AP Physics 1
Summer Assignment

Welcome to AP Physics 1! I am so excited you are challenging yourself and taking this class with me. We do many fun and engaging labs and activities all year long while learning the basics of college level physics. We will be working hard but it will be worth it! Here is the summer assignment to be completed before the first day of classes. You can do your work on a separate piece of paper or print it out on your own. I would do this over several days. We will start right away on Day 1. Have a great summer!!

1. Come down to room 206 and get a textbook from Mrs. Rees OR get a textbook from the counseling center. (during summer hours)
2. Read Pages # 5-28 in the textbook - **Ch. 1 - Representing Motion**
    a. Do the following questions on your own paper
        i. On pages 28-29 Do # 4 - 18, 26-30, and 33-37
        ii. Complete the AP Physics math review packet (you can print out or use your own paper)
            1. AP Physics 1 Summer Math Review Packet Link
3. Read Pages # 33-55 in the textbook - **Ch. 2 - Motion in One Dimension**
    a. Do the following questions on your own paper
        i. On pg. 65 Do # 5-13
        ii. On pg. 66 Do 19-21
        iii. On pg. 67 Do # 29,30,32,33 and 35
    b. Read pgs. 93-94 on Relative Velocity for one dimensions
4. Complete the Student Workbook 1A - 1H - Kinematics- One Dimension
    a. Here is a link for that - AP Classroom - Student Workbook 1A-1H
    b. I will hand this out to you.
5. Complete the AP Physics Summer Assignment from AP Classroom
    a. AP Classroom Summer Assignment - Multiple Choice Questions
    b. I will hand this out to you.

Name: _____

AP Physics Summer Math Review Homework

Conversion Factors

1. Convert each of the following length measurements to its equivalent in meters.
   a. 1.1 cm

   b. 76.2 pm

   c. 2.1 km

   d. 0.123 Mm

2. Convert each of the following mass measurements to its equivalent in kilograms.
   a. 147 g

   b. 11 mg

   c. 7.23 Mg

   d. 478 mg

3. Convert each of the following measurements into meters.
   a. 42.3 cm

   b. 6.2 pm

   c. 21 km

   d. 0.023 mm

   e. 214 mm

   f. 570 nm

Algebraic manipulation - Questions #1-5: Solve each equation for *r*.

1. $F_e = \frac{kq_1q_2}{r^2}$

2. $A = \pi r^2$

3. $C = 2\pi r$

4. $F_g = \frac{Gm_1m_2}{r^2}$

5. $a_c = \frac{v^2}{r}$

5.5. $\mathbf{T = 2\pi\sqrt{\frac{L}{g}}}$ Solve for L

Percent difference and percent error

6. Henry has completed his data collection for the latest physics lab. He has taken the following measurements of velocity of his toy car after 10 seconds:

    1. 12.3 m/s
    2. 12.8 m/s
    3. 11.9 m/s
    4. 13.1 m/s
    5. 12.5 m/s

What is his % difference for each measurement?

1.
2.
3.
4.
5.

7. If the known speed of the velocity of his car is 12.5 m/s what is his % error for the average measurement?

Workbook | 2021

Unit 1 - Kinematics

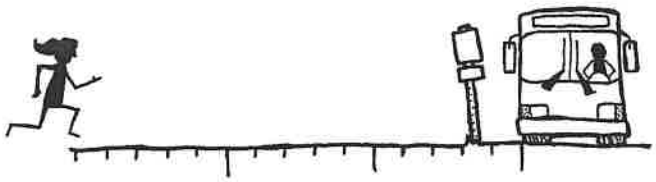
NAME _____ DATE _____

Scenario

Angela is running to the bus 15 *meters away.*

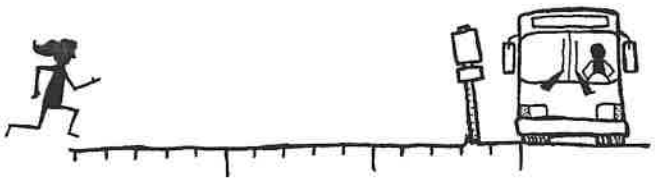
Using Representations

PART A: On the diagram to the right, label Angela's position with zero meters and label the position of the bus door 15 meters. Label the marks between Angela and the bus with appropriate position values.



Based on the labels along the axis in the diagram above, what direction (left or right) should be labeled positive? Label this direction on the diagram using an arrow (vector).

PART B: If the positive direction was labeled as the opposite direction of what you chose in Part A, think about how the locations of the labels for 0 meters and 15 meters would change. Relabel the diagram at right, with the positive direction pointing the opposite way as in Part A. Include position values along the bottom of the scale.



Argumentation

PART C: You are asked to make a ***claim*** about the *physical meaning* of Angela's *displacement* in Part B. Fill in the blanks below to complete the Claim, Evidence, and Reasoning paragraph.

Evidence: When Angela gets to the bus, her position is _____ meters.
number

Angela's initial position was _____ meters.
number

Reasoning: Displacement is equal to the final position minus the initial position.
$\Delta x = x_f - x_i$ or $\Delta x = x - x_f$

Claim: Therefore, Angela's displacement is _____ meters minus _____ meters
number number

which equals _____ meters.
number

Data Analysis

PART D: How does the displacement in Part C compare to the displacement in Part A?

_____

_____

PART E: If Angela ran to the bus and back to where she started, what distance would she travel? Compare that to her displacement.

