Glider Aerodynamics

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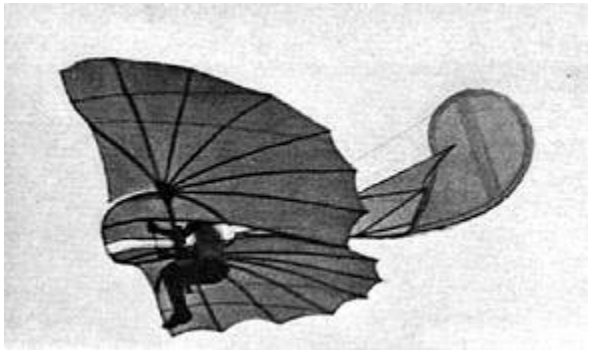
Glider Aerodynamics Terms

- Chamber
- Chord
- Relative Wind
- Angle of Attack
- Angle of Incidence
- Center of Pressure (Lift) and Center of Gravity
- Aspect Ratio (Span/Chord)
- Aileron, Elevator and Rudder controls
- Elevator Trim
- Bernoulli's Principle

Types of Gliders

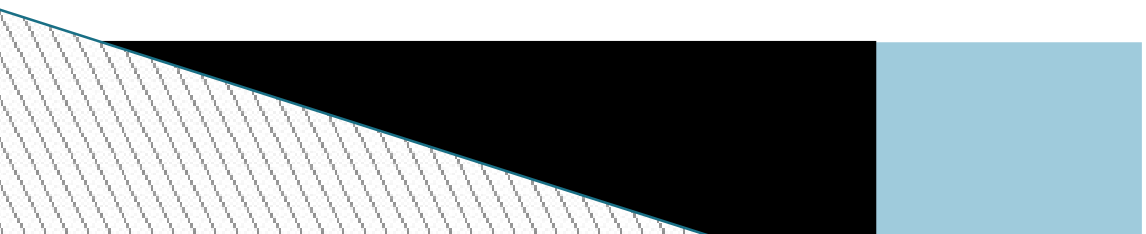


And of Course…..

Glider Forces and Axes

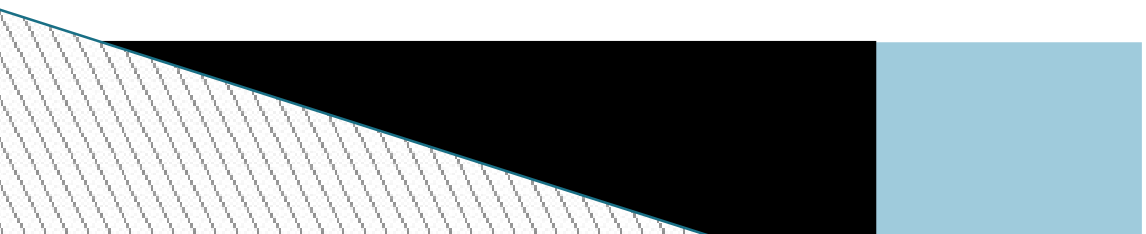
Four Forces
- Lift
- Weight
- Drag
- Thrust

