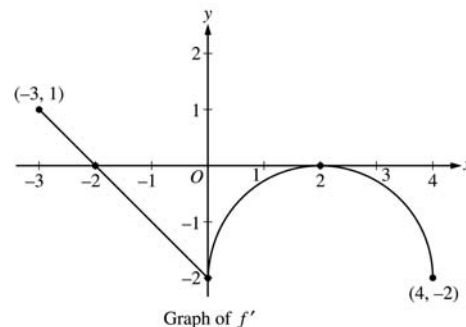


**AP[®] CALCULUS AB
2003 SCORING GUIDELINES**

Question 4

Let f be a function defined on the closed interval $-3 \leq x \leq 4$ with $f(0) = 3$. The graph of f' , the derivative of f , consists of one line segment and a semicircle, as shown above.



- (a) On what intervals, if any, is f increasing? Justify your answer.
 (b) Find the x -coordinate of each point of inflection of the graph of f on the open interval $-3 < x < 4$. Justify your answer.
 (c) Find an equation for the line tangent to the graph of f at the point $(0, 3)$.
 (d) Find $f(-3)$ and $f(4)$. Show the work that leads to your answers.

(a) The function f is increasing on $[-3, -2]$ since $f' > 0$ for $-3 \leq x < -2$.

2 : $\left\{ \begin{array}{l} 1 : \text{interval} \\ 1 : \text{reason} \end{array} \right.$

(b) $x = 0$ and $x = 2$
 f' changes from decreasing to increasing at $x = 0$ and from increasing to decreasing at $x = 2$

2 : $\left\{ \begin{array}{l} 1 : x = 0 \text{ and } x = 2 \text{ only} \\ 1 : \text{justification} \end{array} \right.$

(c) $f'(0) = -2$
 Tangent line is $y = -2x + 3$.

1 : equation

$$\begin{aligned} \text{(d)} \quad f(0) - f(-3) &= \int_{-3}^0 f'(t) dt \\ &= \frac{1}{2}(1)(1) - \frac{1}{2}(2)(2) = -\frac{3}{2} \end{aligned}$$

$$f(-3) = f(0) + \frac{3}{2} = \frac{9}{2}$$

$$\begin{aligned} f(4) - f(0) &= \int_0^4 f'(t) dt \\ &= -\left(8 - \frac{1}{2}(2)^2\pi\right) = -8 + 2\pi \end{aligned}$$

$$f(4) = f(0) - 8 + 2\pi = -5 + 2\pi$$

1 : $\pm \left(\frac{1}{2} - 2\right)$
 (difference of areas of triangles)
 1 : answer for $f(-3)$ using FTC
 4 : $\left\{ \begin{array}{l} 1 : \pm \left(8 - \frac{1}{2}(2)^2\pi\right)$
 (area of rectangle - area of semicircle)
 1 : answer for $f(4)$ using FTC \end{array} \right.