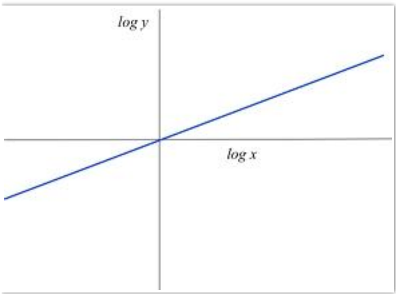
Instructions 1

You may use any course materials, websites, Netlogo models, calculators, etc. for this test. Just don't ask another person for the an share your answers with other people.

Question 2

Suppose you see the following graph (a log-log plot), where the slope of the line is equal to 1/2.



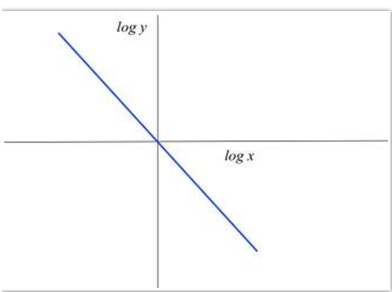
What power law does this correspond to?

- A. $y = x$
- B. $y = x^2$
- C. $y = x^{1/2}$
- D. $y = (1/2)\, x$

Question 3

Suppose you see the following graph, which plots the function

log y = -2 log x

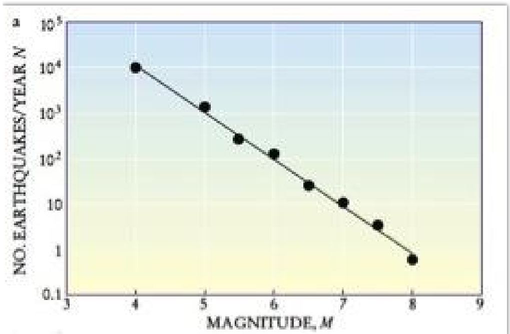


What power law does this correspond to?

- A. $y = -\, x$
- B. $y = x^{-2}$
- C. $y = -2\, x$
- D. $y = x^{-1/2}$

Question 4

Consider the following log-log plot of earthquake magnitudes recorded worldwide.(from http://www.physics.buffalo.edu/phy410505/2011/topic1/app2/index.html):



Which of the following is true, given the data in the plot?

- A. There are about 2 times as many magnitude 4 earthquakes as magnitude 5 earthquakes
- B. There are about 10 times as many magnitude 4 earthquakes as magnitude 5 earthquakes
- C. There are about 100 times as many magnitude 4 earthquakes as magnitude 5 earthquakes

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Question 5

The surface hypothesis states that metabolic rate is proportional to body mass raised to the 2/3 power.

Assume that the following equation is true:

metabolic rate = 4 * (*body mass*)$^{2/3}$

where *metabolic rate* is measured in watts and *body mass* is measured in kilograms.

Given this equation, what is the approximate metabolic rate of a 60 kilogram person?

Hint: **See the quiz in Unit 10.2 for instructions on how to use Google as a calculator for problems like this, or use the NetLogo mode PowerLawCalculator.nlogo, which is linked from the Course Materials page under "Unit 10".**

- A. 11 watts
- B. 61 watts
- C. 90 watts
- D. 98 watts

Question 6

Now assume Kleiber's law is true, that is, metabolic rate is proportional to body mass raised to the 3/4 power, and

assume that the following equation is true:

metabolic rate = 4 * (*body mass*)$^{3/4}$

where *metabolic rate* is measured in watts and *body mass* is measured in kilograms.

Given this equation, what is the approximate metabolic rate of a 60 kilogram person?

- A. 44 watts
- B. 57 watts
- C. 86 watts
- D. 105 watts

Question 7

Another observed scaling law mentioned in the lectures is that resting heart rate is proportional to body mass raised to the −1/4 pow
question, assume that:

heart rate = C * (*body mass*)$^{-1/4}$,

where heart rate is measured in beats per minute, and body mass is measured in kilograms.

Using a calculator or PowerLawCalculator.nlogo (on the Course Materials Page), find the constant C such that a 60 kg human will h
heart rate approximately 70 beats per minute.

Hint: **You can do this either via trial and error, or by solving an equation. In PowerLawCalculator.nlogo, set X to 60, alpha to −0.25,**
experiment with different values of C.

- A. C is about 100
- B. C is about 200
- C. C is about 300

Question 8

Using the same value of C that you found for question 6, find the predicted resting heart rate in beats per minute of a 7 kg dog.

(If you have a dog at home, measure the dog's heart rate to see if it is close to what the equation predicts!)

- A. About 123
- B. About 155
- C. About 203