Three Axes
- Longitudinal - Roll
- Lateral - Pitch
- Vertical - Yaw

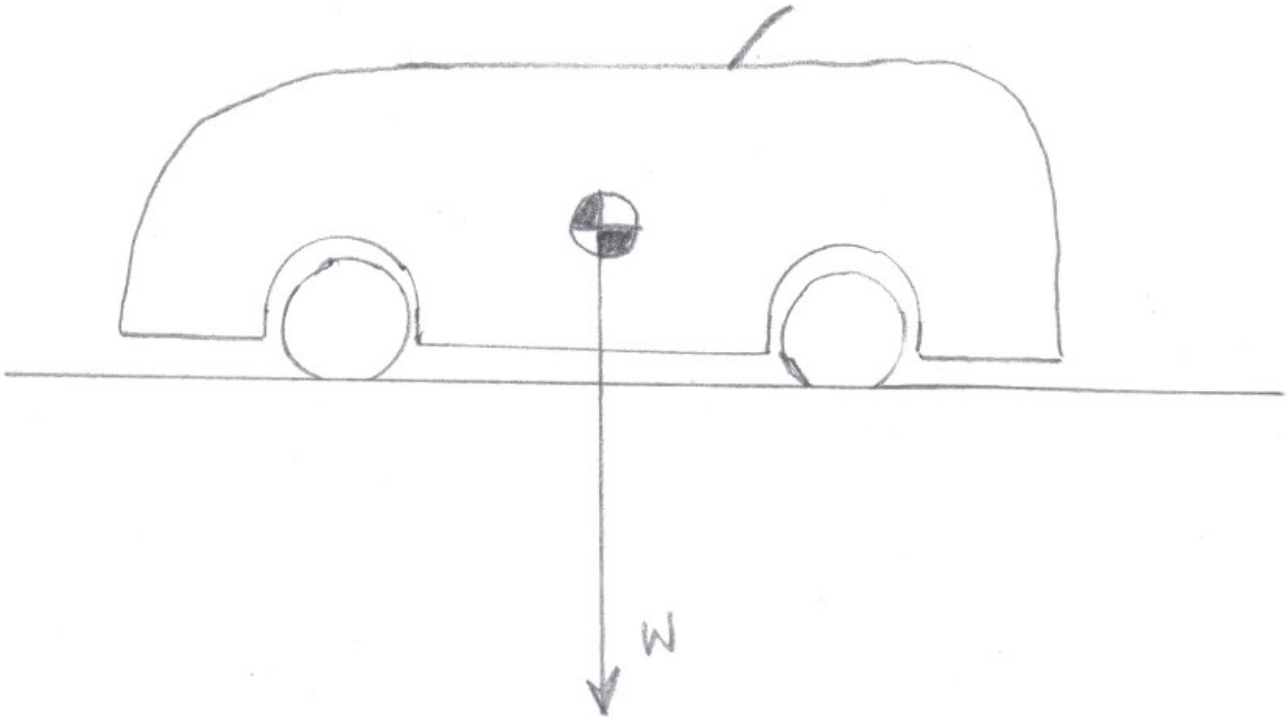


Lift or Weight? Drag or Thrust?

