Key

Name:_____
Block:_____

Interpreting Velocity vs. Time Graphs

Recall:

$Slope = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1}$ and when the y-axis is distance and the x-axis is time, then:

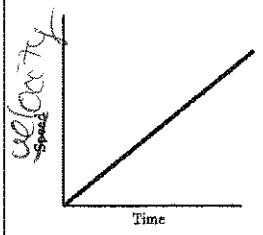
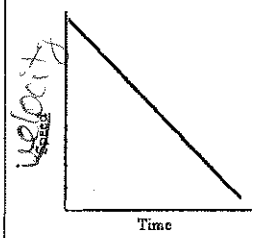
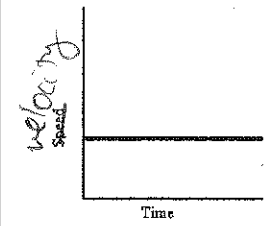
$Slope = \frac{d_2 - d_1}{t_2 - t_1} = velocity$, meaning that the slope represents the velocity

Now let's consider a velocity versus time graph. In this case, velocity is on the y-axis and time is on the x-axis so

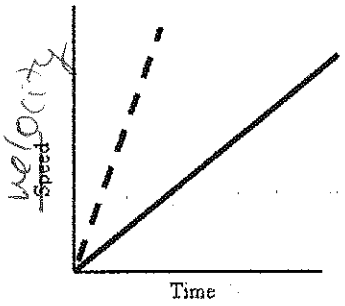
$Slope = \frac{v_2 - v_1}{t_2 - t_1}$

Does this look familiar? This is the same calculation for acceleration!

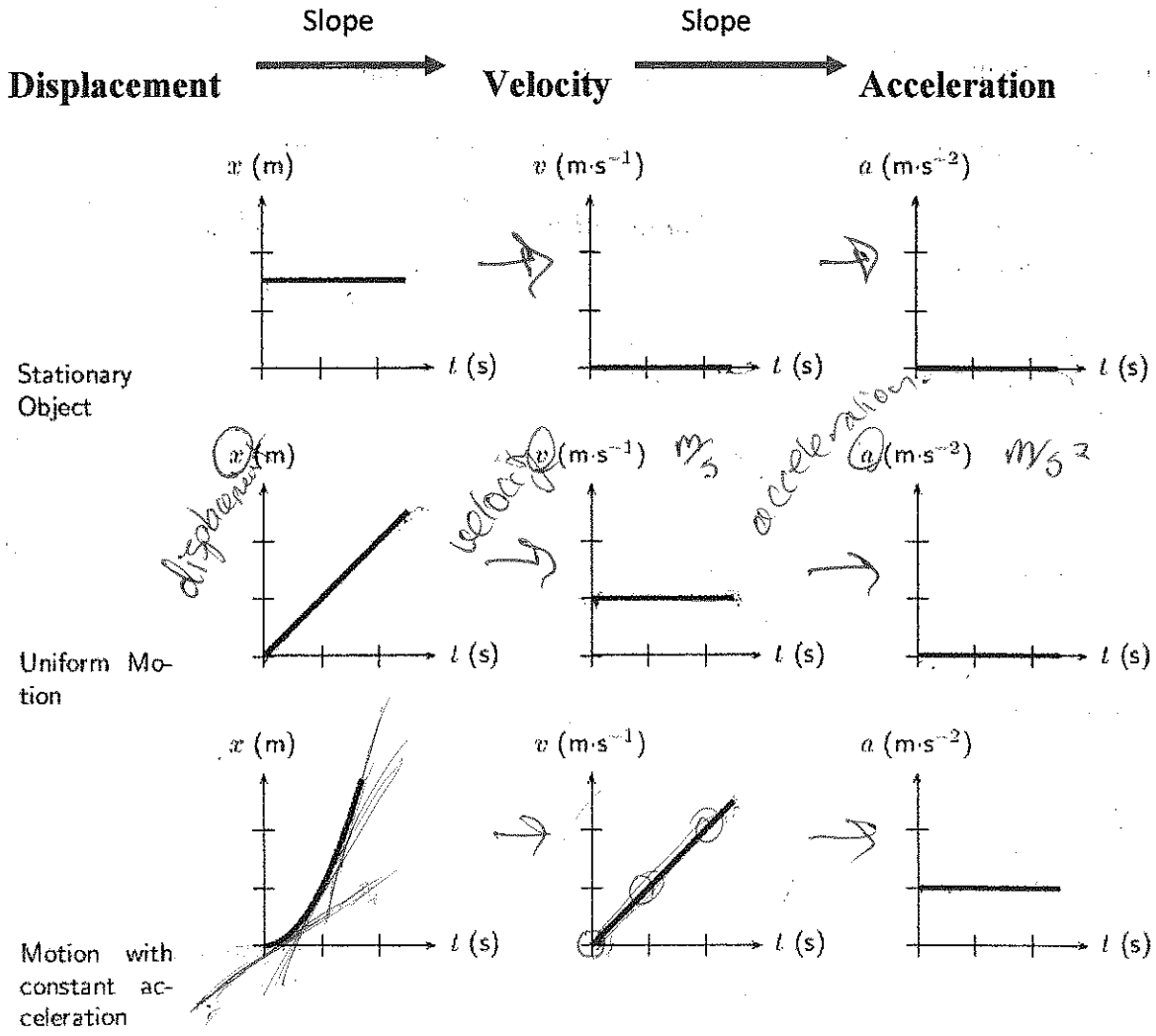
∴ the slope of a velocity versus time graph is equal to the acceleration.

