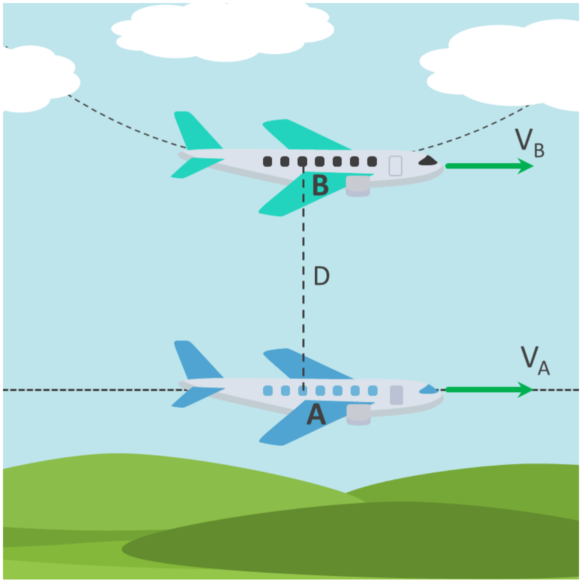
2.7.6 Aircrafts passing each other



Aircraft B is making looping's with a radius of $400m$ and at a constant speed of 100 m/s. Aircraft A is flying horizontally with a constant speed of 150 m/s and exactly 100m below the bottom of the looping (D=100m). When aircraft B is at the bottom of the loop, aircraft A passes. Determine the velocity of aircraft A seen from aircraft B in m/s.

Using known expressions:

$$\boldsymbol{\omega} = \frac{v_B}{r}\mathbf{k} \tag{1}$$

When defining the origin of the rotating coordinate system at point B:

$$\mathbf{v}_A = \mathbf{v}_B + \boldsymbol{\omega} \times \mathbf{r}_{A/B} + \mathbf{v}_{rel} \tag{2}$$

Given:
Velocity of aircraft A: $\mathbf{v}_A = 150\mathbf{i}$ m/s.
Velocity of aircraft B: $\mathbf{v}_B = 100\mathbf{i}$ m/s.
Radius of the looping: $r = 400$ m.
Distance between the aircraft's: $D = \mathbf{r}_{A/B} = -100\mathbf{j}$ m.

$$\boldsymbol{\omega} = \frac{v_B}{r}\mathbf{k} = \frac{100}{400}\mathbf{k} = 0.25\mathbf{k} \text{ rad/s.} \tag{3}$$

Filling in all the known values in equation 2:

$$150\mathbf{i} = 100\mathbf{i} + 0.25\mathbf{k} \times (100\mathbf{j}) + \mathbf{v}_{rel} \tag{4}$$

Solving for $\mathbf{v}_{rel}$ gives $\mathbf{v}_{rel} = 25\mathbf{i}$ m/s