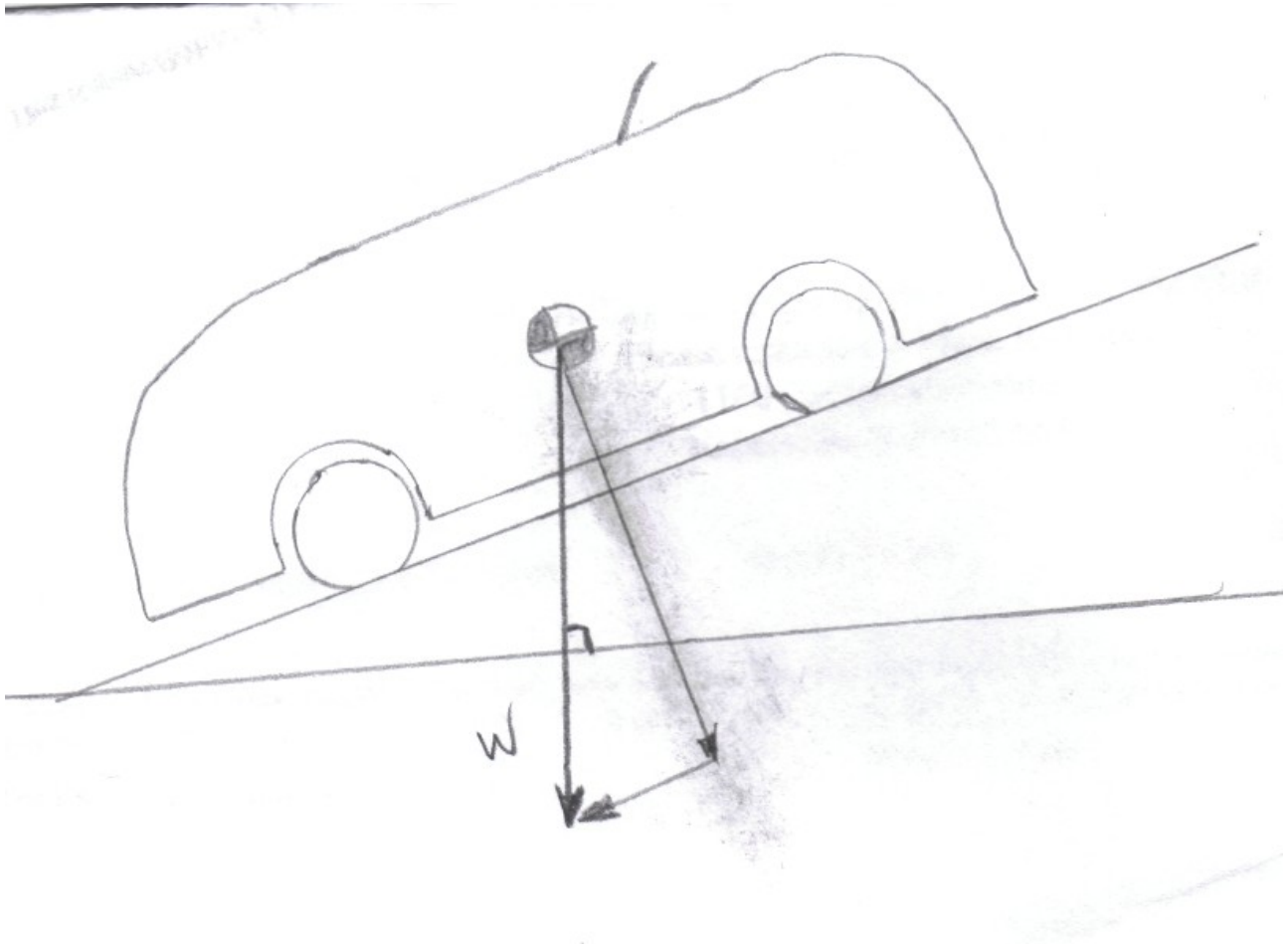
- What powers the glider thru the air?
- What causes the glider to speed up?
- What causes the glider to slow down?
- How are Lift, Drag and Weight related?