Term:	Looks like:	Means:
Positive acceleration		accelerating in the positive direction
Negative acceleration		accelerating in the negative direction
Zero acceleration		travelling at a constant velocity

Which of these two objects has a greater acceleration? How do you know?



So to summarize, velocity is the slope of a displacement vs. time graph, and acceleration is the slope of a velocity vs. time graph. This means if we are given a displacement vs. time graph, we can sketch a velocity vs. time graph, and from this, we can sketch an acceleration vs. time graph.



But that's not all we can with graphs! Recall:

$\vec{a} = \frac{\vec{v}}{t}$ which we can rearrange to look like: $\vec{v} = \vec{a} \cdot t$

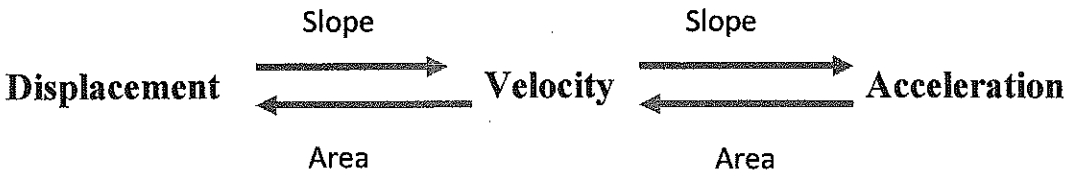
If we are looking at an acceleration vs. time graph where the y-axis is acceleration and the x-axis is time, multiplying these two values together will give us velocity. Also recall that multiplying a height (y-coordinate) by a width (x-coordinate) gives you area.

$\therefore$ The area under the curve of an acceleration vs. time graph is equal to the velocity

Similarly, on a velocity vs. time graph, multiplying the y-value (velocity) times the x-value (time) gives you displacement:

