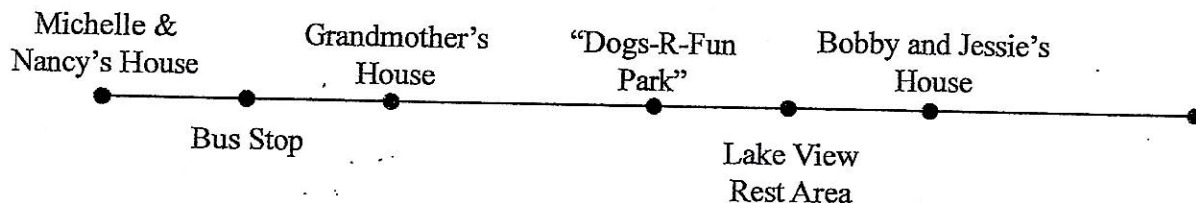# Putting the Pieces Together

1. Michelle and Nancy's parents have told them that they must exercise each day after school. They have allotted 1 hour each day for their workouts. This week they decided to describe their workout, create a graph to map their routine and to track their speed, and then write a set of equations for each graph. They like to run, walk, or bike each day in their neighborhood. From Michelle and Nancy's house, the Dogs-R-Fun park is 2 miles away, Uncle Bobby and Aunt Jessie's house is 3 miles away, and Grandmother lives 1 mile away. To ride the bus to school in the morning, they have to walk $\frac{1}{2}$ a mile to the Bus Stop. The Lake View Rest Area is exactly half way between the Dogs-R-Fun Park and Uncle Bobby and Aunt Jessie's House.

Based upon the verbal description of their exercise for the day, determine the distance-time graph that matches the description and tape it in the appropriate blank and then complete the piecewise-defined function for the distance-time graph. Match the graph of the speed-time based on the distance-time graph, and complete the piecewise function for the speed graph. Fill in the blanks for the description as you work through the activity.

Description	Piecewise Graph	Piecewise Function for Distance/Time Graph	Speed Graph	Piecewise Function for Speed Graph
On Monday, Michelle and Nancy left their house, ran to the dog park at a constant rate of ____ miles per hour, stopped for 10 minutes and then ran to Bobby and Jessie's house for dinner at a rate of ____ miles per hour.		$$d(t) = \begin{cases} \quad & 0 \le t \le \frac{1}{2} \\ \quad & \frac{1}{2} \le t \le \frac{2}{3} \\ 3(t-1)+3, & \frac{2}{3} \le t \le 1 \end{cases}$$		$$s(t) = \begin{cases} \quad & 0 < t < \frac{1}{2} \\ \quad & \frac{1}{2} < t < \frac{2}{3} \\ 3, & \frac{2}{3} < t < 1 \end{cases}$$
On Tuesday, Nancy and Michelle were at Grandmother's house when they began their exercise. They left Grandmother's house and first walked home at a constant rate of ____ miles per hour. When they got home, Mom told them to go walk the dog. They were home for 10 minutes before they left for the dog park. They walked to the park at a constant rate of 6 miles per hour.		$$d(t) = \begin{cases} \quad & 0 \le t \le \frac{1}{2} \\ 0, & \frac{1}{2} \le t \le \frac{2}{3} \\ \quad & \frac{2}{3} \le t \le 1 \end{cases}$$		$$s(t) = \begin{cases} 2, & 0 < t < \frac{1}{2} \\ \quad & \frac{1}{2} < t < \frac{2}{3} \\ \quad & \frac{2}{3} < t < 1 \end{cases}$$
On Wednesday, Michelle and Nancy left their house, rode their bikes at a constant rate of ____ miles per hour until they arrived at the Lake View Rest Area. They rested for 10 minutes and then rode back home at a constant rate of ____ miles per hour.		$$d(t) = \begin{cases} 5t, & 0 \le t \le \frac{1}{2} \\ 2.5, & \frac{1}{2} \le t \le \frac{2}{3} \\ \quad & \frac{2}{3} \le t \le 1 \end{cases}$$		$$s(t) = \begin{cases} 5, & 0 < t < \frac{1}{2} \\ \quad & \frac{1}{2} < t < \frac{2}{3} \\ \quad & \frac{2}{3} < t < 1 \end{cases}$$

