

Name & Number (if applicable): _____

Unit 1 Learning Goals – One-Dimensional Motion

Goal Set 1:

Students will be able to analyze average velocity as displacement per unit of time ($v = \Delta x / \Delta t$) and can solve problems involving average velocity, displacement, and time.

4.0	I can analyze complex problems involving velocity.
3.0	I can analyze average velocity as displacement per unit of time ($v = \Delta x / \Delta t$) and can solve problems involving average velocity, displacement, and time.
2.0	I can recognize, recall, and explain specific vocabulary and concepts including: <ul style="list-style-type: none">• Distance, displacement• Speed, velocity• Instantaneous velocity, average velocity I am able to... <ul style="list-style-type: none">• Describe the multi-dimensional nature of the universe.• Distinguish distance from displacement by recognizing and generating examples that compare and contrast both.• Interpret and express direction using physics conventions.• Distinguish velocity from speed by recognizing and generating examples that compare and contrast both.• Distinguish instantaneous velocity from average velocity by recognizing and generating examples that compare and contrast both.
1.0	With help, partial success at 2.0 content

Check yourself:

Level 2.0

- 1.) Describe the dimensional nature of the universe:

- 2.) Define distance:

3.) Define displacement:

4.) Compare distance and displacement:

5.) Contrast distance and displacement:

6.) Generate one example in which distance and displacement are the same value:

7.) Generate one example in which distance and displacement are different values:

8.) Define speed:

9.) Define velocity:

10.) Compare speed and velocity:

11.) Contrast speed and velocity:

12.) Generate one example in which speed and velocity are the same value:

13.) Generate one example in which speed and velocity are different values:

14.) Define instantaneous velocity:

15.) Define average velocity:

16.) Compare instantaneous velocity and average velocity:

17.) Contrast instantaneous velocity and average velocity:

18.) Generate one example in which instantaneous velocity and average velocity are the same value:

19.) Generate one example in which instantaneous velocity and average velocity are different values:

20.) Go back to your previous answers and express direction in values for which it's appropriate to express direction.

Level 4.0

You are driving home from visiting a friend at college. You are traveling steadily at 65 miles/hr for 130 miles. It then begins to rain, and you slow to 55 miles/hr. You arrive home after driving for 3 hours and 20 minutes. (a) How far is your hometown from school? Express your answer in miles. (b) What was your average speed over the entire trip? (c) Why did question *b* ask for average speed instead of average velocity?

Goal Set 2:

Students will be able to analyze graphs of position vs. time to interpret information about velocity and displacement.

4.0	I can analyze complex graphs of position vs. time to interpret information about velocity and displacement.
3.0	I can analyze graphs of position vs. time to interpret information about velocity and displacement.
2.0	I can recognize, recall, and explain specific vocabulary and concepts including: <ul style="list-style-type: none">• Displacement, average velocity, instantaneous velocity I am able to... <ul style="list-style-type: none">• Plot graphs of position vs. time.• Calculate a slope.• Compare and contrast slopes by sight.
1.0	With help, partial success at 2.0 content

Check yourself:

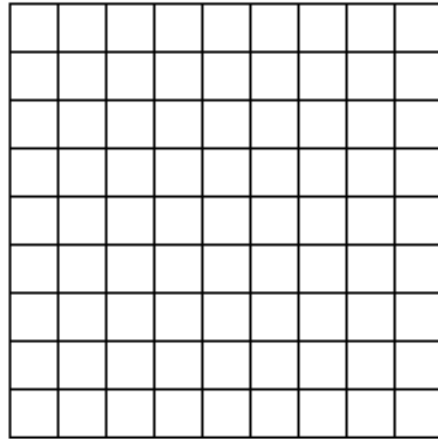
Level 2.0

- 1.) The following data represents the motion of a fresh bagel as it moves along a conveyer belt in a factory.

Position (m)	Time (s)
0	0
5	4
10	6
15	8

- a.) What is the total displacement?
- b.) What is the average velocity?
- c.) Identify the time period (if any) when the average velocity is the same as the instantaneous velocity.