$\vec{v} = \frac{\vec{d}}{t}$ rearranged looks like, $\vec{d} = \vec{v} \cdot t$

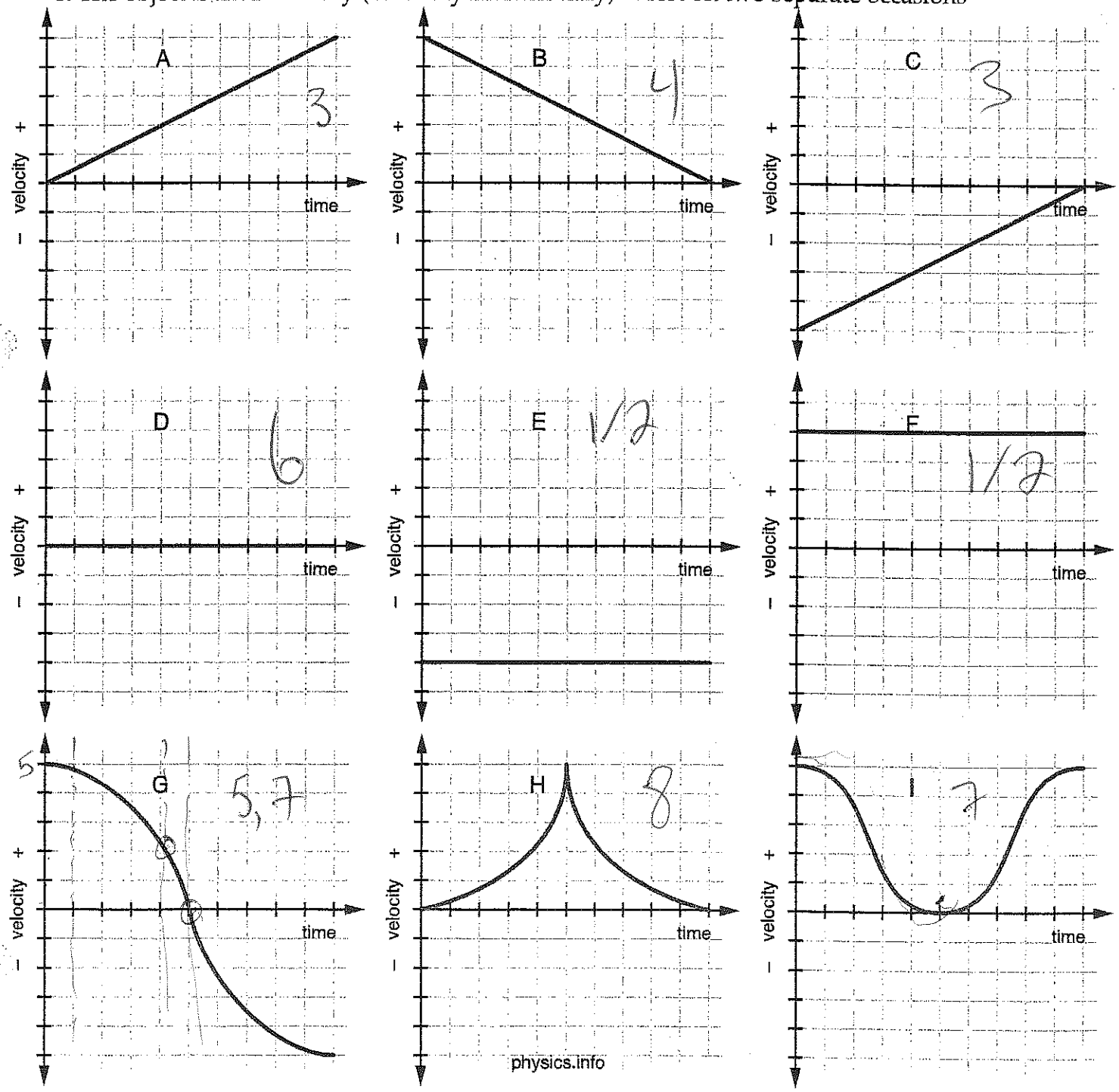
$\therefore$ The area under the curve of a velocity vs. time graph is equal to displacement



VELOCITY–TIME GRAPHS

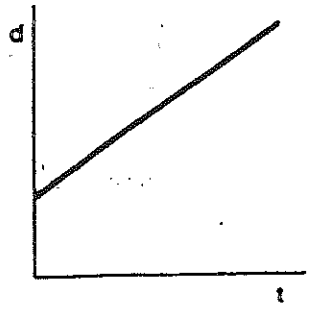
The graphs below show the velocity of a hypothetical object moving along a straight line. Choose the lettered graph that best represents each of the numbered descriptions. A graph may be used for more than one description or it may not be used at all. Some descriptions may correspond to more than one graph and some may not correspond to any graph at all. Be prepared to explain your choices.