Description	Piecewise Graph	Piecewise Function for Distance/Time Graph	Speed Graph	Piecewise Function for Speed Graph
On Thursday, Michelle and Nancy had to take Duke, the dog, for a walk. They left home and walked at a constant rate of ____ miles per hour, stopped for 10 minutes at the dog park to let Duke play, then they returned home at a constant rate of ____ miles per hour.		$d(t) = \begin{cases} 4t, & 0 \le t \le \frac{1}{2} \\ 2, & \frac{1}{2} \le t \le \frac{2}{3} \\ & \frac{2}{3} \le t \le 1 \end{cases}$		$s(t) = \begin{cases} 4, & 0 < t < \frac{1}{2} \\ & \frac{1}{2} < t < \frac{2}{3} \\ & \frac{2}{3} < t < 1 \end{cases}$
On Friday, Michelle and Nancy decided to take Grandmother's dog for a walk. They left Grandmother's house, walked to the dog park at a constant rate of ____ miles per hour, stopped for 10 minutes at the dog park, and then returned to their home at a constant rate of ____ miles per hour.		$d(t) = \begin{cases} 2t+1, & 0 \le t \le \frac{1}{2} \\ 2, & \frac{1}{2} \le t \le \frac{2}{3} \\ & \frac{2}{3} \le t \le 1 \end{cases}$		$s(t) = \begin{cases} 2, & 0 < t < \frac{1}{2} \\ & \frac{1}{2} < t < \frac{2}{3} \\ & \frac{2}{3} < t < 1 \end{cases}$
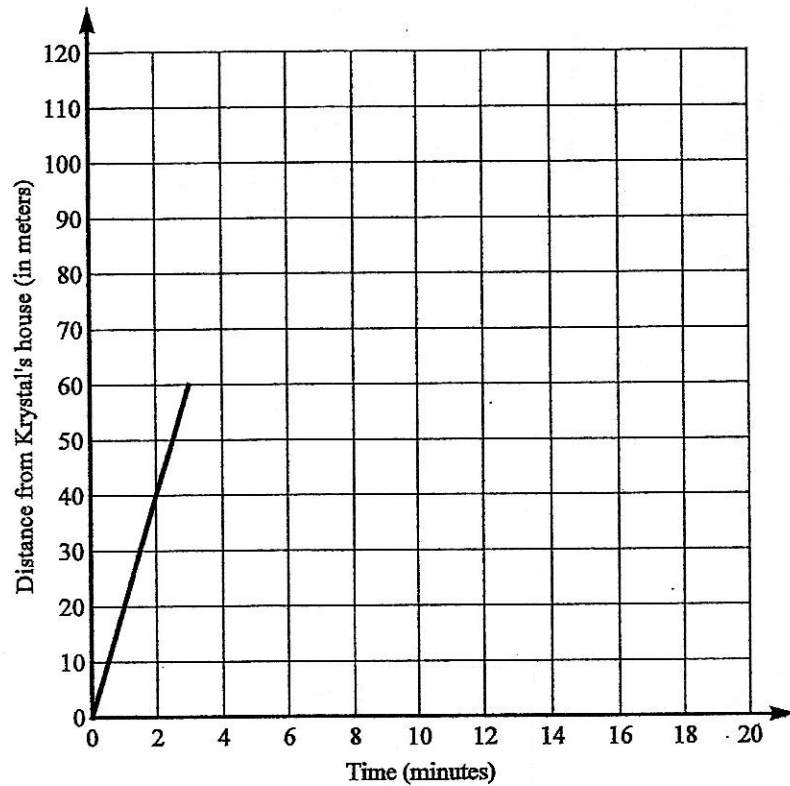
2. The grocery store is located on a straight path 120 meters north of Krystal's house. The following is a description of Krystal's path.