Soap Box Derby Car on Level Ground

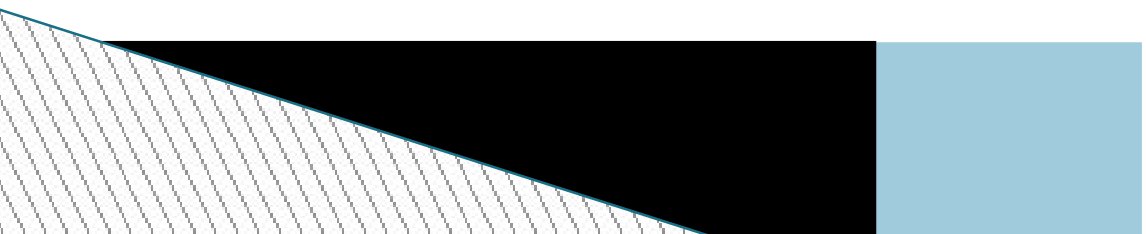


Soap Box Derby Car on Incline Plane



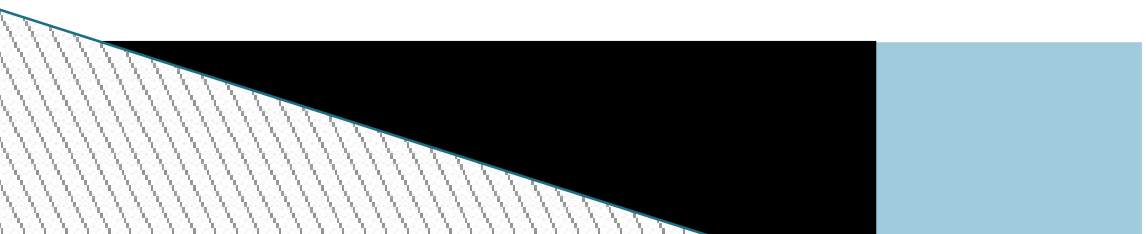
What Powers a Glider? - Gravity

Straight Gliding Flight



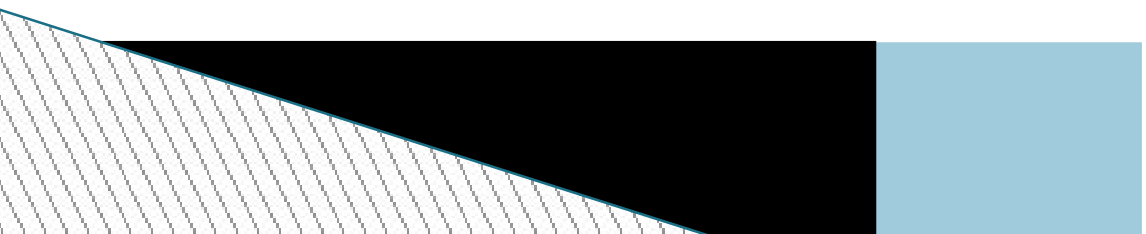
Glider Stability

- Longitudinal Stability – Static & Dynamic
  - Positive
  - Neutral
  - Negative
- Lateral Stability
  - Dihedral
- Directional Stability
  - Vertical Stabilizer – Weather vane effect

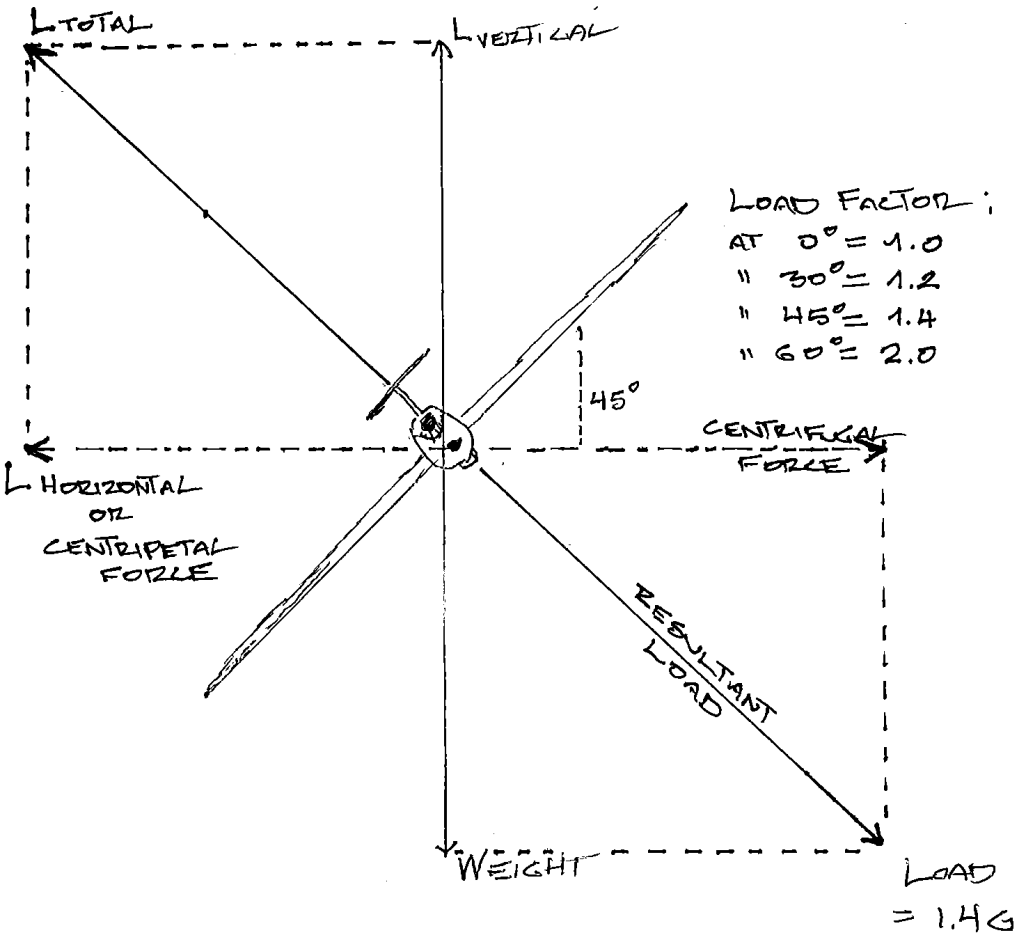


5 Effects of Turning Flight

- Adverse yaw
- Diving tendency
- Over-banking tendency
- Yaw against the turn
- Increase stall speed

