Fall 20_HW04 — Semilog and double log plots

The handwritten homework assignment is **due** on Canvas on **Tuesday, September 1, by 11 pm**. The problems are similar to those from Section 1.4 of our textbook (problems 43 through 78 on pp. 52-53).

When submitting a written homework you will be required to follow these guidelines:

- the document must be in pdf format;
- you must either (a) have all problems in numerical order or (b) start every problem on the left side of the page so that the TA can easily find the problems that s/he chooses to grade.

You will be penalized two points for not following these guidelines on every handwritten assignment.

Problem 1. When $\log y$ is graphed as a function of x, a straight line results. Graph the straight line given by the following two points

$$(x_1, y_1) = (0, 5) \qquad (x_2, y_2) = (3, 1)$$

on a log-linear plot. The functional relationship between x and y is: $y =$ _____.

(**Note:** The original x-y coordinates are given.)

Answer: $y = 5 \cdot 5^{-x/3} = 5 \cdot 0.58^x$

Problem 2. When $\log y$ is graphed as a function of x, a straight line results. Graph the straight line given by the following two points

$$(x_1, y_1) = (-2, 3) \qquad (x_2, y_2) = (1, 1)$$

on a log-linear plot. The functional relationship between x and y is: $y =$ _____.

(**Note:** The original x-y coordinates are given.)

Answer: $y = 3^{1/3} \cdot 3^{-x/3} = 3^{1/3} \cdot (3^{-1/3})^x = 1.44 \cdot 0.69^x$

Problem 3. When $\log y$ is graphed as a function of x, a straight line results. Graph the straight line given by the following two points

$$(x_1, y_1) = (0, 50) \qquad (x_2, y_2) = (2, 800)$$

on a log-linear plot. The functional relationship between x and y is: $y =$ _____.

(**Note:** The original x-y coordinates are given.)

Answer: $y = 50 \cdot 4^x$

Problem 4. Consider the relationship $y = 3 \times 10^{-2x}$ between the quantities x and y.
Use a logarithmic transformation to find a linear relationship of the form

$$Y = mx + b$$

between the given quantities.

$Y =$ _____ $\quad m =$ _____ $\quad b =$ _____.

Graph the resulting linear relationship on a log-linear plot.

Answer: $Y = \log y \qquad m = -2 \qquad b = \log 3$

Problem 5. Consider the relationship $y = 5 \times 2^{4x}$ between the quantities x and y.
Use a logarithmic transformation to find a linear relationship of the form

$$Y = mx + b$$

between the given quantities.

$Y =$ _____ $m =$ _____ $b =$ _____.

Graph the resulting linear relationship on a log-linear plot.

Answer: $Y = \log y \qquad m = \log 16 \qquad b = \log 5$

Problem 6. When $\log y$ is graphed as a function of $\log x$, a straight line results. Graph the straight line given by the following two points

$$(x_1, y_1) = (1, 2) \qquad (x_2, y_2) = (5, 1)$$

on a log-log plot. The functional relationship between x and y is: $y =$ _____.

(**Note:** The original x-y coordinates are given.)

Answer: $y = 2 \cdot x^{-(\log 2)/(\log 5)} = 2 \cdot x^{-0.43}$

Problem 7. When $\log y$ is graphed as a function of $\log x$, a straight line results. Graph the straight line given by the following two points

$$(x_1, y_1) = (4, 2) \qquad (x_2, y_2) = (8, 8)$$

on a log-log plot. The functional relationship between x and y is: $y =$ _____.

(**Note:** The original x-y coordinates are given.)

Answer: $y = \frac{1}{8}x^2$

Problem 8. When $\log y$ is graphed as a function of $\log x$, a straight line results. Graph the straight line given by the following two points

$$(x_1, y_1) = (1, 20) \qquad (x_2, y_2) = (10,000, 20,000)$$

on a log-log plot. The functional relationship between x and y is: $y =$ _____.

(**Note:** The original x-y coordinates are given.)

Answer: $y = 20 \cdot x^{0.75}$

Problem 9. Consider the relationship $y = 2x^5$ between the quantities x and y.
Use a logarithmic transformation to find a linear relationship of the form

$$Y = mX + b$$

between the given quantities.

$Y =$ _____ $m =$ _____ $X =$ _____ $b =$ _____.

Graph the resulting linear relationship on a log-log plot.

Answer: $Y = \log y \qquad m = 5 \qquad X = \log x \qquad b = \log 2$

Problem 10. Consider the relationship $y = 4x^{-3}$ between the quantities x and y.
Use a logarithmic transformation to find a linear relationship of the form

$$Y = mX + b$$

between the given quantities.

$Y =$ _____ $m =$ _____ $X =$ _____ $b =$ _____.

Graph the resulting linear relationship on a log-log plot.

Answer: $Y = \log y$ $m = -3$ $X = \log x$ $b = \log 4$

Problem 11. The following table is based on a functional relationship between x and y that is either an exponential or a power function:

x	y
1	1.8
2	2.07
4	2.38
10	2.85
20	3.28

Use an appropriate logarithmic transformation and a graph to decide whether the table comes from a power function or an exponential function,

☐ power function ☐ exponential function

and find the functional relationship between x and y: $y =$ _____.

Answer: $y = 1.82x^{0.2}$

Problem 12. The following table is based on a functional relationship between x and y that is either an exponential or a power function:

x	y
-1	0.398
-0.5	1.26
0	3.98
0.5	12.59
1	39.8

Use an appropriate logarithmic transformation and a graph to decide whether the table comes from a power function or an exponential function,

☐ power function ☐ exponential function

and find the functional relationship between x and y: $y =$ _____.

Answer: $y = 3.98 \times 10^x$