Sample Answers

Moving Shadows

A Practice Understanding Task

In spite of his nervousness, Carlos enjoys his first ride on the amusement park Ferris wheel. He does, however, spend much of his time with his eyes fixed on the ground below him. After a while, he becomes fascinated with the fact that since the sun is directly overhead, his shadow moves back and forth across the ground beneath him as he rides around on the Ferris wheel.

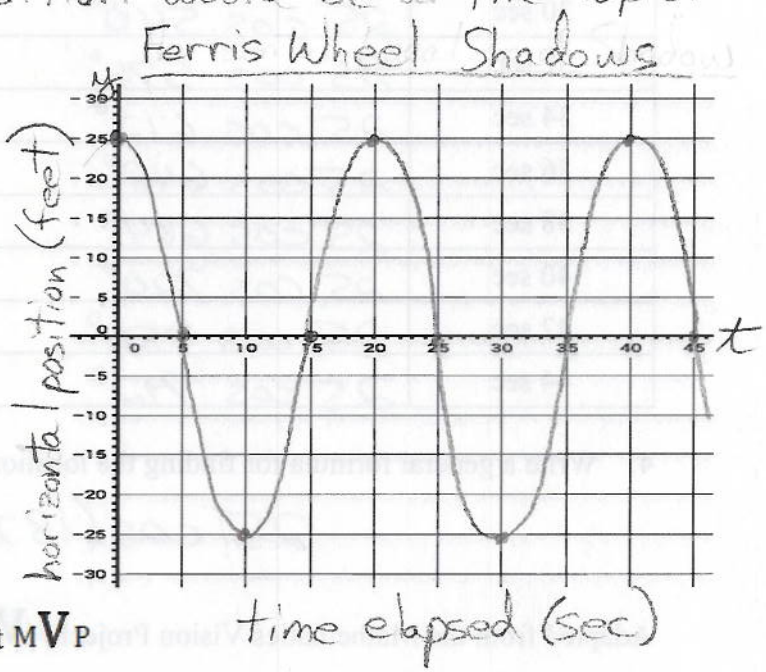
Recall the following facts for the Ferris wheel Carlos is riding:

- The Ferris wheel has a radius of 25 feet
- The center of the Ferris wheel is 30 feet above the ground
- The Ferris wheel makes one complete rotation counterclockwise every 20 seconds

To describe the location of Carlos' shadow as it moves back and forth on the ground beneath him, we could measure the shadow's horizontal distance (in feet) to the right or left of the point directly beneath the center of the Ferris wheel, with locations to the right of the center having positive value and locations to the left of the center having negative values. For instance, in this system Carlos' shadow's location will have a value of 25 when he is at the position farthest to the right on the Ferris wheel, and a value of -25 when he is at a position farthest to the left.

1. What would Carlos' position be on the Ferris wheel when his shadow is located at 0 in this new measurement system? Carlos' position would be at the top or bottom.

2. Sketch a graph of the horizontal location of Carlos' shadow as a function of time t, where t represents the elapsed time after Carlos passes position A, the farthest right position on the Ferris wheel. Be sure to label your graph.



3. Calculate the location of Carlos' shadow at the times t given in the following table, where t represents the number of seconds since Carlos passed the position farthest to the right on the Ferris wheel. Keep track of any patterns you notice in the ways you calculate the location of the shadow. As you calculate each location, plot the position of Carlos' shadow on the graph in #2.

Elapsed Time Since Passing Farthest Right Position	**Calculations**	**Location of the Shadow**
2 sec	$25\cos 36^\circ$	20.2254
4 sec	$25\cos 72^\circ$	7.7254
6 sec	$25\cos 108^\circ$	−7.7254
8 sec	$25\cos 144^\circ$	−20.2254
10 sec	$25\cos 180^\circ$	−25
12 sec	$25\cos 216^\circ$	−20.2254
14 sec	$25\cos 252^\circ$	−7.7254
16 sec	$25\cos 288^\circ$	7.7254
18 sec	$25\cos 324^\circ$	20.2254
20 sec	$25\cos 360^\circ$	25
22 sec	$25\cos 396^\circ$	20.2254
24 sec	$25\cos 432^\circ$	7.7254
26 sec	$25\cos 468^\circ$	−7.7254
28 sec	$25\cos 504^\circ$	−20.2254
30 sec	$25\cos 540^\circ$	−25
32 sec	$25\cos 576^\circ$	−20.2254
34 sec	$25\cos 612^\circ$	−7.7254
36 sec	$25\cos 648^\circ$	7.7254
38 sec	$25\cos 684^\circ$	20.2254
40 sec	$25\cos 720^\circ$	25
42 sec	$25\cos 756^\circ$	20.2254
44 sec	$25\cos 792^\circ$	7.7254

4. Write a general formula for finding the location of the shadow at any instant in time.

$25\cos(18t)$