Physics Virtual Learning

Addition of Velocities

April 9, 2020

PHYSICS

April 9th, 2020

Addition of Velocities

Students will learn how vector addition enables us to add velocities in two dimensions to get a resultant velocity.

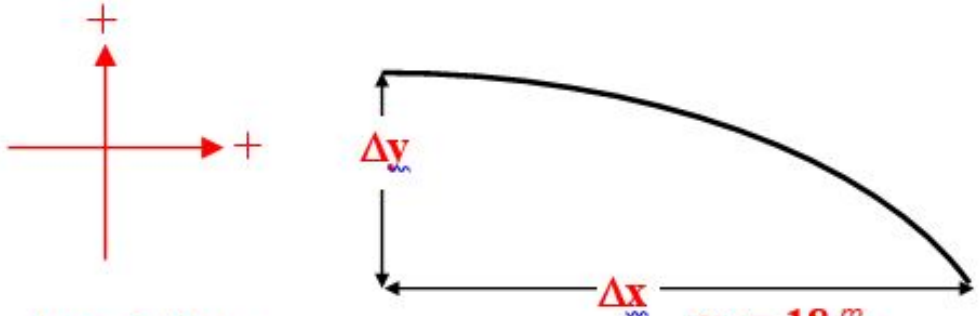
Quick Review

a) Tad drops a cherry pit out the car window 1.0 m above the ground while traveling down the road at 18 m/s. How far, horizontally, from the initial dropping point will the pit hit the ground?

b) If the car continues to travel at the same speed, where will the car be in relation to the pit when it lands?

Quick Review Answers

a)



$\Delta y = -1.0\ m$
$v_{xi} = 0$
$a = g = -10\ \frac{m}{s^2}$

$v_x = 18\ \frac{m}{s}$
$\Delta t = ?$
$\Delta x = ?$

$$\Delta y = v_{yi}t + \tfrac{1}{2}a\Delta t^2 \Rightarrow t = \sqrt{\frac{2\Delta y}{a}} = \sqrt{\frac{2(-1.0m)}{-10\ \frac{m}{s^2}}} = 0.45\ s$$

$$\Delta x = v_x \Delta t \Rightarrow \Delta x = 18\ \tfrac{m}{s}(0.45s) = 8.0m$$

b) Tad will be directly above the cherry pit when it hits the ground.

Addition of Velocities

Link:Addition of Velocities

Directions:

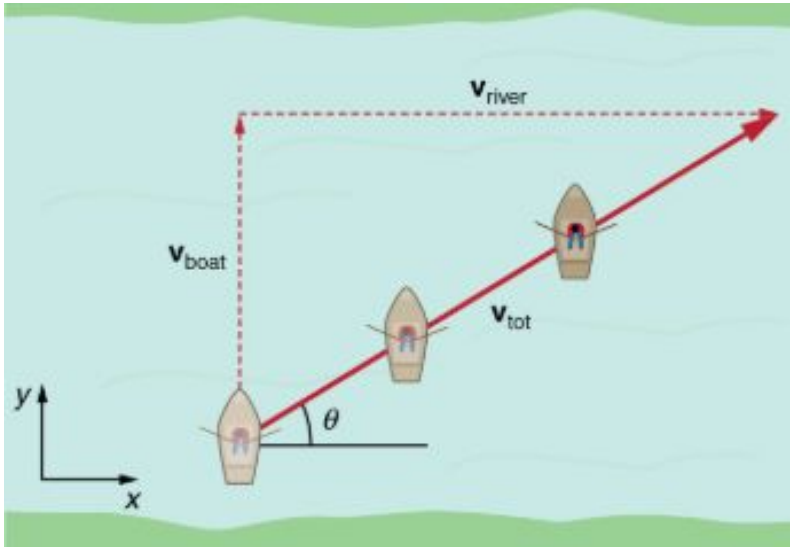
- Read through the section on Addition of Velocities..
- Work through the examples on a separate piece of paper before you scroll down to the solution.
- On a separate piece of paper complete the practice problems on the following slides.
- Check your answers.
- For additional practice check out the conceptual questions and the problems and exercises in the table of contents for the online text linked above.

