Using the Documents

The two calculator files differ in how the user sets, or defines, the velocity function.

Velocity_Position_Distance_PT1.tns:
Use the default velocity function. On page 1.3, observe the numerical values in the left pane and the motion of the particle in the top pane as t increases from 0 to 10. The graph of the position of the object is given on page 1.4. Use these graphs to answer the following questions:

1. Use the velocity function to explain when the object is moving to the right. To the left.
2. Use the velocity function to explain when the object changes direction.
3. When is the object moving fastest? Slowest? Not at all?
4. Find the time at which the object is farthest from its starting point. What is the value of the velocity at that time?
5. Find the average velocity of the object over the time interval $0 \le t \le 10$.
6. When is the object speeding up? Slowing down?
7. Describe the difference between total distance traveled and displacement of the object at any time t.
8. Explain why the values of the total distance traveled and displacement are not the same for all values of t. When are the same for all values of t?
9. Explain how the graph of the motion in the top pane (the trace of the motion in black) can be used to determine when the object is moving fast and when is it moving slowly.
10. For a specific value of t, explain how to use the graph of the velocity function to determine whether the speed of the object is increasing or decreasing.
11. Use values given in the left pane to estimate the acceleration of the particle at time $t = 5$.
12. Explain why the acceleration of the particle does not exist at time $t = 4$.
13. Find the position of the object at time $t = 6$. Explain how to use the velocity graph to find this value. Write an expression involving an integral that gives the position of the object at time $t = 6$.

The following questions involve manipulation of the velocity graph on Page 1.3.

1. Manipulate the velocity graph so that after 10 seconds the object is as far away from the starting point as possible. What is this distance?
2. For $0 \le t \le 10$, construct a velocity graph such that the displacement is 0 and the total distance traveled is greater than 0.
3. Is it possible to construct a velocity graph such that the displacement and total distance traveled are both 0? If so, how?
4. Construct a velocity graph such that the particle changes direction twice and has total distance traveled for $0 \le t \le 10$ equal to 16.
5. Is it possible to construct a velocity graph such that the object changes directions 5 times for $0 \le t \le 10$? If so, how?
6. Construct a velocity graph such that the object has velocity 0 twice in the interval $0 \le t \le 10$, but is always moving in the same direction.

Velocity_Position_Distance_PT2.tns:

Use the default velocity function. On page 1.3, observe the numerical values in the left pane and the motion of the particle in the top pane as t increases from 0 to 10. The graph of the position of the object is given on page 1.4. Use these graphs to answer the following questions.

1. Use the velocity function to explain when the object is moving to the right. To the left.
2. Use the velocity function to explain when the object changes direction.
3. When is the object farthest to the right?
4. Find the average velocity of the object on the interval $[0,5]$. Estimate a value of t_a in the interval $[0,5]$ such that the $v(t_a)$ is equal to the average velocity. On page 1.4, use the built-in calculator functions to draw the line segment connecting the points $(0,s(0))$ and $(5,s(5))$. Draw the tangent line to the graph of s at the point $(t_a,s(t_a))$. How are these two lines similar?
5. Find the average speed of the object on the interval $[0,5]$.
6. Find the first value of t for which the distance traveled by the object is different from the displacement of the object. Use the graph of the velocity to explain why this has occurred.
7. Use the values in the left pane to estimate the acceleration of the particle at time $t=3$.
8. Use the graph of the velocity to determine whether the object is speeding up or slowing down at time $t=2$. Explain how the path of the particle in the top pane supports your conclusion.
9. On page 1.3, use the built-in calculator functions to evaluate $\int_0^4 v(t)dt$. Explain how this value is related to $s(4)$. Drag to the right the point on the graph corresponding to $(4,0)$. Observe the values of s and v, and write an expression involving a definite integral relates the functions s and v.
10. Find the total distance traveled at times $t=5$ and $t=10$. How are these values related? This suggests that the object travels half the total distance in half the time. Define a velocity function such that this is false.

Set the initial position to 0.

1. Find a velocity function such that the distance traveled is equal to displacement at $t=10$. Explain why this is true for your function.
2. Find a velocity function such that the displacement is equal to (-1) times the distance traveled.
3. Find a velocity function such that at $t=10$ the displacement is 0 but the distance traveled is nonzero.
4. Find a velocity function such that the object changes direction once for $0 \le t \le 10$.
5. Find a velocity function such that the object changes direction twice and has negative displacement for $0 \le t \le 10$.