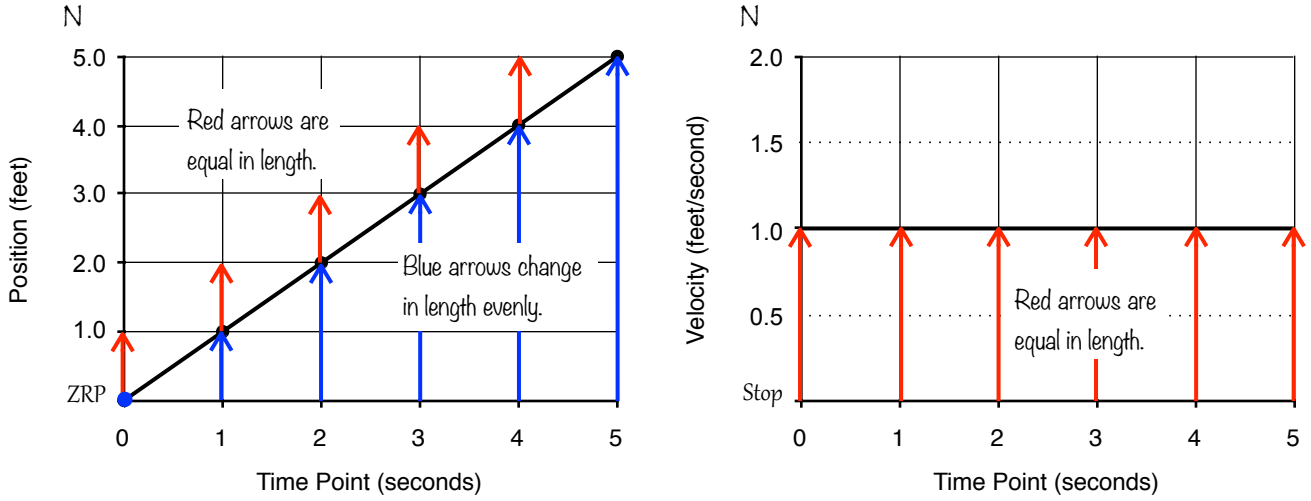
Name: _____

Lesson 3.8. The Velocity Graph

Date: _____ Period: _____

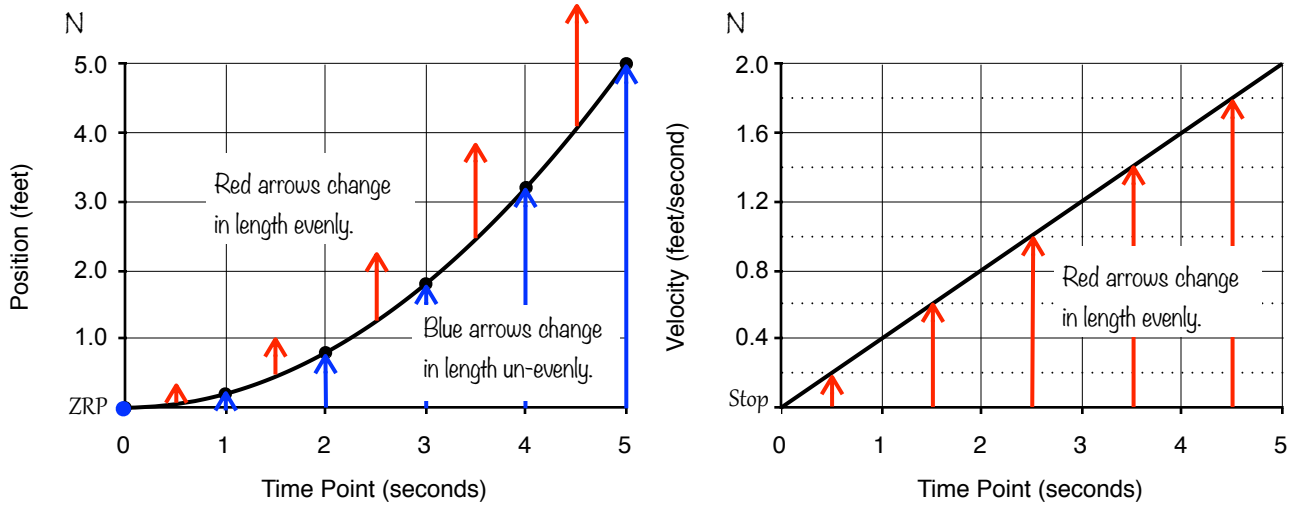
Introduction

Our model of *constant velocity motion* states that if an object travels equal distances during equal time intervals, then the velocity is constant. The *position* changes by equal amounts during during each time interval and the *velocity* is always the same. The position and time point data for such motion produces a *straight* trend line on the position graph. The trend line on the *velocity* graph is also straight, but it is horizontal because the velocity neither increases nor decreases.



Our model of *evenly changing velocity motion* states that if the *displacement* changes by an equal amount from one time interval to the next, then the velocity changes evenly. The blue *position* arrows change in length *un-evenly*, which causes the trend line on the position graph to curve. On the other hand, the *instantaneous velocity* changes by an *equal* amount during each time interval, so the trend line on the velocity graph is still *straight,* but inclined instead of horizontal.

(Have you noticed yet that whenever something changes **evenly**, the trend line on its graph is **straight**?)

