Name ________________________________

Seat # ________________________________

- Do not open this test booklet until told to do so.
- Turn off all cell phones.
- You are not allowed to borrow another student’s calculator during the test.
- Show your Student ID when you turn in your test.

Do not write below this line

#1 (6 points) _______________________
#2 (6 points) _______________________
#3 (8 points) _______________________
#4 (8 points) _______________________
#5 (12 points) _____________________
#6 (12 points) _____________________
#7 (16 points) _____________________
#8 (12 points) _____________________
#9 (12 points) _____________________
#10 (8 points) _____________________

Total (100 points) __________________
1. (6 points) Suppose \( f \) is a linear function with \( f(0) = 2 \) and \( f(2) = 8 \).

What is the value of \( f(4) \)?

(a) 0  (b) 2  (c) 4  (d) 6  (e) 8  (f) 10

(g) 12  (h) 14  (i) 16  (j) 18  (k) 24  (l) 32

2. (6 points) Suppose \( g \) is an exponential function with \( g(0) = 2 \) and \( g(3) = 6 \).

What is the value of \( g(6) \)?

(a) 0  (b) 2  (c) 4  (d) 6  (e) 8  (f) 10

(g) 12  (h) 14  (i) 16  (j) 18  (k) 24  (l) 32

3. (8 points) The population of a city is currently 2000. It is expected to decrease at a continuous rate of 6% per year. Which one of the following functions represents the city’s population \( t \) years from now?

(a) \( P(t) = 2000e^{0.06t} \)  
(b) \( P(t) = 2000e^{-0.06t} \)

(c) \( P(t) = 2000e^{0.94t} \)  
(d) \( P(t) = 2000e^{-0.94t} \)

(e) \( P(t) = 2000e^{1.06t} \)  
(f) \( P(t) = 2000e^{-1.06t} \)

(g) \( P(t) = 2000(0.06)^t \)  
(h) \( P(t) = 2000(0.94)^t \)

(i) \( P(t) = 2000(1.06)^t \)  
(j) \( P(t) = 2000 - 120t \)

4. (8 points) The population of a city is currently 100. It is expected to increase by 6 people per year. Which one of the following functions represents the city’s population \( t \) years from now?

(a) \( P(t) = 100(1.06)^t \)  
(b) \( P(t) = 100e^{0.06t} \)

(c) \( P(t) = 100(6)^t \)  
(d) \( P(t) = 100e^{1.06t} \)

(e) \( P(t) = 6t + 100 \)  
(f) \( P(t) = 100t + 6 \)

(g) \( P(t) = 106t \)  
(h) \( P(t) = 0.06t + 100 \)
5. (12 points) Suppose 800 milligrams of some drug was shipped from a producer to a hospital. This drug has a half-life of 10 hours. If it took 48 hours for the shipment to arrive, then how many milligrams of the drug actually arrived at the hospital? Show sufficient work to justify your answer and round your answer off to one place after the decimal point.

6. (12 points) By each graph, state whether $f'(2)$ is positive, negative, or zero.
7. (16 points) Production costs for a company which makes frisbees consist of a fixed overhead of $10,000 plus variable costs of $2 per frisbee. Each frisbee sells for $6.

(a) Find the total cost, \( C(q) \), and total revenue, \( R(q) \), as a function of the number of frisbees produced and sold.

(b) If this company produces and sells 800 frisbees, do they earn a profit or suffer a loss? What is the dollar amount of that profit (or loss)?

(c) What is the exact number of frisbees that this company must produce and sell in order to break even? (i.e., to have a profit of $0)?
8. (12 points) The net worth (in millions of dollars) for a company $t$ years after its formation is given by $A(t)$ in the table below.

<table>
<thead>
<tr>
<th>$t$</th>
<th>0</th>
<th>9.9</th>
<th>10.0</th>
<th>10.1</th>
<th>19.9</th>
<th>20.0</th>
<th>20.1</th>
<th>29.9</th>
<th>30.0</th>
<th>30.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A(t)$</td>
<td>800</td>
<td>1146.3</td>
<td>1150.0</td>
<td>1153.7</td>
<td>1673.2</td>
<td>1680.0</td>
<td>1686.8</td>
<td>2371.6</td>
<td>2380.0</td>
<td>2388.4</td>
</tr>
</tbody>
</table>

(a) What is the average rate at which net worth increased during the first 10 years? Give your answer in dollars per year.

(b) Approximate the instantaneous rate at which net worth was increasing 20 years after the formation of the company. Give your answer in dollars per year.
9. (12 points) Mary Ellen deposited $5000 in an account at an interest rate of 4.5% per year, compounded annually.

   (a) Find a formula for $A(t)$, the amount in her account $t$ years after the initial deposit.

   (b) How many years does it take for the amount in Mary Ellen’s account to reach a balance of $8000? Round your answer off to one place after the decimal point.

10. (8 points) **Without using a calculator**, solve for $x$ in the equation below. Show sufficient work to justify your answer.

    \[ \ln(x^6) - 2000 = 3000 - \ln(x^4) \]