3. Table 1 below displays some values of an invertible, differentiable function \( f(x) \), while Figure 2 depicts the graph of the function \( g(x) \). Set \( h(x) = f(g(x)) \) and \( j(x) = \frac{f(x)}{g(x)} \).

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f(x) )</td>
<td>-5</td>
<td>-2</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>( f'(x) )</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>( f''(x) )</td>
<td>1</td>
<td>-1</td>
<td>-3</td>
<td>-2</td>
<td>0</td>
</tr>
</tbody>
</table>

Evaluate each of the following. To receive partial credit you must show your work!

(a) (4 points) \((f^{-1})'(2)\)

\[(f^{-1})'(2) = \frac{1}{f'(f^{-1}(2))} = \frac{1}{f'(3)} = \frac{1}{2}\]

(b) (4 points) \(h'(4)\)

By the chain rule, \( h'(x) = f'(g(x)) \cdot g'(x) \). Therefore,

\[h'(4) = f'(g(4)) \cdot g'(4) = f'(2) \cdot \frac{-1}{3} = -2\]

(c) (4 points) \(h''(4)\) [Hint: you may want to use your work from part (b).]

To find \( h'' \), we differentiate the formula we obtained for \( h'(x) \) in part (b). Using the product rule and the chain rule, we find

\[h''(x) = \left(f'(g(x))\right)' \cdot g'(x) + f'(g(x)) \cdot g''(x) = f''(g(x)) \cdot g'(x) \cdot g'(x) + f'(g(x)) \cdot g''(x) = f''(g(x)) \cdot (g'(x))^2 + f'(g(x)) \cdot g''(x)\]

Therefore, \( h''(4) = f''(2) \cdot \left(\frac{1}{3}\right)^2 + f'(2) \cdot 0 = \frac{2}{9} + 0 = \frac{2}{9} \approx -0.111 \).

(d) (4 points) \(j'(4)\)

By the quotient rule,

\[j'(x) = \frac{g(x) \cdot f'(x) - f(x) \cdot g'(x)}{g(x)^2}\]

Therefore,

\[j'(4) = \frac{g(4) \cdot f'(4) - f(4) \cdot g'(4)}{g(4)^2} = \frac{2 \cdot 3 + 4 \cdot \frac{1}{3}}{4} = \frac{11}{6} \approx 1.833\].