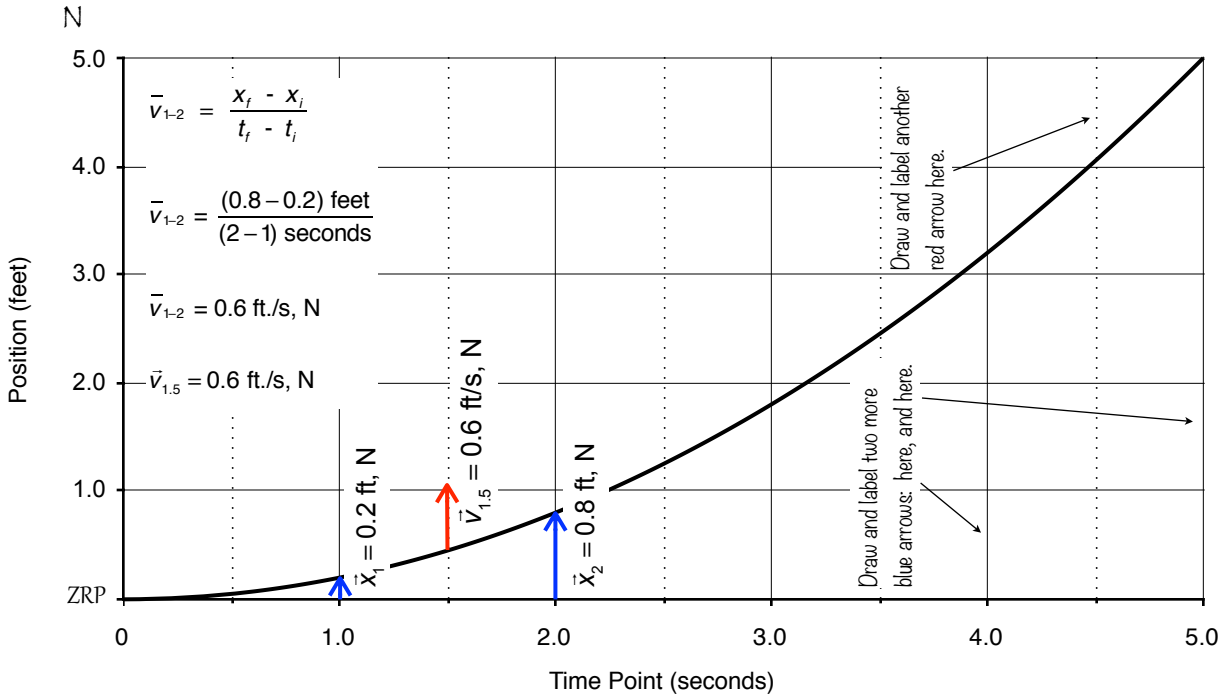


Drawing the Velocity Graph

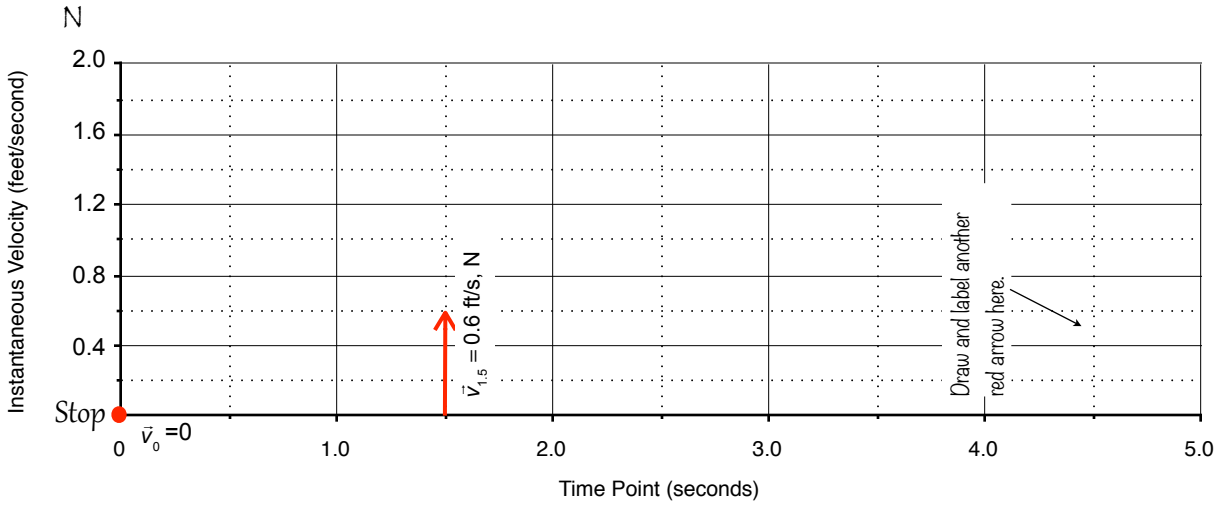
The position graph below represents the motion of an object that accelerated from rest.

Begin by determining the *average velocity* over ***two intervals***, one near the beginning of the trend line and one near the end of the trend line: t_i = 1.0 s to t_f = 2.0 s and t_i = 4.0 s to t_f = 5.0 s.

- ☐ ***Draw and label*** blue and green arrows and their dotted lines in order to calculate average velocity during the intervals. I have drawn the first two blue arrows for you. (*You're welcome.*)
- ☐ Determine the *average velocity* over each interval. Show ***one*** sample calculation right on the graph. Oops. I have already written it out for you. *You're welcome, again.* Please notice that there are ***four*** lines written. The fourth line shows where the value of *instantaneous velocity* comes from.
- ☐ ***Draw and label*** a red *instantaneous velocity* arrow at the ***midpoint in time*** of each of the ***two intervals***.



