1. Compute the derivative of each of the following functions.

   (i) $x^5$
   (ii) $1/x^2$
   (iii) $4^x$
   (iv) $x^8 + 4x^{3/2} + 1$
   (v) $x \ln x^2$
   (vi) $\ln(x^4 + 1)$
   (vii) $(x + 1)/(x - 1)$
   (viii) $(x^2(1 + x)^6)^2$
   (ix) $e^{x^2 + x}$
   (x) $x(x^2 + 1)(x - 1)^3$

2. Compute the second derivative of each of the following functions.

   (i) $x^4$
   (ii) $xe^x$
   (iii) $\ln(x + x^2)$

3. Find an antiderivative for each of the following functions.

   (i) $x^4$
   (ii) $x + \frac{1}{x}$
   (iii) $x^3(2 + x^4)$
   (iv) $x \ln(x^2 + 1)$
   (v) $e^{2x}$

4. Say whether each of the following formulas is true or false.

   (i) $\int \ln x \, dx = x \ln x - x$
   (ii) $\int (1 + x)e^x \, dx = xe^x$
   (iii) $\int \frac{1}{1+x^2} \, dx = \frac{x}{1+x^2}$
   (iv) $\int \frac{1}{x} \ln x \, dx = \frac{1}{2}(\ln x)^2$
5. Answer the following questions about the function \( f(x) = 3x^4 + 4x^3 - 12x^2 + 1 \) on the interval \(-3 \leq x \leq 3\).

   (i) What is \( f'(x) \)?
   (ii) Where are the critical points of \( f \)?
   (iii) List all local minimums of \( f \) (include endpoints).
   (iv) Where is the global minimum of \( f \) on this interval?
   (v) What is the minimum value of \( f \) on this interval?

6. The DERIVATIVE of \( f \) is graphed below. Answer the questions about \( f \).

   (i) At what interior points does \( f \) have a local maximum?
   (ii) If \( f(0) = 0 \), what is \( f(2) \)?
   (iii) Which is larger: \( f''(-2) \) or \( f''(2) \)?
   (iv) Where does \( f \) take its global maximum?
   (v) Evaluate \( \int_{0}^{3} f'(x) \, dx \).
   (vi) Evaluate \( \int_{0}^{3} f''(x) \, dx \).
   (vii) What is the maximum value of \( f'(x) \)?

7. Find the area under the graph of \( x^2 + 8 \) between \( x = -2 \) and \( x = 2 \).

8. The rate of flow of oil though a pipeline is measured every quarter of an hour. As the outside temperature cools, the rate of flow slows down and the data is given by the following table:

<table>
<thead>
<tr>
<th>time (in minutes)</th>
<th>0</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>60</th>
<th>75</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>rates (gallons per hour)</td>
<td>1000</td>
<td>900</td>
<td>800</td>
<td>750</td>
<td>700</td>
<td>700</td>
<td>650</td>
</tr>
</tbody>
</table>

   Assuming the rate is never increasing, given upper and lower bounds for total amount of oil which flowed through the pipe during the hour and a half of observations.

9. Suppose the second derivative \( F'' \) of \( F \) is given by the following graph. Assume that \( F'(0) = 0 \) and \( F(0) = 1 \). Answer the following questions:

   (i) What is \( F'(2) \)?
   (ii) What is \( F'(4) \)?
   (iii) Give a formula for \( F'(x) \) on \( 0 \leq x \leq 2 \).
   (iv) Give a formula for \( F(x) \) on \( 0 \leq x \leq 2 \? 
   (v) What is \( F(2) \)?