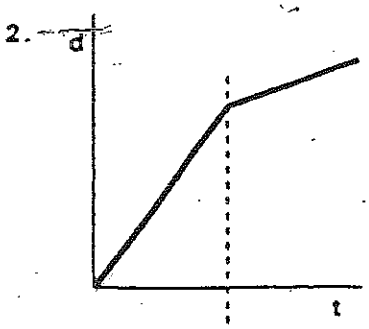
1. The object is moving away from position 0 at a constant velocity
2. The object is moving toward position 0 at a constant velocity
3. The object's velocity is increasing at a uniform rate
4. The object's velocity is decreasing at a uniform rate
5. The object changes direction
6. The object is standing still for an extended period of time
7. The object is momentarily (and only momentarily) at rest on one occasion
8. The object is momentarily (and only momentarily) at rest on two separate occasions

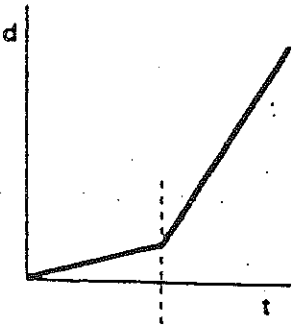


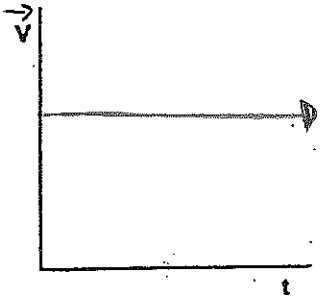
INTERPRETING GRAPHS

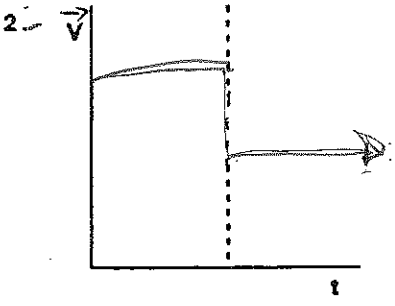
For each graph shown, draw the other graph or graphs for the same motion. Line up the times so that they correspond.

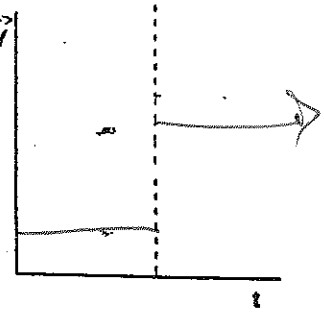
1. 

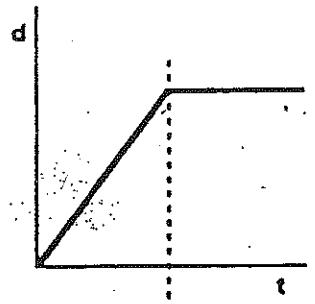
2. 

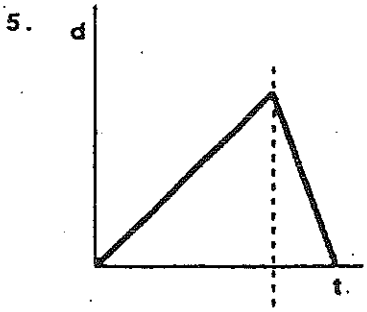
3. 

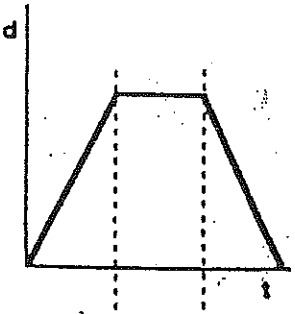
1. 

