CFI Bootcamp
Flight Instructor Training

Teaching Maneuvers

Advanced Knowledge of the Commercial Maneuvers – The How's and the WHYs!

Power Hour 199

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Deep Dives Into

Steep Spirals

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Deep Dives Into

Chandelles

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Deep Dives Into

Lazy Eights

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Deep Dives Into

Eights on Pylons

CFI Bootcamp
Flight Instructor Training

What's Right and What's Wrong

The images in the handbooks are not quite right!

Advanced Knowledge of the Commercial Maneuvers

What we will cover

The descriptions of to perform the maneuvers are mostly right!

CFI Bootcamp
Flight Instructor Training

Eights on Pylons

At a particular altitude for a given groundspeed a point on the ground will appear to pivot

Eights on Pylons

The question that isn’t answered is WHY?

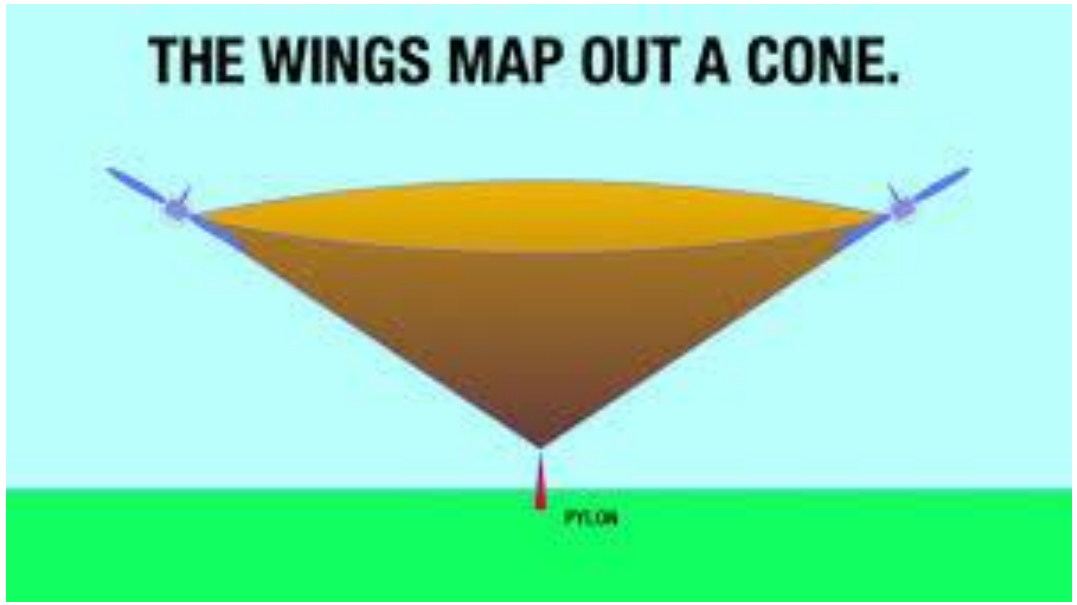
Advanced Knowledge of the Commercial Maneuvers

What we will cover

It’s about a little geometry

Advanced Knowledge of the Commercial Maneuvers

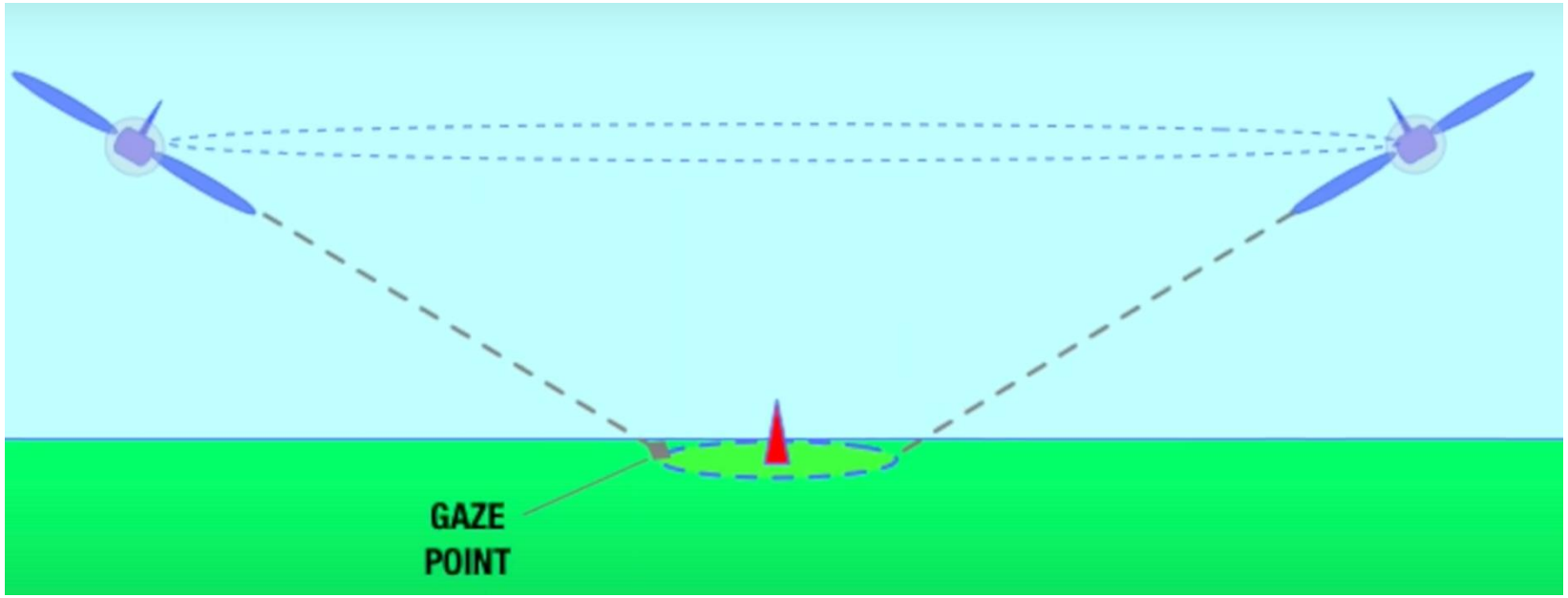
Your line of sight equates to the angle of bank – This defines a cone



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

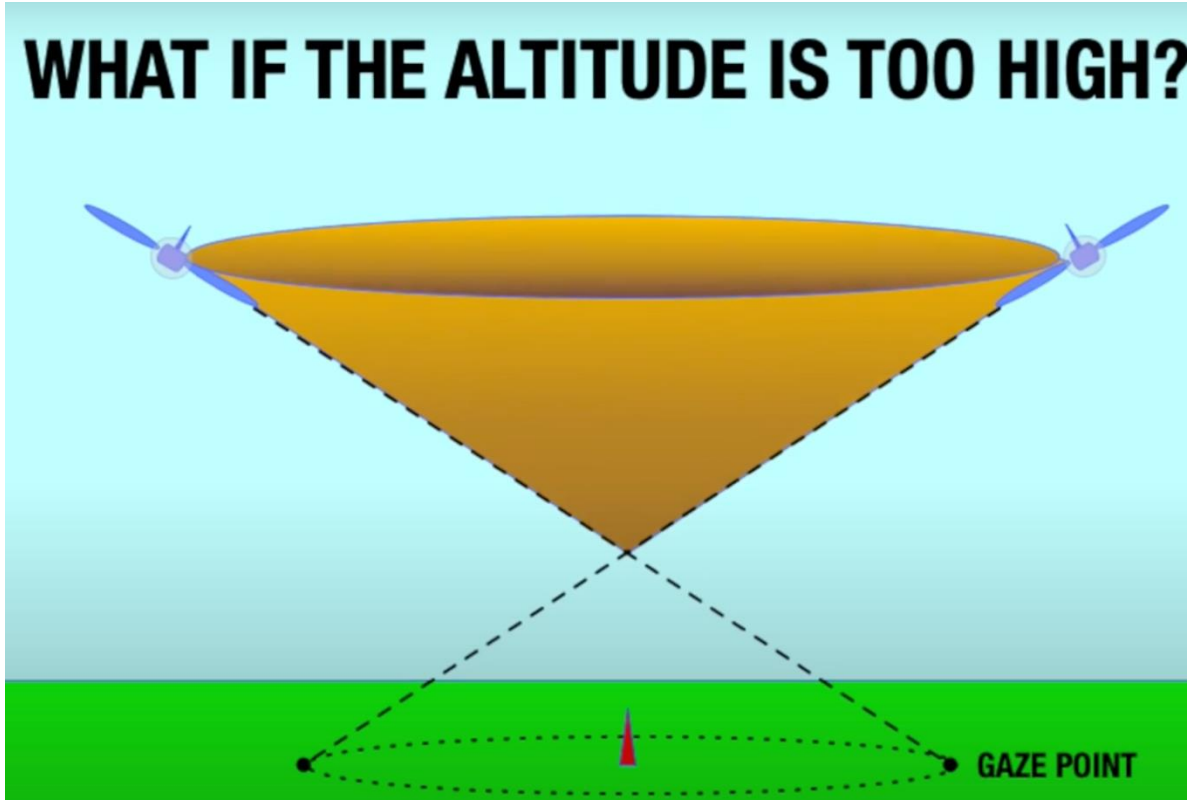
Too low – Apex of the cone is below the earth – a circle is made



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

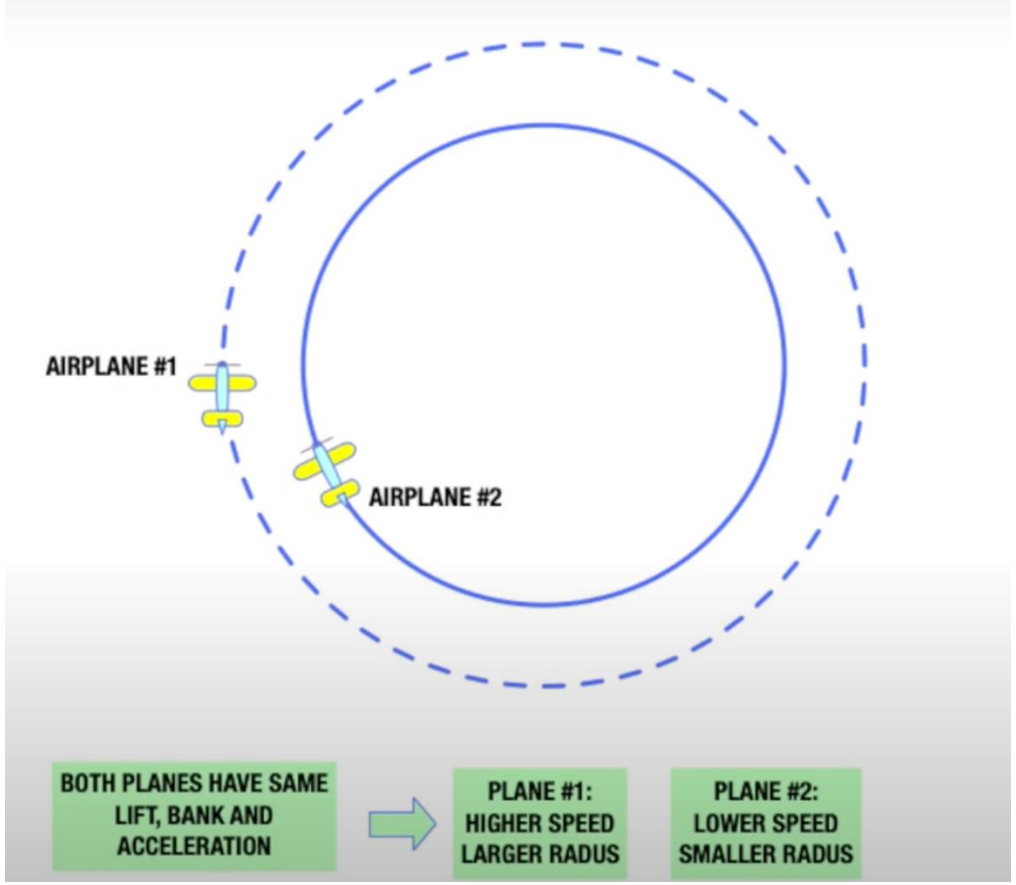
Too high – a circle is also made but in a different direction



CFI Bootcamp
Flight Instructor Training

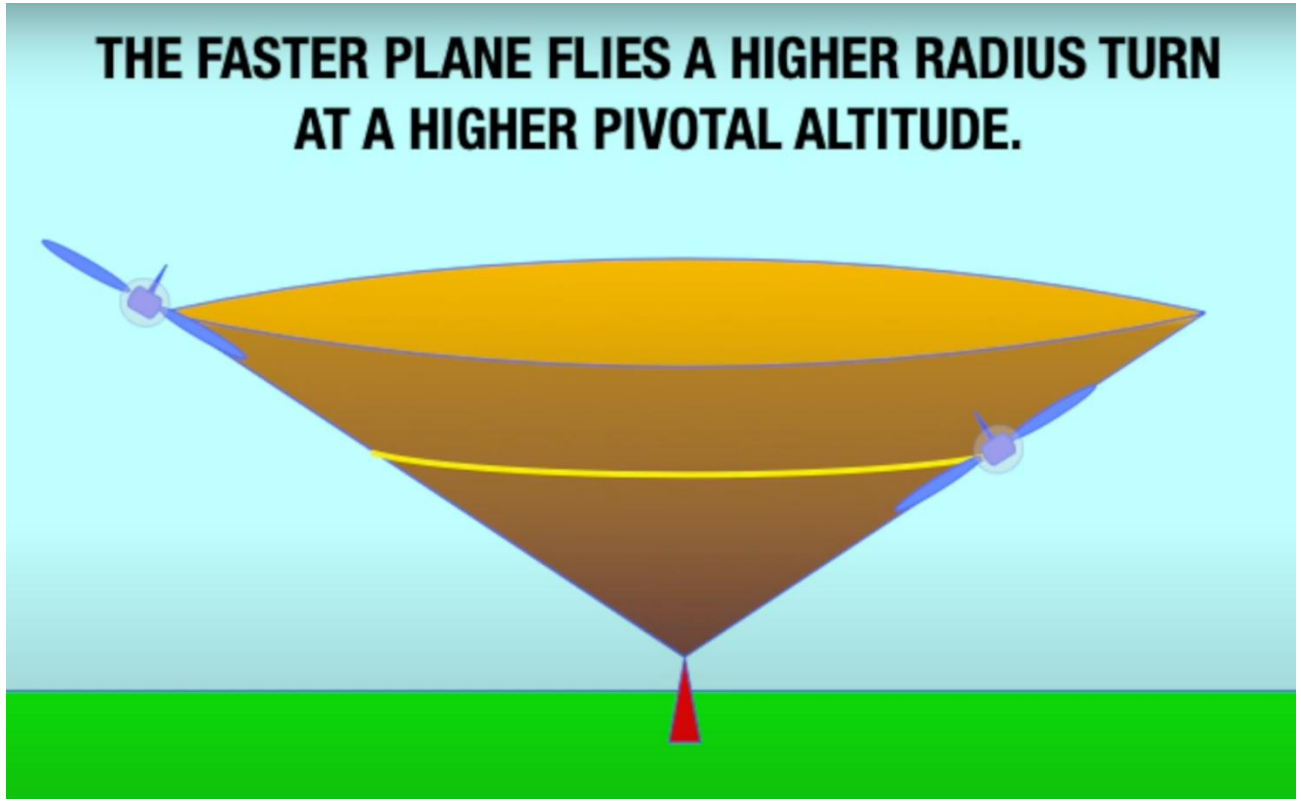
Advanced Knowledge of the Commercial Maneuvers

The higher the speed the larger the radius and vice versa



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers



CFI Bootcamp
Flight Instructor Training

Pivotal Altitude=$(GS)^2/11.3$

It is only necessary to calculate the highest pivotal altitude. Why not the lowest too?

Advanced Knowledge of the Commercial Maneuvers

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

PA with a 20kt tailwind is 1071 ft
PA with a 20kt headwind is 434 ft

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

You would only need to fly between these two altitudes if you maintained the same indicated airspeed

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

Indicated airspeed is allowed to vary during this maneuver

CFI Bootcamp
Flight Instructor Training

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

If too high – pitch forward. This lowers the altitude and increases the airspeed which in turn raises the pivotal altitude

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

If too low – pitch up. This increases the altitude and decreases the airspeed which in turn lowers the pivotal altitude

Advanced Knowledge of the Commercial Maneuvers

Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

This is referred to as a doubling effect

Advanced Knowledge of the Commercial Maneuvers

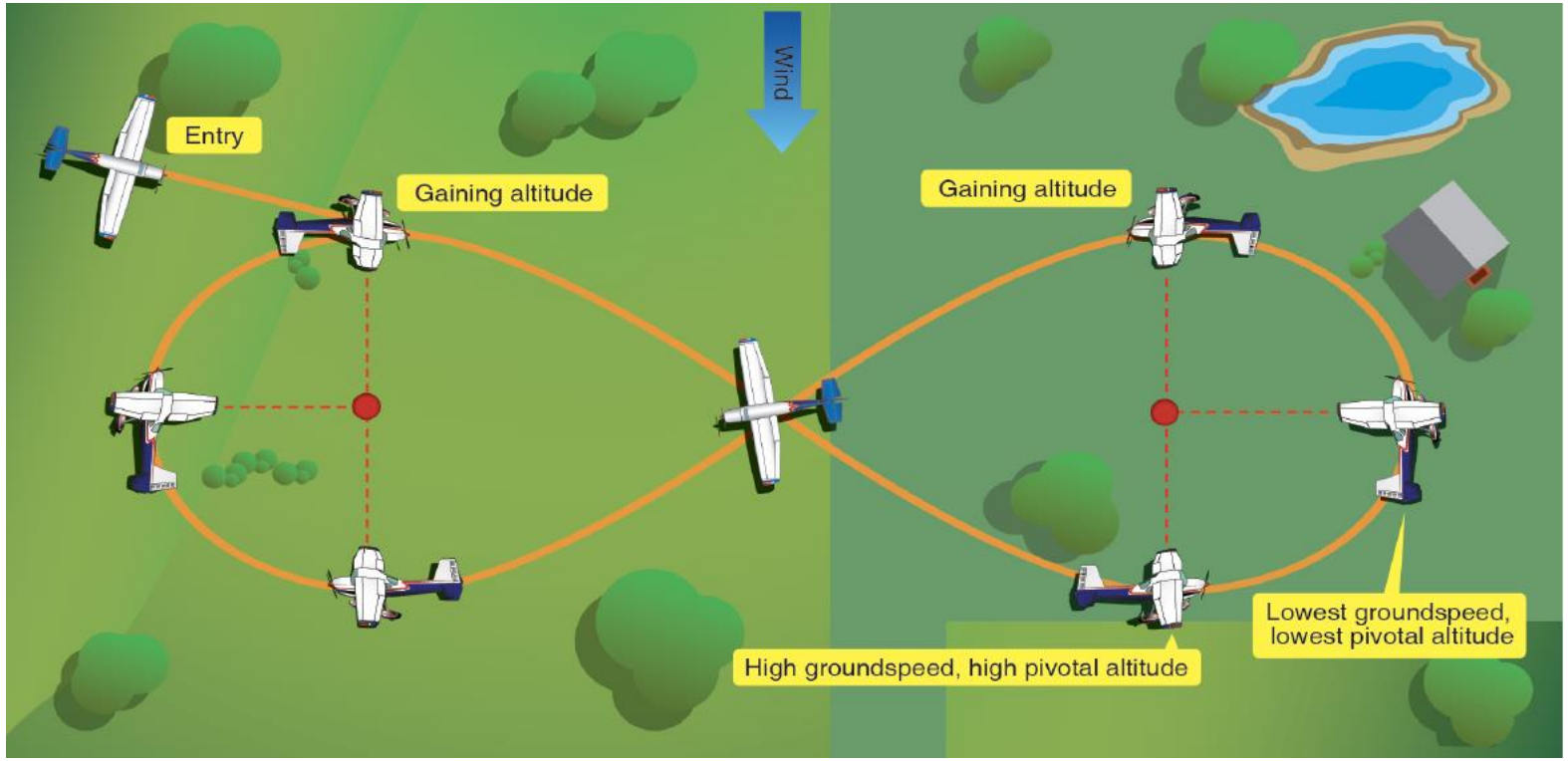
Pivotal Altitude=$(GS)^2/11.3$ – Example 90Kts with 20kt wind

This is also the reason that only small changes in altitude are made

CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

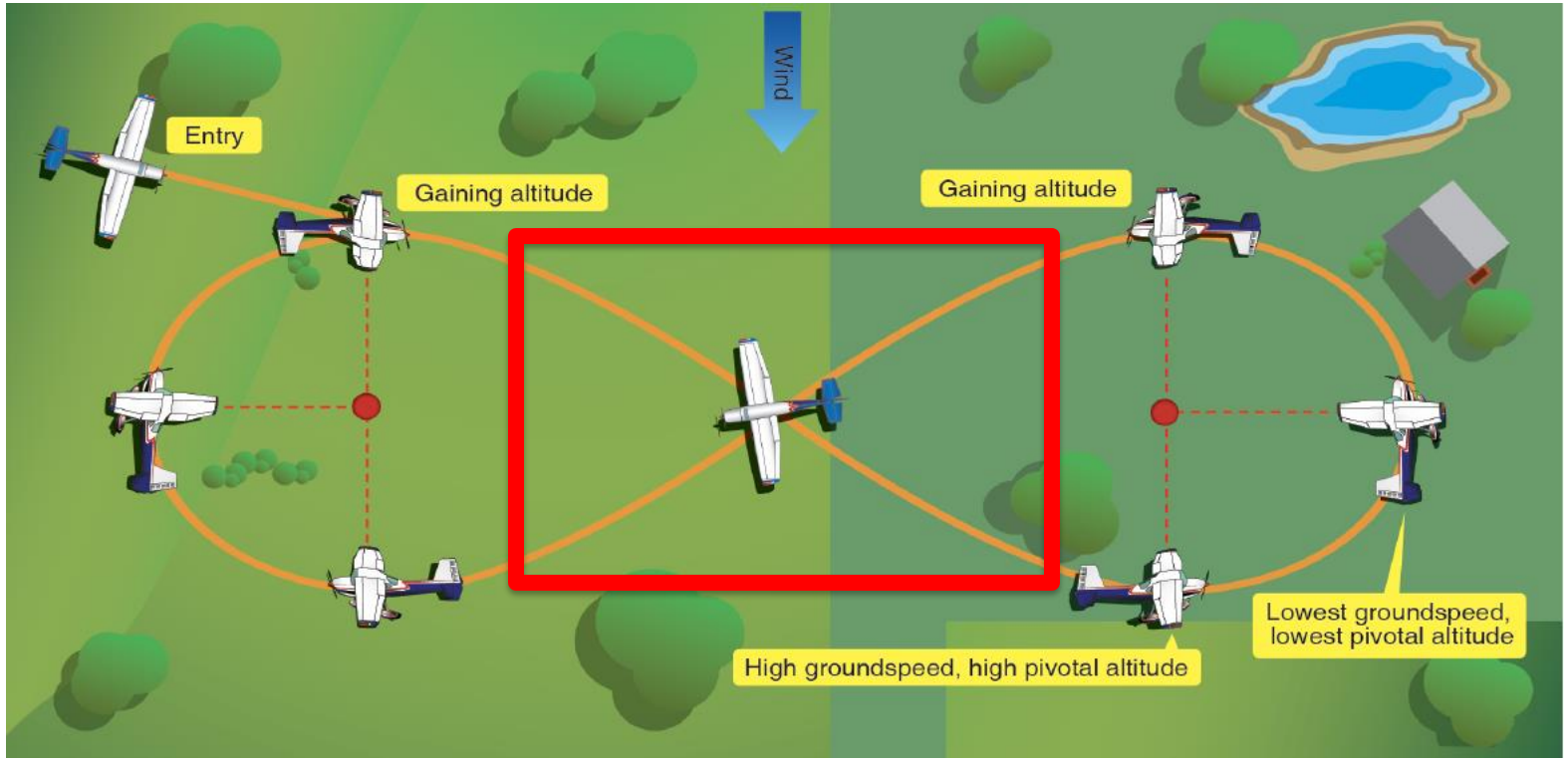
This diagram is WRONG!



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

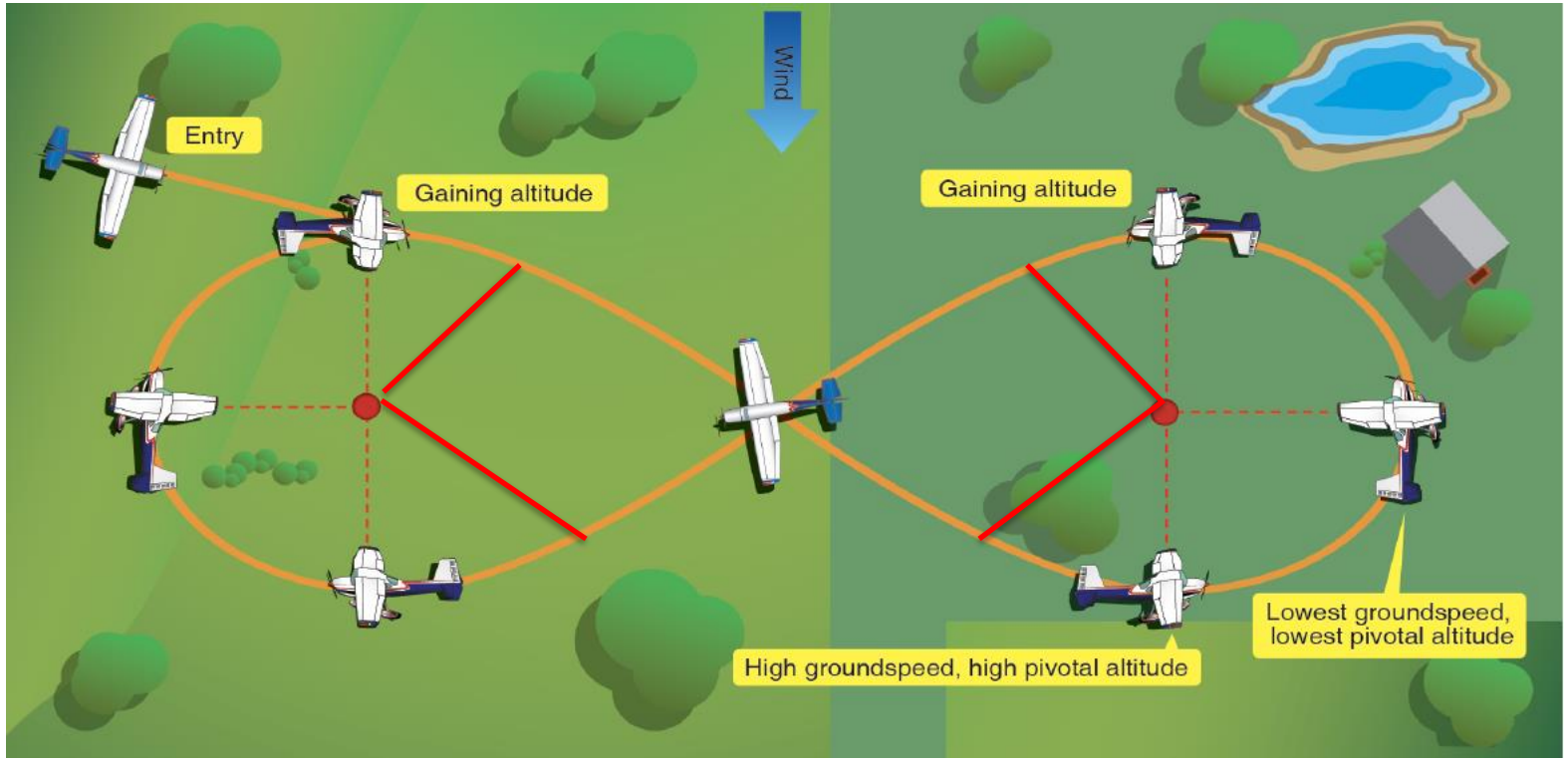
The angles between the pylons are too shallow



