<u>Gyroplane questions – from Rotorcraft CFI bank</u>

(From Rotorcraft questions that obviously are either gyroplane or not helicopter)

FAA Question Number: **6.3.6.1**
FAA Knowledge Code: **A22**
What is the minimum age requirement for the applicant who is seeking a Student Pilot Certificate limited to gyroplane operations?

  A. 14 years.
  B. 18 years.
X **C.** 16 years.

FAA Question Number: **6.3.8.4**
FAA Knowledge Code: **A23**
How much solo time in a gyroplane is required to be eligible for a Private Pilot Certificate with a gyroplane rating?

  A. 20 hours.
  B. 15 hours.
X **C.** 10 hours.

FAA Question Number: **6.3.9.3**
FAA Knowledge Code: **A24**
As pilot, how much gyroplane flight time should an applicant have for a Commercial Pilot Certificate with a gyroplane rating?

  A. 150 hours.
X **B.** 25 hours.
  C. 100 hours.

FAA Question Number: **6.4.4.3**
FAA Knowledge Code: **B08**
What is the minimum fuel requirement for flight under VFR in a rotorcraft? Enough to fly to

  A. the first point of intended landing and to fly after that for 45 minutes at normal cruise speed.
  B. the first point of intended landing and to fly after that for 30 minutes at normal cruise speed.
X **C.** the first point of intended landing and to fly after that for 20 minutes at normal cruise speed.

FAA Question Number: **6.5.0.3**
FAA Knowledge Code: **H762**
Rotor blade rotation during powered flight in a gyroplane is produced by the

- **A.** interaction between engine propeller thrust and rotor blade drag.
- X **B.** horizontal component of rotor lift.
- **C.** transfer of engine power through the clutch to the rotor shaft.

Comment: B is an incomplete and technically incomplete answer. But, since A and C are clearly wrong, the answer the FAA wants is probably B!!!! Rotor blade rotation (autorotation) is produced by the component of rotor BLADE lift acting in the direction of the plane of rotation of the rotor - not necessarily horizontally. The plane of rotation may or may not be horizontal - depending on the mode of flight! One confusion with this answer is that it refers to "rotor lift". There are two aspects of "rotor lift": Rotor DISK lift and drag, and rotor BLADE lift and drag. Rotor blade lift and drag are what cause autorotation. Rotor DISK lift and drag are what supports the gyroplane in flight! The answer - "horizontal component of rotor lift" is very incomplete terminology and does not verify the testee's understanding of autorotation - as should be the intent of the question! – Greg Gremminger

FAA Question Number: **6.5.9.7**
FAA Knowledge Code: **H70**
When the angle of attack of a symmetrical airfoil is increased, the center of pressure will

- **A.** move aft along the airfoil surface.
- X **B.** have very little movement.
- ??? **C.** remain unaffected.

Comment: The FAA's Rotorcraft Flying Handbook says for a symmetrical airfoil, "the center of pressure will remain virtually unchanged as the angle of attack changes." I wonder what answer the FAA wants! – Greg Gremminger
Comment: General aerodynamics. Rotor blades tend to be symmetrical airfoils because we don't want the centre of pressure to move around too much in a rotorcraft it would require a lot of extra work for the pilot to maintain flight attitude. If the centre of pressure changed to create more lift on the left side of the rotor disc for example the aircraft would turn to the right and the pilot would have to correct to keep flying straight. We want the centre of pressure to remain as still as possible during changes in angle of attack.
Comment: THIS ANSWER IS INCORRECT !!!! According to your book Flight/Ground Instructor Written Exam page 28 question 14: When the angle of attack of a symmetrical airfoil is increased, the center of pressure will- remain unaffected. I don't believe this changes just because the question is related to rotorcraft. Please let me know if there are any other incorrect responses that I am studying. Todd@Pollack.net

FAA Question Number: **6.5.9.8**
FAA Knowledge Code: **H70**
The rotor blade pitch angle is the acute angle between the blade chord line and the
X **A.** rotor plane of rotation.
B. angle of attack.
C. direction of the relative wind.

Comment: 'B' makes no sense having an angle between a line and another angle. 'C' this is the angle of attack of the rotor blade not the pitch angle 'A' is correct and is similar to the pitch angle of a propeller blade

FAA Question Number: **6.5.9.9**
FAA Knowledge Code: **H71**
During flight, if you apply cyclic control pressure which results in a decrease in pitch angle of the rotor blades at a position approximately 90° to your left, the rotor disc will tilt
X **A.** aft.
B. right.
C. left.

Comment: Depends on the direction of rotation of the rotor.
Comment: A rotor behaves like a gyroscope when it is rotating and is thus subject to precession. Any force applied to the rotor disc will act 90 deg in the direction of rotation. The cyclic pitch control is rigged is such a way as to compensate for this - an aft movement of the stick will decrease blade pitch to the left and cause the rotor disc to tilt aft. All this assumes we have a rotor which turns anticlockwise when viewed from above. Neither of the alternative answers to the question would be correct in the case of a clockwise rotor so there is no ambiguity.

FAA Question Number: **6.5.9.9**
FAA Knowledge Code: **H71**
Tip path plane may be described as
X **A.** meaning the same as rotor disc.
B. being proportional to disc loading.
C. the longitudinal axis of the rotor disc in horizontal flight.

FAA Question Number: **6.6.0.0**
FAA Knowledge Code: **H71**
The lift differential that exists between advancing and retreating main rotor blades is known as
A. translating tendency.
X **B.** dissymmetry of lift.
C. translational lift.

Comment: Dissymmetry of lift is the accepted correct answer. However, it might be more correct to refer to this as a "dissymmetry of relative wind". There really is no "differential" of lift between the retreating and advancing blades. Precession, due to any unequal lift between the retreating and advancing blades automatically tilts the rotor disk up - against the forward (or lateral) movement. The resulting cyclic action, higher AOA of the retreating blade than the advancing blade, serves to balance the lift on each side! Yes, this is due to unequal lift, but in reality the two lifts are equalized due to precession and cyclic. The DISTRIBUTION of lift along the retreating blade compared to the advancing blade is truly not symmetrical, but the composite lift moment on both blades is equalized due to cyclic flapping in forward (or any direction) flight - as Cierva discovered is basic to rotorcraft flight! – Greg Gremminger

FAA Question Number: **6.6.0.1**
FAA Knowledge Code: **H71**
Rotor blade flapping action is
X **A.** a design feature permitting continual changes in the rotor blade angle of attack, compensating for dissymmetry of lift.
B. an undesirable reaction to changes in airspeed and blade angle of attack.
C. an aerodynamic reaction to high speed flight and cannot be controlled by the pilot.

