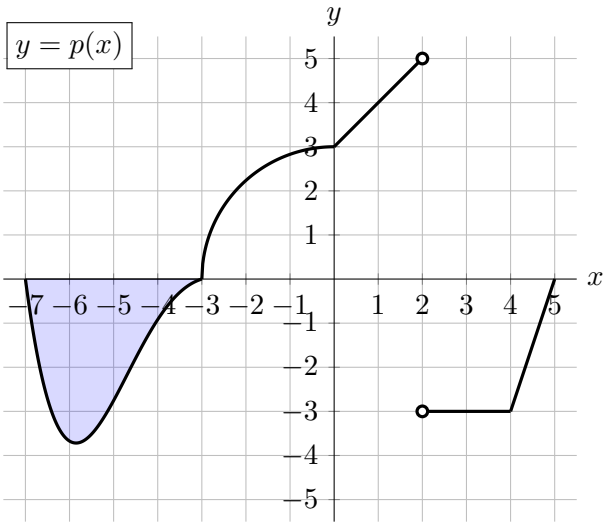
6. [14 points] A portion of the graph of a function $p(x)$ is shown below. The area of the shaded region is 8, and the portion of the graph on the interval $[-3, 0]$ is a quarter circle. Also note that $p(x)$ is linear on the intervals $(0, 2)$ and $(4, 5)$.



Let $P(x)$ be the continuous antiderivative of $p(x)$ passing through the point $(0, 1)$.

a. [3 points] Find all critical points of $P(x)$ in the interval $(-7, 5)$. For each, determine if it a local maximum, local minimum, or neither.

Solution: $x = -3$ is a local min, and $x = 2$ is a local max.

b. [2 points] For what values of x in the interval $(-7, 5)$ is $P(x)$ a linear function? Give your answer as one or more intervals.

Solution: $2 < x < 4$.

c. [2 points] For approximately what values of x in the interval $(-7, 5)$ is the function $P(x)$ concave up? Give your answer as one or more intervals.

Solution: $-5.8 < x < 2$ and $4 < x < 5$

d. [2 points] For approximately what values of x in the interval $(-7, 5)$ is the function $p''(x)$ positive? Give your answer as one or more intervals.

Solution: $-7 < x < -4.5$

e. [5 points] Create a table giving the **exact** values of $P(x)$ at $x = -7, -3, 0, 2, 4$, and 5.

Solution: $P(-7) = 9 - \frac{9}{4}\pi$
$P(-3) = 1 - \frac{9}{4}\pi$
$P(0) = 1$
$P(2) = 9$
$P(4) = 3$
$P(5) = 1.5$