Motion – Day 4

Distance and Displacement

For problems 1 – 2, the velocity of an object is \( v(t) = (t - 2)^2 \)
1. Determine the total distance traveled by the object from \( t = 0 \) to \( t = 5 \).
2. Determine the net displacement from \( t = 0 \) to \( t = 5 \).

3. The velocity of a particle moving along the x-axis is given by the expression \( v(t) = 1 + t \cos t \), where \( t \geq 0 \) is measured by seconds. Find the total distance traveled by the particle in the first four seconds.

For problems 4 – 5, a particle moves along the x-axis so that at time \( t \) its position is given by \( x(t) = t^3 - 6t^2 + 9t + 11 \).
4. Find the total distance traveled by the particle over the time interval \( 0 \leq t \leq 5 \).
5. Find the net displacement traveled by the particle over the time interval \( 0 \leq t \leq 5 \).

For problems 6 – 9, a particle starts at time \( t = 0 \) and moves along the x-axis so that its position at any time \( t \geq 0 \) is given by \( x(t) = (t - 1)^3(2t - 3) \).
6. Find the velocity of the particle at any time \( t \geq 0 \).
7. Find all times when the acceleration is zero.
8. Find \( v(2) \).
9. Find the total distance traveled from \( t = 0 \) to \( t = 4 \).

For problems 10 – 15, the velocity of an object moving along the line \( y = 2 \) is given by the equation \( v(t) = t^2 - 4t + 3 \). Find the following for the time interval from \( t = 0 \) to \( t = 5 \).
10. When is the object at rest?
11. When is the object moving forward?
12. When is the object moving backward?
13. How far does the object travel in the first second?
14. How far does the object travel from \( t = 1 \) to \( t = 5 \)?
15. How far from the origin is it after 4 seconds?

16. Use the following table to approximate the value of \( \int_0^{10} |v(t)| \, dt \) using a trapezoidal approximation with the three sub-intervals indicated by the value in the table. Explain the meaning of the definite integral in the context of the problem.

<table>
<thead>
<tr>
<th>Time, t</th>
<th>0</th>
<th>2</th>
<th>6</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity, ( v(t) )</td>
<td>5</td>
<td>3</td>
<td>-1</td>
<td>-8</td>
</tr>
<tr>
<td>Acceleration, ( a(t) )</td>
<td>0</td>
<td>-1</td>
<td>-3</td>
<td>-5</td>
</tr>
</tbody>
</table>

17. One way to determine total distance traveled over a time interval is to find the sum of the absolute values of the differences in position between all resting points. Here’s an example: if the position of a time particle is given by:

\[ x(t) = \frac{1}{3}t^3 - t^2 - 3t + 4 , \]

find the total distance traveled on the interval \( 0 \leq t \leq 6 \).