FAA Question Number: **6.6.0.1**
FAA Knowledge Code: **H71**
Flapping of rotor blades is the result of
X **A.** dissymmetry of lift.
B. retreating blade stall.
C. transverse flow effect.

FAA Question Number: **6.6.0.2**
FAA Knowledge Code: **H71**
The combination of lift and centrifugal force produces
A. flapping.
X **B.** coning.
C. Coriolis effect.

FAA Question Number: **6.6.0.2**
FAA Knowledge Code: **H71**
With the rotor turning at normal operating RPM, blades will bend upward due to
A. lift being greater than centrifugal force.
X **B.** centrifugal force being greater than lift.
C. lift being greater than drag.

Comment: A cannot be correct - centrifugal force is much greater than lift. B may be the more correct answer, centrifugal force IS greater than the lift. But, this question suggests incomplete understanding of coning angle - which is the amount of blade bending as a result of the vector sum of centrifugal force and lift on each blade. The question does not determine correct understanding of these forces or of coning of rotor blades. None of the answers answer the actual question - either the question should be changed or the answers should be changed to test real understanding of the subject! – Greg Gremminger

FAA Question Number: **6.6.0.3**
FAA Knowledge Code: **H71**
What will cause an increase in coning?

- **A.** Decrease in lift; decrease in centrifugal force.
- **B.** Increase in lift; increase in centrifugal force.
- X **C.** Increase in lift; decrease in centrifugal force.

Comment: The coning angle or upward "bend" of the rotor blades is determined by the vector sum of the centrifugal force pulling the blade outward, and the lift bending the blade upward. The reason the blades don't just bend all the way up and break off is that the centrifugal force is pulling outward much harder! As a result, rotor blades must be very strong in tension (outward pull), and do not need to be strong enough in the bending direction to support the entire rotorcraft weight on their own. If a rotorcraft is lifted by its (unspinning rotors), the rotor blades will bend up and be certainly damaged! In flight, the centrifugal force gives the rotor blades their ability to lift the weight of the rotorcraft.
– Greg Gremminger

FAA Question Number: **6.6.0.3**
FAA Knowledge Code: **H95**
How does an increase in airspeed above normal cruise airspeed affect rotor drag? Rotor drag will

- **A.** increase.
- **B.** remain the same.
- X **C.** decrease.

Comment: The "trick" in this question is that it asks what the ROTOR drag will do - not what total drag will do. With any aircraft, there are two types of drag produced - INDUCED drag and PARASITIC drag. The drag of the "rotor" is induced drag - the drag induced in the production of lift - such as with a wing. At higher airspeeds, the required rotor disk angle of attack decreases so the rotor induced drag reduces at higher airspeeds. The rest of the "total drag" consists of the the "parasitic" drag of everything else - airframe, wheels, body, etc. "Parasitic" drag increases with higher airspeeds - the drag that is "intuitive" - the drag that increases by a cube factor at higher and higher airspeeds! The airspeed at which induced drag and parasitic drag are equal (cross over) is the minimum total drag - best rate of climb airspeed, best glide airspeed, minimum power required airspeed! – Greg Gremminger

FAA Question Number: **6.6.0.4**
FAA Knowledge Code: **H71**
The forward speed of a rotorcraft is restricted primarily by
X **A.** dissymmetry of lift.
B. transverse flow effect.
C. high-frequency vibrations.

Comment: Actually, forward speed is limited by the flapping range of the rotor to compensate for dissymmetry of lift. As long as there is flapping range still available, there is no dissymmetry of lift until that flapping range is maxed out! Probably just semantics, but there is a tendency with use of the term "dissymmetry of lift" to presume there is always less lift on the retreating blade and more lift on the advancing blade - not true until flapping becomes limited at higher airspeeds. This also leads to the assumption that a gyroplane rolls toward the retreating blade at higher airspeeds - it does not do that either! – Greg Gremminger

FAA Question Number: **6.6.0.5**
FAA Knowledge Code: **H71**
What is dissymmetry of lift?
X **A.** The difference in lift that exists between the advancing blade half and the retreating blade half of the disc area.
B. A term used to differentiate between air flowing downward through the rotor in powered flight and upward through the rotor in autorotative flight.
C. The difference in lift that exists between the rearward part and the forward part of the rotor disc during forward flight.

Comment: A is the accepted definition of Dissymmetry of lift. However, it might be more correct to refer to this as a "dissymmetry of relative wind". There really is no "differential" of lift between the retreating and advancing blades in flight. Precession, due to any unequal lift between the retreating and advancing blades automatically tilts the rotor disk up - against the forward (or lateral) movement. The resulting cyclic action, higher AOA of the retreating blade than the advancing blade, serves to balance the lift on each side! Yes, this is due to unequal lift, but in reality the two lifts are equalized due to precession and cyclic. The DISTRIBUTION of lift along the retreating blade compared to the advancing blade is truly not symmetrical, but the composite lift on both blades is equalized due to cyclic flapping in forward (or any direction) flight - as Cierva discovered is basic to rotorcraft flight! – Greg Gremminger

FAA Question Number: **6.6.0.6**
FAA Knowledge Code: **H71**
During forward cruising flight at constant airspeed and altitude, the individual rotor blades, when compared to each other, are operating at
A. unequal airspeed, equal angles of attack, and unequal lift moment.
X **B.** unequal airspeed, unequal angles of attack, and equal lift moment.
C. constant airspeed, unequal angles of attack, and unequal lift moment.

Comment: Now this is an intelligent question and correct answer that truly does test understanding of "dissymmetry of lift"! Precession and cyclic action compensate for any dissymmetry of lift. So, it can be said there is no dissymmetry of LIFT. But there actually is a dissymmetry of relative wind and a dissymmetry of rotor blade AOA.
– Greg Gremminger

FAA Question Number: **6.6.0.7**
FAA Knowledge Code: **H71**
In forward flight and with the blade-pitch angle constant, the increased lift on the advancing blade will cause it to

X **A.** flap up, causing a decrease in the angle of attack.
B. flap down, causing a decrease in the angle of attack.
C. flap up, causing an increase in the angle of attack.

