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Authored
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MICRO - PERFORATED SHEETS

Chemistry Vol VII

120
SHEETS
FEUILLES

3 SUBJECT COLLEGE RULED
NOTEBOOK
CAHIER DE NOTES
À 3 SUJETS LIGNES MOYENNES

10.5 in x 8 in (27 cm x 20 cm)

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Lab Notes Dec 14 2014 Volume 07 (Chemistry Cont)

We have discovered a higher order [illegible] from the climate model aberrations.

We have [illegible] via [illegible] zero points showing up.

We have the great idea of [illegible] & this has led to the solution

$$\frac{\Delta M_1^2}{\Delta M_2^2} = \frac{Cp_1^2 \Delta C_2^2}{Cp_2^2 \Delta C_1^2}$$ which was not at all obvious

Let's check

$Cp_1 = \Delta C_1 \Delta M_1$ and $Cp_1^2 = \Delta C_1^2 \Delta M_1^2$

$Cp_2 = \Delta C_2 \Delta M_2$ $\quad Cp_2^2 = \Delta C_2^2 \Delta M_2^2$

$$\frac{Cp_1^2}{Cp_2^2} = \frac{\Delta C_1^2 \Delta M_1^2}{\Delta C_2^2 \Delta M_2^2} \quad \text{or} \quad \frac{\Delta M_1^2}{\Delta M_2^2} = \frac{Cp_1^2 \Delta C_2^2}{Cp_2^2 \Delta C_1^2}$$

$$\therefore \left(\frac{\Delta M_1}{\Delta M_2}\right)^2 = \left(\frac{Cp_1 \Delta C_2}{\Delta C_1 Cp_2}\right)^2 \quad \therefore \frac{\Delta M_1}{\Delta M_2} = \frac{Cp_1 \Delta C_2}{Cp_2 \Delta C_1}$$

Test: $$\frac{\Delta M_1}{\Delta M_2} = \frac{\Delta C_1 \cdot \Delta M_1 \cdot \Delta C_2}{\Delta C_2 \, \Delta M_2 \cdot \Delta C_1}$$

or

$$\frac{\Delta M_1 \cdot \Delta M_2}{\Delta M_2 \cdot \Delta M_1} = \frac{\Delta C_1 \cdot \Delta C_2}{\Delta C_2 \cdot \Delta C_1} \quad \text{or} \quad 1 = 1$$ which is true.

We do not have anything yet.

You still have no idea why -.0065 is ~~important~~

One solution is implied when $C_{p_1} = -C_{p_2}$

~~Given this is the imbalance point~~

$C_{p_1} = \Delta C_1 \Delta M_1$

$C_{p_2} = \Delta C_2 \Delta M_2$

$C_{p_1} + C_{p_2} = \Delta C_1 \Delta M_1 + \Delta C_2 \Delta M_2$

$C_{p_1} - C_{p_2} = \Delta C_1 \Delta M_1 - \Delta C_2 \Delta M_2$

$2C_{p_1} \stackrel{?}{=} 2\Delta C_1 \Delta M_1$ [illegible]

$(C_{p_1} - C_{p_2})(\Delta C_1 \Delta M_1 + \Delta C_2 \Delta M_2) = (C_{p_1} + C_{p_2})(\Delta C_1 \Delta M_1 - \Delta C_2 \Delta M_2)$

$C_{p_1} \Delta C_1 \Delta M_1 + C_{p_1} \Delta C_2 \Delta M_2 - C_{p_2} \Delta C_1 \Delta M_1 - C_{p_2} \Delta C_2 \Delta M_2$

$\stackrel{?}{=} C_{p_1} \Delta C_1 \Delta M_1 - C_{p_1} \Delta C_2 \Delta M_2 + C_{p_2} \Delta C_1 \Delta M_1 - C_{p_2} \Delta C_2 \Delta M_2$

~~$\varphi = 2C_{p_1} \Delta C$~~

Our model is

$\Delta C_{par} = \Delta C_{p4} M_4 + \frac{\Delta C_{p5} M_5}{3.4}$

First zero occurs when

$\Delta C_{p4} M_4 \cdot 100 = \frac{\Delta C_{p5} M_5}{3.4}$

$3.4 \Delta C_{p4} M_4 = -\Delta C_{p5} M_5$

$\frac{M_4}{M_5} = \frac{\Delta C_{p5}}{3.4 \Delta C_{p4}}$ $\Delta C_{p4} = .015$

$= \frac{1.225}{3.4(.015)}$

Now what? @ ratio = -.65

$\frac{M_4}{M_5} = \frac{5}{} = -7.692 = -1.225$

Your heating function must be more complicated than this.

After all it is the .90 heating that reaches a max.

$\Delta C = \left(\Delta C_{p4} \Delta M_4 + \frac{\Delta C_{p5} \Delta M_5}{3.4} \right) M_{air} \cdot 1000.$

$\Delta T_{am} = \left(\frac{.05}{100} \Delta M_4 + \frac{.05 \, M_5}{M_5 \, 3.4} \right) \frac{M_{air}}{100}$

ΔE_{atm} $|\Delta C| \cdot \Delta T$

$\%E_{Ratio} = \frac{\Delta E_{atm} \cdot 100}{K} = |\Delta C| \cdot \Delta T \cdot 100$

$E^{\%}_{RATIO} = \left(C_{p4} M_4 + \frac{C_{p5} M_5}{3.4}\right) \left(\frac{\cdot 100}{K}\right) \left(\frac{\Delta a \cdot M_4}{100}\right) +$

$E^{\%}_{RATIO} = \left(C_{p4} M_4 + \frac{C_{p5} M_5}{3.4}\right) \left(\frac{b \cdot 100}{K}\right) \left(\frac{a M_4}{100} + \frac{a M_5^2}{M_4 \cdot 100}\right)$

$E^{\%}_{RATIO} = \left(C_{p4} M_4 + \frac{C_{p5} M_5}{3.4}\right) \left(\frac{d}{100 K}\right) \left(a M_4 + \frac{a M_5^2}{M_4}\right)$

$E^{\%}_{RATIO} = \left(C_{p4} M_4 + \frac{C_{p5} M_5}{3.4}\right) (f) \left(M_4 + M_5^2\right)$

$E^{\%}_{RATIO} = f \left(M_4 + M_5^2\right) \left(C_{p4} M_4 + \frac{C_{p5} M_5}{g}\right) =$

$\frac{d E^{\%}_{RATIO}}{d m_i} = f \left[\left(M_4 + M_5^2\right) (C_{p4}) + \left(C_{p4} M_4 + \frac{C_{p5} M_5}{g}\right) \right]$

remove f

set to zero

$\left[\left(M_4 + M_5\right) (C_{p4}) + \left(C_{p4} M_4 + C_{p5} M_5\right) \right]$

$C_{p4} M_4 + C_{p4} M_5^2 + C_{p4} M_4 + \frac{C_{p5} M_5}{g}$

$C_{p4} \left(M_4 + M_5^2 + M_4\right) + \frac{C_{p5} M_5}{g}$

Pasc 5

$y = 2x^2$

$\phi = 5 \cdot x$ $\quad y' = 2 \cdot 2 \cdot x = 2 \cdot (2x)$

$0 \neq x$

$b = M_{air} \cdot 1000$

$a = \frac{1}{20} = .05$ $\quad$ let $= 3.4$

$\left(\frac{a m_5}{m_4} \cdot \frac{m_5}{100}\right)\left(\frac{1}{K}\right) \cdot 100$

Now factor let $\left(\frac{da}{100}\right)$

$y = 5(ax+5)$

$y' = 5(a) + (ax+5)$

$= 5a$

$+\left[\left(m_4+m_5^2\right)\left(\frac{C_{p5}}{g}\right) + \left(C_{p4}m_4 + C_{p5}\frac{m_5}{g}\right)(2m_5)\right]$

$= -\left[(m_4+m_5)\left(\frac{C_{p5}}{g}\right) + \left(C_{p4}m_4 + C_{p5}\frac{m_5}{g}\right)(2m_5)\right]$

$= -\frac{C_{p5}m_4}{g} - \frac{C_{p5}m_5}{g} - 2m_5C_{p4}m_4 - \frac{2m_5C_{p5}m_5}{g}$

$= -C_{p5}\left(\frac{m_4}{g} + \frac{m_5}{g} + \frac{2m_5^2}{g}\right) - C_{p4}2m_5m_4$

$$C_{p4}\left(M_4\ \cancel{M_4 M_5^2}\ \cancel{2 M_4} + M_4 2M_5\right)$$

$$\frac{C_{p4} \cdot g}{C_{p5}} = \frac{-\left(M_4^2 + 2M_5^2\right)}{\left(2M_4^2 + 2M_4 M_5 + M_5^2\right)}$$

$m_4 = .05$
$M_5 = .0065$

$$\frac{C_{p4} \cdot g}{C_{p5}} = \left[\frac{.05008}{.10069}\right]$$

$$\frac{C_{p4} \cdot g}{C_{p5}} = -.4974$$

$C_{p4} = \frac{.015}{.1.215}(3.4) = .04198$ No match.

Try again.
Good Try

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$= -\frac{C_{p5}}{g}\left(M_4 + M_5 + 2M_5^2 - M_5\right)$

Even though we have not solved for the [illegible] we can see that the additional maximum and the additional [illegible] point is due to some complex interaction of ~~temperature~~ [illegible] mechanism contributes to be decreased

Try again to see if you can come up with the same solution.

$\Delta E_{atm} = |\Delta C| \cdot \Delta T$

$E^{\%}_{RATIO} = \frac{\Delta E_{atm}}{K} \cdot 100 = \frac{|\Delta C|}{K} \cdot \Delta T \cdot 100$

Even though we have not pre[illegible] for the

$= \left(C_{p4} m_4 + \frac{C_{p5} m_5}{3.4}\right)(m_{air} \cdot 1000)\left(a \cdot m_5 \cdot 100 \cdot \frac{m_5}{m_4}\right)$

$\Delta E^{\%}_{RATIO} = (d)\left(C_{p4} m_4 + \frac{C_{p5} m_5}{g}\right)\left(1 - \frac{m_5^2}{m_4^2}\right)$

this looks all wrong.

$C_{p4} m_4 - \frac{C_{p4} m_4 m_5^2}{m_4^2} + \frac{C_{p5} m_5}{g} - \frac{C_{p5} m_5 m_5^2}{g\, m_4^2}$

$C_{p4}\left(m_4 - \frac{m_5^2}{m_4}\right) \quad (\pm)\left(\frac{C_{p5}}{g}\right)\left(\frac{m_5^3}{m_4^2} - m^5 - m_4 - \frac{m_5^2}{m_4}\right)$

$\frac{C_{p4} \cdot g}{C_{p5}} = \frac{\left(\frac{m_5^3}{m_4^2} - \frac{m_5^2}{m_4} - m_5 - m_4\right)}{\left(\frac{m_4 - m_5^2}{m_4}\right)}$ $\quad \frac{-.05724}{.99916} = -.05729$

$m_5 = .0065$
$m_4 = .05$

$C_{p4} = .015$
$C_{p5} = 1.215$

$\frac{(.015)(3.4)}{1.215} = .04198$

This is very close.

What we have is a 3rd order polynomial in M_5 (CH_4) & a quadratic in M_4 (CO_2)

let $a = 1/20 = .05$

$g = 3.4$

$b = Max \cdot 1000$

$y = a^2 \cdot x$

$y' = (-1)(a^2)x^{-2}$

$= \frac{-a^2}{x^2}$

$\cdot \frac{100}{K}$

let $d = b\left(\frac{100}{K}\right)(a \cdot 100)$

$+ \left(M_4 + \frac{M_5}{M_4}\right)\frac{C_{p5}}{g} = \emptyset$

$+ \frac{C_{p5} M_4}{g} + \frac{C_{p5} M_5^2}{g \cdot M_4} = \emptyset$

It looks like you are getting it.
You have a sign difference
and a slight magnitude difference.

Figure out the sign error & correct it.

Remember also your absolute value term

[redacted]

Page 10

Spirochete —

Chlamydia.

½ max

Babesia

Erlichia.

Parasite

Arthropods. Arthropods

It looks like we are getting it.

We have a large difference.

And a slight magnitude difference.

Figure out the sign. Draw & select it.

Remember also your absolute value here.

Co 2471 - 1225 - 3912

The agenda [illegible] Value [illegible]

Agree or Disagree

1. Increase range on Application slider

2. Abs value taken away

3. Post article in revision

4. A cookie a [illegible] request?

5. [illegible]

Has any diagnosis or [illegible] your life personal or professional life in any significant way? Please describe below.

6. Make a new plot [illegible]

7. Tutorial had the wrong link

Scott - Distribution list

Testing the absolute value [illegible]

[illegible] has taken on this issue and talked. There was a problem.

The model [illegible]

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Page 13

				Heatg
	5th	∅	∞	∅.98
				.87
		-.04	-125	.76
		.08		.66
			-62	.56
		-.10		.47
				.37
			-36	.28
		-.16	-31	.20
			-28	.12
		-.20	-25	.04
			-23.0	∅
		-.25	-20	-.14
			-18	-.31
		-.35	-14.3	-.45
		-.4	-12.5	-.56
		-.45	-11	-.66
		-.5	-10	-.74
83yrs	6 cal Minimum =	-.65	[illegible]	-.84
		-.7	[illegible]	-.83
		-.8	-6.2	-.75
-5.0			-5.6	-.58
-4.8	-1.05 -.17	-1.09	-4.6	∅
-4.3	-1.16 +.26	-1.29	-4.2	+.44% ~~1.28~~
-3.8	+.95	-1.4	3.6	1.54
		-1.6	-3.1	2.99
		-1.8	-2.8	4.77
		-2.0	-2.5	6.90

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Heat Capacity Station

Let's try to solve this problem.

Our proposed equation is $\Delta E_{atm} = \Delta C \cdot \Delta T$

$$\Delta C = \left(C_{p4} m_4 + C_{p5} m_5\right)(m_{atm} \cdot 7000) = \text{Joules}$$

$$\Delta T = a \cdot m_4 \cdot 100 + a \cdot m_5 \cdot 700 \left(\frac{m_5}{m_4}\right)$$ ← No, these are constants!

What you actually used is

$$\Delta T = a \cdot m_4 \cdot 100 + \left[25 \cdot \frac{C_{m}}{C_{CO_2}}\right] a\, m_5$$

Yes, constants!

The 25 is the GWP factor. So this is all OK.

So

$$\Delta E_{atm} = \left(C_{p4} m_4 + C_{p5} m_5\right) e \left(100 a\, m_4 + b m_5\right)$$

$$= e\left[C_{p4} m_4 100 a\, m_4 + C_{p4} m_4 b m_5 + C_{p5} m_5 100 a\, m_4\right]$$

$$d\Delta E = \frac{d\Delta E}{d m_4} \Delta m_4 + \frac{d\Delta E}{d m_5} \Delta m_5 = \text{Goal Minimize}$$

$$= e\left[\left(2 m_4 C_{p4} 100 a + C_{p4} b m_5 + C_{p5} m_5 100 a\right) \Delta m_4\right]$$

or $$\frac{\Delta m_4}{\Delta m_5} = \frac{C_{p4} b m_5 + C_{p5} 100 a\, m_4 + C_{p5} b m_5}{2 m_4 C_{p4} 100 a + C_{p4} b m_5 + C_{p5} m_5 100 a}$$

~~We did this wrong.~~ Isolate C_{p4} & C_{p5}

but $\Delta m_4 = m_4$! $\Delta m_5 = m_5$!

where $C_{p4} = (C_{pCO_2} - C_{pair})$ $C_{p5} = (C_{pCH_4} - \ldots)$ $= 0$

$\frac{Joules}{kg \cdot C^\circ}$ $\frac{Joules}{C^\circ}$

and $a = .05$

C_m = Static current methane

~~C_{CO_2} = Static current CO_2~~

~~we can take~~ $2500 \frac{(C_m \; C_a)}{C_{CO_2}}$ $d = M_{atm} \cdot 1000$

$e \neq 3.4$

$+ C_{p5} m_5 b m_5]$ error

$p \Delta m_4 + q \Delta m_5 = 0$

$p \Delta m_4 = -q \Delta m_5$

$\Delta m_4 = \frac{-q \Delta m_5}{p}$

$\frac{\Delta m_4}{\Delta m_5} = \frac{-q}{p}$ → $-\frac{\Delta m_4}{\Delta m_5} = \frac{q}{p}$

$+ (C_{p4} b m_5 + C_{p5} 100 a m_4 + C_{p5} b m_5) \Delta m_5$ (q)

$\phi =$ ~~[illegible]~~ (where $Cp = (Cp_{corr} - Cp_{air})$ Cp_5 / Cp_4 [illegible])

~~$\phi = 2m_4^2 Cp_4 100a m_4 + Cp_5 b m_5 m_4 + Cp_5 m_5 100a m_4$~~

$\phi = Cp_4 (2m_4^2 100a + b m_5 m_4 + b m_5^2)$ and $a = .05$

$m =$ static current motions

$Cp_4 = -Cp_5 \dfrac{(m_5 100a m_4 + 100a m_4 m_5 + b m_5^2)}{(2 m_4^2 100a + b m_5 m_4 + b m_5^2)}$

$\dfrac{Cp_4}{Cp_5} = -\dfrac{(m_5 100a m_4 + 100a m_4 m_5 + b m_5^2)}{(2 m_4^2 100a + b m_5 m_4 + b m_5^2)}$

$m_5 = 1.096$

$m_4 = 5$

$a = .05$

$b = 25 \dfrac{C_{m_{CH_4}}}{C_{m_{CO_2}}} (.05)$

error [+ $Cp_5 m_5 b m_5$]

$\phi \Delta m_4 + \phi \Delta m_5 = \phi$

$\phi \Delta m_4 = -\phi \Delta m_5$

$\Delta m_4 = -\dfrac{\phi \Delta m_5}{\phi}$

$\dfrac{\Delta m_4}{\Delta m_5} = -\dfrac{\phi}{\phi}$ + $\dfrac{\Delta m_4}{\Delta m_5} = -\dfrac{\phi}{\phi}$

$(Cp_4 b m_5 + Cp_5 100a m_4 + Cp_5 b m_5) \Delta m_5$

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$+ \quad C_{p4} b m_5^2 + C_{p5} 100a M_4 M_5 + C_{p5} b m_5 \quad = 0$

$+ \quad C_{p5}(M_5 100a M_4 + 100a M_4 M_5 + b m_5)$

$$\Delta E_{atm} = \left(Cp_4 m_4 + \frac{Cp_5 m_5}{e}\right)(d)(100a m_4 + b m_5)$$

$$\Delta E_{atm} = (d)\left(Cp_4 m_4 + \frac{Cp_5 m_5}{e}\right)(a^* m_4 + b m_5)$$

$\emptyset =$ $Cp_4 b m_5^2 + Cp_5 100a m_4 m_5 + Cp_5 b m_5$ +

$$\Delta E' = (d) \int \left(Cp_4 m_4 + \frac{Cp_5 m_5}{e}\right)(a^*)\, dm_4$$

$Cp_5 (m_5 100a m_4 + 100a m_4 m_5 + b m_5)$ +

but $dm_4 \cong m_4$ and $dm_5 \cong m_5$. so

$$\emptyset = \Delta E' = d\left[(a^*)\left(Cp_4 m_4^2 + \frac{Cp_5 m_5 m_4}{e}\right)\right]$$

so $$\emptyset = a^* Cp^4 m_4^2 + \frac{Cp_5 m_5 m_4}{e}$$

$$\emptyset = Cp_4(a^* m_4^2) + \frac{Cp_5}{e}\left(\frac{m_5 m_4}{a} + a^* m_4 m_5 + b m_5^2\right)$$

$$Cp_4(a^* m_4^2) = -\frac{Cp_5}{e}\left(m_5 m_4 + a^* m_4 m_5 + b m_5^2\right)$$

$$\frac{Cp_4}{Cp_5} = -\frac{m^5 m_4 + a^* m_4 m_5 + b m_5^2}{e \cdot a^* m_4^2}$$

$$\frac{Cp_4}{Cp_5} = -\frac{m_5 m_4(1 + a^*) + b m_5^2}{a^* e\, m_4^2} \qquad -.00596$$

$$= -.14034$$

$$\frac{Cp_4 = .015}{Cp_5 = 1.215} = .0115 \quad \text{NO}$$

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$.25$

$$\left(a^* m_4 + b m_5\right) \frac{C_{p5}}{e}$$

Approximation

$$+ \left(a^* m_4 m_5 + b m_5^2\right) C_{p5}$$

$$+ \; C_{p5}\, a^* m_4 m_5 + C_{p5}\, b m_5^2$$

$a = .05$

$a^* =$

$m_5 = 1.096 \qquad = .0196 \qquad e = 3.4$

$m_4 = 5 \qquad = .05$

$$25 \; \frac{Cm_{CH_4}}{Cm_{CO_2}} \qquad \frac{1.0E-4}{5.7E-4} \quad .05$$

$= .2193$

$$\frac{C_{p4}}{C_{p5}} =$$

$.0028$

$.0085$

$.0193$

not

Looks like I have it:

Go again:

Looks like I have it.

Page 20

Go again.

$\Delta E_{atm} = \left(C_{p4} m_4 + \frac{C_{p5} m_5}{e}\right) d \left[~~100 a m_4~~ + ~~100 a m_5~~ \left(\frac{C_{m5}}{C_{m4}}\right) \right]$

.25! you missed this term

$\Delta E_{atm} = d\left[\left(C_{p4} m_4 + \frac{C_{p5} m_5}{e}\right) + \left(a^* m_4 + a^* f m_5\right)\right]$

$\Delta\left(\hat{\Delta E}_{atm}\right) = d\left[\left(C_{p4} m_4 + \frac{C_{p5} m_5}{e}\right)\left(a^* m_4 \ldots\right)\right.$ +

So

$\Delta\left(\Delta E_{atm}\right) \approx a^* C_p m_4^2 + a^* \frac{C_{p5}}{e} m_5 m_4$ +

Approximation!

