

Section 3.4: Airplane Navigation

$${}_p \vec{v}_e = {}_p \vec{v}_a + {}_a \vec{v}_e$$

Symbol	Velocity Vector	Speed	Direction
${}_p v_e$	Velocity of plane wrt earth	ground speed	tracking
${}_p v_a$	velocity of plane wrt air	airspeed	heading
${}_a v_e$	velocity of wind wrt earth	wind speed	wind velocity

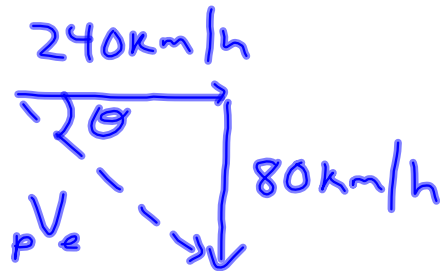
Type 1

1. An airplane has an air speed of 240 km/h and a heading of east. An 80.0 km/h wind is blowing from the north.
A) Calculate the plane's ground speed and tracking.

$$V_a = 240 \text{ km/h [E]}$$

$$V_e = 80 \text{ km/h [S]}$$

$$V_{pe} = ?$$



$$V_{pe}^2 = (240 \text{ km/h})^2 + (80 \text{ km/h})^2$$

$$V_{pe} = 252 \text{ km/h}$$

$$V_{pe} = 250 \text{ km/h [E } 18^\circ \text{ S]}$$

$$\tan \theta = \frac{80 \text{ km/h}}{240 \text{ km/h}}$$

$$\theta = 18^\circ$$

- B) What is the plane's displacement after 2.3 hours.

$$\begin{aligned} d &= V_{pe} t \\ &= (250 \text{ km/h [E } 18^\circ \text{ S]})(2.3 \text{ h}) \\ &= 580 \text{ km [E } 18^\circ \text{ S]} \end{aligned}$$

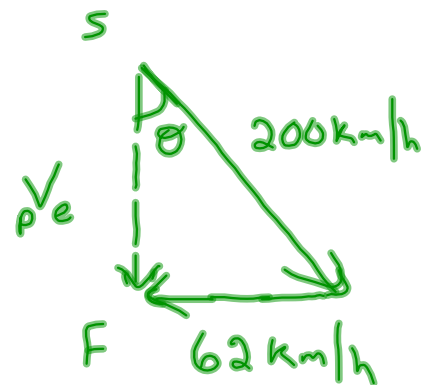
Type 2 tracking

2. A pilot wants to fly due South. The airplane has an air speed of 2.0×10^2 km/h. There is a 62 km/h wind blowing from the East.

A) Determine the heading the pilot should use.

$$\begin{aligned} \textcircled{2} v_{pa} &= 200 \text{ km/h } [?] \\ \textcircled{2} v_{pe} &= 62 \text{ km/h } [W] \\ \textcircled{1} v_{pe} &= ? [S] \end{aligned}$$

(b) head to head



$$\sin \theta = \frac{62 \text{ km/h}}{200 \text{ km/h}}$$

$$\theta = 18^\circ$$

$$[S 18^\circ E]$$

B) Determine the pilot's ground speed.

$$\begin{aligned} v_{pe}^2 &= (200 \text{ km/h})^2 - (62 \text{ km/h})^2 \\ v_{pe} &= 190 \text{ km/h} \end{aligned}$$

C) How long will it take him to get to his destination which is 350 km [S] of his initial position?

$$t = \frac{d}{v} = \frac{350 \text{ km}}{190 \text{ km/h}} = 1.8 \text{ h.}$$