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

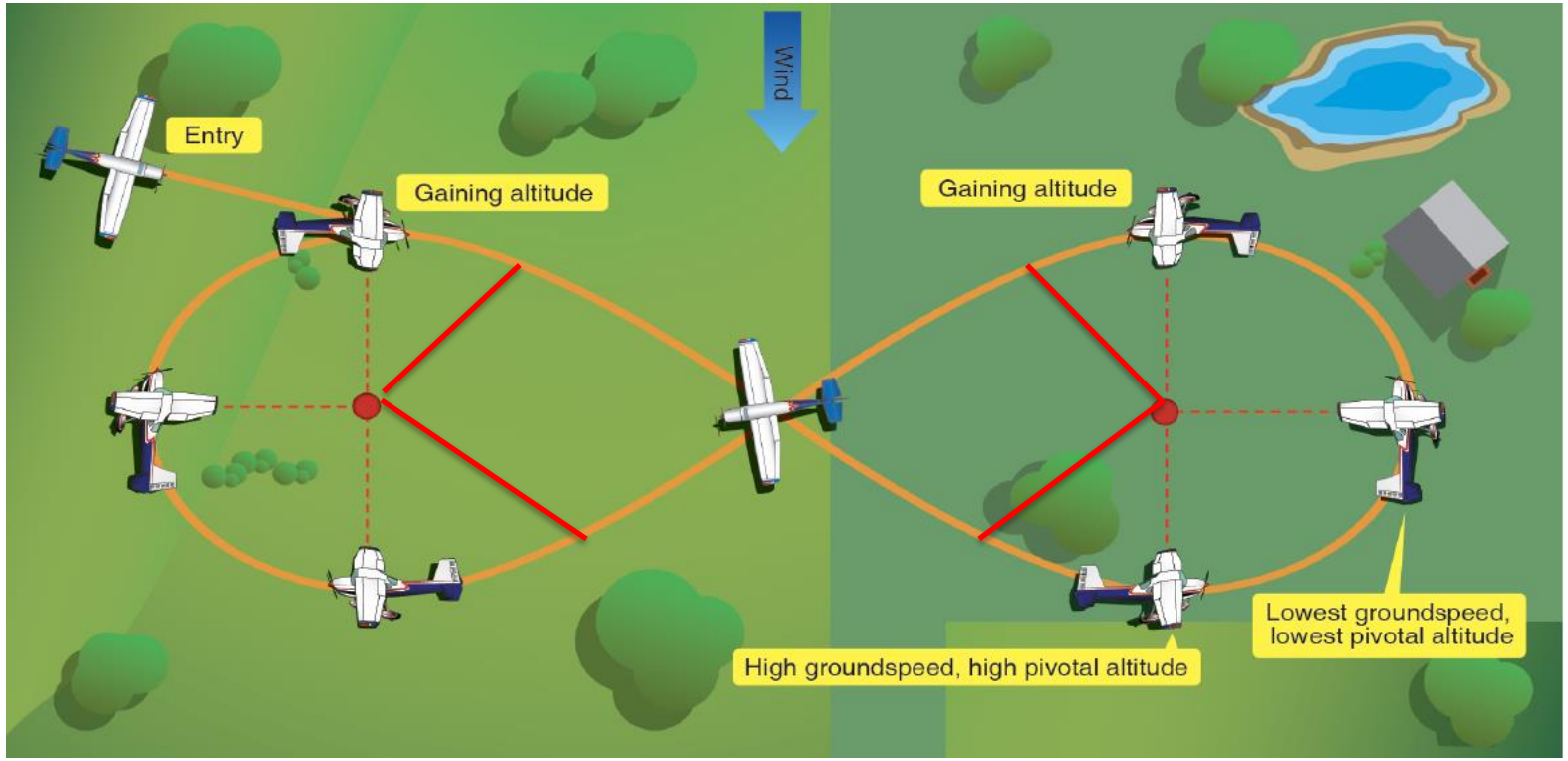
At 45° the pylon would be intercepted and left at different points



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

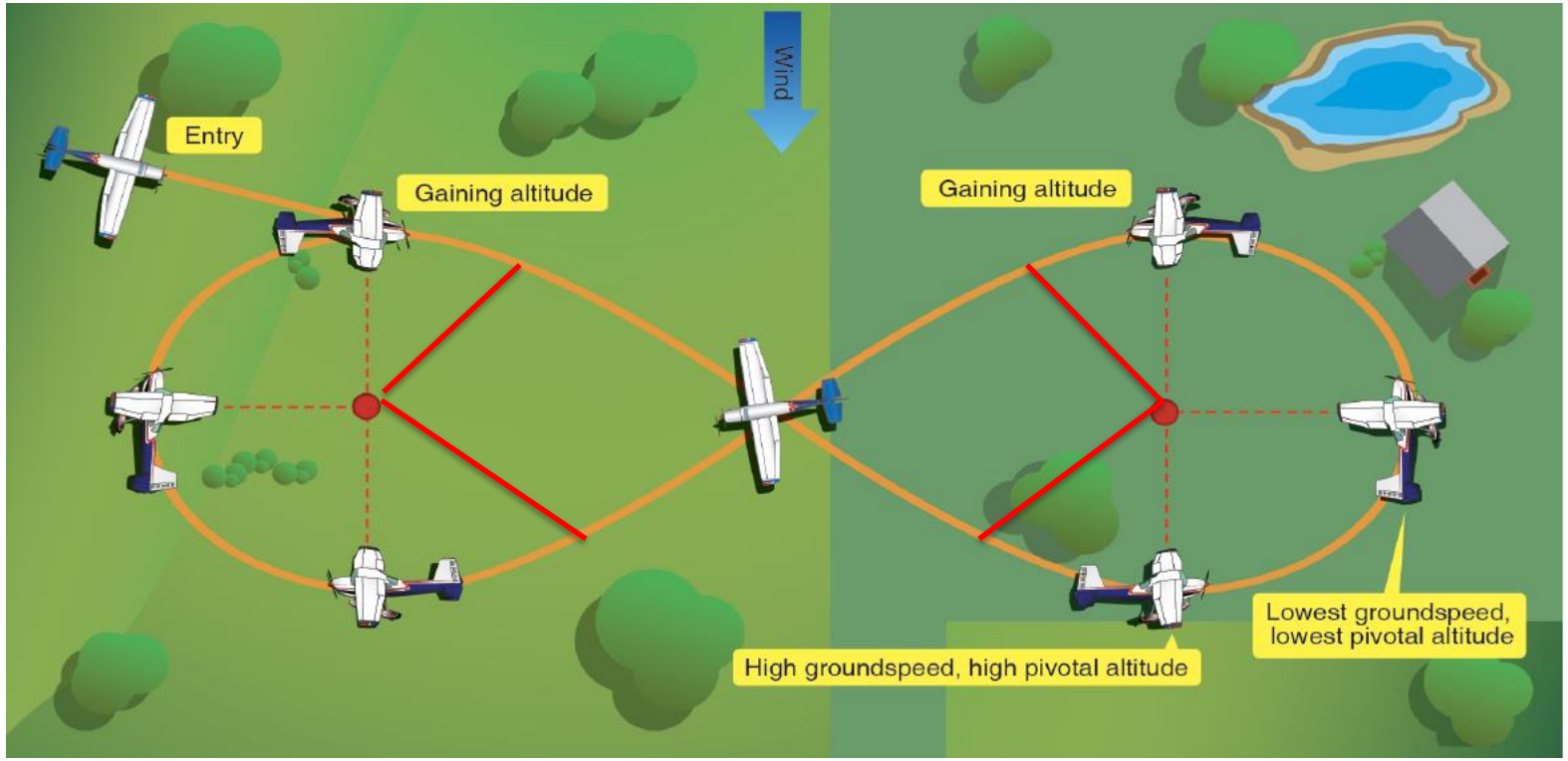
The solid red lines show where the turn would begin and stop



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

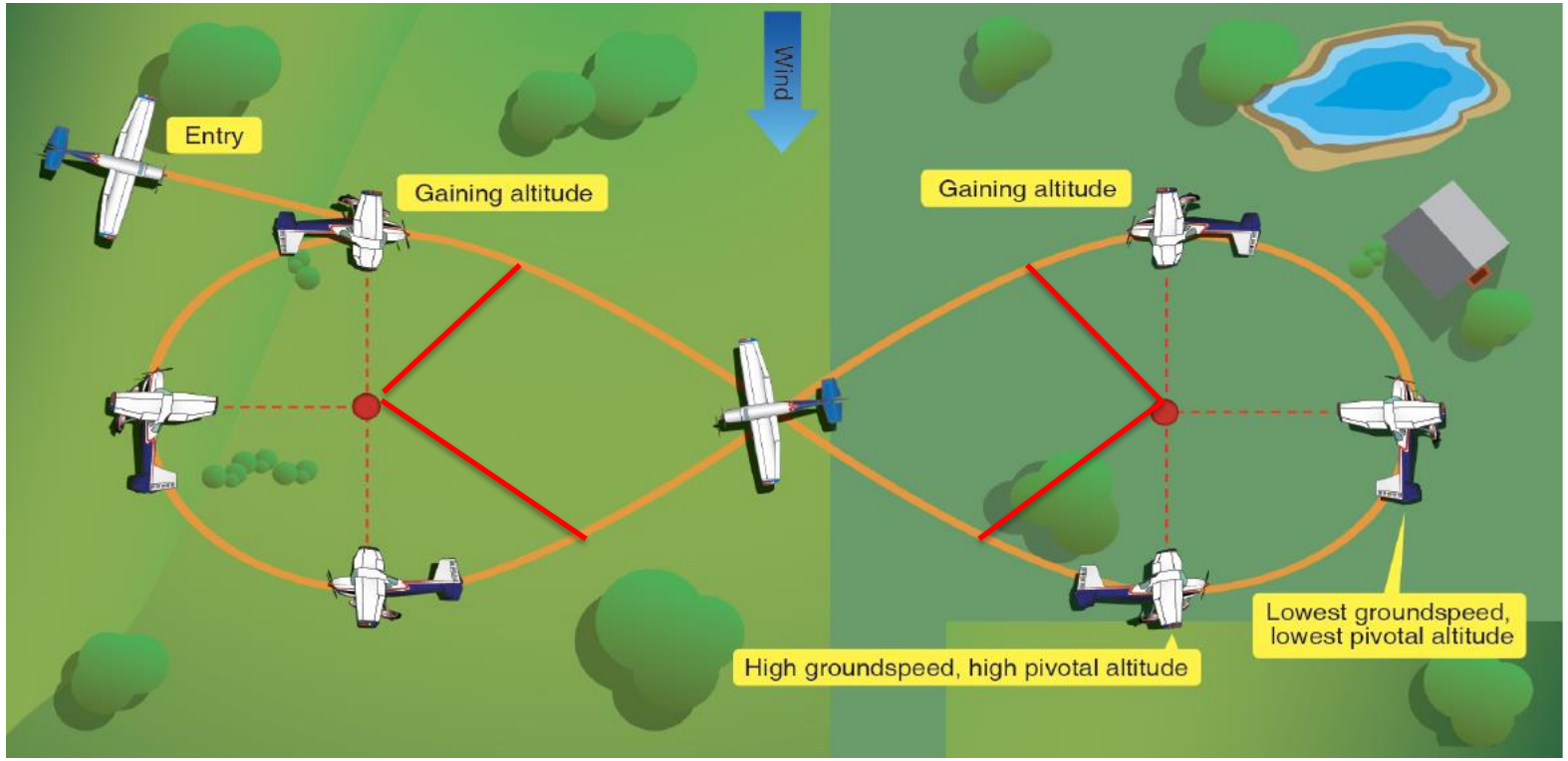
It’s sooner than they have drawn with the dashed red line



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

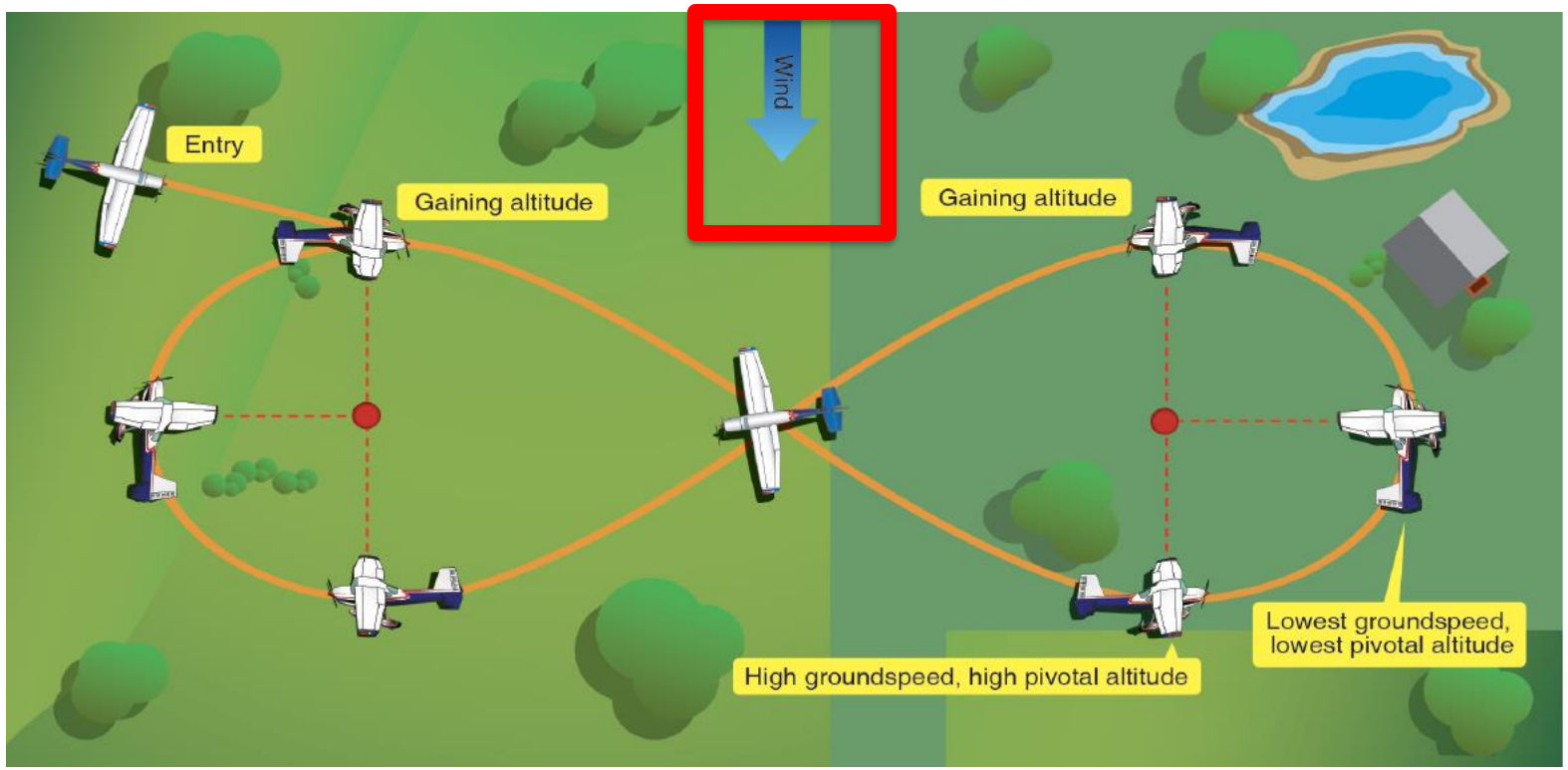
The pattern over the ground is incorrect – it shows constant radius



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

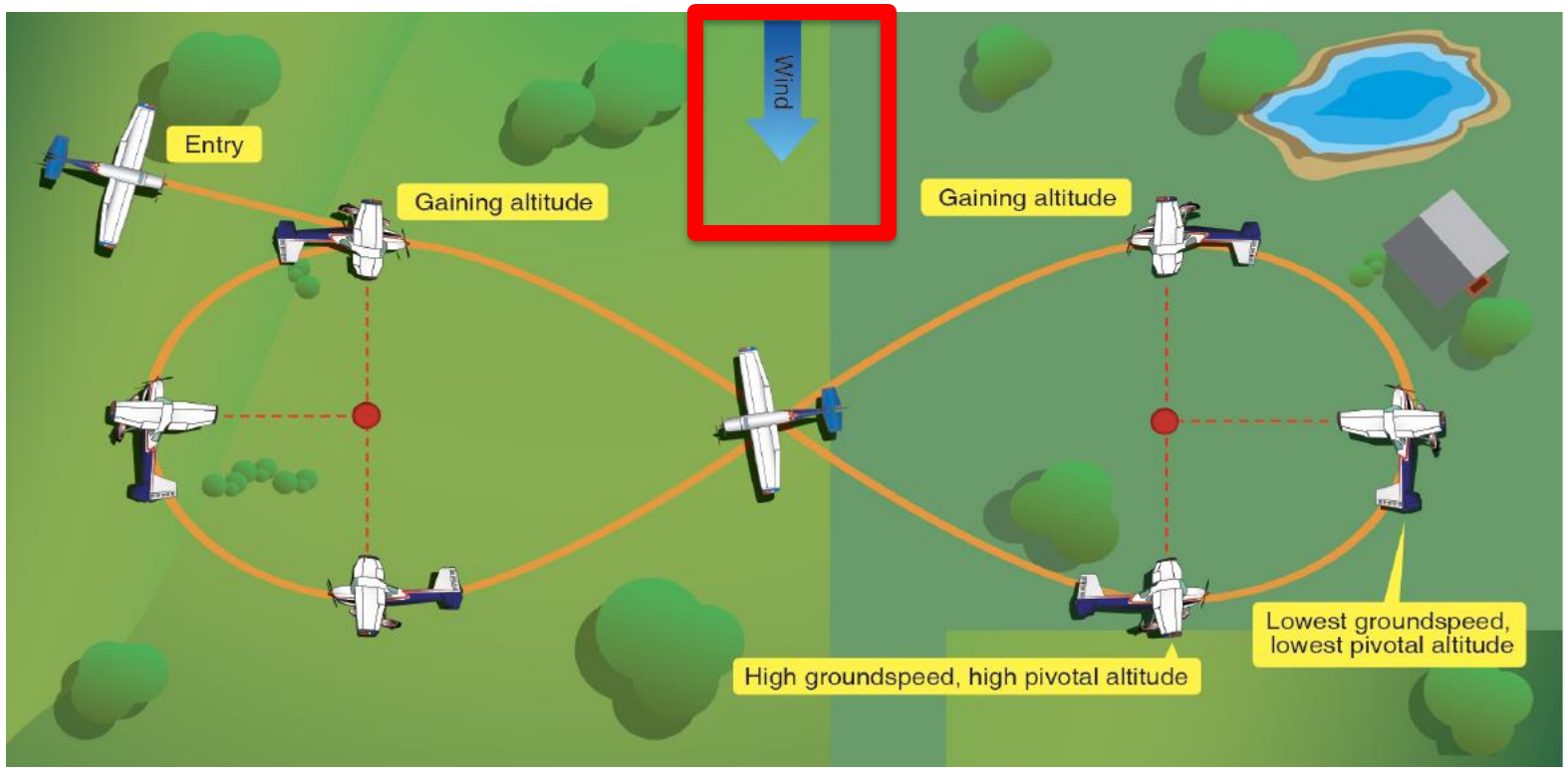
But there is wind – No correction for wind while turning can be made



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

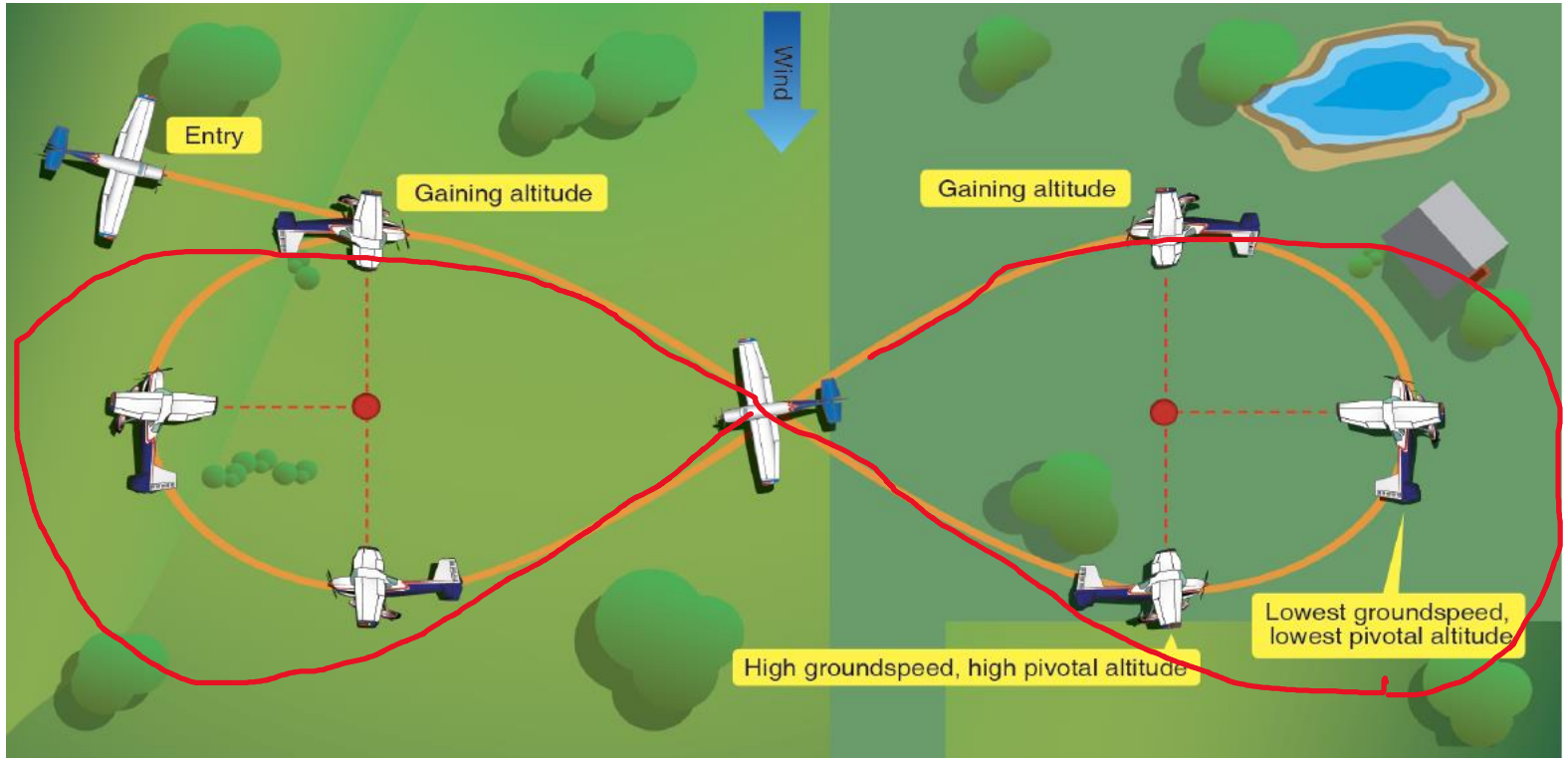
If you try to correct for wind in the turn – your line of sight will change



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

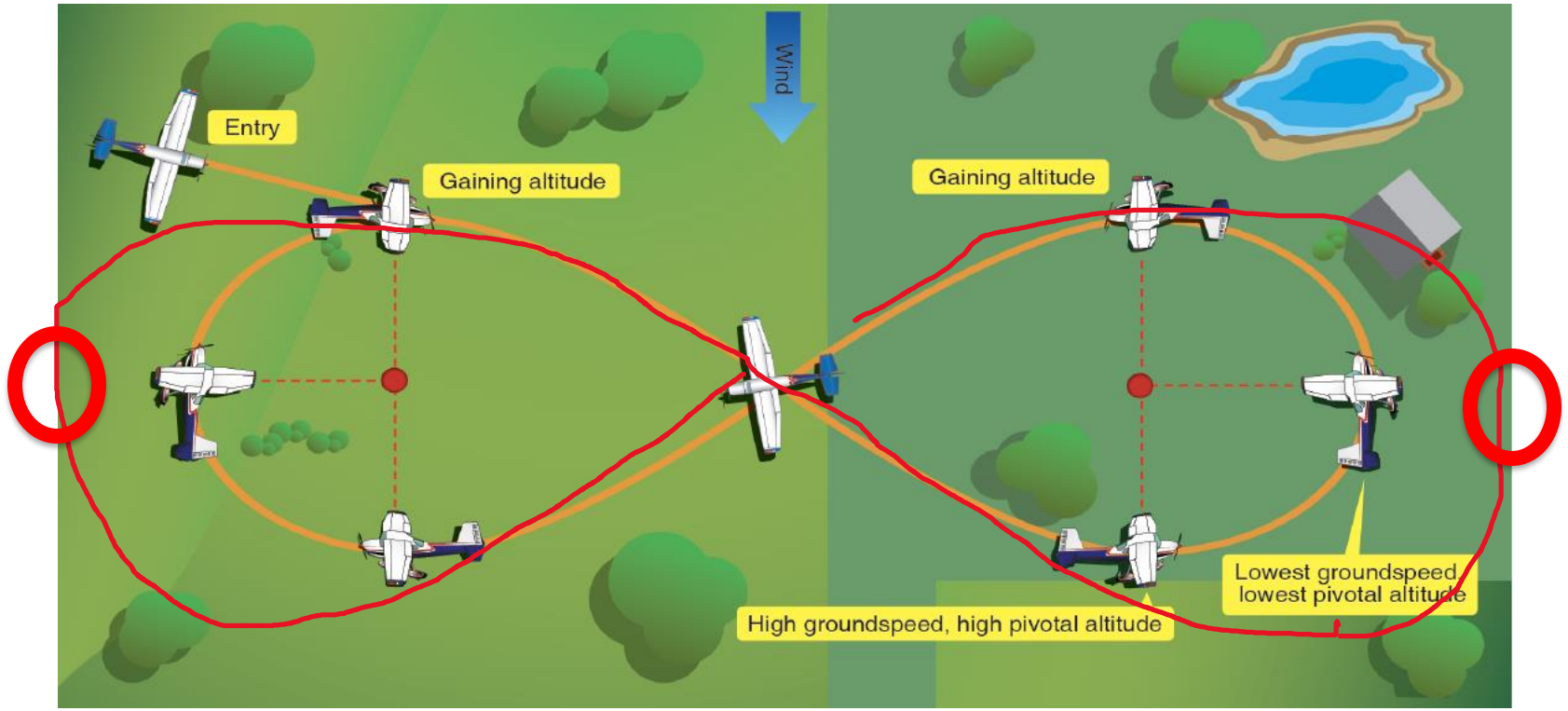
The real ground track would resemble the red line



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

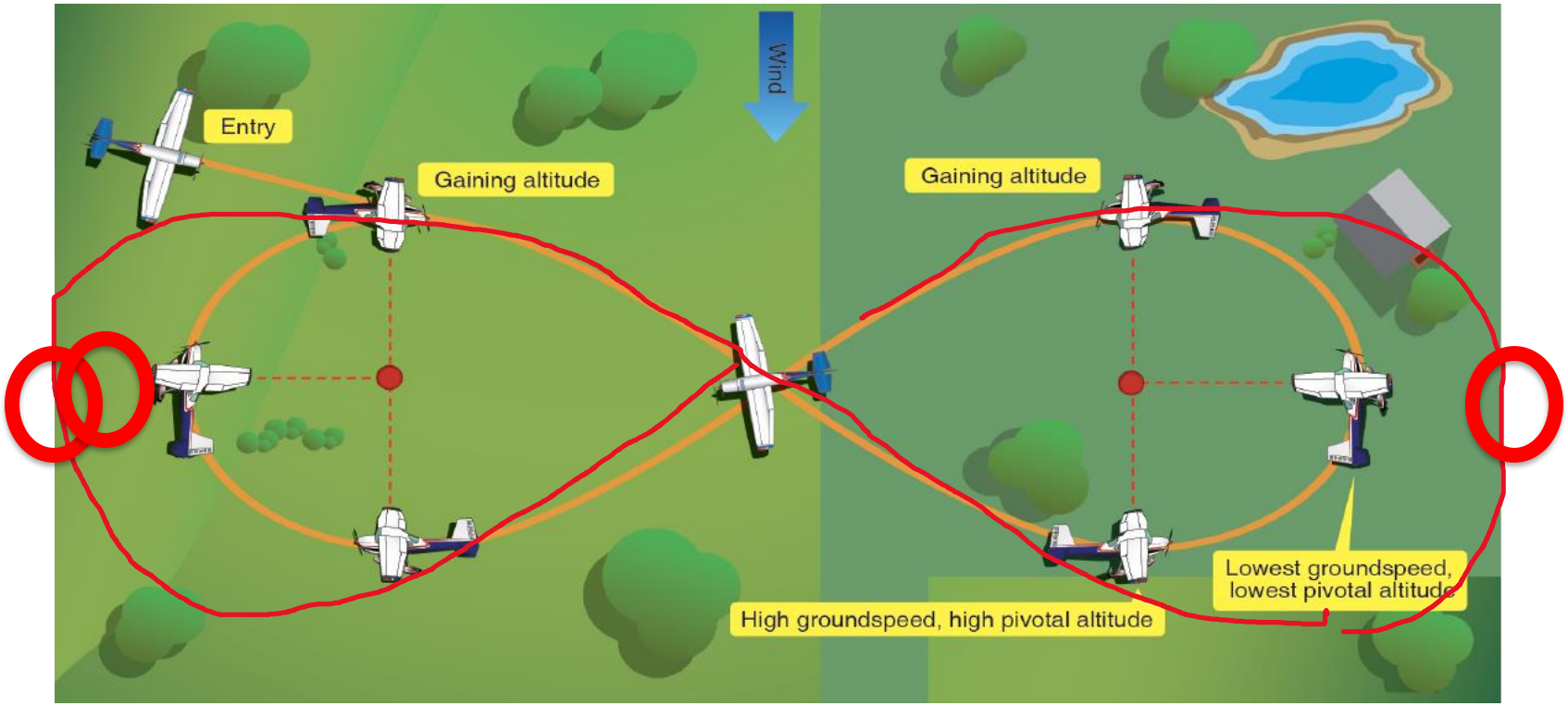
You are farthest from the pylon when no longer drifting – Red circles