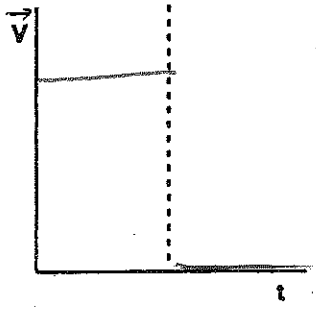
2. 

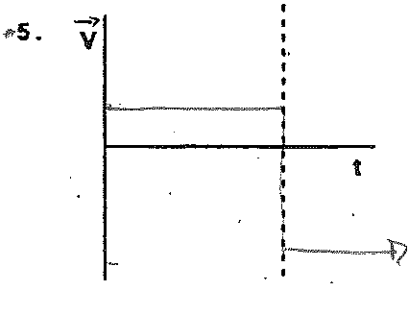
3. 

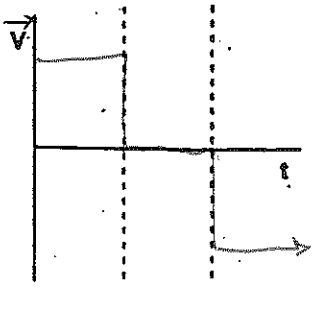
4. 

5. 

6. 

4. 

5. 

6. 

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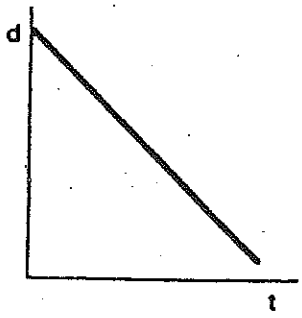

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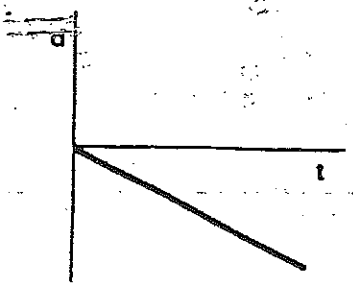

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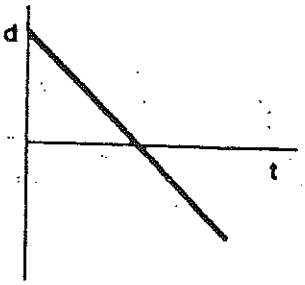

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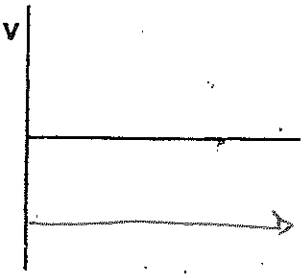

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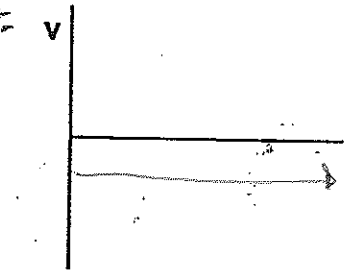

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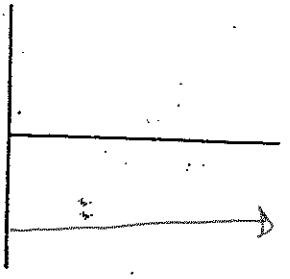

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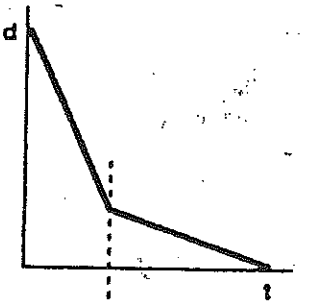

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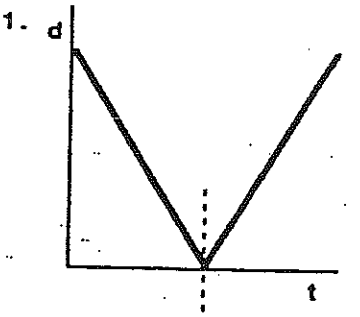

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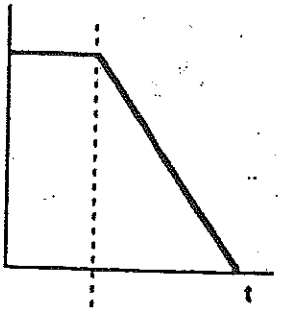