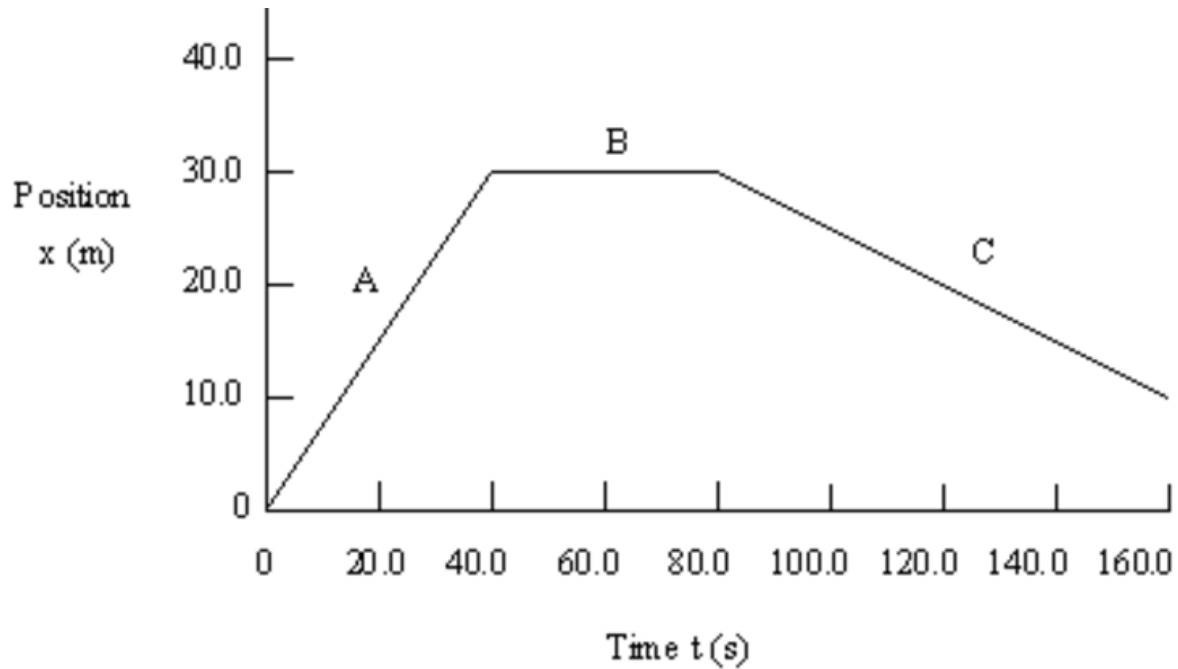
- d.) On the grid below, plot a graph of the position of the bagel as a function of time. Be sure to title the graph correctly and label the axes correctly.



- e.) Calculate the slope of the line of best fit of the data. Use units in your answer.

- f.) Identify the time period during which the slope of the plotted data (not the line of best fit) is steepest.