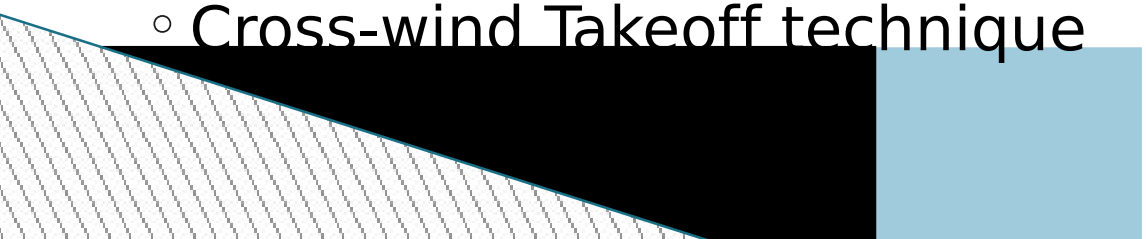


45º Banked Flight



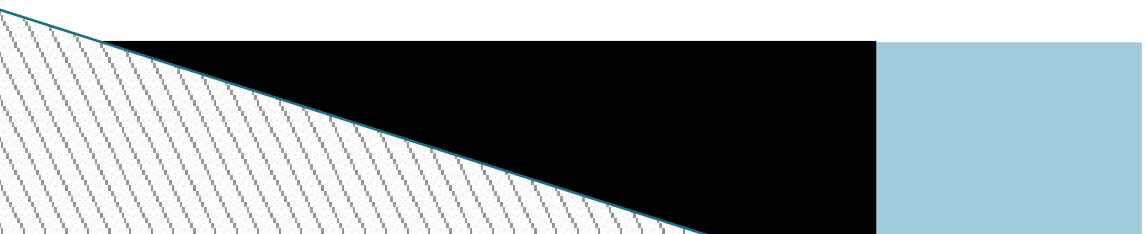
Slips, Skids and Crabbing

- Forward Slip
  - Controlling Glide Path
  - With and Without Dive Brakes
  - Longitudinal Axis alignment
- Side Slip
  - Landing in a Crosswind
  - Cross-wind Takeoff technique
  - Longitudinal Axis alignment
- Turning Slips & Skids
- Crabbing Flight – coordinated turn into wind
  - Cross-wind Correction in the Pattern
  - Cross-wind Takeoff technique



