Math 1010 Drug Filtering Lab

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The purpose of this lab is to come up with a continuous model for exponential decay.

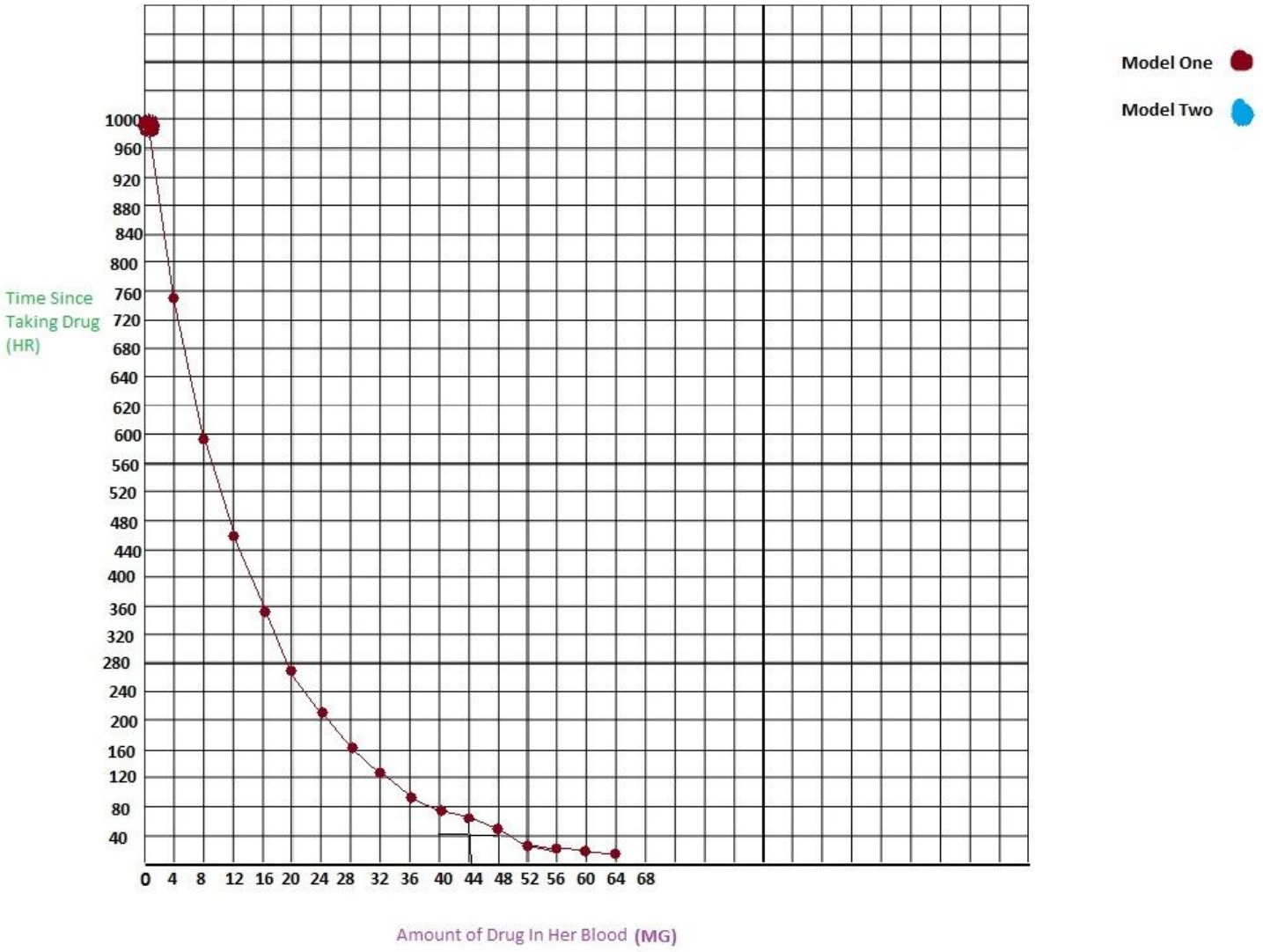
Dot assumes that her kidneys can filter out 25% of a drug in her blood every 4 hours. She knows that she will need to take a drug test for an interview in a couple of days. She plans on taking one 1000-milligram dose of the drug to help manage her pain.

