FlexiPrep

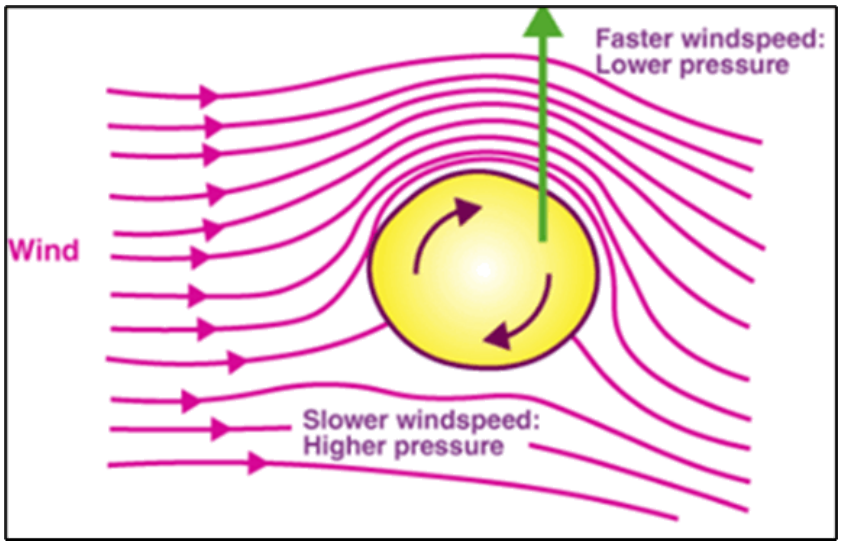
Dynamic Lift and Magnus Effect: Applications, Details of Dynamic Lift (For CBSE, ICSE, IAS, NET, NRA 2022)

Dynamic Lift and Magnus Effect: Applications

About Dynamic Lift

- It is the force that acts on a body by virtue of its motion through a fluid.
- It can be defined as:
  - "Dynamic lift is the force which acts on a body such as an aeroplane wing hydro fall or spinning Ball by virtue of its motion through a fluid."
- For an example, during the game of cricket, tennis, baseball, or golf, we have noticed that a spinning ball deviates from its parabolic trajectory during its motion in the air.

