Instrument Course Study Guide

This guide helps students prepare for the Instrument end-of-course practice exams, which mimic the real FAA Instrument Rating Airplane Written Exam. It contains a summary of the Instrument Ground School flashcard questions.

We recommend that you take your time while reviewing this material. In particular, if you don't understand a concept, be honest with yourself and take extra time to learn that material. It will pay dividends in the end: applicants with higher written exam scores often have an easier time on the oral portion of the checkride. Plus, if you put in the work now, you'll know that much more, and have that much more confidence when it's game time.

This guide contains only the review questions. If you are looking for the answers as well, check your Flight Bag for the Course Study Guide with the answers.

We are dedicated to providing the very best material that we can. If you find any errors, confusing phrasing, or have any recommendations for changes to this guide, please don't hesitate to reach out to us at support@flightapprentice.com, on social media or at FlightApprentice.com

Thanks for your continued support,

The Flight Apprentice Team

Preflight Preparation

Recency and Logging Requirements

A pilot has performed one instrument approach, including holding and tracking procedures, per month starting in June, except they skipped December because of holiday commitments. Are they legal to operate a flight as PIC under IFR in January?

You are talking to an old-timer at the airport. He says that even though he never explicitly holds, he satisfies currency requirements to operate under IFR because he does one approach with a full procedure turn each month. Is he right?

If a pilot accomplishes all currency requirements on October 10th, 2019 and then stops flying, when will they be required to complete an IPC to operate as PIC under IFR?

Say the pilot above has let her IFR currency expire, but is not yet required to complete an IPC. How can she renew her currency without an IPC?

Basic Med

Your last medical certificate was issued in September 2012 and expired in 2014. You do not have a U.S. driver's license, but you have a U.S. passport. Are you eligible for BasicMed?

Can BasicMed be used in operations for compensation or hire?

Your Cessna 310 has a maximum certified takeoff weight of 5,825lbs and is capable of seating 6. Can you operate it under BasicMed?

Advanced Weather

Embedded Thunderstorms

Why do embedded thunderstorms pose such a risk to instrument pilots in particular?

If an embedded thunderstorm is encountered, what options does the pilot have?

Icing

There are two major reasons why freezing rain is such a major focus when it comes to icing. What do you think these reasons are?

What is significance of large super-cooled droplets?

Why may a pilot flying slightly inland turn towards the coast when encountering icing conditions?

What is the risk associated with encountering icing with the autopilot engaged?

How does airplane performance change with ice accrual? What considerations should be made during approach and landing?

Freezing Levels

You are flying at 7,500′ MSL over terrain at 5,000′ MSL during a day with a freezing level of approximately 9,000′ MSL. After crossing the next fix, your minimum en-route altitude (MEA) changes to 9,500′ MSL. What do you need to consider in this situation?

You are preparing to dispatch from a sea level airport on a local flight to shoot approaches and take advantage of the widespread 500′ ceilings. The freezing level is 1,000′ MSL. What consideration do you need to make, aside from the potential that you will encounter icing?

Super Cooled Large Droplets

What conditions can lead to the formation SLDs?

Why are SLDs such a significant hazard to instrument pilots?

If SLDs are caused by collision-coalescence, how effective will a climb be in getting out of icing conditions?

What methods can a pilot use to avoid SLD during a flight?

Instrument Flying Techniques

Instrument Scan

In a level constant-rate turn, while increasing power, which instruments are primary?

In a constant speed descent, which instruments are primary?

Which instrument is primary for bank in all straight (non-turning) flight?

Which instrument is primary for pitch in all level (non-climbing/descending) flight?

Recognizing Abnormal Situations

What is the cardinal sin of instrument failures?

Why is overreaction such a dangerous response to an instrument failure?

While in IMC, you notice the attitude indicator is drifting off to the left. The directional gyro indicates a turn left, while the turn coordinator shows a slight turn right. What has likely happened?

On climb out, you notice the airspeed is stuck at 55 knots even though you are maintaining a pitch/power combination that should result in a 75 knot climb. What action should you take?

Instrument Techniques

Why are small corrections so critical to good instrument flying?

How does aerodynamic knowledge apply to flying well as an instrument pilot?

Why is it preferable to maintain coordination with your feet versus consistently correcting bank issues with the ailerons?

If you are cruising at 15,000 feet and need to cross an approach fix at 3,000 feet, how far away from that fix should you start down?

What rough vertical speed target should a pilot use for a standard 3° glideslope if their airspeed is 115 knots?