1.) Fill in the table showing the amount of the drug in your blood as a function of time and round each value to the nearest milligram. The first two data points are already completed.

TIME SINCE TAKING THE DRUG (HR)	AMOUNT OF DRUG IN HER BLOOD (MG)
0	1000
4	750
8	597
12	461
16	356
20	275
24	212
28	164
32	127
36	98
40	76
44	58
48	45
52	35
56	27
60	21
64	16
68	12

What might a model for this data look like? **It will start out with a drastic downward slope then change into a horizontal line with a downward slope that you can barely see.**

2.) Use a graphing utility to make a plot of the above data. Label axes appropriately.



3.) Based on your graph, what can you say about the data? For example, is there a pattern? Is there constant slope? **The slope decreases as the hours since taking the drug increases.**

4.) How many milligrams of the drug are in Dot's blood after 2 days?

After 2 days there is 45 mg of the drug in Dot's blood.

5.) How many milligrams of the drug are in Dot's blood after 5 days?
After 5 days there is .43 mg of the drug in Dot's blood.

6.) How many milligrams of the drug are in Dot's blood 30 hours after she took the drug? Explain your reasoning. **Thirty hours after she took the drug there was 144 mg of the drug in Dot's blood. Using the formula y=a(1-b)^x , you solve 1000(1-.062)^30 .**

7.) A blood test is able to detect the presence of this drug if there is at least 0.1 mg in a person's blood. How many days will it take before the test will come back negative? Explain your answer. **It will take 6 days. In 144 hours (6 days) there would be .092 mg of the drug in her**

blood . A blood test can only detect the drug is there is at least .1 mg of that drug in a person's blood.

8.) Will the drug ever be completely removed from her system? Explain your reasoning. What complications might arise from having excess amounts in her system? **There will always be an extremely tiny amount of the drug in her system. Matter cannot decay into nothing. If she used again it would take longer to get the drug out.**

9.) Since there is a constant rate of decay, a continuous exponential decay model can be used to determine how much drug is in her system at any time.

Exponential Decay Model

$$A(t) = A_0 e^{kt}$$

Where A(t) is amount of drug in blood at time t in hours,
A_0 is the initial amount of drug, and
k is the rate of decay (it will be a negative number)

You will have to find the actual value of k that works for this model. Write down the exponential decay model for the amount of drug in Dot's blood as a function of time:

Model: A(t) = 1000e ^ (-0.0719 X t)

Now use that model to fill in the following table:

