Exam 1
Chapters 1 and 2.1-2.2

Answer the following questions. *You must show your work to receive full credit.* Be sure to make reasonable simplifications. Indicate your final answer with a $\boxed{\text{box}}$.

1. Annual sales of music CDs have declined since 2000. Sales were 942.5 million in 2000 and 384.7 million in 2008.

   (a) (6 points) Find a formula for annual sales, S, in millions of music CDs, as a linear function of the number of years, t, since 2000.

   (b) (2 points) Use the formula to predict music CD sales in 2012.

2. A company produces and sells shirts. The fixed costs are \$7000 and the variable costs are \$5 per shirt.

   (a) (4 points) Shirts are sold for \$12 each. Find cost and revenue as functions of the quantity of shirts, q.

   (b) (4 points) The company is considering changing the selling price of the shirts. Demand is $q = 2000 - 40p$, where p is price in dollars and q is the number of shirts. What quantity is sold at the current price of \$12?

   (c) (2 points) What profit is realized at this price of \$12?

3. (6 points) The antidepressant Prozac has a half-life of 3 days. What percentage of a dose remains in one day?

4. In 1923, koalas were introduced on Kangaroo Island off the coast of Australia. In 1996, the population was 5000. By 2005, the population had grown to 27,000, prompting a debate on how to control their growth and avoid koalas dying of starvation. Assume the koala population grows at a exponential rate.

(a) (6 points) Find a formula for the population as a function of the number of years since 1996.

(b) (2 points) Estimate the population in the year 2020.

5. The island of Manhattan was sold for $24 in 1626.

(a) (4 points) How much money would be in the account in 2012 if the yearly interest rate was 5% compounded continuously?

(b) (4 points) If the yearly interest rate was 6% compounded annually, in what year would the account be worth one billion dollars?

6. Consider the functions $f(x) = 5x - 1$, $g(x) = e^{2x}$, and $h(x) = x^2 + 8$. Find the following:

(a) (3 points) $f \circ g(x)$

(b) (3 points) $h(x + 2)$

(c) (3 points) $h(g(0))$

7. (4 points) Use the variable u for the inside function to express $P = \sqrt{5t^2 + 10}$ as a composite function.

**8.** Consider the function $f(x) = \frac{1}{x}$.

  (a) (6 points) Find the average velocity between $t = 2$ and $t = 2 + h$ if:

$$(i) \quad h = 0.1, \quad (ii) \quad h = 0.01, \quad (iii) \quad h = 0.001.$$

  (b) (3 points) Use your answers to part (a) to estimate the instantaneous velocity of the particle at time $t = 1$.

9. Consider the function g given below.

(a) (2 points) On what intervals is g positive?

(b) (2 points) On what intervals in g negative?

(c) (2 points) On what intervals is g' positive?

(d) (2 points) On what intervals in g' negative?
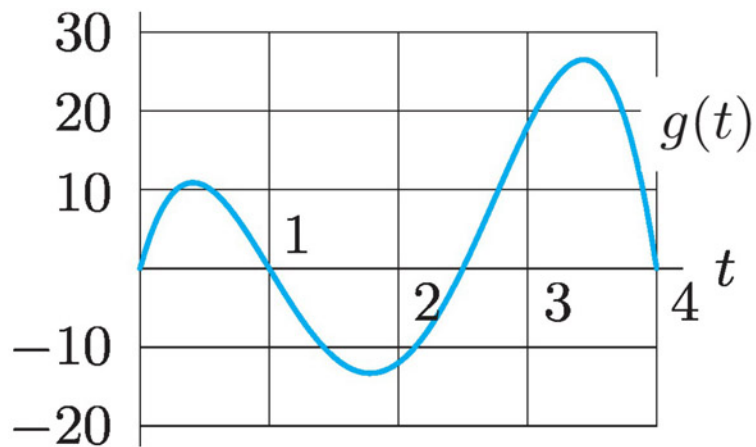
Bonus Question: If you could meet one person in history, who would it be and why?