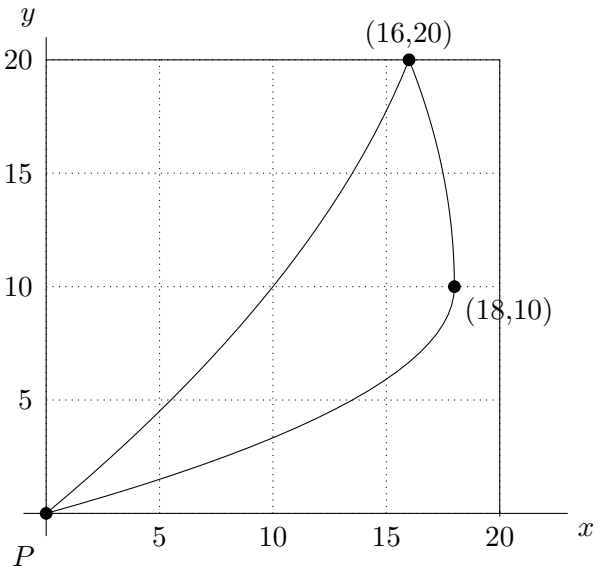
**8.** [13 points] During the first round of the rematch between Paul "Stretch" Cassenick and Stephen "Dee" Boxer, Paul's position in the boxing ring $t$ minutes after the 3-minute round began is given by $(x(t), y(t))$ where $x(t)$ and $y(t)$ are Paul's distance from his corner, in feet, in the $x-$ and $y-$directions, respectively. The ring is the 20x20 foot square pictured below, and the point $P$ is Paul's corner. Suppose $x(t) = -8t(t-3)$, and $y(t)$ has values given in the table below and is **linear** between each consecutive pair of $t$-values in the table.




| $t$ | $y(t)$ |
|---|---|
| 0 | 0 |
| 1 | 20 |
| 1.5 | 10 |
| 3 | 0 |

**a**. [5 points] On the diagram of the ring, sketch a graph of Paul's path through the ring during the first round of the rematch. Label the points corresponding to Paul's position at $t = 1$ and $t = 1.5$ with their $x$- and $y$-coordinates.

**b**. [4 points] Find the slope of the tangent line to Paul's path at $t = 2$.

*Solution:* $\dfrac{dy}{dx} = \dfrac{\left(\frac{dy}{dt}\big|_{t=2}\right)}{\left(\frac{dx}{dt}\big|_{t=2}\right)} = \dfrac{\frac{-20}{3}}{-8} = \dfrac{5}{6}.$

**c**. [4 points] Write an explicit expression involving integrals that gives the distance Paul traveled during the first minute of the round. Your answer should not contain the letters '$x$' or '$y$'.

*Solution:* The distance traveled over the first minute is the arc length of the curve from $t = 0$ to $t = 1$. So the distance Paul traveled is $\int_0^1 \sqrt{(24-16t)^2 + (20)^2}dt$ feet.