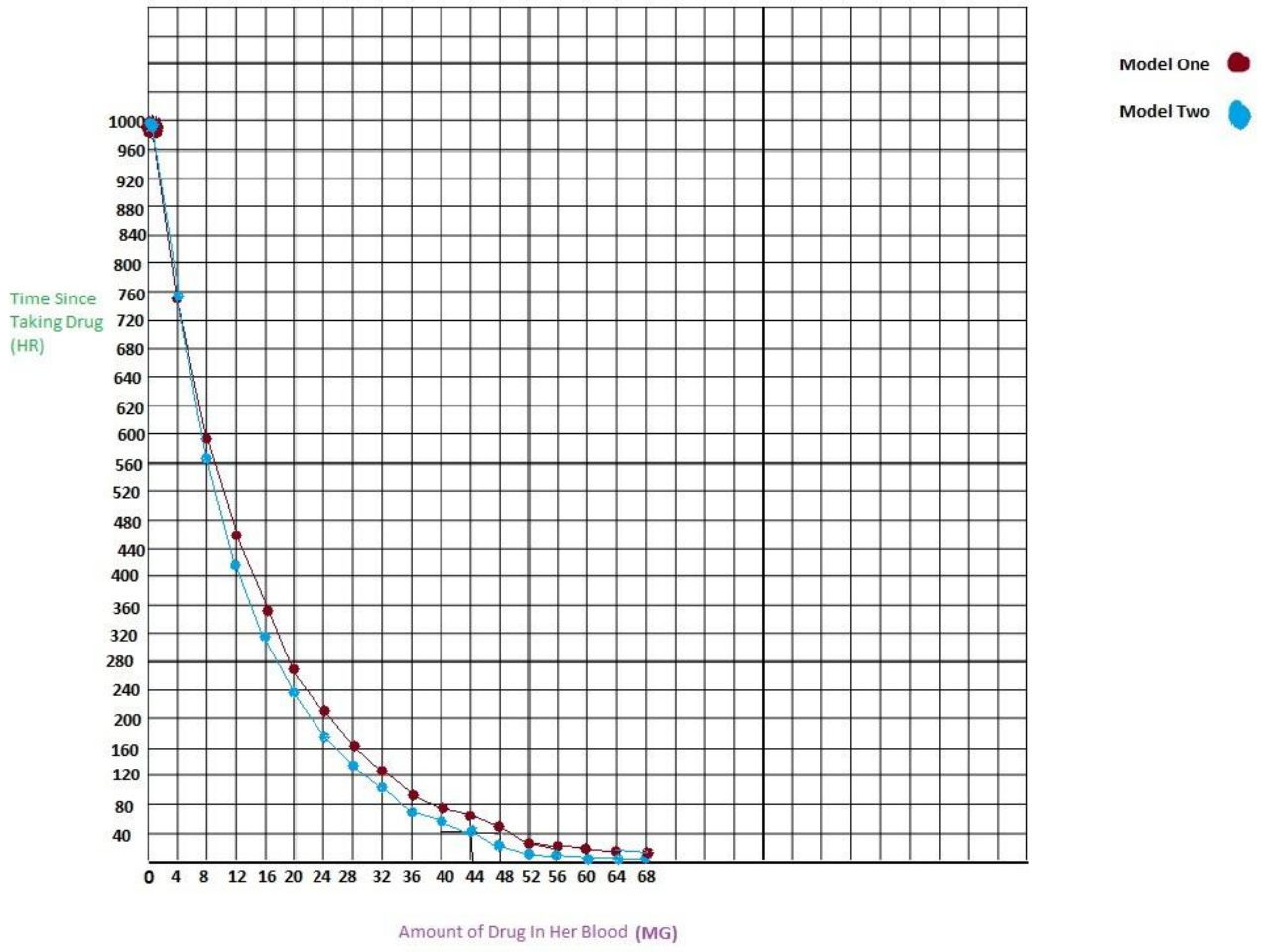
TIME SINCE TAKING THE DRUG (HR)	AMOUNT OF DRUG IN HER BLOOD (MG)
0	1000
4	750
8	563
12	422
16	317
20	237
24	178
28	134
32	100
36	75
40	56

44	42
48	32
52	24
56	18
60	13
64	10
68	8

10.) Interpret the parameters of this exponential model in terms of the context of the problem. **This model allows you to accurately calculate the amount of time Dot would need in order to pass her drug test.**

11.) Compare your values with the estimated values in the model. How close were they? Why might they be different? **My values were close to the values of this model but not exact. I used a different formula to calculate my values.**

12.) Use a graphing utility to graph the original data along with a graph of the model on the same set of axes.



13.) Were you expecting a horizontal asymptote? What might that mean in the context of the problem? **When I saw how the amount of drug in her system was decreasing with the time I figured that that there would be a horizontal asymptote. That probably means that the drug will be there in some tiny amount for a long time.**

14.) Using your model, how much drug is in her system 17 hours after taking the drug?

After 17 hours there is 334 mg of the drug in her system.

15.) Using your model, how long will it take for exactly one-half of the drug to remain in her system?

10 hours and 45 minutes

16.) Using this model, how long will it take for 0.1 mg of the drug to remain in her system?

That would take 96 hours or 4 days.

17.) Do you think the continuous decay model is more accurate for predicting the amount of drug in her blood? Why? Or why not?

I think that the continuous decay model is more accurate because there is a lot of science behind it to back it up. This model has probably been used in legitimate experiments.

18.) What other factors should be considered in coming up with a more realistic model?

I think it would be important to know how much of the drug she had been taking before the final day of taking 1000 mg. If she had been taking it the whole week before or the entire month or months before then she would have to take those amounts into consideration when trying to detox. They all add up.

19.) Reflective writing: Did this project change the way you think about how math can be applied to the real world? Write one paragraph stating what ideas changed and why. If this project did not change the way you think, write how this project gave further evidence to support your existing opinion about applying math. Be specific.

Math is used everywhere, even in the lives of those who say they dislike it on every level. I have always appreciated the use of mathematics. This project broadened my mind to the possibilities and different ways to think and apply math. I struggle with math sometimes and I can't say that I love it but I know the importance of it and I know that those who understand it are better problem solvers on all different levels.