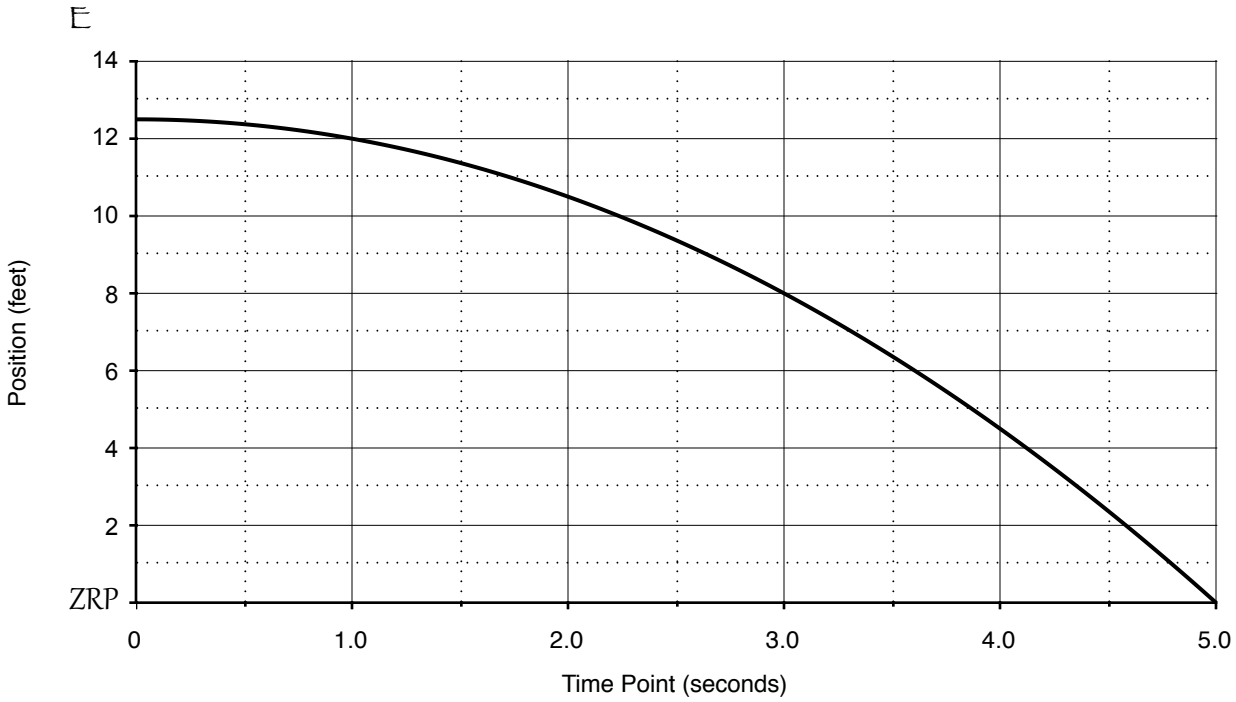
- ☐ ***Draw and label*** the two red arrows on the velocity graph.
  - Remember, *velocity* arrows always begin at Stop.
- ☐ Remember, the object accelerated ***from rest***. So, ***draw and label*** a red dot at Stop at t = 0 s.
- ☐ With your regular writing pencil, draw a straight trend line through the tips of the *instantaneous velocity* arrows.



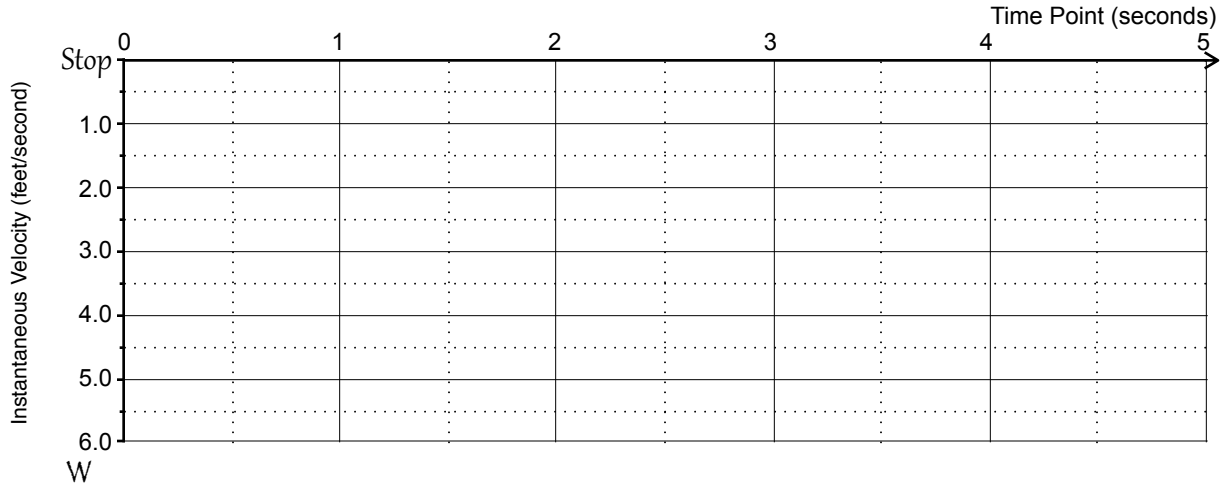
Practice 1

Begin by determining the *average velocity* over ***two intervals***, one near the beginning of the trend line and one near the end of the trend line: this time ***you*** pick the intervals!

