Thermal explosion by putting chemicals in a box

Let T_0 be the initial temp

T is a fuction of time, so $T(t) = T$

$$\Rightarrow T_0 = T(t_0)$$

Note that T is in Kelvin.

Reaction Kinetics:

$$K \approx Be^{-E/RT}$$

and $$\frac{dA_F}{dt} = -\not{c}\, A e^{-E/RT}$$

and $$\frac{dE}{dt} = \frac{d\Theta}{dt} - S$$

Rate of change (in BOX):

$$C_N \frac{dT}{dt} = -\not{c}\, \frac{dA_F}{dt} - H(T - T_0)$$

Where $$\frac{dA_F}{dt} = -\not{c}\, A_F e^{-E/RT}$$

Who wants to write about this part?

PHYSICS

— (4)

Scaling

Define $\hat{T} = \frac{T}{T_0}$

and $\tau = \frac{t}{t_r}$ where $t_r = t_{relative}$

Which makes our inital condition

$\hat{T}(0) = 1$

if $\hat{T} = 1 + \varepsilon\Theta$ and $\varepsilon = \frac{T_0 R}{E}$

and we get

$$\frac{d\Theta}{d\tau} = e^{\Theta} - \frac{\Theta}{\delta}$$ where δ is proportional to $\frac{1}{H}$

Now let $\tau = \delta\sigma$

$$\Longrightarrow \boxed{\frac{d\theta}{d\sigma} = \delta e^{\Theta} - \Theta \quad \text{for } \Theta(0) = 0} \qquad (1)$$

Three cases

1) $\delta e^{\theta} > \theta \implies \theta$ ALWAY's grows EXPONENTIALLY

2) $\delta e^{\theta} < \theta \implies \theta$ will decrease for a while

3) $\delta e^{\theta} = \theta \implies$ (ie. TRANSITION Math speculation)

Where all three happen over time.

$\boxed{\text{So we are solving for } \delta e^{\theta} \text{ and } \theta}$ ——— (2)

AND

The $\boxed{\text{oscilation point;}}$ which happens when

$$\delta^{*} e^{\theta^{*}} = \theta^{*}$$

$$\delta^{*} e^{\theta^{*}} = 1$$

So we choose δ such that $\delta > \frac{1}{e}$ ——— (3)

to ensure $\delta e^{\theta} > \theta$

Which causes unbounded growth in θ and garentees an explosion.

- We want to show...

1) Solve for (1) using RK4.
2) show cases 1 and 2 in (2)
3) show case 3 in (2) by using (3)
4) Write about the physics in (4)
5) Write about the numerics between (1) and (3).