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Real two-sided flashcards you can clip to your kneeboard — question on the front, answer on the back. Print once and you have the whole deck in your flight bag.

1. Print this PDF **double-sided**, set to **flip on the LONG edge** (book-style). Use heavier paper or card stock if you have it.
2. Check one sheet first — the answer should line up behind its question. If it doesn't, switch your printer to flip on the long edge and reprint.
3. Cut along the dashed lines. A paper cutter is fastest; scissors work fine.
4. Shuffle, quiz yourself, and set aside the ones you know. Round-corner punch optional.

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Same cards, tap-to-flip, with shuffle and progress tracking — great between lessons.

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FOUR FORCES Q

Name the four forces acting on an airplane in flight.

FLIGHTPERFORMANCECALC.COM AERODYNAMICS · 01

LIFT Q

How does a wing produce lift? (two complementary explanations)

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LIFT Q

State the lift equation and its variables.

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AOA Q

Define angle of attack.

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STALL Q

What is the critical angle of attack, and what is a stall?

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AOA Q

Distinguish chord line, relative wind, and flight path.

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DRAG Q

Induced drag vs parasite drag — and where each dominates.

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PERFORMANCE Q

What is L/D max?

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LIFT A

It deflects air downward — Newton's third law gives an equal and opposite upward reaction — AND it creates lower pressure over the curved upper surface than beneath (Bernoulli). Both describe the same net upward force.

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FOUR FORCES A

Lift (up), Weight/gravity (down), Thrust (forward), and Drag (rearward). In unaccelerated straight-and-level flight they balance: lift = weight and thrust = drag.

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AOA A

The angle between the wing's chord line and the relative wind. It is NOT the same as pitch attitude — a wing can be at a high angle of attack at any pitch or airspeed.

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LIFT A

$L = C_L \times \frac{1}{2}\rho V^2 \times S$. C_L = coefficient of lift (airfoil shape and angle of attack), ρ = air density, V = velocity, S = wing area. Lift varies with the SQUARE of airspeed.

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AOA A

The chord line runs from the leading to the trailing edge. The relative wind is the airflow opposite the flight path. Angle of attack is the angle between the chord line and the relative wind.

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STALL A

The critical AOA (about 16–18° for many airfoils) is where airflow separates and lift drops sharply. A stall is ALWAYS the result of exceeding the critical angle of attack — it can happen at any airspeed, weight, or attitude.

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PERFORMANCE A

The angle of attack (and corresponding airspeed) that gives the greatest lift-to-drag ratio — the point of minimum total drag. It yields best glide range and underlies best-endurance/economy speeds.

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DRAG A

Induced drag is a by-product of producing lift (wingtip vortices); it is greatest at low speed / high AOA. Parasite drag (form, skin friction, interference) rises with the square of airspeed; it dominates at high speed.

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GROUND EFFECT Q

What is ground effect?

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LEFT TURN Q

Name the four left-turning tendencies.

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LEFT TURN Q

What is P-factor?

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TURNS Q

What is adverse yaw and how do you counter it?

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LOAD FACTOR Q

How does stall speed change with load factor in a level turn?

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LOAD FACTOR Q

Define load factor and give the values at 30°, 45°, and 60° of bank.

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STABILITY Q

Center of gravity vs center of pressure?

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STABILITY Q

Effects of a forward vs an aft CG?

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LEFT TURN A

Torque (reaction to prop rotation), spiraling slipstream (strikes the tail on the left), P-factor (descending blade makes more thrust at high AOA), and gyroscopic precession (felt during pitch changes, e.g., a tailwheel takeoff).

GROUND EFFECT A

Within about one wingspan of the surface, wingtip vortices and induced drag are reduced. It can let an airplane lift off below normal flying speed or float during landing.

TURNS A

When rolling into a bank, the rising (outside) wing has more lift and therefore more induced drag, yawing the nose away from the turn. Counter it with coordinated rudder into the turn.

LEFT TURN A

Asymmetric propeller thrust. At a high angle of attack the descending (right) blade takes a larger bite of air than the ascending blade, producing more thrust on the right and yawing the nose left.

LOAD FACTOR A

Load factor = lift ÷ weight (in G). In a level turn n = 1/cos(bank angle): 30° ≈ 1.15 G, 45° ≈ 1.41 G, 60° = 2.0 G.

LOAD FACTOR A

Stall speed increases with the square root of the load factor: $V_{s(new)} = V_s \times \sqrt{n}$. At a 60° bank the load factor is 2 G, so the stall speed rises about 41% (× 1.41).

STABILITY A

Forward CG: more stable, higher stall speed, heavier control forces, more tail-down force and drag. Aft CG: less stable, lower stall speed, lighter controls — and if too far aft, dangerously unstable and hard to recover from a spin.

STABILITY A

The CG is the airplane's weight balance point. The center of pressure is where the wing's total lift acts, and it moves fore/aft with angle of attack. Their relationship drives pitch stability.

HIGH LIFT Q

What do flaps do aerodynamically?

STABILITY Q

Name the three stability axes and their control surfaces.

SPINS Q

What is a spin, and what is the PARE recovery?

V-SPEEDS Q

What is maneuvering speed (V_a), and why does it change with weight?

AOA Q

Angle of incidence vs angle of attack?

STALL Q

Why is stall speed (in indicated airspeed) about the same at any altitude?

WAKE Q

What are wingtip vortices, and when are they strongest?

PERFORMANCE Q

What is the region of reversed command ("behind the power curve")?

STABILITY A

Longitudinal stability = pitch about the lateral axis (elevator, CG, horizontal stabilizer). Lateral stability = roll about the longitudinal axis (dihedral). Directional stability = yaw about the vertical axis (vertical fin).

HIGH LIFT A

They increase wing camber (and, on some types, area) to raise the coefficient of lift — allowing slower flight and steeper approaches. They also add drag, which is greatest at high flap settings.

V-SPEEDS A

The maximum speed at which full, abrupt control deflection won't overstress the airframe — the wing stalls before it breaks. V_a DECREASES as weight decreases, so a lighter airplane has a lower maneuvering speed.

SPINS A

An aggravated stall with autorotation — one wing more deeply stalled than the other (yaw present at the stall). PARE: Power idle, Ailerons neutral, Rudder full opposite the spin, Elevator forward to break the stall, then recover from the dive.

STALL A

A wing stalls at a fixed angle of attack, which corresponds to a fixed INDICATED airspeed (dynamic pressure). So the stall IAS stays nearly constant with altitude even though true airspeed increases.

AOA A

Angle of incidence is the FIXED angle at which the wing is mounted to the fuselage (built in by the designer). Angle of attack is variable and set by the pilot through pitch relative to the relative wind.

PERFORMANCE A

The low-speed, high-AOA regime where MORE power is required to fly SLOWER because induced drag dominates. On approach it means correcting a low, slow condition may require adding power rather than only pitching down.

WAKE A

Circulating air spilling from the high-pressure area below the wingtip to the low-pressure area above — the source of induced drag and wake turbulence. They are strongest when an aircraft is heavy, clean (no flaps/gear), and slow.