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

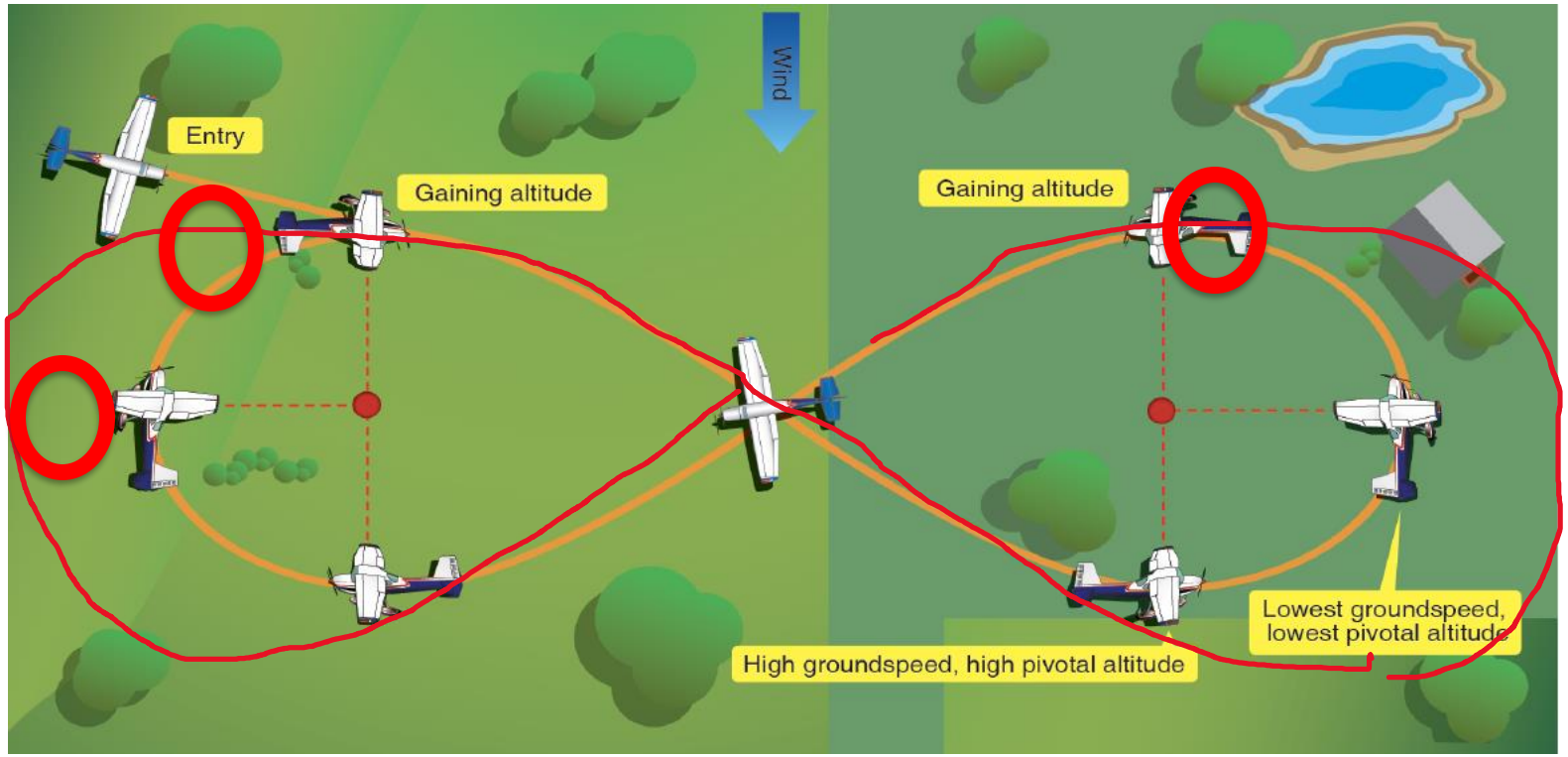
You are farthest from the pylon when no longer drifting – Red circles



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

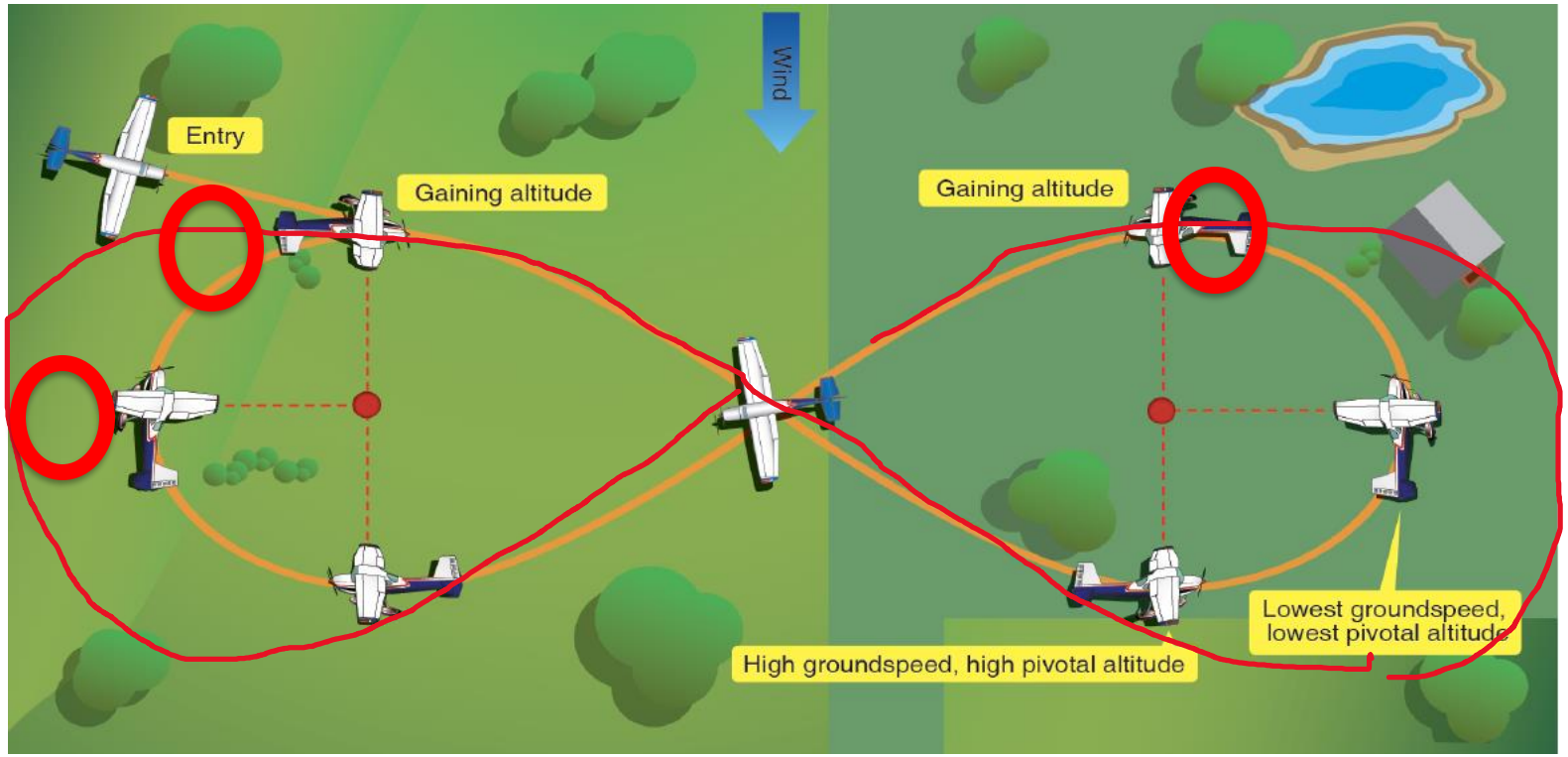
Steepest bank – red circles



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

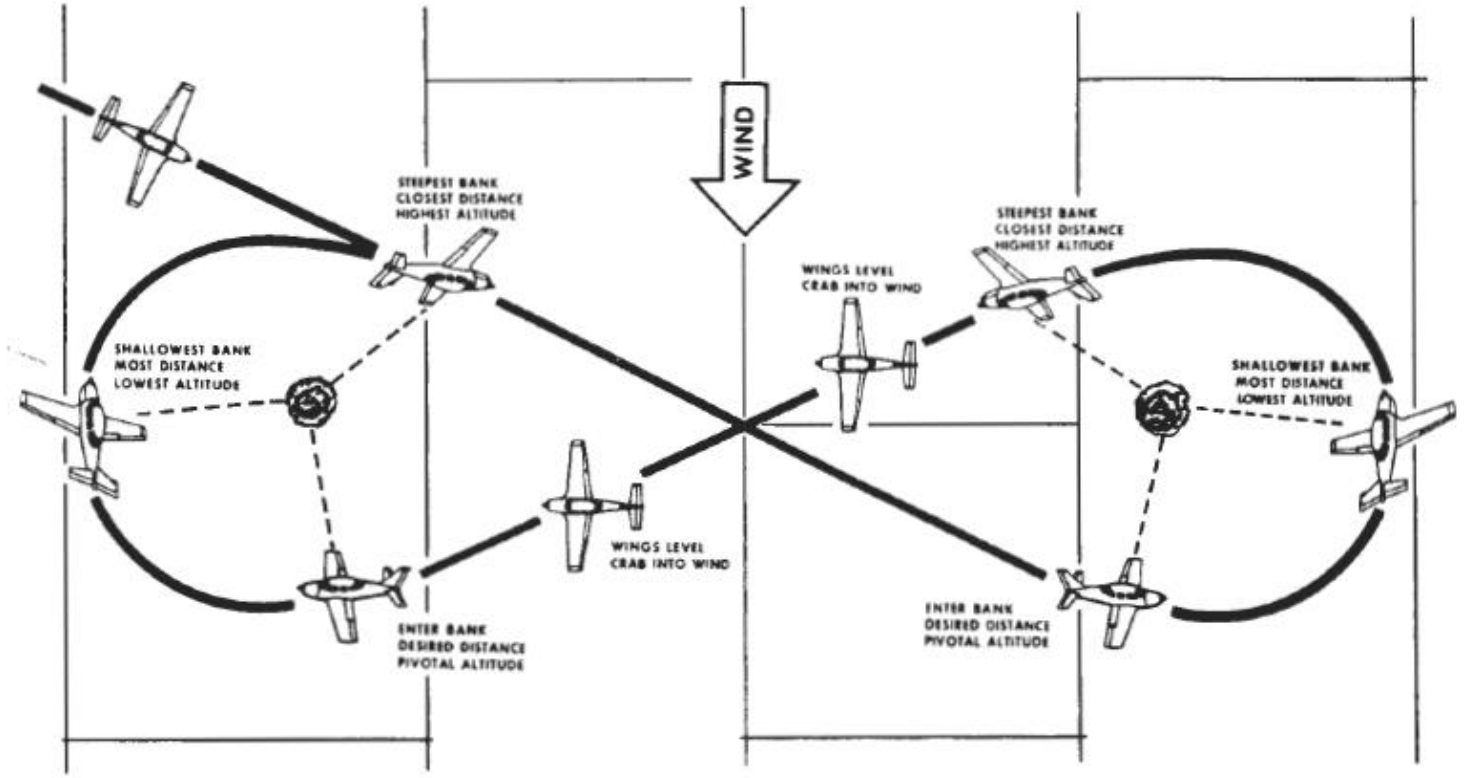
Because no correction for wind drift is done while turning – A steep turn is required here to not get blown across the pylon



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

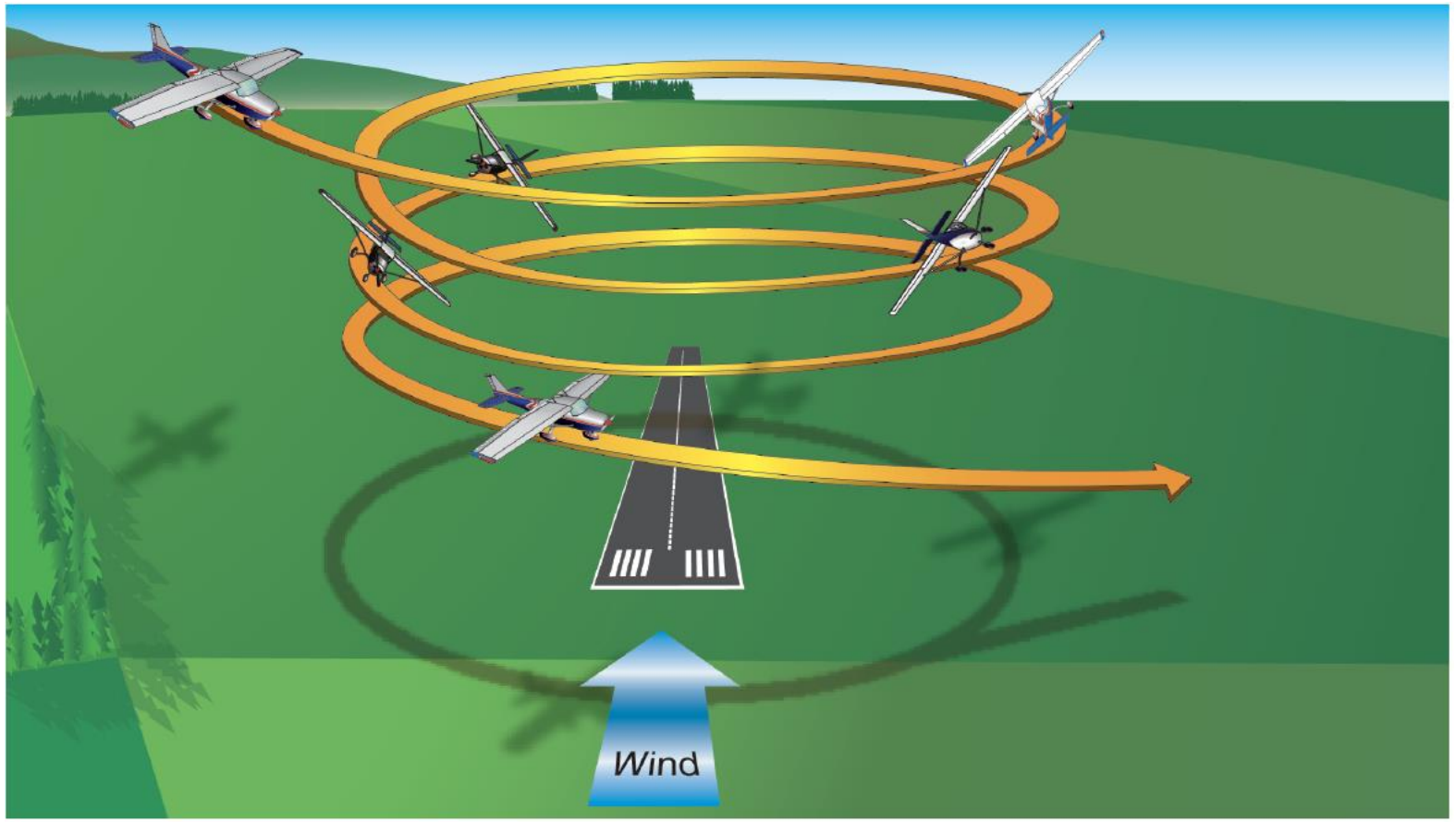
From the 1965 Flight Training Handbook



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

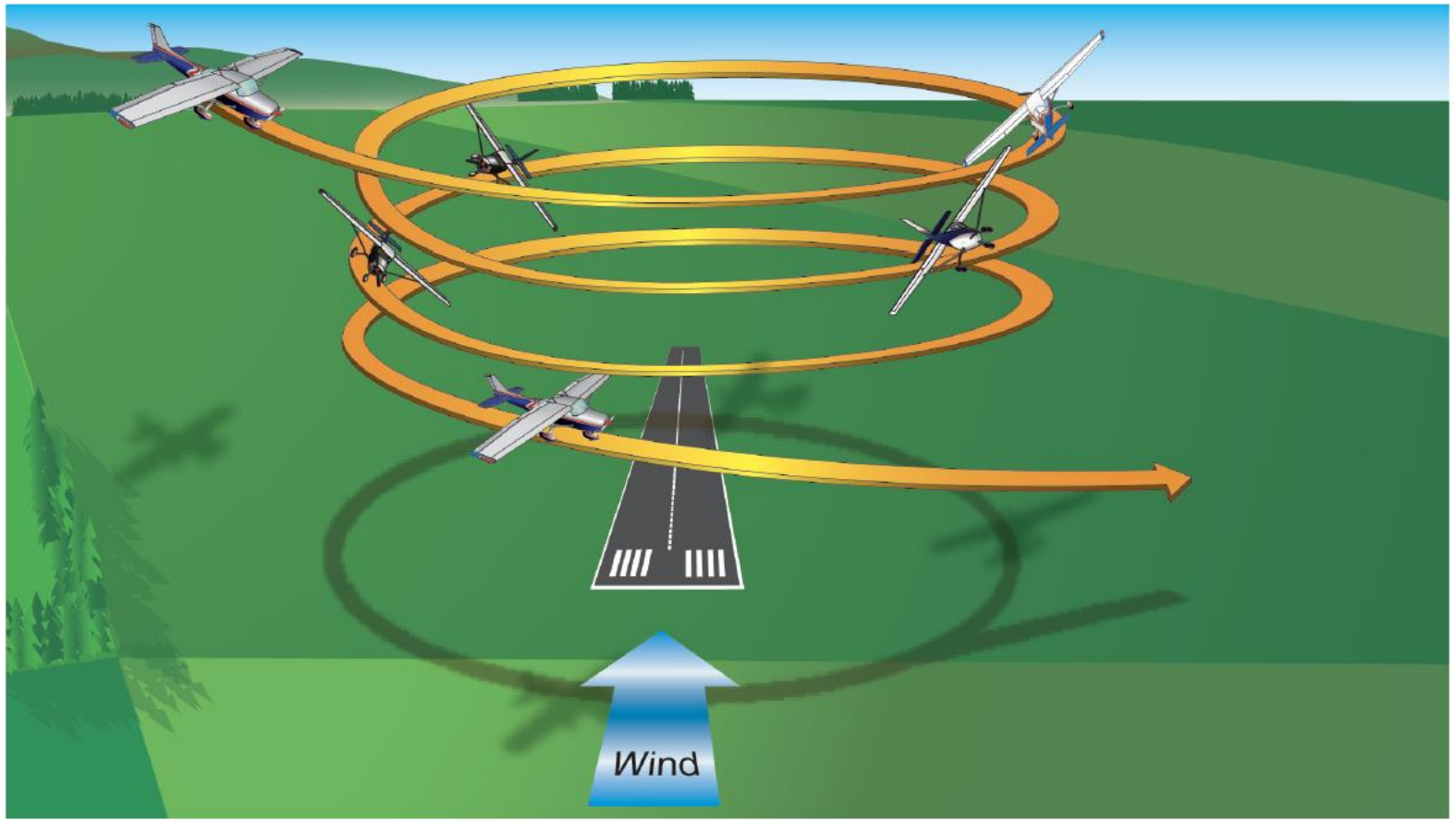
Steep Spirals



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

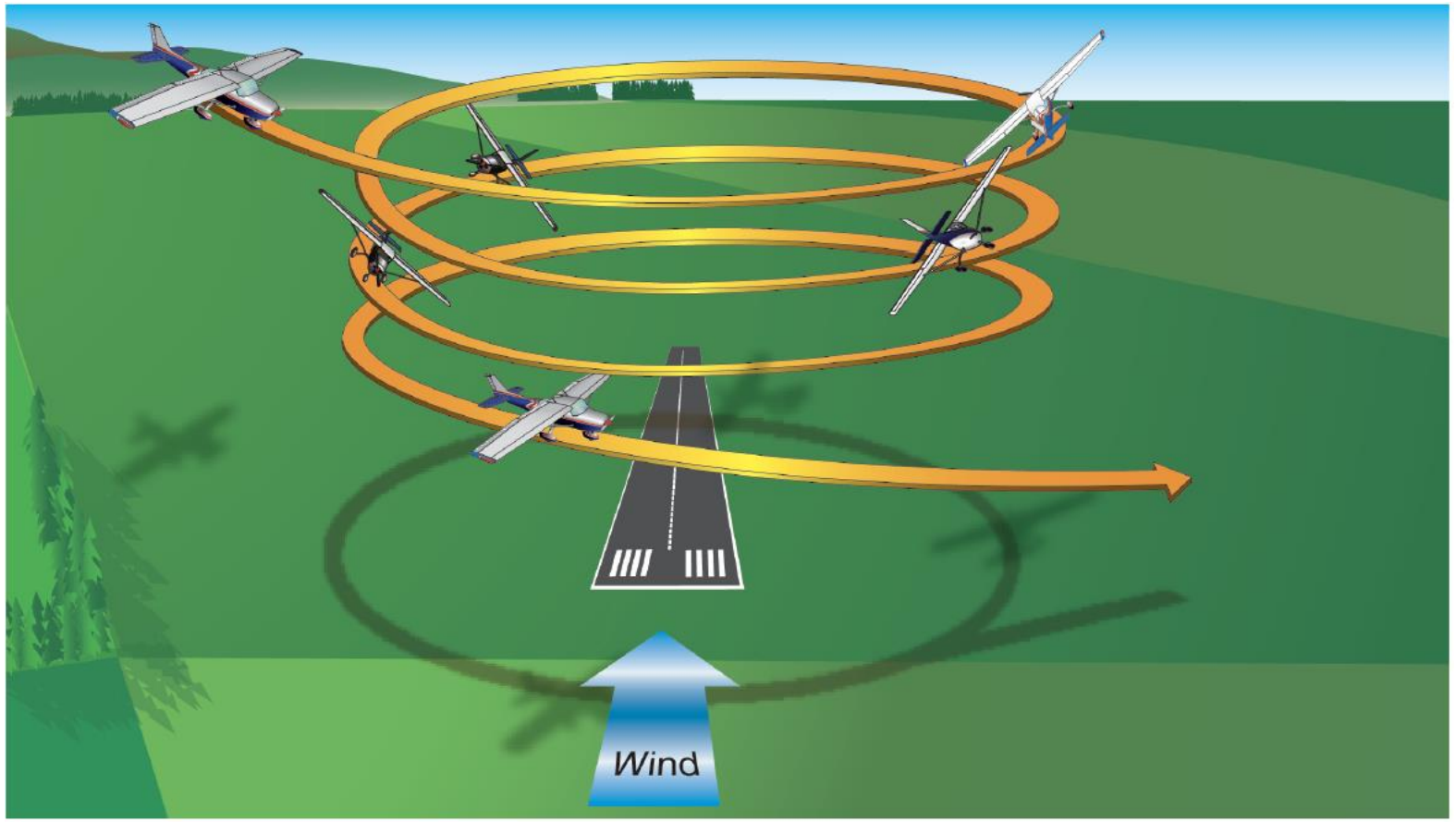
Steep Spirals



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

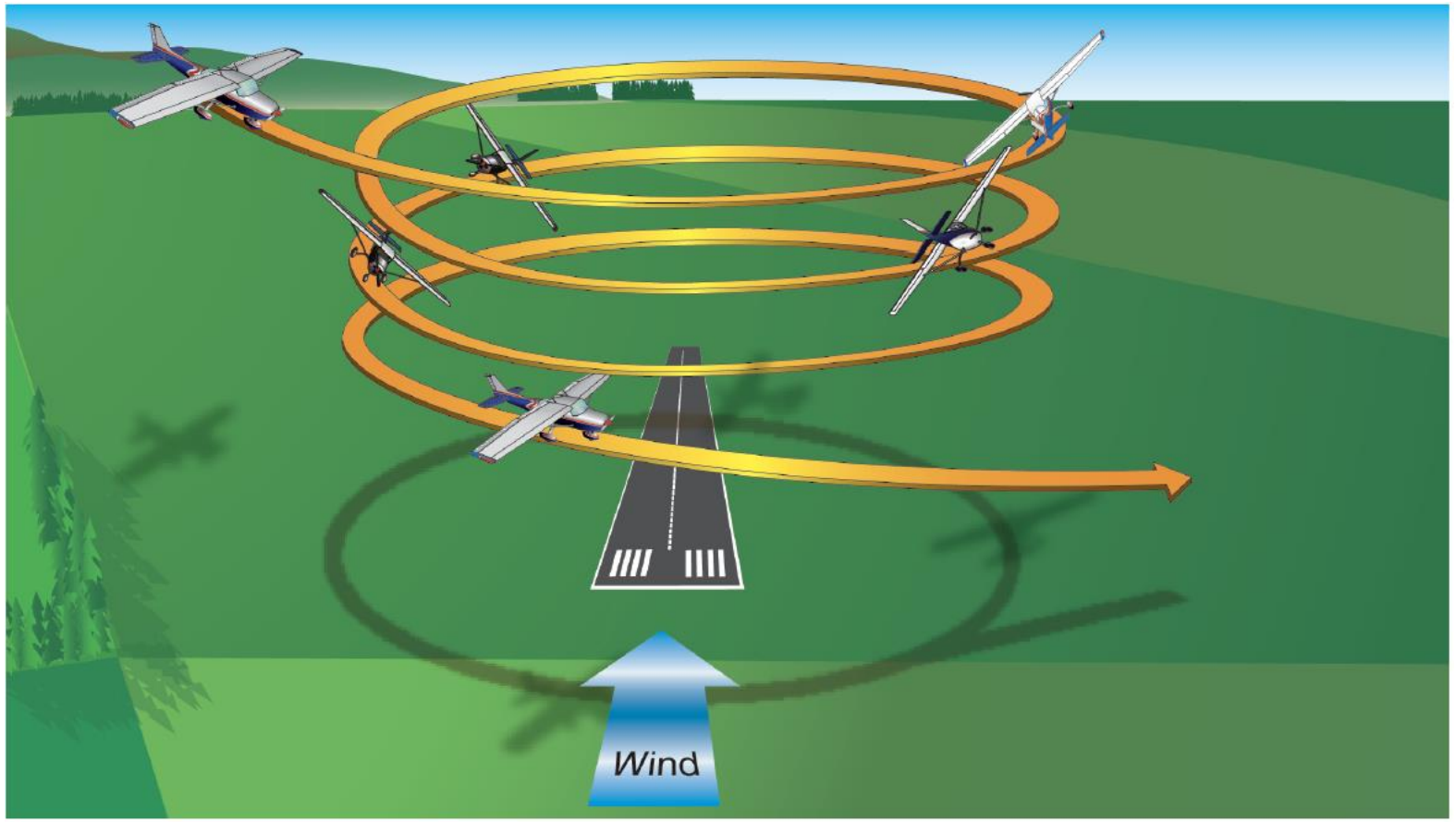
Some Lost Information – Recovered Here!