Comment: Any unbalance of lift on the advancing blade causes the advancing blade to rise due to precession of the spinning rotor. This flapping up decreases the blade lift until the unbalance of lift is corrected. The opposite happens on the retreating blade. This is how the "flapping" of the rotor blades compensates for the dissymmetry of relative wind between the advancing blade(s) and the retreating blade(s). This cyclic "flapping" creates a cyclical dissymmetry of rotor blade angle of attack that corrects for any dissymmetry of lift! – Greg Gremminger

FAA Question Number: **6.6.0.7**
FAA Knowledge Code: **H71**
Figure 37A for this question
(Refer to figure 37A). The area of a rotor blade area contributing most during an autorotation is

A. 70-100 percent area, known as the stall region.
B. 0-25 percent area, known as the driven region.
X **C.** 25-70 percent area, known as the driving region.

Comment: The DRIVEN area is also contributing very significantly to lift during an autorotation? True, the lift vector of the driven area is tilted aft a bit and serves to regulate the autorotation RPM, but, due to the high L/D of a rotor blade airfoil, the lift generated by this area of the blade is very significant! In terms of lift, this driven area cannot be dismissed - it is moving very fast and is creating gobs of actual lift! C is the correct answer, but it suggests incomplete understanding of autorotation. C is the most correct answer because it is the only somewhat correct answer. This question does not test full understanding of autorotation! – Greg Gremminger

FAA Question Number: **6.6.0.7**
FAA Knowledge Code: **H71**
Figure 37A for this question
(Refer to figure 37A). During an autorotation, which portion of the rotor blades provides the thrust required to maintain rotor RPM?

  A. Inner or stall.
X **B.** Middle or autorotative.
  C. Outer or propeller.

Comment: The terminology in this question for the sections of the rotor are not consistent with current terminology for such. And, they are not consistent with the Figure provided! The proper terms for these areas of the rotor are - STALLED, DRIVING and DRIVEN! – Greg Gremminger

FAA Question Number: **6.6.0.8**
FAA Knowledge Code: **H71**
The purpose of lead-lag (drag) hinges on a three-bladed, fully articulated rotor system is to compensate for

  A. dissymmetry of lift.
X **B.** Coriolis effect.
  C. blade flapping tendency.

FAA Question Number: **6.6.0.8**
FAA Knowledge Code: **H71**
Coriolis effect causes rotor blades to

  A. vary the angle of attack.
X **B.** accelerate and decelerate.
  C. precess 90 degrees in the direction of rotation.

FAA Question Number: **6.6.1.0**
FAA Knowledge Code: **H71**
As each blade flaps up and down, it produces a shift of the center of its mass. When the blade flaps up, the CG moves closer to its axis of rotation, giving that blade a tendency to

  A. stabilize its rotational velocity, thus compensating for dissymmetry of lift.
X **B.** accelerate its rotational velocity; this tendency is known as Coriolis effect.
  C. decelerate its rotational velocity; this tendency is known as translating tendency.

FAA Question Number: **6.6.1.0**
FAA Knowledge Code: **H650**
What factor primarily determines the rotor RPM of a gyroplane in flight?

  A. Engine RPM.
  B. Airspeed.
X **C.** Rotor disc loading.

FAA Question Number: **6.6.1.4**
FAA Knowledge Code: **H71**
In preparing to take off in a gyroplane, your student engages the clutch and prerotates the rotor to takeoff RPM. If brakes are released prior to disengaging the clutch, the gyroplane will turn

A. left because of rotor torque.
X **B.** right because of rotor torque.
C. right because of engine propeller torque.

FAA Question Number: **6.6.1.5**
FAA Knowledge Code: **H72**
What changes take place regarding lifting force and load factor produced by the rotor system when a gyroplane goes from straight and level flight into a 45° banked turn while maintaining constant altitude?

A. Total lift will remain constant; load factor will increase.
B. Total lift must increase; load factor will remain constant.
X **C.** Total lift must increase; load factor will increase.

FAA Question Number: **6.6.1.5**
FAA Knowledge Code: **H652**
Unloading the rotor on a gyroplane can lead to

A. increased rotor RPM.
B. pilot induced oscillation.
X **C.** a power push over.

Comment: True, if the gyroplane has it's CG lower than the thrust line. If the thrust line is lower than the CG, then a "Power push over" can not occur. – Dave DeWinter
Comment: C is the most correct answer. However a "buntover" can occur in any gyroplane that is G-Load unstable, regardless of where the CG is relative to the propeller thrustline. A "Power Pushover" is just one form of a "buntover". Even a high propeller thrustline is "Centerline Thrust" if the propeller is producing no thrust - same as a Centerline thrust or even a low prop thrustline if the propeller is producing no thrust. The real issue with the ability to "buntover" if the rotor is unloaded depends on whether the CG is forward of aft of the Rotor Thrustline in flight. If the CG is forward of the RTV in flight, a gyro is G-Load statically unstable, and capable of a "buntover" regardless of propeller thrustline. So, it may be dangerous to imply that only high thrustline gyroplanes can buntover - they all can if not properly configured for positive G-Load stability in all configurations of flight (airspeed, power and loading). "Unloading" the rotors does not necessarily lead to a buntover, but the pilot shouild never assume it is safe to do so in any case. If the propeller thrustline is lower than the CG, it can still "buntover", but that might not strictly be called a "Power Pushover", but semantics would make no difference to the results. – Greg Gremminger

FAA Question Number: **6.6.1.6**
FAA Knowledge Code: **H72**
When a rotorcraft transitions from straight-and-level flight into a 30° bank while maintaining a constant altitude, the total lift force must

X **A.** increase, and the load factor will increase.
B. increase, and the load factor will decrease.
C. remain constant, and the load factor will increase.

FAA Question Number: **6.6.1.7**
FAA Knowledge Code: **H73**
Feathering of rotor blades means the angular change of the blades during a cycle of revolution in order to

X **A.** equalize lift on the opposite (retreating and advancing blade) side of the disc.
B. equalize lift on upwind and downwind sides of the rotor disc.
C. counteract gyroscopic precession.