$\Delta\left(\hat{\Delta E}_{atm}\right) = C_{p4}\left(a^* m_4^2\right) + \frac{C_{p5}}{e}\left(a^* m_5 m_4 + \right.$ +

$\phi = \Delta\left(\Delta E_{atm}\right) = C_{p4}\left(a^* m_4^2\right) + \frac{C_{p5}}{e} a^* \left(m_5 m_4 + f m_5^2\right)$

$C_{p4}\left(a^* m_4^2\right) = -\frac{C_{p5}}{e} a^* \left(2 m_4 m_5 + f m_5^2\right)$

$\frac{C_{p4}}{C_{p5}} = -\frac{\left(2 m_4 m_5 + f m_5^2\right)}{e\, a^* m_4^2}$

$= -.240$

$= -\left(.0196 + 4.386(.0196)^2\right)$

$\frac{.0123}{1} = \frac{.015}{1.215}$

$= -\frac{.0028}{.0085} \ldots$ ~~2.30~~ $-.033$

Not too bad!

We seem to be close here

Ratio ≈ 30

Remember we chose $\Delta m \approx m$ an approximation.

Page 21 Remember your Clue $\underline{\underline{\Delta m^2 = m}}$ This has some error of course

$e = 3.4$

$a^* = 100a = 100(.05) \quad a = .05 \quad = 5 = a^*$

let $25\left(\frac{C_{m5}}{C_{m4}}\right) = f$ ~~$a^*\Delta M_4 C_{p4} 25 (\ldots) = 1$~~ $5.7E-4$

$\Delta(\Delta U_{th}) = \dot{Q} = a^* d\left(C_{p4} M_4 + \frac{C_{p5} M_5}{e}\right)$ (written upside down)

but $\Delta M_4 = M_4$

$+\left(a^* M_4 + a^* f M_5\right)\frac{C_{p5}}{e}\Delta M_5 \quad \Delta M_5 = M_5$

This is not the maximum (written upside down)

it is when it's equal to zero (written upside down)

$+ a^* M_4 M_5 \frac{C_{p5}}{e} + a^* f$ ~~$M_5 C_{p5}$~~ e By ... (illegible)

$a^* M_4 M_5 + a^* f M_5^2)$

$a^* = 5$

$M_4 = .05$

$M_5 = .0196$

$e = 3.4$

$f = (25)\left(\frac{1.0E-4}{5.7E-4}\right) = 4.386$

Simple case

$C_{p4} M_4 = \frac{C_{p5} M_5}{e}$

~~$\frac{C_{p4}}{C_{p5}}$~~ $= \frac{C_{p5}}{C_{p4}} = e$

This has some error course

Remember you chose $\Delta m \cong m$

We have

$e = 3.4$

$a^* = 5 = a^*$ $a = .05$ $a^* = 1000a = 100(.05)$

let $f = .25 \left(\frac{C_{m5}}{C_{m4}}\right)$

~~$\Delta(\Delta E_{atm})\ C_{p4} M_4 a^* / (5.7E{-4})$~~

$$\Delta(\Delta E_{atm}) = \emptyset = a^* d\left(C_{p4} M_4 + \frac{C_{p5} M_5}{e}\right)$$

but $\Delta M_4 = M_4$

$\Delta M_5 = M_5$

$+ (a^* M_4 + a^* f M_5)\left(C_{p5}\ \Delta M_5\right)$

This is not the maximum

It is when it is equal to zero

By differentiating

$+ a^* M_4 M_5 \frac{C_{p5}}{e} + a^* f M_4$

$a^* M_4 M_5 + a^* f M_5^2)$

$a^* = 5$
$M_4 = .05$
$M_5 = .0196$
$e = 3.4$

$f = (.25)\left(\frac{1.0E{-4}}{5.7E{-4}}\right) = 4.386$

Single case

$C_{p4} M_4 = \frac{C_{p5} M_5}{e}$

$\frac{C_{p5}}{C_{p4}} = e$

Times

Not Addition

and $\emptyset = \frac{Cp_5}{Q} a^* (M_4 + f m_5)$ & equation from above

$\Delta Extn = d[(Cp_4 M_4 + Cp_5 M_5)/Q + (a^* M_4 + a^* f m_5)]$

This means $M_4 + f m_5 = \emptyset$ or $f m_5 = -M_4$

or ~~f~~ equals zero is not the same

$f = \frac{-M_4}{M_5} = .05 \cdot (.4386)(.0196)$

= to zero

$.05 - .08597 = .036$

$\emptyset = M_4 f^* Q + a^* M_4 + Cp_5 M_5 / Q + Cp_4 M_4 = .036$

Conclusion

when $M_4 + f m_5 = \emptyset$ or

$f m_5 = -M_4 \cdot M_4 (Cp_4 + Cp_5/Q + a^*)$

$f = \frac{-M_4}{m_5}$ or when $\frac{-M_4}{m_5} = 4.386$

when $(f^* = .05)$: $M_4 (Cp_4 + a^*) + M_5 (Cp_5 / Q)$

or $M_4 (Cp_4 + a^*) = -M_5 (Cp_5/Q + a^* f)$

or $\frac{M_4}{M_5} = -\frac{(Cp_5/Q + a^* f)}{Cp_4 + a^*}$

-4.44

$Cp_5 = 1.215$

$Cp_4 = .015$

$Q = 3.4$

$a^* = 5$

$f = 4.385$

Close but no cigar

actual answer 4.415

So how and why are we so

Close but how messy?

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Times

Not Addition

Over equation for $(M_4 + f M_5) * \Delta C$ ... $= \emptyset$ ...

$\Delta E_{atm} = d \left[(C_{p4} M_4 + C_{p5} M_5) * (a^* M_4 + a^* f M_5) \right]$

This means ...

... equals zero is not the same ...

... !

to zero:

... = -.08597 ...

$C_{p4} M_4 + \frac{C_{p5} M_5}{e} + a^* M_4 + a^* f M_5 = \emptyset$

or

...

$M_4 (C_{p4} + a^*) + M_5 \left(\frac{C_{p5}}{e} + a^* f \right) = \emptyset$

or $M_4 (C_{p4} + a^*) = -M_5 \left(\frac{C_{p5}}{e} + a^* f \right)$

or $\frac{M_4}{M_5} = \frac{-\left(\frac{C_{p5}}{e} + a^* f \right)}{C_{p4} + a^*}$

$C_{p5} = 1.215$
$C_{p4} = .015$
$e = 3.4$
$a^* = 5$
$f = 4.386$

-4.44

Close but no cigar

-4.6 is actual answer

So how and why are we so close but have missed?

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We can have $\Delta C = \emptyset$ and $\Delta T = \emptyset$

$\Delta C = 0$

$\Delta T = \emptyset$

We have ... you have two zero points

ΔC ... $(C_{p4} M_4 + C_{p5} M_5)$ ... d ... we know ... Mam. 1000

$\Delta T = a M_4 \cdot 100 + a M_5 \cdot 100 \left(\frac{C_{m5}}{C_{m4}}\right) .25$ $a = .05$

$= .05 \cdot 100 = 5$

$f = 25 \frac{C_{m5}}{C_{m4}}$

$\Delta E = \Delta C \Delta T$

$= d\left((C_{p4} M_4 + C_{p5} M_5)(a^* M_4 + a^* f M_5)\right)$

zero ... $\emptyset = C_{p4} M_4 a^* M_4 + C_{p4} M_4 a^* f M_5 + \frac{C_{p5} M_5}{e} a^* M_4 + \frac{C_{p5} M_5}{e} a^* f M_5$

Not needed!

$a^* M_4 + a^* f M_5 = \emptyset$ ... $a^* M_4 = a^* f M_5 = \emptyset$

$M_4 = f M_5$. $f = 25\left(\frac{1.04E-4}{5.7E-4}\right) = 4.5614$

$\frac{5}{4.561} = 1.096$

Zero Point 2: ... zero point 5

Zero Point 1: $\Delta C = \emptyset$

$\frac{M_4}{M_5} = \frac{C_{p5}}{C_{p4} e}$

$M_4 = \frac{C_{p5} M_5}{C_{p4} e}$

$\frac{M_4}{M_5} = \frac{C_{p5}}{C_{p4} e} = \frac{7*.02*5}{.015(3.4)} = 23.82$ ... $\frac{M}{M_5}$

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Now we find the maximum

$\Delta E = d[(C_{p4} M_4 + C_{p5} M_5) * (a^* m_4 + a^* f M_5)]$

$\frac{d\Delta E}{dM_4} = 0 \qquad \frac{d\Delta E}{dM_5} = 0$

$0 = \frac{d\Delta E}{dM_4} = d\left[\left(C_{p4} M_4 + \frac{C_{p5} M_5}{e}\right) a^* + (a^* M_4 + a^* f M_5) C_{p4}\right]$

$0 = \frac{d\Delta E}{dM_5} = d\left[\left(C_{p4} M_4 + \frac{C_{p5} M_5}{e}\right)(a^* f) + (a^* M_4 + a^* f M_5)\frac{C_{p5}}{e}\right]$

Therefore

$\left(C_{p4} M_4 + \frac{C_{p5} M_5}{e}\right) a^* + (a^* M_4 + a^* f M_5) C_{p4} = 0$

or $C_{p4} M_4 a^* + \frac{C_{p5} M_5}{e} a^* + a^* M_4 C_{p4} + a^* f M_5 C_{p4}$

or $M_4(C_{p4} a^* + a^* C_{p4}$ [illegible] $+ C_{p4} a^* f + a^* C_{p5})$

or $\frac{M_4}{M_5} = -\frac{\left(\frac{C_{p5}}{e} + a^* f C_{p4} + \frac{C_{p5}}{e} a^* f + a^* f C_{p5}\right)}{C_{p4} a^* + a^* C_{p4} + C_{p4} a^* f + a^* C_{p5}}$

8.507 28.05

$\frac{M_4}{M_5} = \frac{\frac{C_{p5}}{e}(-1 + a^* f) + a^* f (C_{p4} + C_{p5})}{2 a^* C_{p4} + a^*(f C_{p4} + C_{p5})}$

.15 + 6.4M

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$$m_4(a) + m_5(b) = 0$$

$$m_4 = -\frac{m_5 b}{a}$$

$$\frac{m_4}{m_5} = -\frac{b}{a}$$

$$= -\left(C_{p4} m_4 + \frac{C_{p5} m_5}{e}\right) a^* f - \left(a^* m_4 + a^* f m_5\right) C_{p5}$$

$$= C_{p4} m_4 a^* f - \frac{C_{p5} m_5 a^* f}{e} - a^* m_4 C_{p5} - a^* f m_5 C_{p5}$$

$$+ m_5\left(\frac{C_{p5}}{e} + a^* f C_{p4} + \frac{C_{p5}}{e} a^* f + a^* f C_{p5}\right) = 0$$

$C_{p5} = 1.215$ $\qquad \frac{m_4}{m_5} = -5.567$

$C_{p4} = 2.0159$ $\qquad = \frac{m_4}{m_5}$ — No, it should be -1.1

$e = 3.4$

$a^* = 5$

$f = 4.5$

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We have simultaneous conditions.

$$\frac{\partial \Delta E}{\partial m_4} = \emptyset = \left(C_{p4} m_4 + \frac{C_{p5} m_5}{e}\right) a^* + \left(a^* m_4 + a^* f m_5\right) C_{p4} = \emptyset$$

$$\frac{\partial \Delta E}{\partial m_5} = \emptyset = \left(C_{p4} m_4 + \frac{C_{p5} m_5}{e}\right) a^* f + \left(a^* m_4 + a^* f m_5\right) C_{p5} = \emptyset$$

$$C_{p4} m_4 a^* + \frac{C_{p5} m_5}{e} a^* + a^* m_4 C_{p4}$$

Start Here

$$m_4\left(C_{p4} a^* + C_{p4} a^* - a^* f C_{p4} - a^* C_{p5}\right)$$

$$+ m_5\left(\frac{C_{p5} a^*}{e} + a^* f C_{p4} - \frac{C_{p5} a^* f}{e} - a^* f C_{p5}\right) = \emptyset$$

$$+ m_5\left(a^* f C_{p4} + C_{p5}\left(\frac{a^*}{e} - \frac{a^* f}{e} - a^* f\right)\right) = \emptyset$$

$$\frac{m_4}{m_5} = -\frac{a^* f C_{p4} + C_{p5} a^*\left(\frac{1}{e} - \frac{f}{e} - f C_{p5}\right)}{2C_{p4} a^* - a^*(f C_{p4} - C_{p5})}$$

$$\frac{m_4}{m_5} = -\frac{\left[a^* f C_{p4} + C_{p5} a^*\left(\frac{1}{e} - \frac{f}{e}\right)\right]}{a^*\left(2C_{p4} - (f C_{p4} - C_{p5})\right)}$$

−40.02

$$\frac{+39.69}{5.883} = 6.746$$

Close but not quite

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OK $-Cp_4 M_4 a^* f - \frac{Cp_5 m_5 a^* f}{e} - a^* m_4 Cp_5 \cdot a^* f m_5 Cp_5 = 0$

now $+ m_5 \left(\frac{Cp_4 a^*}{e} + Cp_4 a^* - \frac{Cp_5 a^* f}{e} \ldots a^* f\, Cp_5 \right) = 0$

$a^* = 5$

$f = 4.5$

$Cp_4 = .015$

$Cp_5 = 1.215$

$e = 3.4$

I am close but

again:

$$a^*\left(C_{p4}m_4 + \frac{C_{p5}m_5}{e}\right) + (a^*m_4 + a^*fm_5)C_{p4} = \emptyset$$

$$(a^*f)\left(C_{p4}m_4 + \frac{C_{p5}m_5}{e}\right) + (a^*m_4 + a^*fm_5)\frac{C_{p5}}{e} = \emptyset$$

so

$$m_4\left(C_{p4}a^* + C_{p4}a^* - C_{p4}a^*f - \frac{a^*C_{p5}}{e}\right)$$

$$+ m_5\left(a^*C_{p5} + a^*fC_{p4} - C_{p5}a^*f - a^*fC_{p5}\right) = \emptyset$$

$$\frac{m_4}{m_5} = -a^*C_{p5}\left(\frac{1}{e} + \frac{f}{e} + \frac{f}{e}\right) + a^*fC_{p4}$$

$$\frac{a^*C_{p5}}{e}(1+f+f) + a^*fC_{p4}$$

$C_{p4} = .215$

$C_{p5} = 1.215$

$$\frac{m_4}{m_5} = -a^*C_{p5}\left(\frac{1}{e} + \frac{2f}{e}\right) + a^*fC_{p4}$$

$$\frac{a^*C_{p5}}{e}(1+2f) + a^*fC_{p4}$$

close

$$\frac{m_4}{m_5} = -\left[a^*C_{p5}\left(\frac{1+2f}{e}\right) + a^*fC_{p4}\right] \quad 18.428$$

NO

$$\left(\frac{a^*C_{p5}}{e}\right)(1+2f) + a^*fC_{p4} \quad 18.428$$

[illegible]

$m_1(a) = -m_2(b)$

$A^* = .5$

$C_{p5} = 1.215$

$f = 4.561$

$C_{p4} = .015$

$\frac{M_4}{M_5} = \frac{\left(\frac{a^* f C_{p5}}{e}\right)\left(1 + 1 + \frac{f}{e}\right) + a^* A C_{p4}}{C_{p4} a^* (2 - f) + \frac{a^* C_{p5}}{e}}$ 21.573 / 2.279

-12.099 should be -7.8

11.504 3.685

$\frac{M_4}{M_5} = \left[\frac{\frac{a^* C_{p5}}{e}(1 - 2f) + a^* A C_{p4}}{a^* C_{p4}(2 - f) - \frac{a^* C_{p5}}{e}}\right]$ 4.170 / -1.979

seems better

7.16

Really close

but it should be

Close to -.65

and you have a sign problem

again

$\frac{dΔE}{dm_4}$ $a^*(C_{p4}m_4 + \frac{C_{p5}m_5}{e}) + (a^*m_4 + a^*(f m_5))C_{p4} = \emptyset$

$\frac{dΔE}{dm_5}$ $a^*f(C_{p4}m_4 + \frac{C_{p5}m_5}{e}) + (a^*m_4 + \frac{a^*}{e}f m_5)C_{p5} = \emptyset$

$m_4(a^*C_{p4} + a^*C_{p4} + a^*fC_{p4} + \frac{a^*C_{p5}}{e})$

$+ \ m_5(\frac{a^*C_{p5}}{e} + a^*fC_{p4} + \frac{a^*fC_{p5}}{e} + \ldots) = \emptyset$

$\frac{m_4}{m_5} = -a^*(\frac{C_{p5}}{e} + fC_{p4} + \frac{2fC_{p5}}{e})$

$a^*(C_{p4} + C_{p4} + fC_{p4} + \frac{C_{p5}}{e})$

$\frac{m_1}{m_2} = -\frac{(\frac{C_{p5}}{e} + fC_{p4} + \frac{2fC_{p5}}{e})}{\ldots}$ — 3.685

.456

= 8.08

mf ratio

$2C_{p4}$ .170

M_5 = .619

-.64 seems better?

$\frac{3.6855}{.4558} = 8.086$

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I have it. Maximum

C_{p4} = [illegible]

C_{p5} = 1.255

f = 4.561A max fract [illegible]

l = 3.4

why?

Ms

Mass Ratio CO_2 ≈ 8.03

so if CO_2 = 1% [illegible] = 124

Looks like we have it.

maximum

Δ specific heat from air

SWR

Current mass fraction

I have it. Maximum

The idea that [illegible] generates more or less heat [illegible] its specific heat [illegible]

IS ENTIRELY ERRONEOUS

[illegible] mass [illegible] there is.

why?

eg barium is [illegible] quickly but how much mass is there?

Liquid water cools [illegible] Ice water actually causes things to heat up. Why?

Water albedo is [illegible]

albedo = reflectivity...

Something w/ a high specific heat release [illegible] slower.

Something w/ a low specific heat release [illegible] it up.

Something w/ a high albedo reflects [illegible]

Something w/ a low albedo absorbs heat.

Thick Clouds Cp is high (cooling down) true

Albedo High - reflects

heat will go into air

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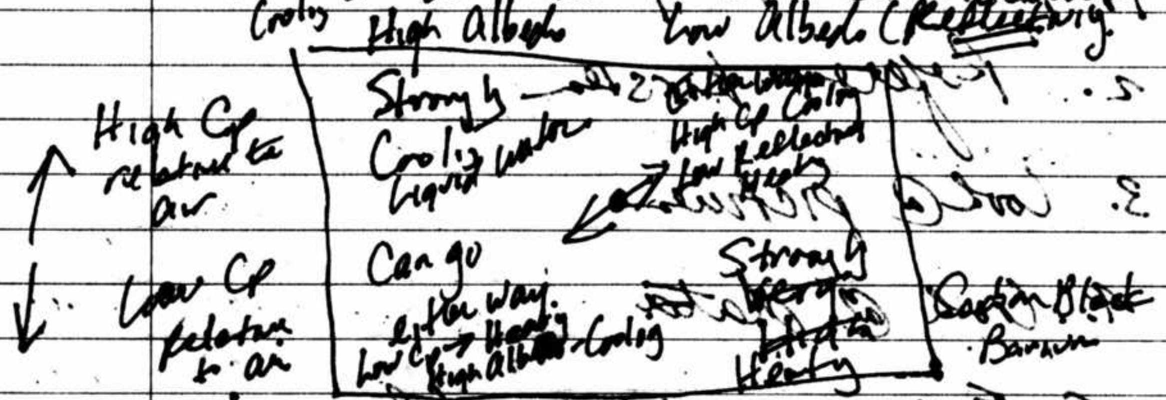
$C_p\ CO_2 = 1.02$
$C_p\ CH_4 = 2.22$

1. Specific Heat
2. Reflectivity
3. Where it is

Aerosol Impact

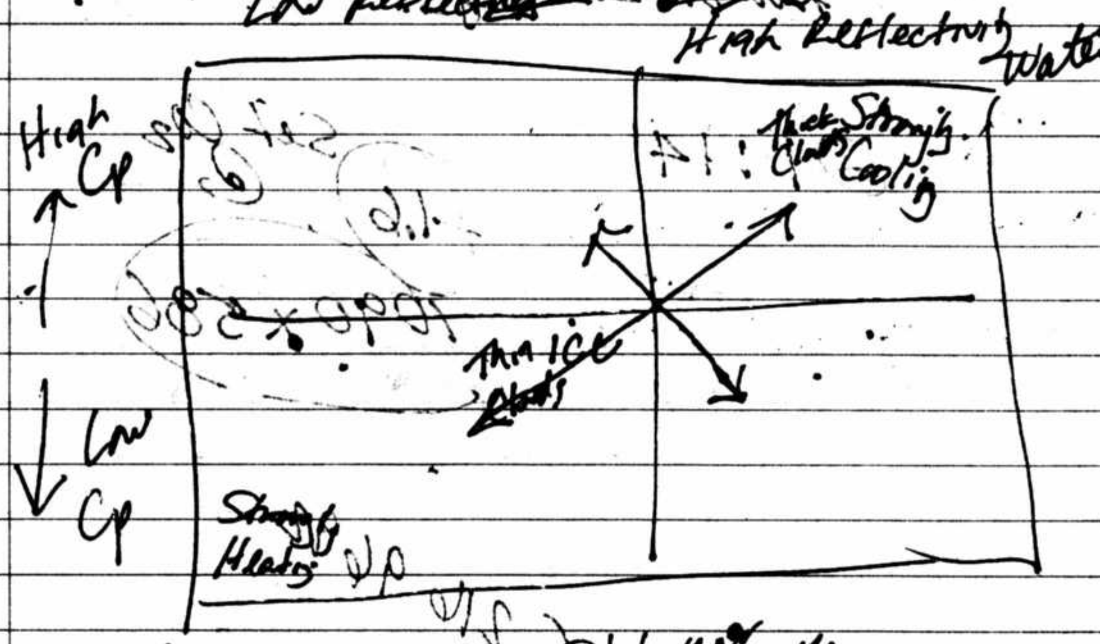
Symmetrically it is quite [illegible]

Something of a high specific heat relative to [illegible]



Heating ... a Heating Effect

High Cp, High Reflectivity - is Cooling
Low Cp, Low Reflectivity → Heating
Low Reflectivity



Plot your set on the graph.

