

Name: SolutionsInstructor's Name: Patrick Dylan Zwick Section: 03

Instructions: Please note that there are two parts. Part I is worth a total of 30 points. Part II is worth 70 points. Show your work on each question.

The formulas below are provided for your convenience

Savings Plan:
$$A = \text{PMT} \frac{\left[\left(1 + \frac{\text{APR}}{n} \right)^{(nY)} - 1 \right]}{\left(\frac{\text{APR}}{n} \right)}$$

Loan:
$$\text{PMT} = \frac{P \times \left(\frac{\text{APR}}{n} \right)}{\left[1 - \left(1 + \frac{\text{APR}}{n} \right)^{(-nY)} \right]}$$

Final Examination Score : _____

Part I: (30 pts) There are five questions and each question is worth 6 points.

1. Time magazine (November 16th, 2007): "1,500— Number of tigers in India's reserves and jungles, which reflects a 40% drop in the past five years. The Indian government says it plans to recruit soldiers to patrol tiger sanctuaries."

How many tigers did India's reserves and jungles have 5 years ago.

$$\% \text{ change} = \frac{\text{new value} - \text{old value}}{\text{old value}}$$

$$\Rightarrow - .4 = \frac{1500 - x}{x}$$

$$\Rightarrow .6x = 1500$$

$$\Rightarrow x = \frac{1500}{.6} =$$

Answer 2500

2. If you deposit \$2,100 now and you can get an APR of 2.25% compounded continuously, how much will you have in 30 years?

$$A = \$2,100 e^{(.0225 \times 30)}$$

$$= \$4,124.47$$

Answer \$4,124.47

3. You plan to travel to Nepal and you are practicing how to deal with different measurement systems. Consider the following situation.

Suppose, an outdoor market in Nepal offers apples priced at 28 Nepalese Rupees per kilogram. What is the price of these apples in US dollars per pound if 1 US dollar is 71.08 Nepalese Rupees and 1 kilogram is 2.2 pounds.

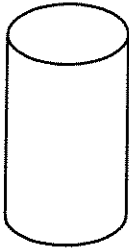
$$\left(\frac{28 \text{ Rupees}}{\text{kilogram}} \right) \left(\frac{1 \text{ kilogram}}{2.2 \text{ lbs}} \right) \left(\frac{\$1}{71.08 \text{ Rupees}} \right)$$

$$= \$.18 / \text{lb}$$

Answer \$.18 / lb

4. The shape below with the given dimensions is a scale model of a cylinder. The cylinder will be scaled down so that the new cylinder will have a height of 4 inches. What will the surface area and the volume of the model be?

Model



height = 15 in

surface area = 1060.3 in^2

volume = 2650.7 in^3

$$SA = 1060.3 \text{ in}^2 \left(\frac{4}{15} \right)^2$$

$$= 75.4 \text{ in}^2$$

$$V = 2650.7 \text{ in}^3 \left(\frac{4}{15} \right)^3$$

$$= 50.3 \text{ in}^3$$

Surface area of the new cylinder 75.4 in^2

Volume of the new cylinder 50.3 in^3

5. Your house was appraised at \$ 369,000 in 2003. If you assume that the housing market is steadily going up at a rate of 5.5%, how much will your house be worth in 2015?

$$A = \$369,000 (1 + 0.055)^{12}$$

$$= \$701,545.56$$

Answer $\$701,545.56$

Does this situation represent a linear or exponential model? Why?

Exponential. The growth rate is proportional.

Part II (70 pts): There are 7 questions and each question is worth 10 points.

1. A certain medication breaks down in the human body (decreases) at a rate of 12% per hour.

a) Find the approximate half-life.

$$T_{1/2} = \frac{-\log_{10}(2)}{\log_{10}(.88)} = 5.4 \text{ hours}$$

Answer 5.4 hours

b) How long will it take for this drug (in your bloodstream) to reduce to 15% of the original amount?

$$.15 = (.88)^t$$
$$\Rightarrow \frac{\log_{10}(.15)}{\log_{10}(.88)} = t = \boxed{14.8 \text{ hours}}$$

Answer 14.8 hours

c) If the initial dose was 500 mg, how much (in mg) is left in your bloodstream after 2 days?

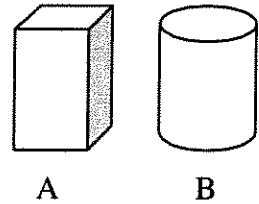
$$A = 500 \text{ mg } (.88)^{48}$$
$$= 1.1 \text{ mg}$$

Answer 1.1 mg

2. You plan to buy one of two extra gas tanks shown below to take in your Jeep for off-roads trips. Tank A is a rectangular box with a base of 18 cm by 25 cm and height equal to 30 cm. Tank B is a cylinder with radius 6 inches and height 7.5 inches.

a) Determine the volume of each tank using appropriate units.

$$\begin{aligned}\text{Volume of A} &= 18\text{ cm} \times 25\text{ cm} \times 30\text{ cm} \\ &= 13,500\text{ cm}^3\end{aligned}$$



$$\begin{aligned}\text{Volume of B} &= \pi (6\text{ in})^2 (7.5\text{ in}) \\ &= 270\pi\text{ in}^3\end{aligned}$$

Volume of A $13,500\text{ cm}^3$

Volume of B $270\pi\text{ in}^3$

b) Which tank will have the greater volume? Recall: 1 inch = 2.54 cm

$$\text{Volume of B} = 270\pi\text{ in}^3 = 848\text{ in}^3$$

$$\begin{aligned}\text{Volume of A} &= 13,500\text{ cm}^3 \left(\frac{1\text{ in}}{2.54\text{ cm}} \right)^3 \\ &= 823.8\text{ in}^3\end{aligned}$$

Answer B

3. The following data represents measurement of the concentration of a substance in a patient's bloodstream, after the start of a treatment meant to boost the concentration:

Days after start of treatment	3	5	8	15
Concentration in ppm	2.6	3.2	4.1	6.2

a) Create a linear equation that would represent this situation.

