River Crossings and Airplanes

Tuesday, September 13, 2011
1:51 PM

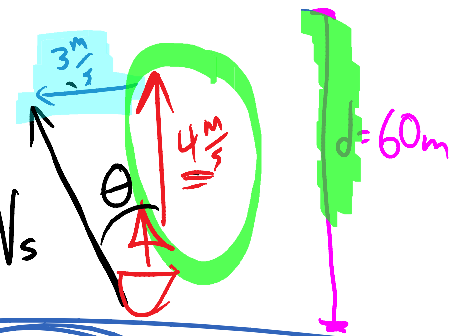
When crossing a river 2 vectors are added together 1) velocity of the boat as provided by the motor, and 2) the river velocity (current).

These combine to give the velocity as seen from shore

$$V_b + V_c = V_s$$

Ex: A boat keel hauling a cat travels due north at 4.0 m/s in a river of width 60m and current 3.0 m/s due west.

Find a) the velocity as seen from shore
b) the time to get across the river
c) the downstream displacement of the boat



$V_s = 5.0\ \frac{m}{s}$

$\theta = 37°$ W from N

$$\frac{\Delta d}{\Delta t} = V_{ave}$$

$$\frac{60m}{t} = 4\ \frac{m}{s}$$

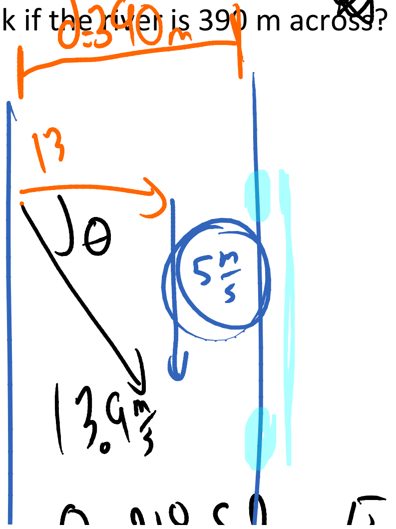
$$\frac{60}{4} = t = 15\ s$$

$$\frac{\Delta d}{\Delta t} = V_c$$

15

$$\Delta d = V_c t = 3(15) = 45m$$

A river flows south at 5.0 m/s a drug-lord in a cigar boat rips across away from the US Marshalls at 13 m/s due east. What is the resulting velocity, and how far downstream is the boat when reaches the far bank if the river is 390 m across?



$$\frac{\Delta d}{\Delta t} = V$$

$$\frac{390}{t} = 13$$

$$\frac{390}{13} = t = 30s$$

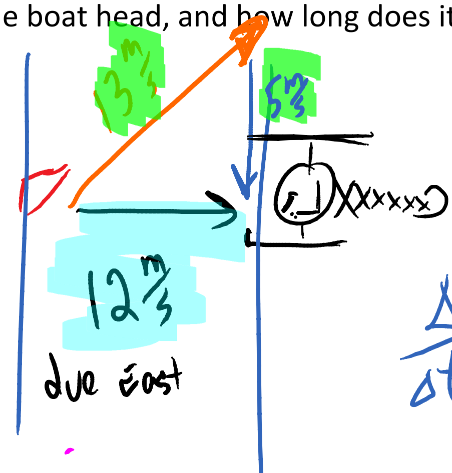
$$\frac{\Delta d}{\Delta t} = V$$

$$\Delta d = 5 \times 30 = 150m$$

$\theta = 21^\circ$ S from E

$\frac{\Delta d}{\Delta t} = V$

Because the drug-lord's escape helicopter is directly across the river from the boat's entry point the boat must travel straight across the river. How can this be accomplished, at what angle upstream should the boat head, and how long does it take to cross?



$\sin\theta = \frac{5}{13}$

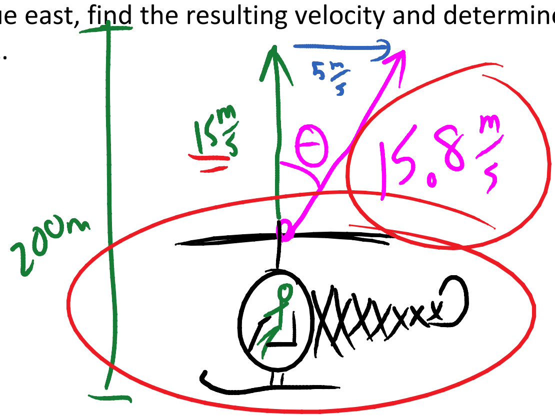
$\theta = \sin^{-1}\left(\frac{5}{13}\right)$

$= 23^\circ$ N from E

$\frac{\Delta d}{\Delta t} = V$

$\frac{390}{t} = 12 \qquad \frac{390}{12} = 32.5\,s$

The drug-lord reaches his helicopter and it lifts off at 15 m/s [UP], there is a wind blowing at 5.0 m/s due east, find the resulting velocity and determine how long it takes to reach an altitude of 200m…