Level 3.0



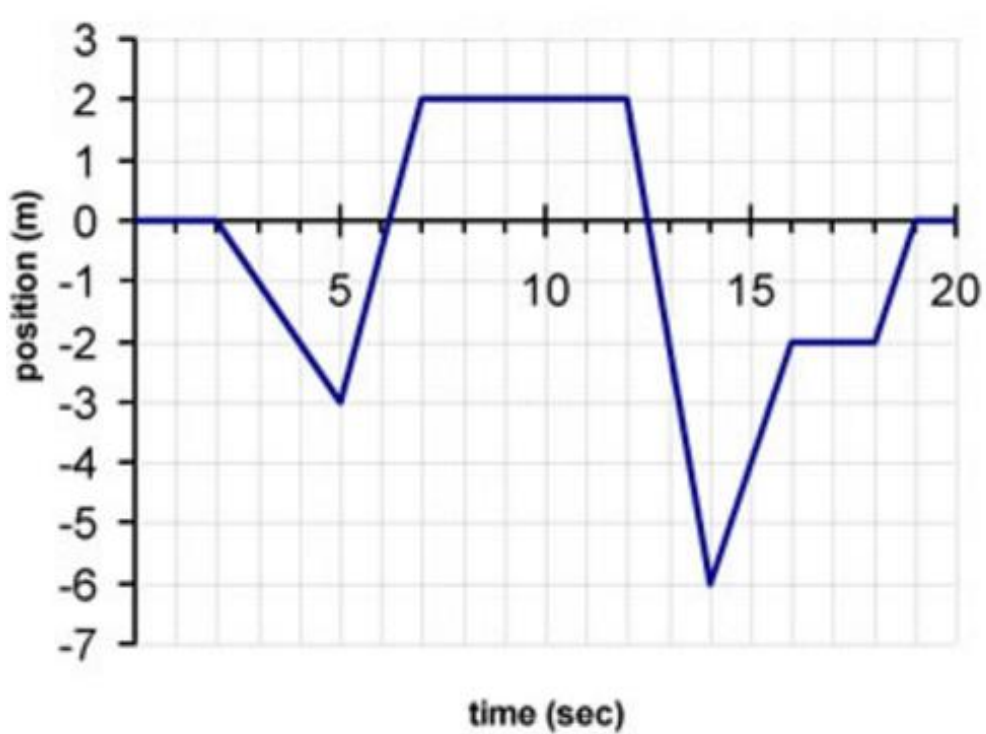
The following questions deal with the graph above which represents the straight-line motion of an object:

- 1.) What is the instantaneous velocity at a time of 20.0 seconds?
- 2.) How far does the object move in the first 40.0 seconds?
- 3.) How far does the object travel during the time interval 50.0 seconds through 70.0 seconds?
- 4.) Compare the average velocity during all 160.0 seconds to the following velocities in terms of greater than, less than, or equal
 - a.) Time period A:
 - b.) Time period B:
 - c.) Time period C:

- 5.) During which time interval does the object move the fastest?
- 6.) During which time interval does the object move the slowest?
- 7.) True or false: The object moves in the same direction the entire time.
- 8.) True or false: The object's position is sometimes negative.

Level 4.0

Write at least five conclusions you can draw from the graph below that depicts the straight-line motion of an object. Some of your conclusions must include information about positive v. negative position, direction of velocity, comparisons between the instantaneous velocities at a variety of time intervals, and comparison of the instantaneous velocity during one time interval with the average velocity during the entire time interval. Your conclusions do not have to include calculations but should refer to specific time intervals.



Goal Set 3:

Students will be able to analyze acceleration qualitatively, quantitatively, and graphically as change in velocity per unit of time ($a = \Delta v / \Delta t$) to determine its effect on motion.

4.0	I can analyze complex information (including graphs of position vs. time, velocity vs. time, and acceleration vs. time) to interpret information about acceleration, velocity and displacement.
3.0	Students will be able to analyze acceleration qualitatively, quantitatively, and graphically as change in velocity per unit of time ($a = \Delta v / \Delta t$) to determine its effect on motion.
2.0	I can recognize, recall, and explain specific vocabulary including: <ul style="list-style-type: none">• Displacement, average velocity, instantaneous velocity, acceleration I am able to... <ul style="list-style-type: none">• Plot graphs of displacement vs. time, velocity vs. time, and acceleration vs. time.• Calculate a slope.• Compare and contrast slopes by sight.
1.0	With help, partial success at 2.0 content

Check yourself:

Level 2.0

- 1.) Define acceleration qualitatively and semi-quantitatively¹.
- 2.) Describe your level of success with the 2.0 skills from Goal Set 2.

Level 3.0

- 1.) A sprinter accelerates from rest to 10.0 m/s in 1.35 seconds. What is her acceleration?

¹ Qualitatively in this context means referring to the concept without reference to formulas or numbers. Semi-quantitatively means referring to variables and formulas without using actual numbers.

2.) At highway speeds, a particular automobile is capable of an acceleration of 1.3×10^4 miles/hr². At this rate, how long does it take to accelerate from 50 miles/hr to 65 miles/hr? Express your answer in both hours and seconds.