_____

_____

_____

_____

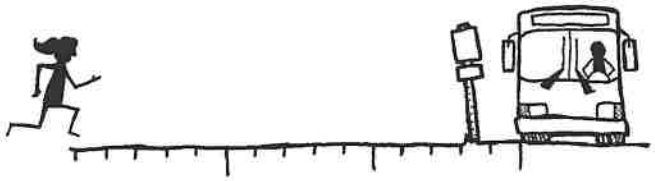
NAME _____ DATE _____

Scenario

Angela is running at 3 m/s *toward the bus* 15 m *away.*

Using Representations

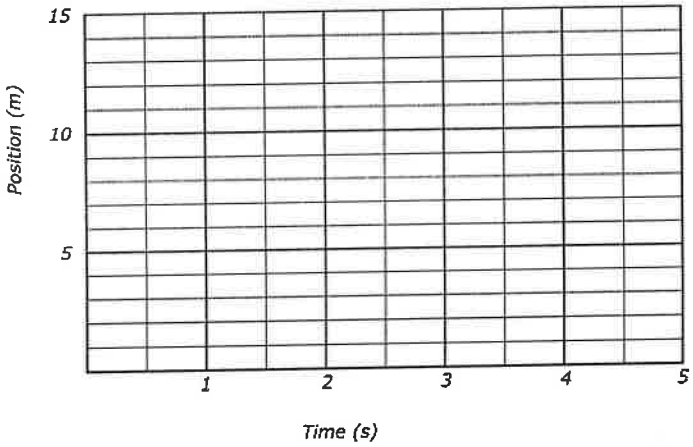
PART A: Below is a table of Angela's position at each second. Complete the table. Then, on the diagram of Angela and the bus, create a ***motion map*** of Angela's position at every second. Do this by marking with a dot where Angela is at every second.



X	Time (s)	0	1	2	3	4	5
Y	Position (m)	0	3	6			

PART B: Another way to represent Angela's motion is by creating a ***position vs. time graph.*** Finish filling out the data table above and then mark Angela's position at every second on the graph. (Plot the data points with solid filled-in dots.)

Sketch a best-fit line through the data points by drawing a single continuous straight line through the points. (Sketch the best-fit line as close as possible to all points and as many points above the line as below.)



Quantitative Analysis

PART C: Calculate the slope of the line you drew in Part B by choosing two points ***on the line*** and filling in the equation below. (Choose two locations on the line that will be used to calculate the slope. Circle these two places on the line—remember DO NOT use data points from the table.)

$$slope = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(\quad)\text{ m} - (\quad)\text{ m}}{(\quad)\text{ s} - (\quad)\text{ s}} = \frac{\quad\text{ m}}{\text{s}} = (\quad)$$

The slope of a position vs. time graph represents the _____ (physical quantity). (Hint: Check units!)

Using the equation for a line ($y = mx + b$), write an equation (including units) for the position vs. time line given above. (Remember that m is the slope and b is the vertical intercept.)

_____ (letter) = _____ (number) _____ (letter) + _____ (number)

Write a more general equation for Angela's motion using standard physics symbols (x, v, t).

_____ (letter) = _____ (letter) _____ (letter)

NAME _____ DATE _____

Scenario

A toy company claims to have developed two toy car models which they call A and B, where the average speed of each car is identical ($0.50 \pm 0.02 \frac{m}{s}$). Each group of students is given two toy cars (one of each model), metersticks, and stopwatches and is asked to test the toy company's claim.

Experimental Design

PART A: The students decide that they need to collect distance and time data for each car to test the company's claim. The students design a procedure.

Cross out any extraneous steps and order the remaining procedural steps:

_____ Turn the car on and release along the measured path.

_____ Gather equipment.

_____ Repeat to reduce error.

_____ Measure and record the time the car took to travel the 2 meters with a stopwatch.

_____ Measure a 2-meter-long path on the floor.

_____ Draw a data table in your notebook.

Data Analysis

PART B: Given is a data set collected by students in the class. Based on these data, what conclusion should the students make about the hypothesis that the two cars, A and B, have the same speed?

Lab Group Number	CAR A Speed	CAR B Speed
1	0.45 m/s	0.54 m/s
2	0.46 m/s	0.52 m/s
3	0.42 m/s	0.56 m/s
4	0.43 m/s	0.55 m/s
5	0.74 m/s	0.23 m/s
6	0.44 m/s	0.54 m/s
AVERAGE	**0.49 m/s**	**0.49 m/s**

_____ The cars have the same average speed.

_____ The cars have different average speeds.

Explain your choice in one short sentence.

_____

_____

Experimental Design

PART C: The students decide that additionally they want to test the toy company's claim that the car's speed is constant throughout the motion. How, if at all, does the experimental procedure from Part A need to be modified to verify that the car's instantaneous speed is constant?

_____ Angela thinks they should use a motion sensor to collect speed vs. time data. If the graph of speed vs. time is horizontal with a zero slope, the instantaneous speed is constant.

_____ Blake thinks that they should use photogates positioned at the beginning and end of the 2-meter-long track to determine the instantaneous speed of the cart. The students measure the length of the cart and divide this length by the time recorded by the photogate to determine the instantaneous speed.

Identify which student's procedure will provide evidence for the claim that the instantaneous speed of the cart is constant.