- ☐ ***Draw and label*** blue and green arrows and their dotted lines in order to calculate average velocity during the intervals.
- ☐ Show ***one*** sample calculation right on the graph. You must write ***four*** lines!
- ☐ ***Draw and label*** a red *instantaneous velocity* arrow at the ***midpoint in time*** of each of the ***two intervals***.
  Think! In what direction did this object travel? In what direction do the red arrows point?



- ☐ ***Draw and label*** the two red arrows on the velocity graph.
  - Remember, *velocity* arrows always begin at Stop.
- ☐ When was the object at rest? At that time point, ***draw and label*** a red dot at Stop.
- ☐ With your regular writing pencil, draw a straight trend line through the tips of the *instantaneous velocity* arrows.

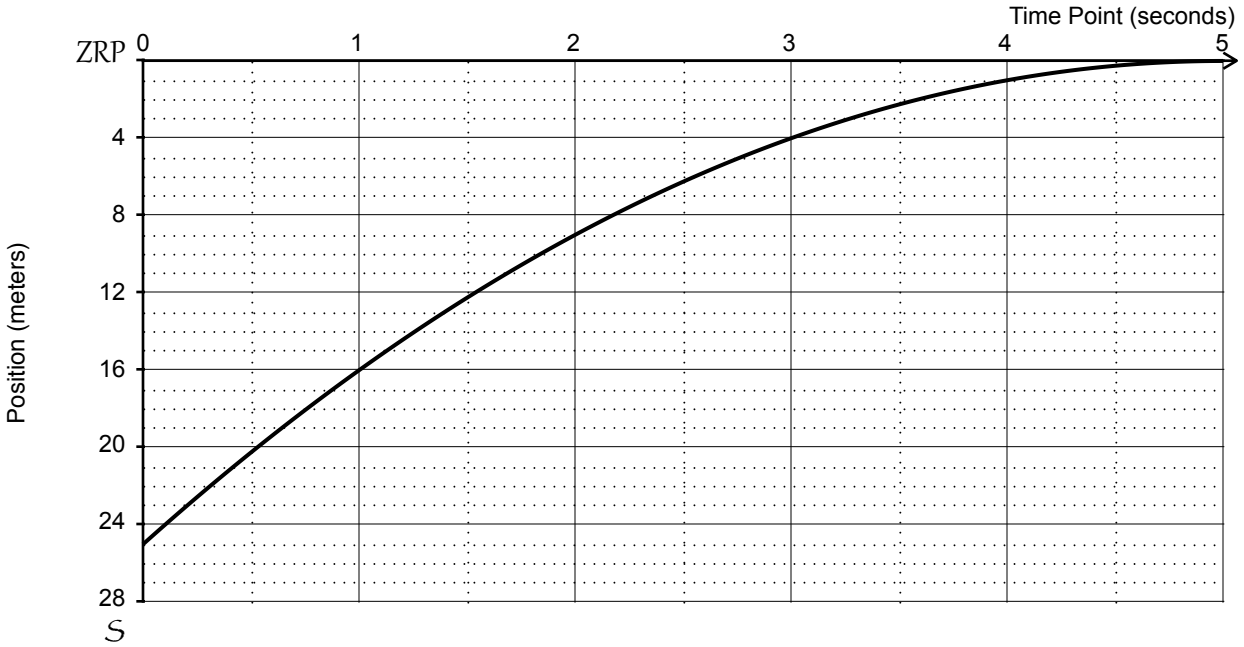


Answers: $\vec{v}_0 = 0.0$ ft./s; $\vec{v}_{0.5} = 0.5$ ft./s, W; $\vec{v}_{1.5} = 1.5$ ft./s, W; $\vec{v}_{2.5} = 2.5$ ft./s, W; $\vec{v}_{3.5} = 3.5$ ft./s, W; $\vec{v}_{4.5} = 4.5$ ft./s, W