1. Specific Heat
2. Reflectivity
3. Where it is

Cp CO_2 = 1.02
Cp CH_4 = 2.22

Impact

Dubly of [illegible] in temperature.

[illegible] of a high specific heat [illegible]

High Albedo / Low Albedo (Reflectivity)

2. Reference [illegible]

3. Look @ pictures

Look @ Data

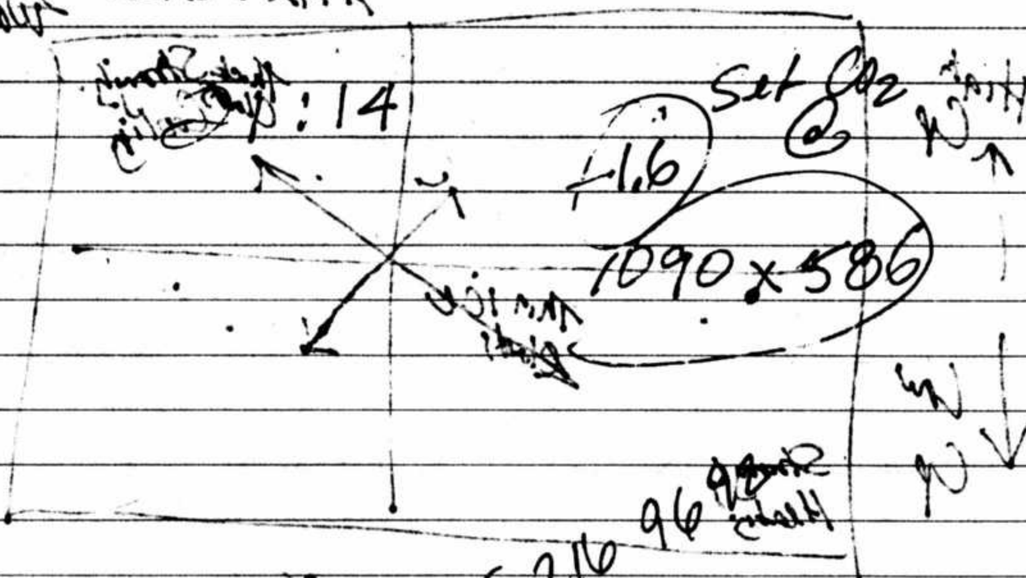
5. Experiment w/ the model

Not a one way street

There are some sign problems.

Specific heat [illegible]

High Reflectivity



Page 3.7

We have a problem w/ negative [illegible]
It is heavy, it. why

$\Delta E = \Delta C \Delta T$

$\Delta C = (C_p - Air) \cdot m_A \cdot M_{air}\ \Delta T$

This can — This can be + or − — This can be + or −

(abs) Δ

− +	− +	− (+)	• (−)	• (−)
	− +	− +		
	+ [illegible] +			
	− + [illegible] +	+	•	+
	− [illegible] flipped.			

One of the last two needs to change

Since $\Delta T = f(m_A)$ it is doubly up on the sign.

Can Heat Capacity be negative ...???

\+ ~~holds heat~~ can gain heat
− ~~gives off heat~~ can release heat

Interesting ... We have a problem w/ negative ... It is heavy it: why

Δ HC of water is positive when negative
∴ + vise versa $\Delta E = \Delta C \Delta T$

Al same thing
$\Delta C = (Cp - Air) \cdot Mg \cdot M_{air} \cdot \Delta T$

Magnesium

This can ... This can ... + or −
Everything else is positive, This makes sense (Abs)
* Sign of Heat Capacity

	ΔC_p *	Δm (abs)	(Product)	ΔT	ΔE
CO_2 + =	> Air	(−)	(+) ...	+ −	+ −
CH_4	> Air		+ ...	+ −	
Aerosols	> Air		+ ...	+	
Thick Cl + =	< Air +	+	+ ...	+ −	
Al	< Air		[illegible]	−	
Mg	< Air		One of the last two needs to change		

Now temperature is dependent on methane
+ ... a problem.

Since $\Delta T = f(M_{a})$ it is doubly up on the sign.
???
Can Heat Capacity be negative ...

+ holds heat can gain heat
− gives off heat can release heat

The aerosol problem can be solved by making it [illegible] & annual temperature changes.

& Methane effect & CO_2 effect

Need a truth table:

	Δm			Products		
				0	>∅	<∅
CO_2	>av	+	−	+	−	∅
CH_4	>av	+	−	+	−	∅
Aerosols	>av	+	−	+	−	∅
Thick Cld	<av	+	−	−	+	∅
Al	<av	+	−	−	+	∅
Mg	<av	+	−	−	+	∅

He $\Delta C_p \cdot$ mass = Heat Capacity

Abstracts Web Site

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We have an issue w/ sign ~~problems~~ problematic ~~ones~~

We have $\Delta E = C \cdot \Delta T$

We already have C and it seems to be correct $C = \Delta C_p \cdot M_{air}$

	C		
	$\Delta C_p \cdot M_{air}$		
CO_2	+ = +, − = − × heat change = temp change		
CH_4	+ = +, − = −		+ = +, − = −
aerosols	+ = +, − = − same as CO_2 & CH_4		
Thick Clouds	+ = −, − = +		
Al	+ = −, − = +		
Mg	+ = −, − = +		

These are reversed.

(written upside down at right:) CO_2 ΔT > 0 and CH_4 > 0 / also CH_4 < 0 / Ok, it looks like CO_2 & CH_4 are OK / Now look @ aerosols

(written upside down at right:)

CO_2	+
CH_4	+
aerosols	+
Thick Clouds	yes
Al	
Mg	

Problems:

$CO_2 < \emptyset$, then temp is $< \emptyset$ which is true

but now you multiply them together which is wrong

(If $CO_2 < 0$ and temp is < 0 ~~then~~ or $CH_4 < 0$ & temp < 0)

then ~~CO_2 = absolutevalue CO_2~~

then Joules = Joules · −1

this is working for CO_2 & Methane

Ok we have the zero condition

taken care of for CO2 & methane

• now check aerosols

~~Anisotropic problem~~ We have an issue of sign

We have $\Delta E = C \cdot \Delta T$

~~C~~ We already have C and it seems to be consistent $C = \Delta c_p \cdot m_{air}$

of $CO_2 < \emptyset$ and $CH_4 > 0$ C

also $CH_4 < \emptyset$ · $CO_2 > \emptyset$ $\Delta c_p \cdot m_{air}$

· heat change = heat change * -+- +=+ CO_2

--- -=- ++ CH_4

Ok, it looks like CO_2 + CH_4 are OK. - += +   Aerosols

Now look @ aerosols   + = - - = +   Thick Clouds

+ = - - = +   Al

+ = - - = +   Mg

CO_2	+
CH_4	+
aerosols	+
Thick Clouds	rev

Problems:

Al ... $CO_2 < \emptyset$, then temp is $< \emptyset$ which is true

Mg ... but when you multiply them together is wrong.

(if $CO_2 < 0$ and temp is < 0 then or $CH_4 < 0$ & temp < 0)

then CO_2 = absolute value CO_2

then Joules = Joules · -1

this is working for CO_2 & Methane

Ok we have the gene condition

Take care of for CO_2 & methane.

Now check aerosols.

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~~Δl~~ is wrong: on the ~~negative~~ positive side only

X negative

~~positive~~ side only

Δl is wrong on ~~both~~ sides.

=2 4 8

1, 3, 7 are both sides wrong

0 2 4 5 6 8 9 are wrong on negative side only.

= 1 3 5 6 7 9

Strontium has ... problems.

Δl is wrong on positive side

=2

$\Delta E \cdot C \cdot \Delta T$

$\Delta T = \frac{\Delta E}{C}$

If CO2 ... is wrong. 15

~~80~~ 55 years = X. X = ~~100~~ 150 years

85 ppm ... 200

Round down to 150 years. 150 years

@ 400 ppm ... Rise to 600 ppm.

= 50% increase

Double CO_2 = 5°C increase

T = .05 % Increase

.05 ... 2.5° ...

$\frac{1°C}{X \text{ years}} = 2.5°$

Y years = 2.5 · X years

85 ppm in 85 years = $\frac{85}{400}$ 21%

~~21% in 85~~

$\frac{21\%}{85 \text{ years}} = \frac{50\%}{X}$ X = 202 years

·−1.6

$\frac{85 \text{ ppm}}{55 \text{ years}} = \frac{X}{1 \text{ year}}$

X = 1.5 ppm per year

1090 + 586

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(1.) Next we looked @ aerosols combined w/ CO_2

.15 Problem:

Carbon Black 30 @ 400

add CO_2 Ø.5

CO_2 Ø.1 = .15?

.3	.46
.4	.61
.5	.77
1.0	1.56

Anomaly here? Ø = .18? Why

-.1	+ .15
-.2	+ .30
-.3	.45
-.4	.60
-.5	.75
-1.0	-1.48

When Carbon Black > 0 and CO_2 < Ø

$CO_2 = -1 * CO_2$?

Combined
w/ GG Jack w/ CO_2

Separat heat energy components

Gas HEK Aerosol HEK HEK

CO_2 ~~+30@280~~

CarbonBlk +30@280

Heavier elements have more atoms per unit mass.

Page 47

	Value	Gas HEat	Aerosol HEat	My	Heat
CO_2	∅	∅			
Carbon BlE	[illegible]@400		.00102		+.18%
CO_2	[illegible]	1.0016			
Cbn Blk	[illegible]		∅		.16%
CO_2	30@400	.0016			
Cbn Blk	50.2		.0304		20%

Clearly this number is out of [illegible] by a factor of about 16 why?

~~[illegible] aerosol heat change seems [illegible]?~~

This says the aerosol heat capacity change has a problem.
this says aerosol delta specific heat of air is very high

What if you just scaled down the contribution of aerosols by a factor of 16?

48.

100/4 = 25
1000/4 = 250

Your strategy worked perfectly to isolate the problem. I split the problem up between gases & aerosols. The aerosols were the problem.

Aerosols act as a smog magnifier & a fancy convoluter

It looks like I have a consistent model now.

Heavier elements have fewer atoms per unit mass.

Heat	My [illegible] Aerosols		CAS HC	Value	
					CO2
Heating	Carbon	.71	.20	.67	.67
	Volcanic Ash	.84	.30	1.1	[illegible]
	Sulfuric Acid	.85	.30	.85	.85
	Barium	[illegible]	.30	1.45	.88 CO2
	Strontium	[illegible]	.30	.88	.88
	Thin High Clouds	2.03	.37		.91
Neutral	Magnesium	1.05	.40		1.02
Cooling	Al_2O_3				
	Thick Clouds				

Clearly this number is out of ...

This says the aerosol heat capacity change has a problem.

This says aerosol delta specific heat of air is very high.

Silver Atomic Mass 160 years 1°C

What if you just scale down the ... of aerosols by a factor of 1.6?

.84 (82)

100/4 = 25

1000/4 = 250

[illegible]

Aerosols act as a magnifier & a heavy ...

It looks like I have a consistent model now.

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$\frac{\text{Avogadro (no. of atoms)}}{\text{Molar mass}} = \frac{X}{1 \text{ gram}}$ = no of atoms / unit mass

Avogadro No. constant, molar mass varies

Ba heat capacity [illegible]

Heat Capacity, Specific Heat

$C = C_p \cdot \text{mass}$

Heat capacity relates to a large amount of something

Specific heat relates to a unit mass.

[illegible] – Layout – Uncomfortable 2. Reflecting 3. Location

Properties

Heat properties, Chemical Consequences, Health & Biological Consequences

$C_p = f\left(\frac{\text{no. of atoms}}{\text{unit mass}}\right)$

A heavy element has fewer atoms per unit mass than a light element

eg Al : molar mass = 26.9 gms/mole

Ag : = 107.9 gms/mole

Ba : 137.3 gms/mole

(Aluminum heats up less; smaller & lighter; more atoms per unit mass)

So

Al: $\frac{6.02E23 \text{ atoms}}{26.9 \text{ gms}} = \frac{X}{1 \text{ gm}}$ $X = 2.24E22$ atoms/gm

Ag: $X = 5.58E21$ atoms/gm

Ba: $X = 4.38E21$ atoms/gm

(Barium heats up more; less atoms per unit mass; bigger & heavier)

Energy in is the same

Energy photon is the key / no of atoms varies.

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Avogadro (no. of atoms) / Molar mass = X / 1 gram = no of atoms / unit mass

X = Avogadro No. — constant; Molar mass — varies

C = Heat Capacity (Specific Heat)

C = Cp · mass

A Heating Aerosol.

Cp Heat Capacity relates to ... LESS than air

Absorbs a ... (high reflectivity) of a unit mass.

Dominates — Cooling Influences:

White (Very high reflectivity) ... little

Very ... Cp ... Layer

Properties

Dominates — High Clouds — Heating.

15 ... reflecting ... absorption.

Cp is still air so absorption dominates

Health & Biological Environment

Cp is close to air

So mild heating from ...

It is also highly reflective so ...

This means per unit mass ... little dominates

e.g. Al : Molar mass = 26.9 gms/mole

Pt : = 101.9 gms/mole

Ba : 137.3 gms/mole

So Al: 6.02 E23 atoms / 26.9 gms = X / 1 gm → X = 2.24 E22 atoms/gm

Pt: X = 5.58 E21 atoms/gm

Ba: X = 4.38 E21 atoms/gm

Cropt

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(1-albedo) is more understable to me

Final Scenario

1. Pollution Causes
2. "Room to move" ie leeway
3. Public framing of defeated

4. CO_2 Methane Aerosol Cloud Scenario;

5. Subsequent blocking of heat & sunlight
aerosol

6. Heat Exchange - Changing weather temperature pressure

1457
0536

9149-1457 →

4537 23.75
3107 49.59

The debugger in Firefox (Firebug) is superb! Very easy & powerful to use!

Crypto

Dec 21 2014 Page 52

(1 - Albedo) is more understandable to me.

We now wish to consider the albedo variation from a norm

1. Pollution Causes
2. "Hyper" to move "
3. [illegible]
Change vs. variance

4. [illegible]

5. [illegible]

The debugger in Firefox (Firebug) is superb! Very likely a powerful tool!

if albedo < 0.3
eg Carbon = 0.2
0.2 - 0.3 = (-0.1)
Now assume Cp is low
you will have a (negative) (negative) = positive

So your planar regression computes a modified version.

Actually you are ok.

You have translated it into a modified Cp value & then subtracting an floor plot.
This is reasonable.

[redacted]

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Man Behind the Curtain

The Consolidation Video — Topics

1. Intro to greenhouse gases
   relative effects of each gas
   Allow for consideration of decrease as well as increase
   Compensating mechanisms
   It is possible to consider cooling as well as heating
   Balance points can exist
   Maximum rate of relative cooling can exist
   Perhaps climate cooling or heating can occur
   Historical perspective is very important, esp. geological
   Be willing to look at the data
   Divergence w.r.t. latitude appears to exist
   Methane data does show some decrease

2. We can consider, at first aerosols independently.
   Specific heat and reflectivity (albedo characteristics) & location
   Uncertainty seems to be the name of the game
   Any introduced particle has a consequence

3. Consider Antarctica
4. Meteorologists on hire 1993
5. High & low clouds
6. Additional topics
   1. Energy input - by lamp
   2. Geological
   3. Mortality rate

Software model has

$$\Delta C_{pav} = \Delta C_4 \cdot mf_4 + \left(\frac{1}{3.4}\right) \Delta C_5 \cdot m_5$$

We have

$$\Delta T = a \cdot \Delta CO_2 + a\left(\frac{mf_{CH_4}}{mf_{CO_2}}\right) \cdot mf_{CH_4}$$

$mf\ CH_4 = 1.0E-4$ $\quad \frac{mf_{CH_4}}{mf_{CO_2}} = .175$ $\quad a\ \frac{1}{.175} = 5.7$

$mf\ CO_2 = 5.7E-4$

What we did was take

$\frac{CO_2}{CH_4}$ and we reduced this by 25.

~ equivalently we took $\frac{CH_4}{CO_2}$ and multiplied it by 25!

This means for ΔT we actually have:

1st

$$\Delta T = a \cdot \Delta CO_2 + a(25)\frac{CH_4}{CO_2} \cdot CH_4$$

and this is correct.

$$+\left[(a \cdot \Delta CO_2)(25)\left(\frac{mf_{CH_4}}{mf_{CO_2}}\right)\right] \cdot \Delta CH_4$$

factor

We are now @ a comparison to annual earth heating ~ to 2% level.

We may have a problem
w/ density computation.

We have density of air as $\emptyset.68$ Kg/m3 ??? = .00068 /m3

This is reasonable
Sea level = 1.28 Kg/m3 so we
are half of that.

We are using

ΔC_p = ~~Joules / Kg·C~~ . 1E-6 gms · 1E-3

mf: XE-6gms · 1E-3 / m3
/ Kg/m3 · 1E3

= 1E-9gms/m3 / Gms/m3

NO. This is too small by a factor of 1000,
to be stated as micrograms.

It should be to get mass fraction.

slider * 1E-6gms/m3 / density · 1E3 gms/m3 = 50E-6gms/m3 / 600gms/m3

= .0000001 This is mass fraction

you have now changed aerosol Cpaerosol *
to E-6 (~~micrograms~~ gms)
.68 kg · 1000 = gms
So this is a proper mass fraction.

Cp = Cp · ΔM

Cp air · Mass · 1000 = KJoules / Kg · C° · Kg · * 1000 = Joules / C°

3 $\frac{500}{25}$ = –

your density value is wrong.

Density @ 30000 ft is about 1/3 of that of sea level

$\frac{25E\text{-}6 \text{ grms}/m3}{.68E3 \text{ gms}/m3}$ = mass fraction

$$C_1 \cdot albedo_i + C_2(Cpaerosol_i - Cpair) + C_3$$

$$C_1 \cdot albedo + C_2 (Cpaerosol_i - Cpair) + C_3 - Cpair$$

$$= C_1 \, albedo + C_2 Cpaerosol_i - C_2 Cpair + C_3 - Cpair$$

= ~~Cpair (C2-1)~~ It does not cancel

Reconsideration.
Let us rework the idea of

$Cp^*aerosol$

You should not be using the difference
@ the first level.

k	i	Substance	Cp	Albedo	Estimated Cp* aersol
1	0	Carbon	.71	.20	.67
2	1	Al_2O_3	.78	.45	1.13
3	2	H_2SO_4	.85	.30	.85
4	3	Thick H_2O	4.19	.75	1.45
5	4	Barium	0.29	.30	.88
6	5	Thin Ice	2.03	.37	.91
7	6	Volcanic Ash	.84	.30	.85
8	7	Magnesium	1.05	.40	1.02
9	8	Strontium	.30	.30	.88

Model:

$$C_1(C_p) + C_2(\text{albedo}) * C_3 = f(x)$$

$C_1 = -.063$ $r = .9999$

$C_2 = 1.82$

$C_3 = 0.36$

I think I found my problem with the units
You have two factors of E-3

. No right now it is mg

aerosol Contribution = Σ Cp aerosol * mi

Take this . mass of earth *1000
to get heat capacity.

g aerosol Contribution = Σ (Cp aerosol - Cp air) mf

So with carbon black
aerosol contribution is negative. Why?

Cp of is negative
. So it should be -1.0.

Cp of less than air causes an increase in heat!
This flips the sign.

This is why you reversed the subtraction of
air - Cp aerosol
. vs the standard Cp aerosol - air

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$1 \frac{mg}{m^3}$ has a significant effect

$= 1000 \mu g$. 1.50 EPA = it is only a factor of 20

2% CO_2 increase 0.5 mg = 500 µg vs 50 µg = a factor of 10

Climate Model =

1. −1. Sign. +
2. time for 1° change
3. peak

one degree years = $\frac{\log(2)}{\log\left[\left(1 + \frac{\text{heat energy}}{\text{ratio}}\right) - 1\right]}$

.11%

$\frac{\log(2)}{\log(1.11)} - 1 =$

$\frac{\log(2)}{\log 1.0098} - 1$

If something has added by 2% the firstly year it will be

$X_{n+1} = 1.02 (X_n)$

The first few terms of this series are

n=0	1.0	$= X$
1	1.02	$= (X + \%) X$
2	1.04040	$= (X + \%)(X + \%) X$
3	1.06121	$= (X + \%)^3 \cdot X$
4	1.08243	$= (X + \%)^4 \cdot X$

So our term after n years is

$(X + \%)^n$

it could be formed as

$.02(1) +$

n=0	firstly year	.02	.02
n=1		.02 (1.02)	= .02040
		.02 $(1.02)^2$	.02081
		.02 $(1.02)^3$	.02122

$= .02 + .02 (1.02)^1 + .02(1.02)^2 + .02(1.02)^3 + \ldots$

$= .02(1 + X^1 + X^2 + X^3 + \ldots)$

$= .02 \left(1 + \sum_{i=1}^{n} X^{i}\right)$

So we have

$.02\left(1+\sum_{i=1}^{n} X^{i}\right) = 1$

Why did you say 1? because it is actually

.006 @ a rate of increase

Si start @ .006 per year @ a 2% increase

n	deg C	
0	.006 °C	$.006 \cdot (1+X)^0$
1	(1.02)(.006) = .00612	$.006(1+X)^1$
2	(1.02)(1.02)(.006) = .00624	$.006(1+X)^2$
3	(1.02)(1.02)(1.02)(.006) = .00637	$.006(1+X)^3$

$n\left(1+\frac{\%}{100}\right)^{n} \cdot$ Current heating.

r AR = absolute rate

~~CH(1+~~

$AR\left(1+\frac{HR\%}{100}\right)^{n} = 1°C$

=AR +

$.006 \sum_{i=0}^{n} (1+X)^{i} = 1°C$

=

Series ✓

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So our series

$$= \Delta \text{ annual } C^{\circ}\ .006 \sum_{i=0}^{n} (1+x)^i$$

where $x = \%/100$

$$CR \sum_{0} (1+x)^i = \left(1 + (1+x)^1 + (1+x)^2 + (1+x)^3\right) CR$$

let $U = (1+x)$

$$= 1 + \sum_{i=1}^{n} U^i$$

$$= 1 + U + U^2 + U^3 + U^4 + U^5 \text{ etc}$$

This appear to involve Bernoulli

$$\sum_{k=1}^{n} a^k = \left[\frac{a^{n+1} - 1}{a-1}\right] - 1$$

let $a = 1.02$

$$(1.02)^1 + (1.02)^2 + (1.02)^3 + (1.02)^4 + (1.02)^5 = 5.30812$$

let $a = \left(1 + \frac{\%}{100}\right)$ let $a = (1+r)$

$$= CR\left[\left[\frac{a^{n+1} - 1}{a-1}\right] - 1\right] = 1^{\circ}C$$

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Our problem is

$$CR\left[\left(\frac{a^{n+1}-1}{a-1}\right)-1\right]=1^{\circ}C$$

C = Current Rate of heating in degrees.

divide both sides by CR

$$\left(\frac{a^{n+1}-1}{a-1}\right)-1=\frac{1^{\circ}C}{CR}$$

$$\frac{a^{n+1}-1}{a-1}=1+\left(\frac{1^{\circ}C}{CR}\right)$$

$$a^{n+1}-1=(a-1)\left(1+\frac{1^{\circ}C}{CR}\right)$$

$$a^{n+1}=(a-1)\left(1+\frac{1^{\circ}C}{CR}\right)+1$$

$$(n+1)\log a=\log\left((a-1)\left(1+\frac{1^{\circ}C}{CR}\right)+1\right)$$

$$n+1=\frac{\log\left((a-1)\left(1+\frac{1^{\circ}C}{CR}\right)+1\right)}{\log a}$$

$a=1+r$

$$n=\left[\frac{\log\left((a-1)\left(1+\frac{1^{\circ}C}{CR}\right)+1\right)}{\log a}\right]-1$$

This is quite different $r\neq\emptyset$.