Comment: Answer A seems to be the most correct or intended answer, but the word "side" should be "sides". Answer B is unclear, but is probably intended to mean the forward half of the rotor disk and the aft end of the rotor disk. Both answers should be more clearly stated! However the question and answer implies that the ONLY function of "feathering" of the rotor is for dissymmetry of relative wind compensation. The cyclical "feathering" of the rotor blades also provides the important ability to maneuver the rotor disk and thus the rotorcraft. – Greg Gremminger

FAA Question Number: **6.6.1.7**
FAA Knowledge Code: **H74**
The ability of a rotor blade to rotate about its spanwise axis is called

A. flapping.
X **B.** feathering.
C. dragging or hunting.

Comment: This is probably a helicopter question. “Feathering” is the ability to rotate the rotor about its spanwise axis. Strictly speaking gyroplane fixed pitch rotors also do “feather” – pitch changes on each rotor blade oppositely with cyclic inputs such as when in forward flight or from pilot cyclic control inputs. Some gyroplanes with fully articulating rotor systems are capable of collective “feathering” such as in a helicopter. One common confusion on this question is understanding exactly what axis “spanwise” is referring to. “Spanwise” axis is the axis along the line from the root to the tip of the rotor blade. – Greg Gremminger

FAA Question Number: **6.6.1.8**
FAA Knowledge Code: **H73**
Longitudinal and lateral control of a gyroplane in flight are affected by

- **A.** adjusting the pitch of the rotor blades to the angle and direction that control is desired.
- **B.** antitorque pedals.
- X **C.** tilting the plane of rotation of the rotor in the direction that control is desired.

FAA Question Number: **6.6.2.0**
FAA Knowledge Code: **H78**
A gyroplane will have the greatest tendency to roll during

- **A.** climbing flight in which forward airspeed decreases.
- **B.** descending flight in which forward airspeed decreases.
- X **C.** horizontal flight at high speed.

Comment: C may be the intended correct answer - but possibly for the wrong reasons. In many gyros, it is difficult to observe any rolling tendency at high speeds. Answers A and B can't both be correct because either would depend on what power and airspeed the gyroplane is trimmed to fly straight and level - propeller torque compensation. Normally all aircraft are trimmed to fly straight and level at cruise and could have a rolling tendency in either A or B!???

Answer C is probably intended to consider "dissymmetry of lift" or "retreating blade stall" as the factors of high speed flight. However, any dissymmetry of lift from high speed that exceeds the teetering (or "flapping") range of the rotor would result in increased stick vibration and possibly a pitchup tendency. The teeter limits would be contacted at the fore and aft positions of the rotor - resulting in a forced stick aft and a resulting pitchup - with obvious aft bumping of the cyclic stick. If this question is intended to test understanding of "dissymmetry of lift" or "retreating blade stall", it is technically off the mark.

However, there is another rotor issue that could result in gyroplane roll at high speeds. The forward coned portion of the rotor disk presents higher angles of attack to the rotor blades in the forward half of their rotation than on the aft half. Theoretically, this increasing lift differential at higher airspeeds could, through precession, present a rolling tendency requiring side stick to balance this fore/aft "dissymmetry of lift". It is doubtful the framers of this question intended to test this understanding because this issue is not discussed in the reference material! – Greg Gremminger

FAA Question Number: **6.6.2.1**
FAA Knowledge Code: **H80**
The rotor RPM may momentarily increase during the flare portion of a flare-type autorotation. This increase in rotor RPM is due to
X **A.** the additional lift derived from the increased angle of attack of the main rotor disc.
B. an increased downwash velocity.
C. a decrease in rotor drag brought about by a lack of forward motion.

FAA Question Number: **6.6.2.1**
FAA Knowledge Code: **H702**
When is rotor downwash most prevalent in certain gyroplanes?
X **A.** During a vertical takeoff when rotor blades are in a propeller state.
B. Immediately prior to touchdown after a steep approach.
C. During all surface movement.
Note: The FAA has replaced this question with an undisclosed question. Expect something similar.

Comment: Answer A is most correct, although very few gyroplanes are capable of vertical takeoff. Answer A is correct during prerotation and a "jump takeoff" where the rotor is initially in a propeller state. But, it is a good idea to replace this question or - at least clarify it so that it is not just a "trick question". – Greg Gremminger

FAA Question Number: **6.6.9.4**
FAA Knowledge Code: **H70**
During the transition from prerotation to flight, all rotor blades change pitch
A. to the same degree at the same point in the cycle of rotation.
X **B.** simultaneously but to different angles of incidence.
C. simultaneously to the same angle of incidence.

Comment: This question addresses understanding of the cyclic AOA of the rotor blades as they rotate to different points in the rotation. However, it could be argued that answer A is also correct! In forward flight at steady conditions, each rotor blade does change pitch to the same degree at the same point around the cycle of rotation. The only reason that answer A might not be correct is that the question specifies the TRANSITION to flight, where flight is not a steady state and the blade AOA might not be exactly the same for each successive blade at a particular point in the cycle do to transitional loads on the rotor. As with a lot of FAA questions, tricky words can result in wrong answers, that do not verify actual mis-understanding of the important principles involved! All right, answer B may be MORE correct for tricky reasons, but does it verify real understanding! – Greg Gremminger

FAA Question Number: **6.6.9.5**
FAA Knowledge Code: **H74**
Which statement is true concerning rotor systems?

X **A.** The main rotor blades of a semirigid rotor system can flap and feather as a unit.
B. The horizontal flapping hinge on a fully articulated rotor system enables the main rotor blades to hunt.
C. Dampers are normally incorporated in a fully articulated rotor system to prevent excessive motion about the spanwise axis of each rotor blade.

FAA Question Number: **6.6.9.6**
FAA Knowledge Code: **H74**
The main rotor blades of a fully-articulated rotor system can

A. flap and feather collectively.
X **B.** flap, drag, and feather independently.
C. flap and drag independently, but can feather collectively only.

Comment: This question may be only a helicopter question, but some gyroplanes, such as the Air & Space 18A have fully articulated rotor systems that flap, drag and feather independently. – Greg Gremminger

FAA Question Number: **6.6.9.9**
FAA Knowledge Code: **H78**
A one-per-revolution vibration in a gyroplane indicates which condition?

