Directions: As you follow along through the website, fill in the blanks of the missing definitions and concepts. There is also room for examples and practice problems, so don’t forget those!

An Introduction: There are two ways of representing motion along a line. Write or draw a description of each.

1. 

2. 

Position and Velocity:

Velocity is defined as the rate at which __________ changes in time. Because it is dependent upon which direction the object is moving, it can be both __________ and __________.

Theorem: \( v(t) = \) ______

The critical points of \( d(t) \), when \( v(t) = 0 \) indicate a possible change in ________. This is because the object is at ________.

Practice – Draw an arrow from the position or velocity functions to the correct statement!

\[
d(t) = \frac{1}{6}t^2 - 2t + 2 \quad \text{Object at permanent rest}
\]

\[
v(t) = t^2 - 16t + 64 \quad \text{(8,∞) Moving to the right}
\]

\[
d(t) = 6 \quad \text{(0, 8) and (8, ∞) Moving to the right}
\]

Speed is always ____________, and is the magnitude of velocity. Thus, \( s(t) = \) _____.
**Velocity and Acceleration:**

Acceleration is the rate at which __________ is changing. It is typically measured in ______.

Just because an object has negative acceleration does NOT imply that it is slowing down; conversely, just because an object has positive acceleration does not mean that it is speeding up.

Let’s break acceleration down into four types, depending on the signs of both velocity and acceleration. Draw a graphic of each which somehow represents the acceleration:

+Velocity, +Acceleration:

+Velocity, –Acceleration:

–Velocity, +Acceleration:

–Velocity, –Acceleration:

*Theorem*: \( a(t) = \) _____

The ______________________ of \( v(t) \) indicate possible changes in the sign of __________.

*Practice*: Find where the acceleration is changing if the velocity of an object is given by: \( v(t) = -4t^2 – 4t – 2 \).

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**Tying it all Together**

*Theorem*: \( a(t) = \) ______ = ______

If the position function is concave _______, this implies that acceleration in positive, while concave _______ implies that acceleration is negative.
**Matching Experiment:** Based on the 3 cars, record the data regarding position versus time. Your data doesn’t have to be completely accurate. Afterwards, you should draw a scatter plot of time versus position, and then match your plots with those on the website, and lastly, answer the questions about what you’ve found. Be careful – remember the warning about how acceleration can be tricky!

<table>
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<th>24</th>
<th>36</th>
<th>48</th>
<th>60</th>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<tr>
<td>Car 3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Scatter Plot – Car 1:*

*Scatter Plot – Car 2:*

*Scatter Plot – Car 3:*

**Questions to consider:**

1. Are any of the cars ever at a negative position?

2. Which cars have positive velocity?

3. Cars 1 and 2 share the same sign value for acceleration – is it positive or negative?

4. What’s the acceleration value for Car 3?