Since $a=1-r$

$a-1=1-r-1=r$ so

$$n=\left[\frac{\log\left((r)\left(1+\frac{1^{\circ}C}{CR}\right)+1\right)}{\log 1+r}\right]-1$$

$r\neq 1$

You seemed to have an issue with the ... over zero reference point.

Your original answer may have been correct.

What you solved for was 700% increase or decrease
not 1° C.

So what you are really ending up with is a 1000% increase in so many years.

Current rate is 1° in 167 years
if you double the rate in 167 years
What is the net effect?

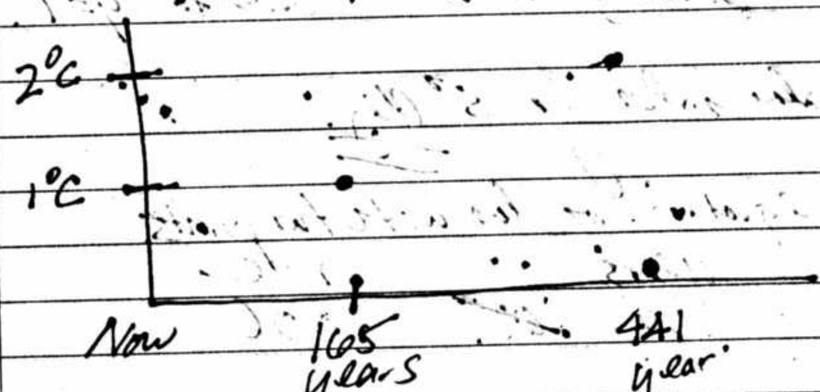
In 167 years the ... is rising @ .012 deg year

What you did was set up a doubling of the heating rate.
Which balances any the heating rate.

So Current situation .006°C / year
= 1°C in 165 years

@ 2% CO_2 increase per year we have a doubling in 441 years

So



This is derivative

So how much will the temp have risen in 441 years?

years * degree

$\frac{dy}{dx} = f(x$

Earth will have risen

$\frac{d(\text{Temp °C})}{d \text{ years}} = f(x)$

@ 2°

rsig @ 1° in 165 years

rsig @ a rate of .006 now
in 441 years .012
1° in 120 years vs 165

you have it.
The earth will now raise 1 degree
in 120 years vs 165 years.

So we solve for two pts.
And the [illegible] & solve for y=1.

You can also solve for 5° deg.

Solve for equation of line with two points

years	rise
0	.006
110 years	.012

You seem to be getting the same value
What does this mean.

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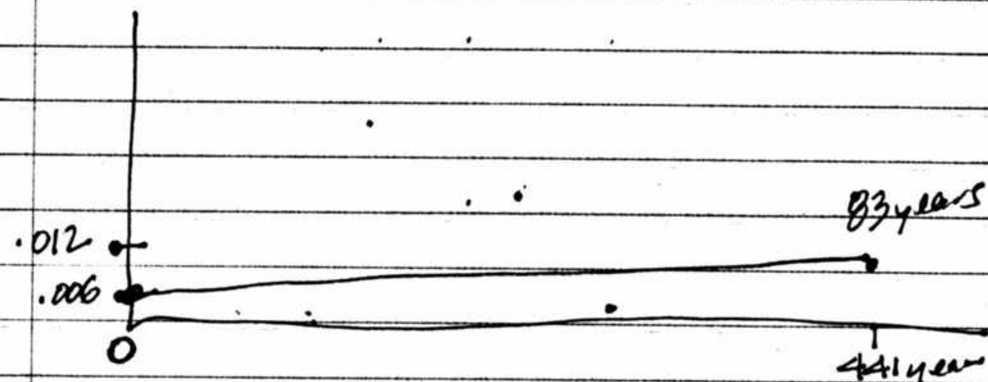

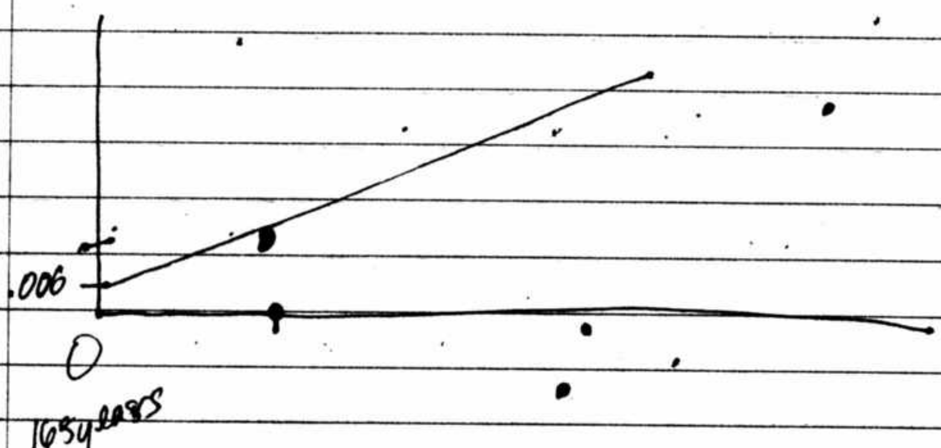

You have an interesting problem here.

Let's think about the

Mathcad full

1. Write Mathcad code

2% CO_2 double in 441 years

0% CO_2 1° in 165 years

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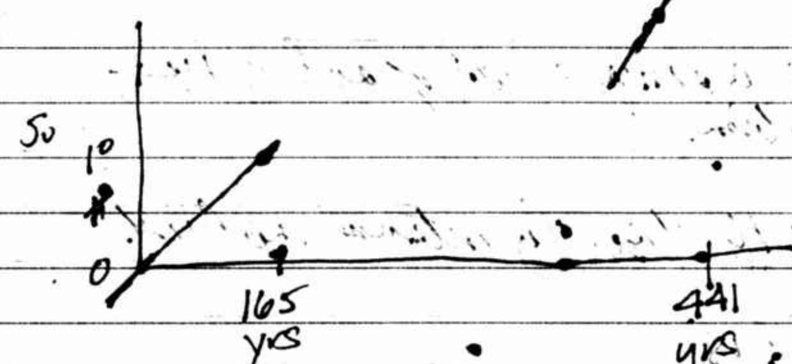
$y = .006x$ @ $x = \emptyset$

$y' = c$

$y = cx + b$

$y = .006x + b$

$y = .006x$



so slope @ 165 yrs is ~~.06~~ .006 /year
slope @ 441 yrs is .012 yrs

This is a differential equation!

$y'(x) = .006$ x = @ ~~x=165~~ $\emptyset$

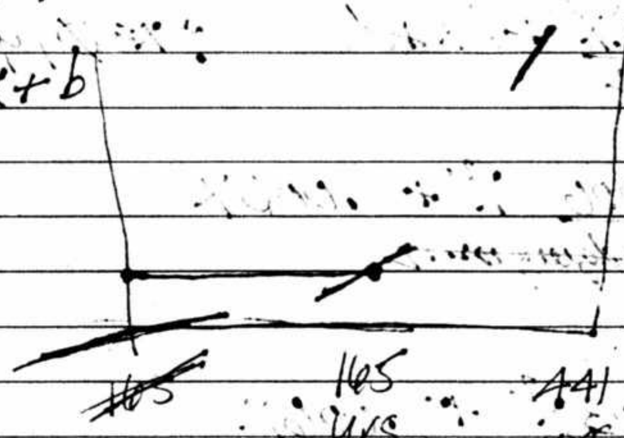
$y'(x) = .012$ @ $x =$ ~~16~~ 441

so what is y(x)??? Wow, ~~a diff equation~~.

$2y'(x) = .018$

ax+b

164 .0
165 .006



115 1°

We have a simple way of solving the time problem.

We have the doubling interval solved.

Our model is

$y' = Cx + b$ (this is a reasonable assumption)

We therefore can form two equations

$.006 = C(0) + b$ so $b = .006$ @ $x = 0$

$.012 = C(\text{double years}) + .006$ ~~one degree year~~

$\therefore C = \frac{.012 - .006}{\text{double yrs}}$ ~~one degree year~~ $= \frac{.006}{\text{one degree year}}$

So $y = \frac{Cx^2}{2} + bx + d$ @ $x = 0, y = 0$, so $d = 0$

So $y = \frac{.006}{\text{double years}} x^2 + .006x$ ~~one degree year~~

$y = \frac{.003}{\text{one degree years}} x^2 + .006x$

double year → determined from model

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We can set $y = 1^\circ$ & 5° respectively

$\frac{ax^2}{2} + bx + c = \emptyset$ $\qquad \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$a = \frac{.003}{\text{~~one degree years~~ double years}}$ $\quad b = .006 \quad c = -1$ and -5

for 1° So $\frac{-.006 \pm \sqrt{.006^2 + 4\left(\frac{.003}{\text{one deg years}}\right)}}{2\left(\frac{.003}{\text{one degree years}}\right)}$

for 5° $\frac{-.006 \pm \sqrt{.006^2 + 4\left(\frac{.003}{\text{one deg years}}\right)5}}{2 \cdot \frac{.003}{\text{~~one deg years~~ double years}}}$

This is not looking right

Smithy is wrong

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~~CHR = C(NOWYRS) + b~~

~~or $b = \frac{CHR}{C \cdot NOWYRS}$~~

CHR = Current Heating Rate

Nowyrs = Origin or close horizon

~~2·CHR = C·doubleyears or $\frac{CHR}{C \cdot NOWYEARS}$~~

Model is

$y' = ax + b$

$y'(0) = .006 = CHR$

$y'(\text{doubleyears}) = .012$

$.006 = a(0) + b$ or $b = .006 = CHR$

$.012 = a(\text{doubleyears}) + .006$

or $2 * CHR = a(\text{doubleyears}) + CHR$

$a(\text{double years}) = 2CHR - CHR$

$a = \frac{CHR}{\text{doubleyears}}$

We know that

$y = \frac{ax^2}{2} + bx + C$ $C = \emptyset$ as $y = \emptyset$ when $x = \emptyset$

So

$y = \frac{CHR\, x^2}{2 \cdot \text{Doubleyears}} + CHR\, x$ x = no of years

In y = 1

typical 1° $\frac{CHR \cdot x^2}{2 \cdot Dbl\,years} + CHR(x) - 1 = \emptyset$

5° $\frac{CHR\,x^2}{2 \cdot Dbl\,years} + CHR(x) - 5 = \emptyset$

CHR = Current heating rate

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Actually we can see that the slope is not likely linear?

0.006 @ y = $\emptyset$
.012 @ y = 44 yrs

1. Radio
PicoScope 20MHz
Signal Generator
Choke
Cell Sensor

OK, let's move on. We have percent double year and a longterm function.

We have

$y' \approx ax + b$

$y(0) = 0.006$ (Current Healthy Rate)
$y(pdy) = .012$ (2 * Current Healthy Rate)

$CHR = a(0) + b \quad CHR = b \quad \therefore b = CHR$

$2CHR = a(pdy) + CHR \qquad .012 = a(pdy) + .006$

$a = \frac{.006}{441}$

Should I both sides? ~~$2CHR(x) + c = a\frac{(pdy)^2}{2} + CHR(x) + d$~~

= OK

~~$a\frac{(pdy)^2}{2} = 2CHR(x) - CHR(x) + e$~~

~~$a = \frac{2(CHR)(x)}{pdy^2} + 2e$~~ $\qquad e = 0.$

~~eg $pdy = 441$, $CHR = .006$ $\quad a = 2.7E{-5}$?~~

So the method is

$y' = ax + b$

$y'(0) = .006 = CHR$
$y'(44) = .012 = 2CHR$

$.006 = a(0) + b \Rightarrow b = CHR$

$(2CHR)\ .012 = a(\text{percent doubling years}) + CHR$

$a = \frac{CHR}{\text{percent double years}}$

and

$y = \frac{ax^2}{2} + bx + C$ when $x = 0, y = \emptyset \Rightarrow C = \emptyset$

$T^{\circ} \overset{so}{=} \left(\frac{CHR}{2 \cdot pdy}\right) years^2 + CHR(years)$

solve for $T = 1^{\circ}$ & $T = 5^{\circ}$

so $a = \frac{\text{current heating rate}}{\text{percent double years}}$

$= b =$ current heat rate
$C = \emptyset$

$T^{\circ} = \left(\frac{CHR}{2(pdy)}\right) years^2 + CHR(years)$

see below

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ solve for positive roots first

to solve for $T^\circ = 1^\circ C$

$-1 = \left(\frac{CHR}{2pdy}\right) years^2 + CHR(years)$

or $\left(\frac{CHR}{2pdy}\right) years^2 + CHR(years) + 1 = 0$

Now solve for roots.

9) CHR = .006
pdy = 441

The problem is when you back it loses all information on variables. So you must store it to access the data in another function. It is better to use it in the same function. GOING BACK is the problem. You can go forward but not back unless you write to storage.

So you must write the variable to local storage because you went back it will not pass variables when you hit back.

Ok, I am in the routine now.

+2% PDY = 441.05

−2% PDY = −442.4

so it goes both ways.
except it neutralizes heaty
it does not count the ...
So instead of the slope being double
it is zero.

So same idea:

$y' = ax + b$ $\qquad$ $y'(0) = .006$
$\qquad\qquad\qquad\qquad$ $y'(pdy) = \emptyset$

so

$CHR = a(0) + b \Rightarrow b = CHR$

~~$\emptyset = a\,pdy$~~

$\emptyset = a(pdy) + CHR$ $\qquad$ $y = \frac{ax^2}{2} + bx + c$

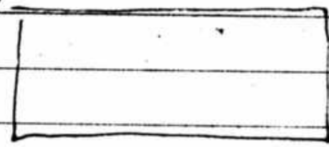
$a(pdy) = -CHR$

$a = -\frac{CHR}{pdy}$ $\qquad$ it is essentially the same equations

so $y = \left(\frac{CHR}{2pdy}\right) years^2 + CHR \cdot years$

−1
−5

90



800, 800

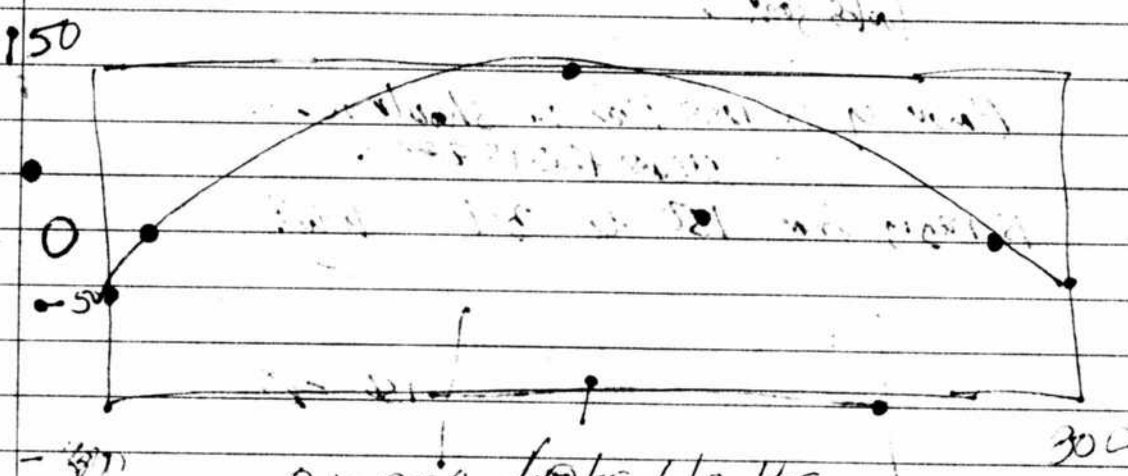
0, 150

We get coords. for:

- 800 · · - 53.6
+ + 800 - 54

We go as high as +150

	X	Y
50	-800	-54
	~~800~~ -690	0
	0	150
	+684	0
	800	-54



Overlap looks like this

OK, lets go back.

Should be 1° @ 129 years
5° @ 425 years
This is not what we have.

Our first point is
-1000 -54 why -1000, why -54?

because x = -1000!
OK, you are getting close.

It looks close but still not right.

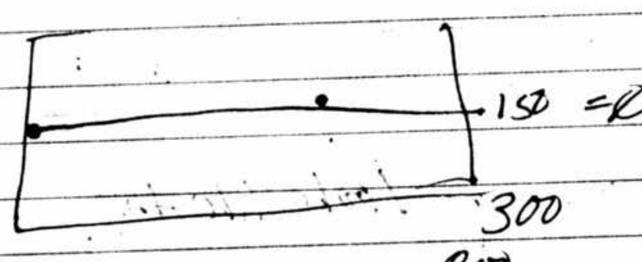
$$X = my\,X \left(\frac{X\,max}{my\,X\,max} \right)$$

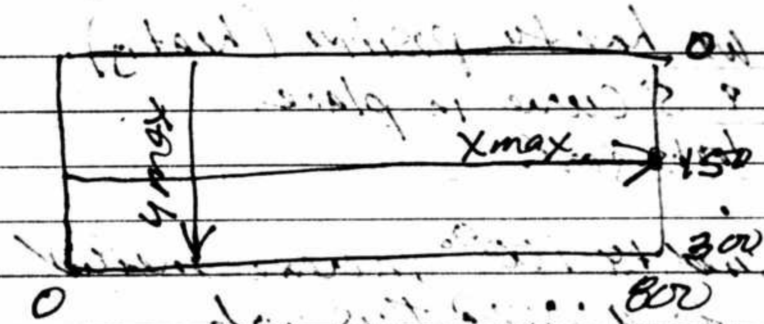
800

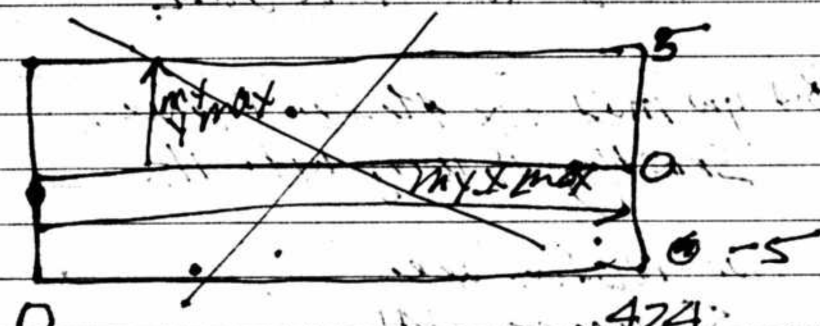
0 to 424 424
looks good.

Now y is less than it should be
because this is zero.

Is ranging from 150 to 37 Why?



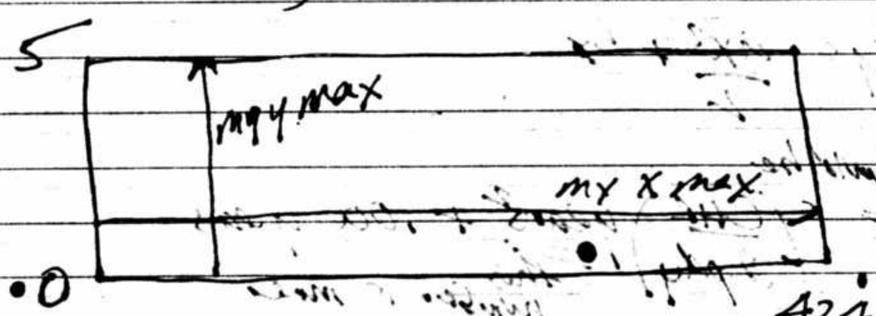




$$x = myX \cdot \frac{Xmax}{myXmax}$$

(800) over Xmax; (0 to 424) under myX; (424) under myXmax

First off, I think we should take care of heatg first and use



You are getting close

800, 1A

but should be 800, 0

OK, we have the positive (heating) 1° & 5° curve in place.
It looks good.

We used the 100% increase method to arrive @ this work.

But you must fix the curve. Something is wrong with it.

