

Physics 122: Application of Vectors Examples

2. What is the acceleration of a glider that goes from 10 m/s [N] to 10 m/s [E] in 2.5 seconds?

$$a = \frac{v_f - v_o}{t} \quad v_{fE} = 10 \text{ m/s} \quad v_{oE} = 0 \text{ m/s}$$

$$v_{fN} = 0 \text{ m/s} \quad v_{oN} = 10$$

$$a_E = \frac{v_{fE} - v_{oE}}{t} = \frac{10 - 0}{2.5} = \underline{4 \text{ m/s}^2}$$

$$a_N = \frac{v_{fN} - v_{oN}}{t} = \frac{0 - 10}{2.5} = -4 \text{ m/s}^2$$

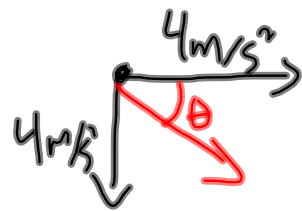
$$|a| = \sqrt{a_E^2 + a_N^2}$$

$$= \sqrt{32}$$

$$= \underline{5.7 \text{ m/s}^2}$$

$$\theta = \tan^{-1} \left| \frac{a_N}{a_E} \right| = \tan^{-1} 1$$

$$\theta = 45^\circ$$



$$\vec{a} = 5.7 \text{ m/s}^2 \text{ [E } 45^\circ \text{ S]}$$

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3. What is the average force on the glider if it has a mass of 92kg?

$$\vec{F} = m \vec{a}$$

$$\vec{F} = (92)(5.7 \text{ m/s}^2)$$

$$\vec{F} = 524 \text{ N [E } 45^\circ \text{ S]}$$

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5. An object initially has a velocity of 25 m/s [E62°N] and accelerates at 5.5 m/s² [E12°N] for 15 seconds. What is the displacement in that time?

$$\vec{d}_f = \cancel{\vec{d}_0} + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2$$

$$v_{0E} = 25 \cos 62^\circ = 11.7 \text{ m/s} \quad v_{0N} = 25 \sin 62^\circ = 22.1 \text{ m/s}$$

$$a_E = 5.5 \cos 12^\circ = 5.4 \text{ m/s}^2 \quad a_N = 5.5 \sin 12^\circ = 1.1 \text{ m/s}^2$$

$$d_{fE} = v_{0E} t + \frac{1}{2} a_E t^2$$

$$= (11.7)(15) + \frac{1}{2}(5.4)(15)^2$$

$$d_{fE} = \underline{783 \text{ m}}$$

$$d_{fN} = v_{0N} t + \frac{1}{2} a_N t^2$$

$$= (22.1)(15) + \frac{1}{2}(1.1)(15)^2$$

$$d_{fN} = \underline{455 \text{ m}}$$

$$|d_f| = \sqrt{d_{fN}^2 + d_{fE}^2}$$

$$= \underline{906 \text{ m}}$$

$$\theta = \tan^{-1} \left(\frac{d_{fN}}{d_{fE}} \right) = \tan^{-1} \left(\frac{455}{783} \right) = 30^\circ$$

$$\vec{d}_f = 906 \text{ m [E } 30^\circ \text{ N]}$$