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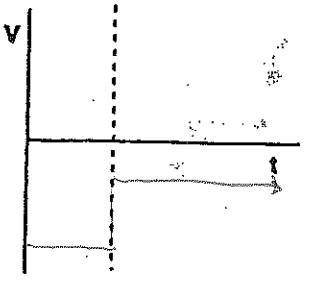

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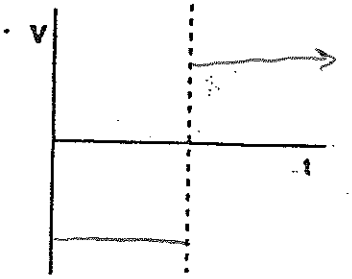

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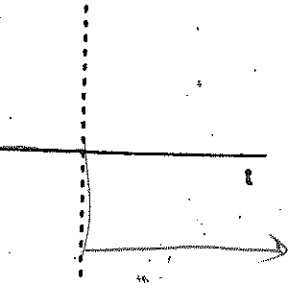


Name: _____ Date: _____

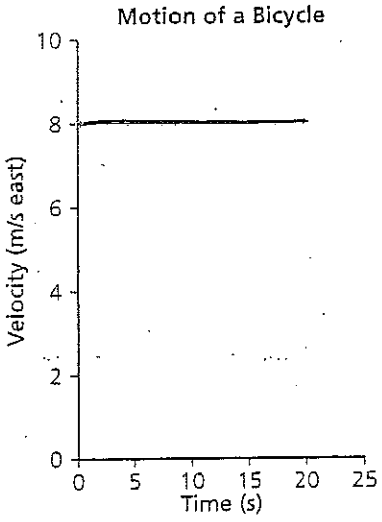
Graphical Calculation of Displacement

Area Under a Velocity–Time Graph = Displacement

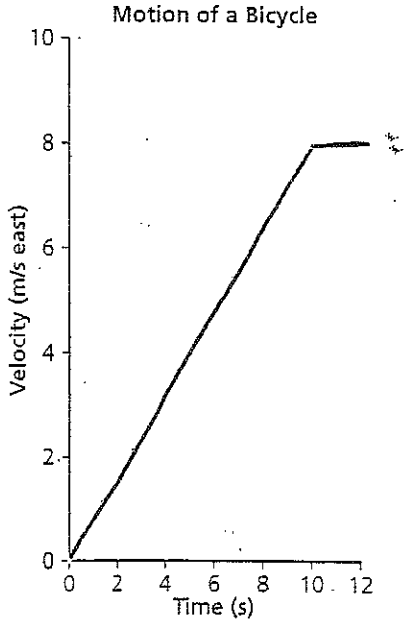
Formulas for Area:

