

### Question:

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### Viscous Drag

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- These viscous drag forces are most severe for objects with lots of surface relative to their masses/weights.

### Compressibility

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  - Molecules touch one another.
  - Liquid volume set by molecular volume.

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- Gases are compressible.
  - Molecules rarely touch one another.
  - Gas volume set by pressure.

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## Compressibility

- Pressure changes causes volume changes.
- Liquids are incompressible.
- Gases are compressible.
- In low-speed airflow, pressure changes are small.
- In low-speed airflow, air is essentially incompressible.

## Accelerating Flows

- Fluids in steady-state flow can accelerate.

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- Acceleration must be partly to the side.
  - Pure forward accel would expand fluid.
  - Pure backward accel would compress fluid.

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- Acceleration must be partly to the side.
- Sideways accel requires obstacles.

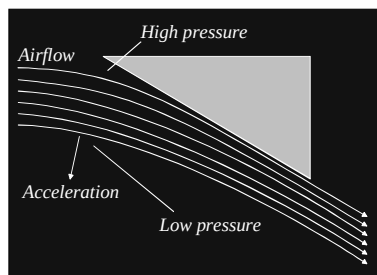
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- Sideways accel requires obstacles.
- Sideways accel causes pressure imbalances.
- Sideways accel causes speed changes.

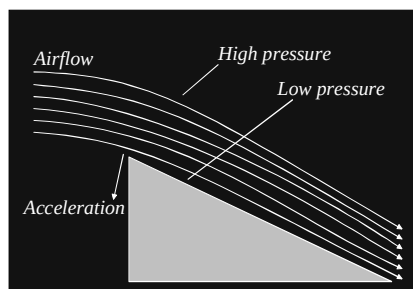
## Outward Bend



## Outward Bend

- Deflecting air away from a surface
  - Involves acceleration away from surface.
  - Caused by outward pressure gradient.
  - Pressure is higher near surface.
  - Pressure is lower away from surface.
  - Air travels slower near surface.

## Inward Bend



## Inward Bend

- Deflecting air toward a surface
  - Involves acceleration toward surface.
  - Caused by inward pressure gradient.
  - Pressure is lower near surface.
  - Pressure is higher away from surface.
  - Air travels faster near surface.

## Nozzles

- Air passing through a narrowing
  - Speeds up.
  - Experiences a drop in pressure.
- Air passing through a widening
  - Slows down.
  - Experiences a rise in pressure.

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