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

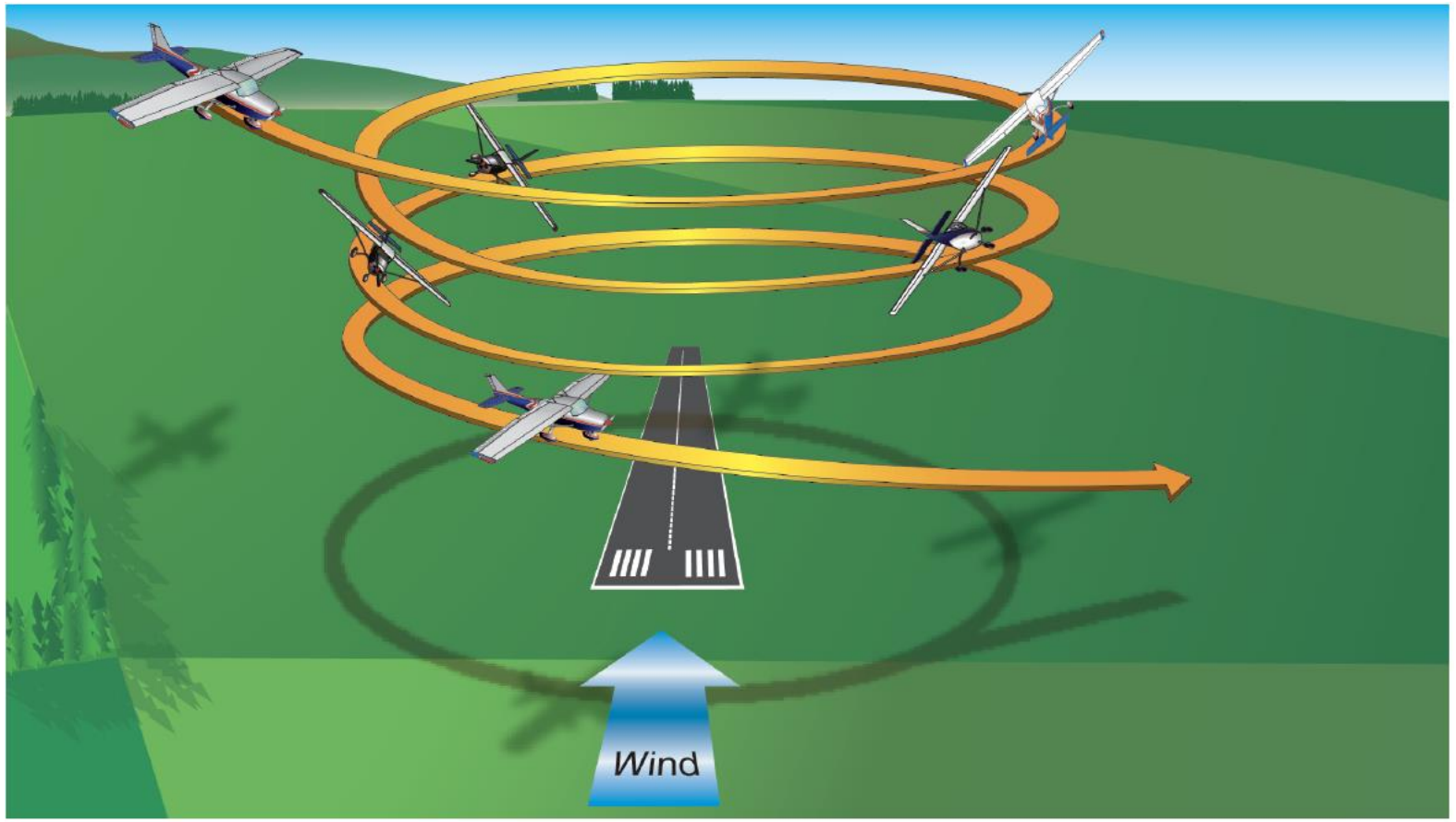
In the beginning it was over 10 turns to teach vertigo avoidance



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

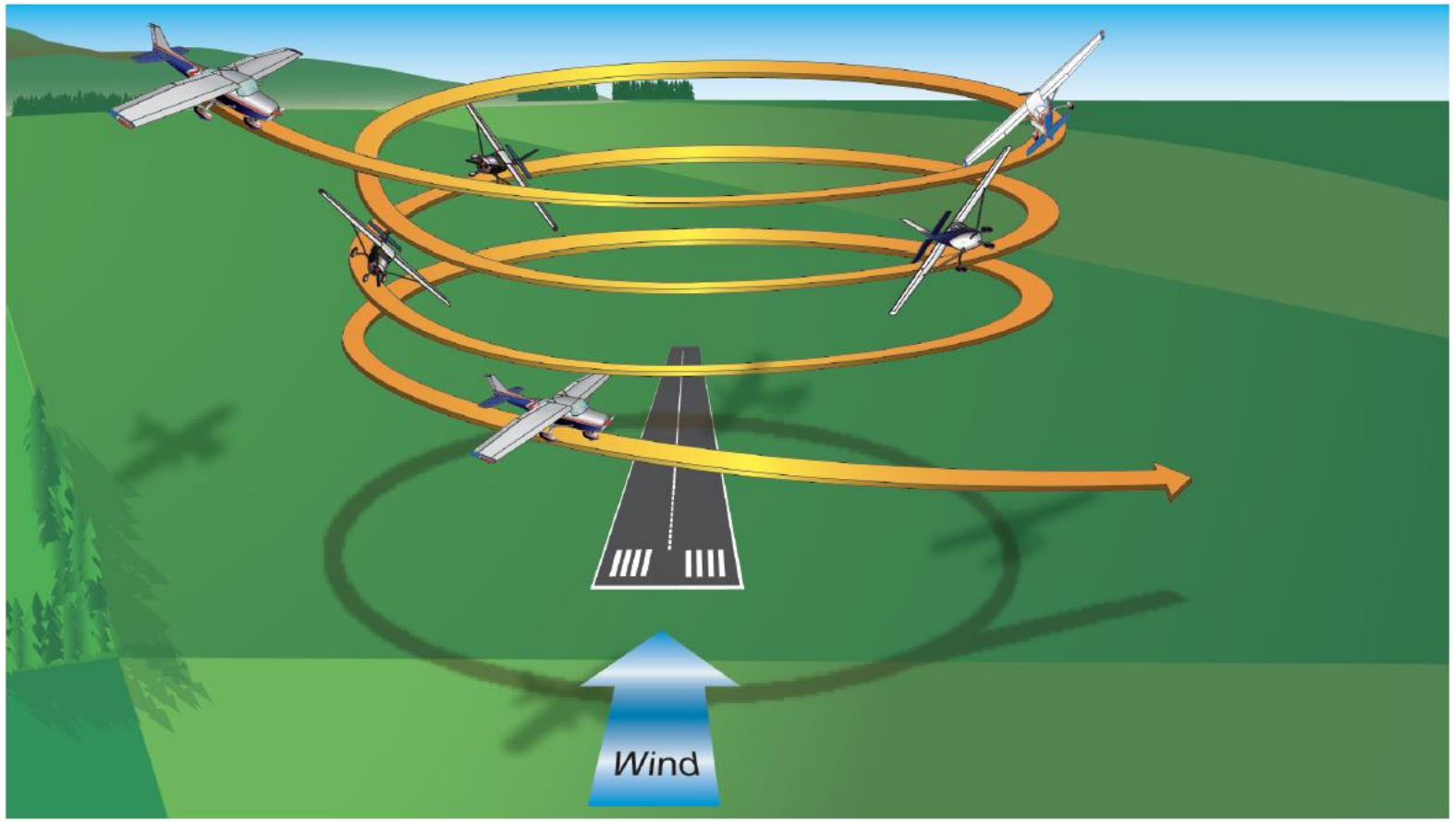
After no vertigo – a ground reference is introduced to spiral over



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

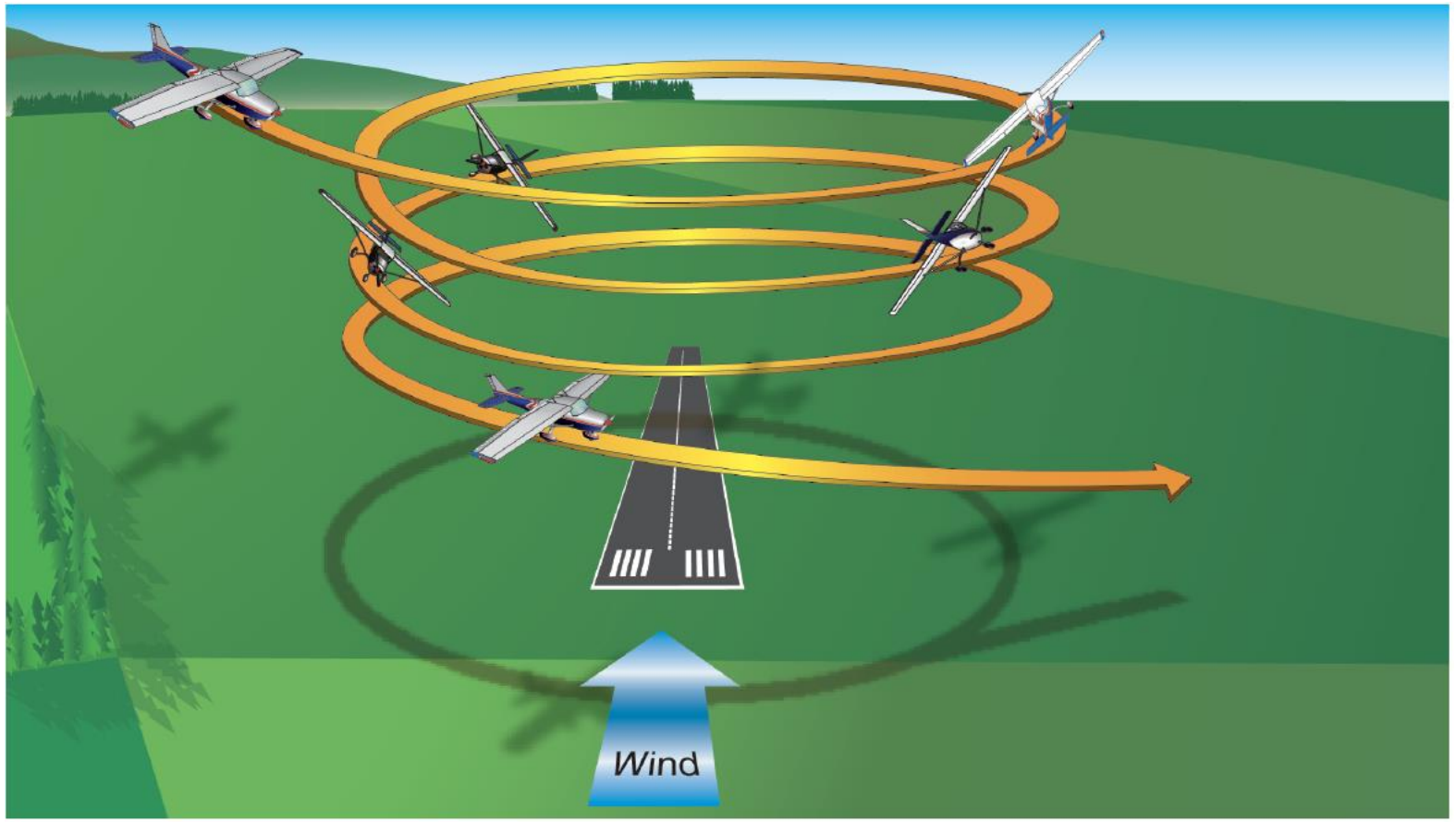
The maneuver is started UPWIND. Why?



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

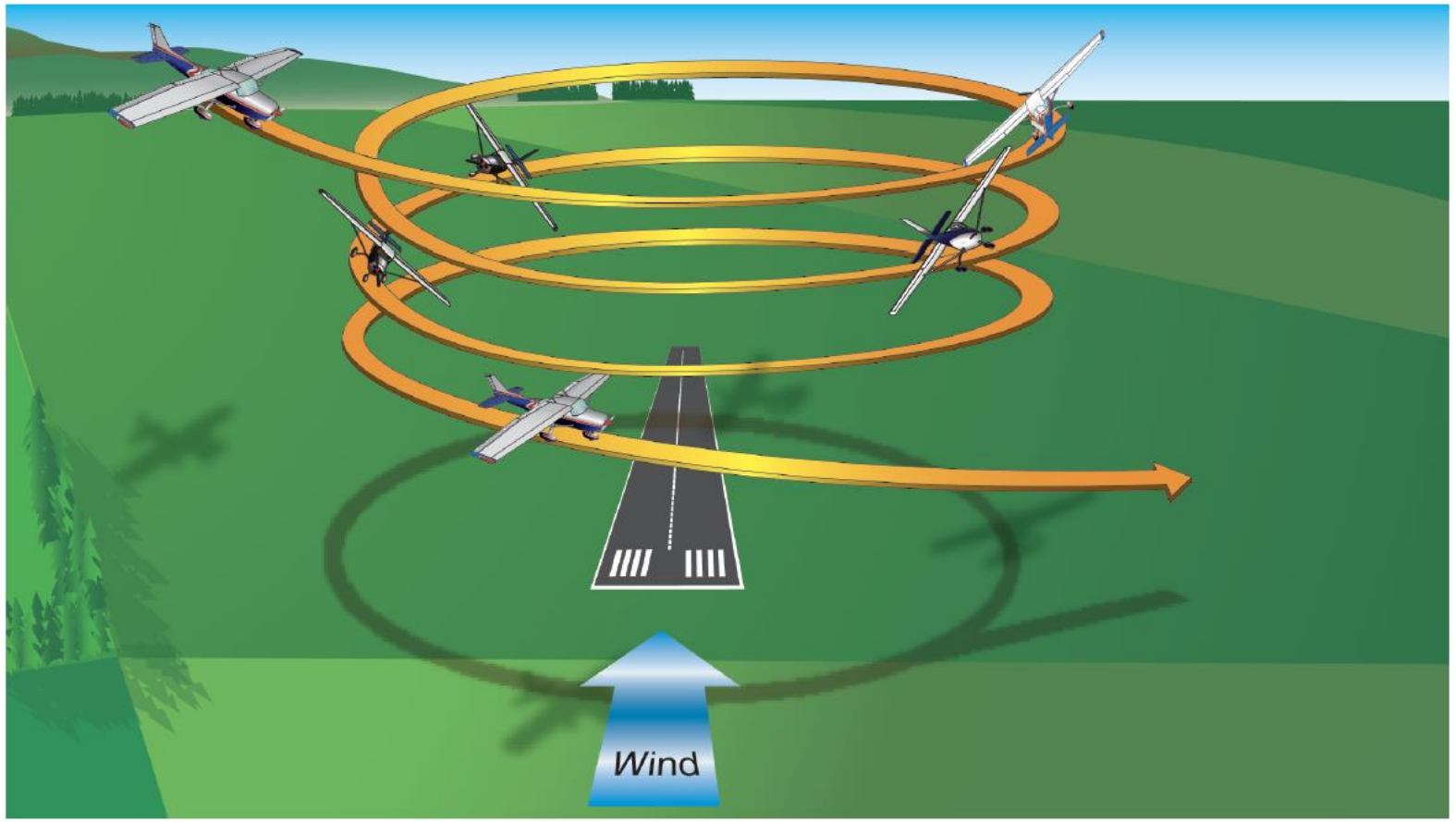
Why are all other ground reference maneuvers started downwind?



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

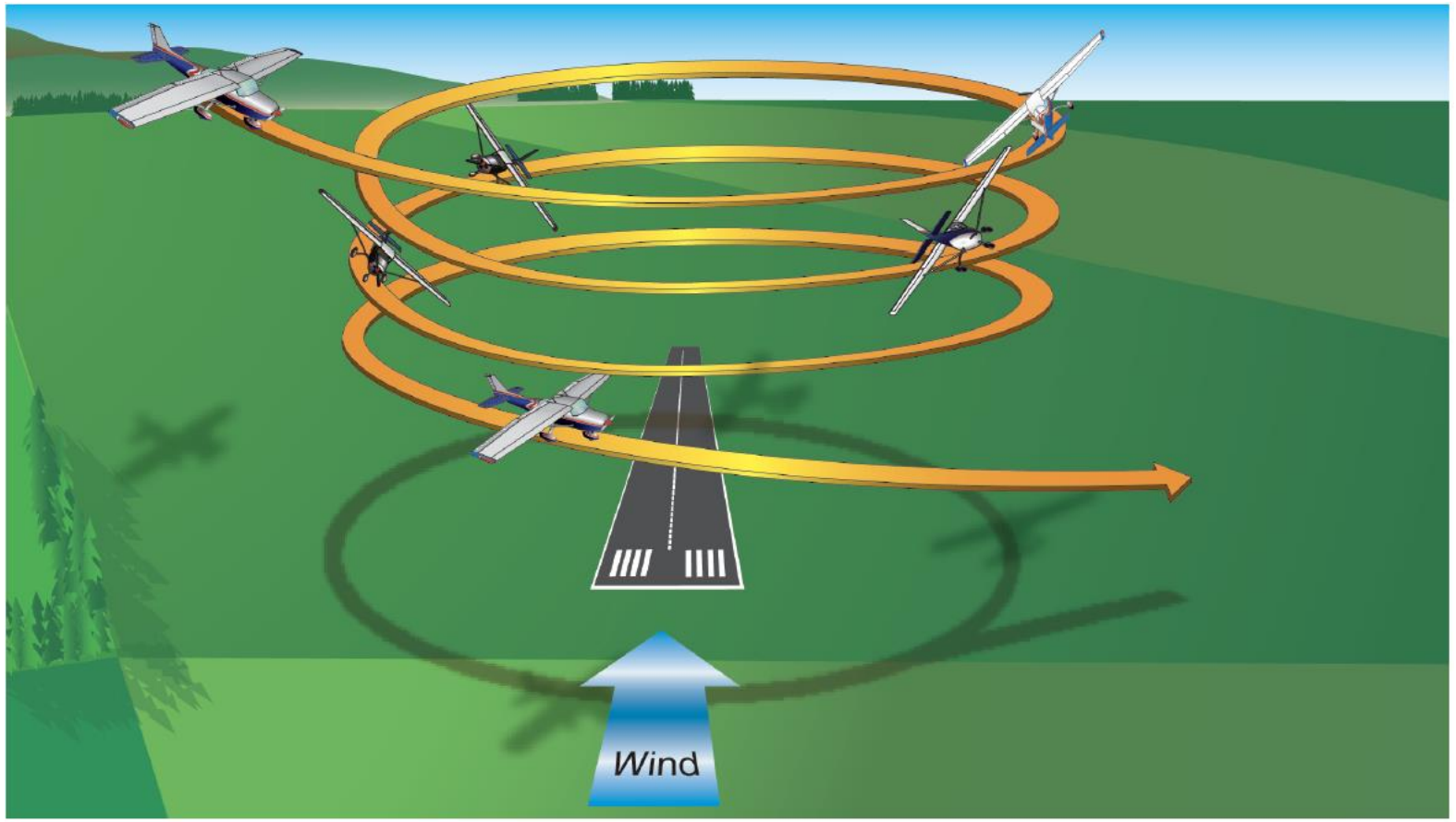
Because the max bank angle allowed is 45°



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

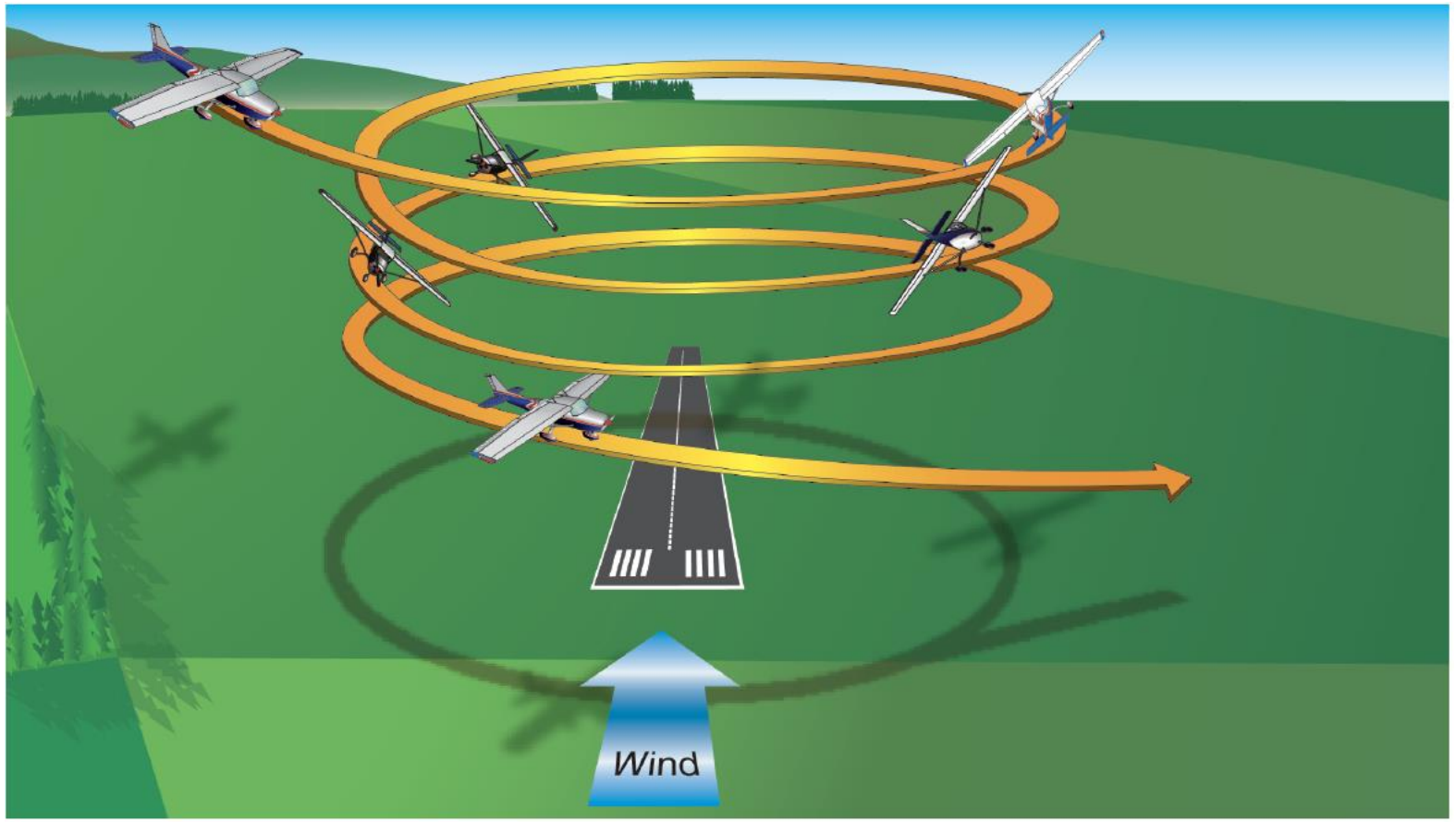
The downwind is where the steepest bank will be thus up to 45°



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

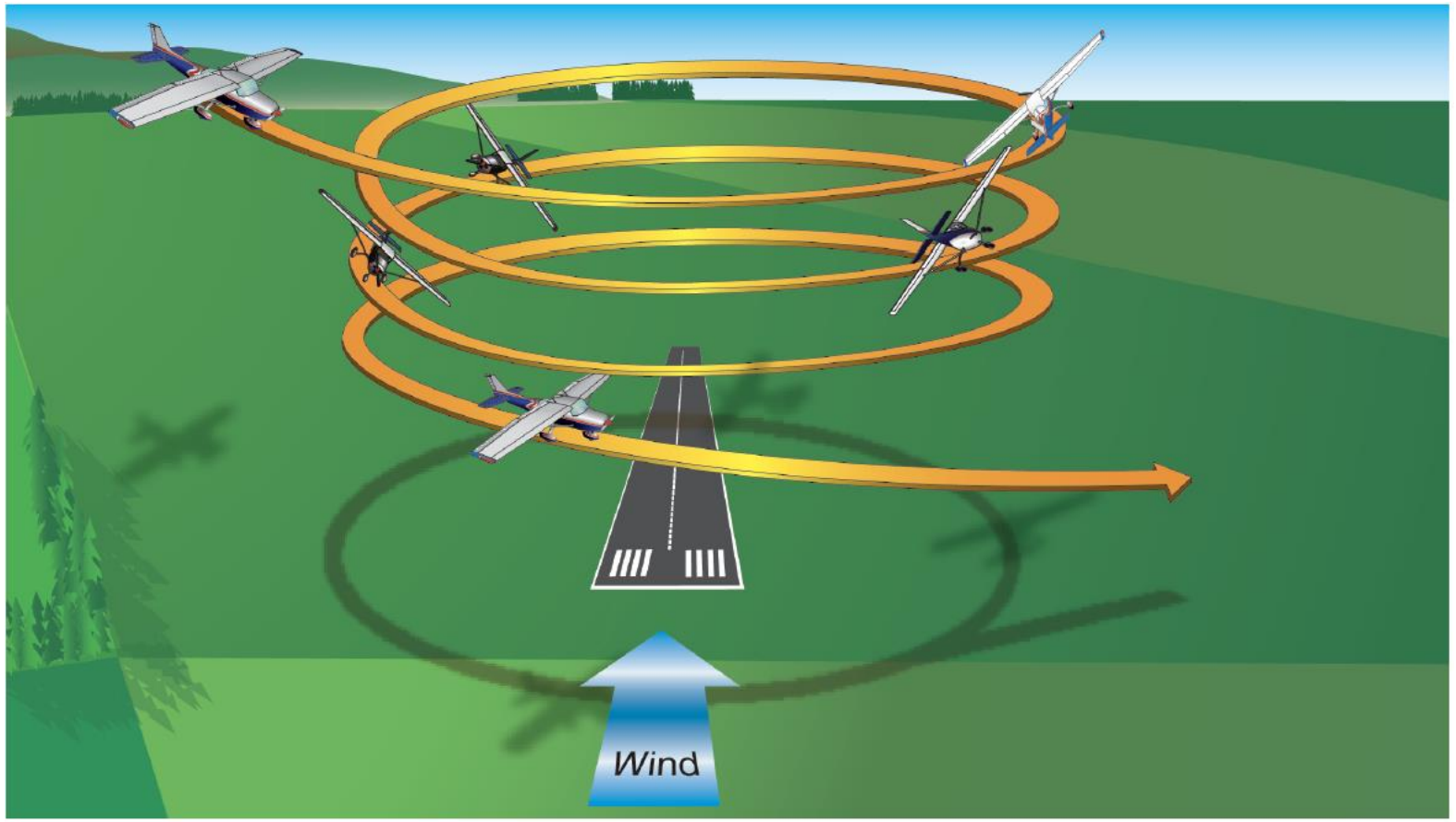
All other points during ground reference maneuvers will be under 45°



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

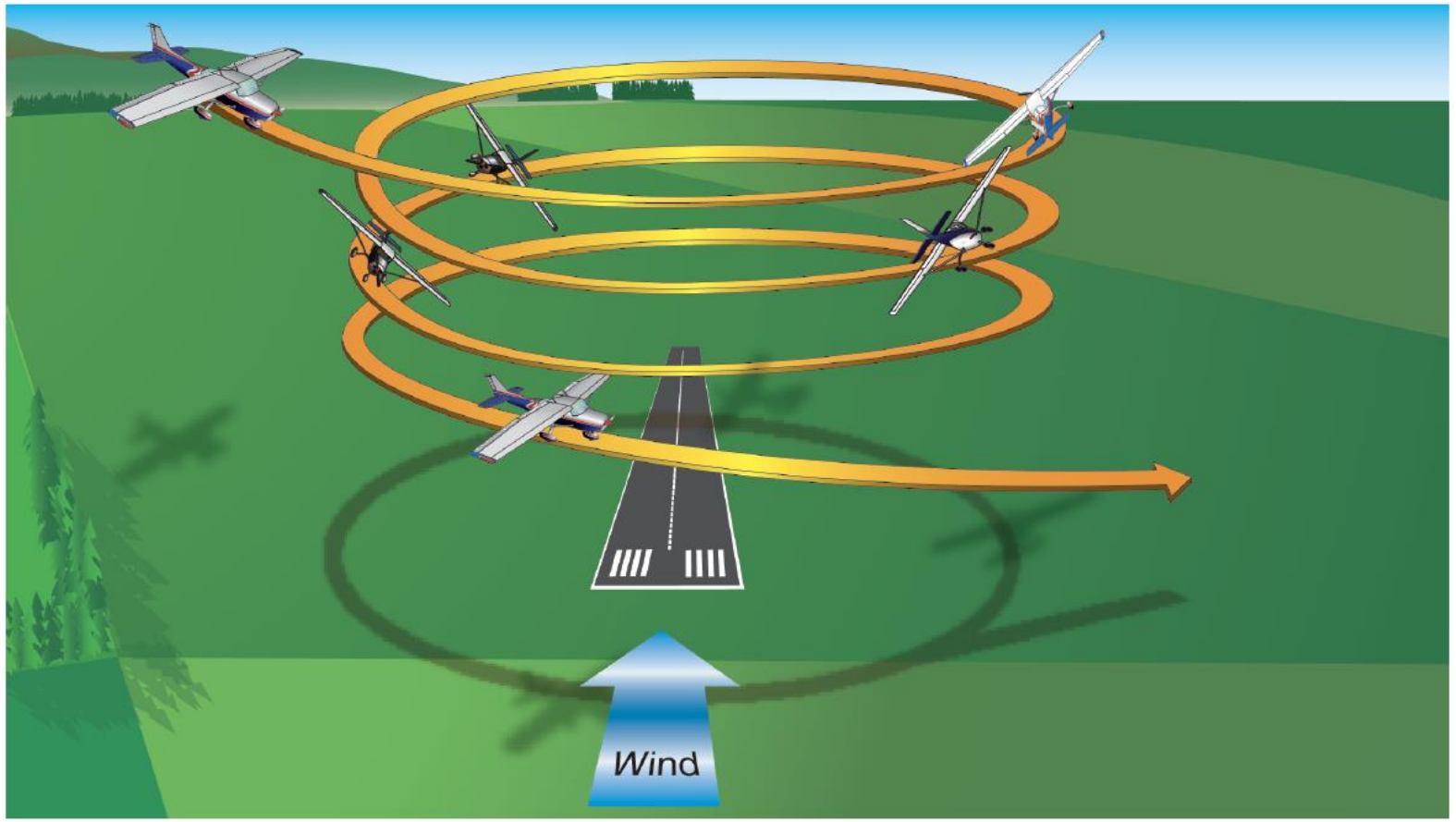
The Steep Spiral started Upwind with an allowable bank angle of 60°



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

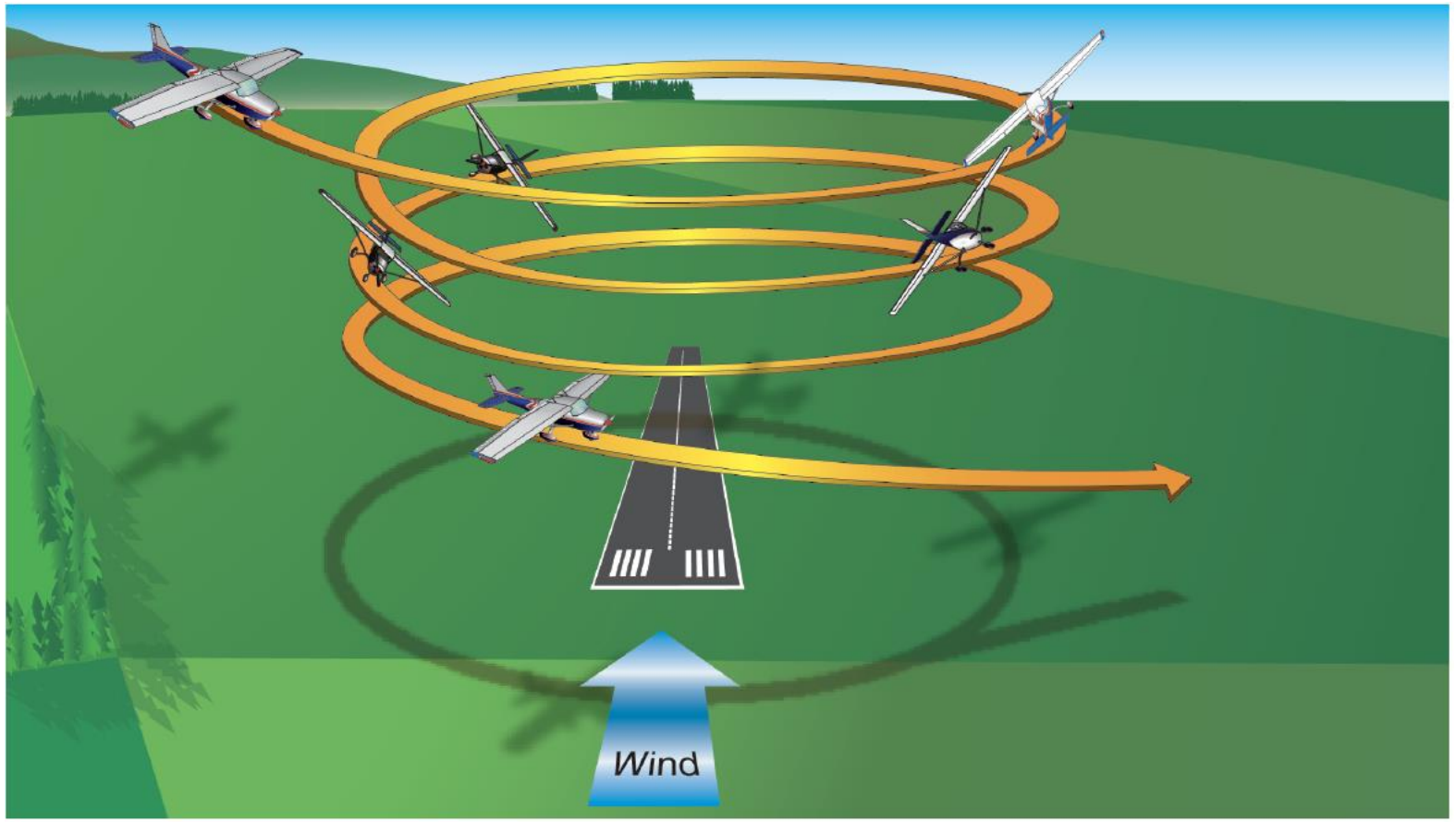
The reason is that is was supposed to be landed from