_____

_____

_____

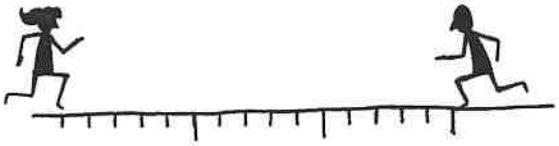
_____

_____

NAME _____ DATE _____

Scenario

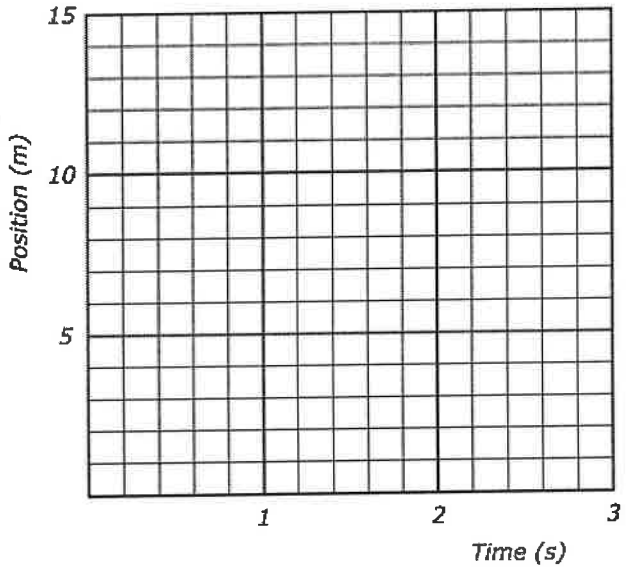
Angela and Blake are running toward each other from 15 m *away. At time* $t = 0$ s, *Angela runs to the right at* 5 m/s, *and Blake runs to the left at* 3 m/s.



Using Representations

PART A: Complete the table and draw a position vs. time graph for Angela and Blake for the first 3 seconds. Make each graph a different color and include a key.

Time (seconds)	*Angela's Position (meters)*	*Blake's Position (meters)*
0		
1		
2		
3		



Quantitative Analysis

PART B: Calculate the ***slope*** of the line you drew in Part A for Angela by choosing two points on the line and filling in the equation below:

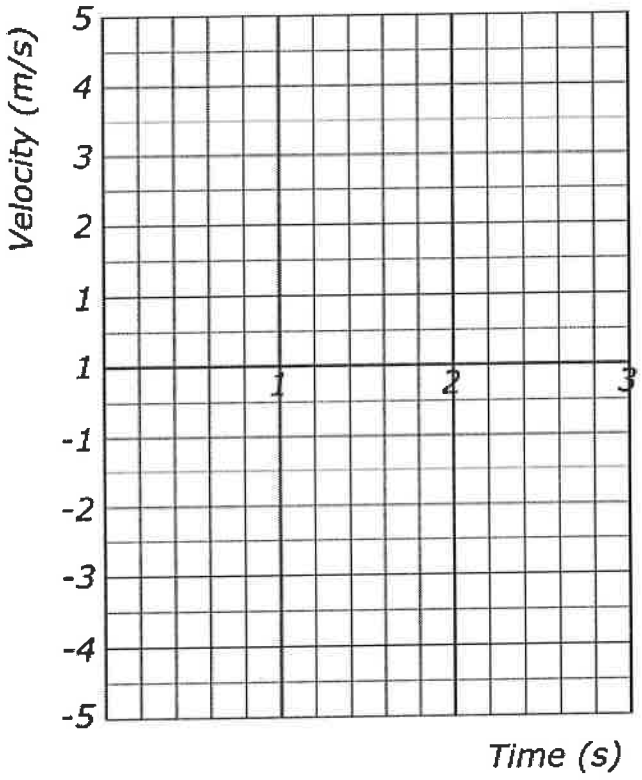
$$slope = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(\quad)\text{ m} - (\quad)\text{ m}}{(\quad)\text{ s} - (\quad)\text{ s}} = \frac{\quad}{\quad}\frac{\text{m}}{\text{s}} = (\quad)$$

PART C: Calculate the ***slope*** of the line you drew in Part A for Blake by choosing two points on the line and filling in the equation below:

$$slope = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(\quad)\text{ m} - (\quad)\text{ m}}{(\quad)\text{ s} - (\quad)\text{ s}} = \frac{\quad}{\quad}\frac{\text{m}}{\text{s}} = (\quad)$$

Using Representations

PART D: Based on the slopes you calculated in Parts B and C, sketch a velocity vs. time graph for Angela and Blake. Make each graph a different color and include a key.



Argumentation

PART E: Carlos makes the following claim about the intersection point of the two lines on the position vs. time graph in Part A. "The point on the position vs. time graph where the two lines cross represents the time when Angela and Blake are at the same position and traveling at the same velocity."

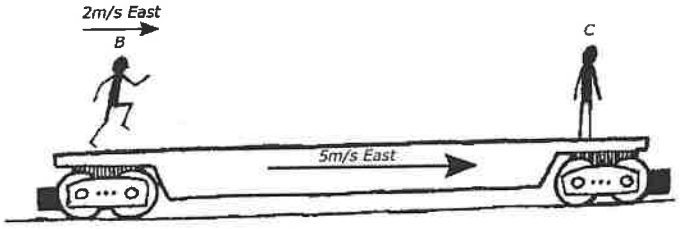
The student's claim is partially correct. Fill in the blanks of the following statement using evidence from the graph to correct the student's claim.

Claim: I agree that the _____ (physical quantity) is the same because Angela and Blake do have the same _____ (physical quantity) of _____ (number) meters at _____ (number) seconds. However, I do not agree that they have the same _____ (physical quantity) because the slope of one line is _____ (number) m/s and the slope of the other line is _____ (number) m/s.

NAME _____ DATE _____

Scenario

Blake and Carlos are playing on a train while Angela watches. While the train passes Angela, it is traveling at 5 m/s *to the east. At this time, Blake is running at* 2 m/s *east relative to the train toward Carlos (who is taking a break). (All speeds given for Blake are relative to the train.)*



Using Representations

PART A: Identify and label a direction to be positive. In the sketch above, label the positive direction.

