

# Topic 1C: Constant Velocity

## Skill 10 (Relative Velocity)

43. What is the resultant velocity of a person walking 2 m/s east on a ship that is moving north at 10 m/s? What is the resultant displacement of the object after 5 seconds?

$$\begin{aligned}
 V_x &= 2 \text{ m/s} & V &= \sqrt{V_x^2 + V_y^2} & \theta &= \tan^{-1}\left(\frac{V_y}{V_x}\right) \\
 V_y &= 10 \text{ m/s} & &= \sqrt{(2 \text{ m/s})^2 + (10 \text{ m/s})^2} & &= \tan^{-1}\left(\frac{10 \text{ m/s}}{2 \text{ m/s}}\right) \\
 V &=? & &= 10.2 \text{ m/s} & \theta &= 78.7^\circ \\
 \theta &=? \\
 d &=? & d &= vt \\
 t &= 5 \text{ s} & &= (10.2 \text{ m/s})(5 \text{ s}) \\
 & & &= 255 \text{ m}
 \end{aligned}$$

44. What is the horizontal velocity of an object that has a resultant velocity of 30 m/s if the vertical velocity is 20 m/s north? What is the direction of the resultant motion?

$$\begin{aligned}
 V &= 30 \text{ m/s} & V^2 &= V_x^2 + V_y^2 \\
 V_y &= 20 \text{ m/s} & (30 \text{ m/s})^2 &= V_x^2 + (20 \text{ m/s})^2 \\
 V_x &=? & V_x &= 22.36 \text{ m/s}
 \end{aligned}$$

45. A ball launched at an angle of 60 degrees with a velocity of 15 m/s. What are the horizontal and vertical components of the ball?

$$\begin{aligned}
 \theta &= 60^\circ & V_x &= V \cos \theta & V_y &= V \sin \theta \\
 V &= 15 \text{ m/s} & V_x &= 15 \text{ m/s} \cos 60^\circ & &= 15 \text{ m/s} \sin 60^\circ \\
 V_x &=? & &= 7.5 \text{ m/s} & &= 13 \text{ m/s} \\
 V_y &=?
 \end{aligned}$$

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46. A canoe in an eastward current is traveling at an angle of 70 degrees relative to the shore.  
a) If the canoeist is paddling north with a velocity of 3m/s, determine the velocity of the canoe.

$$V_y = 3 \text{ m/s}$$

$$\theta = 70^\circ$$

$$V = ?$$

$$V_y = V \sin \theta$$

$$3 \text{ m/s} = V \sin 70^\circ$$

$$V = 3.2 \text{ m/s}$$

- b) Determine the eastward velocity of the current.

$$V_x = ?$$

$$V_y = 3 \text{ m/s}$$

$$\theta = 70^\circ$$

$$\tan \theta = \frac{V_y}{V_x}$$

$$V_x = \frac{V_y}{\tan \theta} = \frac{3 \text{ m/s}}{\tan 70^\circ} = 1.1 \text{ m/s}$$