A. Possible onset of retreating blade stall.
X **B.** Rotor blades out of balance.
X?? **C.** One rotor blade out of track.

Comment: Both B and C are true???, but B may be the more correct answer: Rotor blades out of track result in a one-per-rev vibration mostly detected as a vertical cabin "bounce". This is essentially an aerodynamic "out of balance" between the two blades. A mass "out of balance" results in a one-per-rev vibration mostly detected in the cyclic stick. Answer C refers to just one type of "out of balance", while answer B covers both types of "out of balance". I have no idea which answer the FAA expects!
– Greg Gremminger

FAA Question Number: **6.6.9.9**
FAA Knowledge Code: **H95**
What should help prevent aircraft induced oscillation on a gyroplane?

A. Lowering the center of gravity below the thrust line.
X **B.** Adding a horizontal stabilizer.
C. Increasing cyclic control sensitivity.

Comment: Aircraft Induced Oscillations? Typically all reference materials refer to Pilot Induced Oscillations (PIO). If the aircraft itself oscillates without pilot help, this is a truly dangerous gyro! This would probably indicate something was obviously loose or flexing. I have not seen any references to "Aircraft" induced oscillations in the reference materials for gyroplanes. However, either "aircraft" induced or "pilot" induced oscillations are a DYNAMIC stability issue. A Horizontal stabilizer is a DYNAMIC pitch dampener and therefore should help prevent DYNAMIC oscillations from any source!
– Greg Gremminger

FAA Question Number: **6.7.0.0**
FAA Knowledge Code: **H95**
Low speed blade flap on a gyroplane is a result of
X **A.** taxiing too fast.
B. rotor blade pitch set too high.
C. the rotor blades being too heavy.

Comment: Blade Flap can occur even with the gyroplane stopped. The question would be better if it stipulated "In a zero wind situation, low speed blade flap COULD be the result of ....." – Dave DeWinter

FAA Question Number: **6.8.2.7**
FAA Knowledge Code: **H76**
If the CG is located aft of allowable limits, the pilot may find it impossible to
X **A.** fly in the upper allowable airspeed range due to insufficient forward cyclic control.
B. recognize this out-of-balance condition when hovering in strong headwinds.
C. raise the nose, if necessary, during flight in gusty wind conditions.

Comment: This may not be included on gyroplane tests, but it applies to gyroplanes as well as helicopters. – Greg Gremminger

FAA Question Number: **6.8.2.7**
FAA Knowledge Code: **H95**
How does a negative G maneuver affect a gyroplane's rotor RPM?
A. Increases rapidly.
X **B.** Decreases rapidly.
C. Remains the same.

FAA Question Number: **6.8.2.7**
FAA Knowledge Code: **H76**
Too much forward cyclic during flight is probably due to

A. tendency of the nose to pitch up due to transverse flow effect.
B. excessive forward speed at maximum gross weight.
X **C.** critical aft CG.

Comment: This may not be included on gyroplane tests, but it applies to gyroplanes as well as helicopters. – Greg Gremminger

FAA Question Number: **6.8.3.0**
FAA Knowledge Code: **H77**
The most favorable combination of conditions for rotorcraft performance is

A. low density altitude, high gross weight, and calm to light wind.
B. high density altitude, low gross weight, and moderate to strong wind.
X **C.** low density altitude, low gross weight, and moderate to strong wind.

FAA Question Number: **6.8.3.2**
FAA Knowledge Code: **H95**
When does the vortex ring state mode of flight cause a problem for a gyroplane?

A. After a pushover from a steep climb.
B. Just prior to landing
X **C.** During a steep descent.

Comment: This is an improper question for gyroplanes - there is no vortex ring state for a gyroplane. A vortex ring state requires a powered rotor - gyroplane rotors are unpowered. There is no correct answer and the question itself makes no sense! "Vortex Ring State is not in the gyroplane portion of 8083-21. The helicopter portion says, page 11-6, Vortex Ring State requires '1. A vertical descent of at least 300 ft/min." (this is possible in a gyroplane) '2. The rotor system using some engine power." (where downwash comes from. It causes the accelerated descent. The gyroplane with no rotor power and no downwash isnt able) '3. Horizontal velocity slower than effective translational lift.' (A helicopter phenomena that the gyroplane doesn't share. This question doesn't have a correct answer and this phenomena isn't relevant to a gyroplane.

FAA Question Number: **6.8.3.3**
FAA Knowledge Code: **H78**
http://www.gleim.com/aviation/naqas/figures/FI-37.gif
(Refer to figure 37.) Blade tip stall is most likely to occur in what area?

A. 2 at high forward airspeed.
B. 4 at low forward airspeed.
??? **C.** 1 at high forward airspeed.

Comment: From the Figure 37 which depicts an Air and Space 18A gyroplane, this question must be assumed to be a gyroplane question. The question is improper - there is no such thing in a gyroplane as "blade tip stall". At higher and higher airspeeds, the stalled inner sections of the rotor blades does expand toward the tips. But, well before the tips can stall, the teeter (flapping) reaches its maximum range due to inability of the cyclic blade AOA to fully compensate for the dissymmetry of lift. "Blade tip stall" is a helicopter phenomena. The FAA probably does expect C to be the correct answer - but it is still not valid. – Greg Gremminger

FAA Question Number: **6.8.3.3**
FAA Knowledge Code: **H652**
Which may lead to a power push-over in a gyroplane?

A. Decreasing power too quickly.
B. Low speed.
X **C.** High speed.

Comment: The word "may" is the "trick" in this question that allows that C is the most correct answer. The question suggests that all gyroplanes may be susceptible to "PPO" at high airspeeds. But, since PPO is just one version of a "buntover" that requires a high propeller thrustline to meet the terminology of a PPO. A low propeller thrustline, by definition cannot "pushover"! However, that does not mean that all gyros may be susceptible to a buntover either - at high, or any, airspeeds. Any gyroplane that is G-Load stable in that airspeed flight condition is not able to "buntover" or "Power Pushover"! Answer A, decreasing power too quickly can actually lead to a "buntover" (not a PPO) in a low propeller thrustline gyroplane. This question promotes some erroneous understandings of PPO and buntovers and gyroplane stability in general.
– Greg Gremminger

FAA Question Number: **6.8.3.5**
FAA Knowledge Code: **H652**
How does lowering the seat on a gyroplane affect the flight characteristics?