- She began walking to the store at 9:37 a.m.
- She walked 60 meters toward the store in 3 minutes
- She realized she left her wallet on her desk at home
- She turned around and walked back home at the same speed
- She spent 1 minute looking for her wallet before finding it on the kitchen counter
- She biked all the way to the store at twice her original speed

a. Complete the distance-time graph that accurately represents Krystal's trip to the store.

b. Determine how many total meters Krystal traveled before reaching the store.

c. At what time did she arrived at the store?

d. Write a piecewise function for the distance time graph.

$$d(t) = \begin{cases} \underline{\hspace{3cm}}, & 0 \leq t \leq 3 \\ \underline{\hspace{1cm}}(t-3) + \underline{\hspace{1cm}}, & \underline{\hspace{0.5cm}} \leq t \leq \underline{\hspace{0.5cm}} \\ \underline{\hspace{3cm}}, & \underline{\hspace{0.5cm}} \leq t \leq \underline{\hspace{0.5cm}} \\ \underline{\hspace{3cm}}, & \underline{\hspace{0.5cm}} \leq t \leq \underline{\hspace{0.5cm}} \end{cases}$$

e. It takes Krystal 33 minutes to collect her groceries and check-out. She then returns home at a constant rate of 1.2 kilometers per hour. What time does Krystal arrive back home? Show your work that leads to your answer.
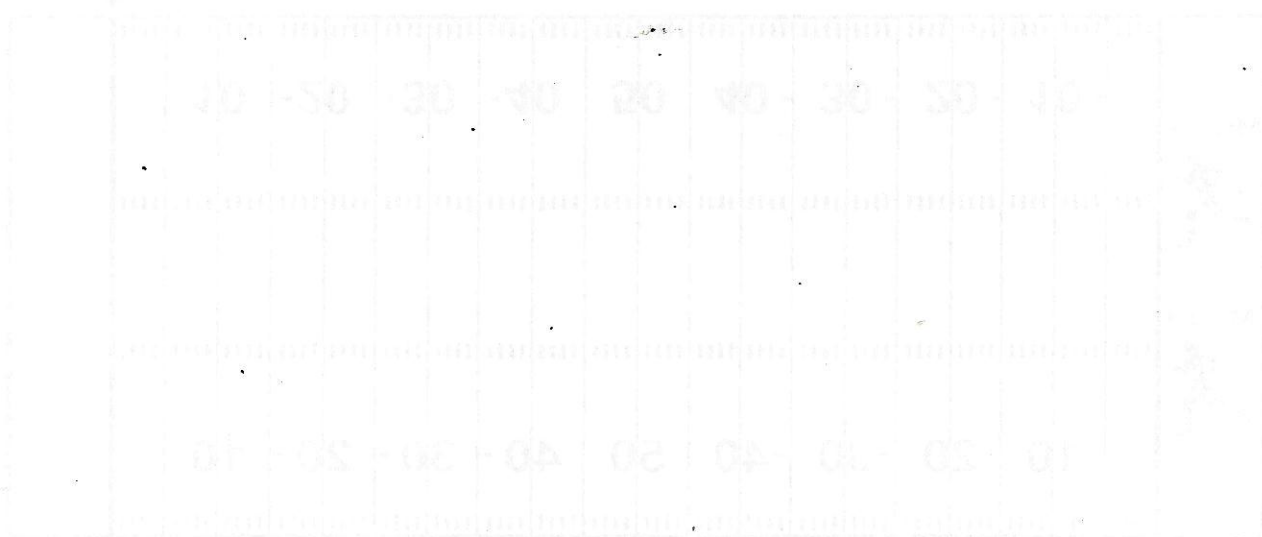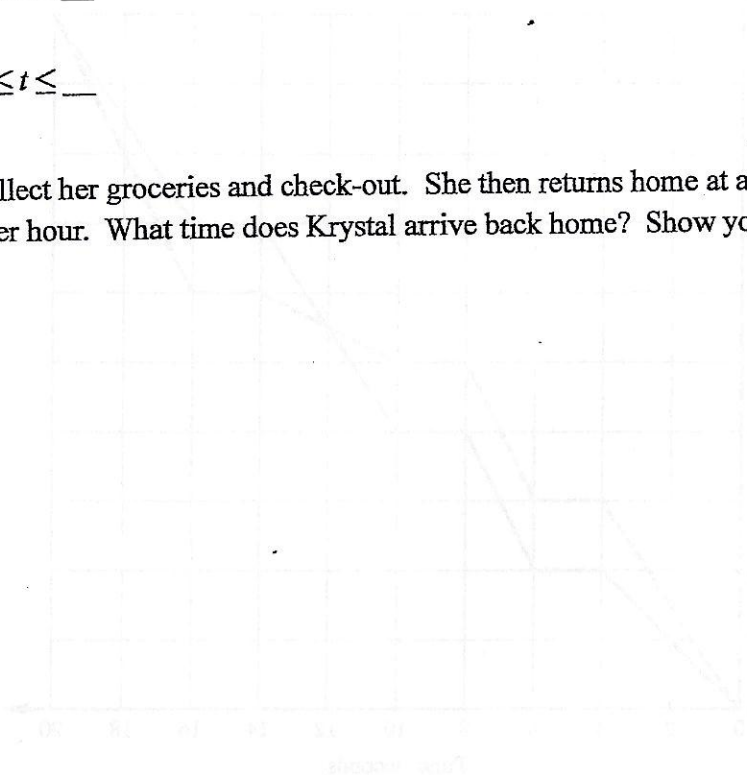
3. Marcus and Miguel are participating in after school conditioning for football. Coach Morris has the boys line up on the south goal line of the football field. As they run to the north goal line, they must stop the instant the coach blows the whistle, do a push-up, and then resume running toward the goal line at the next whistle. They must continue the process until they reach the north goal line.

