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Math 231 Group Lab

Lab Number 3 Lab Date October 4

Student Name: Richard Ch

Group Name: Super awesomeness

Problem 1 A student performs the following experiment using two identical cups of water. One cup is removed from a refrigerator at 34°F and allowed to warm in its surroundings to room temperature (72°F). A second cup is simultaneously taken from room temperature surroundings and placed in the refrigerator to cool. The time at which each cup of water reached a temperature of 53°F is recorded. Are the two recorded times the same or not? Explain.

Cup 1 34 → 53 Δ19 ✓

Cup 2 72 → 53 Δ19

rate of cooling
 $y' = k(y - T_r)$
 constant for liquid
 current temp.
 room temp.

The two recorded times should be the same because it is the same liquid, which would produce the same constant (k) and the room temperature is a constant 72°F and the change in overall temperature of 19°F, therefore it should take the same amount of time to reach 53°F.

Separation of variables

$$\frac{y}{y - T_r} = k dt$$

$$\ln|y - T_r| = kt + C$$

$$e^{\ln|y - T_r|} = e^{kt + C}$$

$$y - T_r = e^{kt + C}$$

$$y = ce^{kt} + T_r$$

$$53 = ce^{kt_1} + 34 \rightarrow 19 = ce^{kt_1} \checkmark$$

$$53 = ce^{kt_2} + 72 \rightarrow -19 = ce^{kt_2} \checkmark$$

$$ce^{kt_1} = -ce^{kt_2} \quad c \text{ will cancel out}$$

$$e^{kt_1} = -e^{kt_2}$$

$$\ln e^{kt_1} = \ln -e^{kt_2}$$

$$kt_1 = -kt_2 \quad k \text{ will cancel out}$$

$$t_1 = t_2$$

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Student Name: Sonhan Nahael Ken

Group Name: Team Table

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$$\frac{dy_1}{dx} = k_1 (y_1 - 72) = k_1 y_1 - k_1 \cdot 72$$

$$y_2 = k_2 (y_2 - 34) = k_2 y_2 - k_2 \cdot 34$$

$$\frac{dy_1}{(y_1 - 72)} = k_1 dx$$

$$\ln(y_1 - 72) = k_1 x + C$$

$$y_1 - 72 = e^{k_1 x + C}$$

$$y_1 = e^{k_1 x + C} + 72 \quad e^C = d$$

$$y_1 = d e^{k_1 x} + 72$$

$$34 = d + 72$$

$$d = -38$$

$$y_1 = -38 e^{k_1 x} + 72$$

34

yes

$$\frac{dy_2}{(y_2 - 34)} = k_2 dx$$

$$\ln(y_2 - 34) = k_2 x + C$$

$$y_2 = e^{k_2 x} C + 34$$

$$72 = C + 34$$

$$C = 38$$

$$y_2 = 38 e^{k_2 x} + 34$$

LOOK BACK
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Student Name: Duke J Weaver

Group Name: Rita Rocks

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Newton's law of cooling //

$$\begin{cases} y' = k(y - T_e) \\ y = Ae^{kT} + T_e \end{cases}$$

$$\begin{aligned} y_1' &= k(y_1 - 34) \quad // \text{cup in refrigerator} \\ y_2' &= k(y_2 - 72) \quad // \text{cup in open air} \end{aligned}$$

$$y_1 = A_1 e^{kT} + T_{e1}$$

$$72 = A_1 e^{0T} + 34 = A_1 = 38$$

$$y_2 = A_2 e^{kT} + T_{e2}$$

$$34 = A_2 e^{0T} + 72 = A_2 = -38$$

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Temp relative to time in fridge.

$$y_1 = 38e^{kT} + 34$$

$$y_2 = -38e^{kT} + 72 \quad // \text{Temp relative to time in air.}$$

$$53 = 38e^{kT} + 34$$

$$53 = -38e^{kT} + 72$$

$$\frac{19}{38} = e^{kT} = y_1 = y_2$$

K is an unknown constant; however since the liquid are the same K is also equivalent. Since the final ratio and K are the same; they must also be equivalent. They are the same temperature at the same time.

