I. The following graph shows the derivative $y = f'(x)$ for some function $f(x)$.

A) (15) Using the information here, construct a “qualitative” plot of $y = f''(x)$.
B) (10) Over which intervals is $f$ increasing?
C) (5) Is $f'$ continuous at $x = 1$? Why or why not? What happens on the graph $y = f(x)$ at $x = 1$?

II. (10) The function $H(t)$ gives the number of hours of daylight $t$ days after the start of the year in Worcester. At $t = 304$ days (October 31 in a non-leap year), $H'(304) = -0.083$. Give the meaning of this equation as a sentence, using appropriate units.

B) (10) The table below gives the position $s$ (in miles) of a freight train moving along a straight line track as a function of time $t$ (in hours).

<table>
<thead>
<tr>
<th>$t$</th>
<th>.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s$</td>
<td>10</td>
<td>25</td>
<td>42</td>
<td>50</td>
<td>55</td>
</tr>
</tbody>
</table>

Estimate the train’s instantaneous velocity at $t = 1.5$ hours as closely as you can from this information.

III. (15) Using the limit definition, find $f'(x)$ for $f(x) = 1/x$.

IV. Find derivatives of each of the following functions by applying the appropriate “shortcut” derivative rules:

A) (10) $f(x) = 5x^7 - \frac{3}{\sqrt{x}} - 4^{2x}$
B) (10) $g(x) = (x^2 + 1)^{12}2^x$
C) (10) $h(x) = \frac{x^2}{e^x - 1}$

V. (5) Say whether the following statement is true or false, and explain your reasoning:
If the time interval is short enough, then we expect the average velocity of a car over the interval will be close to its instantaneous velocity at any time in the interval.