Name: _____

Show your work. Answers without work earn reduced credit. This test has 100 points.

1. [**4 parts, 5 points each**] Solve the following equations for t *exactly*. Decimal approximations are worth partial credit.

   (a) $6^{-2t} = 8$.

   (c) $e^{5t} = 2^{t+1}$.

   (b) $9\left(\dfrac{3}{7}\right)^t = 8$.

   (d) $4\ln(8 - 3t) = 12$.

2. [**2 parts, 6 points each**] Tables for $f(x)$ and $g(x)$ appear below. Each function is either linear or exponential. Give a formula for each function.

(a)

x	4	5	6	7
$f(x)$	5	2	-1	-4

(b)

x	-1	0	1	2
$g(x)$	16	24	36	54

3. A movie theater incurs \$8000 in fixed expenses each day. Each customer costs the theater an additional \$2.00. The theater sells movie tickets for \$10.

(a) [**3 points**] Give a formula $C(q)$ for the cost (in dollars) of running the theater for a day when the theater sells q movie tickets.

(b) [**3 points**] Give a formula $R(q)$ for the revenue (in dollars) received on a day when q tickets are sold.

(c) [**6 points**] How many tickets must be sold in a day for the theater to break even?

4. In 2000, Town A had a population of 3 million. The population of Town A grows at a discrete rate of 4% each year. Town B had a population of 8.2 million in 2000 and declines at a discrete rate of 2.5% each year.

   (a) [**3 points**] Find a formula for the population P (in millions) of Town A.

   (b) [**3 points**] Find a formula for the population P (in millions) of Town B.

   (c) [**8 points**] What is the half-life of the population of Town B?

   (d) [**8 points**] When will the towns have the same population?

5. [**12 points**] The graph of a function $f(x)$ appears below. Sketch the derivative $f'(x)$. Your sketch of $f'(x)$ should capture the important features of $f'(x)$.
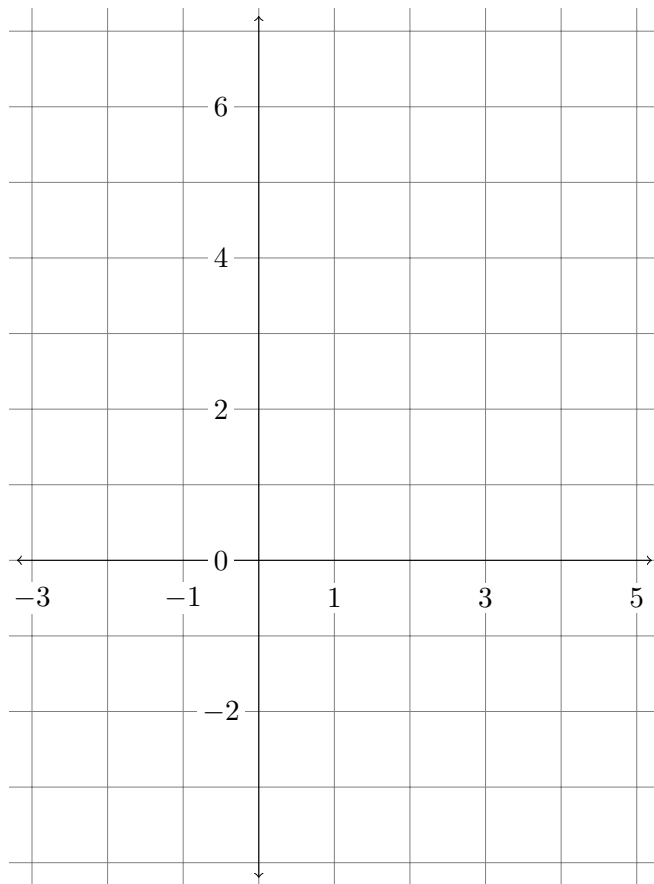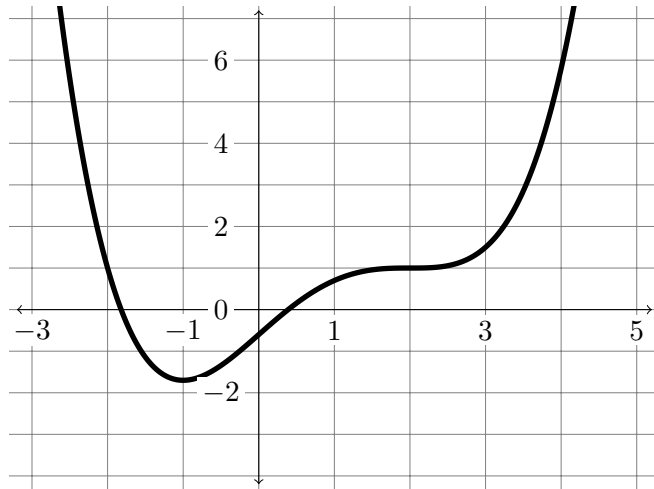
6. Let $f(x) = 4x^2$.

   (a) [**6 points**] Find the average rate of change of f over the interval $[1, 3]$.

   (b) [**14 points**] Find the average rate of change of f over the interval $[x, x + h]$.

   (c) [**2 points**] Using part (b), find $f'(x)$.