3.) A cyclist moving at 15 m/s accelerates at -3.0 m/s^2 for 4.0 seconds. How fast is she going at the end of this time interval?

4.) Describe in the scenarios below whether the object is (A) Slowing down in the positive direction, (B) slowing down in the negative direction, (C) speeding up in the positive direction, or (D) speeding up in the negative direction. Circle A, B, C, or D as your answer.

(a) A child on roller skates is moving in the positive direction with a positive acceleration.

A B C D

(b) A pumpkin is pushed so that it rolls up a hill with a positive velocity, but it experiences a negative acceleration due to gravity and friction.

A B C D

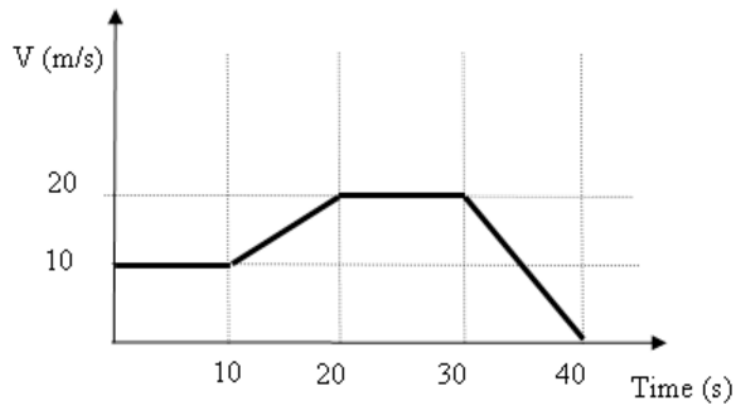
(c) An acorn falls off of a tree so that it accelerates downward due to gravity.

A B C D

(d) A car moving in reverse with negative velocity experiences a positive acceleration.

A B C D

The remaining questions refer to the following graph of the velocity as a function of time of an object moving in a straight line.



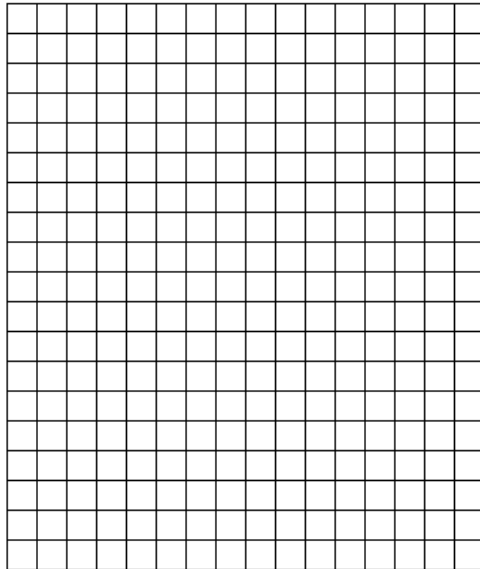
For each question 1-13, use the following multiple choice answer bank. There may be more than one right answer, so include all correct answers.

- A. 0 s to 10 s
- B. 10 s to 20 s
- C. 20 s to 30 s
- D. 30 s to 40 s
- E. All of the above
- F. None of the above

