Eg. @ 6:00, body temp is 33°C, @ 7:00, temp = 31.5°C

Δ in atmosphere temperature modelled by $20e^{-0.02t}$ in winter ± 3hours

T of the body is 37°C

$$\frac{dT}{dt} = -k(T - T_m)$$

$$= -k(T - 20e^{-0.02t}), \text{ 1st order, linear}$$

$$\frac{dT}{dt} + kT = \underbrace{20ke^{-0.02t}}_{Q(t)}$$

$$\underbrace{k}_{P(t)}$$

$$\int P(t)\,dt = \int k\,dt = kt$$

$$e^{\int P(t)\,dt} = e^{kt}, \quad e^{-\int P(t)\,dt} = e^{-kt}$$

$$\int Q(t)\,e^{\int P(t)\,dt}\,dt = \int 20ke^{-0.02t} \cdot e^{kt}\,dt$$

$$= 20k\int e^{(k-0.02)t}\,dt = 20k \cdot \frac{1}{k-0.02}\,e^{(k-0.02)t}$$

$$T(t) = e^{-\int P(t)dt}\left[\int Q(t)e^{\int P(t)dt}\,dt + C\right]$$

$$= e^{-kt}\left[\frac{20k}{k-0.02}e^{(k-0.02)t} + C\right], \text{ GS}$$

$$= \frac{20k}{k-0.02}e^{-0.02t} + Ce^{-kt}$$

(6:00)

When $t=0$, $T=33°C$

$$33 = \frac{20k}{k-0.02} + C \quad , \quad C = 33 - \frac{20k}{k-0.02}$$

One hour later, $t=1hr$, $T=31.5°C$

$$31.5 = \frac{20k}{k-0.02} e^{-0.02} + \left[33 - \frac{20k}{k-0.02}\right] e^{-k}$$ Transcendental Equation

$k = 0.1206$, from Matlab

When was the victim murdered? $T=37°C$, $t=?$

$$T = \frac{20k}{k-0.02} e^{-0.02t} + \left[33 - \frac{20k}{k-0.02}\right] e^{-kt} \quad , \quad k=0.1206$$

$$37 = \frac{20k}{k-0.02} e^{-0.02t} + \left[30 - \frac{20k}{k-0.02}\right] e^{-kt}$$ Transcendental Equation

↳ Solve for t w/ MATLAB

$t = -2.913$ hr

$= -2$hr 18 minutes

6:00 pm is $t=0$, $t = -2$hr 18 min, 3:42 pm