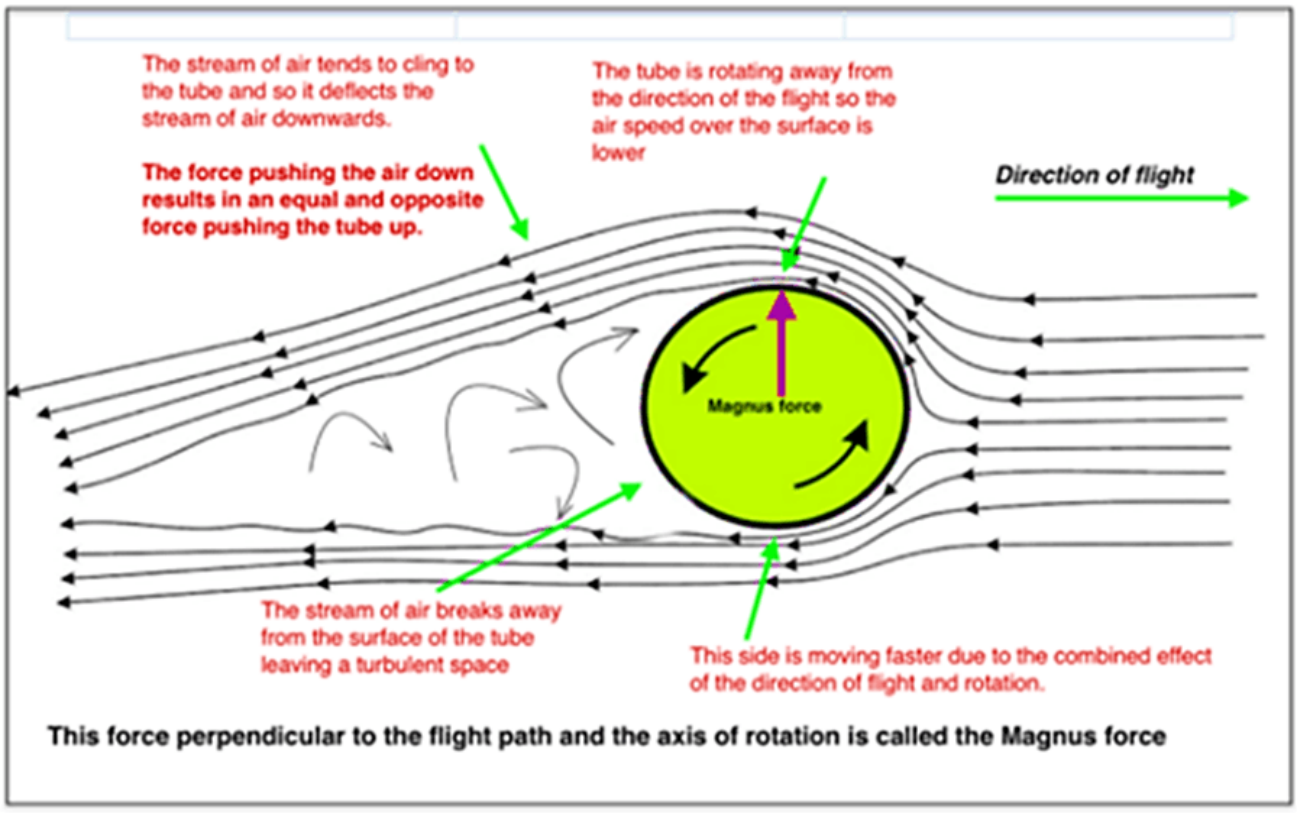
Details of Dynamic Lift



- The deviation for a spinning and a non-spinning ball is given on the basis of the Bernoulli's principle.
- For a non-spinning ball, the streamlines around the ball move relative to the fluid (air) .
- From the symmetry of streamlines, it can be incurred that the pressure difference at points above and below the ball at corresponding points is zero as the velocity of the fluid above and below the ball at the corresponding points is the same.
- So, there is no upward or downward force acting on the ball due to air.

- For a spinning ball, the air is dragged along a spinning ball as it moves. If the ball moves forward, air relatively moves in the backward direction, therefore, the relative velocity of the air above the ball is larger than that below the ball.
- The streamlines thus get rarified below and crowded above the ball.
- Here the difference in the velocity between the corresponding points above and below the ball result in a pressure difference between the two faces and a net upward force acts on the ball.
- This results in a dynamic lift that the ball experiences which is termed as the Magnus effect.

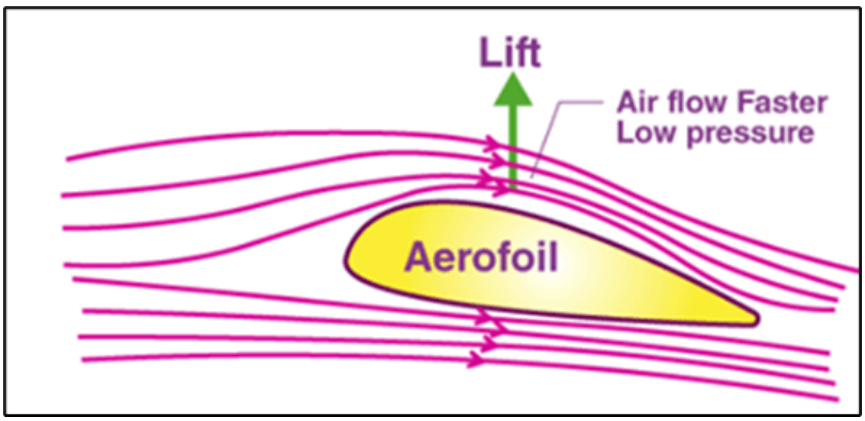
About Magnus Effect



- The Magnus effect is an effect in which a spinning ball or a cylinder curves away from its principle path of flight as can be seen in the image above.

- It can be defined as: “The Magnus effect is an observable phenomenon that is commonly associated with a spinning object moving through the air or a fluid.”
- The path of the spinning object is deflected in a manner that is not present when the object is not spinning.

Applications of Magnus Effect



- Dynamic lift holds great importance in many fields such as aerodynamics and many ball sports. The dynamic lift is given consideration while designing the rotor ships and aero planes.
- The figure above shows an aerofoil, which is a solid piece, shaped to provide an upward dynamic lift when it moves horizontally through the air.
- You can recall that the cross-section of the wings of an aero plane looks like the aerofoil with streamlines around it.
- When the aerofoil moves against the wind, the orientation of the wing relative to flow direction causes the streamlines to crowd together above the wing more than those below it.
- The flow speed on top is higher than that below it. Thus, an upward force results in the dynamic lift of the wings.