Sketch a motion map based on Angela's measurement of Blake's motion.

Sketch a motion map based on Carlos's measurement of Blake's motion.

Data Analysis

PART B: Use the diagram in Part A to determine Blake's speed relative to Angela.

_____

_____

PART C: Blake now turns around and runs at 2 m/s west.

Use the diagram at right to determine Blake's velocity relative to Angela's.

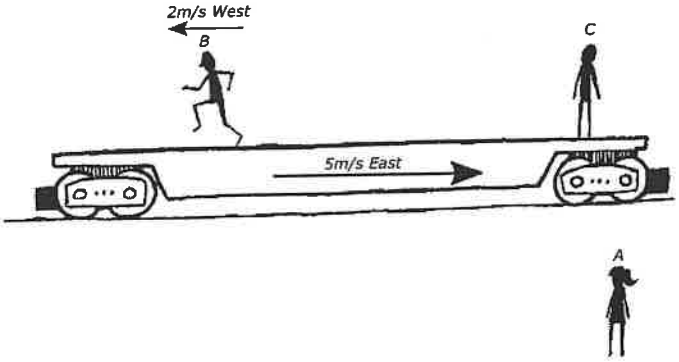
_____

_____

_____

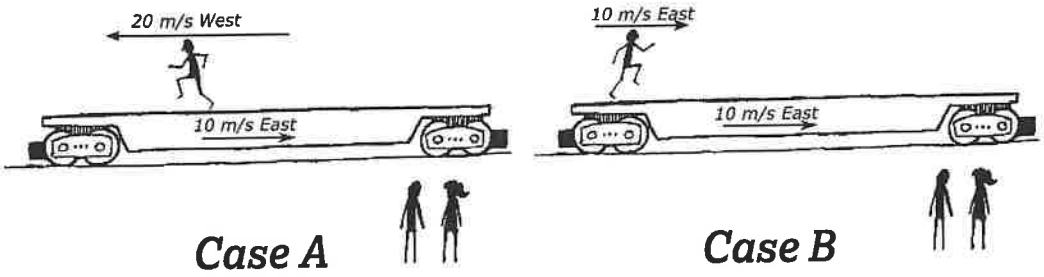
_____

_____



Argumentation

PART D: In both cases shown below, Blake is running on a train as it travels. In which case is Blake's speed relative to the ground the greatest?



Case A *Case B*

Circle the correct parts of each student's argument.

Blake: I'm running the fastest in Case A. Therefore, I will appear to be moving fastest relative to the ground. Who cares what the train is doing?

Carlos: No, the train does matter, but since 20 + 10 is greater than 10 + 10, you are right that in Case A is where Blake is the fastest.

Angela: Blake is running fastest relative to the ground in Case B because Blake's velocity and the train's velocity are in the same direction and add up to 20 m/s east; but in Case A, Blake's velocity is in the opposite direction of the train and they add up to 10 m/s west.

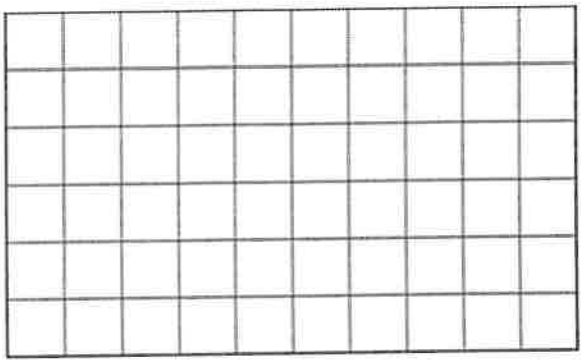
NAME _____ DATE _____

Scenario

Carlos places a constant motion vehicle on the ground and releases it so that the vehicle travels down the hall at 5 m/s in a straight line for 10 seconds.

Using Representations

PART A: Scale and label the axes on the graph to the right. Draw a velocity vs. time graph of the constant motion vehicle for the first 10 seconds of its motion.



Argumentation

PART B: Collect evidence about the physical meaning of the slope of the graph that could be used to support a claim. Fill in the blanks below.

Evidence: The slope of the velocity vs. time graph is equal to _____ (number) _____ (units) · _____ (units) is also the unit for _____ (physical quantity).

PART C: **Claim:** The constant motion vehicle will travel a distance of 50 meters during the 10-second time interval.

Collect evidence about the physical meaning of the area under the line on the graph that can be used to support the claim above. Using the equation for the area of a rectangle (*Area = length × width*), write an equation (including units) for the area of the rectangle between the velocity vs. time line and the x-axis between $t = 0$ and $t = 10$ seconds.

Evidence: The area under the line of the velocity vs. time graph is equal to _____ (number) _____ (units) × _____ (number) _____ (units) = _____ (number) _____ (units). This area is also known as the _____ (physical quantity) of the vehicle.

Reasoning: Fill in the blanks of the following statement.

The claim makes sense because if the constant motion vehicle is traveling at a velocity of _____ (number) m/s, then each second it will move a distance of _____ (number) meters. After 2 seconds, the vehicle has moved _____ (number) meters. After 3 seconds, it has moved _____ (number) meters. After _____ (number) seconds, it has moved 25 meters.

Quantitative Analysis

PART D: Rewrite the equation for the area of a rectangle (*Area = length × width*) using the symbols and numbers (with units) from the graph in Part A between $t = 0$ and $t = 10$ seconds.

_____ (letter) = _____ (number (with units)) _____ (letter)

The area under a velocity vs. time graph represents the _____ (physical quantity). (Hint: Use the units.)