North Goal Line

South Goal Line
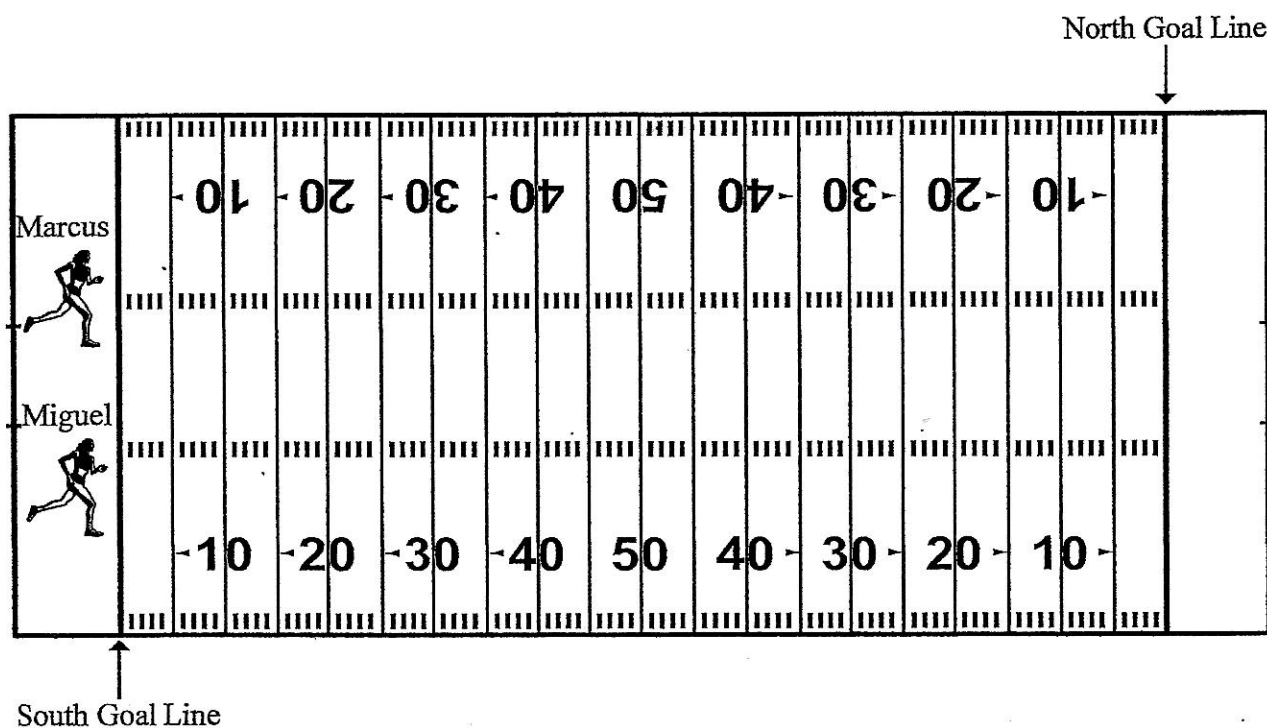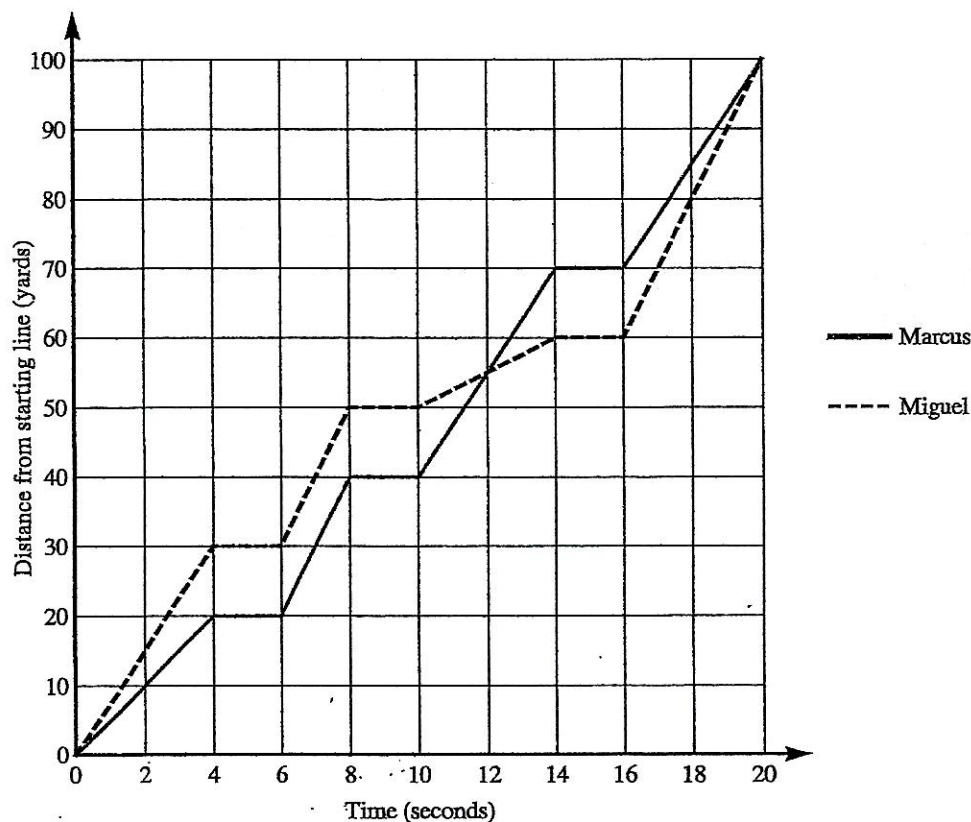
a. Illustrate, on the field, the path of each athlete using an X to notate when the coach blows the whistle and arrows to show the direction the runner is traveling.

b. How far does each runner travel in the first 4 seconds?

c. Miguel looked at the graph and made a conjecture that from $0 \leq t \leq 4$ and $6 \leq t \leq 8$, he ran faster than Marcus. Determine if Miguel's conjecture is true. Explain your reasoning.

d. Complete the table to show how fast Marcus and Miguel are running for the indicated time intervals.

