Motion Diagram Jogging

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Spring 2024

This material is borrowed/adapted from PH 201 Tutorial 1 for Fall 2020.

Activity

Mary runs east at 6.0 km/h for 0.50 hr. She then turns around and runs west at 4.0 km/h for 1.0 h. Let east be the positive direction.

a) Draw a motion diagram for Mary. Assume turning around takes negligible time.

Here, we have chosen $\Delta t = 10$ min. Other choices are also acceptable.

b) How far does Mary run?

To find how far she runs, we want the total distance she ran. Distance doesn't include directional information, so we just find how far she ran east and how far she ran west (two positive numbers) and add them together:

$$\begin{aligned} d_E &= (6.0 \text{ km/h})(0.50 \text{ h}) = 3.0 \text{ km} \\ d_W &= (4.0 \text{ km/h})(1.0 \text{ h}) = 4.0 \text{ km} \\ d &= d_E + d_W = 3.0 \text{ km} + 4.0 \text{ km} = 7.0 \text{ km}. \end{aligned}$$

c) What is Mary's displacement?

Displacement is a vector, so we need to add the displacement of her eastward run (a positive number) to the displacement of her westward run (a negative number) to get the total displacement:

$$\begin{aligned} \vec{d}_E &= (6.0 \text{ km/h})(0.50 \text{ h}) = 3.0 \text{ km} \\ \vec{d}_W &= (-4.0 \text{ km/h})(1.0 \text{ h}) = -4.0 \text{ km} \\ \vec{d} &= \vec{d}_E + \vec{d}_W = 3.0 \text{ km} + (-4.0 \text{ km}) = -1.0 \text{ km}, \text{ i.e. } 1.0 \text{ km, west.} \end{aligned}$$