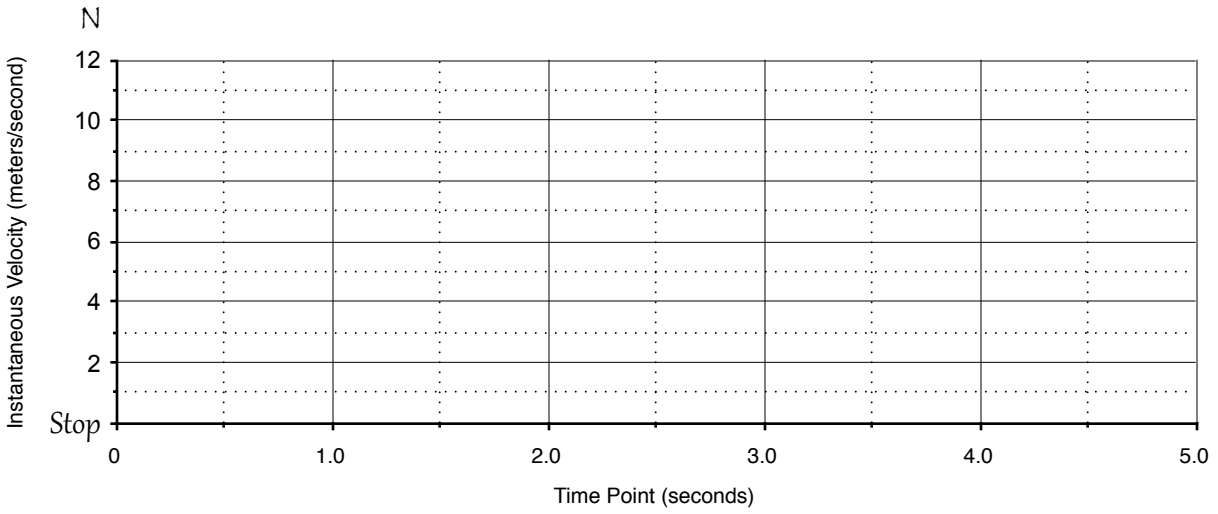
Practice 2

Begin by determining the *average velocity* over ***two intervals***, one near the beginning of the trend line and one near the end of the trend line: this time ***you*** pick the intervals!

- ☐ ***Draw and label*** blue and green arrows and their dotted lines in order to calculate average velocity during the intervals.
- ☐ Show ***one*** sample calculation right on the graph. You must write ***four*** lines!
- ☐ ***Draw and label*** a red *instantaneous velocity* arrow at the ***midpoint in time*** of each of the ***two intervals***.
  - ***Think!*** In what direction did this object travel? In what direction do the red arrows point?



- ☐ ***Draw and label*** the two red arrows on the velocity graph.
  - Remember, *velocity* arrows always begin at Stop.
- ☐ When was the object at rest? At that time point, ***draw and label*** a red dot at Stop.
- ☐ With your regular writing pencil, draw a straight trend line through the tips of the *instantaneous velocity* arrows.



Answers: $\bar{v}_{0.5} = 9.0$ m/s, N; $\bar{v}_{1.5} = 7.0$ m/s, N; $\bar{v}_{2.5} = 5.0$ m/s, N; $\bar{v}_{3.5} = 3.0$ m/s, N; $\bar{v}_{4.5} = 1.0$ m/s, N; $\bar{v}_{5} = 0.0$ m/s

Name: _____

Homework 3.8. The Velocity Graph

Date: _____ Period: _____

Please answer the following questions neatly, in pencil, ***right on the printed sheets!*** *I will not read messy work and I will not read work done in ink. Please express your ideas as complete thoughts in clear, declarative English sentences that connect the ideas in the question with the ideas in your answer. Make every pronoun refer unmistakably to a definite antecedent.*

I had to put the following questions on this page because of formatting and space considerations. Please answer them **after** *you have completed questions 1-3 on the following pages.*

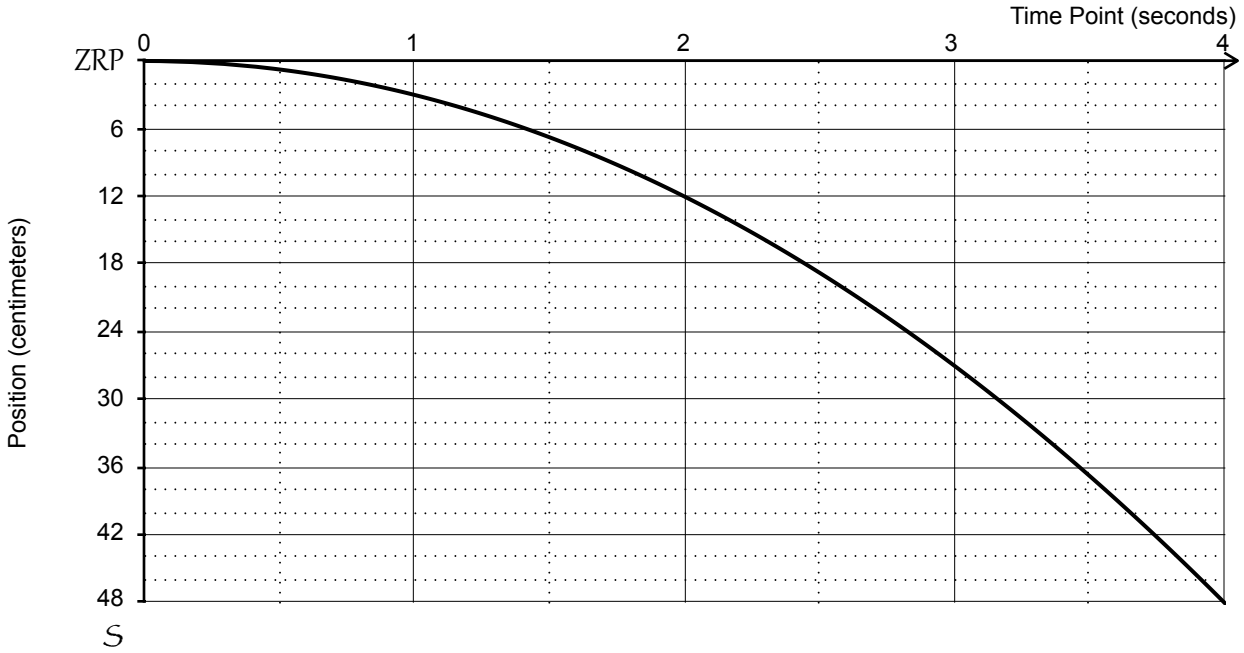
4) In words, describe the motion that is represented by the position and velocity graphs in question 1. Examples of written descriptions of motion may be found in *Lesson 3.1: The Position Graph*.

5) In words, describe the motion that is represented by the position and velocity graphs in question 2. Examples of written descriptions of motion may be found in *Lesson 3.1. The Position Graph*.