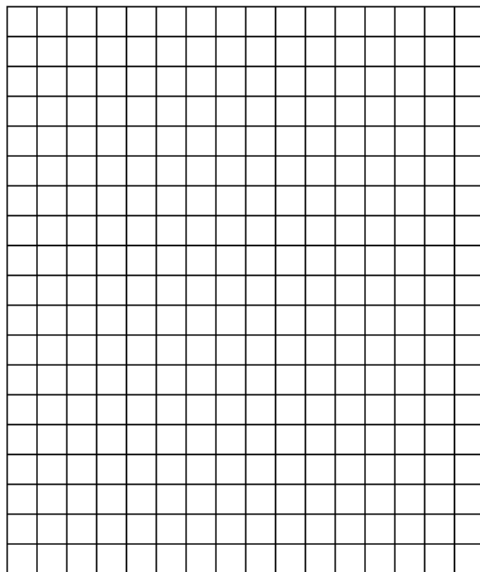
- 5.) During which time interval(s) is the object at rest?
- 6.) During which time interval(s) does the object have a positive velocity?
- 7.) During which time interval(s) does the object have a negative velocity?
- 8.) During which time interval(s) does the object have a positive acceleration?
- 9.) During which time interval(s) does the object have a negative acceleration?
- 10.) During which time interval(s) does the object have no acceleration?
- 11.) During which time interval(s) is the object speeding up?
- 12.) During which time interval(s) is the object slowing down.
- 13.) During which time intervals is the object changing direction?
- 14.) Calculate the acceleration during the 10 second to 20 second interval.

Level 4.0

- 1.) Plot a position as a function of time graph to represent the motion of the object from the previous set of questions. This graph simply needs to have the correct shape for each time interval. (In other words, you do not have to calculate the exact positions for the start and end of each interval.) Assume the initial position is 0 m.



- 2.) Plot an acceleration as a function of time graph to represent the same motion.



Goal Set 4:

Students will be able to analyze the motion of objects undergoing constant acceleration. This includes the ability to use the kinematic equations to analyze the relationship between any one of the following values based on the other values: displacement, initial velocity, final velocity, acceleration, time.

4.0	I can analyze complex problems involving multiple kinematic variables under complex situations. This includes analysis of objects falling in the presence of significant air resistance.
3.0	Students will be able to analyze the motion of objects undergoing constant acceleration. <ul style="list-style-type: none">• This includes the ability to use the kinematic equations to analyze the relationship between any one of the following values based on the other values: displacement, initial velocity, final velocity, acceleration, time.• This also includes analysis of freely falling objects in a vacuum or when air resistance is negligible.
2.0	I can recognize, recall, and explain specific vocabulary and concepts including: <ul style="list-style-type: none">• Displacement, average velocity, instantaneous velocity, acceleration, kinematics, free fall, g I am able to... <ul style="list-style-type: none">• Perform calculations involving the kinematic equations in order to solve for one unknown variable when given three of the five variables.
1.0	With help, partial success at 2.0 content

Check yourself:

Level 2.0

1.) Define kinematics:

2.) Define free fall:

3.) A car accelerates from 12m/s to 25 m/s in 6.0 s. Assume constant acceleration. How far did it travel in this time?

4.) A world-class sprinter can burst out of the blocks to a top speed of 11.5 m/s in the first 15.0 m of the race. What is the average acceleration of this sprinter?

Level 3.0

Questions 1 - 3 refer to question 3 (above.)

1.) Explain how your answer would be different if the velocity change occurred in half the time.

2.) What is the acceleration during the 6.0 s period referred to in the original problem?

3.) Another car undergoes the same acceleration for 6.0 s but is initially traveling in the opposite direction at -25 m/s. Will the car speed up or slow down? Explain.

The following questions no longer refer to the earlier question 3.

4.) An acorn drops from a small tree. Will air resistance significantly affect its rate of fall? Why or why not?

Level 4.0

Questions 1-5 refer to the following scenario: A leaf and an acorn both drop from the same height from the same tree at the same time. Assume there is no wind, but there is air.

- 1.) Which (if either) accelerates with a higher initial acceleration?
- 2.) Which (if either) accelerates for a longer period of time?
- 3.) Which (if either) reaches terminal velocity first?
- 4.) Which (if either) reaches a higher terminal velocity?
- 5.) Which (if either) hits the ground with a higher final speed?

Question 6 does not refer to the above scenario.

- 6.) A squirrel tosses a nut from a tree branch that is 5.5 m above the ground, and it falls into a nest that is 4.8 m above the ground. The squirrel tossed the nut with an initial upward velocity of 0.56 m/s. How long did it take the nut to reach the nest?

Chart your Progress

Goals Set 1



Goals Set 2



Goals Set 3



Goals Set 4

