

# Who dunnit? (Intro to exponentials)

Known info:

Temp Surrounding: 76

Temp when found: 88

Temp after 2 hrs: 85.8

Newton's Law of Cooling:

$$u(t) = T + (u_0 - T)e^{-kt}$$

We don't know  $k$ , but can use what we know to find  $k$ .

~~85.8 = 76 + (88 - 76)e^{-k(2)}~~

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Solve for  $k$

$$9.8 = 12e^{-2k}$$
$$.81\bar{6} = e^{-2k}$$

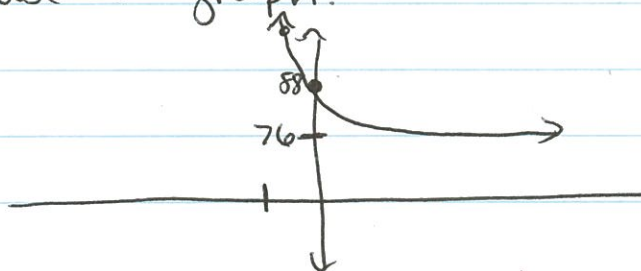
Natural log

$$\ln(.81\bar{6}) = \ln e^{-2k}$$
$$-2.025 = -2k$$
$$\boxed{.10126 = k}$$

Now we use  $k$  to find the time when the body was alive.

$$u(t) = 76 + (88 - 76)e^{-.10126t}$$

What time ( $t$ ) is  $u(t) = 98.6$ ? Solve algebraically or use a graph.



$$u(t) = 76 + (88 - 76)e^{-.101t}$$

Looking at the graph, we see that the body was  $98.6^\circ$  at  $t = -6.26$

Which means he was killed 6.26 hours before Holmes found him (4:30am)

$$4:30 - 6.26 \text{ hours} \approx \boxed{10:12 \text{ pm}}$$

The only character without an alibi at that time is the business partner.

*[Faint handwritten notes and calculations, including a graph sketch at the bottom, are visible but mostly illegible.]*