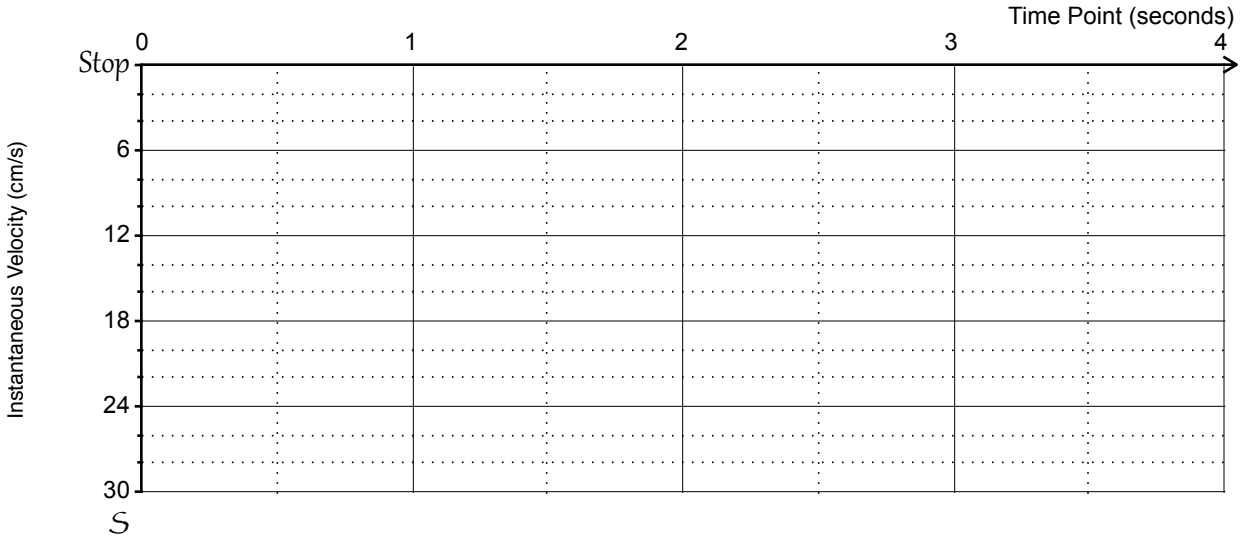
6) In words, describe the motion that is represented by the position and velocity graphs in question 3. Examples of written descriptions of motion may be found in *Lesson 3.2. The Position Graph*.

1) Begin by determining the *average velocity* over ***two intervals***, one near the beginning of the trend line and one near the end of the trend line: this time ***you*** pick the intervals!

- ☐ ***Draw and label*** blue and green arrows and their dotted lines in order to calculate average velocity during the intervals.
- ☐ Show ***one*** sample calculation right on the graph. You must write ***four*** lines!
- ☐ ***Draw and label*** a red *instantaneous velocity* arrow at the ***midpoint in time*** of each of the ***two intervals***.
  - ***Think!*** In what direction did this object travel? In what direction do the red arrows point?



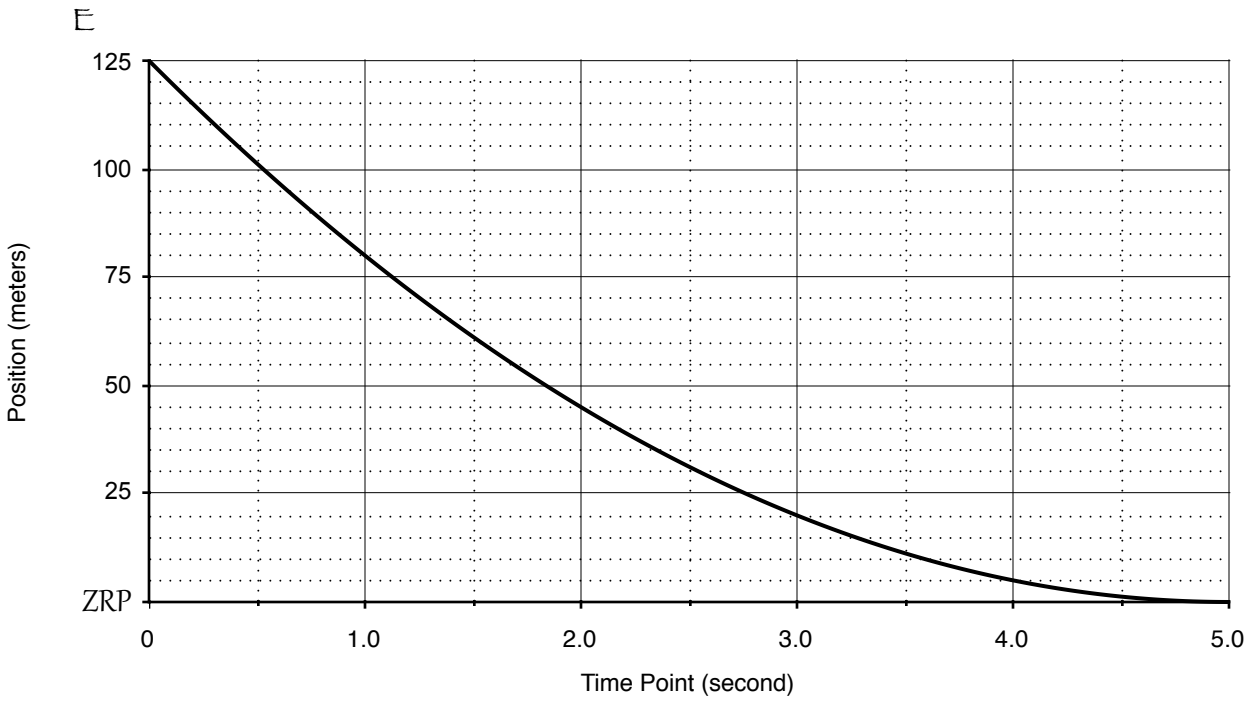
- ☐ ***Draw and label*** the two red arrows on the velocity graph.
  - Remember, *velocity* arrows always begin at *Stop*.
- ☐ When was the object at rest? At that time point, ***draw and label*** a red dot at *Stop*.
- ☐ With your regular writing pencil, draw a straight trend line through the tips of the *instantaneous velocity* arrows.



