



## S20 Unit B: Acceleration and Displacement

Name: Key!Date: Mar 17<sup>th</sup> 2020

Two new formulas on your Data Sheet connect displacement and acceleration:

$$\vec{d} = \frac{(\vec{v}_f + \vec{v}_i)t}{2}$$

$$\vec{d} = \vec{v}_i t + \frac{1}{2} \vec{a} t^2$$

Activity: *World's Fastest Nerd*

Variables List (Nerd 1):

$$\vec{v}_i = \underline{0 \text{ m/s}} \quad \vec{d} = \underline{8.5 \text{ m}}$$

$$\vec{v}_f = \underline{12 \text{ m/s}} \quad t = \underline{1.42 \text{ s}}$$

Variables List (Nerd 2):

$$\vec{v}_i = \underline{4.5 \text{ m/s}} \quad \vec{d} = \underline{9.0 \text{ m}}$$

$$\vec{v}_f = \underline{7.9 \text{ m/s}} \quad t = \underline{1.45 \text{ s}}$$

Variables List (Nerd 3):

$$\vec{v}_i = \underline{2.2 \text{ m/s}} \quad \vec{d} = \underline{54 \text{ m}}$$

$$\vec{v}_f = \underline{13 \text{ m/s}} \quad t = \underline{5.0 \text{ s}}$$

Variables List (Nerd 4):

$$\vec{v}_i = \text{n/a} \quad \vec{d} = \text{n/a}$$

$$\vec{v}_f = \text{n/a} \quad t = \text{n/a}$$

Calculation 1: Using  $\vec{d} = \vec{v}_i t + \frac{1}{2} \vec{a} t^2$  calculate the acceleration of each person.

Nerd 1:

$$8.5 \text{ m} = (0 \text{ m/s})(1.42 \text{ s}) + \frac{1}{2} (\vec{a})(1.42 \text{ s})^2$$

$$8.5 = \left[ \frac{1}{2} \vec{a} (2.0164) \right] \div \frac{1}{2} \div 2.0164$$

$$\underline{\underline{8.4 \text{ m/s}^2}} = \vec{a}$$

Nerd 2:

$$9.0 \text{ m} = (4.5 \text{ m/s})(1.45 \text{ s}) + \frac{1}{2} \vec{a} (1.45 \text{ s})^2$$

$$9 = 6.525 + \frac{1}{2} \vec{a} (2.1025)$$

$$2.475 = \left[ \frac{1}{2} \vec{a} (2.1025) \right] \div \frac{1}{2} \div 2.1025$$

$$\underline{\underline{2.4 \text{ m/s}^2}} = \vec{a}$$

Nerd 3:

$$54\text{m} = (2.2\text{m/s})(5\text{s}) + \frac{1}{2} \vec{a} (5\text{s})^2$$

$$\vec{a} = 3.4\text{ m/s}^2$$

Nerd 4:

N/A

Calculation 2: Using  $\vec{d} = \frac{(\vec{v}_i + \vec{v}_f)t}{2}$ , calculate the displacement you ran and check to see if it matches your measurement. **2**

Nerd 1:

$$\vec{d} = \frac{(12\text{m/s} + 0\text{m/s})(1.2\text{s})}{2}$$

$$\vec{d} = \underline{\underline{7.2\text{m}}}$$

Nerd 2:

$$\vec{d} = \frac{(4.5\text{m/s} + 7.9\text{m/s})(1.4\text{s})}{2}$$

$$= \underline{\underline{9.0\text{m}}}$$

Nerd 3:

$$\vec{d} = \frac{(13\text{m/s} + \overset{8.6}{2.2}\text{m/s})(5.0\text{s})}{2}$$

$$\vec{d} = \underline{\underline{54\text{m}}}$$

Nerd 4:

N/A