1. [11 points] Mad scientist Kiki LeBlanc is continuing her experiments with size-change technology. She is trying out her technology on ants. Below is a table showing some data for \( w \), the weight of an ant in grams, \( \ell \), the length of an ant in cm, and \( t \), the strength of an ant in marches (a unit of strength). Suppose \( t \) is a function of \( w \).

<table>
<thead>
<tr>
<th>( w )</th>
<th>0.1</th>
<th>0.25</th>
<th>1</th>
<th>2</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ell )</td>
<td>0.05</td>
<td>0.10</td>
<td>0.15</td>
<td>0.2</td>
<td>0.25</td>
</tr>
<tr>
<td>( t )</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

a. [3 points] Circle all statements that could be true given the information in the table. Any unclear answers will be marked incorrect.

- \( \ell \) could be a function of \( t \).
- \( t \) could be a function of \( \ell \).
- \( w \) could be a linear function of \( \ell \).
- \( \ell \) could be a function of \( w \).

b. [3 points] If the function \( f \) relates \( t \) and \( w \), i.e. \( t = f(w) \), could \( f \) be only concave up, only concave down, or is it not possible for \( f \) to be either only concave up or only concave down? Give a brief justification.

Solution: \( f \) could be only concave up because the average rates of change between consecutive values in the table are increasing.

(c) [3 points] Find the average rate of change of \( t \) between \( w = 0.25 \) and \( w = 2.5 \). Leave your answer in exact form, and don’t forget to include units.

The average rate of change of \( t \) between \( w = 0.25 \) and \( w = 2.5 \) is \( \frac{1}{2.25} \) marches/gram.

d. [2 points] Give a practical interpretation of the rate of change you found in part (c).

Solution: Our answer from (c) means that, on average, between weights of 0.25g and 2.5g, ants gain \( \frac{1}{2.25} \) of strength for each increase in weight of 1g.