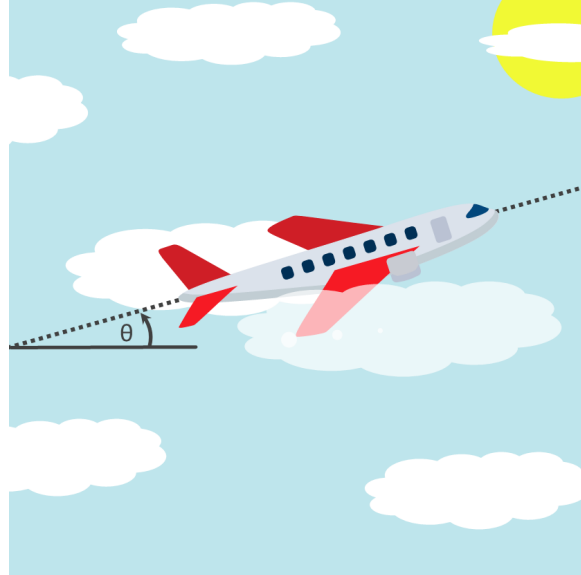




Ascending Airplane



An airplane ascends after take-off with $\theta = 20^\circ$. Its acceleration in the flight direction is described by $a = 3t + 6 \text{ m/s}^2$. What is the velocity of the plane in the flight direction after 3 seconds if its initial velocity is 300 km/h?

Using known expressions:

$$a = \frac{dv}{dt} \Rightarrow dv = a dt \quad (1)$$

$$\int_{v_0}^v dv = \int_0^t a dt \quad (2)$$

Given:

Acceleration in direction of flight: $a = 3t + 6 \text{ m/s}^2$

Initial velocity in direction of flight: $v_0 = 300 \text{ km/h} = 83.33 \text{ m/s}$

$$\int_{v_0}^v dv = v - v_0 \quad (3)$$

$$\int_0^t a dt \Rightarrow \int_0^t 3t + 6 dt = \frac{3}{2}t^2 + 6t \quad (4)$$

Combining both equations results in:

$$v(t) = \frac{3}{2}t^2 + 6t + v_0 \quad (5)$$

After 3 seconds the velocity becomes:

$$v(t) = \frac{3}{2}t^2 + 6t + 83.33 \quad \Rightarrow \quad v(3) = \frac{3}{2} \cdot 3^2 + 6 \cdot 3 + 83.33 = 114.83m/s \quad (6)$$

Thus the final answer is: $v(3) = 114.83m/s = 413.4km/h$.