Practice problems

1) A parrot flies at a speed of 10m/s in still air.
   a) If he flies into a 2m/s headwind, how fast will he be traveling relative to the ground below?
   b) Relative to the ground below, how fast will he travel when he experiences a 2m/s tailwind?
   c) While flying at 10m/s, suppose the parrot encounters a 10m/s crosswind (coming at a right angle to his heading). What is his speed relative to the ground below?

Practice Problems

2) A boat is rowed at 8 km/h directly across a river that flows at 6 km/h.

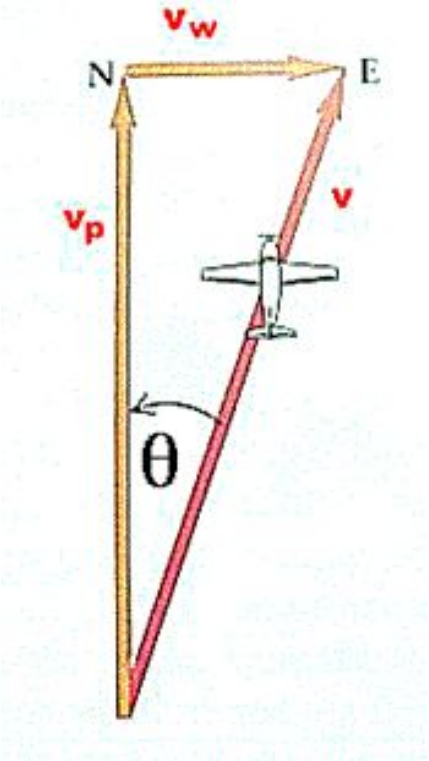


a) What is the resultant velocity of the boat?

b) How fast and in what direction can the boat be rowed to reach a destination directly across the river

Practice Problems

3) Calculate the resulting velocity of an airplane with an airspeed of 120.0 km/h pointing due north when it encounters a wind of 50.0 km/h directed from the west.



Practice Problems Answers

1a) Speed in headwind = 10 m/s - 2m/s = 8 m/s

1b) Speed in tailwind = 10 m/s + 2 m/s = 12 m/s

1c) speed in a right angle crosswind, The parrot and wind form two vectors that when added head to tail form two sides of a right triangle. The bird would fly a path that matches the hypotenuse of that triangle so….

$$v = \sqrt{v_x^2 + v_y^2}$$

$$v = \sqrt{((10\frac{m}{s})^2 + (10\frac{m}{s})^2)}$$

= 14 m/s at 45 degrees from the original course

Practice Problems Answers

2a) The boat and river form two vectors that when added head to tail form two sides of a right triangle. The boat would travel in a path that matches the hypotenuse of that triangle so….

$$v = \sqrt{v_x^2 + v_y^2}$$

$$v = \sqrt{((8\frac{km}{h})^2 + (6\frac{km}{h})^2)}$$

= 10 km/h

Direction = θ =$\tan^{-1}$(opp/adj)

=$\tan^{-1}$(6/8)

= 37° downstream

2b) To travel straight across the boat would travel at 10 km/h at 37 degree up stream(into the current)

Practice Problem Answers

3)

$$v = \sqrt{v_x^2 + v_y^2}$$

$$v = \sqrt{((120.0\frac{km}{h})^2 + (50.0\frac{km}{h})^2)}$$

= 130. km/h

Direction = θ =$\tan^{-1}$(opp/adj)

=$\tan^{-1}$(50.0/120.0)

= 22.6° east of north

Additional Practice

For additional practice check out the conceptual questions and the problems and exercises in the table of contents from the online text linked above.