Time Interval	Marcus	Miguel
$0 \leq t \leq 4$		
$4 \leq t \leq 6$	$0 \dfrac{\text{yards}}{\text{second}}$	
$6 \leq t \leq 8$		
$8 \leq t \leq 10$		
$10 \leq t \leq 14$	$7.5 \dfrac{\text{yards}}{\text{second}}$	$2.5 \dfrac{\text{yards}}{\text{second}}$
$14 \leq t \leq 16$		
$16 \leq t \leq 20$		

e. At which yard line are the runners the same distance from the south goal line at the same time? How many yards from the south goal line is each boy at this time?

f. Which runner is the farthest from the starting line at $t = 14$ seconds? How many yards is the runner from the south goal line? At which yard line is the runner at this time?

g. At ____ $\leq t \leq$ _____ Marcus was 30 yards from reaching the north goal line. On this same time interval, Miguel was _____ yards from the north goal line.

h. From the south goal line to the north goal line, the boys spend _____ % of their time running, and _____ % of their time was spent doing push-ups.

i. After the boys reached the north goal line, the coach gave them 5 seconds to rest and then they had to sprint back to the 50 yard line, do 5 push-ups and then return to the beginning goal line. Continue the graph and the illustration on the football field for each student using the criteria for Marcus and Miguel.

Marcus:	Miguel:
• runs at a constant rate for 4 seconds and then begins his push-ups at the 50 yard line. • finishes his push-ups in 4 seconds. • runs the remaining 50 yards traveling at a rate of 10 yards per second.	• runs to the 50 yard line at a rate of 2.5 yards per second slower than Marcus. • finishes his push-ups in 4 seconds. • finished 2 seconds after Marcus.
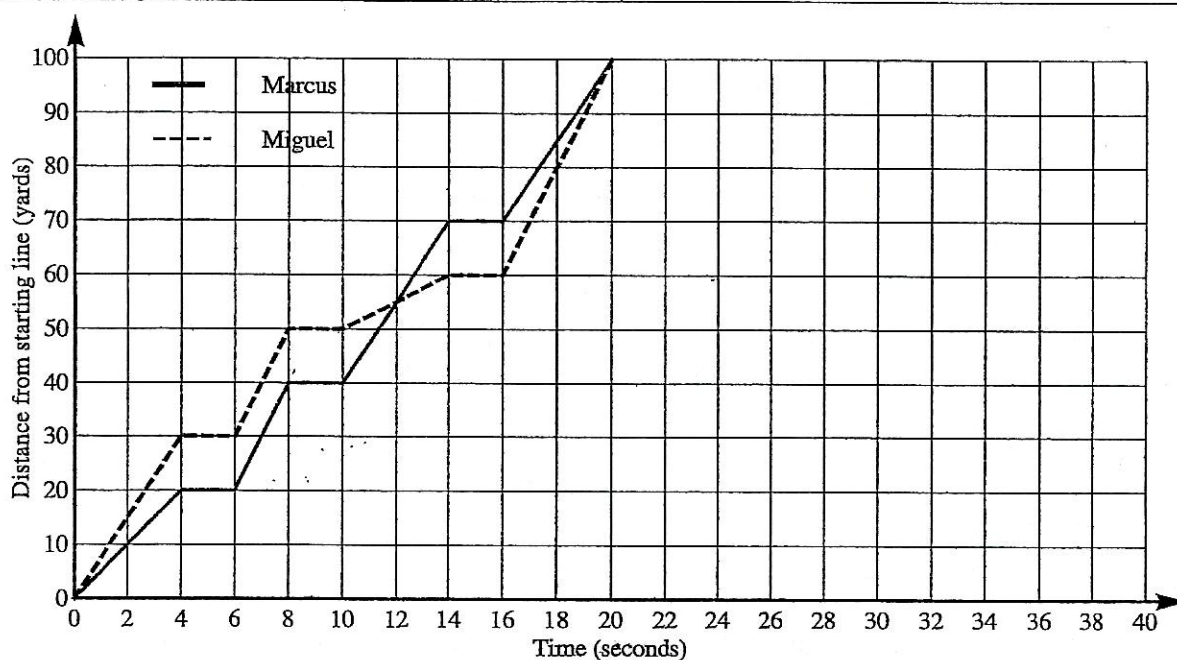
j. Shade in the True or False column to identify whether each statement is valid based on the graph.

Based on the graph:	True	False
Marcus always runs faster than Miguel.		
For $0 \le t \le 20$, the average rate of change for both Marcus and Miguel is 5 yards per second.		
The fastest speed that either boy ran was 10 yards per second.		
Miguel and Marcus ran the same total distance of 200 yards.		