NAME _____ DATE _____

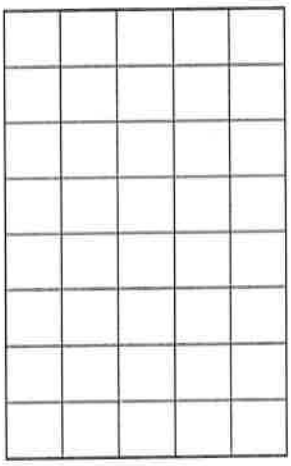
Scenario

A car traveling in a straight line to the right starts from rest at time $t = 0$.
At time $t = 2$ s, the car is traveling at 4 m/s. At $t = 4$ s the car is traveling at 8 m/s.

Using Representations

PART A: Scale and label the axes on the graph to the right. Using the data table below, plot a velocity vs. time graph for the car for the first 4 seconds it is traveling.

Time (s)	*Speed (m/s)*
0	0
1	2
2	4
3	6
4	8



Argumentation

PART B: **Evidence:** Calculate the slope of the velocity vs. time graph in Part A using two points on the line (NOT data points).

$$slope = \frac{rise}{run} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(\quad)\frac{\text{m}}{\text{s}} - (\quad)\frac{\text{m}}{\text{s}}}{(\quad)\text{s} - (\quad)\text{s}} = \frac{\quad}{\text{s}^2}\text{m} = (\quad)$$

Claim: Use the evidence above to make a claim by filling in the following blanks:

The slope of the velocity vs. time graph is equal to _____ (number) _____ (unit) · _____ (unit) is also the unit for _____ (physical quantity).

Quantitative Analysis

$Area = \frac{1}{2}bh$

PART C: Rewrite the equation for the area of a triangle ($Area = \frac{1}{2}\ base \times height$) using the symbols and numbers (with units) from the graph in Part A between $t = 0$ and $t = 4$ seconds.

_____ (letter) $= \frac{1}{2}$ _____ (number (with units)) _____ (number (with units))

Write a more general equation for the car using standard physics symbols (x, v_f, and t).

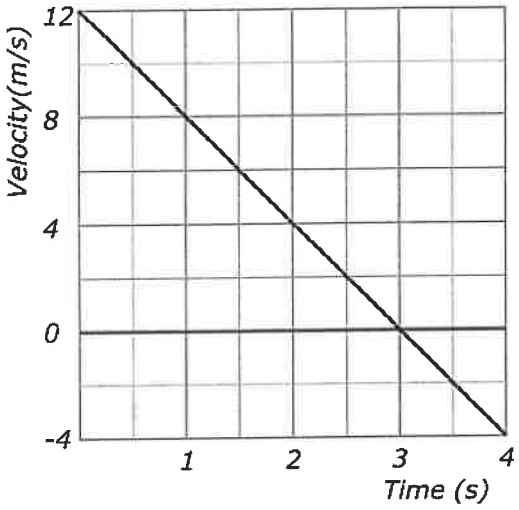
_____ (letter) $= \frac{1}{2}$ _____ (letter) _____ (letter)

The area under a velocity vs. time graph represents the _____ (physical quantity). (Hint: Check units!)

NAME _____ DATE _____

Scenario

The motion of a car, starting from position $x = 0$ m is modeled in the velocity vs. time graph at right.



Quantitative Analysis

PART A: Using the equation for a line ($y = mx + b$), write an equation (including units) for the velocity vs. time line given above.

_____ (letter) = _____ (number with units) _____ (letter) + _____ (number with units)

Write a more general equation for the motion of the car using standard physics symbols (x, v_x, t, a_x).

The slope of a velocity vs. time graph represents the _____ (physical quantity).

Argumentation

PART B: Carlos makes the following claim about the motion of the car.

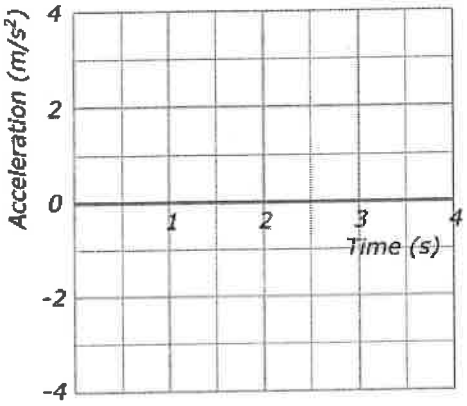
Carlos: "The car is slowing down for the entire distance it travels because the slope of the line is always negative and never changes.

Evidence: Fill in the blanks and circle the appropriate choices to complete the following statement of evidence to disprove Carlos's claim:

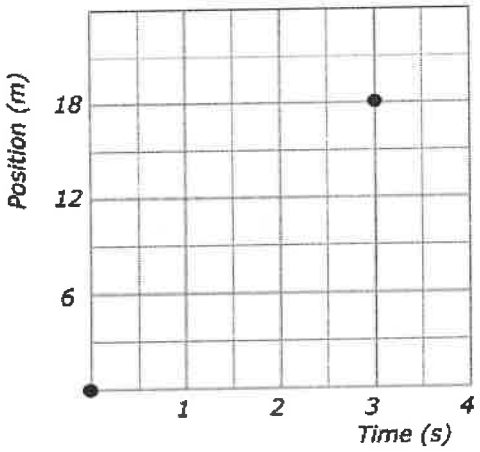
The car starts with an initial velocity of _____ (number) m/s and is (slowing down/speeding up) for the first 3 seconds and (slowing down/speeding up) for the last second. At 3 seconds, the car's motion changes from traveling (in the positive direction/in the negative direction) to traveling (in the positive direction/in the negative direction). The horizontal intercept represents the _____ (physical quantity) when the _____ (physical quantity) of the car is equal to _____ (number). The car accelerates constantly with a magnitude of _____ (number) m/s^2 because the _____ (mathematical term) of the line never changes.