Why are rules of thumb important in instrument flying?

IFR Planning

Route Selection

You have planned to fly a particular departure procedure, and have received the departure procedure as part of your clearance. Soon after departure, ATC tells you to procedure direct to a VOR, deviating from your original clearance. What are some reasons ATC might do this?

At a minimum, departure and arrival procedures are designed to assure what?

The clearance ATC assigns you is completely different from what you filed for. What should you do before you fly according to that clearance?

How can you minimize the likelihood of ATC changing your clearance?

What is Tower En-route Control?

What is an ATC preferred route?

Alternate Requirements

You are planned to arrive at your destination at 2325Z. The forecast weather at 2230Z is 2sm and overcast at 1,500. At 2330Z, the forecast is clear skies and more than 6sm. Do you need an alternate?

What is required to use an airport as alternate if it lacks instrument approach procedures?

[Requires reference figure on lesson page] Burbank (KBUR) and Van Nuys (KVNY) towers are closed. Which approach(es) is/are available to use Van Nuys as an alternate, if the forecast weather upon arrival is 6sm visibility and 850′ ceilings? You are category B.

Many precision approaches cannot be used to meet alternate requirements when local weather is unavailable. Why might this be?

What does the 'A' in a black triangle signify on an approach plate?

Navigation Equipment

Instrument Landing System (ILS)

What is a false glideslope?

How can you positively identify an ILS?

When a NOTAM exists for "GS INOP" are you still able to shoot the localizer approach?

What limitations exist on ILS service volumes?

Each dot of deflection from a CDI is how many degrees of course?

VHF Omni-directional Range (VOR)

In simple terms, how does a VOR work?

What navigational information can a VOR provide?

What does the TO/FROM arrow on a VOR instrument indicate?

What is the difference between a radial and a bearing? Can they ever be the same?

What condition will create reverse sensing?

What is the primary danger in reverse sensing?

Distance Measuring Equipment (DME)

What is DME?

How does DME work?

Do all VORs have DME? How do we know if a VOR has DME equipment?

Do VORTACs have DME capability?

What is slant-range error?

Global Positioning System (GPS)

How does GPS work?

How many GPS satellites are needed to establish a 3 dimensional position?

What is the advantage of GPS compared to VORs or NDBs?

Why do many GPS systems require contact with 5 satellites in order to function properly?

Systems for Instrument Flight

VOR/DME/ILS/Radios

VORs and localizers provide similar information. Do they function similarly?

True or false: localizers and glideslopes provide different information, but function essentially the same way.

What is a fix?

Can a fix be reliably produced by receiving only two DME signals? Why or why not?

Marker Beacon

What is the function of marker beacons?

Where will a pilot usually be if they fly over an outer marker?

What is the difference between an outer marker (OM) and low outer marker (LOM)?

What is the advantage of a LOM?

RNAV/GPS/WAAS

What is the difference between RNAV and GPS?

What is an INS?

What is WAAS?

What are the advantages of RNAV systems?

How many GPS satellites are needed to determine a 3D position? Why do aviation systems require contact with an extra?

GPS is designed to maintain line of sight, anywhere on earth, to how many satellites?

Flight Management System (FMS)

What are FMS? What is the function of FMS?

What are some ways that FMS can reduce pilot workload?

Anti-ice and De-ice

What is the general operating philosophy behind de-ice boots?

What is the general operating philosophy behind weeping wings?

If an airplane has anti-ice or de-ice equipment, which parts of the airplane usually are protected? Why is this?

What is the advantage of heated wings over boots or glycol fluid?

Pitot-Static

What steps can a pilot take to ensure that they never takeoff with pitot-static covers still on the airplane?

Will a pitot failure cause any abnormal indications on the altimeter and/or VSI?

What is the risk associated with a clogged pitot tube drain only (ram air port is open)?

In cruise flight, you notice the airspeed indicator, which should be indicating roughly 110 knots, is indicating 55. The altimeter and VSI are level and the attitude indicator shows a 2˚ nose up attitude. What has likely failed?

In the question above, you also notice a bumpiness that you think could be pre-stall buffet. Does this change your assessment as to which instrument is failed?

Breaking either the VSI or altimeter would create a make-shift static alternate source. Why is it usually better to break the VSI?

Why does use of an alternate static source cause slightly higher-than-normal altitude and VSI indications?

Gyroscopic Instruments

On takeoff, the attitude indicator indicates a left turn while the turn coordinator and directional gyro indicator a right turn. Which instrument has likely failed?