Area of Rectangle	Area of Triangle
length × width	$\frac{1}{2}$ height × base

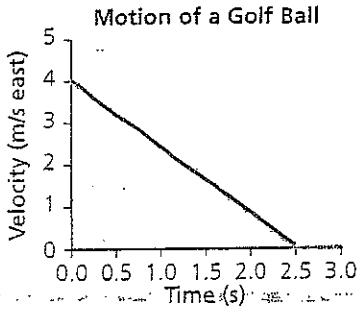
Case 1: Velocity is constant, positive



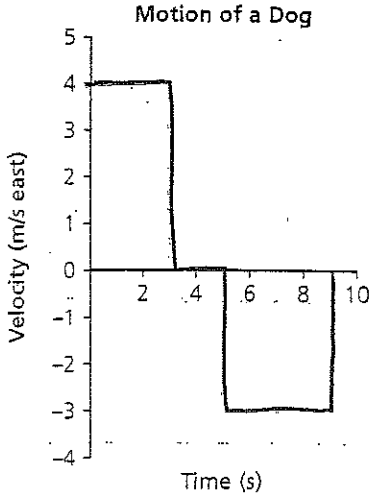
Case 2: Velocity is increasing

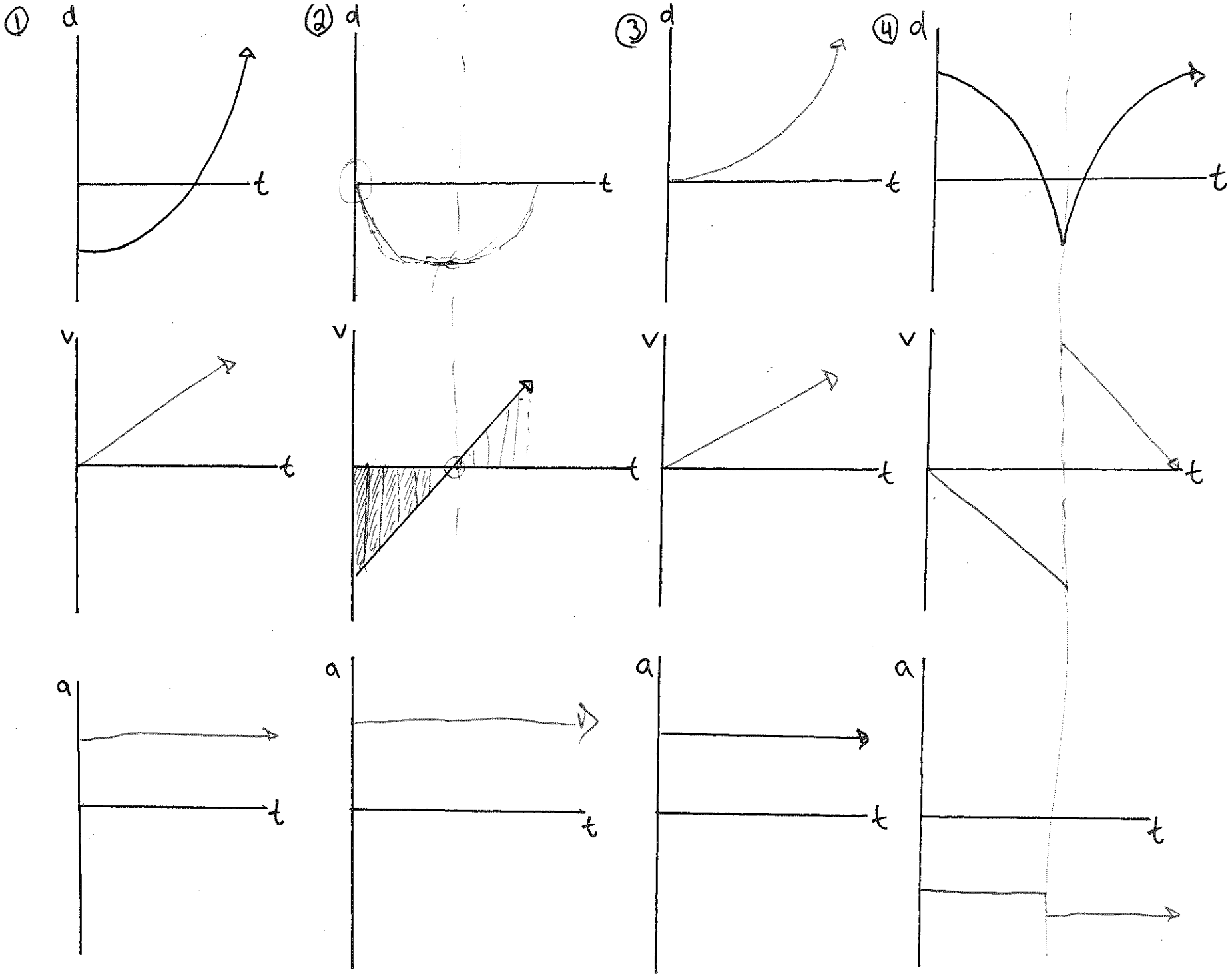


Case 3: Velocity is decreasing



Case 4: Velocity is constant, negative

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