Stalls

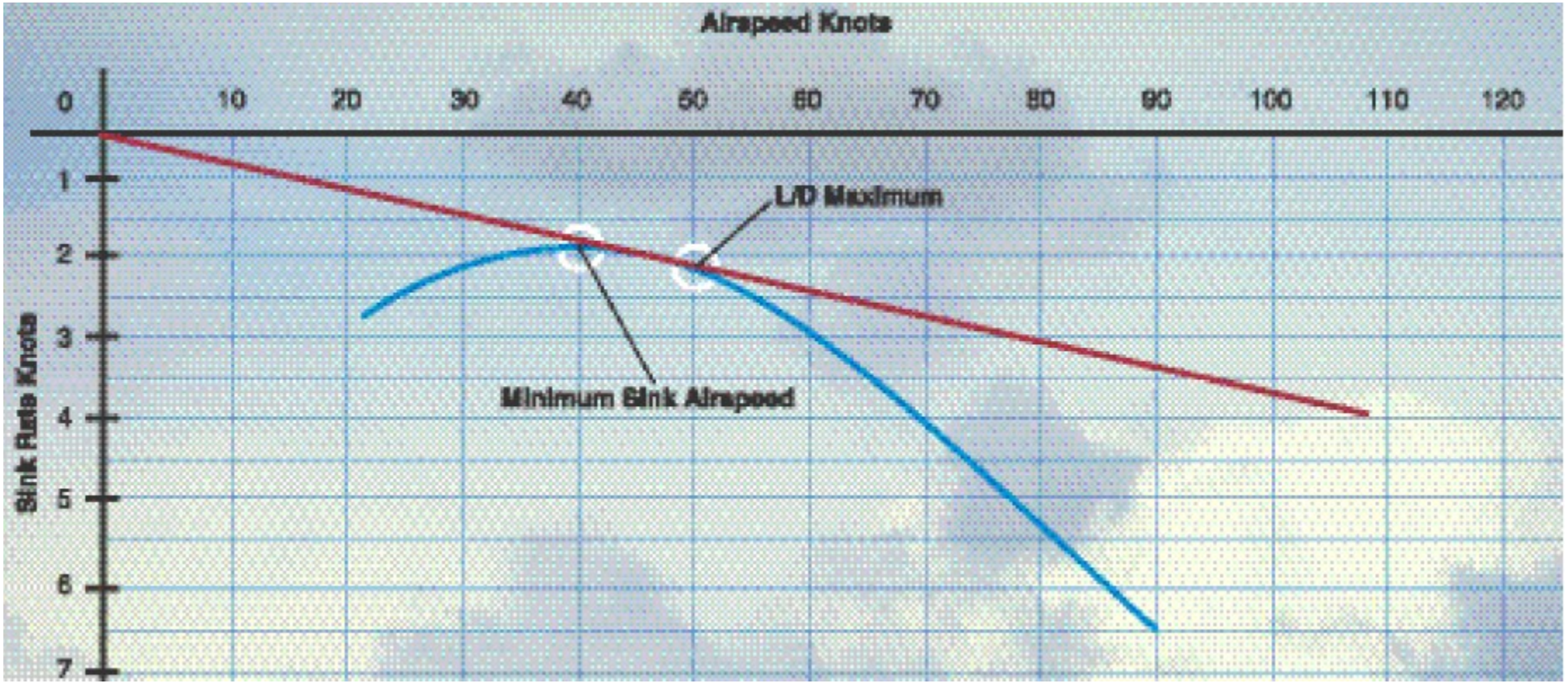
- Critical Angle of Attack
  - Any Attitude
  - Any Airspeed
- 0° Bank – 1.0 G – 0% Increase in Stall
- 30° Bank – 1.2 G – 10% Increase in Stall
- 45° Bank – 1.4 G – 18% Increase in Stall
- 60° Bank – 2.0 G – 41% Increase in Stall



