Airplanes

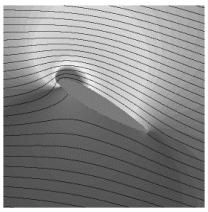
Question:

As you ride in a jet airplane, the clouds are passing you at 600 mph. The air just in front of one of the huge jet engine intake ducts is traveling

1. much faster than 600 mph.
2. much slower than 600 mph.
3. about 600 mph.

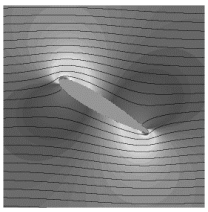
Lifting Wing

- Under the wing,
  - air undergoes an outward bend
  - pressure rises at wing surface
  - air slows down
- Over the wing,
  - air undergoes an inward bend
  - pressure drops at wing surface
  - air speeds up
- Wing experience strong upward lift, little drag



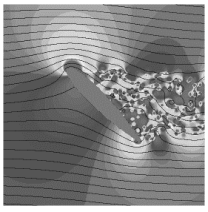
At Take-Off

- Wing starts with symmetric airflow
- Wing starts with no lift
- Airflow becomes unstable at the trailing edge bend
- The wing sheds a vortex
- After the vortex leaves, the wing has lift



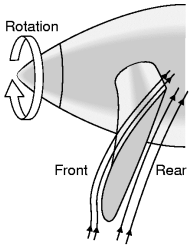
Stalled Wing

- Upper boundary layer stops heading forward
- Upper airstream detaches from wing's top surface
- Lift is reduced
- Pressure drag appears
- Wing can't support plane



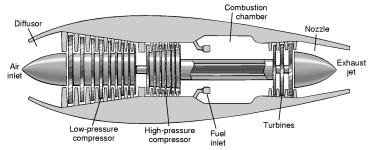
Propellers

- Propellers are spinning wings
  - They deflect air backward
  - Do work on air (add energy)
  - Pump air toward rear of plane
- Action-Reaction
  - They push the air backward
  - Air pushes them forward



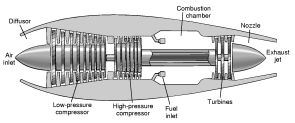
Jet Engines 1

- Jet engines pump air toward rear of plane
  - Add energy to air inside a "duct"
  - Duct resembles a ball with hole through middle
  - Duct uses Bernoulli effect to change air's speed



Jet Engines 2

- Air entering duct slows and pressure rises
- Compressor does work on air
- Fuel is added to air and mixture is burned
- Expanding exhaust does work on turbine
- Exhaust leaving duct speeds up and pressure drops



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