Math 113 College Algebra

Sample Problems from Class Activities

(Based on problems from "College Algebra in Context" by Harshbarger and Yocco)

Instructions: Work together to solve the problems. Be sure to show all work and state your answers in complete sentences with appropriate units.

1. The table in Figure 1 shows the total of federal direct student loans (in billions of dollars) for selected years from 2011 to 2021. Use the data in the table to answer the given questions.

   a) Begin by aligning the data so that the x-value of each point represents the number of years after 2010. Complete the table to the right.

Year	x	Debt, y (in billions of dollars)
2011		702
2013		940
2015		1220
2017		1500
2019		1775
2021		2000

Figure 1: Table for Problem 1

   b) Explain why a linear function cannot *exactly* model the points from the table.

   c) Use your calculator to find a linear function that models the total loan debt $\mathbf{y}$, in billions of dollars, as a function of the number of years after 2010. This should be a line of best fit; round to three decimal places.

   d) Use this model to predict the student loan debt in the year 2027.

2. The formula: $\frac{D}{H} * Q = x$ is called the universal drug calculation formula[1] in Health Sciences. Solve this formula for Q in terms of the other variables. (Note: the "*" symbol is used here to denote multiplication.)

3. If a drug is injected into the bloodstream, the **percent** of the maximum dosage that is present at time t is given by $y = 100(1 - e^{-0.35(10-t)})$ where t is in hours.

   a) What percent of the drug is present after 2 hours?

   b) Sketch a graph of this model. Identify the domain of this model within the context of the scenario described. Explain why the domain you chose makes sense.

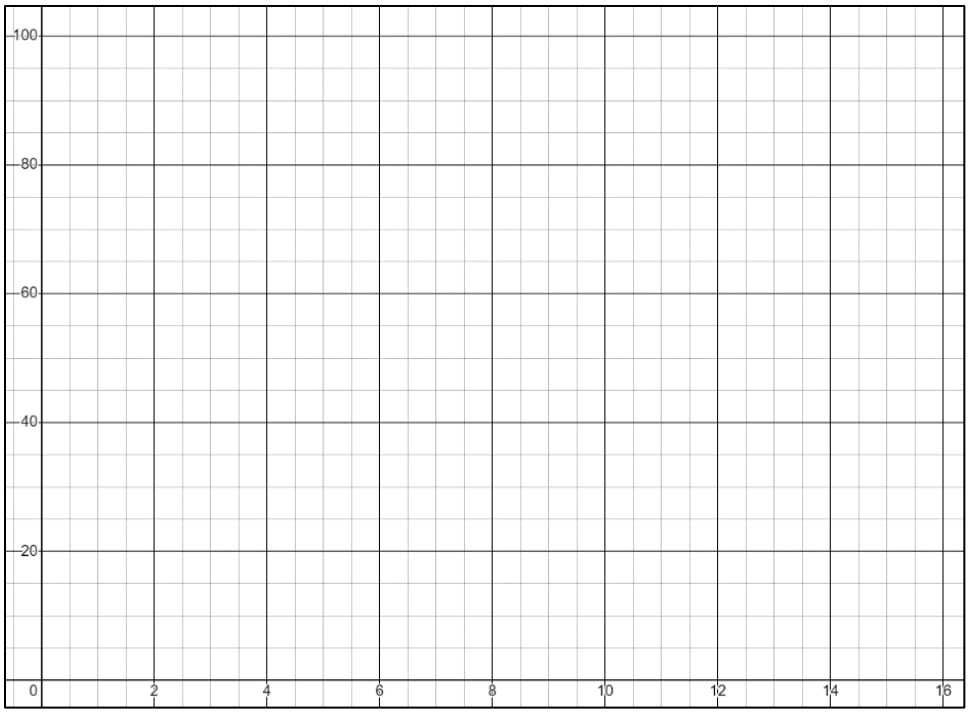


Figure 2: Graph for Problem 3

   c) When is the drug totally gone from the bloodstream? Explain.

[1] In the universal formula, the **desired amount (D)** is the dose prescribed and the **amount on hand (H)** is the available dose or concentration. **The quantity (Q)** is the form and amount in which the drug is supplied. This formula then yields the **needed dose (x)**.

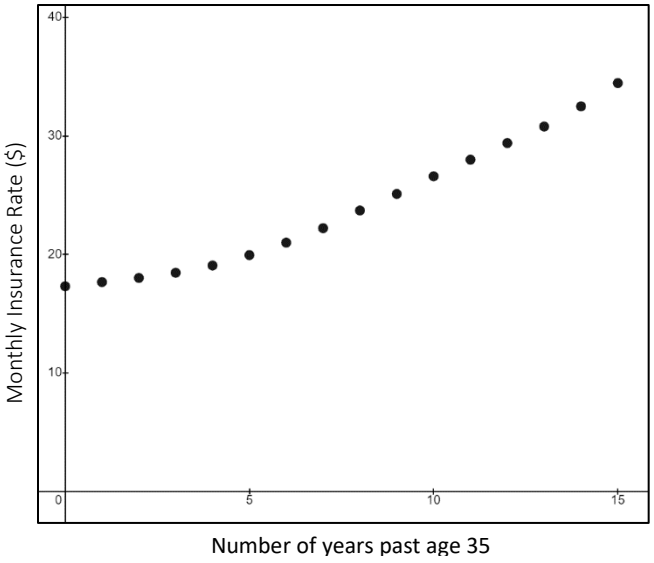
4. The following table gives the monthly insurance rates for a $100,000 life insurance policy for smokers 35–50 years of age.

Age	x	Monthly Insurance Rate (in dollars)
35		17.32
36		17.67
37		18.02
38		18.46
39		19.07
40		19.95
41		21.00
42		22.22
43		23.71
44		25.11
45		26.60
46		28.00
47		29.40
48		30.80
49		32.55
50		34.47

Figure 3: Table for Problem 5
(Source: American General Life Insurance Company)

a) Create a scatter plot for the data where x is the number of years past age 35.

(Note: I'm including the plot here to save time, but the students would input the data and create the scatter plot on their own.)



b) Which of the models that we have studied (linear, quadratic, power, exponential, or logarithmic) seem like they could provide a good model for these data?

c) Use technology to identify two reasonable "best-fit" models (of those you selected in part b).

d) Compare the two models by graphing each model on the same axes with the data points. Which model appears to be the better fit? Explain.

5. In an effort to reduce climate change, it has been proposed that a tax be levied based on the emissions of carbon dioxide into the atmosphere. The cost–benefit equation:

$$\ln(1 - P) = -0.0034 - 0.0053T$$

estimates the relationship between the percent reduction of carbon dioxide emissions, P, (given as a decimal) and the tax T in dollars per ton of carbon.

a) Use the model to estimate the amount of tax that will give a carbon dioxide emissions reduction of at least 50%?

b) Solve the cost-benefit equation for P, the estimated percent reduction in emissions.

c) Determine the estimated percent reduction in emissions if a tax of $100 per ton is levied.