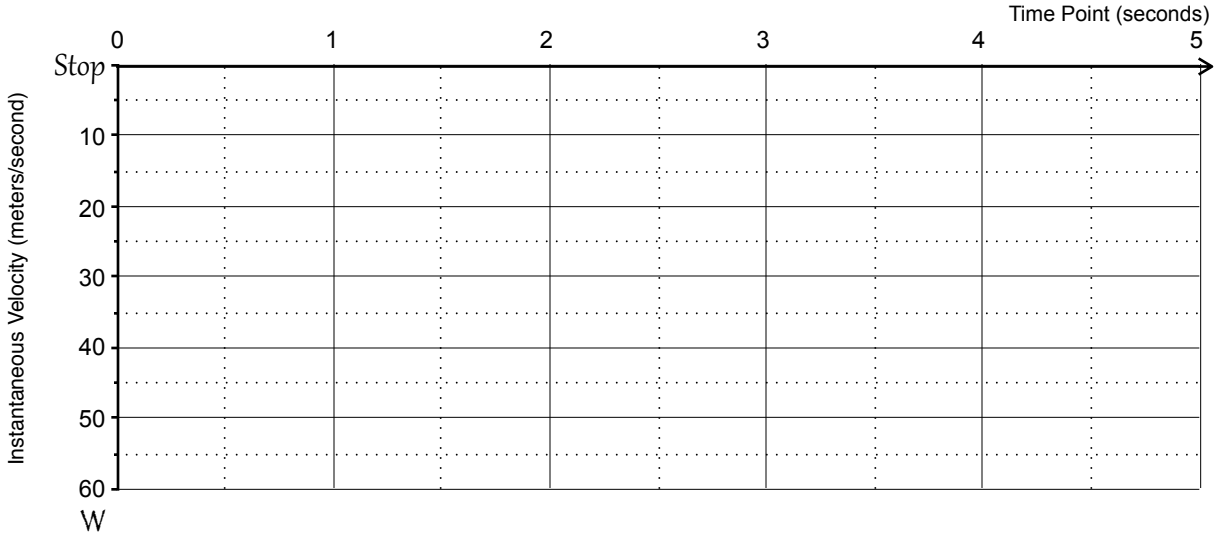
Answers: $\vec{v}_0 = 0.0$ m/s; $\vec{v}_{0.5} = 3.0$ m/s, S; $\vec{v}_{1.5} = 9.0$ m/s, S; $\vec{v}_{2.5} = 15.0$ m/s, S; $\vec{v}_{3.5} = 21.0$ m/s, S

2) Begin by determining the *average velocity* over ***two intervals***, one near the beginning of the trend line and one near the end of the trend line: this time ***you*** pick the intervals!

- ☐ ***Draw and label*** blue and green arrows and their dotted lines in order to calculate average velocity during the intervals.
- ☐ Show ***one*** sample calculation right on the graph. You must write ***four*** lines!
- ☐ ***Draw and label*** a red *instantaneous velocity* arrow at the ***midpoint in time*** of each of the ***two intervals***.
  - ***Think!*** In what direction did this object travel? In what direction do the red arrows point?



