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1) The Dynamic equation of a system is a mathematical relationship relating two(2) or more ~~quantities~~ physical quantities in a system. This equation is used to model the system. for example

i) Radioactive decay systems are modeled by the dynamic equation

$$N = N_0 e^{\lambda t}$$

Where N => Number of atoms of element after time 't'
N_0 => Original number of atoms
λ => radioactive decay Constant
t => time for decay

ii) Capacitors are ~~modeled~~ modeled in their working by the equations

$$Q = Q_0 e^{-\frac{t}{CR}}$$ [~~charging a~~ Discharging a Capacitor]

$$Q = Q_0 e^{1-\frac{t}{CR}}$$ [charging a Capacitor]

Q => Quantity of charge stored or discharged after time 't'
Q_0 => original quantity of charge passed to the Capacitor
C => Capacitance of Capacitor
R => Resistance

2.) $y = Ate^t$

$$\frac{dy}{dt} = At(te^t) + e^t(A)$$

$$\frac{dy}{dt} = At^2e^t + Ae^t$$

$$\frac{dy}{dt} = A(e^t(t^2+1))$$

$$A = \frac{1}{e^t(t^2+1)} \frac{dy}{dt}$$

$$\therefore y = \frac{1}{e^t(t^2+1)} \frac{dy}{dt} \times t \times e^t$$

$$y = \frac{t}{t^2+1}\left(\frac{dy}{dt}\right)$$