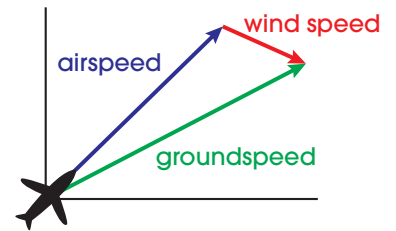


## 3.4 Trigonometry in Aviation

Designing, developing, producing, and operating aircraft are all considered to be part of the field of aviation. Aviation takes significantly more planning and computations than ground-based transportation as it requires a solid foundation in physics and mathematics to produce and operate aircraft. To account for a range of factors that could affect the control of an aircraft, including angles of ascent and descent, wind speed, and air resistance, pilots must have a thorough understanding of geometry. In fact, trigonometry plays an important role in ensuring a reliable and safe flight. To understand how trigonometry is applied in aviation, we need to know the important factors such as wind speed and angles of ascent and descent.

### Wind Speed, Airspeed, and Groundspeed

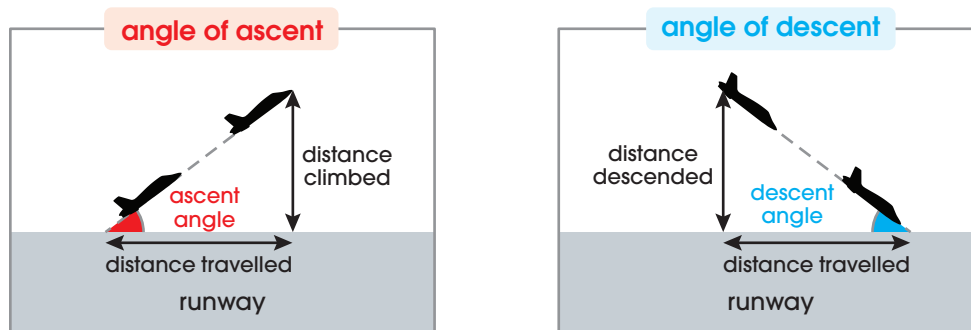
Wind is a significant factor that pilots must take into consideration when controlling an aircraft. This is because an aircraft's speed can be greatly affected by the speed and direction of the wind. High winds are particularly dangerous to aircraft, so pilots must make adjustments accordingly.



Airspeed refers to the speed of an aircraft relative to the air and groundspeed is the horizontal speed of an aircraft relative to the ground. With the wind's effects, the groundspeed may be higher or lower than the airspeed. By using trigonometry, we will be able to determine the relationships among airspeed, wind speed, and groundspeed. It helps pilots make sure every flight arrives at its destination safe and sound.

### Angles of Ascent and Descent

The angle at which an aircraft positions itself is critical during takeoff and landing. If an aircraft has a very steep ascent angle on the runway, the tail of the aircraft may hit the ground. Conversely, if the ascent angle is too small, the aircraft may run the risk of colliding with tall objects that are on the aircraft's departure path.



Knowing the horizontal distance that the aircraft travels and the distance that the aircraft climbs or descends allows us to determine the angle of ascent or descent using the trigonometric ratios.

## 3.4 Trigonometry in Aviation

### Aviation and Trigonometry

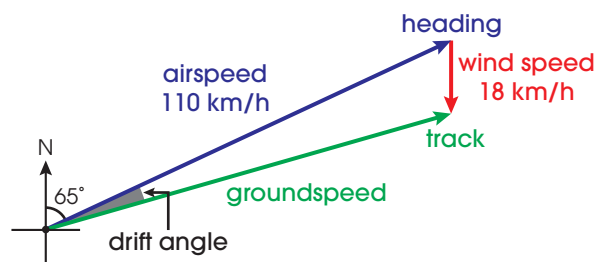
During a takeoff, the wind's effects on an aircraft may cause it to drift away from its desired path. This drift can be described as an angle. It is the angle between the aircraft's heading (the direction in which its nose is pointing) and its track (the actual direction in which the aircraft is travelling). To maintain the aircraft's track on the desired path, pilots must correct the heading according to the wind's effects on the aircraft.

Consider that an aircraft is taking off in the direction of N65°E at 110 km/h and the wind is blowing south at 18 km/h. To calculate the groundspeed, the cosine law can be applied.

$$c^2 = a^2 + b^2 - 2ab \cos C \leftarrow a = 110, b = 18, \angle C = 65^\circ$$

$$c^2 = 110^2 + 18^2 - 2(110)(18) \cos 65^\circ$$

$$c = 103.68$$



It is calculated that the groundspeed is 103.68 km/h. Now that the groundspeed is determined, the sine law can be applied to find the drift angle. The calculations on the right show that the drift angle is 9.05°.

$$\frac{\sin B}{b} = \frac{\sin C}{c}$$
$$\frac{\sin B}{18} = \frac{\sin 65^\circ}{103.68}$$
$$B = 9.05^\circ$$

Trigonometry is widely employed in aviation, both in pilots' manuals' on-the-spot calculations, and in calculations made by the computers that pilots use. Although the use of manual calculations by pilots have dropped over the years as the capability of computers has drastically improved, the foundation of aviation remains heavily rooted in trigonometry.