EXAM 4 - MATH 111   Friday, November 30

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Read each problem **very carefully** before starting to solve it. Each problem is worth 10 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. The total sales S, in thousands of dollars, of a small firm is growing exponentially with time t (measured in years since the start of 2008). Analysis of the sales growth has resulted in the following linear model for natural logarithm of the sales:

$$\ln S = 0.049t + 2.230.$$

   (a) Find an exponential models for the sales. Explain steps, meaning of variables, units.

   (b) By what percentage do sales grow every year? Explain.

   (c) Calculate $S(6)$ and explain in practical terms the meaning of your answer.

   (d) At which point in time are sales expected to reach a level of $ 12,000 dollars?

2. Under certain conditions tsunami waves that encounter land will develop into what are called *bores*. The velocity V of the tip of a bore is proportional to the square root of its height h, with constant of proportionality k:

$$V = k \cdot h^{0.5}.$$

(a) How does the velocity of the tip compare with its initial velocity, when the height of the bore is reduced to half its initial height?

(b) How does the height of the bore compare to its initial height when the velocity of its tip is reduced to half of its initial velocity?

(c) If the tip of one bore is three times the height of another, how do their velocities compare?

(d) In a specific tsunami in Japan, a geophysicist measured that the tip of a bore which was 12 feet high was traveling at 25 miles per hour. Which model best describes the velocity V of the tip of a bore as a function of its height h for this specific tsunami?

3. The following table shows the diameter d and the height h (both in feet) of some types of trees:

Type	Cottonwood	Hackberry	Weeping Willow	Ponderosa Pine	Douglas fir
Diameter d	2.9	5.7	6.2	8.6	14.4
Height h	80	113	95	162	221

(a) Create a table showing the data for $\ln h$ versus $\ln d$.

(b) Make a **neat** plot of $\ln h$ versus $\ln d$. Make sure to label your axes.

(c) Find a formula for the regression line of $\ln h$ vs. $\ln d$.

(d) Find a formula that models h as a power function of d.

4. The following table gives the height h in inches and the weight w in pounds of an average adult male.

h	61	62	66	68	70	72	74	75
w	131	133	143	149	155	162	170	175

(a) Use logarithms to create a power model for weight versus height. Show all your steps.

(b) If the height is increased by 10%, what percentage increase in weight can be expected according to your model?

(c) If the weight is increased by 20%, by which percentage is the height expected to increase?