STAEDTLER® No. 937 811E Engineer's Computation Pad

•16 An electron moving along the x axis has a position given by $x = 16te^{-t}$ m, where t is in seconds. How far is the electron from the origin when it momentarily stops?

$x(t) = 16te^{-t}$ (in meters)

$v(t) = \frac{dx}{dt} = 16e^{-t} + (-1)16te^{-t}$

$v(t) = 0$ when $16e^{-t} - 16te^{-t} = 0$

$\Rightarrow t = 1$

$x(t=1) = 16(1)e^{-1}$

$= \frac{16}{2.71828181828} = 5.89$ m

PERHAPS WE SHOULD REVIEW A FEW DERIVATIVE RULES:

$\frac{d}{dt} c f(t) = c \frac{df}{dt}$ (factor out constants)

$\frac{d}{dt} f(t) g(t) = f \frac{dg}{dt} + \frac{df}{dt} g$ (The Product Rule)

The Chain Rule:

Consider $f(x)$ where $x = x(t)$

$\Rightarrow$ we have a function of time

$= f(x(t))$

$\frac{df}{dt} = \frac{df}{dx}\frac{dx}{dt}$

The HIDHO Formula: (where $D = \frac{d}{dt}$ & ... ... $HI = HI(t)$ & $HO = HO(t)$)

$D\left(\frac{HI}{HO}\right) = \frac{HO\,DHI - HI\,DHO}{HO\,HO}$

Our example: $x(t) = c\,q(t)\,e^{f(t)}$

$\frac{dx}{dt} = \left(c\frac{dq}{dt}\right)e^{f(t)} + c\,q(t)\left\{\frac{de^{f(t)}}{dt} = e^{f(t)}\frac{df}{dt}\right\}$