Using Representations

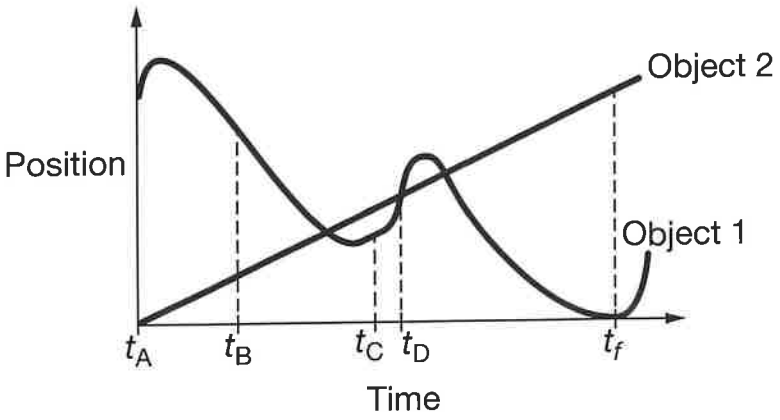
PART C: Use the graph in Part A to draw an acceleration vs. time graph for the motion represented above.



PART D: Use the graph in Part A to draw a position vs. time graph for the motion represented above. The position vs. time graph will pass through the two dots plotted for you.



Summer Assignment



The position as a function of time for two objects moving along a straight line is shown in the graph.

1. Which statement is true about the distances the two object have traveled at time t_f?

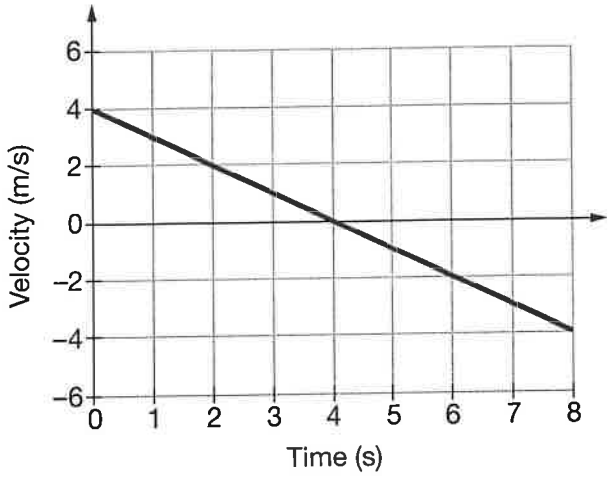
(A) Object 1 has traveled a greater distance.
(B) Object 2 has traveled a greater distance.
(C) Both objects have traveled the same distance.
(D) The total distance traveled by each object cannot be compared using the graph.

2. At which of the following times do the two objects have the same velocity?

(A) t_A
(B) t_B
(C) t_C
(D) t_D

Summer Assignment

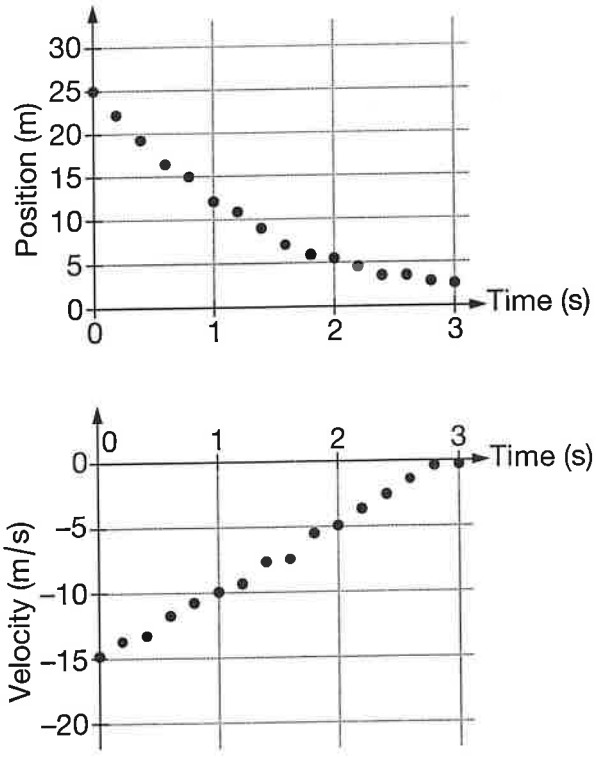
3.



An object is sliding to the right along a straight line on a horizontal surface. The graph shows the object's velocity as a function of time. What is the object's displacement during the time depicted in the graph?

(A) 0 m
(B) 1 m
(C) 8 m
(D) 16 m

4.



The position and velocity of a car moving along a straight road are recorded as functions of time, as shown in the graphs above. Which of the following correctly describes the car's speed and acceleration?