Our relations are
5° years = 441
1° years = 129

$b = CHR = .006$

$a = \frac{CHR}{pdy}$ should be

$y = \frac{ax^2}{2} + bx$

should be

$\Delta T = \left(\frac{CHR}{2pdy}\right) years^2 + .006\ years$

this number is made

let years = 441 = 3.96 this is the problem
it is not 5

pdy is not 5 degree years!

Page 83

your answer for one degree years
& 5 degree years are wrong

2nd CO_2

double = 441	not
1° = 143.4 yrs	129
5° = 523.1 yrs	441

double = 441 ok
1° years is wrong
heating rate = .006 ok

a varies this is the problem
— mathcad: 6.803E-6 ??
Javascript ... 3.6 + 5 ...???

Ok I found my problem.

Ok, let's find out which one is right.
Your problem was not using "a" here

if $a = \frac{CHR}{pdy}$ then $\frac{ax^2}{2} = \frac{CHR}{2PDY}x^2$

This is actually "a") and you forgot the factor of 2.

Ok, this is better

OK, now [illegible] the [illegible]
[illegible] [illegible] now [illegible]

Corley

Now lets go after negative values.

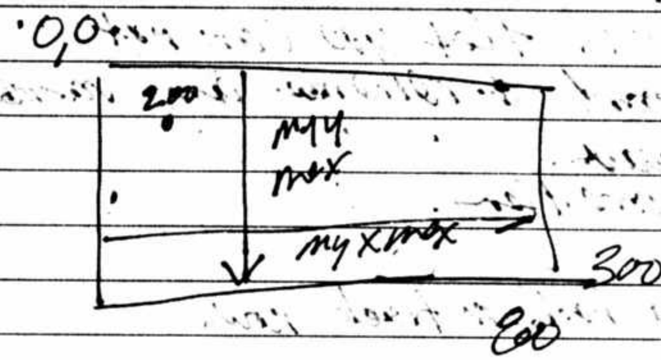
One degree . first degree
are 1st absolute value.
so we need heat energy [illegible]

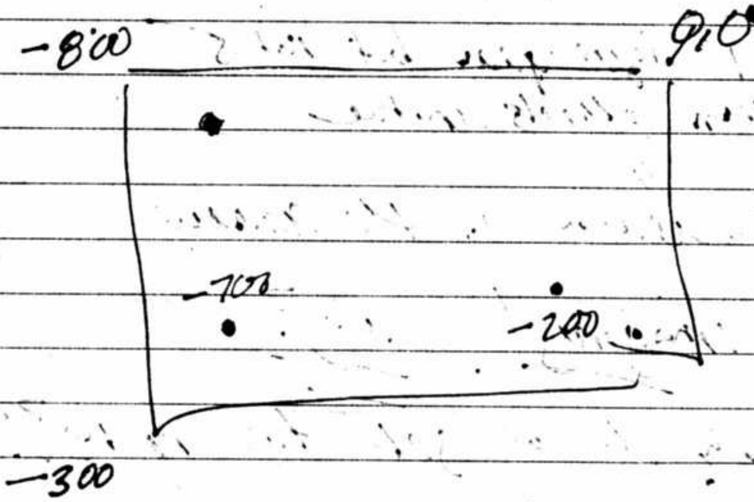
The only thing you [illegible] out
was one degree years

You retrieved the values from disk.

Then you determined one & 5 degree years

Then you called the graphics [illegible]





$X = (-100) - (-800) = +100$

$= my\ x - (xmax)$

$Y =$ ~~$(-200) - (-300) =$~~

$- (my\ meyy)$

Your numbers now are $-\infty$ ∞

Dec 29 2014

Your problem is that you can not go ~~forward~~ & remember any variables backward.

You must store them.

Cool, you are back on track now.

Now get to negative graph only.

We have 1 degree year but not 5 in long term effects routine

Ok, the answer is the answer is imaginary! Why?

also, why do we get two roots???

@ 1.324 it switches to imaginary root. Why?

@ 1.323 = 441 years (notice = double years)
@ 1.324 = imaginary

We have an unusual & unexpected situation that has come up.

For energy ratio if when the no of years exceeds the percent-equalize year, the root becomes an imaginary no.

for a positive root

857 years = 5° 5 = 523.1 years

223.1 years 1° very interesting results. 1° = 143.4 years

So it is not symmetrical which make sense.

If something is heating it takes longer to cool it down.

eg 1° @ .006/yr = 167 years

Cooling takes?:
Heating takes 441 years to double
Cooling says 442 " " neutralize
So it is saying the same for both.
but integration of concave is not the same? why -?

$ax^2 + bx = 1$

$ax^2 + bx = 5$

$ax^2 + bx = -1$

$ax^2 + bx = -5$

you are going to end up with

root 1 = $\sqrt{\text{a negative number}}$
how do you find the solution of a negative number?

What is the square root of −5

$b^2 = x$
So $\sqrt{5}$.

$\sqrt{-5} = \sqrt{+5 \cdot i^2} = i\sqrt{5}$

Method if $b^2 - 4ac < 0$ roots are complex.

So we can compute the roots.

$$a = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$ we have everything we need.

First part, real part is $\frac{-b}{2a} = \frac{-CHR}{\frac{1}{\frac{2\,CHR}{pdy}}}$

$= \frac{-CHR}{1} \cdot \frac{pdy}{2CHR} = -pdy$

$a = \frac{CHR}{2pdy}$ so $\frac{-b}{2a} = \frac{\frac{-CHR}{1}}{\frac{CHR}{2pdy}} = \frac{-CHR}{1} \cdot \frac{2pdy}{CHR}$

$= -2pdy$

$$\frac{\frac{-CHR}{1}}{\frac{2CHR}{2pdy}} = \frac{-CHR}{1}\,\frac{2pdy}{2CHR}$$

$$= \frac{-pdy}{CHR} \qquad \frac{-CHR}{\frac{2CHR}{2pdy}}$$

$$= \frac{CHR}{1}\,\frac{2pdy}{2CHR} = \frac{-pdy}{} \text{ OK}$$

when $pdy < -441$

when $\sqrt{b^2 - 4ac} < -441$

Getting closer, you have to break the work up into real & complex components when $b^2 - 4ac < \emptyset$.

Something wrong w/ real parts of our degree years.

Page
90

[redacted]

+ 2% CO_2 ... $ax^2 + bx = 1$
% double years ≈ 241 $ax^2 + bx = 5$

1° t = 143.4 years   all OK
5° t = 523.1 years

Watch for double years at ΔT < ∅:

CO_2 = −1%   ... double = 1761 years
1° is 175.4°
5 is 1345 this looks good

CO_2 = −1.5%   double = 786
ΔT = ... 789.5 OK
ΔT = +5 ... 786 ... 786 + 822i

Very interestingly like an lily observed here.
When CO_2 = -1.5°

We have cooling early phase
a balance point being reached
a minimum (maximum cooling being reached)
and then a dramatic rise in temperature gain

What is the mechanism for the increase?

If it was exponential it would not reverse itself

It starts rising again @ the zero point.
This is not reversible.

We are interested in the pattern of the curve from 5° to 5° ΔC.

OK, the curve is only good in the vicinity of the origin, i.e. E=0.
every temperature change ~~then [illegible]~~
graph. 10 degree change is more likely to be accurate than 5°

CO_2 = −1%

−1° −175 years] ok
−5 −1346 years]

CO_2 −1.5
−1° −189 ok
−5° −186 ok (complex no. results)

CO_2 −0.5% 7068 yrs neutralize

−1° = −169 yrs] ~~[illegible]~~ yrs
−5° = −889 yrs] real roots

CO_2 − 1.0% 1761 yrs neutralize
−1° −175.4 yr
−5 1346 yrs

Why if you are cooling it down quicker does it take longer?

These numbers are checking. What does it mean? Graph them.

maybe the second [illegible] more
realistic?

Plotting $y = ax^2 + bx$

is not the same as finding the roots of
$x^0 = ax^2 + bx$
$5^0 = ax^2 + bx$
These are different operations. — -5^0

-1.5

The plot of the temperature — -1.0%
curve [illegible] the same [illegible] — -5.0%
the x^0 and 5^0 [illegible]
let's think this through.

As far as the temperature plot goes we assume
a constant change in temperature of .006 °/C year
under all circumstances. This means
roughly 165 [illegible] years for 1° change
@ this point. At the double point
the change is .012 °C per year and the zero
values

		doubling year		[illegible] year
CO_2	+.5°	1067	-.5%	1068
	+1.0	1766	-1.0	1767
	+1.5°	185	-1.5	186
	+3.0°	196	-3.0	197

The [illegible] [illegible] [illegible] [illegible] be [illegible]

So with any given scenario the double zero rate years are the same for both heating and cooling but it is [illegible] unique

double zero rate years = f (heat energy ratio)
That is all that it is a function of.

$$= \frac{\log(2)}{\log\left(1+\frac{\Delta E}{E}\right)} - 1$$

There is a question on our series [illegible] instead of the [illegible] sum = [illegible] should it not equal zero?

It seems like you have solved this [illegible] the solution of the series [illegible] added the same

But there is no problem. It is not the neutral point ! ! ! !

IP of computer is 192.168.254.27
Mellon 192.168.254.25

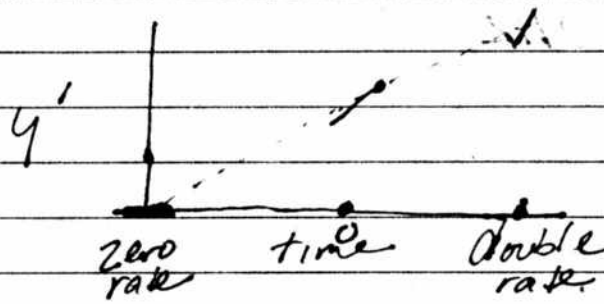
Jan 03

Ok, on wego w/ to Complex m. issue

We need a clear understanding of what we have and what it is that we are seeking

We know that our model for a reference of $y' = .006$
We know that @ double rate year $y' = .012$
And we know @ zero rate year $y' = 0.000$

Now, how does this graph act?
How does this relate to temperature.



So you chose $y' = ax+b$
this is not unreasonable

You solved this equation with initial conditions
$y'(0) = .006$
$y'(\text{double}) = .012$
$y'(\text{zero}) = .000$

Let's check this work and all that holds true.

$y' = ax + b$

$y'(0) = .006$
$y'(\text{double}) = .012$
$y'(\text{zero}) = .000$

$y'(0)$ $.006 = b = CHR$

$y'(\text{double})$ $.012 = a(\text{double}) + CHR$

or

$2CHR = a(\text{double}) + CHR$

or $a(\text{double}) = CHR$

$a = \dfrac{CHR}{\text{double}}$

$y'(\text{zero})$ $0.00 = a(\text{zero}) + CHR$

$a(\text{zero}) = -CHR$

$a = \dfrac{-CHR}{\text{zero}}$

but we learn that zero = −1 · double

so that

$a = \dfrac{-CHR}{(-1)(\text{double})} = \dfrac{CHR}{\text{double}}$

So this is very consistent.

Now what does this mean in terms of temperature change? - Magnitude of temp change is not the same as change of temperature dy/dx. Since our model is

$y' = ax+b$

We know that

$y = \frac{ax^2}{2} + bx + C$ and we already know a, b

So the question is what is why when t=0?
The answer is that we assume the temp is zero or a constant. It is immaterial.
Therefore

$T = \frac{CHR}{2\,(double\_zero)} \cdot x^2 + CHR_2(x)$

Double_zero can be positive or negative.

Temperature graph is not the same as change graph

. Lets work up some examples: (Taking abs. value)

	Double rate years	Zero Rate years
CO_2 - +.5	1061	1068
+1.0	1766	1767
+1.5	185	186
+3.0	196	197

Now lets look closely at what T actually is as it approaches these points.

Positive, then negative ΔE

Positive DE (Matlab now)
Now it is @ this point that we use our equations
Our model is

$y = \frac{ax^2}{2} + bx$ $T = \frac{CHR}{2 \cdot double\_zero} x^2 + CHR(x)$

Now, for $X > 0$, $T > 0$.
and this is a monotonic function.

However, if we wish to solve for T=1 and T=5 (and we do), we are free to do so, and this is a good thing.

It is @ this point that we become involved w/ the roots of the equation.

We have $T = \frac{CHR}{double\_zero} x^2 + CHR(x)$

Now in the case of T=1 & 5 we have

$$\frac{CHR}{2 \cdot double\_zero} x^2 + CHR(x) - 1 = \emptyset$$

and

$$\frac{CHR}{2 \cdot double\_zero} x^2 + CHR(x) - 5 = \emptyset$$

So you solve this for X. Let us look @ this behavior

Tonight : Most advance research.

Page 99

Results	CO_2	double years	$+1°C$ X_1	X_2	$+5°C$ X_1	X_2
165,189	0.5	1067	161.7	-1.43E4	789.3	-1.49E4
159,696	1.0	1766	159.5	-3.7E3	696.1	-4.3E-3
152,602	1.5	785	152.0	-1.7E3	602.3	-2.1E3
126,408	3.0	196	126.1	-518	408	-800

Let's test these results out.
The results look perfect & make good sense.
We know that negative values for X are meaningless
so these roots may be disregarded.
Now let's go to cooling. Notices we are
using an absolute value in the program &
story that as well.

CO_2 %	(-) zero years	$-1°C$ X_1	X_2	$-5°C$ X_1	X_2
-0.5	-1068	-165	+1.4E4	-789	1.5E4
-1.0	-1767	-159.5	+3.7E3	-696.2	+4.2E3
-1.5	-786	-152.0	+1.7E3	-602.4	+2.1E3
-3.0	-197	-126.1	+518	-408	+800

Ok, we found the problem, not using -1 double years
which equals zero years in the equation.
Notice the symmetry is all in place!

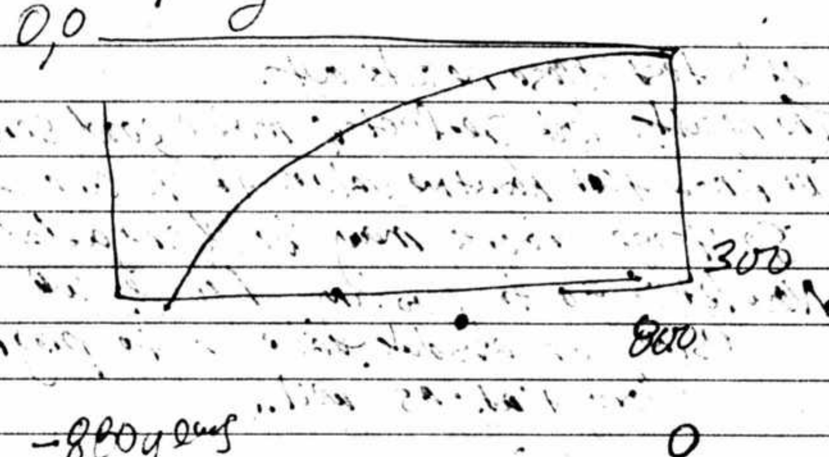
We have tried current heating rate
double or zero rate years
heat energy ratio

one

∴ Sequence is

1. Short Term Results → Long Term Results
2. Take positive charge

We are repeating both scenarios 400



∴ my y max = Ø

∴ Ø − Ø / Ø = Undefined

[redacted]

$-1 - (-5) = 4$

$-5 - (-1) = -4$

$\frac{-4}{5} = \frac{4}{5}\left(\frac{-5}{1}\right) = -4$

-1 deg C OK Okay exactly close

0

4

-5

We need 1/5 instead of 4/5

-1 OK = $\frac{1}{-5}$

always work DNA Sequence

Dec 04 2015

OK, we have made progress but we still have problems with the numbers.

Lets plot curves for +1% & -1% CO_2

CO_2	a	b	doubleyears zeroyears
+1%	1.699E-6	6E-3	1766
-1%	-1.699E-6	6E-3	~~1766~~ -1767

Model for T is $y = ax^2 + bx$

OK, this is all perfectly consistent.

What you see is that your final model should be a cubic not a quadratic.

ΔE ~~≤~~ 0 ΔE > 0 OK

✓ Heating Rate

✓ double or zero rate year

✓ heat energy ratio

175 one degree years
1095 five degree years these are wrong!

???

+1°   +5°   -1°   -5°

159.5   696.1

-159.5   -696.1

We definitely have a problem
We get   -175   -1345
Check these numbers:

X is going from 0 to 1345 and this is wrong

The problem is my X 5 degree gear

OK, you're getting closer
one degree and 5 degree were wrong
for DE=0 because of sign change
Oza

Page 104

Got a long term button
on the second page.

Ok, we have it:
Now we need a button w/in javascript
to call long term

w/in drawgraphics.
Call is to long term effects.

We want the button within drawgraphics()

side by side with Go back

1214

There is a problem
w/ long term effect of
graphics not setting

Set a very small Coz and
submit & then look @ long
term graphics & you will
see the problem.

Cooling curve w/ small
Coz is wrong.

You need to set current rate

~~Dec~~ Jan 05 2015

OK, time to solve a problem.
Now before we take on the issue of
access to a function...
lets graphically look @ the cooling curve.
Definitely a problem

If we introduce a small change in CO_2 decrease
it is all cooling & does not effect current
heating. Lets look @ this.

q. we had $y' = .006$ or $y'(0) = .006$
@ double years $y'(\text{double}) = .012$
@ zero : $y'(\text{zero}) = .000$

This then lead to
$y' = ax + b$ a & b have been solved for
with the initial conditions

we then solved for
$y = \frac{ax^2}{2} + bx + C$

Now the question revolve around what is C?
We assume that $C = 0$ but what does this mean?

What we actually have is a heating curve
plus cooling curve together.

So we have a cooly influence
but we also have a heaty influence.

The last heaty influence fun.
now for assumption to be constant
@ Heat = CHR × X

So we have

$$\Delta_{Cooly} = \frac{aX^2}{2} + bX$$

one degree year & 5 degree years
are actually wrong because they
do not include heating

one degree year for cooling is different
than for heating.

(1) Why isn't line straight?

2. one degree year is wrong
We have a stated point to zero rate.

Example:
@ -0.5 CO_2 what we see, only from
the graph is that we have a combined
influence of $-0.3°C$ in about 709 years.

So 1° will take about 2363 years
5° will take about 11,8[illegible] years.
zero point is about 7000 years.
$-.3°C$ in 709 years
So we have
[illegible] years to the [illegible] point.

~~Lets: [illegible]~~
~~[illegible] actually [illegible]~~
~~do not [illegible]~~

One degree year & 5 degree year are the
~~[illegible]~~ [illegible] root solution.
The original model is

$y' = ax^2 + bx + c \quad ax + b$

$T = \frac{ax^2}{2} + bx + c$ and $a = CHR$

2 zero rate years

$b = CHR$

and we set $c = 0$

but ~~you~~ we also actually have:

(x is negative) x is positive

$T = -ax^2 + bx + CHR \cdot x \quad x$ 1s

So what this means is that actually

$T = -ax^2 + 2CHRx$ very interesting

The roots should be found for this instead.

So the two linear terms cancel
themselves out.

an $T = -ax^2$
which has real roots.

				linear estimate
1/2 grt	-1^0	= -1535 yrs	vs	2363
WH CO_2 = -0.58	-5^0	= -3432		11,816

It is [illegible] (~~[illegible]~~) [illegible] that

or $-ax^2$ - ~~[illegible]~~ [illegible] [illegible] [illegible] [illegible] [illegible] ..

or $-ax^2$.

and you can solve for the roots:

$-x = -ax^2$ ... $x = ax^2$ ... $x^2 = \frac{1}{a}$

a $x = \left(\frac{1}{a}\right)^{1/2} = \frac{1}{\text{CHR} \cdot 2 \cdot \text{zero rate years}}$

and

$-5 = -ax^2$ or $x^2 = \frac{-5}{-a}$ or $x = \sqrt{5}$

$x = \sqrt{\frac{5}{\text{CHR} \cdot 2 \cdot \text{zero rate years}}}$

so $\Delta T = f(\text{CHR}, \text{zero rate years})$

So it is not the heating of the Earth that is cancelled out. It is the rate of heating that is cancelled. What does this mean?

This scenario will produce a 1° [illegible] in temperature in [illegible] years

and a 5°

Short term model does have a problem.

You are using one degree years
improperly then..?

Jan 05 2014

We must now go to and interpret what
the short term graph actually means.

We have $y'(0) = +.006$
y' (zero years) $= .000$
y' double years $= .012$

and the model was
$y' = ax+b$ ΔE
and $y = ax^2+bx+C$ $C=\emptyset$ for $x>0$
$C = -bx$ for $<\emptyset$
The model for y is one of ΔE
temperature.

$\frac{dT}{dx} = ax+b$

The model for zero or double years is
based upon Energy

but Energy = Heat
So they really are related directly.

Page 112

Problem:
How can "cancelling of heating of earth" occur
in

Okay, Reset should be reset & save - NO
not just reset.

CO_2 increase/decrease - double/zero years		1°C yrs	5°C
+.02%	4.4E6	167	833
-.02%	4.4E6	38,371	85801

So what is happening here?
For 1°C & 5°C The earth is heating up..
It will continue to heat up if you do nothing.
& the long term curve should reflect this.

You are saying that they do not get to see
what is happening if they do nothing?
This is not right. If they do nothing
the earth is heating up.

What is the relationship between
heating rate + heat

$y' = ax+b$

$y = ax^2 + bx + c$

Could it take a very long time
for y' to double

but only a short time for the temp to increase?

This matches perfectly.
1766 years shows rise from
.006 to .012
perfect

CO_2 to .06% doubles 490790

a= 6.113E-9
It does seem to be in the right direction
It is in excess of 500,000 years

Fix the graph a bit on cooling.
and then we go to
Random inputs!

[redacted]

5

1. Protein
2. Lipids

[redacted]

There remains a problem.
When it flips over to heating, it loses
the effect of the cooling.
It is the same problem as before.

There is a real weakness here.

Page 115

Maybe the model should have been adapted

? $y' = ax^2 + bx + c$

It is not realistic what you have.
It is losing the cooling component

So idea it is not a matter of heating or cooling exclusively. It is a combination of both.

$-.006x$????

.007

We are ready for random inputs!

