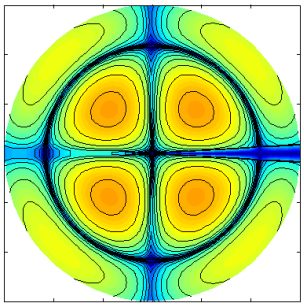


HSC PHYSICS ONLINE

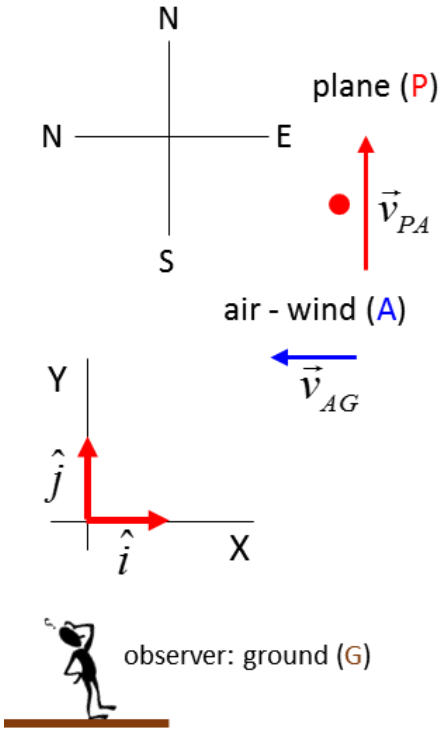
KINEMATICS
PROBLEMS and ANSWERS

P1673

An aircraft is trying to fly due north with a velocity of 200 $m.s^{-1}$ but is subject to a cross wind blowing from the east at 50 $m.s^{-1}$. What is the velocity of the plane with respect to the ground?

ANSWER

Problem category: relative velocity



velocity of the plane w.r.t. air

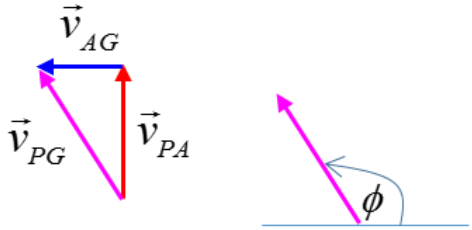
$$v_{PAx} = 0 \text{ m.s}^{-1} \qquad v_{PAy} = 200 \text{ m.s}^{-1}$$

velocity of the plane w.r.t. ground

$$\vec{v}_{PA} = ?\text{m.s}^{-1}$$

velocity of the air w.r.t. ground

$$v_{AGx} = -50 \text{ m.s}^{-1} \qquad v_{AGy} = 0 \text{ m.s}^{-1}$$



$$\vec{v}_{PA} = \left(0\ \hat{i} + 200\ \hat{j}\ \right)\text{m.s}^{-1}$$

$$\vec{v}_{AG} = \left(-50\ \hat{i} + 0\ \hat{j}\ \right)\text{m.s}^{-1}$$

Velocity of the plane w.r.t. the ground

$$\vec{v}_{PG} = \vec{v}_{PA} + \vec{v}_{AG}$$

N.B. on RHS subscripts A "cancel"

$$\vec{v}_{PG} = \left(-50\ \hat{i} + 200\ \hat{j}\right)\ \text{m.s}^{-1}$$

Magnitude

$$v_{PG} = \sqrt{{v_{PGx}}^2 + {v_{PGy}}^2} = \sqrt{(-50)^2 + (200)^2}\ \text{m.s}^{-1} = 206\ \text{m.s}^{-1}$$

Direction (w,r,t. X axis)

$$\phi = \text{atan}\left(\frac{v_{PGy}}{v_{PGy}}\right) = \text{atan}\left(\frac{200}{-50}\right) = 104^0$$

14° W of N