**Kinematics Problems**

1. An orienteer runs north at 5 m/s for 120 seconds, and then west at 4 m/s for 180 seconds. What is the resultant displacement with respect to the starting position? Provide an angle with respect to the north direction.  
   (answer: 937.2 m; 50.2 degrees)

2. A skier was gliding downhill at 15 m/s. How long did it take her to ski the 630 m to the base of the hill? A less proficient skier averaged 12 m/s down the slope. If they started together, how far behind the first skier was she by the time she got to the bottom of the hill? (describe this in both time and distance.)  
   (answers: 10.5 s; 126 m)

3. The world record for the 24-hour run is about 160 miles. What is this distance in meters? What is 24 hours in seconds? What would be a runner's average speed in going 160 miles in a day?  
   (answer: 2.98 m/s)

4. Bobsleds accelerate from rest to high speeds in a few seconds. If one sled's speed increased from 0 to 32 m/s in 8 seconds, what was its average acceleration during that time period? How far did the sled travel down the track in the 8 seconds?  
   (answers: 4 m/s/s; 128 m)

5. The table below shows the instantaneous velocity of a different bobsled during the first 10 seconds after the driver and crew had gotten on board. Plot a velocity vs Time graph from the data and answer the following questions: What was the sled's acceleration in the first 5 seconds? How far did the sled travel during those 5 seconds? What was the sled's average velocity during the first 5 seconds? Finally, describe what was happening to the bobsled's motion after 8 seconds.  
   (answers: 3.5 m/s/s; 73.75 m; 14.75 m/s)

6. The graph below shows a car's position as a function of time as it progressed. Initially, the car was moving forward at constant speed. Then it slowed to a stop, backed up, stopped and went forward again. Based on the position-time graph, create a graph of velocity vs time for the car's motion. When was the car's speed greatest? when least? When was the car's velocity greatest? when least? You can use excel to create the velocity-time graph based on the data from the position-time graph.
Question #5 table:

<table>
<thead>
<tr>
<th>TIME (s)</th>
<th>VELOCITY (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6.0</td>
</tr>
<tr>
<td>1</td>
<td>9.5</td>
</tr>
<tr>
<td>2</td>
<td>13.0</td>
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<tr>
<td>3</td>
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<tr>
<td>6</td>
<td>27.0</td>
</tr>
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<td>7</td>
<td>30.5</td>
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<tr>
<td>8</td>
<td>33.0</td>
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<tr>
<td>9</td>
<td>34.5</td>
</tr>
<tr>
<td>10</td>
<td>35.0</td>
</tr>
</tbody>
</table>

Question #6 graph:

Position vs Time

![Position vs Time Graph](image-url)
Projectile problems

1. A soccer ball is kicked with an initial horizontal speed of 5 m/s and an initial vertical speed of 3 m/s. Assuming projection and landing heights are the same, identify the following quantities:
   a. The ball’s horizontal speed 0.5 seconds into its flight (5 m/s)
   b. The ball’s horizontal speed midway through its flight (5 m/s)
   c. The ball’s horizontal speed immediately before contact with the ground (5 m/s)
   d. The ball’s vertical speed at the apex of flight (0 m/s)
   e. The ball’s vertical speed midway through its flight (0 m/s)
   f. The ball’s vertical speed immediately before contact with the ground (-3 m/s)

2. A rugby player attempts a kick after scoring a try. The ball was kicked at an angle of 60 degrees with an initial resultant velocity of 40 miles/hour!
   a. What was the initial resultant velocity in meters/second? (17.9 m/s)
   b. What was the initial horizontal velocity in m/s? (9.0 m/s)
   c. What was the initial vertical velocity in m/s? (15.5 m/s)
   d. If the player was 40 meters away from the goal, and the height of the horizontal bar was 3 meters, did the player score? Assume that the trajectory of the ball was on target! (No)

3. A soccer ball is kicked from the playing field at a 45˚ angle. If the ball is in the air for 3 seconds, what is the maximum height achieved? (11.25 m)

4. A mountain biker encounters a deep gorge. He has “heard” that if he jumps off the log on the edge of his side of the gorge he can expect 50° for his trajectory. He has also “heard” that the other side of the gorge is 1 meters higher that the side he is on. He knows that he can ride to a maximum speed of 20 mi/hr on the trail approaching the gorge and off of log. Assuming what the rider “heard” is accurate, how wide can the gorge be for him to not plummet to his death? (6.9 m)