Random Inputs

$y' = ax + b \implies y = ax^2 + bx + c$ (linear term removed)

So we have
$y = ax^2$ but what if we now have

$y' = a.x + r_x$

$y' = ax + r(x)$ this is like $y' = f_1(x) + f_2(x)$

so
$y = \frac{ax^2}{2} + \int r(x)$

or
$y = \frac{ax^2}{2} + \sum r(x) \Delta x$ but $\Delta x = 1$

signed! Take only ~~signed~~ values

so
$y = \frac{ax^2}{2} + \sum r(x)$ So this could vary in duration & magnitude

What if it was not random but it was in pulse function?

- +

sign

magnitude

duration

A very interesting time now.
It is time for random inputs.
We now have both magnitude & frequency.

Now lets decide where to input.
We got into a little trouble w/ the long term module & it still is not optimally placed.

This means we want as much as possible to drive from the mainline routine & you can branch out from there by saving variables to disk IF Possible.
A separate module is ok but it does imply a level of separation.

Now assuming we feed into mainline routine.
Where are we going to go, what model are we going to use, and where and how is it going to effect the output?

Lets start by getting magnitude and frequency from 0 to 10
random_magnitude_slider
random_magnitude_number
random_frequency_slider
random_frequency_number
random_magnitude_form, random_frequency_form
First thing is to save the values & reset them.

Page 118

Somehow I lost the ... function.
No idea how that happened.

OK, we now have the random inputs
saved loaded & reset
and available now as variables.

Now when do we want to work.
maybe all we want to do is save those
to disk.

It is only for y values over time that it has
an influence. It has no effect upon
immediate results.

1254
OK, I have the random inputs into
the long term graphics.
Now ask what do we want to do w/them.

OK not only should it flip the sign it should
change the heat energy ratio by
some amount.

What if it was a percentage applied?
(1+random) [1+abs(random)] ← sign affected heat energy ratio

What about instead of flipping the sign you used the above.

Now we have a new heat energy ratio. What do we do with it?

First off it changes if the new [illegible]

So what this really did, is not just change the y curve, it changed the heat energy ratio to something non standard.
• And this is where you should have started.

520 [illegible]
1200 [illegible]

It may have worked

Good! It did work. Reference Values
CO_2 +1% . .04% per year
years = 1766

Yes it is changing.
Now we need to see by how much.
Also the sign issue.

-99 did change it, but it always seems to be positive in effect
~~So 4% went~~ to .04% went to .08%
not bad.

because 1 + Δ% is still positive!
That's why

Page 120

Xtemp = ΔE

ΔE = ΔE + r

~~We keep~~ adding to the problem

heat energy is computed

inside loop

heat energy is modified

we continually keep adding to it.

exit the loop.

i=1 to n	xtemp = X, X = Ø hold on to it
	for i = 1 to n
X = X+5	X = xtemp + 5
next i	next i

xtemp = X hold on to a number

X = Ø set the original to zero

enter the loop for i = 1 to n

value gets modified X = xtemp + 5

xtemp = X

X = Ø

X = xtemp + 5

X = xtemp

upon exit.

X = xtemp

say ~~X~~ X=1

xtemp = 1

X = Ø

X = 1 + 5

X = 1

xtemp = U_1

U_1 = Z

Z = xtemp

xtemp = 1

X = Ø

xtemp = X

X = 1 + 5

X = 1

Actually none of the concern is warranted.
When you hit back, it resets the value.

Yes OK, this IS starting to work well

OK, now that we have the magnitude of a random effect to the heat binding, what would you like to do with it?

So what we have is a
percent heat energy ratio change

How would we like to use it.
as
Stored percent heat energy change

What if you could scale the magnitude of the slider in %?
Is this possible?

Your range right now is

Slider × 1E-3 × random number -1 to +1
(1-10)
So we have
(1) · 1E-3 · Slider Max · 1E-2
10

So we are taking X =
1-10 and multiply it by .01
or actually 1-100%

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Random Generated	Arbitrary Scale Factor	Slider
Max of 1	.001	Max of 10

∴ Max of (1)(.001)(10) = .01

So if we multiply slide by .01

.01 slide (1-1)

CO_2	ΔE	
.5%	.01	
1%	.04	5x = 0.20
2%	.16	
3%	.35	5x = 1.75
4%	.63	

Increase of 1% doubles ΔE . . 0E-6

Now for slide @ CO_2 of 1%

- Ok, I have a good scaling factor on the slider for 500% range
- It is 3.0E-5

Page 123

CO_2	ΔE	Multiplier ratio		Division
1%	.04	35	(1.41)	7
2%	.16	10.1	(1.62)	2
3%	.35	5X	(1.75)	1
5%	.98	2.4	(2.32)	.5
10%	3.92	1.28	(5.02)	.25

So

	Multiplier
1%	.15
2%	.5
3%	1.0
5%	2.0
10%	4

Slider at 50% max.

This relationship is linear

Multiplier for Slider Scaler = 0.433 Slider − .29

r^2 .998

12oz

CO_2 %	Slider Max	Orignal	Modified
1%	500		
2%	500		
3%	500		
5%	500		
10%			

You would set for 5% .98 ×5 = 5%

2.44 3.02

We have a factor 6E-5 that seems to be an order for scaling the slider @ 500 ppm

The variation factor should not been based upon the [illegible] heat energy it should come from anywhere.

% CO_2 % , CO_2 Reference ~~Max~~ ΔE %

100 .5

Emax / Eref

CO_2 %	ΔE_{ref}	Slider	CO_2 · Slider	ΔE_{max} "	Ratio
~~.5~~	.01	100	50	.41 ~~.32~~	~~32~~ 40
.5	.01	300	150	1.74	174
1.0	.04	100	100	.63	16
1.0	.04	300	300	1.73	43

we want x to be this

This would be very hard to scale.

Clearly a non linear [illegible] in effect.

The greater ΔE is, the less influence the slider should have.

Clearly we would like a multiplier of the effect

C_1 * slider * ΔE

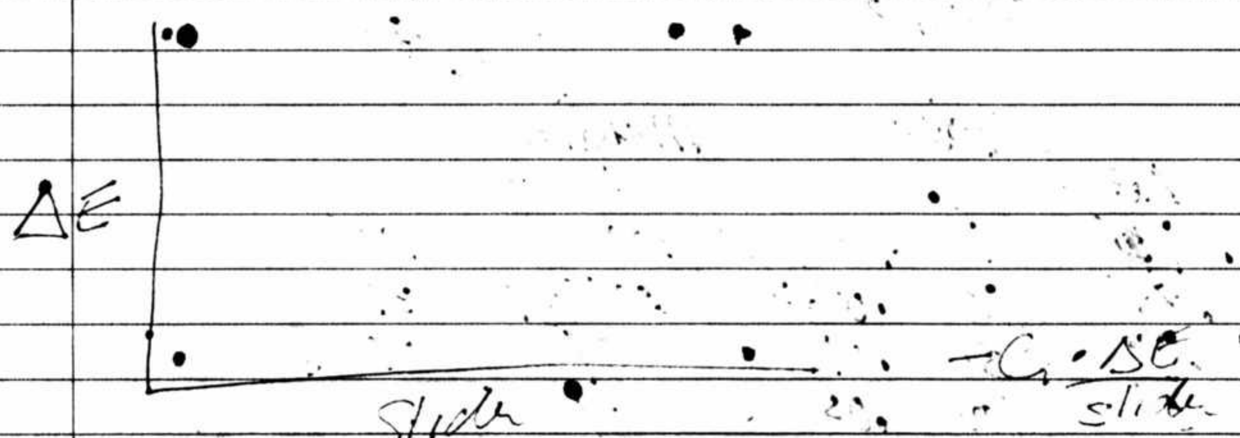
~~Stride Value~~ Max % ΔE

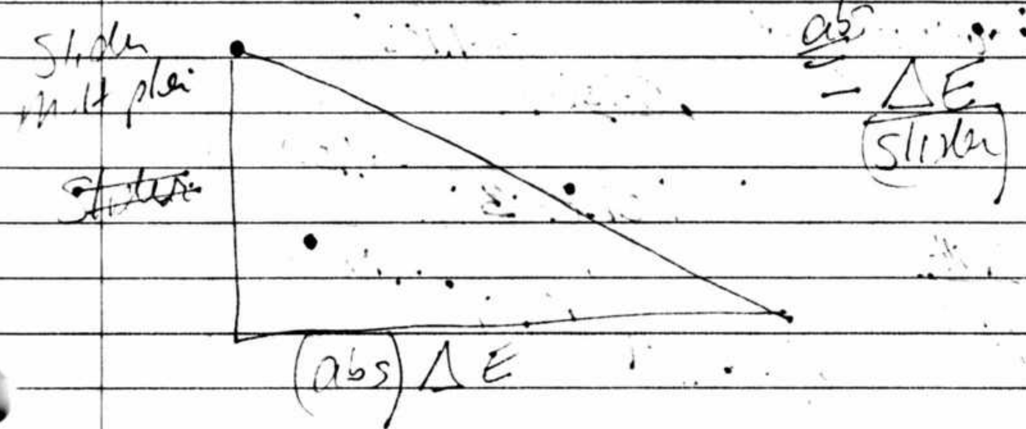
CO_2 %	% ~~Stride~~ Ref. Value ΔE	Slider	CO_2 • Slide ΔE ~~ΔE~~	Ratio ~~Ratio~~
.5	.01	100		

So the slide is directly proportional

$(-1 \text{ to } +1)$ ~~x~~ (Multiplier Effect (Slider)) x Existing ΔE

random window





We need to [illegible] exponential

$y = Ce^{-5x}$

@ 1% - need

ax^2

X

ax^2

U

$\frac{10}{Slider^3}$ $\frac{|\Delta E|}{Slider^3}$

ΔE	Slider C		Multiplier	
.01	1	.0001	1000	100
.35	25	.0035	~~500~~ 31	31
1	50	.01	7	7
3	100	.05	1	1

Power is good

$.0436 x^{-1.105}$

$9.32E{-3}\, x^{-1.50}$

$= \frac{.01}{x^{1.5}}$ $.01 x^{-1.50}$

$5^{1.5} = 1.71$

CO_2 Page 128 969 (10) 1802

%	%	Ratio
.01	~~1.5~~ 2	~~150~~ 200
~~.3 .1~~	~~1.5~~	~~5.~~
1% .04	~~1.5~~ 2	~~1.5~~ ~~40~~ 50
2% .16	~~1.5~~ 2	~~12.5~~ 25
3% .35	~~1.5~~ 2	~~6~~ 12.
5% .98	~~1.5~~ 2	~~2.3~~ 10
10% 3.92	~~1.5~~ 2	~~.5~~ ~~1~~ 5

$y = 2.0 X^{-1} = \frac{2.2}{X} = \frac{3}{X^{.9}}$

$y = 27 X^{-.9}$

$y = 10 X^{-.6} = \frac{10}{X^{.5}} = \frac{10}{\sqrt{X}}$

Your final curve is

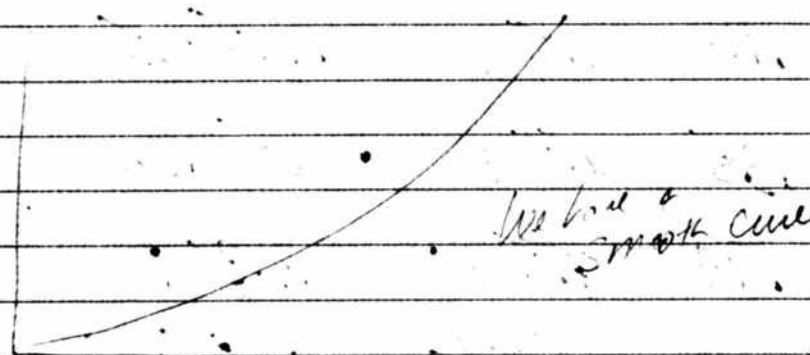
Ok, we have the scaling of the random variable magnitude working fairly well now.

It is of the form $\frac{C}{X^2} \propto \frac{C}{\Delta E^2}$

[redacted]

Matlood looks great.
I may have it now!
Symbolic IS fantastic

Ok lets go to the next question



What exactly is the [illegible] interference in long term [illegible]
you now have a singular random event which occur instantaneously. You also have an unusual frequency input.

What does this mean for a long term graph?

The graph is already different
Well anyone ever notice that.

What about [illegible]?

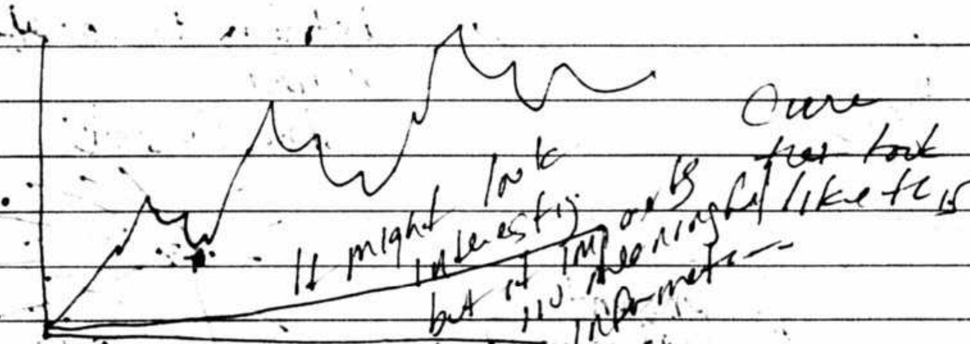
We could have case where it draws the original line and then the new line on top of it?

What is the best way to show a random effect

How about $y = f(x) + r(c)$?
and then show the graph that way.

The curve variation could be a function of $r(c)$ magnitude & frequency.

What if we take the % off and scale that to control the variation in the curve.
What would then be this a.

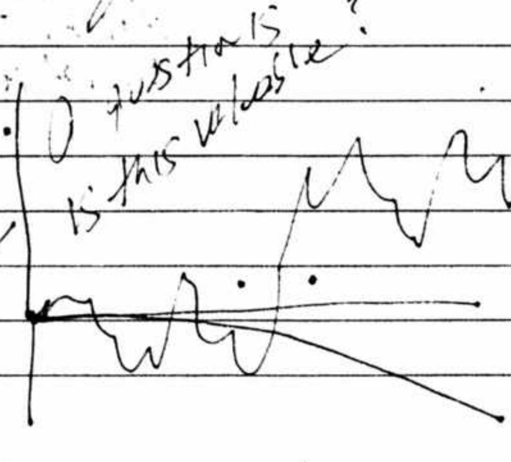


This would be an evolution of 2 curve therefore

but what about

This would be a new plot

This is more realistic



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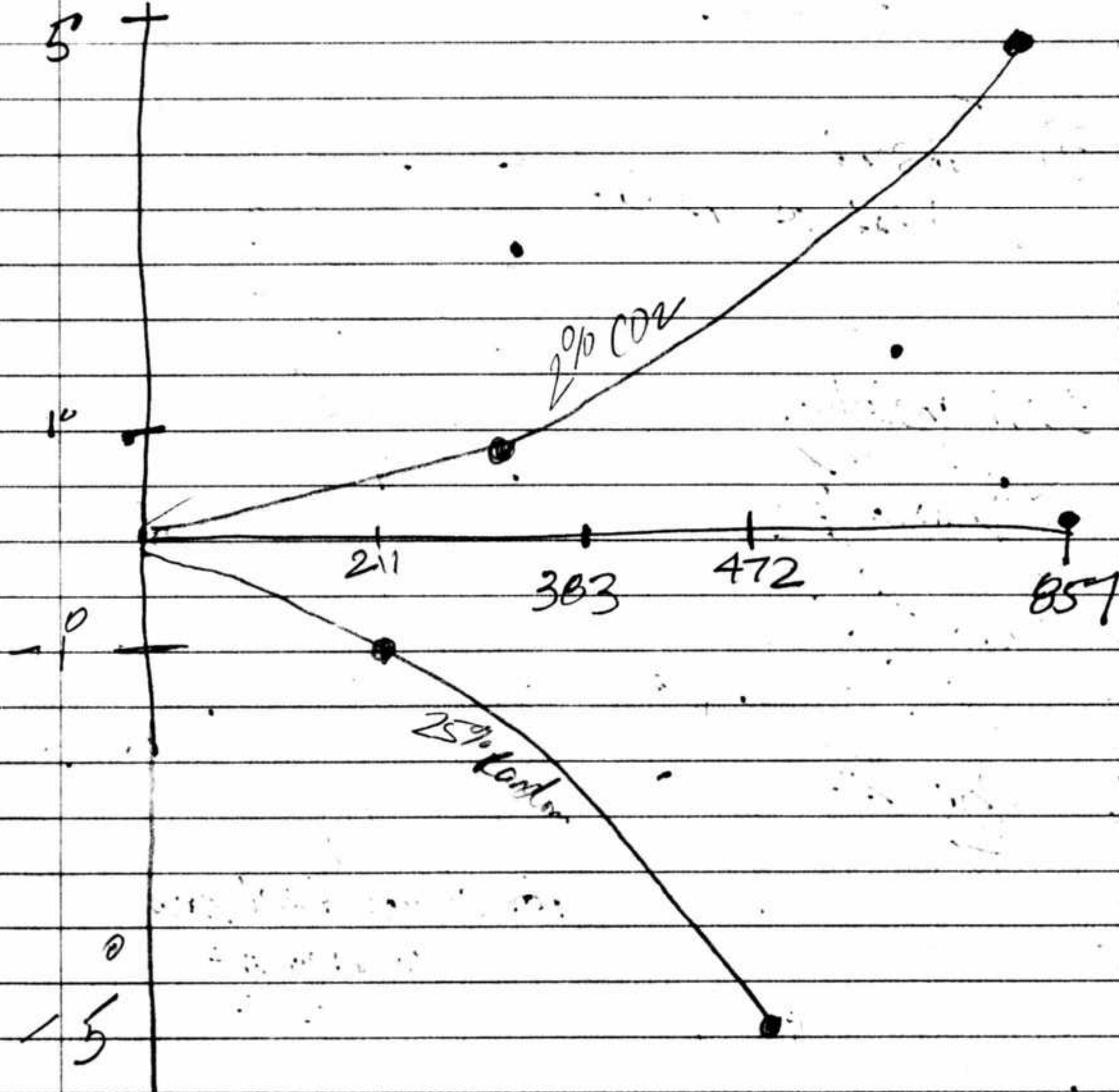
Lets take a 2% CO_2 graph $\Rightarrow \Delta E = .16\%$
Boost it w/ a 25% random Bubble. ~~zero~~ yrs = 44 yrs
This has lead to a Cooling statement -.52% zero = 134 yrs
1° = 211 yrs 5° = 472 yrs
Lets consider stacking both graphs



[redacted]

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Particulate Mortality: $\frac{d(M-M_0)}{dP} = K(M-M_0)$

$\frac{16\%}{100\mu g/m^3}$ $\frac{.7\%}{10\mu g/m^3}$ $\frac{1\%}{10\mu g}$

$\frac{3.4\%}{10\mu g}$ $\sim \frac{1.6\%}{10\mu g/m^3}$ $\bar{X} = \frac{1.1\ \mu g/m^3 \%}{10\mu g/m^3}$

$\frac{25\ mg}{m^3} = \frac{25000\ \mu g}{m^3}$ $1\% =$

lets assume air is within pollution standards

$= \frac{50\mu g}{25000\mu g} = \underline{\underline{0.2\%}}$ of material available.

0.2% not 2%.

$\frac{dM}{dP} = .011$ $\frac{dM}{dP} = KP$

$dM = KPdP$ $dM = K(P-P_0)dP$

$\frac{dM}{dP} = K(P-P_0)$ $dM = KPdP - KP_0dP$

$\frac{\Delta 5.5\%}{\Delta 37\mu g} = \frac{X}{10\mu g}$ $X = \underline{\underline{1.5\%}}$ $X = \frac{1.2\%}{10\mu g}$

Jan 09 2015

Let us Consider Mortality ~~Growth~~ Increase ?%
What is mortality a function of:
1. Increased particulate growth
We have the estimate that 1.2%/10 ug
We also have the estimate
that $\frac{50\,ug}{10{,}000\,ug} = 0.5\%$
of applied operation reach the ground.
This is questionable & might be very low.

So Mortality = f(Δ Particulate Growth, Crop decrease?
(Cold Temperatures)
Biological

codeacademy.com

Javi

Simplest — document.write

Ice cast

email

Online Storage
Group Calendar

OK, let's plant the work.

We want $\Delta M = f(\Delta p, \Delta T)$ — p = particulates, T = Temperature

We have a linear estimate for $\frac{\Delta M}{\Delta p}$ = Constant — questionable but possible.

WHO says 250,000 per year between 2030 & 2050

2030 241,000

2050 303,000

$y'(2030) = 241{,}000$

$y'(2050) = 303{,}000$

$y' = ax + b$

$y'(2030) = a(2030) + b$

$241000 = a(2030) + b$

$303000 = \frac{118.72}{a}\, a(2050) + \frac{118.72}{a}\, b = \frac{241{,}000}{2030a} = \frac{118.72}{a}$

$b = 241000 - a(2030)$

$303000 = a(2050) + 241000 - 2030(a)$

$62{,}000 = 20a$

$a = 3100$ so $y' = 3100(x) - 6052000$

problem

Therefore

$y = \frac{ax^2}{2} + bx + c$

$M = \frac{3100x^2}{2} - 6052000x + C$

@ $x = \emptyset$, $M = \emptyset$. So $C = \emptyset$

$M = 1550x^2 - 6052000x$

Now change to millions

This is really interesting. I have a very gradual

56 million people dying per year.