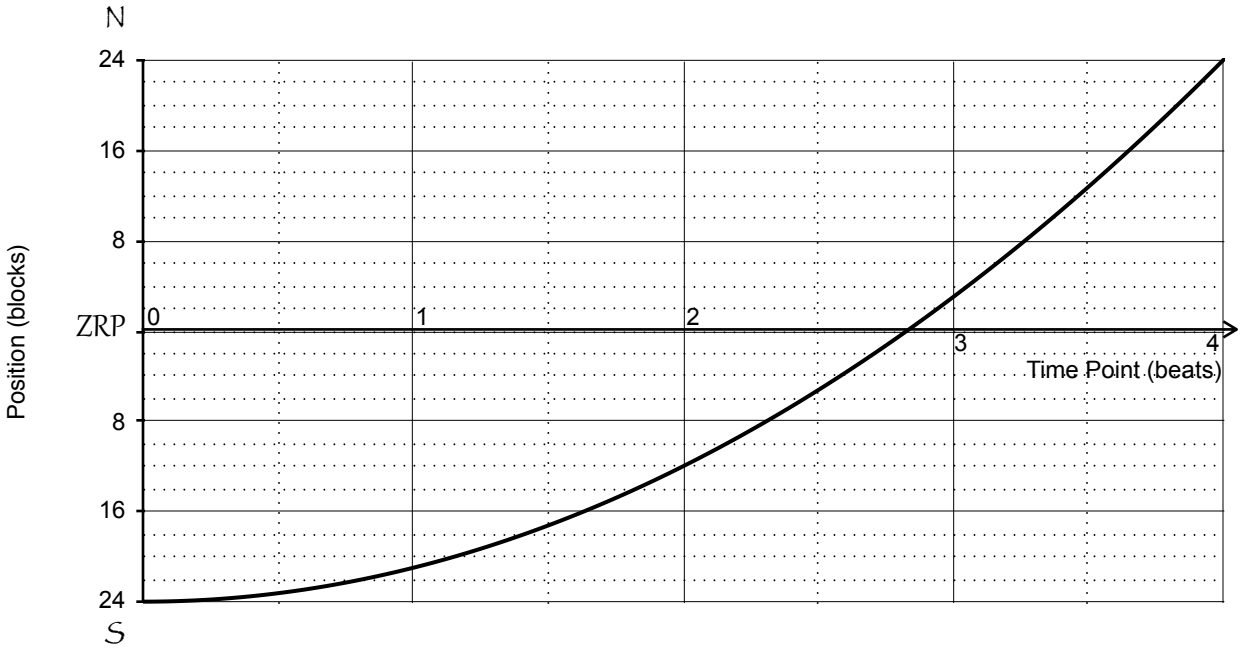
- ☐ ***Draw and label*** the two red arrows on the velocity graph.
  - Remember, *velocity* arrows always begin at *Stop*.
- ☐ When was the object at rest? At that time point, ***draw and label*** a red dot at *Stop*.
- ☐ With your regular writing pencil, draw a straight trend line through the tips of the *instantaneous velocity* arrows.



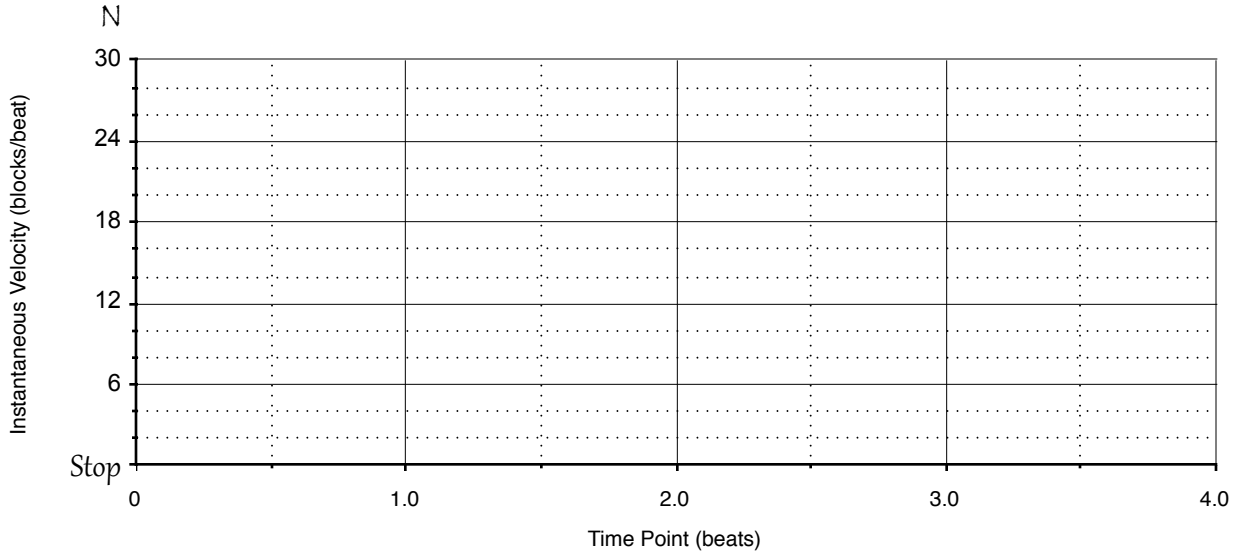
Answers: $\vec{v}_{0.5} = 45$ m/s, W; $\vec{v}_{1.5} = 35$ m/s, W; $\vec{v}_{2.5} = 25$ m/s, W; $\vec{v}_{3.5} = 15$ m/s, W; $\vec{v}_{4.5} = 5$ m/s, W; $\vec{v}_{5} = 0$ m/s

3) Begin by determining the *average velocity* over ***two intervals***, one near the beginning of the trend line and one near the end of the trend line: this time ***you*** pick the intervals!

- ☐ ***Draw and label*** blue and green arrows and their dotted lines in order to calculate average velocity during the intervals.
- ☐ Show ***one*** sample calculation right on the graph. You must write ***four*** lines!
- ☐ ***Draw and label*** a red *instantaneous velocity* arrow at the ***midpoint in time*** of each of the ***two intervals***.
  - ***Think!*** In what direction did this object travel? In what direction do the red arrows point?



- ☐ ***Draw and label*** the two red arrows on the velocity graph.
  - Remember, *velocity* arrows always begin at Stop.
- ☐ When was the object at rest? At that time point, ***draw and label*** a red dot at Stop.
- ☐ With your regular writing pencil, draw a straight trend line through the tips of the *instantaneous velocity* arrows.



Answers: $\vec{v}_0 = 0$ bl/b; $\vec{v}_{0.5} = 3$ bl/b, N; $\vec{v}_{1.5} = 9$ bl/b, N; $\vec{v}_{2.5} = 15$ bl/b, N; $\vec{v}_{3.5} = 21$ bl/b, N