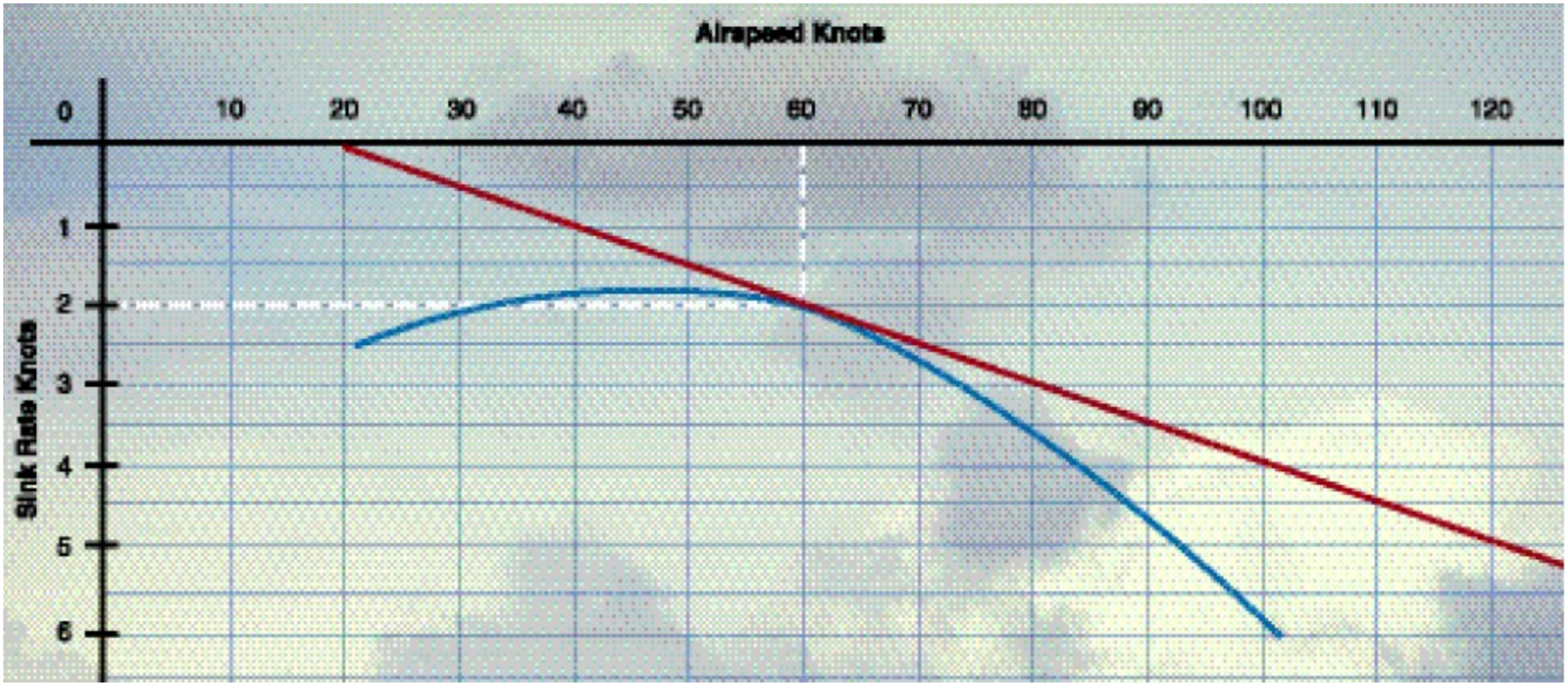
Spins

- Entry
  - Uncoordinated Stall
  - Shallow Bank Skidding Turn
- Recovery
  - Ailerons Neutral
  - Full Opposite Rudder against the Rotation
  - Apply Positive and Brisk Forward Stick – may need full forward stick
  - After Spin Rotation Stops - Neutralize Rudder
  - [redacted] with Gentle Back Stick

Glide Ratio and the Polar Curve



Glide Ratio and Speed to Fly



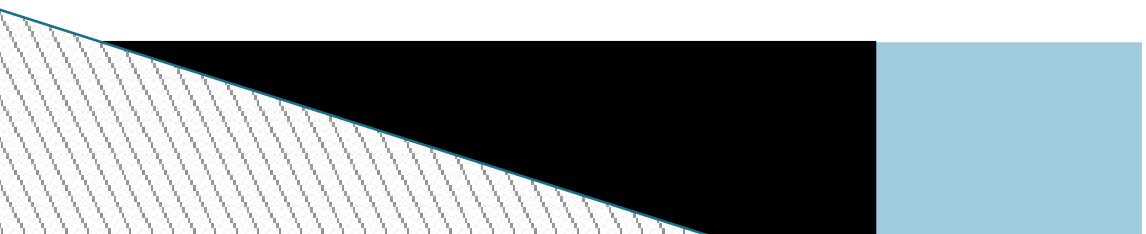
Scenario

Problem

- Pilot not controlling glider in turning flight

Themes

- Bank increases during turns
- Airspeed increases during turns
- Airspeed decreases during turns



Scenario

The pilot will land on runway 36 out of a left hand pattern. The winds are 10 kts from 330. In these conditions the pilot starts the turn to final late, and the airspeed decreases.

