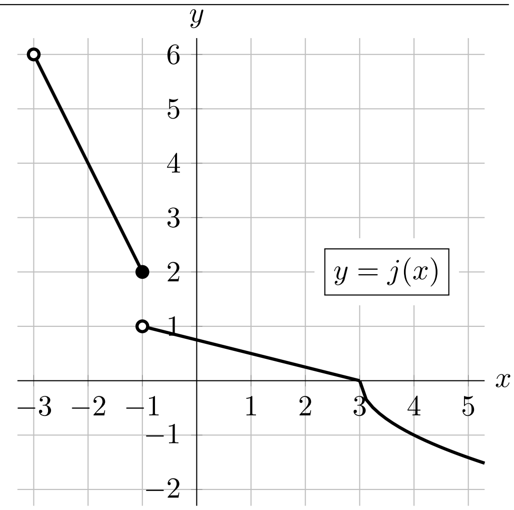
1. [10 points]

A portion of the graph of the function $j(x)$, whose domain is $(-3, \infty)$, is shown to the right. Note that:

- $j(x)$ is linear on $(-3, -1]$ and on $(-1, 3]$.
- On the interval $[3, \infty)$, the function $j(x)$ is given by the formula $-\sqrt{x-3}$.



For parts **a.–c.**, find the **exact** values, or write NEI if there is not enough information to do so, or write DNE if the value does not exist. Your answers should not include the letter j but you do not need to simplify. Show work.

a. [2 points] Find $j'(4)$.

Solution: On $[3, \infty)$, $j(x) = -(x-3)^{1/2}$ so $j'(x) = \frac{-1}{2}(x-3)^{-1/2}$ and Using the chain rule,

$$\left[-\sqrt{x-3}\right]' = -\frac{1}{2}(x-3)^{-1/2}$$

so

$$j'(4) = -\frac{1}{2}(4-3)^{-1/2} = -\frac{1}{2}$$

Answer: $j'(4) =$ $-1/2$

b. [3 points] Let $A(x) = \dfrac{x}{j(x)}$. Find $A'(1)$.

Solution: Using the quotient rule,

$$A'(x) = \frac{j(x) - xj'(x)}{(j(x))^2}$$

$$A'(1) = \frac{j(1) - j'(1)}{(j(1))^2} = \frac{\frac{1}{2} - \left(-\frac{1}{4}\right)}{\left(\frac{1}{2}\right)^2} = 3$$

Answer: $A'(1) =$ 3

c. [3 points] Let $B(x) = 2^{j(x)}$. Find $B'(-2)$.

Solution: Using the chain rule,

$$B'(x) = \ln(2)2^{j(x)}j'(x)$$

$$B'(-2) = \ln(2)2^{j(-2)}j'(-2)$$

$$= \ln(2)2^4(-2) = -32\ln(2).$$

Answer: $B'(-2) =$ $-32\ln(2)$

d. [2 points] On which of the following intervals does $j(x)$ satisfy the hypotheses of the Mean Value Theorem? Circle all correct answers. You do not need to show work for this part.

$[-1, 2]$ $\qquad$ $[0, 5]$ $\qquad$ $\boxed{[3, 5]}$ $\qquad$ NONE OF THESE