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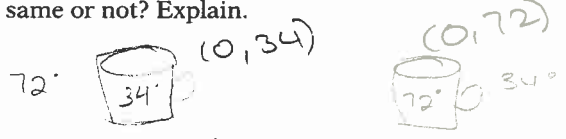
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Lab Number 3 Lab Date October 4

Student Name: Sarah Hussaini

Group Name: Team #1

Problem 1 A student performs the following experiment using two identical cups of water. One cup is removed from a refrigerator at 34°F and allowed to warm in its surroundings to room temperature (72°F). A second cup is simultaneously taken from room temperature surroundings and placed in the refrigerator to cool. The time at which each cup of water reached a temperature of 53°F is recorded. Are the two recorded times the same or not? Explain.



$$y' = -k(y - T_r)$$
$$y = T_e + (y - T_e)e^{-kt}$$
$$y = 72 + (34 - 72)e^{-kt}$$

$$53 = 72 + (34 - 72)e^{-kt}$$
$$\Rightarrow 19 = -38e^{-kt}$$
$$\frac{1}{2} = e^{-kt}$$
$$\ln_e \frac{1}{2} = -kt$$

$$-.6931 = -kt$$
$$\frac{.6931}{k} = t$$

$$y' = k(y - T_r)$$
$$y = T_e + (y - T_e)e^{-kt}$$
$$y = 34 + (72 - 34)e^{-kt}$$

$$53 = 34 + 38e^{-kt}$$
$$19 = 38e^{-kt}$$
$$\frac{1}{2} = e^{-kt}$$
$$\ln_e \frac{1}{2} = -kt$$

$$\frac{.6931}{k} = t$$

k is the same
b/c they are both water

.6931k = .6931k
one is going to be + & one is going to be - (k). B/c for the cooling & heating.

→ 1 is above room temperature & 1 is below

But they will be reaching 53° at the same time: .6931/k

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Student Name: Sabrina Edwards

Group Name: Team Awesome

Problem 1 A student performs the following experiment using two identical cups of water. One cup is removed from a refrigerator at 34°F and allowed to warm in its surroundings to room temperature (72°F). A second cup is simultaneously taken from room temperature surroundings and placed in the refrigerator to cool. The time at which each cup of water reached a temperature of 53°F is recorded. Are the two recorded times the same or not? Explain.

<u>Cup 1</u>	<u>Cup 2</u>
$T_0 = 34^\circ\text{F}$	$T_0 = 72^\circ\text{F}$
$T_e = 72^\circ\text{F}$	$T_e = 34^\circ\text{F}$

Cup 1

$$y(t) = (T_0 - T_r)e^{k \cdot t} + T_r$$

$$53 = (34 - 72)e^{k \cdot t} + 72$$

$$53 = -38e^{k \cdot t} + 72$$

$$-19 = -38e^{k \cdot t}$$

$$\frac{1}{2} = e^{k \cdot t}$$

$$\ln \frac{1}{2} = \ln e^{k \cdot t}$$

$$\ln \frac{1}{2} = k \cdot t$$

$$t = \frac{\ln \frac{1}{2}}{k} \checkmark$$

Cup 2

$$y(t) = (T_0 - T_r)e^{k \cdot t} + T_r$$

$$53 = (72 - 34)e^{k \cdot t} + 34$$

$$53 = 38e^{k \cdot t} + 34$$

$$19 = 38e^{k \cdot t}$$

$$\frac{19}{38} = e^{k \cdot t}$$

$$\frac{1}{2} = e^{k \cdot t}$$

$$\ln \frac{1}{2} = \ln e^{k \cdot t}$$

$$\ln \frac{1}{2} = k \cdot t, t = \frac{\ln \frac{1}{2}}{k} \checkmark$$

~~$$y' = k(y - T_e)$$

$$\frac{dy}{dt} = k(y - T_e)$$

$$dy = k(y - T_e) dt$$

$$dy = k(y - 72) dt$$

$$\int \frac{1}{y - 72} dy = \int k dt$$

$$\ln |y - 72| = kt + c$$

$$e^{\ln |y - 72|} = e^{kt} \cdot e^c$$

$$y - 72 = Ce^{kt}$$

$$y = Ce^{kt} + 72$$~~

~~$$34 = k(0 - 72)$$

$$34 = -72k$$

$$k = -.472$$~~

~~@t=0,~~

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The times the cups of water reach a temperature of 53°F are $\ln \frac{1}{2}$. So, the two recorded k times are the same. For cup 1, the initial temperature used was 34°F and the environment temperature is 72°F. For cup 2, the initial temperature is 72°F, and the environment temperature is 34°F. We used these values to solve for t. ☺