1. (1 point each) First, let’s see if you know the basic differentiation building blocks. Fill in the following table:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>$f$</td>
<td>$f'$</td>
<td>$f$</td>
<td>$f'$</td>
<td></td>
</tr>
<tr>
<td>$x^n$</td>
<td>$e^x$</td>
<td>$\ln(x)$</td>
<td>$\sin(x)$</td>
<td></td>
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<tr>
<td>$\cos(x)$</td>
<td>$\tan(x)$</td>
<td>$\cot(x)$</td>
<td>$\sec(x)$</td>
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</tr>
<tr>
<td>$\csc(x)$</td>
<td>$\arcsin(x)$</td>
<td>$\arctan(x)$</td>
<td>$\text{arcsec}(x)$</td>
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</tbody>
</table>

2. (4 points each) Suppose $h(x) = f(x)g(x)$ and that $F(x) = f(g(x))$. If $f(2) = 3$, $g(2) = 5$, $f'(2) = -2$, $g'(2) = 4$ and $f'(5) = 11$, find

(a) $h'(2)$

(b) $F'(2)$
3. (10 points) Find an equation of the tangent to $y = e^x$ that is parallel to the line $x - 4y = 1$.

4. (10 points) Suppose $f(3) = -1$ and $f'(3) = 5$. Find an equation for the tangent line to the graph of $f(x)$ at $x = 3$.

5. (10 points) Find the linear and quadratic approximation to

$$f(x) = \frac{1}{(x + 1)^2}$$

near 1.
6. (10 points) The graph of \( f(x) = x^3 - 4x + 1 \) shows a zero between \( x = 0 \) and \( x = 1 \). Starting with \( x = 0 \), perform two steps of Newton’s method for approximating this root of \( f \). Remember that you must show your calculations even if you do them on your calculator.

7. (5 points each) Evaluate the following limits: Be sure to show your algebraic simplifications and your applications of the theorems you used to obtain your answer. Calculator approximations will not suffice.

(a) \[ \lim_{x \to \infty} \frac{\ln(\ln(x))}{\ln(x)} \]

(b) \[ \lim_{x \to 0} \left(1 + .05x\right)^{1/x} \]

(c) \[ \lim_{x \to -\infty} \tan^{-1}(x^4) \]
8. (5 points each) Find the derivative of each of the following functions:
   
   (a) $f(x) = \sin^{-1}(\ln(x))$

   (b) $f(x) = 10^{\tan(x)}$

   (c) $f(x) = (\cos(x))^{\sin(x)}$

9. (10 points) Find a parabola $y = ax^2 + bx + c$ that passes through the point $(1, 4)$ and whose tangent lines at $x = -1$ and at $x = 5$ have slopes 6 and $-2$ respectively.