Ex1: Ian tosses a fruit forward to Brad while on a bus to Wondergrad. The bus was moving at a speed of 28 m/s and the fruit was thrown at a speed of 3 m/s.

a) What was the velocity of the fruit relative to the people on the bus? \( \vec{v}_{fb} \) = \( \vec{v}_{fb} \) + \( \vec{v}_{bg} \)  
   \( \vec{v}_{fg} = \vec{v}_{fb} + \vec{v}_{bg} \)  
   \( = 3 \text{ m/s} \ [\text{FWD}] + 28 \text{ m/s} \ [\text{FWD}] \)  
   \( = 31 \text{ m/s} \ [\text{FWD}] \)

b) What was the velocity of the fruit relative to the road?

\( \vec{v}_{fb} \) = \( \vec{v}_{fb} \) + \( \vec{v}_{bg} \)  
   \( \vec{v}_{fg} = \vec{v}_{fb} + \vec{v}_{bg} \)  
   \( = 3 \text{ m/s} \ [\text{FWD}] + 28 \text{ m/s} \ [\text{FWD}] \)  
   \( = 31 \text{ m/s} \ [\text{FWD}] \)
Ex2: A plane heading N50°E at a speed of 700 km/h encounters a wind of 140 km/h from the northeast. Determine the plane’s ground velocity.

\[
\|\vec{v}_{pg}\|^2 = \|\vec{v}_{pw}\|^2 + \|\vec{v}_{wg}\|^2 - 2|\vec{v}_{pw}|\|\vec{v}_{wg}|\cos 5°
\]

\[
= 700^2 + 140^2 - 2(700)(140)\cos 5°
\]

\[
= 314,345.84
\]

\[
|\vec{v}_{pg}| = 560.7
\]

To get direction S is needed:

\[
\sin 45° = \frac{5}{560.7}
\]

\[
45° = \sin^{-1}\left[\frac{5}{560.7}\right]
\]

\[
\approx 1.25°
\]

Direction = 50° + 1.25°

= 51.25°

\[
\therefore \text{The plane’s ground velocity is } 560.7 \text{ km/h [N}51.25°\text{E]}
\]
Ex3: (p.369 #4)

Adam can swim at a rate of 2 km/h in still water. At what angle to the bank of a river must he head if he wants to swim directly across the river and the current in the river moves at the rate of 1 km/h?

\[ |\vec{V}_{aw}| = 2 \text{ km/h} \]
\[ \vec{V}_{wg} = 1 \text{ km/h} \]

\[ \vec{V}_{ag} = ? \]
\[ \vec{V}_{aw} + \vec{V}_{wg} = \vec{V}_{ag} \]
\[ \vec{V}_{ag} = \vec{V}_{aw} + \vec{V}_{wg} \]

\[ \theta = \sin^{-1} \left( \frac{|\vec{V}_{wg}|}{|\vec{V}_{aw}|} \right) \]

\[ = 30^\circ \]

\[ \text{Adam must swim at angle } [N60^\circ E] \text{ (or [E30^\circ N]) to travel directly across the river.} \]
Ex4: A plane wishes to travel to a destination S20°E. The air speed of the plane is 600 km/h. A 90 km/h wind is blowing N40°E. In what direction should the pilot be flying to reach the destination? What is the ground speed of the plane?

\[ \text{Air speed:} \quad \vec{U}_{\text{pw}} = 600 \text{ km/h} \]

\[ \vec{U}_{\text{wg}} = 90 \text{ km/h} \quad \text{[N40°E]} \]

\[ \text{Ground speed} \quad |\vec{U}_{\text{pg}}| = ? \]

\[ \text{In } \triangle APD, \quad \angle D = 180° - 40° - 20° = 120° \]

\[ \frac{\sin \angle P}{90} = \frac{\sin 120°}{600} \]

\[ \angle P = \sin^{-1}\left(\frac{\sin 120° \cdot 90}{600}\right) \]

\[ \approx 7.46° \]

Direction = 20° - 7.46° = 12.54° [S12.54°E]

\[ \frac{|\vec{U}_{\text{pg}}|}{\sin (120° - 7.46° - 120°)} = \frac{600}{\sin 120°} \]

\[ |\vec{U}_{\text{pg}}| \approx 549.92 \]

The ground speed is 550 km/h and the pilot should fly in a direction [S12.54°E].
Assigned Work

p.369 #1, 2, 3, 5, 6, 7, 9, 10