A. Thrust line will be lower.
B. Gyroplane should be more stable both in flight and on the ground.
X **C.** Airspeed at which a power pushover could occur would be lower.

Comment: Answer C is probably what the FAA accepts as the correct answer. The disclaimer word "could" is what makes C the most correct answer. However, the question suggests and promotes erroneous concepts about flight stability and "power pushovers". The height of the seat, or the high location of the propeller thrustline relative to the CG, is not what determines the susceptibility of a buntover or PPO. PPO is just one version of a "buntover" that derives from a configuration that has a high propeller thrustline. Even a low propeller thtustline or a Centerline Thrust (CLT) can "buntover" - but by descriptive definition would not be called a "PPO". The results and causes are still the same!

The susceptibility of a buntover is due to it's G-Load static stability at that flight combination of power and airspeed - location of the CG to the Rotor Lift Vector (RTV) - not to the propeller thrustline. Even a very high thrustline configuration can be made G-Load stable - CG aft of the RTV in flight - and therefore "buntover" less susceptible - by the proper application of a horizontal stabilizer. – Greg Gremminger

FAA Question Number: **6.8.3.5**
FAA Knowledge Code: **H651**
Which is true concerning gyroplane operations?
X **A.** Altitude permitting, a gyroplane can safely descend vertically at zero airspeed.
B. Rotor RPM will decrease during a vertical descent.
C. A gyroplane can take off from any area in which it can safely land.

Comment: Gyroplanes must also respect the "avoid" flight area of the Height vs. Velocity curve defined for that particular gyroplane. This means that at some height above the ground, at the peak of the H vs. V curve, the gyroplane must begin to add enough airspeed to keep it outside the H vs. V curve. The H vs. V curve defines the total energy of height and velocity which will allow the gyroplane, with appropriate pilot operation, to attain sufficient airspeed energy at flare height to achieve a safe landing - if the engine is not available (quits) to supply the deficient energy for a safe landing!
– Greg Gremminger

FAA Question Number: **6.8.6.3**
FAA Knowledge Code: **H342**
GIVEN:

Usable fuel at takeoff	40 gal
Fuel consumption rate	12.2 gal/hr
Constant groundspeed	120 kts
Flight time since takeoff	1 hr 30 min

According to FAR Part 91, how much farther can a rotorcraft be flown under day VFR?

X **A.** 176 NM.
B. 215 NM.
C. 121 NM.

Comment: This question is probably addressing the planning fuel reserves required for cross-country flight in a rotorcraft – which is 20 minutes in a rotorcraft for both day and night VFR. 20 minutes of reserve must be subtracted from the remaining flight hours. Answer A is probably the answer the FAA expects, but the question does not really address the planning reserve requirement – so answer B, without reserve adjustment is possibly the technically correct answer as the question is phrased. It's anyone's guess if the FAA is trying to be tricky here or not! Tricky questions like this may not verify proper understanding of the subject matter. – Greg Gremminger

Comment: I FEEL YOU SHOULD TOUCH MORE ON THE PLANNING ASPECT OF THE FAR PART 91, NOT THE OPERATION OF A ROTORCRAFT UNDER DAY VFR. IF I READ THE MEANING OF THE QUESTION CORRECTLY, IT'S LOOKING FOR A PLANNED VFR RESERVE. FAR PART 91 DOES NOT PROHIBIT FLYING INTO FUEL RESERVES IF REQUIRED, JUST DON'T PLAN ON IT!

FAA Question Number: **7.0.0.3**
FAA Knowledge Code: **H58**
Immediately after takeoff, a downwind turn close to the ground is not good practice because it

X **A.** increases the hazards involved should an emergency landing become necessary.
B. causes an increase in the speed at which rotor stall occurs.
C. decreases the rate of climb significantly.

Comments: Answer C is certainly true – getting behind the power curve as may be likely in a turn to downwind immediately on takeoff. But, answer A is probably more true. This question is probably addressing the likelihood of getting behind the power curve, and possibly even into "Dead Man's Zone" ("Avoid" area of the Height vs. Velocity curve) with an immediate downwind turn. Normally takeoff climb airspeed is at the peak of the power curve. A turn without appropriately increasing airspeed in the turn, coupled with decreasing headwind and increasing tailwind, can result in getting behind the power curve with inadequate height or speed to avoid sinking to the ground. It is also likely, as a result of getting behind the power curve that the rotorcraft may be within dead man's zone making a safe emergency landing upon engine failure much less likely.
– Greg Gremminger

FAA Question Number: **7.0.0.4**
FAA Knowledge Code: **H58**
On a power-off final approach, a pilot establishes a glide attitude which is too flat. The proper recovery procedure for the subsequent high rate of descent is to

A. increase rotor lift by applying aft cyclic pressure.
X **B.** increase power, and if altitude permits, lower the nose.
C. lower the nose immediately, but do not increase the power since this will again raise the nose.

Comment: Knowledge code H58 is not listed in the AC - so it is unclear if this is a gyroplane or helicopter question - or rotorcraft specific at all. For a gyroplane, answer B would be the correct answer. I'm not sure that answer B would not be the correct answer for airplane, helicopter or gyroplane. – Greg Gremminger

FAA Question Number: **7.0.5.3**
FAA Knowledge Code: **H71**
During the full-flare portion of a power-off landing, the rotor RPM tends to

- **A.** decrease initially.
- **B.** decrease during high density altitude days, and increase during low density altitude days.
- X **C.** increase initially.

Comment: Initially increased rotor load during initial flare converts airspeed energy into rotor RPM energy. The act of flaring, slowing down rapidly, presents additional G-Load on the rotor which increases rotor blade angle of attack and increases the Driving area of the rotor – increasing RRPM – until the Driven area balances the Driving area at some increased RRPM. The increased energy (Rotor RPM) can then be expended – during latter part of the flare (or hover for a helicopter) to support the rotorcraft at slower airspeeds (or extended hover for a helicopter). – Greg Gremminger

FAA Question Number: **7.0.5.9**
FAA Knowledge Code: **H78**
Which is true concerning retreating blade stall?

- **A.** Aircraft will pitch up and roll to the right at the onset of the stall.
- **B.** Nose of the aircraft will pitch down and may roll in either direction at the onset of the stall.
- X **C.** When operating at high forward airspeeds, turbulent air or steep and abrupt turns can cause a retreating blade stall.

