Name _____

# Relative Velocity (p. 157 – 159)

## I. Relative Velocity

1. **If a school bus is traveling 8 m/s in a positive direction and you walk 3 m/s in the same direction, what is your velocity relative to :**

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The Bus (Walking Forward) : 3 m/s (Relative to bus)

The Bus (Walking To The Back) : 3 m/s (Relative to bus / opposite direction)

The Bus (Standing Still) : 0 m

The Road : 8 m/s (Standing Still) / 11 m/s (Forward) / 5 m/s (To Back)

2. **When velocities are along the same line, how can the relative velocity be determined?**

Simple addition or subtraction of vectors

3. **What variables can be used to explain the bus situation?**

Velocity of bus relative to the road = $V_{b/r}$ (bus to road)

Velocity of you relative to the bus = $V_{y/b}$ (you to bus)

Velocity of you relative to the road = $V_{y/r}$ (you to road)

4. **Using the above variables, what equation can be used to determine relative velocity of you to the road?**

$$V_{y/b} + V_{b/r} = V_{y/r}$$

5. **Write out the generic formula to determine relative velocity.**

$$V_{a/b} + V_{b/c} = V_{a/c}$$

6. **Which vector indicates magnitude and direction of relative velocity changes?**

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Resultant Vector

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**7. List three other examples of when relative velocities can be combined.**

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1. Air plane flights
2. Boat trips
3. Vertical movement (Escalators, Elevators, Etc.)

**8. What are three factors that pilots need to consider when reaching a destination?**

1. Plane speed relative to air
2. Direction of flight relative to air
3. Velocity of wind relative to ground

**9. What are the general steps needed to determine combined relative velocities?**

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1. Establish a coordinate system.
2. Draw vectors to represent relative velocities (form a triangle!)
3. Apply proper vector addition (and formulas)

**10. Identify the equations for each of the following :** (Review question.)

Pythagorean Theorem (Right Triangles)

$R^2 = A^2 + B^2$ $\left(R = \sqrt{A^2 + B^2}\right)$

Law Of Cosines (Non-Right Triangles)

$R^2 = A^2 + B^2 - 2AB\cos\theta$

Law Of Sines (Non-Right Triangles)

$\frac{R}{\sin\theta} = \frac{A}{\sin a} = \frac{B}{\sin b}$

$\theta = \tan^{-1}\left(\frac{\text{opposite side}}{\text{adjacent side}}\right)$