

Homework 8

Math 147, Fall 2023

This homework is due on Friday, October 13 (at the start of recitation). *Turn in (via Gradescope) your answers to questions 1–11.*

0. Read Sections 4.6–4.10

1. A **differential equation** is an equation involving a function and its derivative(s). (You can read more at the start of Section 4.9.) For which value(s) of r does $y = e^{rx}$ satisfy the differential equation $y + y' = y''$?

2. The equation $N(t) = N_0 2^t$ describes the population size of a colony of bacteria that doubles every unit of time.

(a) What does N_0 represent?

(b) Find a differential equation that $N(t)$ satisfies.

(c) Compute the **per-capita growth rate** $N'(t)/N(t)$.

3. Assume that $W(t) = W_0 e^{t \cos t}$ describes a population size at time t .

(a) Compute the (population) growth rate at time $t = 0$.

(b) Compute the per-capita growth rate at $t = 0$.

4. The radius of a spherical tumor is expanding at a constant rate of k millimeters per year. What is the growth rate of the volume when the radius is 10 millimeters?

5. (a) What is the derivative of

$$y = 3^{x \sin x}$$

at $x = \pi$?

(b) What is the *second derivative* of

$$y = \ln(1 - x)$$

at $x = -1$?

(c) Does

$$y = \cos(-x)$$

satisfy the differential equation $y = y''$? Explain.

(d) What is the derivative of the *inverse* of

$$y = x + \ln x$$

at $x = e + 1$?

- (e) Compute the derivative of $f(x) = x^2 + x^{\cos x} - (\ln x)^x$.
6. Section 4.6 # 14, 16, 20, 24, 25
 7. Section 4.7 # 4, 10, 14(b)
 8. Section 4.8 # 4, 10, 14, 38, 60, 70
 9. Section 4.9 # 2, 16, 40
 10. Section 4.10 # 4, 10, 60
 11. (a) Re-do any problems you missed on Exam 1.
(b) Write a paragraph reflecting on the exam. *How did you prepare for the exam? Which topics were you most/least confident about? Which problems on the exam did you feel good about? What surprised you about the exam? How do you feel about your performance on the exam? Which types of errors (if any) did you make? How will you prepare for the next exam? Any other reflections or comments?*
 12. (These problems are *not* to be turned in!)
 - (a) Section 4.6 # 1, 5, 9, 11, 15, 19, 21, 23, 25, 27
 - (b) Section 4.7 # 1, 5, 9, 13, 14(a,c), 15
 - (c) Section 4.8 # 1, 3, 5, 9, 13, 23, 25, 27, 29, 35, 39, 43, 53, 55, 59, 61, 63, 67, 69
 - (d) Section 4.9 # 1, 5, 9, 13, 17, 25, 31, 33, 37, 43, 47, 53, 55, 59, 61, 69, 71
 - (e) Section 4.10 # 5, 7, 9, 11, 13, 15, 22, 23, 33, 35, 39, 41, 45, 53, 65, 67, 73, 75, 77