Your attitude indicator indicates a nose low attitude, while your airspeed indicates just above stall speed. The altimeter and VSI indicate a slow climb. What instrument has most likely failed?

Why does the turn coordinator usually rely on the electrical system while the other gyroscopic instruments use vacuum power?

What type of gyroscopic failure is likely to create the biggest threat to safety?

After determining that a broken gyroscopic instrument cannot be fixed in flight, what is the best way to mitigate the risk associated with its failure?

Autopilot

What is the purpose of autopilot?

What are the advantages of autopilot?

How does autopilot fit into the concept of single pilot resource management?

Are there times when autopilot should not be used?

What is the risk of becoming over-reliant on autopilot?

Instrument Checks

What engine function should be checked immediately after start?

Before takeoff, engine instruments should indicate what?

How does a pilot determine proper function of pitot-static instruments during taxi?

How does a pilot determine proper function of gyroscopic instruments during taxi?

What function of the electrical system should be checked after start?

ATC and Clearances

ATC Clearances Overview

What is an ATC clearance?

When could an IFR flight be flown without a clearance?

When will a clearance limit be specified?

What are the major components of a clearance?

How do pilots know that they have properly copied the clearance issued?

Activating Flight Plans

How does activating an IFR flight plan differ at towered and non-towered airports?

You are issued a clearance with a void time 3 minutes from now. You have a three minute taxi to the runway, and need to perform a run-up. What should you do?

Clearance Limits and Expected Further Clearance

What is a clearance limit?

What is usually the clearance limit on most flights?

You are approaching your clearance limit, with no further instructions. What should you do?

What is the difference between receiving a new clearance limit and receiving a routing amendment from ATC?

Mandatory Reports

80 miles away from your destination airport while level at 15,000 feet, ATC tells you to "descend pilot's discretion to 7,000 feet." You start down at 45 miles. Is there any report that must be made?

While en-route your #1 VOR receiver suddenly indicates failure flags and you no longer have navigation capabilities. Is an ATC report necessary?

After takeoff on an IFR flight plan your hand held GPS unit fails. Is an ATC report necessary?

What information should be transmitted to ATC upon reaching an assigned holding fix?

What mandatory report may a pilot need to make while climbing to 15,000 feet in a Cessna 172?

Operating in Non-Radar Environments

How do reporting requirements change in radar and non-radar environments?

How would a pilot's response to an in-flight emergency change in a non-radar environment opposed to in a radar environment?

PIC Emergency Authority

You are 15 miles from a large thunderstorm at your twelve o'clock. Should you exercise your emergency authority to avoid it? Why or why not?

What is the difference between requesting something from ATC and using your emergency authority?

Are there times when you could simultaneously involve ATC and exercise PIC authority?

Holding

Overview

Why may a pilot be asked to hold?

Why may pilots choose to hold?

What can pilots do to reduce their chance of holding?

What kinds of fixes can holds be created on?

What defines a particular hold?

How can leg lengths be defined?

A holding clearance states "Grumman 123FA, hold southeast on the SAC 150° radial." What will be the outbound course?

A holding clearance states "Piper 333FA, hold north on the ABQ 013° radial, left turns." What will be the outbound and inbound courses?

Calculating Hold Time

Why do pilots calculate reserve time?

What are the advantages of using conservative calculations for holding time?

Can a pilot legally land with less than 45 minutes of reserve fuel?

What kind of circumstances might warrant landing with more than 45 minutes of reserve fuel?

A pilot calculates that they can hold for 20 minutes in a standard 1-minute hold. How many turns in the hold with that correspond to?

Types of Holds

How do distance-defined holds differ when the distance is defined using GPS vs. DME?

What additional challenges might be encountered when holding over a VOR?

Can pilots requests holds other than published holds, or request published holds with modifications?

Hold Entries

What are the three recommend types of entries?

Why might a pilot elect to use a different entry than suggested?

A pilot is proceeding direct to the holding fix on a heading of 085°. The hold has an inbound course of 065°. What entry type should they make?

How many degrees does a pilot offset while making a teardrop entry?

What minimal information is required to determine the type of hold entry?

Why is it important to quickly and easily determine how to enter a hold?

The Five T's

What is the purpose of using the five T's?

Do we always need to use all five?

Give an example of when a pilot would time upon crossing a fix and an example of when they would not.

Should a pilot adhere to the Five T's while crossing fixes in the en-route structure (e.g. on an airway or when crossing GPS fixes along a non-airway route)? Why or why not? There is not particular right answer to this question — just think a bit about it!

