1. [6] TRUE/FALSE: Circle T in each of the following cases if the statement is *always* true. Otherwise, circle F. Let $f$ be a function and $x$ and $y$ be positive numbers.

<table>
<thead>
<tr>
<th></th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sqrt{4 + x} = 2 + \sqrt{x}$</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>$\log(y) = \frac{1}{y} y'$</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>$\frac{d}{dx}(s^2) = 2s$</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>$\frac{d}{dx}(2^x) = x 2^{x-1}$</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>$\frac{d}{dx}(\log_2(x)) = \frac{1}{x \ln 2}$</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>If $f$ is a continuous function, $f'$ exists.</td>
<td>T</td>
<td>F</td>
</tr>
</tbody>
</table>

Show your work for the following problems. The correct answer with no supporting work will receive NO credit (this includes multiple choice questions).

2. [5] Sketch the graph of an example function $f$ that satisfies the following conditions:

(a) $f$ is not differentiable when $x = -3$

(b) $f$ is continuous when $x = -3$

(c) $f(1) = 2$

(d) $f'(1) = -\frac{1}{2}$
3. [10] Let the graph of \( f \) and \( g \) be those shown below.

Estimate the following (if they exist):
\[
(f - 4g)'(3) \\
(g + f)'(2)
\]

\[
(f \circ g)'(1) \\
(f \cdot g)'(3)
\]
4. [14] Find the derivatives of the following and do not simplify.

\[ y = \sin(x) \cos(x) \]

\[ y = \sin(\cos(x)) \]

\[ y = \frac{x}{x^4 + 2} \]

\[ y = \left(\frac{x}{(4x - 3)^7}\right) \]

\[ y = (\sqrt{x})^x \]
5. [10] (§3.6 #69) The figure below shows a lamp located three units to the right of the $y$-axis and a shadow created by the elliptical region $x^2 + 4y^2 \leq 5$. The point $(-5,0)$ is on the edge of the shadow.

(a) [2] Find $\frac{dy}{dx}$ of the ellipse.

(b) [3] Denote the point that is both on the ellipse and the top dashed line by $(c, d)$. Notice that the slope of the top dashed line is thus $\frac{d-0}{c-(-5)}$. Use this information and what you found in part (a) to find the value of $c$.

(c) [5] Find the equation of the top dashed line and then find out the height of the lamp.
6. (§3.9 #21) [5] Ryan and Stella were being chased by a pack of zombies. At point $P$ they decided to split up and Stella ran south at 12 ft/s. Ryan waited for ten seconds to try to draw most of the zombies towards him and then started to run east at 15 ft/s. One minute later the two of them are still alive and running in their respective directions. At what rate are Ryan and Stella moving apart at this instant?