$\theta = 18^\circ$ East of up

$\frac{\Delta d}{\Delta t} = V$

$\frac{200}{t} = 15 \qquad \frac{200}{15} = 13.3\,s$

$V_p + V_w = V_g$

In any flight problem: $V_g = V_p + V_w$

$\Delta t = 13.3\,s$

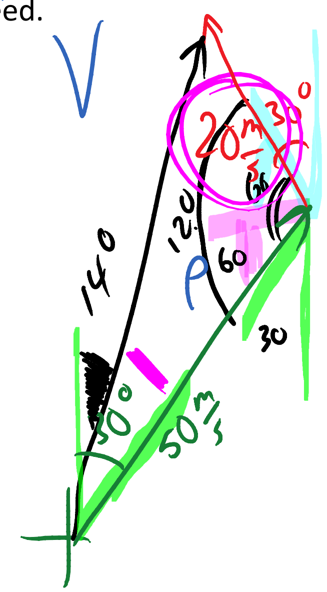
The velocity as viewed from the ground = velocity of the aircraft + the velocity of the wind

ground speed = airspeed + wind speed

$v_g = v_p + v_w$

A plane flies at 50 m/s at 30º E of N, and encounters a wind of 20 m/s at 30º W of N, determine the ground speed.

$$V_p + V_w = V_g$$



$$c^2 = 50^2 + 20^2 - 2(50)(20)\cos 120$$

$$c = 62.5 \tfrac{m}{s}$$

$$\frac{\sin\theta}{20} = \frac{\sin 120}{62.5}$$

$$\sin\theta = \frac{20 \sin 120}{62.5}$$

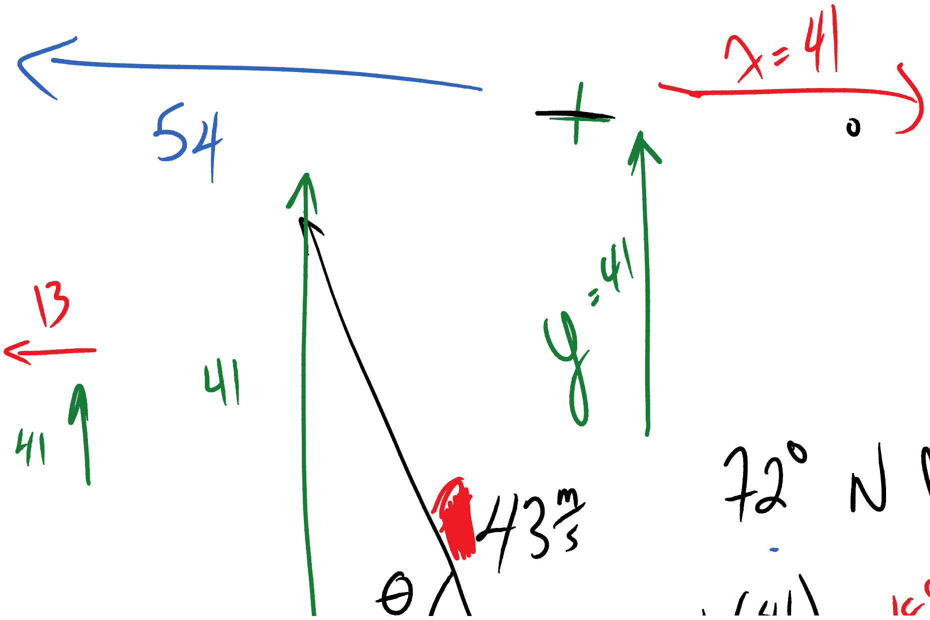
$$\theta = 16^0$$

$= 16.$

14^0 E from N

A Westjet flight from Calgary has groundspeed 54 m/s due west, if the wind is known to be 58 m/s at 45 º S of W, what is the airspeed?

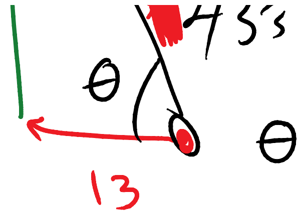
$$V_p + V_w = V_g \qquad V_p = V_g - V_w$$



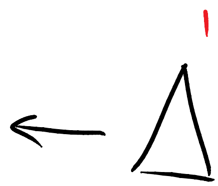
$X_{TOTAL} = \overleftarrow{13}$

$Y_{TOTAL} = 41 \uparrow$

72^0 N from W



$\theta = \tan^{-1}\left(\frac{41}{13}\right)$ 18° W from N



Change in (Δ) anything = final − initial

\$7 − \$20 = −\$13

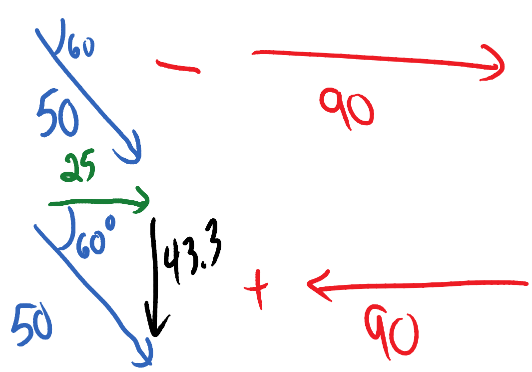
$\Delta V = V_f - V_o$

V_o

A car travells 90 km/h due east, it is later seen moving at 50 km/h at 60° S from E. What is it change in V?

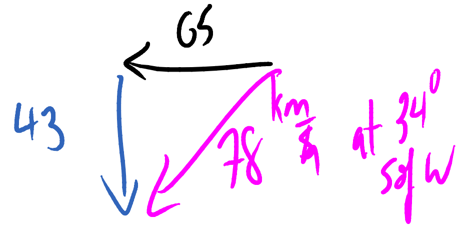
V_f

$\Delta V = V_f - V_o$



X_{TOTAL} : ← 65

Y_{TOTAL} : ↓ 43.3


65
43
78 km/h at 34° S of W