Analyze Scenario

- Identify Pilot factors
  - Write 3 questions you will ask about pilot factors
- Identify Aircraft factors
  - Write 3 questions you will ask about aircraft factors
- Identify Environmental factors
  - Write 3 questions on enVironmental factors
- Identify External factors
  - Write 3 questions on External Factors

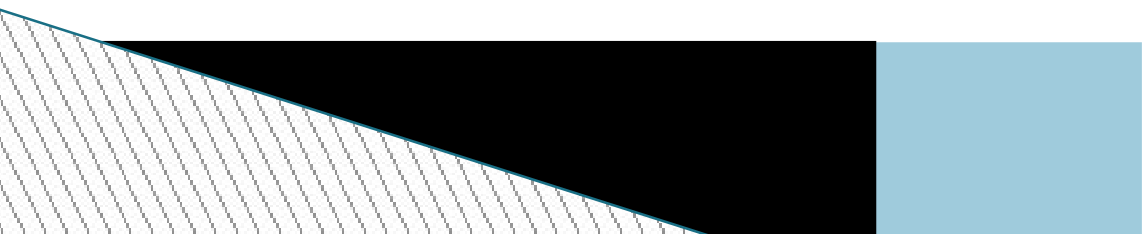
References

- Glider Flying Handbook
- Joy of Soaring
- www.carrotworks.com
- Pilots Handbook of Aeronautical Knowledge

The End

Scenarios and P.A.V.E.

- Cross Country Cruise Flight
- Final Glides
- Thermaling
- Reversing course on the Ridge
- PT3 Turn at 200’
- Normal Pattern turns to Base or Final
- High Speed Pass followed by a 180° Turn



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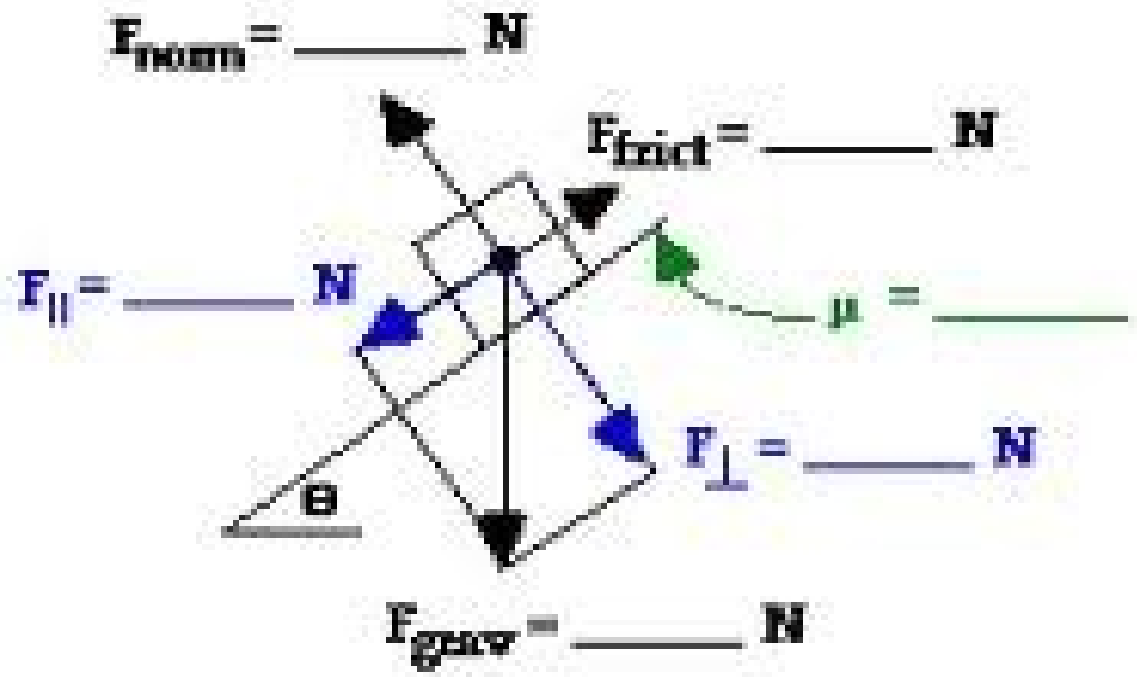

m = _____ kg

F_{net} = _____ N

a = _____ m/s/s