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

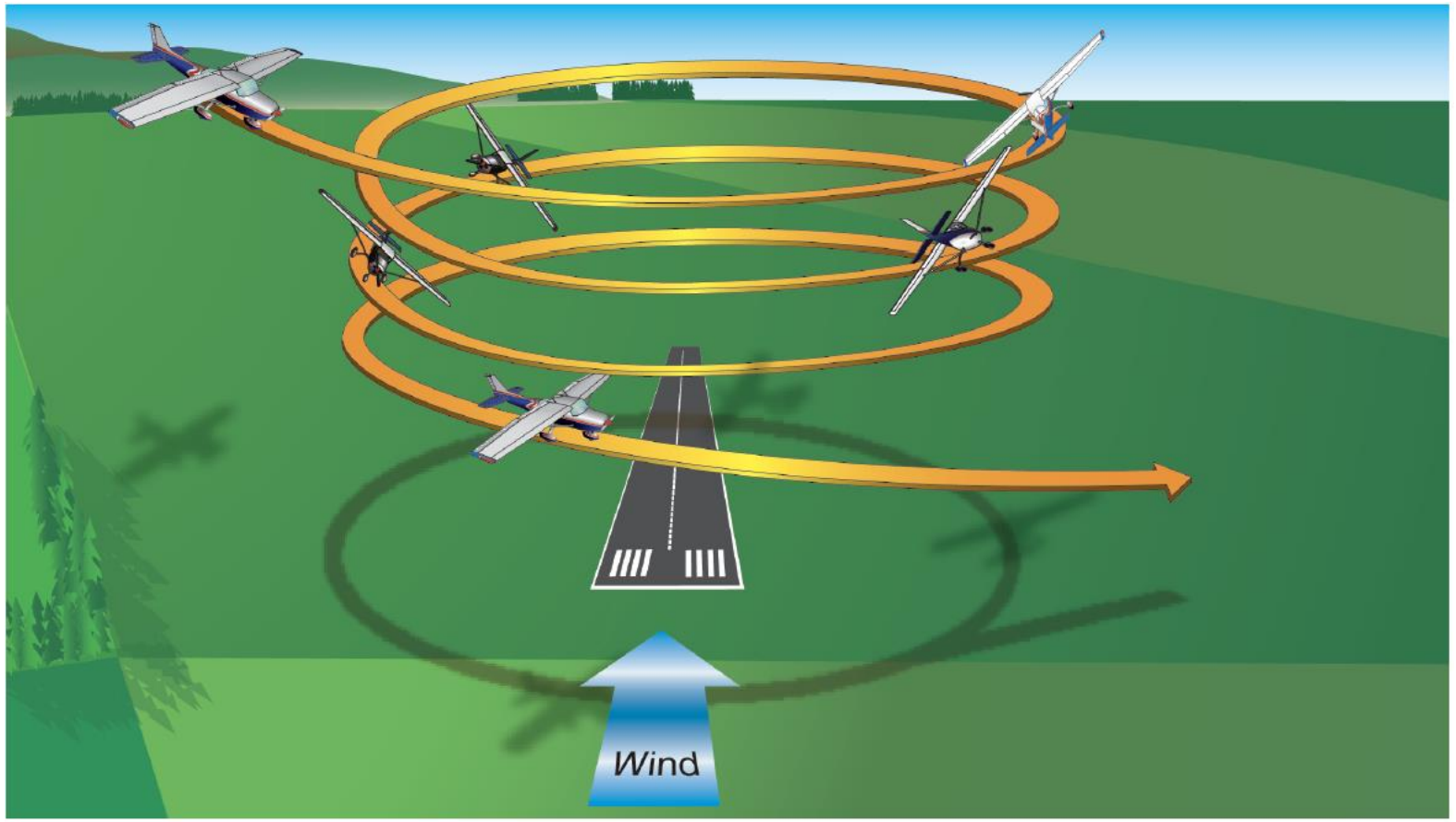
At the completion of the turns the airplane was upwind for landing



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

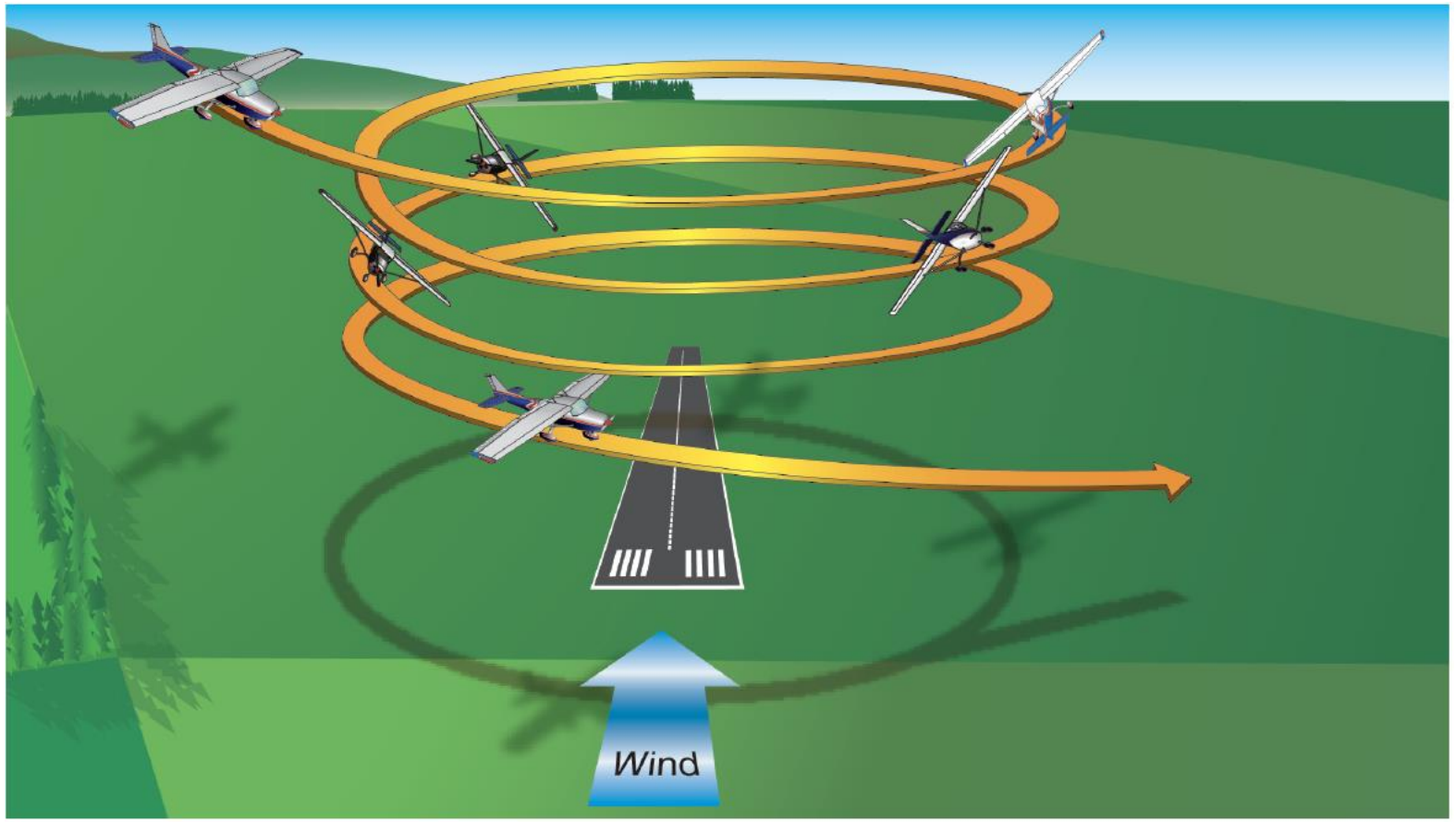
Airspeed is the first parameter to go out of standard



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

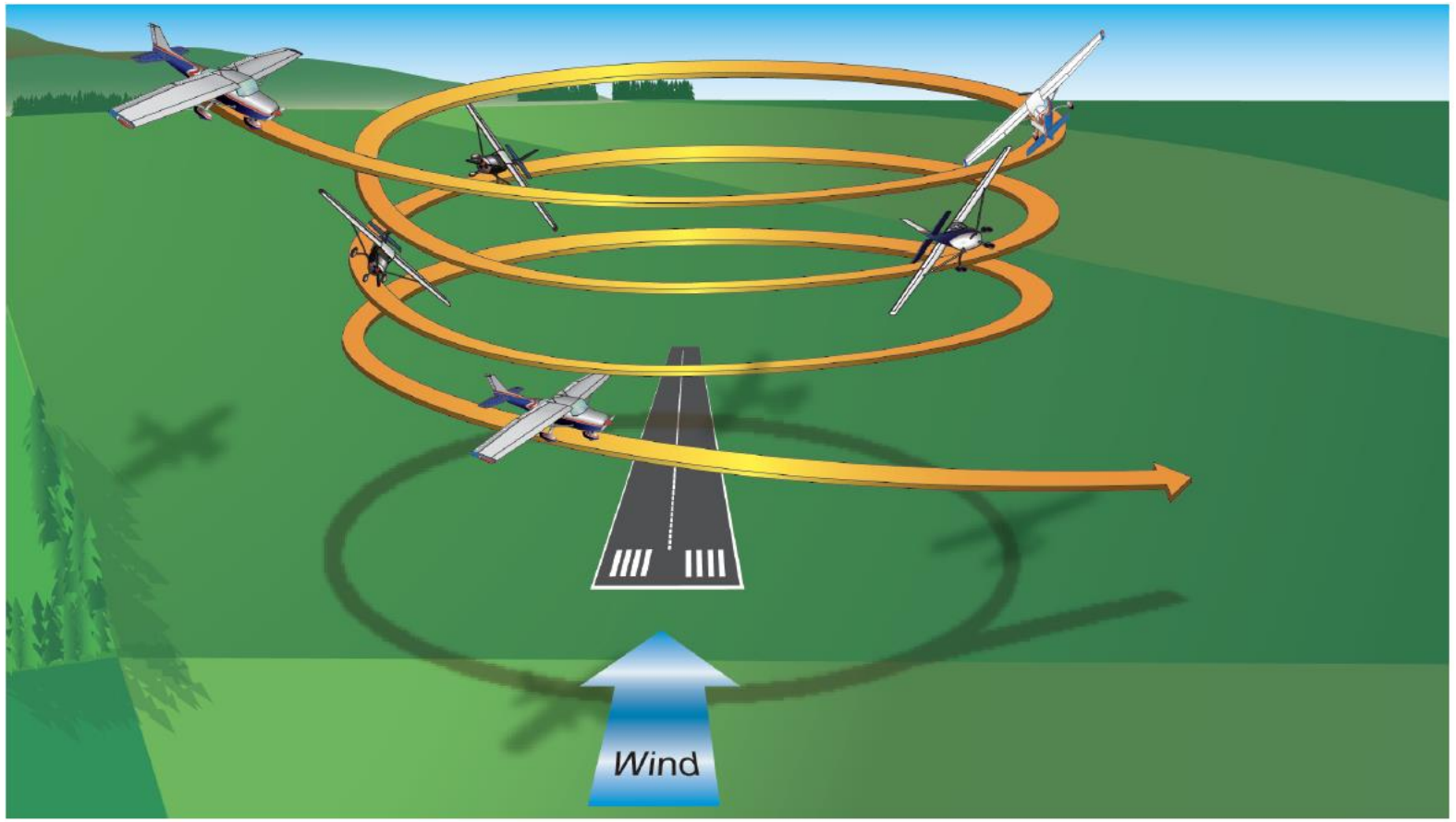
Originally the speed was 1.3-1.4 Vso – Accelerated stall avoidance



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

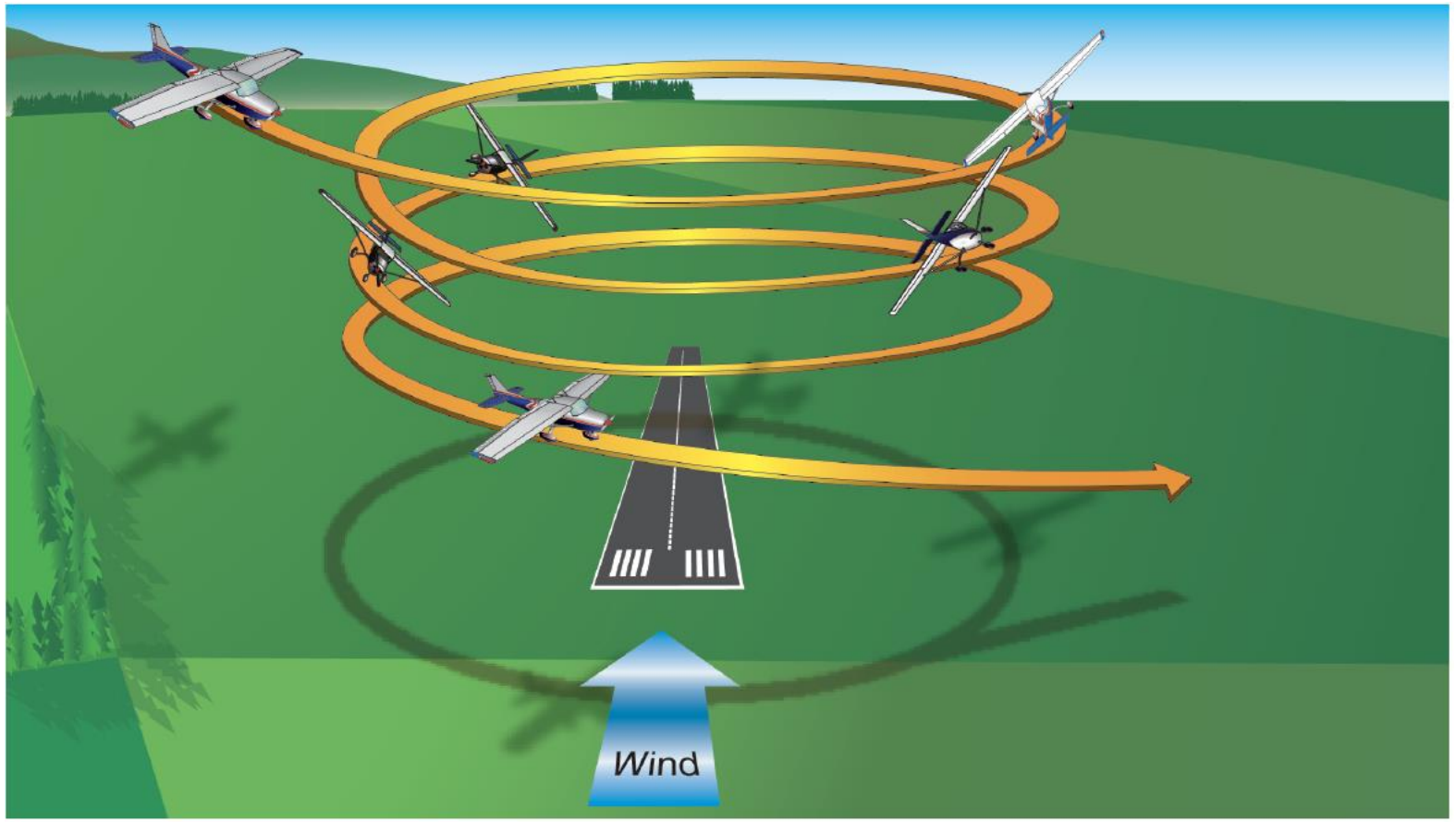
Today a “Glide Speed” is used – Typically best glide



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

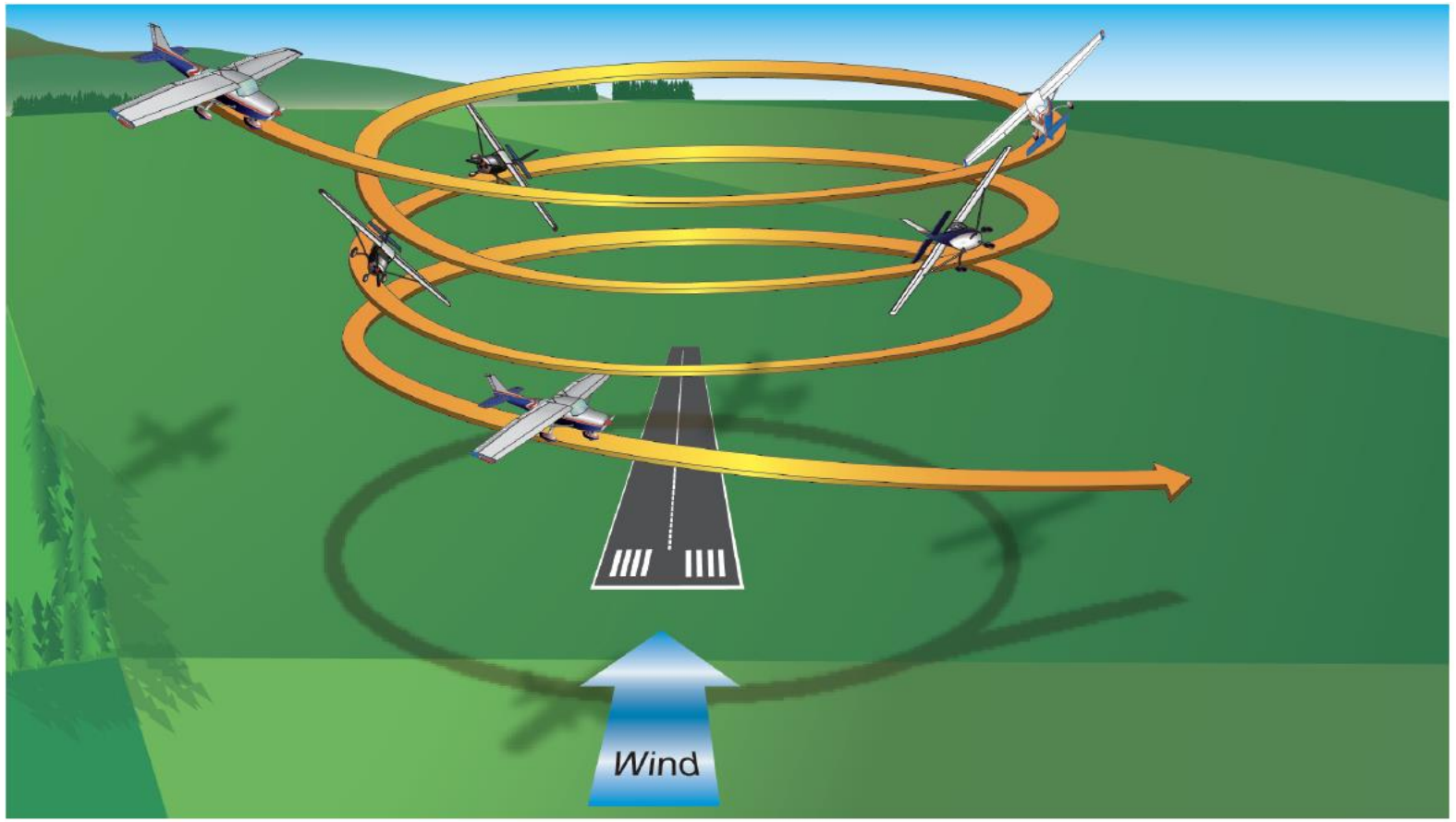
As bank angle increases, airspeed lost due to drag – Lower the nose



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

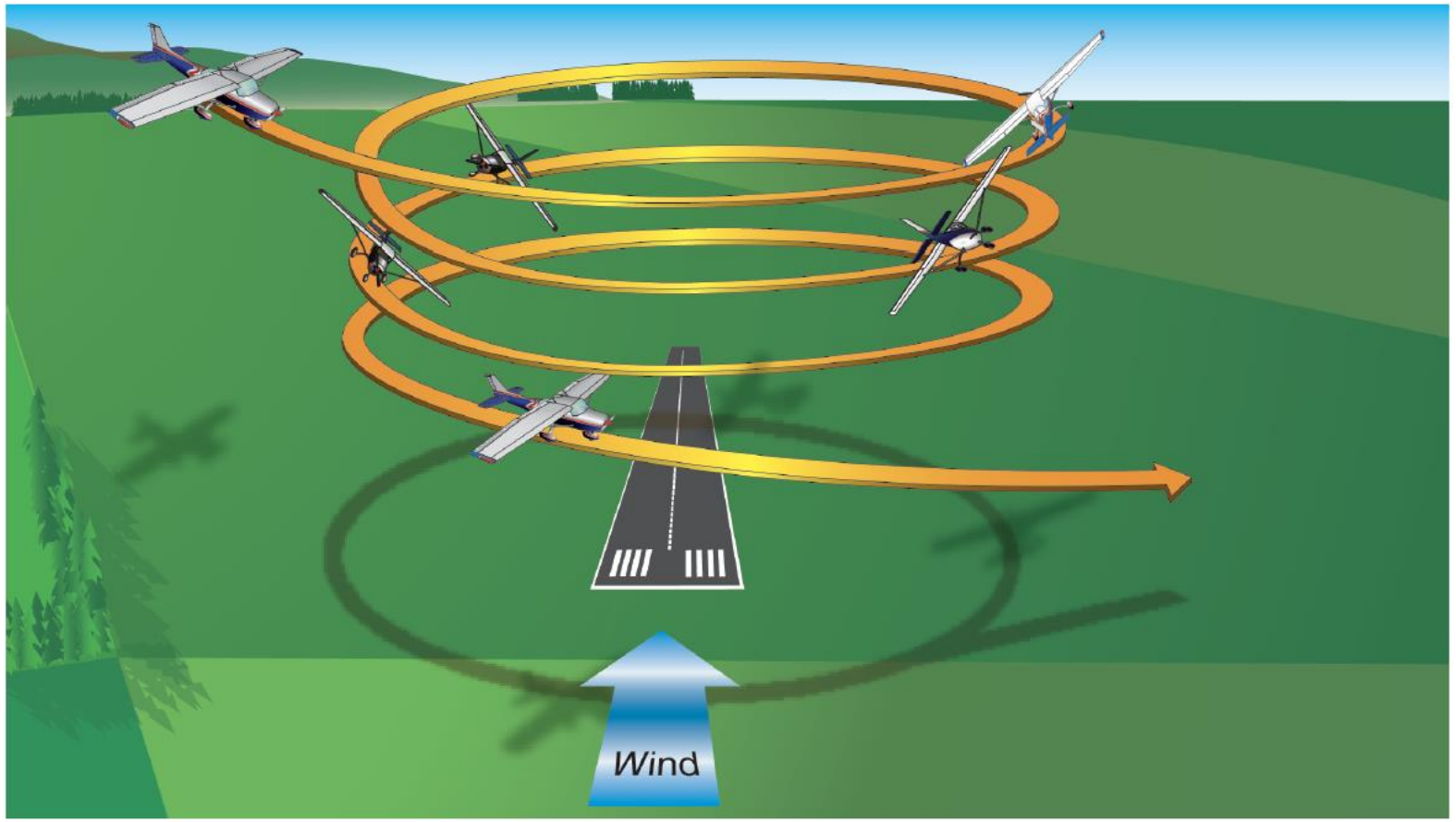
As bank angle decreases, airspeed increases – Raise the nose



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

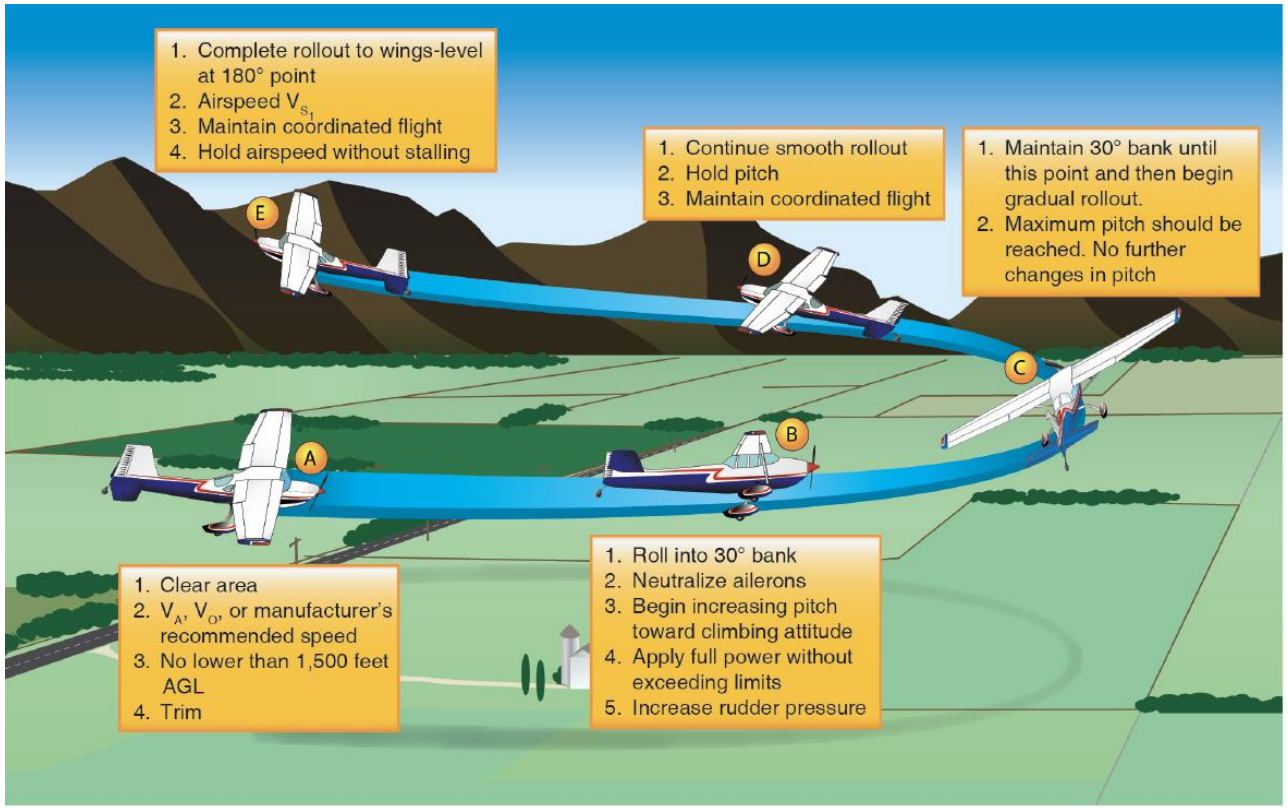
The point to spiral over must be very close to the airplane fuselage