Comment: This should be a helicopter question, but the knowledge code AC does not identify the subject and the FAA may erroneously consider this applies also to gyroplanes. This question does not apply to gyroplanes because retreating blade stall is not an issue with an autorotating rotor. At higher forward speeds, the stalled area of a gyroplane rotor increases, but never fully stalls. The teeter (flapping) limits approach or reach their limits to compensate for the dissymmetry of relative wind long before the rotor can be said to be stalled. But, the FAA would probably Consider C to be the correct answer if this question appears on a gyroplane test. – Greg Gremminger

FAA Question Number: **7.0.6.1**
FAA Knowledge Code: **H78**
Ground resonance is most likely to occur when

- **A.** initial ground contact is made with a combination of high gross weight and low RPM.
- **B.** there is a sudden change in velocity of the plane of rotation.
- X **C.** a series of shocks cause the rotor system to become out of balance.

Comment: This may or may not be included on a gyroplane test. Ground resonance is more of an issue with helicopters with fully articulate rotors. However, a couple of gyroplanes employ fully articulated multi-bladed rotors and as such are subject to ground resonance concerns. If this question appears on a gyroplane test, Answer C is probably what the FAA expects. – Greg Gremminger

FAA Question Number: **7.0.6.3**
FAA Knowledge Code: **H78**
The addition of power in a settling-with-power situation produces an

A. increase in cyclic control effectiveness.
X **B.** even greater rate of descent.
C. increase of airspeed.

Comment: Hopefully, settling-with-power questions will not appear on gyroplane tests – does not apply to autorotating rotors. However, some other test questions suggest the test makers may not understand this. – Greg Gremminger

FAA Question Number: **7.0.8.0**
FAA Knowledge Code: **H80**
During a running takeoff in a crosswind, which describes proper control technique?

A. Pedals control both heading and direction of movement.
X **B.** Heading is maintained with pedals; direction of movement (groundpath or track) is maintained with cyclic.
C. Heading is maintained with cyclic; direction of movement (groundpath or track) is maintained with pedals.

Comment: This question is probably a helicopter question, but the same principles apply to a gyroplane takeoff. – Greg Gremminger

FAA Question Number: **7.0.9.0**
FAA Knowledge Code: **H81**
When conducting a confined area operation, the primary purpose of the high reconnaissance is to determine

A. height of obstructions surrounding the area.
B. if the area will be large enough to permit a safe takeoff after landing.
X **C.** suitability of the area for landing.

Comment: This question is probably a helicopter question only, but it is always essential to determine the suitability of a landing at all times. Takeoffs are optional, landings are essential. – Greg Gremminger

FAA Question Number: **7.0.9.2**
FAA Knowledge Code: **H95**
Which is true concerning taxi procedures in a gyroplane?
X **A.** Keeping the rotor system level creates less lift and more stability.
B. Cyclic stick should be positioned slightly aft of neutral when taxiing.
C. Rotor blades should not be turning when taxiing over a rough surface.

Comment: The answer really depends on what the pilot wishes the rotor to do during taxi. Also, the question does not specify whether or not the rotor is static or turning. In windy and gusty conditions, it's best to not have the rotor stopped. Other times, it may be desirable to have the rotor spinning with the cyclic to the left, right, level, or aft, depending once again upon the circumstances at hand. Answer B needs to be changed, since it is often a true statement. – Dave DeWinter

Comment: This question is confusing and there are several schools of thought on this. The best answer may be "it depends". If prolonged taxiing on a rough surface is necessary, it may be best to have the rotor spinning significantly to avoid extreme flexure of the rotors – but a spinning rotor badly complicates maintaining RRPM and directional control and application of rotor disk AOA in windy conditions! I know of at least one gyro roll-over because of directional PIO while taxiing with a spinning rotor! If the rotor is spinning, the cyclic stick should be held level and forward to avoid possible contact with the tail or prop or ground and to minimize the possible flapping effects of strong or gusty winds. For smooth taxiing, the rotor should be stopped, aligned fore/aft, and maintained laterally and longitudinally level to minimize wind effects and to reduce taxi profile to avoid hitting things with the rotor. This question is similarly confusing as question 3.3.3.9 in the Private Pilot set of questions – both seem to presume that taxiing is done with the rotor spinning! Both questions should be re-designed with more definition and contemporary consensus. It is hard to tell which answer the FAA might accept as correct, but answer A is the only common answer between this question and questions 3.3.3.9 in the Private test and question 5.7.3.8 in the Commercial test! For this reason, I think A is the answer the FAA expects! – Greg Gremminger

FAA Question Number: **7.0.9.3**
FAA Knowledge Code: **H766**
Which statement is true concerning a gyroplane?
A. A gyroplane is capable of getting into a settling-with-power situation much the same way as a helicopter.
X **B.** A gyroplane can safely descend vertically or move backward with respect to ground references during a descent if altitude permits.
C. Rotor RPM will remain constant during changes in airspeed while descending.

Comment: Answer B is always true. Answer C is also technically true, but with turbulence or other G-Load disturbances, the rotor RPM may not remain constant at the same RPM – RRPM is a function of rotor load. So, I guess that answer B is the more correct answer! – Greg Gremminger

FAA Question Number: **7.0.9.3**
FAA Knowledge Code: **H651**
Which is true concerning operation of a gyroplane?

- **A.** Rotor RPM remains constant during changes in airspeed while descending.
- **B.** Like a helicopter, vertical descents to a safe landing are possible.
- X **C.** Altitude permitting, flying behind the power curve is not a problem.

Comment: C is a correct answer. This is a special advantage of gyroplanes, they will not stall and can safely fly at airspeeds even down to zero - if there is enough altitude to recover. Rotor RPM theoretically does not change as a function of airspeed or power. Rotor RPM does change as a function of load changes on the rotor - which is happening, if airspeed is changing – answer A is therefore wrong. – Greg Gremminger

FAA Question Number: **7.0.9.4**
FAA Knowledge Code: **H95**
When landing a gyroplane in crosswind conditions, proper technique requires that the

- X **A.** lateral axis of the gyroplane be parallel to the gyroplane's direction of motion.
- **B.** longitudinal axis be parallel to the runway.
- **C.** direction of motion and heading coincide with runway direction.