Summer Assignment

(A)

Speed	Acceleration
Increasing	Positive

(B)

Speed	Acceleration
Increasing	Negative

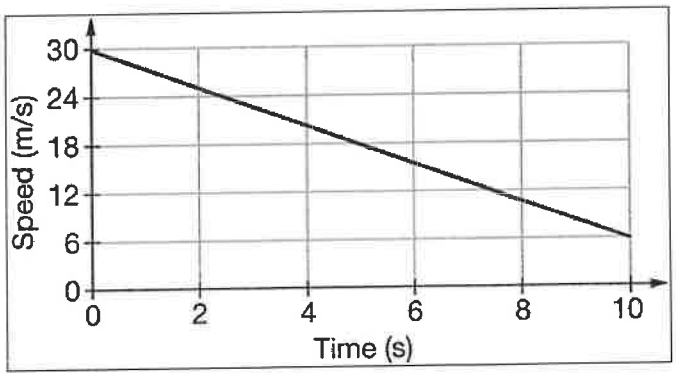
(C)

Speed	Acceleration
Decreasing	Positive

(D)

Speed	Acceleration
Decreasing	Negative

5.

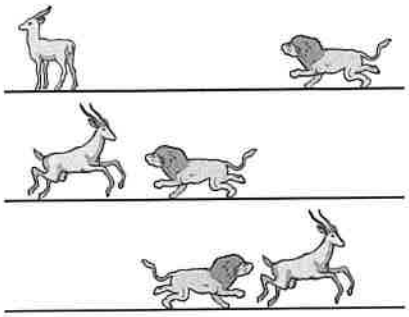


The graph above shows the speed of a truck as it moves along a straight, level road. How far does the truck travel in the 10 s time interval shown?

(A) 120 m
(B) 180 m
(C) 240 m
(D) 300 m

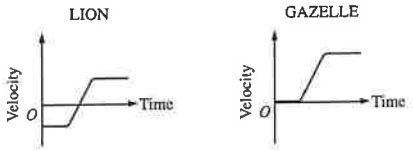
Summer Assignment

6.

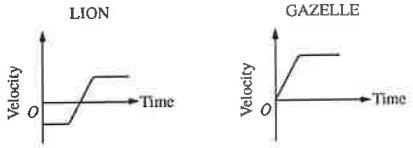


A lion is running at constant speed toward a gazelle that is standing still, as shown in the top figure above. After several seconds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion and force him to reverse direction. As the gazelle accelerates toward and past the lion, the lion changes direction and accelerates in pursuit of the gazelle. The lion and the gazelle eventually each reach constant but different speeds. Which of the following sets of graphs shows a reasonable representation of the velocities of the lion and the gazelle as functions of time?

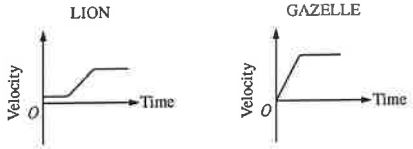
(A)



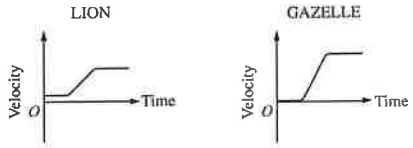
(B)



(C)

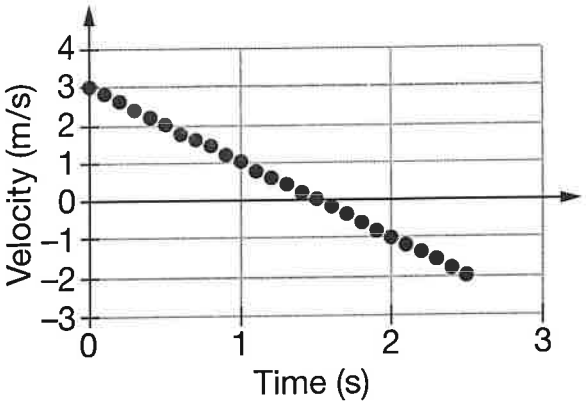


(D)



Summer Assignment

7.



At time $t = 0$, a moving cart on a horizontal track is at position 0.5 m. Using a motion detector, students generate a graph of the cart's velocity as a function of time, as shown above. At $t = 2.5$ s, the cart's position is most nearly

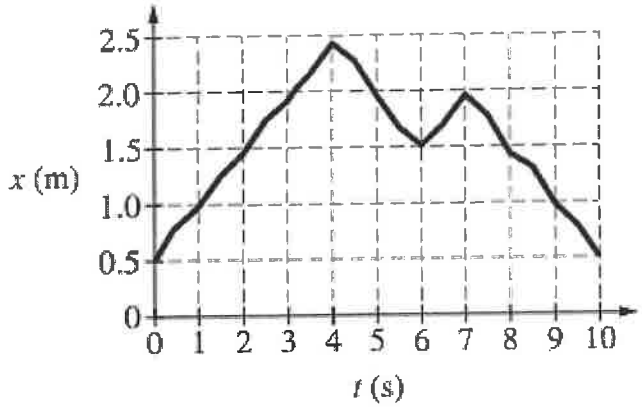
(A) 0.5 m

(B) 1.25 m

(C) 1.75 m

(D) 2 m

8.



A student walks in a straight line in front of a motion detector. The graph shows the data of the student's position x as a function of time t. Which of the following statements regarding the student's motion from time $t = 0$ s to $t = 10$ s is correct?

(A) The distance traveled by the student is 0 m.

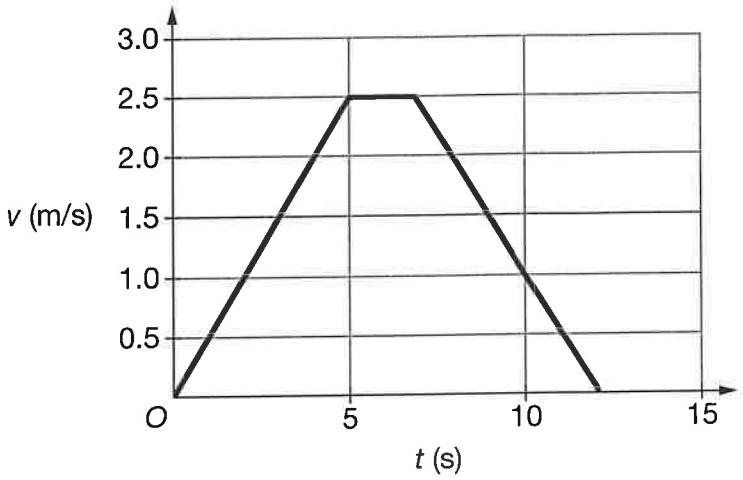
(B) The student's velocity is always positive.