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

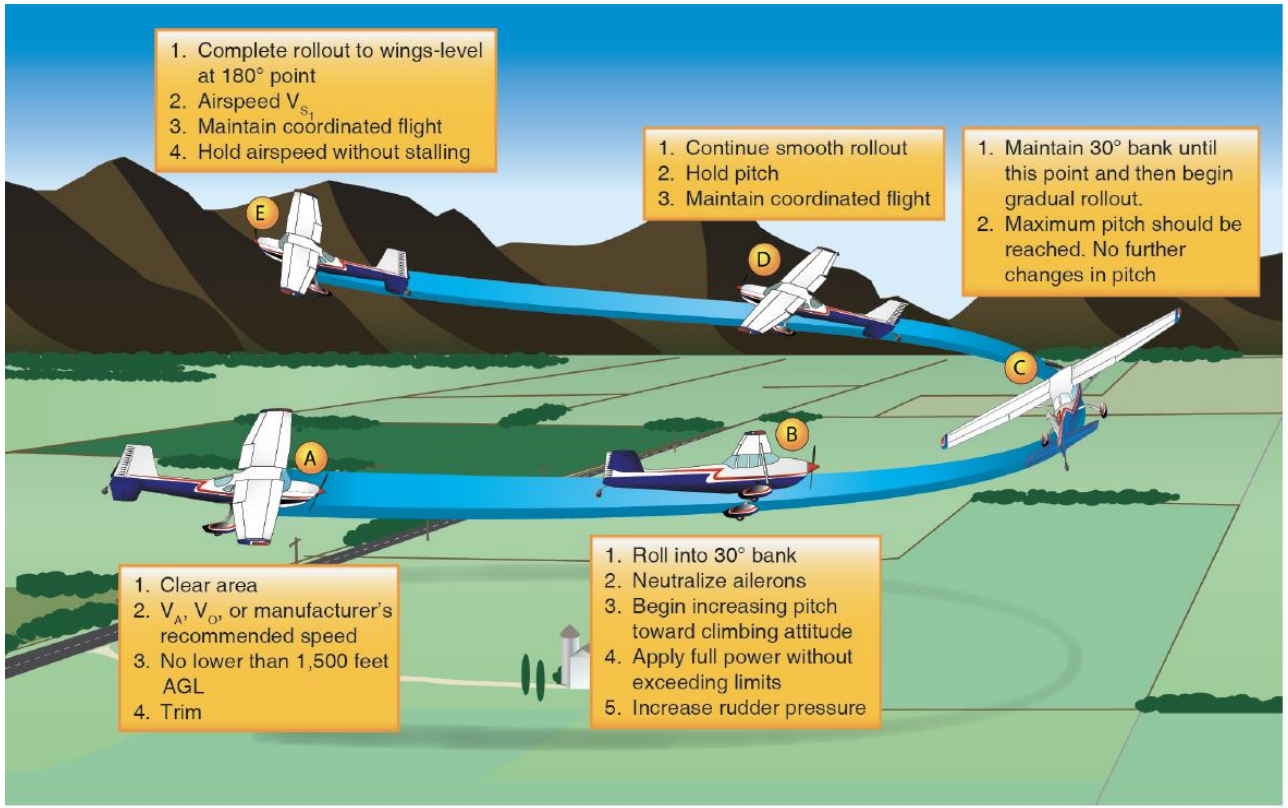
Chandelles



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

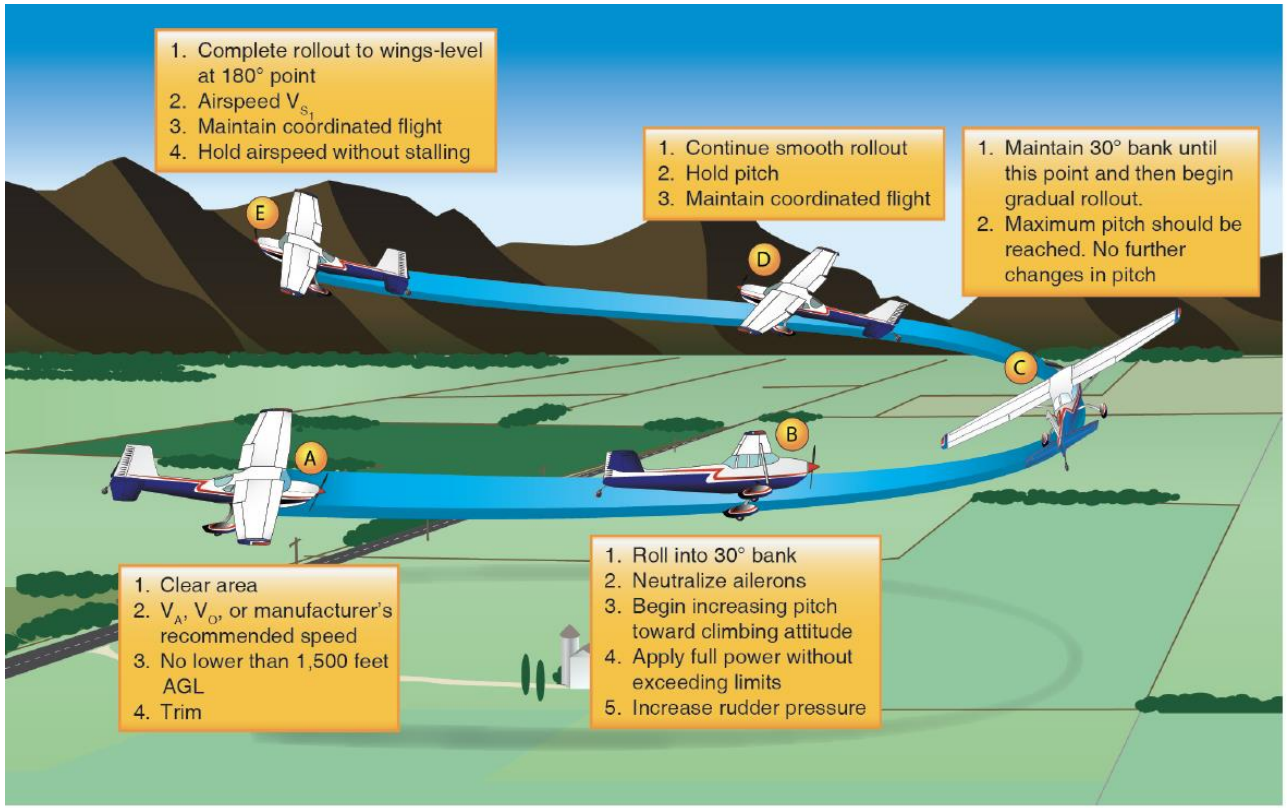
The image is not 100% correct



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

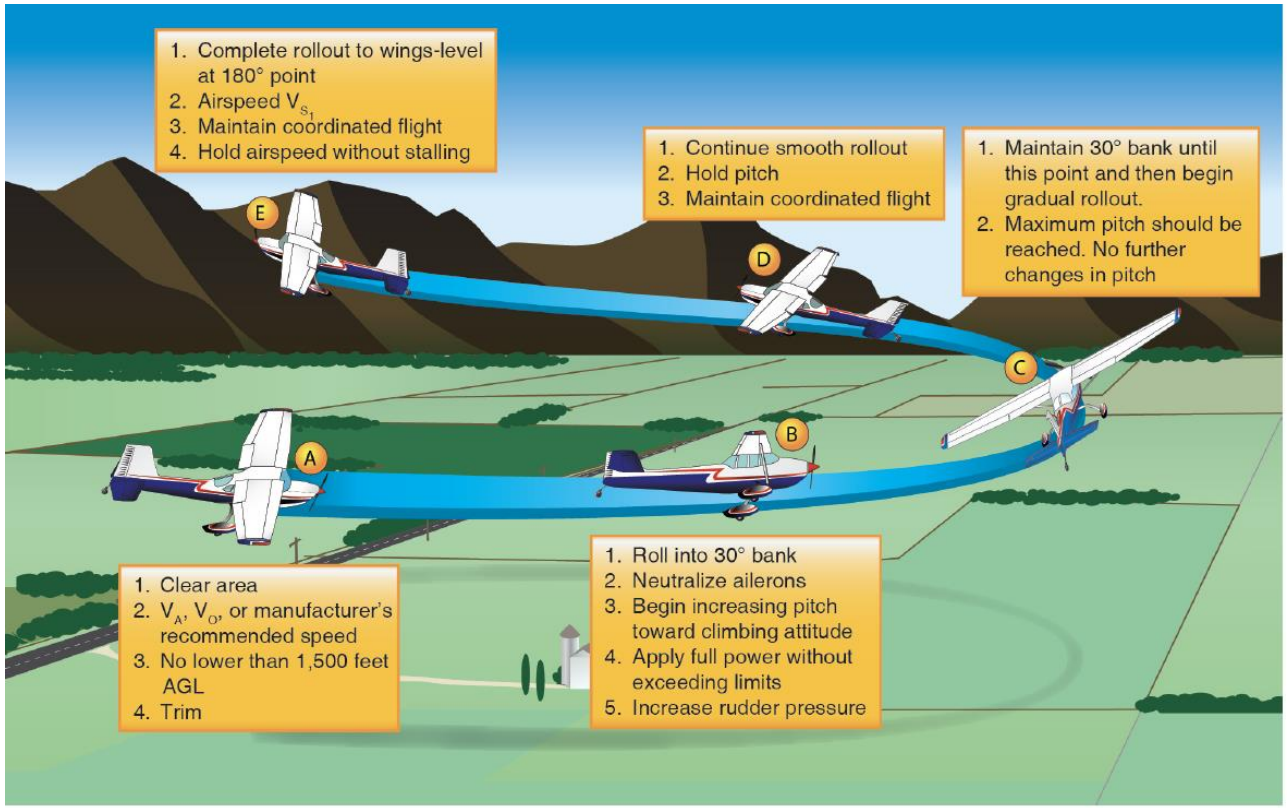
The turn radius decreases as speed is lost – It won't look like depicted



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

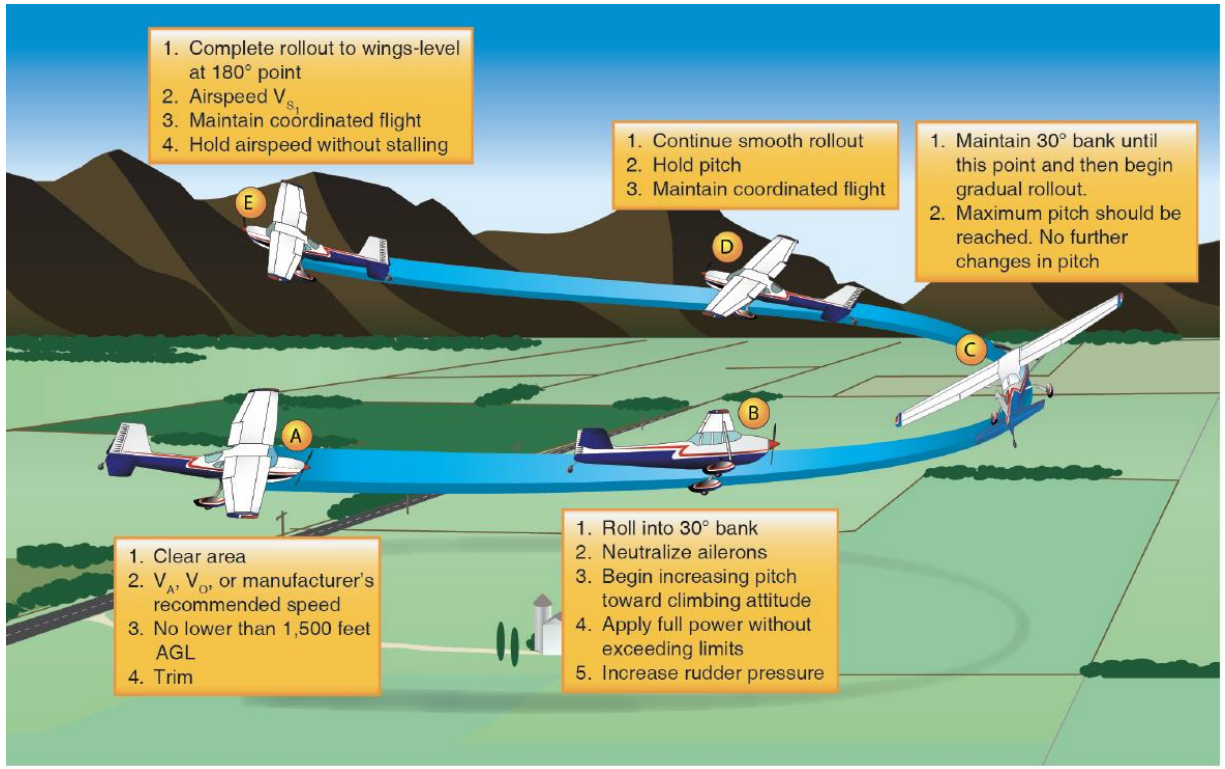
What is the pitch attitude at the 90° point?



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

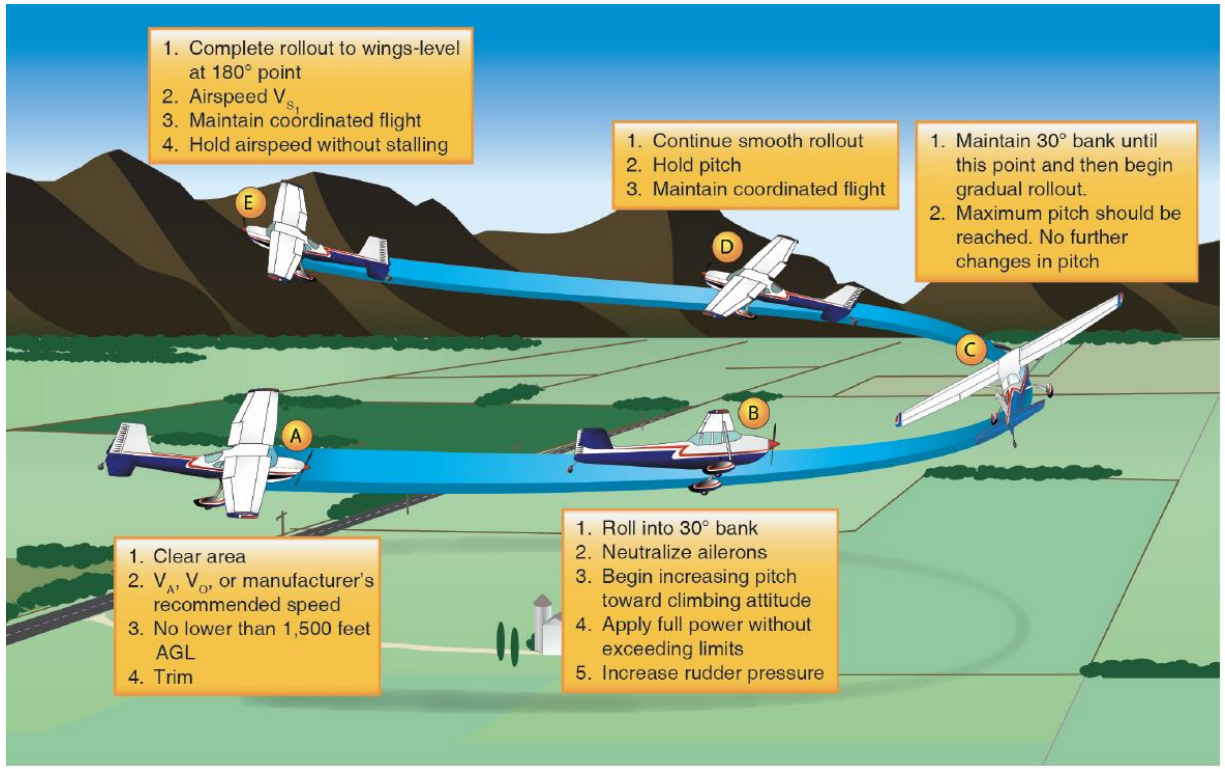
It’s the pitch attitude if held would result in the airplane being just above stall at the 180° point



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

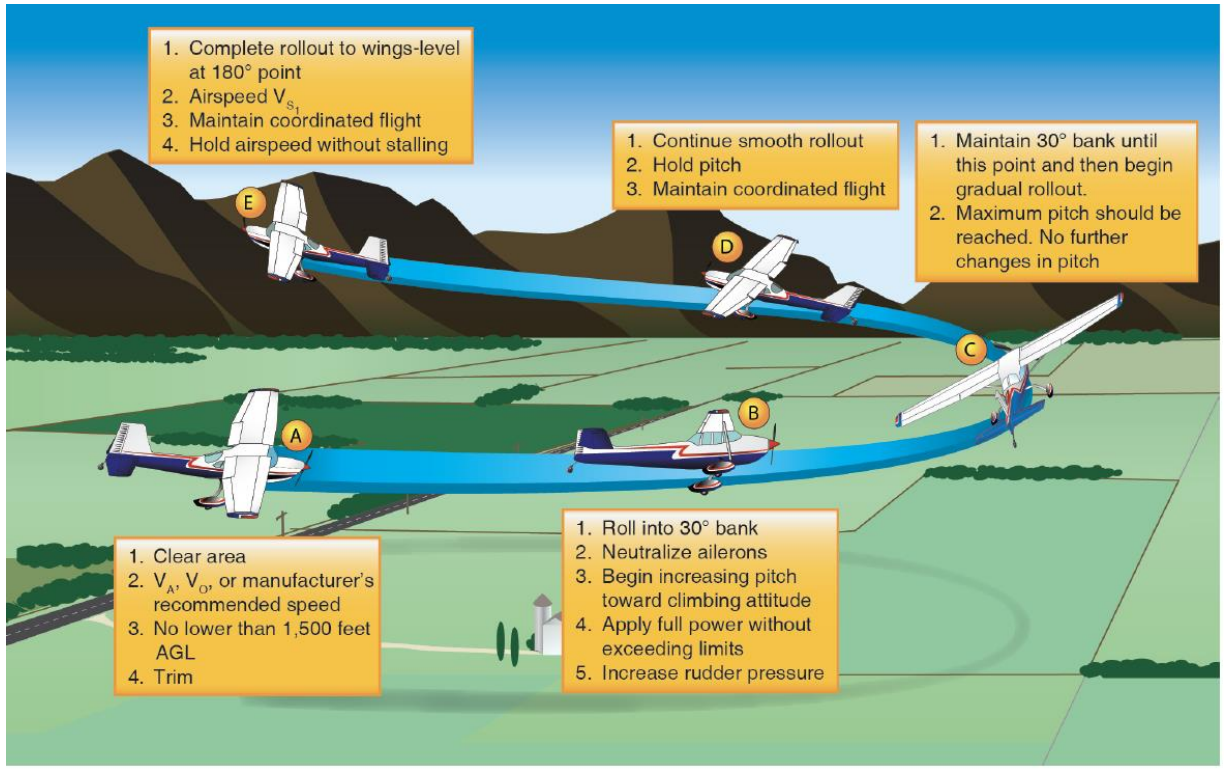
Varies with the plane, density etc.



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

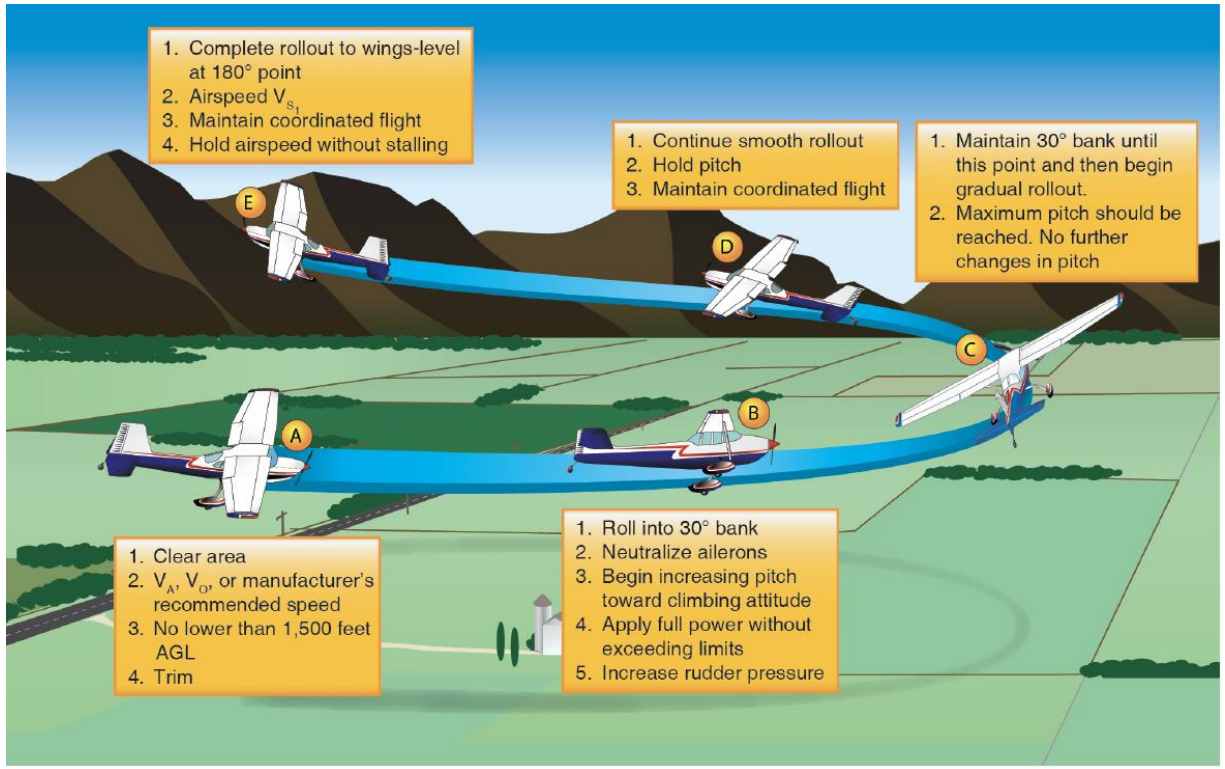
When is right rudder used less in a Chandelle - to the left or right?



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

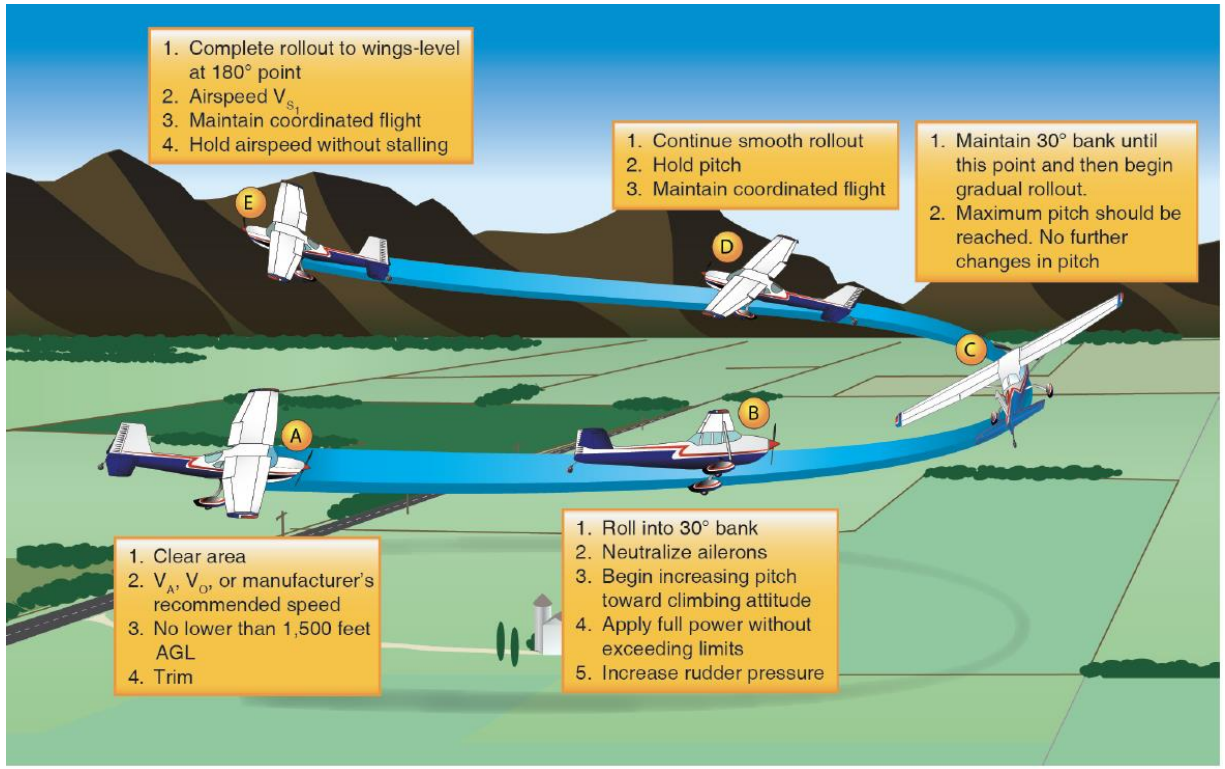
When is right rudder used less in a Chandelle - to the left or right?



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

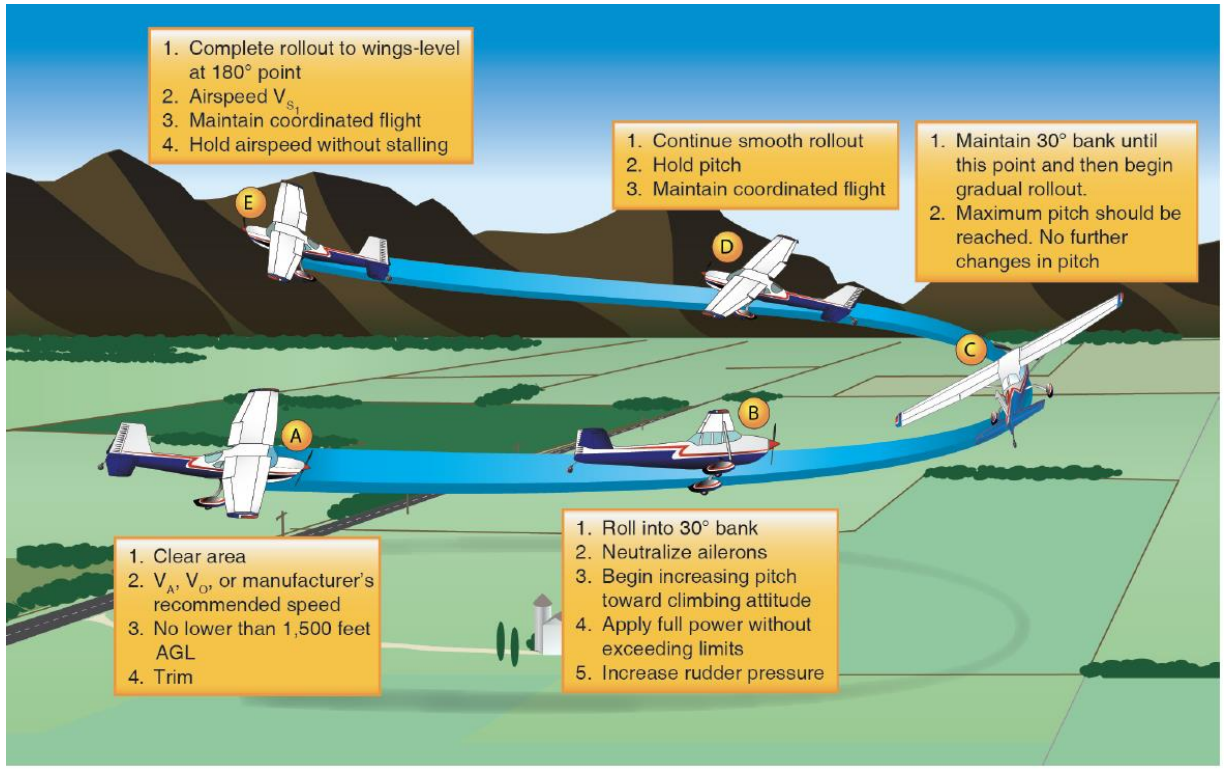
To the right during roll out – Why?



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

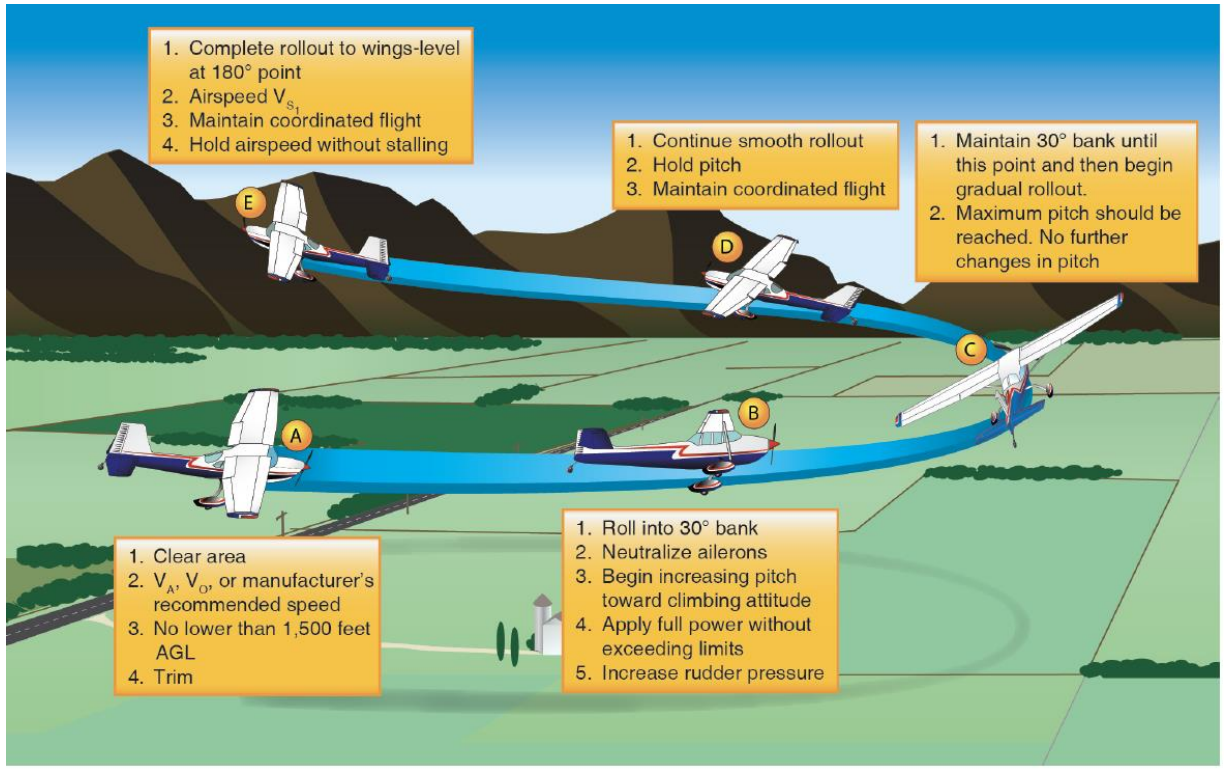
Left turning tendencies pull you left.