So in 20 years rate of increase is approximate

$y' = 3100x$ [redacted] 6052000

$y = \frac{3100x^2}{2}$ [redacted] $6052000x$

$y = \frac{(1550x^2 - 6052000x)}{1E6}$ millions

$x =$ ~~0 to n~~ 2015 to n

Mortality

$y' \cong ax+b$

$y'(2030) = a(2030)+b$

$241{,}000 = a(2030)+b$

$b = 241000 - 2030a$

$y'(2050) = a(2050)+b$

$303000 = a(2050) + 241000 - 2030a$

$62000 = 20a$

$a = \frac{62000}{20} = 3100$

so $y' = 3100(x) + 241{,}000 - 2030(3100)$

thousands $y' = 3100(x) - 6052000$

$y = \frac{3100x^2}{2} - 6052000x + C$

when $x = 0$, $y = 0$ so

thousands $y = 1550x^2 - 6052000x$

millions $y = \frac{1550x^2 - 6052000x}{1E6}$

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I am not getting the proper solution? Why?

n in millions:

$$y' = \frac{(3100X - 6052000)}{1E6}$$ in millions

This IS good

You have a problem w/ integration

$$y = \frac{3100X^2}{2E6} - 6.052x + C$$

Something is wrong here? Why.

Mortality ~~$y = .00155X^2 - 6.052x + C$~~ when $x = 0, y = 0$

~~so $C = 0$~~

~~$M = .00155X^2 - 6.052X$~~ $X = 2015$ to 2215

Something wrong. Numerical integration gives a perfect result. in millions.

~~when x = 2030,~~ y =

Somehow when $x = 2015$, $M = 0.2$ Million. Why?

$$y' = \frac{3100 \cdot year - 6052000}{1E6}$$ millions

Now when year = 2030, $y' = .241E6$ OK. good

Low $0 =$ at 2015

$$\int_{2015}^{2215} .0155x^2 - 6.052x + C$$????

$y = x^2$

by DPlot when $x = 0$, $y = 6.052$ how would we know this.

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It is true that the integral is accurately represented by

$$\int_{year_1}^{year_2} \left(\frac{3100x - 6052000}{1E6} \right) dx$$

e.g.

$$\int_{2015}^{2033} \left(\frac{3100x - 6052000}{1E6} \right) dx = 20.39$$

and this is accurate.

So if we want to integrate from zero

~~$$\int_{year_1}^{year_2} \frac{3100(x-2015) - 6052000}{1E6} dx$$~~

This is wrong

Apparently you cannot just displace x with an integral.

Mcad Symbolic →

$$\left. \frac{5000\left(\frac{31x}{10{,}000} - \frac{1513}{250}\right)^2}{31} \right|_{year_1}^{year_2}$$

= 26.49 − 6.10 = 20.39 so this is accurate.

Let us demonstrate the flaws of displacing x in an integral

Clearly you cannot just shift x.

$$\int_5^{10} 5x\,dx = 187.5 \qquad \int_0^5 5(x-5)\,dx = -62.5$$

Clearly they are not equal!

Lesson: The limits of integration cannot just be shifted. This is a crucial lesson.

Let us create plots to demonstrate this.

The integral is $\frac{5x^2}{2}$

$$\frac{5(10^2)}{2} - \frac{5 \cdot 5^2}{2} \qquad \int_0^5 5(x-5)\,dx$$

$$= 250 - 62.5 \qquad = \int_0^5 5x - 25 \int dx$$

$$= 187.5$$

This is why it is not the same! Two different integrals!

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Ok, this means our diff equation needs to be framed from 2015 as the zero point.

So we need to set up our equation as

$y'(0) = ax + b$

But the problem here is that it is not 2015. 0 corresponds to 2030

What is interesting is that we can already predict that 3.26 million people will die from 2015 to 2030 which is prior to the forecast period! This is pretty clever.

So after the curve is done we can subtract X.

Our condition is that we set y, n M = Ø @ 2015. This is legitimate to do.

So AFTER WE INTEGRATE we can shift X.

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So our equation should actually have been framed as

$y'(15) = ax + b$ $\quad 2030 - 2015 = 15$
$y'(35) = ax + b$ $\quad 2050 - 2015 = 35$
and then $y'(0) = y'(2015)$ actually
so:

thousand $241{,}000 = a(15) + b$
$303{,}000 = a(35) + b$

millions so $b = .241 - 15a$
and $.303 = 35a + .241 - 15a$
or $20a = .062$
or $a = .0031$
and $b = .241 - 15(.0031) = .1945$
so
$y' = .0031x + .1945$ $\quad$ x = years ahead

OK

and $y = 0$ @ $x = 0$

or

$y = .00155x^2 + .1945x$

or $y = 1.55E{-}3\,x^2 + .1945x$

or $\Delta M = 1.55E{-}3\,\text{years}^2 + .1945\,\text{years}$ $\quad$ WHO estimate

OK

in millions

Now we have another piece of info

56 million people die each year right now.

If we assume a Constant level.

$$Ratio = \frac{1.55E{-3}x^2 + .1945x}{56}$$

Now we are ending up with a ΔE .. in our model.

$$\text{or } Ratio\% = \left[\frac{1.55E{-3}x^2 + .1945x}{56}\right] \cdot 100$$

Lets Combine to models before we go further.

every causes must have a name.

look for random frequency variable

Now lets work out the heat multiplier effect:

We have the ratio of current conditions already.
Now, it only gets worse if we heat it further.
I believe our heaty ratio will be

$(1+\Delta E)$ because ΔE is heat influence
it is actually
Actually it should be

$1+\Delta E$ includes greenhouse and aerosols effect
indeed it does heat up more with aerosols.
This does not include particulate health effects

$$\frac{(1+\Delta E)\left(1.55E{-}3\,\frac{\text{one degree years}^2}{\text{fractdegree}} + .1945\,\frac{\text{mideyree}}{\text{fracdegree}}\right)}{56}$$

Current death rate
≈.[illegible]%

$\frac{56E6}{7.3E9}$

1329
It is not the heat energy ratio?

15 — 7.3E9 billion

11% — 3/4 of 1% of global population is dying per year.

4.1% in 383 — .011
6.9 in 511 — .0135

It is increasing @ a rate of +1.2%

So the actual gross growth rate is 1.2+.75≈2.0%

Now lets work out the heat multiplier effect:

We have the ratio of current conditions already.
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(1 + ΔE) because ΔE is heat influence
it is actually
Actually it should be

1 + ΔE includes greenhouse and aerosols effect
indeed it does heat up more with aerosols.
This does not include particulate health effects

$$\frac{(1+\Delta E)\left(1.56E{-}3\,\frac{\text{one degree years}^2}{\text{frac degree}} + .1945\,\frac{\text{no degree}}{\text{frac degree}}\right)}{56}$$

Current death rate
=.11%

1329
It is not the heat energy ratio?

56E6 / 1.3E9

15 — 1.3E9 billion

11% — 3/4 of 1% of global population is dying per year.

4.1% in 303 — .011
6.9 in 511 — .0135

It is increasing @ a rate of +1.2%

So the actual gross growth rate is 1.2 + .75 = 2.0%

Mathcad Analysis

CO_2 %	Heat Energy Ratio %
.2	.0016 %
.5	.0098
1.0	.0039
2.0	.157
5.0	.98
10.0	3.92

So the first thing we see is that the heat energy ratio is a very small number.
Maybe it is better to use temperature

This is the change per year, first of all.
So you need to know what these percents are accumulatively!

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$(1+x)^n \stackrel{?}{=}$ This is same problem as before.

Σ

If something increases 1% per year, how much does it increase after n years.

n	Magnitude
0	1% = .01 1.00
1	1.01
2	1.0201
3	1.0303
4	1.0406
5	1.0510

$= 1.01^5$

$\frac{19.6\%}{767 \text{ years}} \cdot \frac{x}{1}$ $\frac{5.1\%}{196 \text{ years}}$

$= .0256$ $.026$ not much difference?

.77% per year linear is 50 years = 38.5%

1.0077

$(1.0077)^{50} = 1.467$

5

1.0077

50

$(1.0077)^{50}$ years = 1.467

$(1.048)^{50}$ years = 10.245

Ratio of Mortality in 50 years is 6.98 times greater

i.e. a 700% increase in mortality.

1. Current mortality rate %
2. year 50 [illegible] ratio multiplier
3. year 50 mortality percent.

Current Mortality rate = .767% [redacted]

CO_2 %	50 year Multiplier	50 year Mortality	Percent Rate to Current
.2	1.00078	.768	1.001
.5	1.0049	.7709	1.005
1.0	1.0198	.7823	1.020
2.0	1.082	.8297	1.082
5.0	1.6290	1.2499	1.630
10.0	6.848	5.254	6.85

So what you have here is the ratio of mortality rates 50 years from now compared to the current rate.

We need to think about what we know here vs what we want to know

~15 million

Example: Normal we have roughly ~~25~~ million people that have died in 50 years.
But under linear assumption it is 100 years.
or another way of looking at it is
50 yrs (250,000 per year) is 12.5 million people
but in our work

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We have a WHO curve of

$M(\text{millions}) = 1.55E-3\,x^2 + .1945x$
So we know the slope is

$y' = 3.1E-3 \cdot x + .1945$
So @ $x = 0$, the slope is .1945 million per year

@ $x = 50$
$y' = .3495$ and this can be computed any time.

So in our case we have a 50 year multiplier.
So what does this mean?
If it is 2% greater, what does this mean?
I think it means our slope is that much greater.
So this means CO_2 of 2%.

$y'(0) = .1945$ same as before
but
$y'(50) = 1.082\,(.3495) = .3782 + b$

So you need to solve for the new curve, integrate it, and then compare the ratio of the integrals.

$.1945 = a(0) + b \quad b = .1945$

$.3702$ ~~.3495~~ $= a(50) + .1945$

$a = (.3702$ ~~.3495~~ $- .1945)/50 =$ ~~3.1E-3~~ $3.674E-3$

50

$y_1 = \frac{3.674E-3}{2}(50)^2 + .1945(50) = 14.32$

vs $y_2 = \frac{3.1E-3}{2}(50)^2 + .1945(50) = 13.60$

$\frac{14.32}{13.60} = 1.0529 \Rightarrow 5.29\%$ increase in mortality.

this looks good.

50

$$\frac{y_1}{y_2} = \frac{\frac{a_1 \cdot 50^2}{2} + .1945(50)}{\frac{a_2 \cdot 50^2}{2} + .1945(50)}$$

$$\frac{2y_1}{2y_2} = \frac{a_1 \cdot 50^2 + 2(.1945)50}{a_2 \cdot 50^2 + 2(.1945)50} = \frac{ax_1 + b}{ax_2 + b}$$

$a = 50^2 \quad b = .1945(50)$

$$= \frac{2500x_1 + 9.725}{2500x_2 + 9.725}$$

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We have

$y_1 = ax_1^2 + bx_1$ here, $a = \frac{50^2}{2}$, $b = .1945(50)$

$y_2 = ax_2^2 + bx_1$ here $a = \frac{50^2}{2}$ $b = .1945(50)$

$y_1(ax_2 + bx) = y_2(ax_1 + b)$
solve for y_2

$y_2 = \frac{y_1(ax_2 + b)}{ax_1 + b}$

So in our case

$$y_2 = \frac{\left[\left(\frac{50^2}{2}\right)x_1 + .1945x_1\right]\left[\left(\frac{50^2}{2}\right)x_2 + .1945x_2\right]}{\frac{50^2}{2}x_1 + .1945}$$

$x_1 = 3.674E{-}3$
$x_2 = 3.1E{-}3$

$$\frac{(4.593)(3.876)}{4.797}$$

The other way is just to evaluate y_1 + y_2
What you really want is

$\frac{y_1}{y_2} = \frac{ax_1^2 + bx_1}{ax_2^2 + bx_2}$ $b = .1945$

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so

$\frac{y_1}{y_2} = \frac{a x_1^2 + .1945 x_1}{a x_2^2 + .1945 x_2}$ $\quad x_1^2 = 50^2$

$\frac{y_1}{y_2} = \frac{a(50^2) + .1945(50)}{a_2(50)^2 + .1945(50)}$ $\quad a_1 = \frac{(1.082)(.3495)}{2 \cdot 50} - .1945$

so $a_1 = 1.84E-3$ $\quad a_2 = \frac{.3495 - .1945}{2 \cdot 50}$

$a_2 = 1.55E-3$

$\frac{y_1}{y_2} = \frac{14.325}{13.600} = 1.053$ Gar 5.3 % difference

Therefore $a_1 = \frac{((50 \text{ year multiplier})(y_1'(50)) - b}{2 \cdot 50 \text{ years}}$

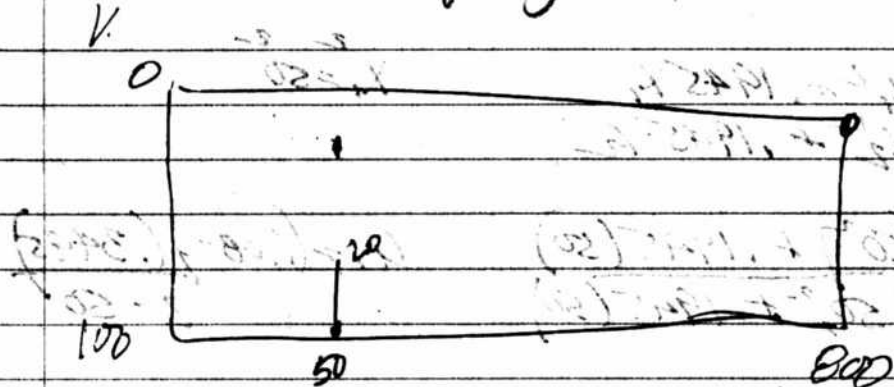
$a_2 = \frac{y_1'(50) - b}{2 \cdot 50 \text{ years}}$ $\quad x_1 = x_2 = 50$

These are the three quantities you need.

Then form: $\frac{a_1 x^2 + bx}{a_2 x^2 + bx}$

Then subtract 1 & multiply by 100.

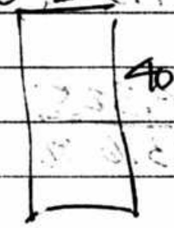
This method involves a ratio of integrals.



50, 19.7

200 80

200, 80 20



(100 - 20)

800 / 100 · 100 = 80

myx myy

200, 154

154 71001

800 -164

200, 100

800, 0

Page 153 Series Solution $\sum_{i=1}^{k} x^k$ Two equivalent answers.

Jan 13 2015

Interesting that we have two different solutions stated for:

$= 1/19$ $= 1/19$

$$\sum_{k=1}^{n} a^k = \left[\frac{a^{n+1}-1}{a-1}\right] - 1 \quad \text{and} \quad \frac{a(a^n-1)}{a-1}$$ this is simpler

Unknown internet source Mathcad 15

let $a = .05$ So they are equivalent very good.
$n = 100$

$$\frac{a^{n+1}-1}{a-1} - 1 \stackrel{?}{=} \frac{a(a^n-1)}{a-1}$$

$$\frac{a^1 a^n - 1}{a-1} - 1 \stackrel{?}{=} \frac{a^1 a^n - a}{a-1}$$ These are equal but how would you know this? I have shown this below.

See mathcad file series_solutions.

$$\frac{a^1 a^n - 1}{a-1} - \frac{(a-1)}{(a-1)} = \frac{a^1 a^n - a}{a-1}$$

$$\frac{a^1 a^n - 1 - a + 1}{a-1} = \frac{a^1 a^n - a}{a-1}$$

$$\frac{a(a^n - ~~1~~)}{a-1} = \frac{a(a^n-1)}{a-1}$$ OK!!

Differential Equation Jan 14 2015

An eye opener

One of many interesting activations that I have gained insight into

$$y' = -3(y+5)^2 - (10 \cdot x)$$

Produced one very interesting result in the dynamic system simulator and even more generally

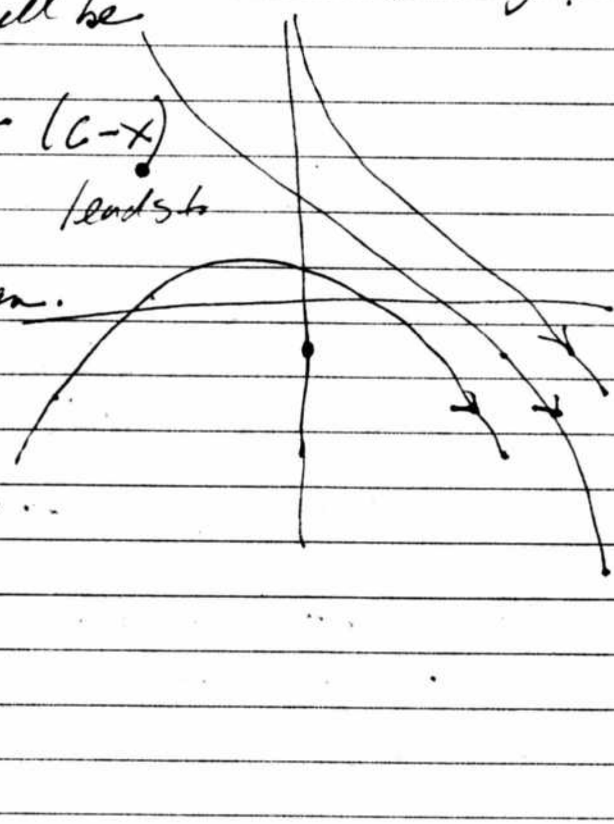
$$y' = a(y+b)^n - (c-x)$$

I bet MCAD cannot solve this analytically. Even more general will be

$$y' = a(y+b)^z - (c-x)$$

leads to

slope field diagram.



Jan 15 2014

Lets fix our mortality graph.

my y is where you print the bar...
this is where you need to print the label

Jan 16 2015

Slope field of an autonomous equation is (indeed) different.

Method: if $y' = f(y)$ with no x then the strategy is to set the slope equal to a constant and plot the result @ a constant y

eg $v' = 9.8 - \left(\frac{v}{4}\right)$ is an example,

$\therefore$

$y' = 9.8 - \left(\frac{y}{4}\right)$ So first set $y' = 0$

$0 = 9.8 - (y/4)$ $\therefore$ $\left(\frac{y}{4}\right) = 9.8$ $\therefore$ $y = 4(9.8)$

so @ $y' = 0$, $y = 39.2$ Notice x has nothing to do w/ anything here.

Set $y' = 5$ (remember x is not involved.)

$5 = 9.8 - \left(\frac{y}{4}\right)$ $\therefore$ $-\frac{y}{4} = -4.8$ $\Rightarrow$ $y = 19.2$

So now that you see how this works how would you graph it en masse?

Back to

$y' = 9.8 - \left(\frac{y}{4}\right)$

Method is to set y' as a constant.

$C = 9.8 - (y/4)$

$(-y/4) = C - 9.8$

$(y/4) = 9.8 - C$

$y = 4(9.8 - C)$ and C = a constant = y'

So in a sense here, for a variable (but constant y')

$y = 4(9.8 - y')$ and then you vary y' for each case.

Then to plot it, you would create a table but reverse y & y'

nos	y	y'
1	39.2	0
2	35.2	1
3	43.2	-1
4	31.2	2
5	41.2	-2

and so many interesting things can be seen here. Sometimes the function is increasing. Sometimes it is decreasing. No matter which happens, as $t \to \infty$ it approaches 39.2. This is the equilibrium point that was referred to.

Now interpret this physically. What does this mean in terms of a moving body?

Here is what it means.

If a body is ejected downwards like from a rocket, it will actually slow down to stabilize @ 39.2 m/sec. If [illegible] drop the body from [illegible], [illegible] speed up until it reaches the same terminal velocity. So you can see that the curve [illegible] totally depends upon V_0, which is the initial condition.

[illegible]

Jan 17 2015

you now need a flowchart for the wonderful ~~tools~~ that you have in place
Merge

[redacted]

6MB

366
240
360

No end of curiosities.
We see if we we plot $y = x^2$ & y'
we see 2 points where $y' = y$
and this is a DQ!

wrong

$y'(0) = 0$ error $y = x^2$
$y'(2) = 2$ $y' = 2x$
$2x = x^2$ @ $y = 0$ and $y = 2$ which is a match

but what if you were to solve

$y' = y$ this is significant $\frac{dy}{dx} = y$ $\frac{dy}{y} = dx$

$\int \frac{dy}{y} = \int dx$

$\int \frac{1}{x} dx = \ln|x| + C$

so $\ln(y) = x$

$e^2 = 7.389$??

or $y = e^x$

This is actually very interesting. The actual solution is $y = x^2$ but you do not match this. Why?

$\ln|x| + C_1 = x + C_2$

~~$\ln|x| = x + C$~~ $\ln|x| = x + C_2 - C_1$ but $C_2 - C_1 = C_3$

so

$\ln|x| = x + C_3$

$|x| = e^{x + C_3}$ when $x = 0$,

$\phi = e^{0 + C_3}$ or $\phi = e^{C3}$

$e^{-\infty} \to \phi$ so C3 approaches $-\infty$ here

@ $x = 2$

$|2| = e^{2 + C_3}$ let $e^x = 2$ $e^{.69315} = 2$

so $C_3 + 2 = .69315$

$C_3 = -1.307$

so $y = e^{x - 1.307}$ $= 2$ @ $x = 2$

So this part matches

but not @ zero!!!

$e^{-1.307} = \phi.27$ and this is not zero!

So we do have a problem.

What we do actually is have
is a system of equations.
y' is not constant, this is true.
The problem is, as we can see from
inspection, is that y' is not a function
of y. It is a function of x!
There is very [illegible], so even though your
conditions are true they only involve the boundary
conditions. This is not the whole story. As a
matter of fact it is only at the boundary
conditions that it holds true.

Let's try again.

$y = x^2 \quad y' = 2x$

but we see that

$y' = y \quad @ \; x = 0$

and $y' = y \quad @ \; x = 2$

So the DE does not appear to involve x?
But yes it does! It is not just
a function of y.
So we have

$\frac{dy}{dx} = y(x) \quad @ \; x = 0$

and $\frac{dy}{dx} = y(x) \quad @ \; x = 2$

[redacted] [redacted]

Current Mortality rate = .767%

[redacted] [redacted]

Page 147

CO_2 %	50 year Multiplier	50 year Mortality	Percent Ratio to Current
.2	1.00078	.768	1.001
.5	1.0049	.7709	1.005
1.0	1.0198	.7823	1.020
2.0	1.082	.8297	1.082
5.0	1.6290	1.2499	1.630
10.0	6.848	5.254	6.85

So what you have here is the ratio of mortality rates 50 years from now compared to the current rate.

