer.

p = total people

$\frac{dp}{dt} = r(t) - .7$

$0 = r(t) - .7$

$t = 166.575$

$t = 33.013$

$p(t) = \int_0^t r(x) - .7 \, dx + 20$

| t | p(t) |
|---|---|
| 0 | 20 |
| 33.013 | 3.803 |
| 166.575 | 158.07014 |
| 300 | 80 |

minimum at time $t = 33.013s$ when 4 people are in line





GO ON TO THE NEXT PAGE.