(C) The student has an instantaneous velocity of 0 m/s at three distinct times.

(D) The student's average speed is 0 m/s.

Summer Assignment

9.



The motion of an object is shown in the velocity-time graph. Which best describes the motion of the object?

(A) The object is either speeding up or slowing down the entire time.

(B) The object starts and finishes at the same position.

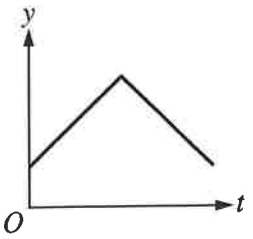
(C) The object travels in the same direction for the entire time.

(D) The object undergoes positive acceleration the entire time.

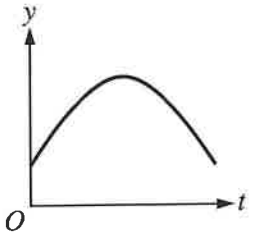
10. A person throws a marble straight up into the air, releasing it a short height above the ground and catching it at that same height. If air resistance is negligible, which of the following graphs of position y versus time t is correct for the motion of the marble as it goes up and then comes down?

Summer Assignment

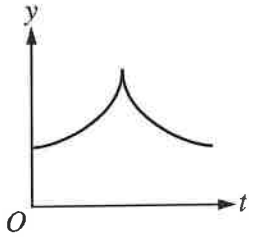
(A)



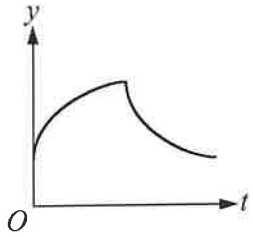
(B)



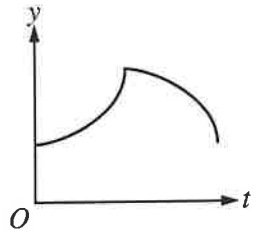
(C)



(D)



(E)



11. A student rolls a ball along the floor so that the ball has a speed of $16\ \text{m/s}$. What is the speed of the ball relative to a second student who is running at $6\ \text{m/s}$ in the same direction that the ball is rolling?

(A) $6\ \text{m/s}$
(B) $10\ \text{m/s}$
(C) $16\ \text{m/s}$
(D) $22\ \text{m/s}$

12. A car goes from rest to 30 m/s in 12 s with constant acceleration. How long does it take the car to go from rest to 15 m/s with the same acceleration?

Summer Assignment

(A) 3.0s

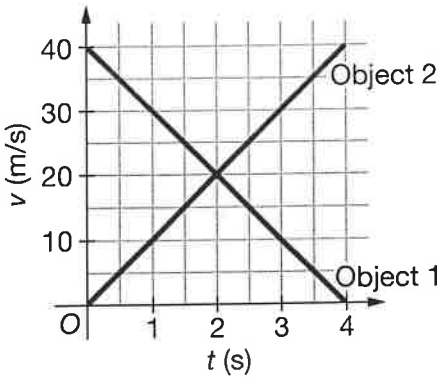
(B) $12/\sqrt{2}\ s$

(C) 6.0s

(D) $12\sqrt{2}\ s$

(E) 24s

13.



Object 1 and object 2 travel across a horizontal surface, and their horizontal velocity as a function of time is shown in the graph. Which of the following statements is correct about the two-object system?

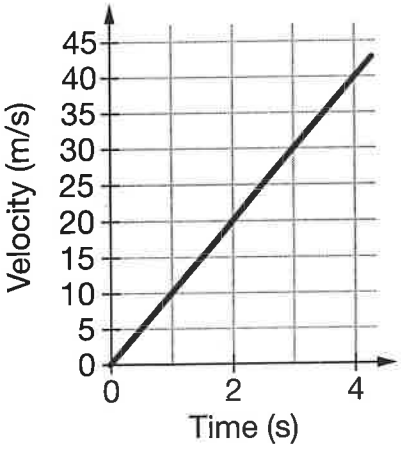
(A) The magnitude of acceleration for object 2 is greater than the magnitude of the acceleration of object 1.

(B) After 2 s, object 1 travels a greater distance than object 2 travels.

(C) Object 1 and object 2 are at the same horizontal position at 2 s.

(D) After 4 s, the speed of object 1 is greater than the speed of object 2.

14.



A student drops a rock from the top of a cliff such that the rock falls downward toward Earth's surface in the absence of air resistance. The downward direction is considered to be the positive direction. The graph shows the rock's velocity as a function of time. Which of the following methods should be used to determine the total distance traveled by the rock after 4 s ?

Summer Assignment

(A) Use the maximum value of the curve, as it states that the rock traveled 40 meters in 1 second, which means that the rock traveled 160 meters in total.

(B) Use the area under the curve, as it states that the rock traveled 80 meters in total.

(C) Use the slope of the curve, as it states that the rock traveled $10\ \frac{\text{m}}{\text{s}}$ in 1 second, which means that the rock traveled 40 meters in total.

(D) The answer cannot be determined unless a graph of the object's position as a function of time is given.