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

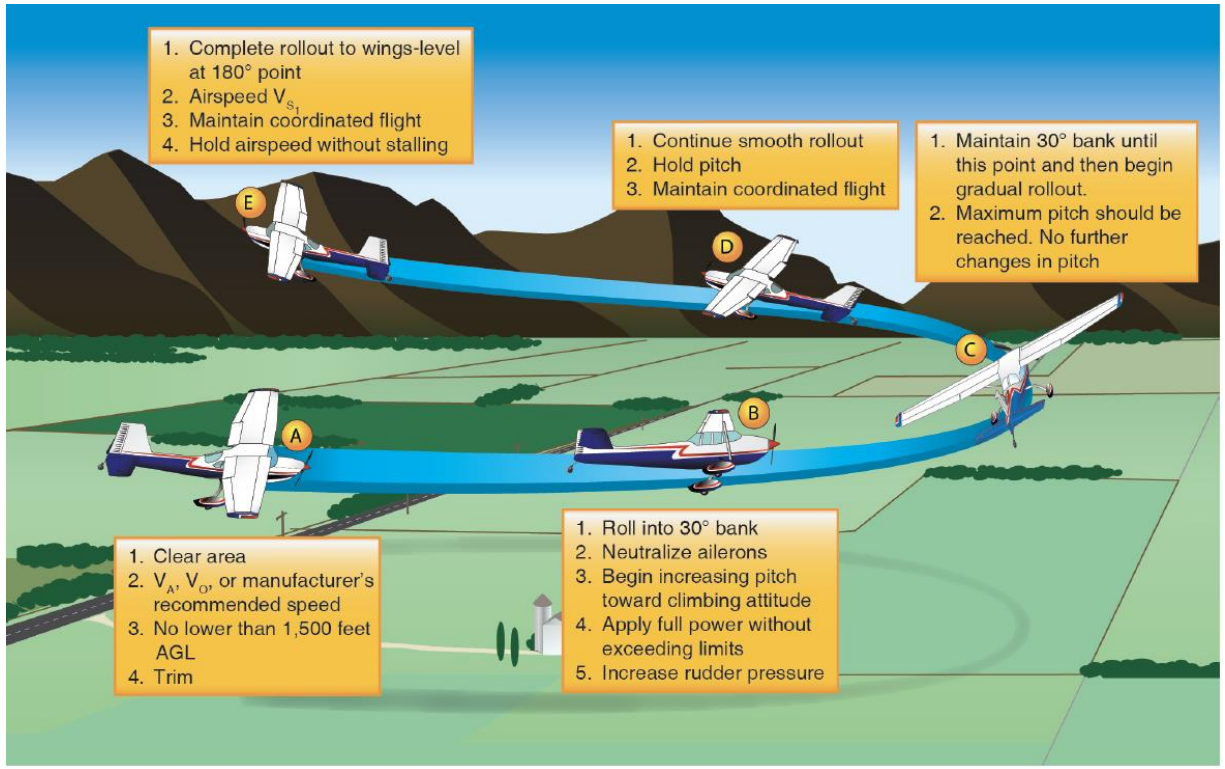
When rolling out of a chandelle to the right, left aileron is used to raise the wing.



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

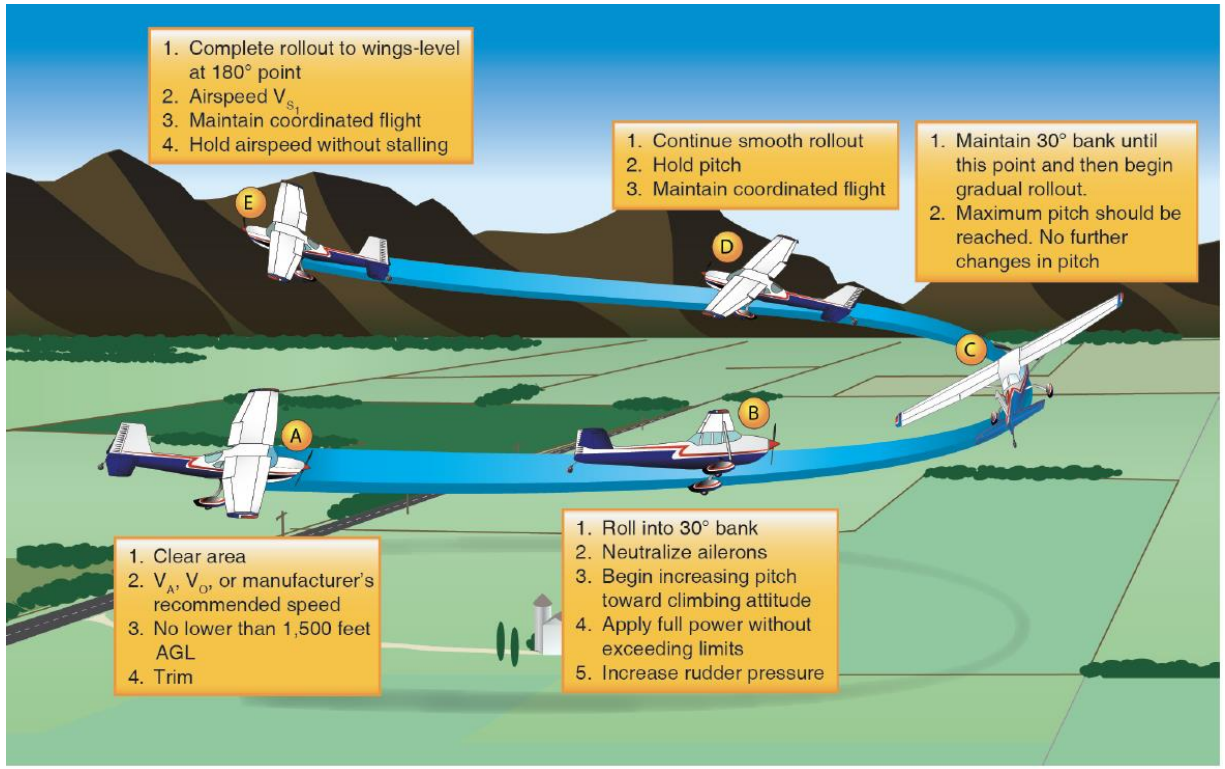
This causes adverse yaw to the right helping cancel the left turning tendencies



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

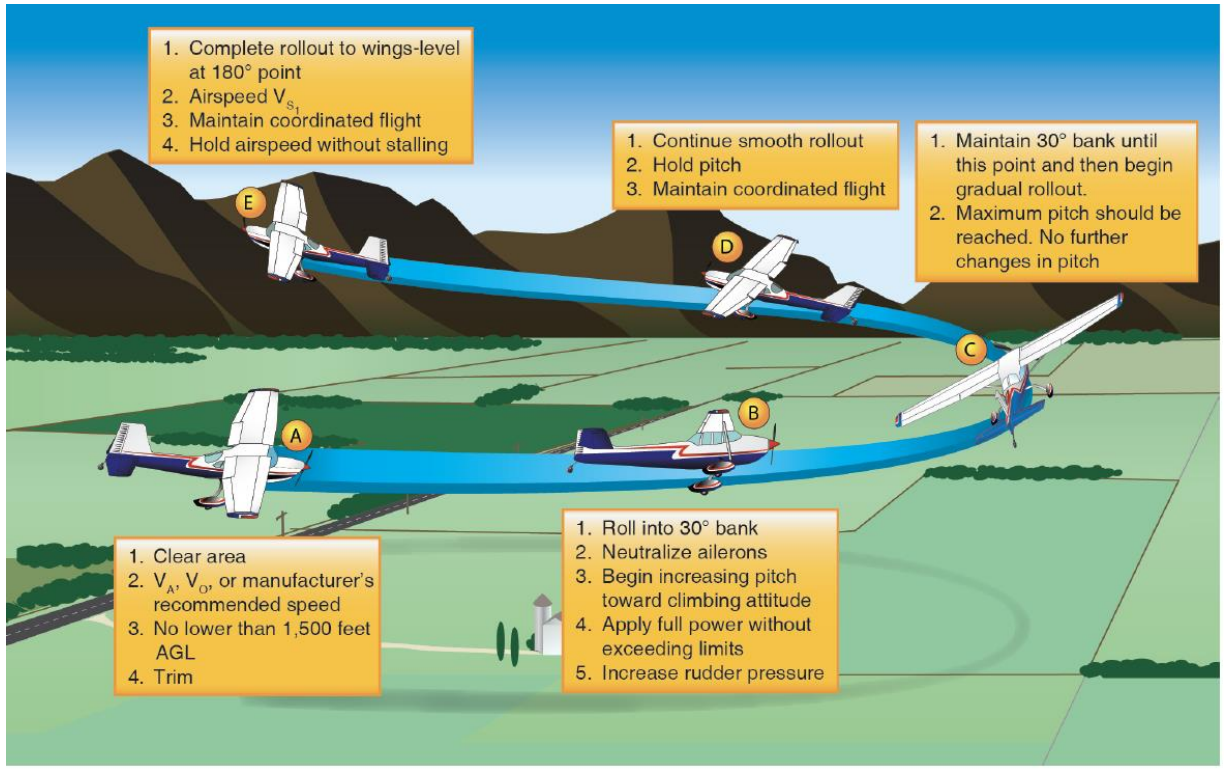
Rolling out of a chandelle to the left you use right aileron to raise the wing



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

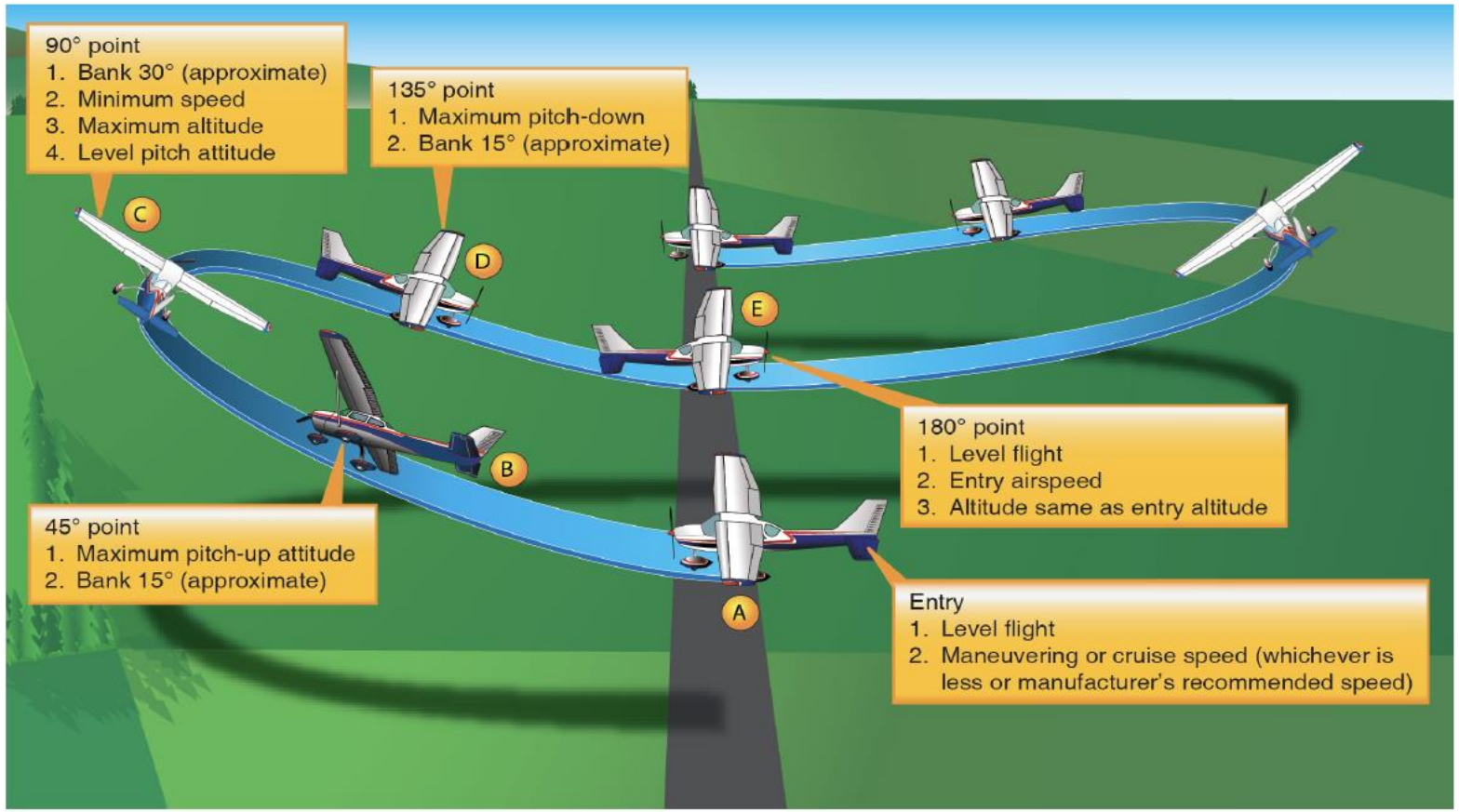
This causes adverse yaw to the left, adding to the left turning tendencies so more right rudder is needed



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

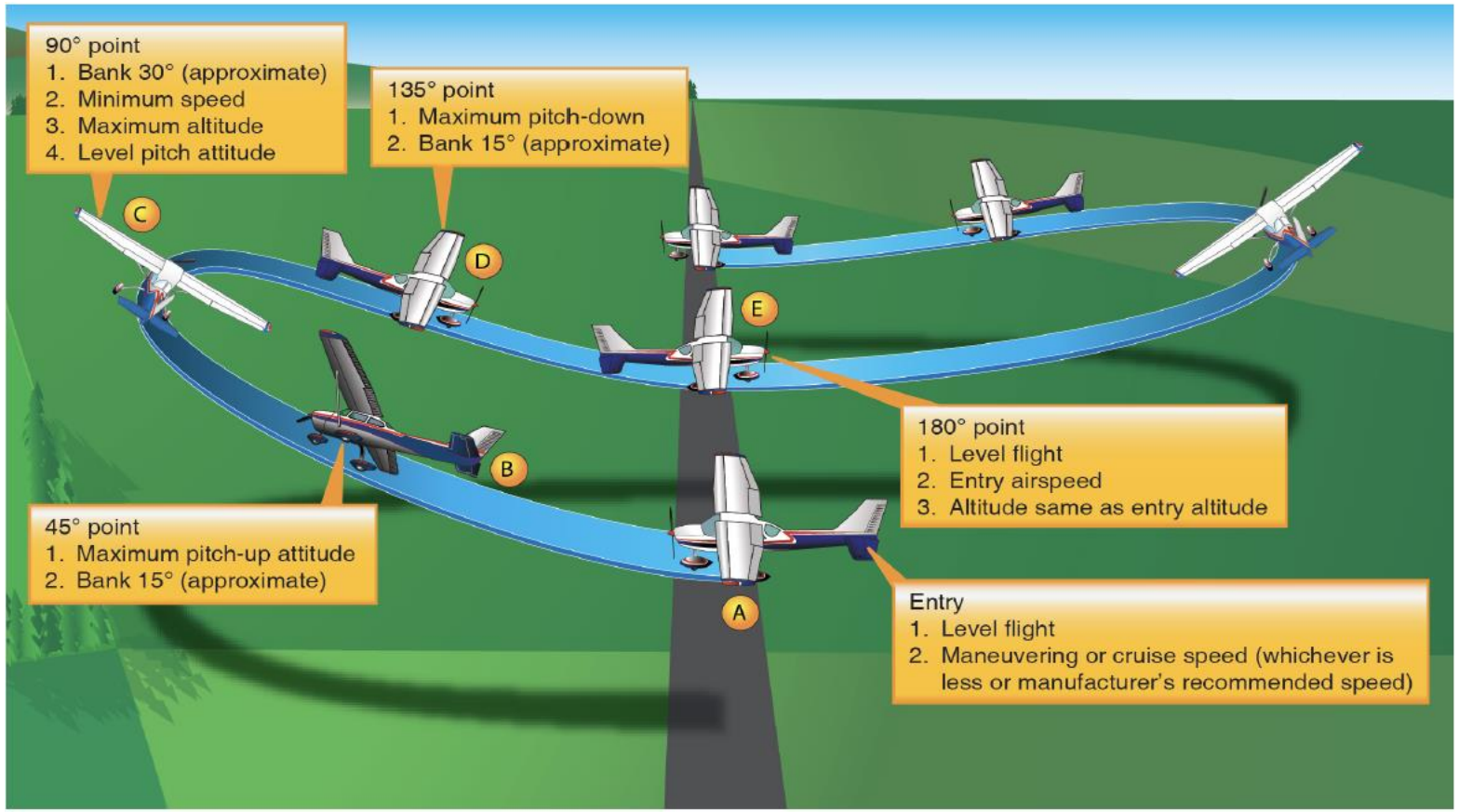
Lazy Eights



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

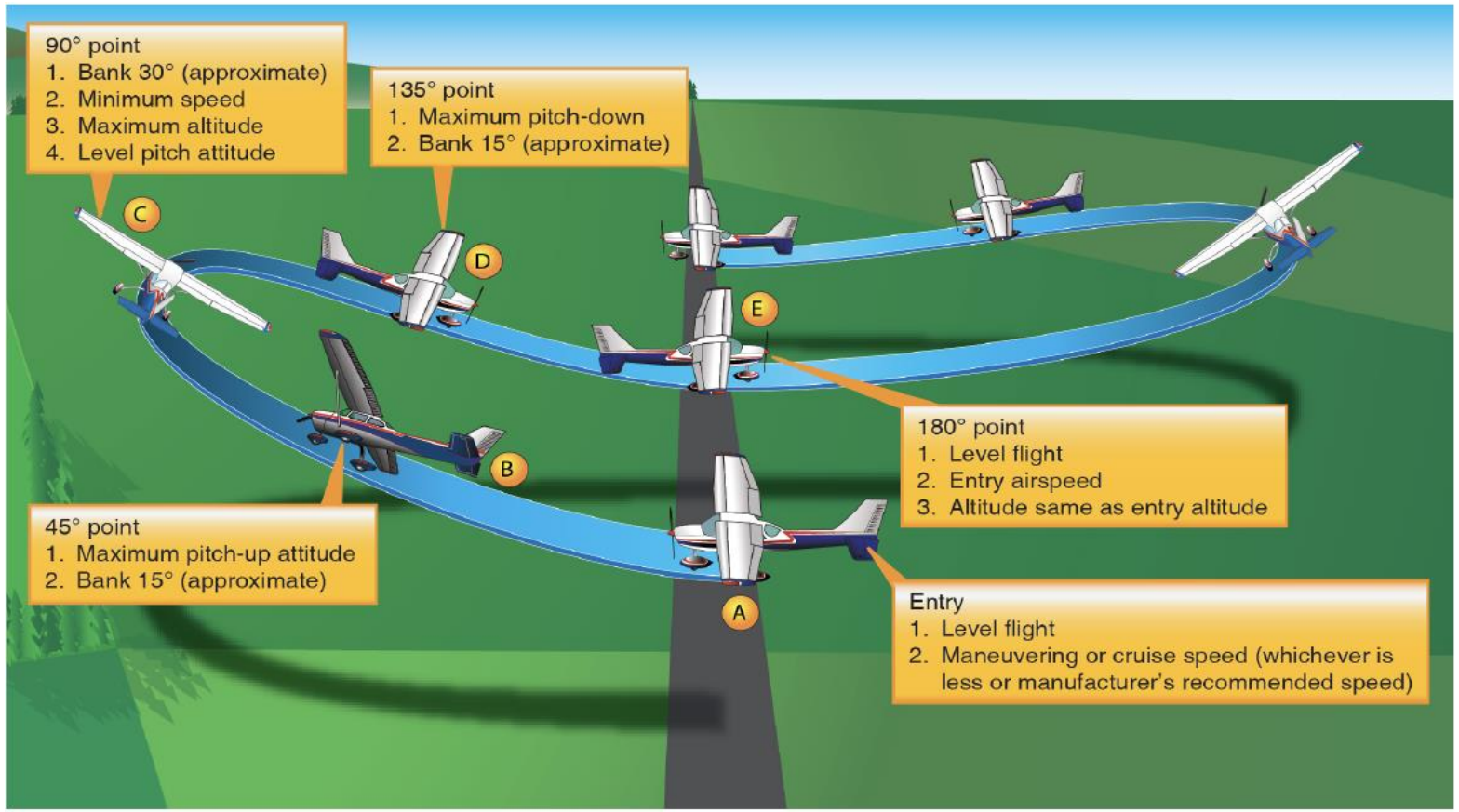
This image is not 100% correct – Similar to the Chandelles image



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

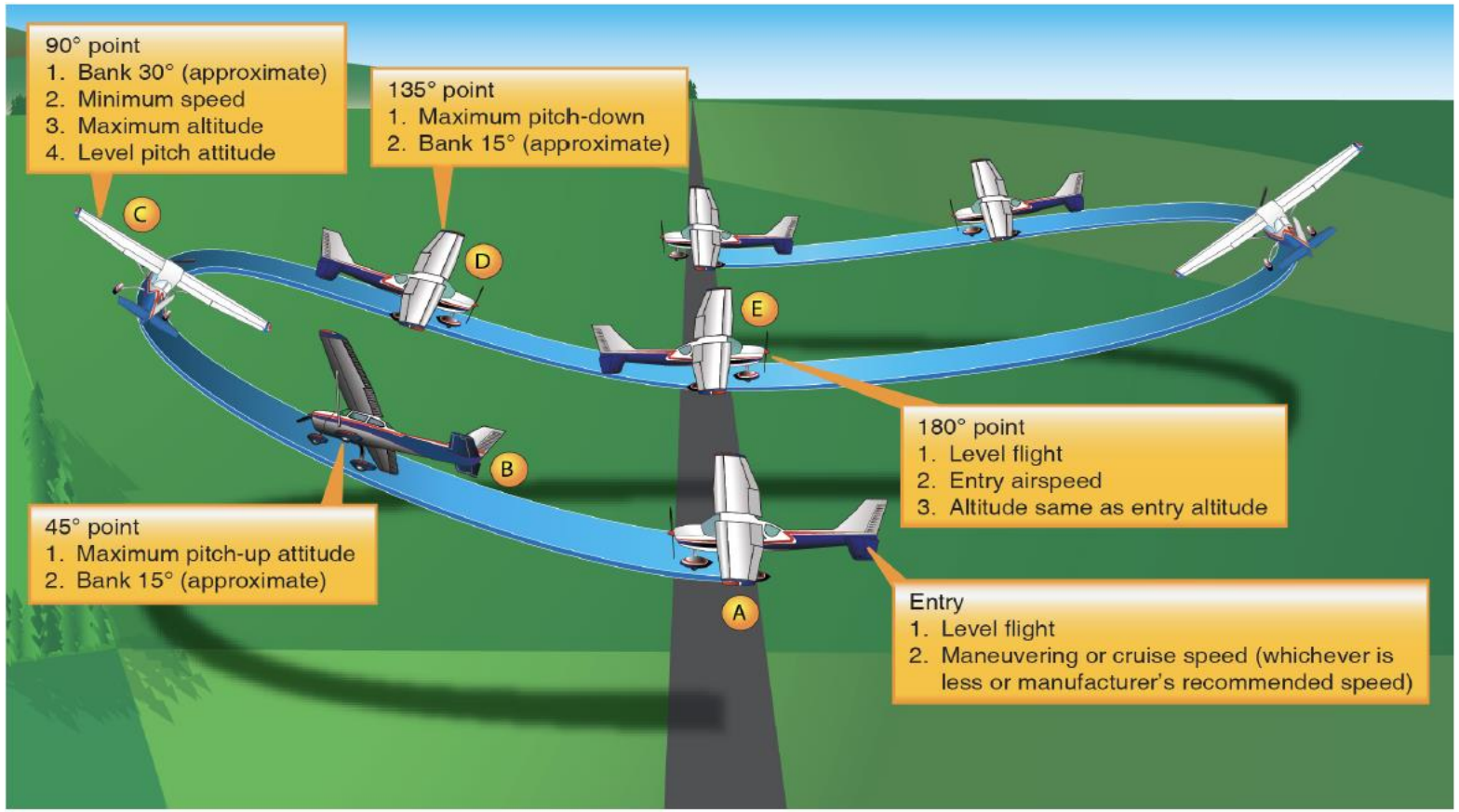
As the speed decreases the radius of the turn decreases



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

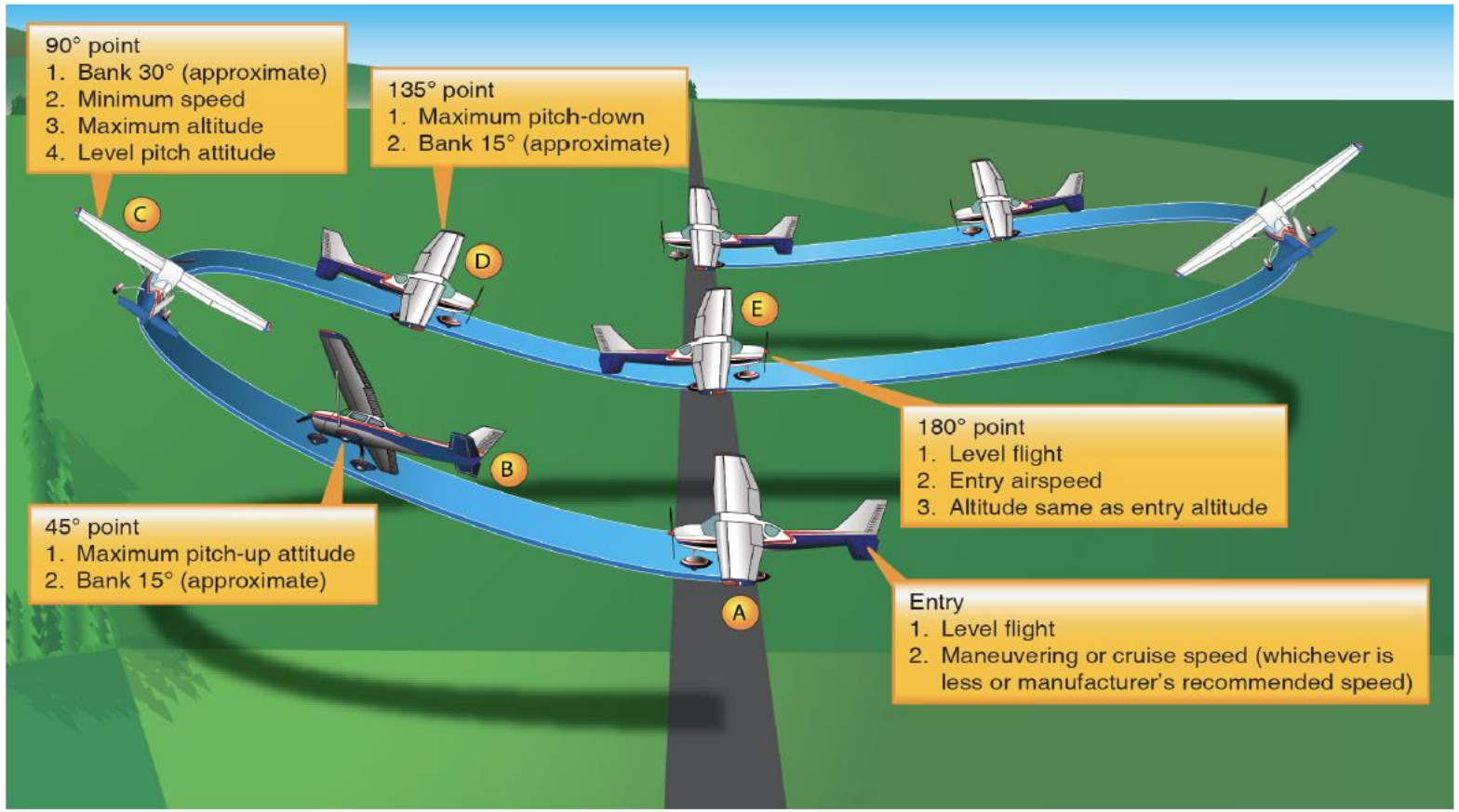
This image shows the turn radius mostly the same



