TEST PREP

INSTRUMENT RATING

2016

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About the Contributors

Charles L. Robertson
Associate Professor, UND Aerospace
University of North Dakota
Charles Robertson as flight instructor, associate professor and manager of training at UND Aerospace, contributes a vital and substantial combination of pilot and educator to ASA's reviewing team. After graduating with education degrees from Florida State University in 1967, and Ball State University in 1975, he began his twenty-year career in the United States Air Force as Chief of avionics branch, 58th Military Airlift Squadron, and went on to flight instruction, training for aircraft systems, and airport managing, while gaining many thousands of hours flying international passenger and cargo, aerial refueling and airlift missions. As Division Chief in 1988, Robertson directed the USAF Strategic Air Command's “Alpha Alert Force” and coordinated its daily flight training operations. He holds the CFI Airplane Land, Multi-Engine, Single-Engine and Instrument, the ATP Airplane Land and Multi-Engine, Commercial Pilot, Advanced and Instrument Ground Instructor licenses.

Jackie Spanitz
Director of Curriculum Development
Aviation Supplies & Academics, Inc.
Jackie Spanitz earned a bachelor of science degree with Western Michigan University (WMU), in Aviation Technology and Operations — Pilot option. In her masters program at Embry-Riddle Aeronautical University, she earned a degree in Aeronautical Science, specializing in Management. As Director of Curriculum Development for ASA, Jackie oversees new and existing product development, ranging from textbooks and flight computers to flight simulation software products, and integration of these products into new and existing curricula. She provides technical support, research for product development, and project management. Jackie holds pilot and instructor certificates and is the author of Guide to the Flight Review, Private Pilot Syllabus, Instrument Rating Syllabus, and Commercial Pilot Syllabus. Jackie is the technical editor for ASA's Test Prep series.

About ASA: Aviation Supplies & Academics, Inc. (ASA) is an industry leader in the development and sale of aviation supplies and publications for pilots, flight instructors, flight engineers, air traffic controllers, flight attendants, and aviation maintenance technicians. We manufacture and publish more than 300 products for the aviation industry. Aviators are invited to call 1-800-ASA-2-FLY for a free copy of our catalog. Visit ASA on the web:

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Preface

Welcome to ASA’s Test Prep Series. ASA’s test books have been helping pilots prepare for the FAA Knowledge Tests since 1984 with great success. We are confident that with proper use of this book, you will score very well on any of the instrument rating tests.

Begin your studies with a classroom or home-study ground school course, which will involve reading a comprehensive instrument pilot textbook. Conclude your studies with this Test Prep or comparable software. Read the question, select your choice for the correct answer, then read the explanation. Use the Learning Statement Codes and references that conclude each explanation to identify additional resources if you need further study of a subject. Upon completion of your studies, take practice tests at www.prepware.com (see inside front cover for your free account).

The FAA Instrument Rating questions have been arranged into chapters based on subject matter. Topical study, in which similar material is covered under a common subject heading, promotes better understanding, aids recall, and thus provides a more efficient study guide. Study and place emphasis on those questions most likely to be included in your test (identified by the aircraft category above each question). For example: a pilot preparing for the Instrument Airplane test (or Flight Instructor—Instrument, Airplane) would focus on the questions marked “ALL” and “AIR,” and a pilot preparing for the Instrument Helicopter test (or Flight Instructor—Instrument, Helicopter) would focus on the questions marked “ALL” and “RTC.” Those people preparing for the Instrument Ground Instructor need to study all the questions.

It is important to answer every question assigned on your FAA Knowledge Test. If in their ongoing review, the FAA authors decide a question has no correct answer, is no longer applicable, or is otherwise defective, your answer will be marked correct no matter which one you chose. However, you will not be given the automatic credit unless you have marked an answer. Unlike some other exams you may have taken, there is no penalty for “guessing” in this instance.

The FAA exams are “closed tests” which means the exact database of questions is not available to the public. The question and answer choices in this book are based on our extensive history and experience with the FAA testing process. You might see similar although not exactly the same questions on your official FAA exam. Answer stems may be rearranged from the A, B, C order you see in this book. Therefore, be careful to fully understand the intent of each question and corresponding answer while studying, rather than memorize the A, B, C answer. You may be asked a question that has unfamiliar wording; studying and understanding the information in this book and the associated references will give you the tools to answer all types of questions with confidence.

If your study leads you to question an answer choice, we recommend you seek the assistance of a local instructor. We welcome your questions, recommendations or concerns:

Aviation Supplies & Academics, Inc.
7005 132nd Place SE Voice: 425.235.1500 Fax: 425.235.0128
Newcastle, WA 98059-3153 Email: cfi@asa2fly.com Website: www.asa2fly.com

The FAA appreciates testing experience feedback. You can contact the branch responsible for the FAA Knowledge Exams at:

Federal Aviation Administration
AFS-630, Airman Testing Standards Branch
PO Box 25082
Oklahoma City, OK 73125
Email: afs630comments@faa.gov
Updates and Practice Tests

Free Test Updates for the One-Year Life Cycle of Test Prep Books

The FAA rolls out new tests as needed throughout the year. The FAA Knowledge Exams are “closed tests” which means the exact database of questions is not available to the public. ASA combines years of experience with expertise in working with the tests to prepare the most comprehensive test preparation materials available in the industry.