Departing Holds

What are the general steps of holding?

What information is required to determine the type of hold entry?

If a turn direct to the outbound course is left and 55°, for a standard hold, what type of entry should be made?

If a turn direct to the outbound course is right and 180°, for a non-standard hold, what type of entry should be made?

If a teardrop entry is to be used, and the outbound course is 155° in a non-standard hold, what will the initial teardrop heading be?

You are flying at 255 knots at 13,000 feet prior to entering a holding pattern. Will you need to slow before your hold entry? If so, by how much?

You are required to slow by 80 knots before entering a holding pattern. How many minutes before crossing the holding fix must you start slowing?

What are the advantages and disadvantages of the "shortest turn to the outbound course" technique?

You enter a hold and time the first inbound leg at 1:20. What leg length should you fly on the next outbound course?

You enter a hold and notice that tracking the inbound course of 125° requires a 10° crab left into the wind. What heading would you fly on the outbound course?

ATC instructs you to "hold SE of the MYV 155° radial 15 DME, left turns". You are currently on the 180° radial at 35 DME. What is your likely hold entry?

ATC instructs you to "hold N of the PVF 355° radial 20 DME, right turns. You are over PVF. What is your recommended hold entry?

Instrument Procedures

Departure

What is the purpose of departure procedures?

What is the difference between ODPs and SIDs?

Why is it so important to brief the departure procedure?

If ATC clears us direct to a fix while we are on a departure procedure, may we accept that clearance?

En-Route

When must pilots make position reports upon crossing a compulsory reporting point?

If, along an airway, the MEA changes from 4,000′ to 6,000′, what is the latest time a pilot may initiate the climb?

If a pilot is flying at 120 knots at 13,000′ and the MEA changes to 16,000′ at the next fix, what is the latest they may initiate a climb, assuming they only climb at the minimum climb gradient?

A pilot crosses over a VOR on an airway that is defined by the 050° radial from one direction and the 230° radial in the other direction. If they navigated correctly to the station and crossover without readjusting the OBS, will they experience reverse sensing?

Are there times when terrain clearance is assured, but navigation reception is not?

Precision Approaches

What is the difference between a precision and non-precision approach?

What are the general steps to an ILS approach?

Does an ILS approach have a final approach fix?

How low are ILS standard minimums?

Does an ILS have a missed approach point?

When is a missed approach commenced on an ILS approach?

If the runway is not in sight, but part of the airport environment is, how does that change the approach?

Non-Precision Approaches

What are the major differences between precision and non-precision approaches?

What are some types of non-precision approaches, and how are they different from one another?

When is a missed approach commenced on a non-precision approach?

What is the significance of the VDP?

How should a pilot execute a missed approach procedure at the VDP?

Missed Approach

What is the purpose of a missed approach procedure?

You have planned and briefed to fly the ILS approach. Before commencing the approach, ATC informs you that the glideslope is inoperative, but the localizer approach is available. How will a missed approach procedure change if you fly the localizer vs. an ILS?

Visual Approach

What is the purpose of a visual approach?

Are airplanes conducting visual approaches still on an IFR flight plan?

A pilot reports the field in sight, with weather conditions at the field reported as overcast at 900 feet and 10 miles visibility. May the pilot fly a visual approach?

Emergency Procedures

Lost Communications

On departure while being vectored to ABC VOR, you experience a communications failure in instrument conditions. What should you do?

Icing

While flying in instrument conditions in the mountains, you encounter rime icing. The ground is only 2,500 below you and you are at MEA. What options do you have?

Conditions have deteriorated considerably in your area, and you are accruing clear ice as a result of freezing rain. The nearest airport is 5 minutes away and reporting 200 foot ceilings and 1 and 1/2 visibility. The ILS requires 200 and 1 3/4. The next closest airport is 15 minutes away and reporting 250 foot ceilings and 2sm visibility, with an ILS approach with minimums of 200′ and 1 1/4sm visibility. What will you do and why?

While flying at 7,000 feet, you experience light rime icing. The MEA is 4,000′ on your segment of the airway. What might you consider doing?

Fuel Emergencies

Why is continuing below minimums dangerous? Why may it very occasionally be the right action?

How can pilots take preemptive action to avoid low-fuel situations?

Equipment Failures

Why can attempting to act at the highest level of precision be a less-safe option in certain situations?

How might fear impede your ability to approach an emergency situation from an ideal vantage point?