~~Note: Answers may vary.~~

$$\text{slope} = \frac{(4.1 - 2.6) \text{ ppm}}{(8 - 3) \text{ days}} = .3 \text{ ppm/day}$$

$$2.6 = (.3 \text{ ppm/day}) \times 3 \text{ days} + b$$

$$\Rightarrow b = 1.7 \text{ ppm}$$

$$\text{Answer } y = .3x + 1.7$$

b) How long will it take for the concentration to reach 35 ppm?

$$35 \text{ ppm} = .3x + 1.7$$

$$\Rightarrow x = \frac{(35 - 1.7) \text{ ppm}}{.3 \text{ ppm/day}}$$

$$= \boxed{111 \text{ days}}$$

$$\text{Answer } 111 \text{ days}$$

4. A savings account pays an annual percentage rate of 2.5% compounded quarterly.
a) Find the annual percentage yield on this account.

$$\begin{aligned}APY &= \left(1 + \frac{.025}{4}\right)^4 - 1 \\&= .02524 \\&= 2.524\%\end{aligned}$$

Answer 2.524%

- b) You decide that you would like to make regular quarterly deposits to this account. Since you would like to have \$700,000 when you retire 40 years from now, how much should your quarterly deposits be in order to accomplish your goal?

$$PMT = \frac{\$700,000}{\left[\left(1 + \frac{.025}{4}\right)^{4 \times 40} - 1\right] \left(\frac{.025}{4}\right)} = \$2,558.73$$

Answer \$2,558.73

5. The doubling time of a state's population is 24 years.

a) If the population was 2,200,000 in 1995, what will the population be in 2028?

$$A = 2,200,000 \times 2^{\left(\frac{33}{24}\right)} \\ = 5,706,094$$

Answer 5,706,094

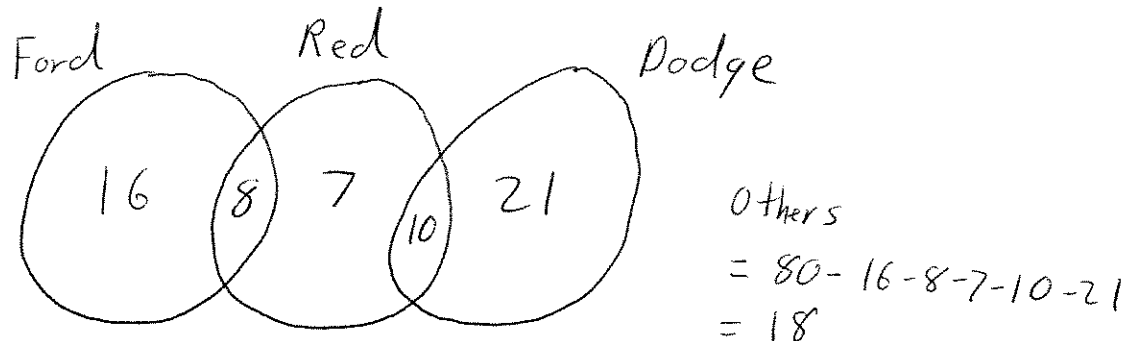
b) If the population was 2,200,000 in 1995, how long will it take for this state to reach a population of 3,700,000?

$$3,700,000 = 2,200,000 \times 2^{\left(\frac{t}{24}\right)} \\ \Rightarrow \frac{\log_{10}(3,700,000) - \log_{10}(2,200,000)}{\log_{10}(2)} \times 24 = t$$

Answer 18 years

6. There are 80 cars on a used car lot. Out of those 80 cars, 24 are Ford and 31 are Dodge, and 25 are red cars. There are 8 red Ford, and 10 red Dodge cars.

a) Draw a Venn diagram to illustrate this information. Use the symbols F, D, R to represent the set of Ford, Dodge, and red cars respectively.



b) Use your diagram to answer the following:

How many cars (on this lot) are red, but are not Ford and not Dodge. Answer 7

How many cars (on this lot) are not red, not Ford, and not Dodge. Answer 18

7. You have found that you are eligible for a 20-year house loan with annual interest rate (APR) of 6.25%, compounded monthly.

a) What will your payment be if the loan amount is \$280,000?

$$PMT = \frac{\$280,000 \times \left(\frac{.0625}{12}\right)}{\left[1 - \left(1 + \frac{.0625}{12}\right)^{(-12 \times 20)}\right]} =$$

Answer \$2,046.60

b) What will be the total amount of interest (in dollars) that you will pay on this loan over 20 years?

$$\$2,046.60 \times 12 \times 20 = \$491,183.75$$

$$\$491,183.75 - \$280,000 = \$211,183.75$$

Answer \$211,183.75

c) You decide instead to get the same loan, but with a 15-year term. What are your monthly payments, and how much interest will you save (in dollars), compared to the 20-year loan.

$$PMT = \frac{\$280,000 \times \left(\frac{.0625}{12}\right)}{\left[1 - \left(1 + \frac{.0625}{12}\right)^{(-12 \times 15)}\right]}$$

$$= \$2,400.78$$

$$\text{Interest} = \$152,141.12$$

$$\begin{aligned} \text{Saved} &= \$211,183.75 - \$152,141.12 \\ &= \$59,042.63 \end{aligned}$$

Monthly payment \$2,400.78

Interest saved \$59,042.63