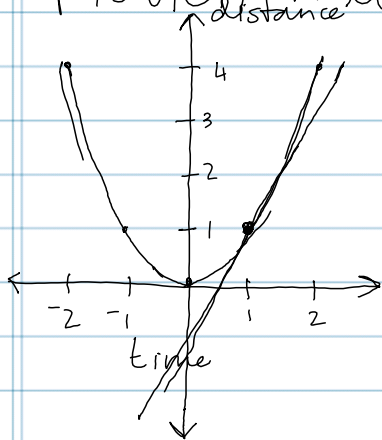


# Motion Along a Curve



$$f(x) = x^2$$

$$f'(x) = 2x \quad (1, 1)$$

$$f'(1) = 2$$

A particle moves on the x-axis so that its position at any time  $t \geq 0$  is given by  $x(t) = 2te^{-t}$

- Find the acceleration of the particle at  $t=0$
- Find the velocity of the particle when the acceleration = 0
- Find the total distance traveled by the particle from  $t=0$  to  $t=5$

$$a) \quad x'(t) = -2te^{-t} + 2e^{-t}$$

$$x''(t) = 2te^{-t} - 2e^{-t} - 2e^{-t}$$

$$x''(0) = 2(0)e^{(0)} - 2e^{(0)} - 2e^{(0)}$$

$$= -4e^{(0)}$$

$$= -4(1)$$

$$= \boxed{-4}$$

$$b) \quad 0 = 2te^{-t} - 2e^{-t} - 2e^{-t}$$

$$0 = -2e^{-t}(t-2)$$

$$0 = e^{-t}(t-2)$$

$$t-2 = 0$$

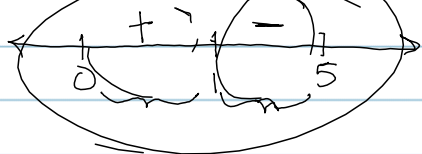
$$x'(t) = \cancel{e^{-t}} = 0$$

$$t = 2$$

$$v(t) = -4e^{-2} + 2e^{-2}$$

$$= -2e^{-2} = \frac{-2}{e^2}$$

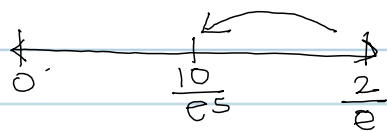
$$c) \quad v(t) = 2te^{-t} - 2e^{-t}$$



$$x(0) = 2(0)e^{(0)} = 0$$

$$x(1) = 2(1)e^{-1} = .735 \rightarrow \frac{2}{e}$$

$$x(5) = 2(5)e^{-5} = .0679 \rightarrow \frac{10}{e^5}$$



$$= \frac{2}{e} + \left( \frac{2}{e^{-1}} - \frac{10}{e^5} \right)$$

$$= \boxed{\frac{4}{e} - \frac{10}{e^5}}$$

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