

Name: _____

This exam covers chapters 6.1 - 6.5 and 7.1 - 7.4.

Directions: Complete all question and **show all applicable work.** Partial credit will be given.

1.) [13pts] A microphone converts sound waves into an electrical signal. If the electrical signal generated is given a equation $s(t) = \sin(t) + 2.5$, what is the average value of the signal during the first 6π seconds of the recording?

Name:

2.) [13pts] Create a graph of the direction field given by the differential equation $\frac{dy}{dx} = x + 2y$.

Name: _____

- 3.)** Let $f(x) = x^3$ and $g(x) = 2x - x^2$ and assume $x \geq 0$.
- (a) [3pts] Create a graph of $f(x)$ and $g(x)$. Be sure to label the intersection points.
 - (b) [10pts] Find the area of the region enclosed between $f(x)$ and $g(x)$.
 - (c) [13pts] Find the volume obtained by rotating the enclosed region of $f(x)$ and $g(x)$ about the x-axis.
 - (d) [13pts] Find the volume obtained by rotating the enclosed region of $f(x)$ and $g(x)$ about the y-axis.

Name: _____

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Name:

4.) [13pts] A race car's position on a track is given by the equations $x(t) = 3 \sin(t)$ and $y(t) = 4 \sin(t)$, where t is the time from the beginning of the race in hours, and x and y is the distance from a central point in kilometers. How far does the car travel during the half hour of the race?

Name: _____

5.) BONUS (5 pts): How far does the race car from the prior problem travel in 3 hours? Explain the extra details that need to be addressed to solve this problem.

Name: _____

6.) [15pts] A bacteria culture contains 200 cells initially and grows at a rate proportional to its size. After half an hour the population has increased to 360 cells.

- (a) Find the number of bacteria after t hours.
- (b) Find the number of bacteria after 4 hours.
- (c) Find the rate of growth after 4 hours.
- (d) When will the population reach 10,000?