We need to think about what we know here vs what we want to know.

~15 million

Example: Normal we have roughly ~~25~~ million people that have died in 50 years.
But under linear assumption it is 100 years.
or another way of looking @ it is
50 yrs (250,000 per year) is 12.5 million people
but in our work

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This means our equation is actually already separated.

$$\frac{dy}{dx} = y(x) \cancel{dx}$$

So

$\emptyset = \emptyset$ @ $x=\emptyset$
$2 = 4$ @ $x=2$

Therefore $\frac{dy}{dx} = 2x$. This is indeed the solution to the equation.

So your problem was not that it was equal to y, but that it was equal to y(x)
The diff Q was not a function of y, it is a function of x.

Which brings us back to our original problem in the workshop - where indeed the DQ is sometimes indeed a function of y.
We must therefore think very clearly about this

How would I know if I was only given

$y = \emptyset$ @ $x=\emptyset$ let's try again.
$y' = 4$ @ $x=2$

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We do indeed have

$y' = \emptyset$ @ $x = \emptyset$
$y' = 4$ @ $x = 2$ you did have an error here

so just assume that

$y' = y$
Therefore

$\frac{dy}{dx} = y$ assumed

Therefore

$\frac{dy}{y} = dx$

$\int \frac{dy}{y} = \int dx$

or
$\ln|y| + C_1 = x + C_2$

$\ln|y| = x + C_2 - C_1 = x + C_3$

$|y| = e^{x + C_3}$

@ $y = \emptyset$, $e^{x+C_3} = \emptyset$.
and this only occurs @ $C_3 = -\infty$
and this is the first sign of a problem.

We cannot determine a C_3 that matches this condition and this tells us that we have a problem w/ the proposed solution.

So in Case 1 $C_3 = -\infty$

Now for Case 2:

$|4| = e^{x+C_3}$ or $\ln|4| = x + C_3$ (x corrected to 2)

~~$C_3 = x = \ln$~~

$C_3 = \ln|4| - 2$

$= 1.386$

so $|4| = e^{2+C_3}$

$\ln|4| = 2 + C_3 \quad C_3 = \ln|4| - 2 = -.614$

so $C_3 = -\infty$ @ one point @ at the other end $C_3 = -.614$ This is definitely a contradiction.

$|y| = e^{x-.614}$ @ $x=2$

$|y| = 4.0$ so this part is a match

but @ $x=0$, $y = e^{-.614} = 0.54$ which is not zero

And this is how we know that the equation is not valid.

This is a great example of the thought process that needs to go behind the analysis of a DQ.

OK, Now we go back to our vector field analysis. This is where we left off.

In our book we had

$$\frac{dy}{dx} = 9.8 - \frac{x}{4}$$ ~~why!~~

and we learned some very interesting things about the slope field here.

$$\frac{dv}{dx} = 9.8 - \frac{y}{4}$$ so it is indeed known and stated to be a function of y.

So we solve for the vector field by letting y' = 0, 1, -1, 2, -2 etc. no! y...!!

~~y'(0) = 9.8~~ and then we let y vary
How would you know this and not the other way around?

If y was a constant, the solution would not be a function of y, now would it?

This IS why.

So the only option left is let
y' = a constant, & let y vary.
An interesting approach

~~t this a really interesting~~

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So let $y' = 0, 1, -1, 2, -2$, etc

$0 = 9.8 - \frac{y}{4}$ or $C = 9.8 - \frac{y}{4}$

or ~~(4) 4C = 9.8 - y~~ $4C = 4(9.8) - y$

or ~~C = 0~~

~~$-y = 4C - 9.8$~~

or ~~$y = 9.8 - 4C$~~ remember that $C = y'$ here

$-y = 4C - 4(9.8)$

$y = 4(9.8) - 4C$

$y = 4(9.8 - C)$ <u>OK</u> here

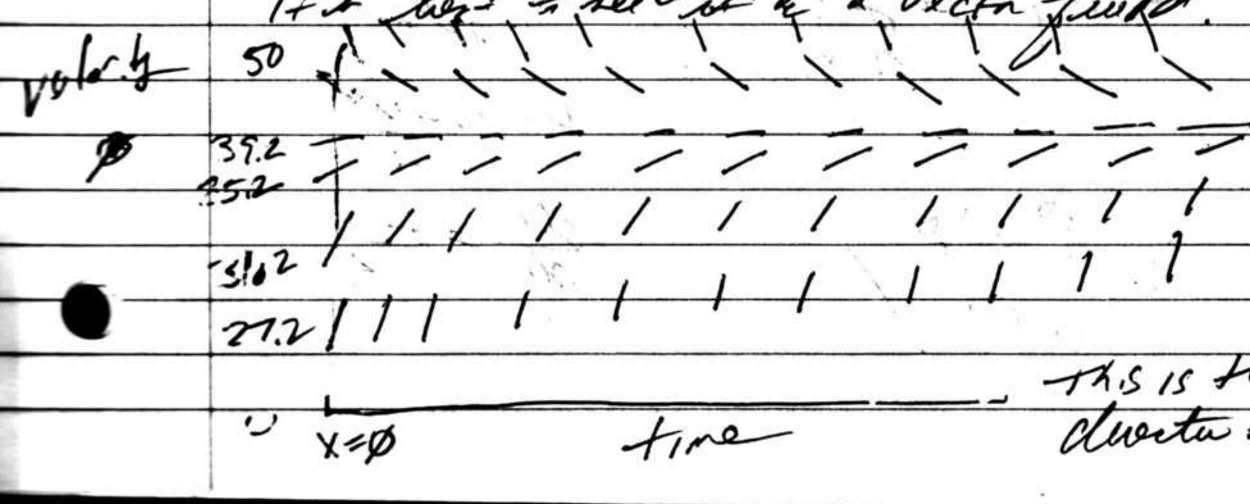
This is your data set.

y' ~~C~~	y
0	39.2
1	35.2
-1	43.2
2	31.2
-2	47.2
3	27.2
-3	51.2

So our data set is

y'	y
0	39.2
1	35.2
-1	43.2
2	31.2
-2	47.2
3	27.2
-3	51.2

Now, how could we graph this?
It is best to see it as a vector field.



This is the direction field

We now know what the equation will look like and its general behavior. Now you go to solve it.

How do you do this? Given that:

$y' = c - \frac{y}{4}$ or $\frac{dy}{dx} = c - \frac{y}{4}$

You need to separate the variables

$\frac{dy}{c - \frac{y}{4}} = dx$ now we have $\int \frac{v}{dv} =$

So this is really

$\frac{1}{c - \frac{y}{4}} dy = dx$ $\frac{v}{dv} \frac{dv}{v} = \frac{1}{v} + c$

$\ln\left(\frac{1}{v}\right)^{dv} + C$

$c = 9.8$

This is how it is to be entered in symbolic processing. Answer from math studio is

$v = 9.8$

$-4 \ln\left(-c + \frac{y}{4}\right) = x$ you need to solve this

$v = c - \frac{y}{4}$

$\frac{dv}{dy} = -\frac{1}{4}$

Something here wrong /

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~~So it is~~ $\ln\left(c - \frac{y}{4}\right)$

We have form Math Studio, (need to solve)

$-4\ln\left(\frac{y}{4} - c\right) = x$

$\ln\left(\left(\frac{y}{4}\right) - c\right) = \frac{x}{-4}$ $\quad c = 9.8$

$\left(\frac{y}{4}\right) - c = e^{\frac{-x}{4}}$

$\left(\frac{y}{4}\right) = e^{\frac{-x}{4}} + 9.8$ $\quad$ close but C is not yet.

or

$y = 4e^{\frac{-x}{4}} + 39.2$

↑ you had this term wrong.

~~$y = 4\left(e^{\frac{-x}{4}} + 9.8\right)$~~ Mine is wrong. Wrong

he gets $y = \text{Constant}\left(e^{\frac{-x}{4}} + 9.8\right)$

this is our difference. Why?

We know that $y = 39.2$ @ $x \to \infty$

You need to work on this a little more.

Your graph says that @ $t = 0$, $y = 43.2$

This is wrong.

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Ok, we found an alternate answer from Microsoft

$-4\ln\left(\frac{y}{4} - \frac{49}{5}\right)$

$= -4\ln\left(\frac{y}{4} - 39.2\right) = x + c$

$\ln\left(\frac{y}{4} - 39.2\right) = \frac{x+c}{-4}$

$y - 39.2 = e^{\frac{x+c}{-4}}$

$y = e^{\frac{x+c}{-4}} + 39.2$

$y = e^{\frac{-x}{4}} \cdot e^{c} + 39.2$

$y = Ce^{\frac{-x}{4}} + 39.2$ Ok here it is.

When $t = 0$, $y = ?$ This is the initial condition. Let $y = 0$ @ $t = 0$

So: $0 = C + 39.2$ or $C = -39.2$

So

$y = -39.2e^{\frac{-x}{4}} + 39.2$

Now plot

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OK, you have it.

@ $t = 15$ sec
$v = 38.3$

$\frac{38.3}{39.2} = 98\%$ of terminal velocity.

Now you have something.
Now you have an understanding of what is up.

The remaining question is how do you automatically plot slope fields for autonomous DEQ's??

This does not seem possible.

You have a much better feel for this now.
There is a terminal velocity.

Basically the drag of the function is proportional to the function (velocity) itself.

How do we get to direction field?

$$\frac{dy}{9.8-\left(\frac{y}{4}\right)} = dx$$

$$\frac{dy}{9.8-\left(\frac{y}{4}\right)} = dx$$ This is what we want to plot

y can be anything.
x goes from t=0 to ∞

Which is really

Notice this term is one, not x!

$$\frac{1}{9.8-\left(\frac{y}{4}\right)} dy = (1) dx$$

So indeed this is correct. You do indeed plot

$$\text{VectorPlot}\left(1, \frac{1}{9.8-\frac{y}{4}}\right)$$

and it gives you a perfect slope field!

Our solution is velocity $= -39.2e^{\frac{-v}{4}} + 39.2$

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You have learned how to plot the vector field of an autonomous differential equation.

This is very valuable.

Ok, we can now move forward with our particulate concentration contribution to mortality.

Notice that even though your DQ was a function of y only

The solution is only a function of x (time)

This is a fascinating observation and not @ all intuitive.

Our vector plot is actually

$$\text{VectorPlot}\left(1, \frac{1}{9.8 - \left(\frac{y}{4}\right)}\right)$$

Since these are the coefficients of the slopes

Now, how would you solve this in software? Mathcad?

What I am getting out of MCAD is a numerical solution, Not a Symbolic one.

This is interesting to me.

Apparently I would need to turn it into an integral form, eg

$$\frac{1}{9.8-\left(\frac{y}{4}\right)}\,dy = (1)\,dx$$

You must now integrate both sides

and then integrate the left side. See this works!

Mathcad gives:

$$\int dx = \int \frac{1}{9.8-\left(\frac{y}{4}\right)}\,dy = -4\ln\left(\frac{y}{4}-9.8\right) + C_1$$

(mcad does not show the constant!)

You must then solve this for y.

So:

$$C_1 + \ln\left(\frac{y}{4}-9.8\right) = x+C_2$$

* ~~$\frac{y}{4} - 9.8 = e^{x+C_2}$~~

$$\frac{y}{4} = e^{x+C_2} + 9.8$$

I have solved it

~~$y = 4e^{x+C_2} + 39.2$~~

~~$y = 4(e^{x} + e^{C_2}) + 39.2$~~

~~$y = 4e^{x} + 4e^{C_2} + 39.2$~~

$\ln\left(\frac{y}{4} - 9.8\right) = x + C_2 + C_1 = x + C_3$

$\frac{y}{4} - 9.8 = e^{x+C_3}$

$\frac{y}{4} = e^{x+C_3} + 9.8$

$y = 4e^{x+C_3} + 39.2$ when $x = 0, y = 0$

~~$0 = 4e^{0} \cdot e^{C_3} + 39.2$~~

~~$0 = 4 + e^{C_3} + 39.2$~~

~~$e^{C_3} = -43.2$~~

~~$C_3 = \ln(-43.2) =$~~ Not possible. We have a mistake.

again

$-4\ln\left(\frac{y}{4} - 9.8\right) + C_1 = x + C_2$

$-4\ln\left(\frac{y}{4} - 9.8\right) = x + C_2 - C_1 = x + C_3$

$\ln\left(\frac{y}{4} - 9.8\right) = \frac{x + C_3}{-4}$

$\frac{y}{4} - 9.8 = e^{\frac{x+C_3}{-4}}$

$\frac{y}{4} = e^{\frac{x+C_3}{-4}} + 9.8$

$y = 4e^{\frac{x+C_3}{-4}} + 39.2$

$y = 4e^{\frac{x}{-4}} \cdot e^{\frac{C_3}{-4}} + 39.2$

but $4e^{\frac{C_3}{-4}} = C_4$!!!! so

$$y = C_4 e^{\frac{-x}{4}} + 39.2$$

OK we have it!

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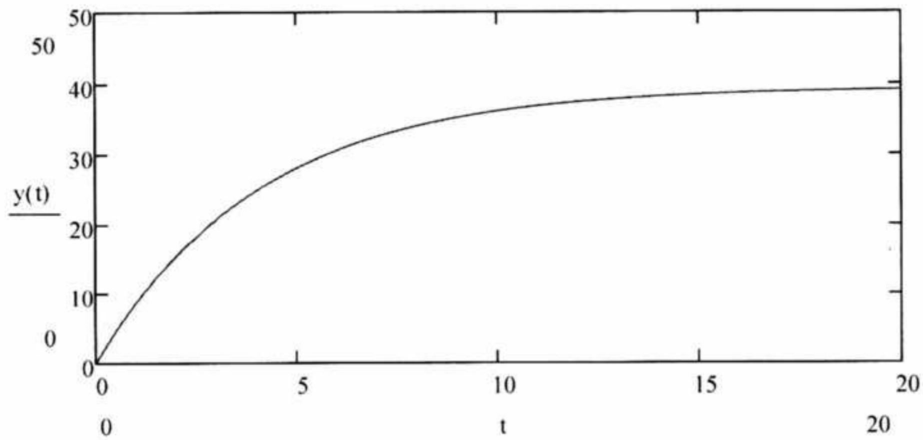
Terminal Resistance Method Solution.

Given

$y'(t) = 9.8 - \left(\frac{y(t)}{4}\right)$ $\quad y(0) = 0.0$ $\quad y := \text{Odesolve}(t, 20)$



$$\int \frac{1}{\left[9.8 - \left(\frac{y}{4}\right)\right]} \, dy \rightarrow -4 \cdot \ln\left(\frac{y}{4} - 9.8\right) \qquad \int 1 \, dx \rightarrow x$$

add a constant of integration to each side
and equate both terms and solve for y.

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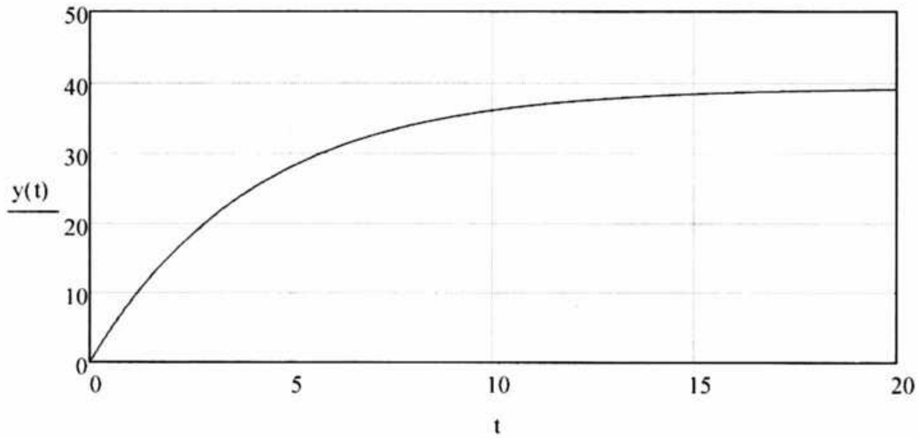
How do we extract the values from
RDE solve?

CTRL F7 gives prime

Given

$$y'(t) = 9.8 - \left(\frac{y(t)}{4}\right) \qquad y(0) = 0.0 \qquad y := \mathrm{Odesolve}(t, 20)$$



$$\int \frac{1}{\left[9.8 - \left(\frac{y}{4}\right)\right]}\,dy \rightarrow -4\cdot\ln\left(\frac{y}{4} - 9.8\right) \qquad \int 1\,dx \rightarrow x$$

add a constant of integration to each side
and equate both terms and solve for y.

$yrk := 0.0$

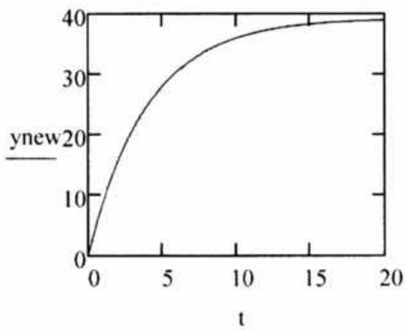
$$D(t,y) := 9.8 - \left(\frac{y}{4}\right)$$

$M := 30$

$out := \mathrm{rkfixed}(yrk, 0, 20, M, D)$

CTRL 6 gives column

$t := out^{\langle 0 \rangle}$ $ynew := out^{\langle 1 \rangle}$



t =

	0
15	10
16	10.667
17	11.333
18	12
19	12.667
20	13.333
21	14
22	14.667
23	15.333
24	16
25	16.667
26	17.333
27	18
28	18.667
29	19.333
30	...

ynew =

	0
15	35.982
16	36.476
17	36.894
18	37.248
19	37.548
20	37.802
21	38.016
22	38.198
23	38.352
24	38.482
25	38.592
26	38.686
27	38.765
28	38.831
29	38.888
30	...

Jan 18 2015

It is very interesting but math studio is giving what seems to be an erroneous error when DSolve is used.

Using

$$DSolve\left(y'(x) = \left[\frac{1}{\frac{9.8 - y(x)}{4}}\right], y(x), no\right.$$

and it is giving

$$y = (\emptyset.4C_1 - 8x + 1536.64)^{1/2} + 39.2$$

But solving the integral directly does give the correct answer. w/ Integrate(,)
This one seems plain wrong.

$$0 = (\emptyset.4\,C_1 + 1536.64)^{1/2} + 39.2$$

~~C_1~~

$$-39.2 = (\quad)^{1/2}$$
$$39.2^2 = \emptyset.4\,C_1 + 1536.64$$
$$.4C_1 = 39.2^2 - 1536.64$$

$$C_1 = \frac{39.2^2 - 1536.64}{.4} = \emptyset$$

So this says

$$y = (-8x + 1536.64)^{1/2} + 39.2$$

S' if, y x=20

y = 16.3 No this is wrong

So DSolve in Math Studio is dangerous.
It is giving an erroneous result.

Maybe we need all the terms on the left

Math Studio is outright giving an incorrect solution to

$y' = \frac{1}{y} dy$. It says that you must check all work & do not assume anything is correct.

How did they do this?

OK I found the error!

In Math Studio DO Solve the problem directly, not the integral form.
They are two different problems!

We have a beautiful solution

$y = -39.2e^{-\frac{x}{4}} + 39.2$ when $y(0) = \emptyset$

We found it.

The tables in Math Studio plots has a problem but you can trick it by changing the step size.

The general solution is

$$y = 0.2\,e^{\left(5C_1 - 0.25x\right)} + 39.2$$

if $x = 0$, C_1 must equal -39.2

Develop a Flow Chart of your traits

Found the error!

DO in Math Studio solve the problem directly, not the integral form! They are two different problems

We have a beautiful solution

$$y = -39.2\,e^{\frac{x}{4}} + 39.2 \text{ when } y(0) = 0$$

Jan 18 2015

It is time to start working on the particulate problem of contribution to Mortality.

We have a piece of information

$\frac{+1.2\%}{10 ugms}$ Therefore $\frac{\Delta M}{\Delta p} \cong \frac{1.2\%}{10 ug}$

So we could go straightforward on this one.
$\Delta M \cong 1.2\% \frac{\Delta ug}{10 ug}$ This would be a straight linear relationship.

Is there any reason that it should be more complicated than this?
It would be confined to solid aerosols not acute.

It appears that linear will be sufficient.

i 1. Σ up contribution of aerosols that are solid
1 0 Carbon black
2 1 Aluminum Oxide Code 1194 is the values
3 2 Sulfuric Acid
5 4 Barium
7 6 Volcanic Ash
8 7 Magnesium
9 8 Strontium

Ok, we now have to
total aerosol contributions in mg / m3

= Total of seven aerosols * .02 * no. of applications
(=2% conversion)

O.K, with tons of aerosol we get
14.13 ug / m3

$\frac{14.13}{10 ug}$ (1.2%) = 1.69% additional mortality

Ok, we have the mortality percent

now we have ~~.08~~ 0.2% mortality
the ground. This may not be realistic.

~~5% = a~~ factor of 25

We now are using a conversion
rate of 1%

call it aerosol mortality percent

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50 yrs 200 yrs

5% 30% CO_2 2%

Carbon Black 3 mg/m3

= 4.5 mg/m3

= 0.54%

Changes to

10% 58% So it doubles the mortality. Why —

We have 0.54% increase in mortality

= .0054 decimal

We are back to 0.2%

of materials going to ground.

1965 = 320 1.6 PPM per year

2015 400

Currently about 0.4% per year

[redacted]

The manual for Math Studio is lacking.
This is understandable.

We can buy a [illegible] a [illegible]!
Gene & Jim

Regression parameters is very valuable
(X, Y, X, a, b) this is great

Regression is not documented in the
Math Studio 5 manual.

The advantage of Mathcad is that it
is documented [illegible] well. You
have lots of books. Commands with
keystrokes, however are obscure.
So it tends to be slow but more thorough
when you have it

Math Studio is incredibly efficient &
mobile. It is however, not
documented well so examples
are sparse

I [illegible] gradually take advantage of both