***PhET LAB 3-1 Velocity – Time Graphs***  Name(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Background –** Graphs are a means of communication.

**Learning Goals** – *Analyze* **velocity – time graphs**, *relate* these to **position - time graphs**, and *distinguish* the means for determining whether a person is standing, moving forward (or backwards), or accelerating. Also, relate the slopes of position – time and velocity – time graphs and the area to the time axis for the velocity – time and acceleration – time graphs.

**Procedure –** Go here: <https://phet.colorado.edu/en/simulation/legacy/moving-man> . Then, *click* **PLAY**, or ***download*** then, keep and **double click** to activate “The Moving Man.”



1. **START.** After “Moving Man” is open, choose Charts. Leave the **position – time graph**, and the **velocity – time graph** *open*, but *close the* acceleration-time graph. Your screen should look like this. Please, *turn the sound off*.

2. **EXPLORE.** *Press* **PLAY**, then *click* and *drag* the man to move him forward and backward. *Observe* what shows up on the graphs.

3. **Without using *Moving Man***, *sketch* what the motion graphs will look like if the man *starts* at the **tree** and *moves toward the house* with **constant velocity**. Briefly*explain* your reasoning.

|  |  |
| --- | --- |
| **GRAPH**(*starting* at the tree, *moving toward the house* with at a constant velocity) | **Explanation**(reasoning for its shape) |
| **Position - Time** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Velocity - Time** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Now, *check your graphs* using the *Moving Man* simulation. If they need repaired, *sketch* the correct curve in a *different color pencil or pen*. Also, confirm and/or mend your explanation.

4. **Using *Moving Man***, *sketch* the motion graphs will look like if the man *leans against* the wall by his house without moving.*Write* down the reason why these graphs appear as they do.

|  |  |
| --- | --- |
| **GRAPH**(*leaning against* the wall by his house without moving) | **Explanation**(reasoning for its shape) |
| **Position - Time** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| **Velocity - Time** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**Position (sx/m)**

**Time (t/s)**

**0 2 4 6 8**

**7.0**

**-8.0**

**5**

5. Suppose this **position – time graph** *represent*s the Man’s motion, starting at 0.0 m. To draw the velocity – time graph, we need the slope (velocity) from 0 to 2 seconds.

*List* the other two **velocities including their time intervals** required to draw an accurate **velocity – time graph** of this motion.

 a. $\vec{v}\_{0-2s}=slope from 0-2 seconds$

 b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Time (t/s)**

**Velocity (vx/ms-1)**

6. *Determine* the values listed in a, b, and c.

 a. $\vec{v}\_{0-2s}=$\_\_\_\_\_\_\_\_\_\_

 b. \_\_\_\_\_\_\_ $=$ \_\_\_\_\_\_\_\_\_

 c. \_\_\_\_\_\_\_ $=$ \_\_\_\_\_\_\_\_\_

Calculation of **a.** goes here!

7. Now, *sketch* the **velocity – time graph** that matches the Man’s motion (on the right).

8. Here are the motion graphs showing the person moving forward for **4.0 s**, starting at **-9.0 m**, traveling to **11.0 m**. *Find* **values** and write the **units** for the following **(2 SF)**:

**Position (sx/m)**

**Velocity (vx/ms-1)**

**Acceleration (a/ms-2)**

**Time (t/s)**

**-9.0**

**11.0**

a. initial position ($x\_{i}$): \_\_\_\_\_\_\_\_\_\_\_

b. final position ($x\_{f}$): \_\_\_\_\_\_\_\_\_\_\_

c. total displacement ($\vec{s}$): \_\_\_\_\_\_\_\_\_\_\_

 *(shade the area relating this on the v-t graph)*

v

 *(show the calculation of that area )*

d. time interval ($t$): \_\_\_\_\_\_\_\_\_\_\_

e. initial velocity ($\vec{u}$): \_\_\_\_\_\_\_\_\_\_\_

f. final velocity ($\vec{v}$): \_\_\_\_\_\_\_\_\_\_\_

g. acceleration ($\vec{a}$): \_\_\_\_\_\_\_\_\_\_\_

 *(draw the rise over the run on the v-t graph)*

 *(show a calculation of that slope)*

h. change in velocity ($∆\vec{v}$): \_\_\_\_\_\_\_\_\_\_\_ 9. We know that a **velocity – time graph** allows us to

 *(shade the area linked to this on the a-t graph)* generate an object’s **instantaneous acceleration**,

v

 *(show a calculation of this area)* (and change in velocity). But, *what* can it **NOT** convey?

10. *Draw* the **velocity – time graph** for a person, starting at rest, who moves from 11.0 m to -9.0 m with an **acceleration** of -5.0 m/s2 in 4.0 s.

**Velocity (vx/ms-1)**

**Time (t/s)**

*Loeblein, King, and Forbes 2018*