Comment: Answer A is more correct. In a crosswind landing, with such a short ground roll (if any), a gyroplane pilot can utilize the width of the runway and land going across the runway. Thus reducing the crosswind component. There is no FAR that requires a pilot to land straight down the centerline of the runway. – Dave DeWinter

FAA Question Number: **7.0.9.5**
FAA Knowledge Code: **H766**
In which takeoff situation would a gyroplane with jump takeoff capability have an advantage?

- **A.** Short field.
- X **B.** Soft field.
- **C.** High elevation.

Comment: Jump takeoffs are often difficult or impossible at high density altitudes. Often, as the "jumped" gyroplane increases forward airspeed through translational lift, it will sink from its maximum jump height - therefore clearing an obstacle is not especially a smart thing to expect a jump takeoff to accomplish. Jump takeoffs are especially useful if the rolling surface is unsuitable for a rolling takeoff. – Greg Gremminger

FAA Question Number: **7.0.9.6**
FAA Knowledge Code: **H766**
In order to maintain level flight (laterally) as airspeed increases on climbout after takeoff in a gyroplane, the pilot will have to increase

A. rudder and cyclic pressure to the left.
B. rudder pressure to the left.
X **C.** cyclic pressure to the right.

Comment: This question is improperly posed. There is no effect on roll or yaw from the rotor as a result of airspeed or power - the rotor produces no torque in flight - autorotation! Rotor Precession has no effect on roll for purely fore or aft cyclic position or pressure changes - rotor precession exactly compensates for dissymmetry of lift and the rotor presents no roll or torque factors in any steady flight condition. Like any aircraft, engine/propeller torque / "P" factor can require stick and/or rudder to compensate from the trimmed condition. The direction of corrections depend on the rotation direction of the propeller - which is not specified in the question. The amount and direction of corrections depend on what the trim condition of the aircraft is set up to - cruise, high power climb, low power descent, etc.! **But, the FAA probably considers this a dissymmetry of lift question and expects answer C** to correct for a non-existent "dissymmetry of lift" – the rotor cyclic is automatically correcting for dissymmetry of relative wind. – Greg Gremminger

FAA Question Number: **7.0.9.7**
FAA Knowledge Code: **H95**
What should be the first step in correcting pilot induced oscillation in a gyroplane?

?? **A.** Reduce power.
B. Apply positive forward cyclic.
X **C.** Establish a climb.

Comment: Answer C is most correct. Although the Rotorcraft Flying Handbook says to reduce power and start a climb, this is not always proper for various configurations of gyroplanes. For low thrustline gyros, rapidly reducing power, especially at higher airspeeds where PIO may be more likely, can result in an immediate reduction in static stability margin with a rapidly lowering nose attitude – not a good combination for buntover concerns. Therefore, although the **FAA may expect the correct answer to be "reduce power"** – to be consistent with the first words in the RFH, a much more proper and safe answer would be to follow the manufacturer's specific directions – which probably includes starting a climb to load the rotor. – Greg Gremminger

FAA Question Number: **7.0.9.7**
FAA Knowledge Code: **H95**
Which pilot action will help reduce pilot induced oscillation in a gyroplane?

A. Prior to a climb, increase pitch attitude before increasing power.
B. Increase power if nose pitches down.
X **C.** Avoid flight at high speeds.

Comment: This question is improperly posed. Avoiding flight at high airspeeds is a way to reduce the potential for PIO. Once PIO occurs, it is too late to "AVOID" flight at that airspeed - but reducing airspeed carefully may, if you are lucky, reduce or stop the PIO. But, often, when PIO occurs, it is often too late for recovery! This question suggests poor understanding of gyroplane aerodynamics and stability. Answer B is certainly a dangerous thing to do in an unstable type gyroplane. Answer A would be an improper thing to do on some gyroplane configurations resulting in very low airspeeds. Gyroplane pilots should be taught how to "avoid" PIO or buntover situations - because once started, recovery is very doubtful! The real answer may be "it depends" – due to many various gyroplane configurations, pilots should follow the manufacturer's or designers directions. However, the FAA probably expects answer C to be the correct answer!
- Greg Gremminger

Comment: Terrible question. With a properly designed gyroplane, PIO is very difficult to achieve. If you're assuming the gyroplane has too high of thrust line, then the best way to avoid PIO (other than redesigning/building the machine) is thorough Pilot Training. If PIO is encountered, the correction is a smooth, and deliberate, reduction of power, and aft cyclic pressure. – Dave DeWinter

FAA Question Number: **7.0.9.7**
FAA Knowledge Code: **H652**
What should be the first action taken if a gyroplane begins to oscillate in flight?

A. Unload rotor system.
X **B.** Apply aft cyclic pressure to increase pitch and reduce airspeed.
?? **C.** Reduce power.

Comment: Answer B is most correct. Although the Rotorcraft Flying Handbook says to reduce power and start a climb, this is not always proper for various configurations of gyroplanes. For low thrustline gyros, rapidly reducing power, especially at higher airspeeds where PIO may be more likely, can result in an immediate reduction in static stability margin with a rapidly lowering nose attitude – not a good combination for buntover concerns. Therefore, although the **FAA may expect the correct answer to be C, "reduce power"** – to be consistent with the first words in the RFH, a much more proper and safe answer would be to follow the manufacturer's specific directions – which probably includes starting a climb to load the rotor. – Greg Gremminger

FAA Question Number: **7.0.9.7**
FAA Knowledge Code: **H652**
Which will help prevent pilot induced oscillation in a gyroplane?

- **A.** Decreasing loading on the rotor blades.
- X **B.** Adding a horizontal point of reference.
- **C.** Raising the center of thrust above the center of fuselage drag.

Comment: This is the best answer among these answers. But, a better answer would be to install a dynamic dampener – a horizontal stabilizer. – Greg Gremminger

FAA Question Number: **7.0.9.7**
FAA Knowledge Code: **H766**
Rotor torque is a concern in gyroplanes only during

- **A.** maneuvers requiring high rotor RPM.
- **B.** maximum performance climbs and go-arounds requiring higher engine RPM.
- X **C.** prerotation or clutch engagement.

Comment: That's the most correct answer, but the question is flawed. The torque is NOT created by the rotor, it is created by whatever is used to prerotate the rotor.
– Dave DeWinter