1. **(1 pt) mathbioLibrary/setABiocLabs/Lab121_E2_biodiversity.pg**
Because of the accuracy of WebWork, you should use 5 or 6 significant figures on all problems.

Currently there is a debate on the importance of preserving large tracts of land to maintain biodiversity. Many of the arguments for setting aside large tracts are based on studies of biodiversity on islands. In this problem you apply the power rule to determine the number of species of herpetofauna (amphibians and reptiles) as a function of island area for the given Caribbean islands. You are given the following data [1]:

Island	Area (km^2)	Species
Redunda	2.4	3
Saba	12.5	8
Montserrat	84.8	10
Puerto Rico	8898	40
Cuba	121132	101

a. Let N be the number of species and A be the area of the island, then the power law expression relating the number of species to the area of the island is given by

$$N = kA^a.$$

Use the power law under Excel's trendline to best fit the data above. The best fit coefficients, k and a, found by Excel are
$k =$ _____.
$a =$ _____.
Determine the sum of square errors between the species model and the data.
Sum of Square Errors = _____.

b. In your Lab Report, plot the data and the best power law fit. Show the formula for the best fitting model on the graph. How well does the graph match the data?

c. Next we want to fit a straight line to the logarithms of the data. From the allometric model above, we obtain the formula

$$\ln(N) = \ln(k) + a\ln(A).$$

In the table above, take the logarithm of the Number of Species ($\ln(N)$) and the logarithm of the Island Area ($\ln(A)$). Graph the ($\ln(N)$) vs ($\ln(A)$) with Excel's scatter plot, then apply a linear fit under trendline to see how this fits the data.
What is the value of the slope of this best fitting line?
Slope = _____.
What is the value of the $\ln(N)$-intercept?
Intercept = _____.

d. In your Lab Report, plot the logarithm of the data and the best straight line fit to these data. Show the formula for the best fitting linear model on the graph. How well does the graph match the data? Write a brief discussion of how the coefficients obtained in this manner compare to the ones found in Part a.

e. The Caribbean island of Dominica has an area of $287km^2$. Use the allometric model found above to determine the predicted number of species of herpetofauna on this island
Number of species on Dominica = _____.
If it is determined that Dominica has 14 species of herpetofauna on the island, then determine the percent error between the model and the actual number of species found. (Use the actual number of species as the best value in your percent error formula.)
Percent Error (species) for Dominica = _____.
Suppose that the island of Grenada has an area of $347km^2$. Use the allometric model found above to determine the predicted number of species of herpetofauna on this island
Number of species on Grenada = _____.
If it is determined that Grenada has 13 species of herpetofauna on the island, then determine the percent error between the model and the actual number of species found.
Percent Error (species) for Grenada = _____.
Now suppose that the Caribbean island of Jamaica is found to have 39 species of herpetofauna. Use the allometric model found above to determine the predicted an area km^2 of Jamaica.
Area of Jamaica = _____ km^2
The actual area of Jamaica is $11435km^2$. Use this information to determine the percent error between the model and the actual area. (Use the actual area as the best value in your percent error formula.)
Percent Error (area) for Jamaica = _____
Suppose that the Caribbean island of Hispaniola is found to have 91 species of herpetofauna. Use the allometric model found above to determine the predicted an area km^2 of Hispaniola.
Area of Hispaniola = _____ km^2
The actual area of Hispaniola is $76480km^2$. Use this information to determine the percent error between the model and the actual area.
Percent Error (area) for Hispaniola = _____

f. This problem helps address the importance of maintaining a large tract of land for the maintenance of biodiversity. Based on the allometric model computed above, determine a factor of how much a land area must increase to double the number of species supported by the environment.
Area is multiplied by _____ to double the number of species of herpetofauna in the Caribbean region.

g. Write a brief paragraph about this mathematical model. What does this model say about the size of land tracts needed to preserve biodiversity? How can this model be extended to different regions on Earth and different types of animals? Would you expect a similar power law relationship, and if so, which of the coefficients in a new model for a different set of species in a different geographic location is most likely to be similar to the one computed for the herpetofauna data?

[1] J. Mazumdar (1989), An Introduction to Mathematical Physiology and Biology, Australian Mathematical Society Lecture Note Series, Cambridge University Press, Cambridge.