

Math 122 Worksheet: Sections 1.8-1.9

Instructions: Answer all questions. Show all work and justify all your answers in **complete sentences**. Unless otherwise specified, **include the appropriate units in your answers** whenever units are included in the problem statement.

1 Section 1.8

Problem 1) For each of the following pairs of functions, find $f(g(x))$, $g(f(x))$, and $f(f(x))$.

(a) $f(x) = 5x - 1$ and $g(x) = 3x + 2$

(b) $f(x) = x - 2$ and $g(x) = x^2 + 8$

(c) $f(x) = 3x$ and $g(x) = e^{2x}$

Problem 2) Let $f(x) = x^2$ and $g(x) = 3x - 1$. Find the following:

(a) $f(2) + g(2)$

(b) $f(2) \cdot g(2)$

(c) $f(g(2))$

(d) $g(f(2))$

Problem 3) Use the following table to evaluate the following:

(a) $f(g(1))$

(b) $g(f(1))$

(c) $f(g(4))$

(d) $g(f(4))$

(e) $f(g(6))$

(f) $g(f(6))$

x	1	2	3	4	5	6
f(x)	5	4	3	3	4	5
g(x)	6	5	4	3	2	1

2 Section 1.9

Problem 4) Determine whether or not the function is a power function. If it is a power function, write it in the form $y = kx^p$ and give the values of k and p .

(a) $y = x/5$

(b) $y = 5\sqrt{x}$

(c) $y = 8/x$

(d) $y = 3^x$

(e) $y = (5x)^3$

(f) $y = 3x^2 + 4$

(g) $y = \frac{5}{2\sqrt{x}}$

Problem 5) Write a formula representing the function:

- (a) The strength S of a beam is proportional to the square of its thickness, h .
- (b) The energy E expended by a swimming dolphin is proportional to the cube of the speed, v , of the dolphin.
- (c) The average velocity v , for a trip over a fixed distance d , is inversely proportional to the time of travel.
- (d) The gravitational force F between two bodies is inversely proportional to the square of the distance between them.

Problem 6) The surface area of a mammal S satisfies the equation $S = kM^{2/3}$, where M is the body mass and the constant of proportionality k depends on the body shape of the mammal. A human of body mass 70 kg has surface area 18,600 cm².

1. Find the constant of proportionality for humans.
2. Then find the surface area for a human with body mass 60 kg.

Problem 7) Biologists estimate that the number of animal species of a certain body length is inversely proportional to the square of the body length.

- (a) Write a formula for the number of animal species N of a certain body length L .
- (b) Are there more species of large lengths or small lengths? Justify your answer.

Problem 8) Zipf's Law states that in a given country, the population of a city is inversely proportional to the city's rank by size in the country. Assuming Zipf's Law:

- (a) Write a formula for the population P as a function of its rank R .
- (b) If the constant of proportionality $k = 300,000$, what is the population of the largest city (rank 1)? What about the second largest city (rank 2)?
- (c) Repeat part (b) for $k = 6$ Million.
- (d) Interpret the meaning of the constant of proportionality in this context.