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

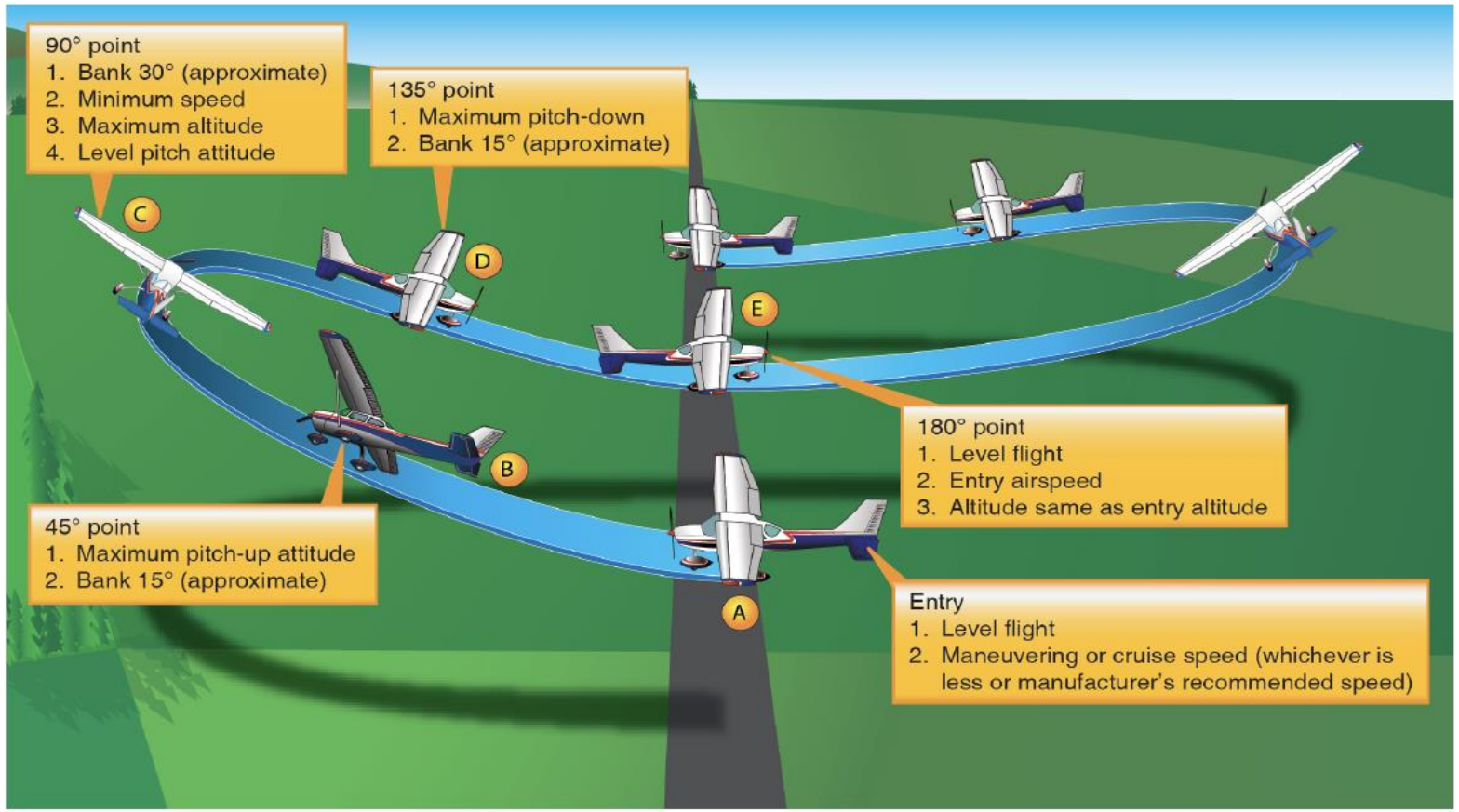
The maneuver resembles a snowboarder in a half pipe



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

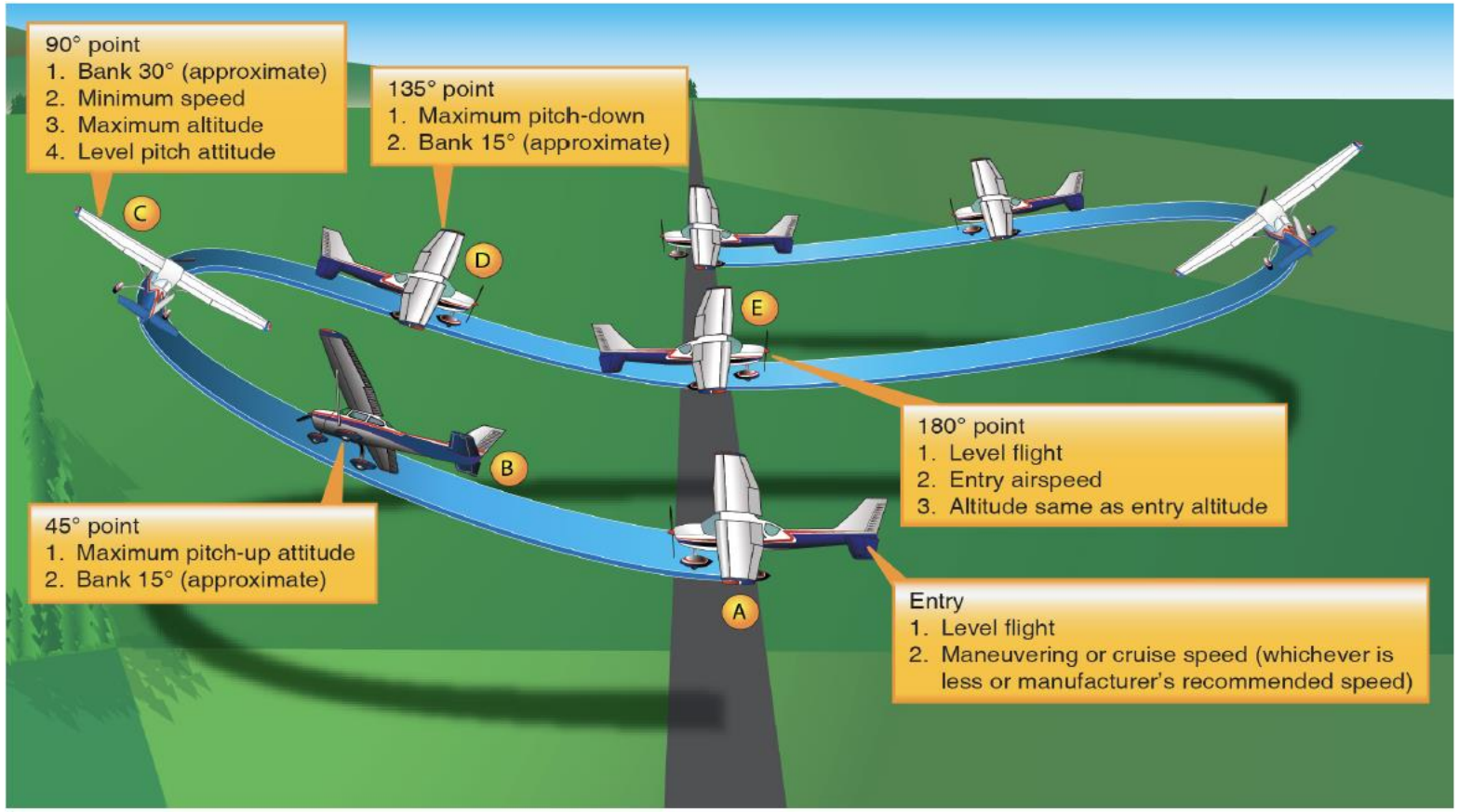
Entry speed is fast but at the top of the pipe it's slow – small radius



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

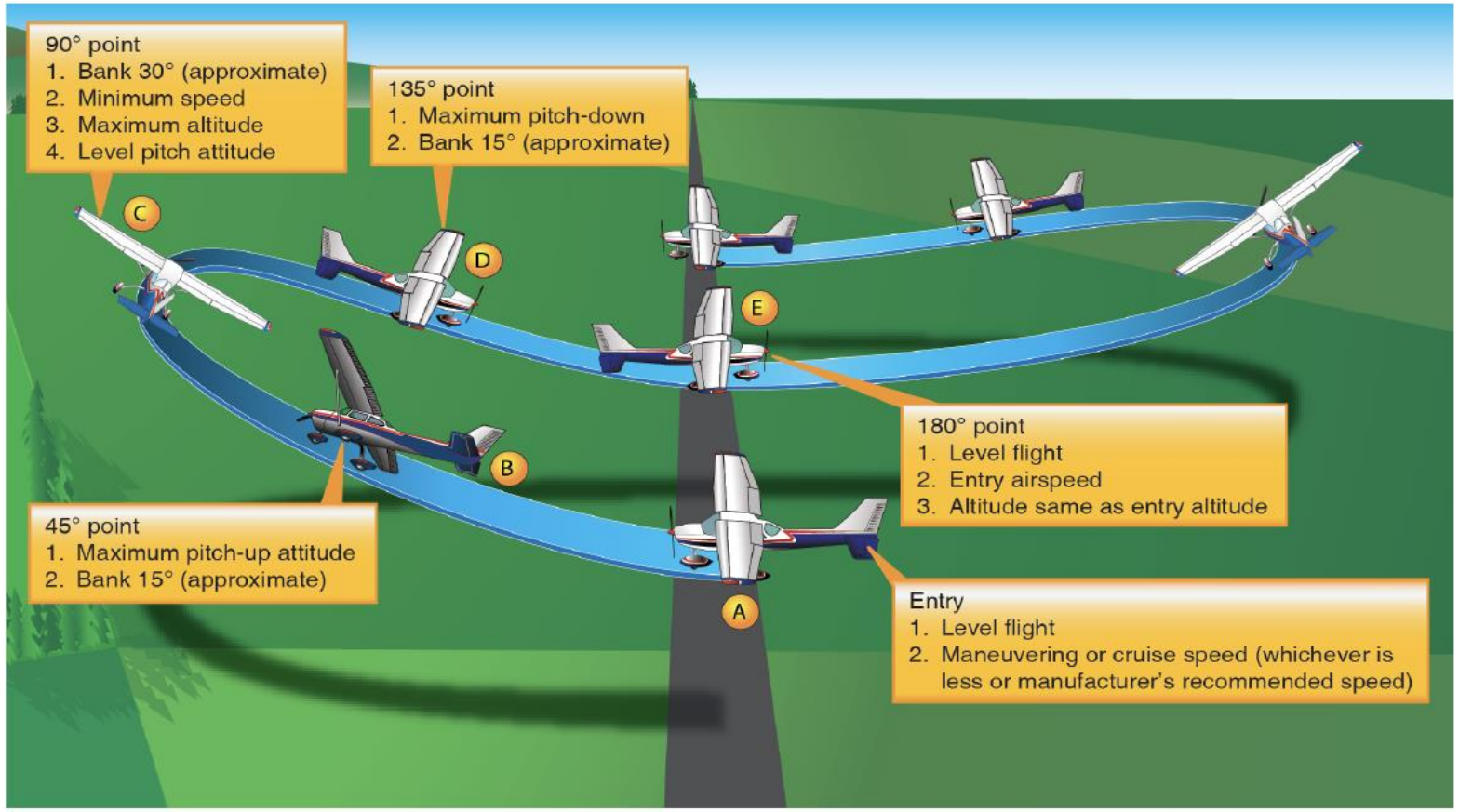
If the speed isn't slow enough at the 90° point the turn will not be completed to 180°



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

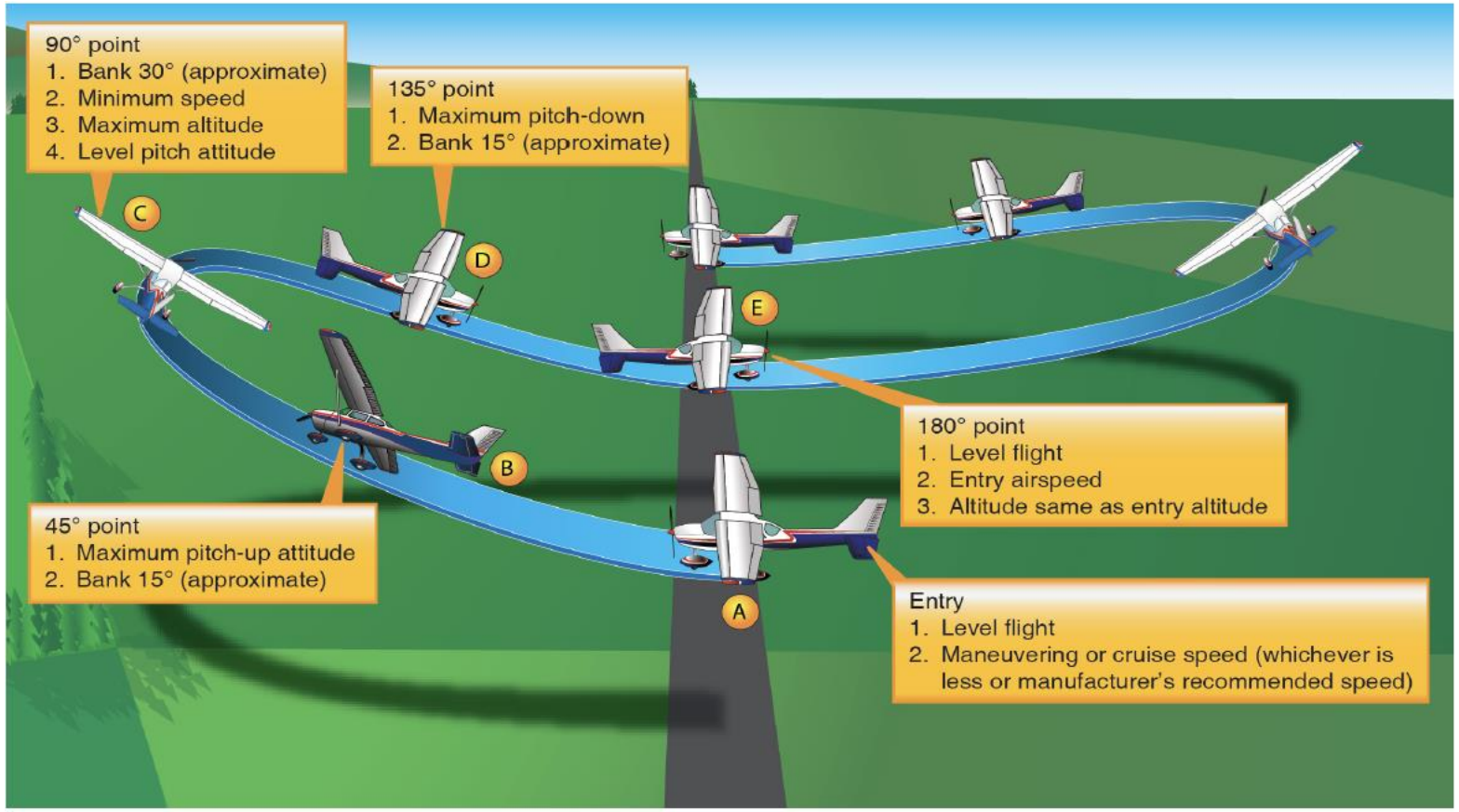
Visual references for 45°, 90°, 135° and 180° should be on the horizon



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

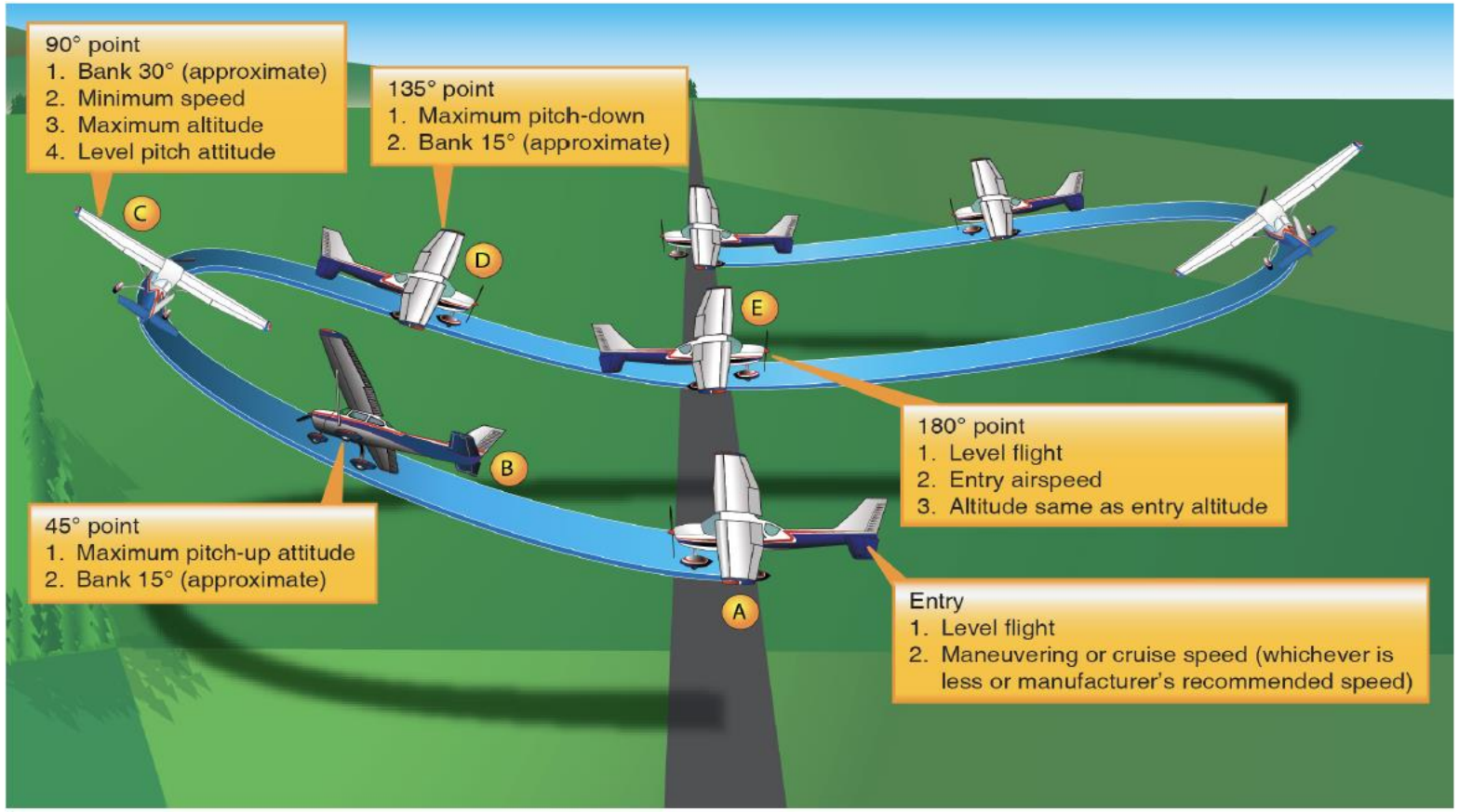
Rudder pressure – Rolling right at low airspeeds and high-power settings requires the most right rudder



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

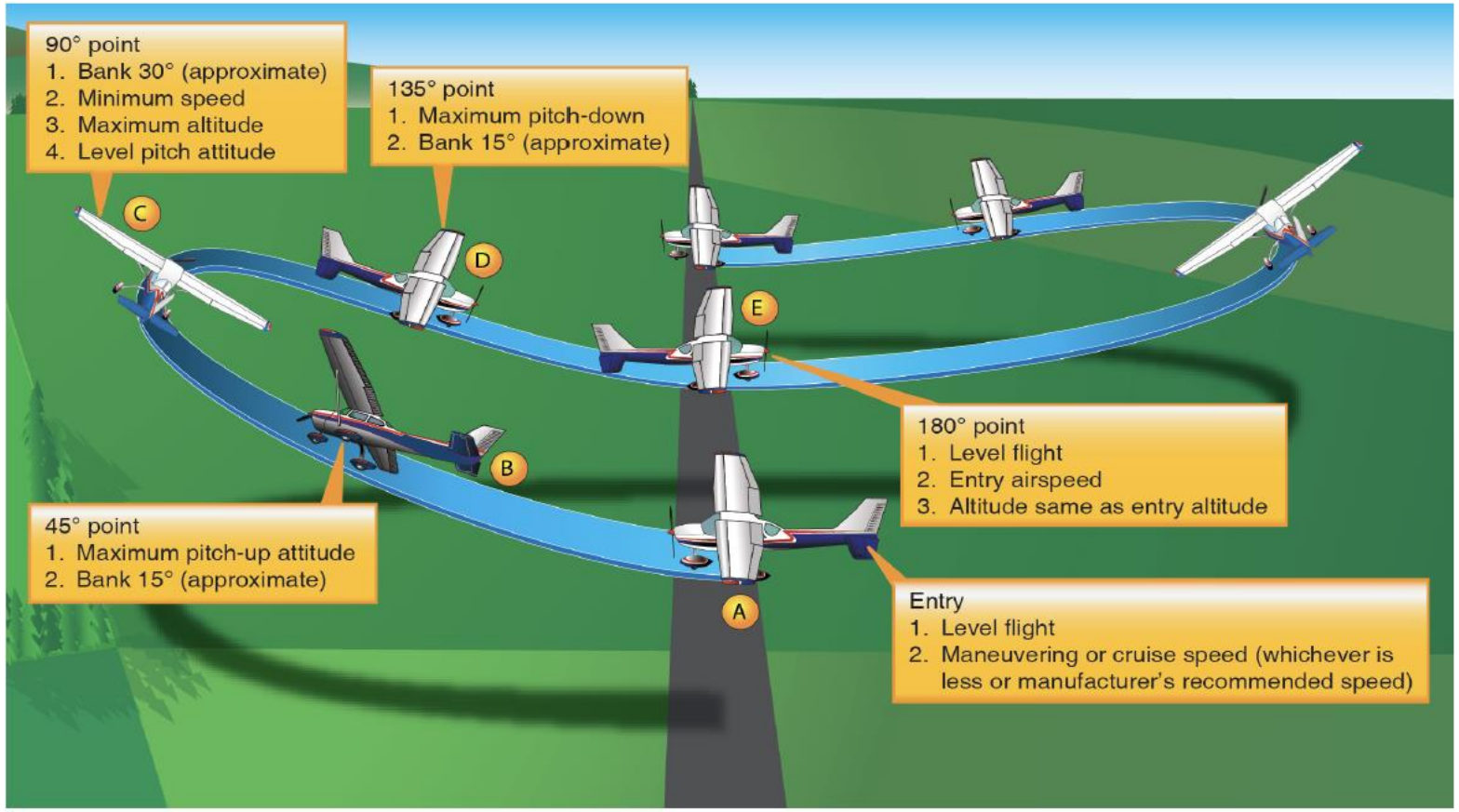
Overbanking tendency requires slight opposite aileron



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

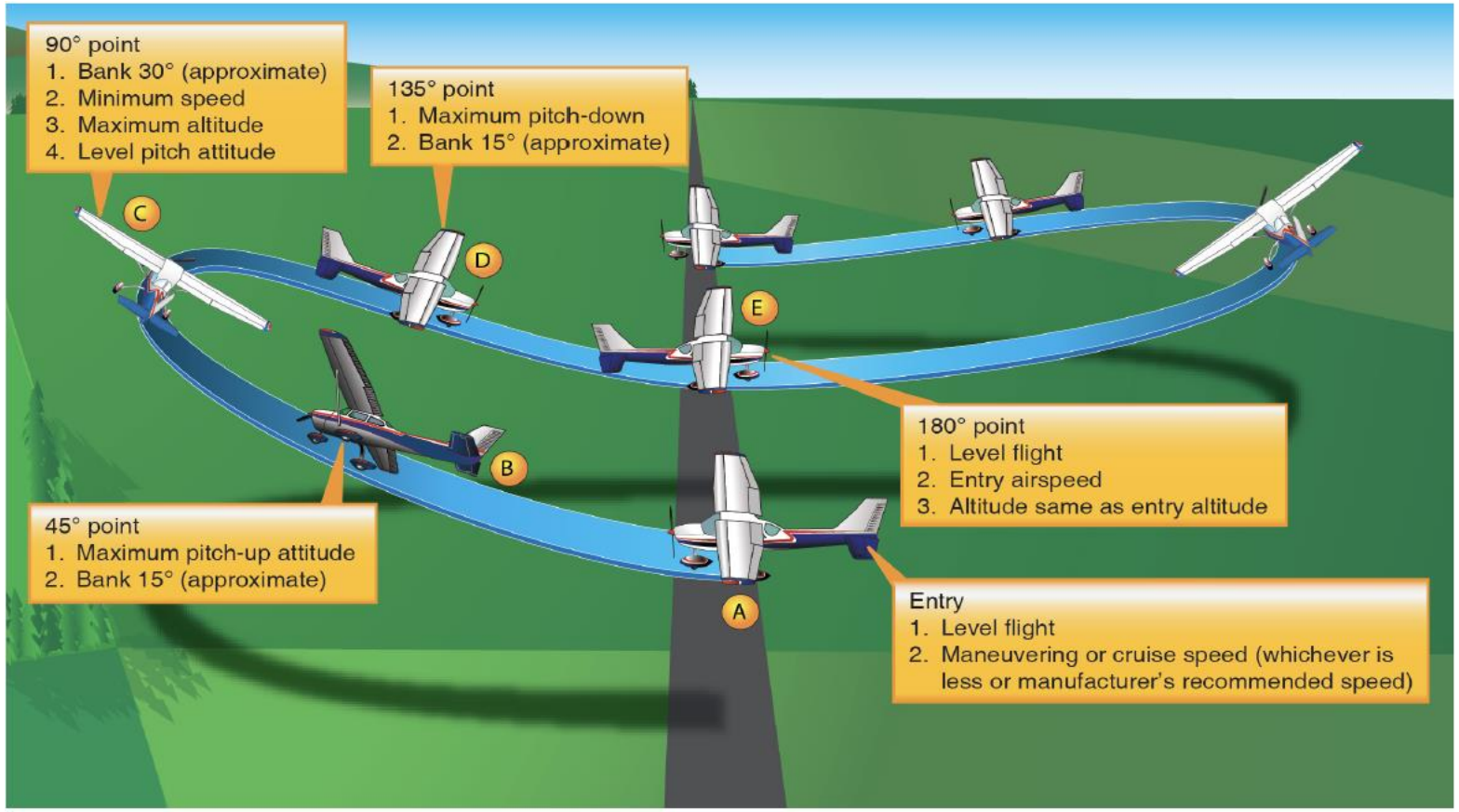
As speed decreases the outer wing produces more lift than the inside wing



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

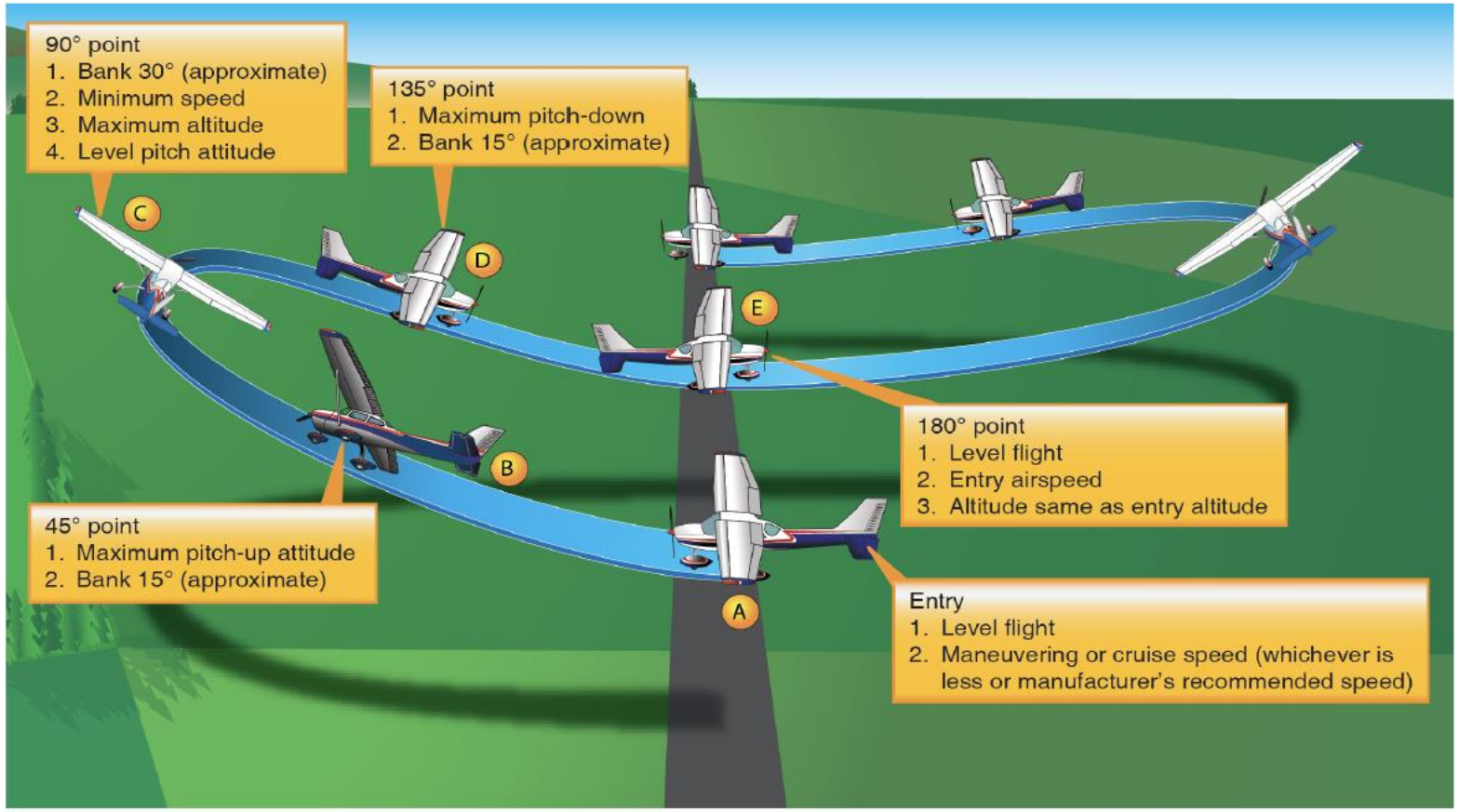
Example: At very low speeds the inside wing may be almost stationary across the ground but the outside wing is still moving causing more lift and overbanking



CFI Bootcamp
Flight Instructor Training

Advanced Knowledge of the Commercial Maneuvers

Example: The faster the airspeed, the less this happens



CFI Bootcamp
Flight Instructor Training