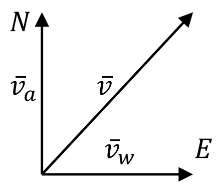
The compass of an aircraft indicates that it is headed due north, and its airspeed indicator shows that it is moving through the air At 120 mi.hr- 1. a) If there is a wind of velocity 50 mi.hr-1from west to East , what is the velocity of the aircraft relative to earth?(b) in what direction should the pilot head in order to travel due north?(c) what will then be his velocity relative to the earth?

Solution

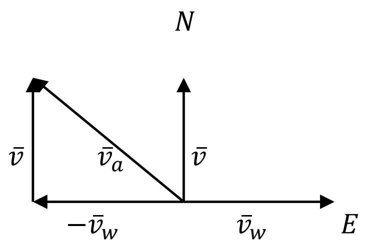


$\bar{v}_a$- velocity of the aircraft relative to the air, $\bar{v}_w$- velocity of a wind, $\bar{v}$- velocity relative to the earth.

a) A vector diagram shows that

$$\bar{v} = \bar{v}_a + \bar{v}_w \rightarrow v^2 = v_a^2 + v_w^2 \rightarrow v = \sqrt{v_a^2 + v_w^2} = \sqrt{120^2 + 50^2} = 130\,\frac{mi}{h}$$

b) A vector diagram shows that $\cos\alpha = \left(\frac{v_w}{v_a}\right)$ and $\bar{v} = \bar{v}_a - \bar{v}_w$



The direction is

$$\alpha = \cos^{-1}\left(\frac{v_w}{v_a}\right) = \cos^{-1}\left(\frac{50}{120}\right) = 65^\circ \text{ North of West} .$$

c) $\bar{v} = \bar{v}_a - \bar{v}_w \rightarrow v^2 = v_a^2 - v_w^2 \rightarrow v = \sqrt{v_a^2 - v_w^2} = \sqrt{120^2 - 50^2} = 109\,\frac{mi}{h}$

Answer: a) $30\frac{mi}{h}$, b) 65° North of West , c) $109\frac{mi}{h}$.