You can feel confident you will be prepared for your FAA Knowledge Exam by using the ASA Test Preps. ASA publishes test books each June and keeps abreast of changes to the tests. These changes are then posted on the ASA website as a Test Update.

Visit the ASA website before taking your test to be certain you have the most current information. While there, sign up for ASA’s free email Update service. We will then send you an email notification if there is a change to the test you are preparing for so you can review the Update for revised and/or new test information.

www.asa2fly.com/testupdate

We invite your feedback. After you take your official FAA exam, let us know how you did. Were you prepared? Did the ASA products meet your needs and exceed your expectations? We want to continue to improve these products to ensure applicants are prepared, and become safe aviators. Send feedback to: cfi@asa2fly.com

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Description of the Tests

All test questions are the objective, multiple-choice type, with three answer choices. Each question can be answered by the selection of a single response. Each test question is independent of other questions; that is, a correct response to one does not depend upon, or influence the correct response to another.

A significant number of the questions are “category-specific” and appear only on the airplane test or the helicopter test. The 20-question “added rating” tests are composed mostly of these category-specific questions. A 20-question “added rating” test is administered to an instrument instructor applicant (CFII) who already holds an instrument instructor rating in one category (airplane or helicopter) and wishes to meet the knowledge requirements for the other category. The category-specific questions pertain to such knowledge areas as recency of experience and weather minimums.

If you are pursuing a powered lift instrument rating, you may take either the airplane or the helicopter knowledge test. You are not required to take an additional knowledge test when you already hold an instrument rating.

For the most efficient and effective study program, begin by reading the book cover to cover. Study all the questions first, then refer to the following table, placing emphasis on those questions most likely to be included on your test (identified by the aircraft category above each question number).

<table>
<thead>
<tr>
<th>Test Code</th>
<th>Test Name</th>
<th>Test Prep Study</th>
<th>Number of Questions</th>
<th>Min. Age</th>
<th>Allotted Time (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRA</td>
<td>Instrument Rating—Airplane</td>
<td>ALL, AIR</td>
<td>60</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>IRH</td>
<td>Instrument Rating—Helicopter</td>
<td>ALL, RTC</td>
<td>60</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>IFP</td>
<td>Instrument Rating—Foreign Pilot</td>
<td>ALL &amp; AIR or RTC</td>
<td>50</td>
<td>N/A</td>
<td>2.5</td>
</tr>
<tr>
<td>FII</td>
<td>Instrument Flight Instructor—Airplane</td>
<td>ALL, AIR</td>
<td>50</td>
<td>16</td>
<td>2.5</td>
</tr>
<tr>
<td>FIH</td>
<td>Instrument Flight Instructor—Helicopter</td>
<td>ALL, RTC</td>
<td>50</td>
<td>16</td>
<td>2.5</td>
</tr>
<tr>
<td>IGI</td>
<td>Instrument Ground Instructor</td>
<td>All questions</td>
<td>50</td>
<td>16</td>
<td>2.5</td>
</tr>
<tr>
<td>AIF</td>
<td>Instrument Flight Instructor—Airplane (Added Rating)</td>
<td>ALL, AIR</td>
<td>20</td>
<td>16</td>
<td>1.0</td>
</tr>
<tr>
<td>HIF</td>
<td>Instrument Flight Instructor—Helicopter (Added Rating)</td>
<td>ALL, RTC</td>
<td>20</td>
<td>16</td>
<td>1.0</td>
</tr>
<tr>
<td>ICP</td>
<td>Instrument Rating Canadian Conversion*</td>
<td>ALL, AIR</td>
<td>40</td>
<td>18</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*This test focuses on U.S. regulations, procedures and operations, not airplane know-how.

A score of 70 percent must be attained to successfully pass each test.
ASA Test Prep Layout

The sample FAA questions have been sorted into chapters according to subject matter. Within each chapter, the questions have been further classified and all similar questions grouped together with a concise discussion of the material covered in each group. This discussion material of “Chapter text” is printed in a larger font and spans the entire width of the page. Immediately following the sample FAA Question is ASA’s Explanation in italics. The last line of the Explanation contains the Learning Statement Code and further reference (if applicable). See the EXAMPLE below.

**Figures referenced by the Chapter text only** are numbered with the appropriate chapter number, i.e., “Figure 1-1” is Chapter 1’s first chapter-text figure.

**Some Questions refer to Figures or Legends** immediately following the question number, i.e., “4201. (Refer to Figure 14.).” These are FAA Figures and Legends which can be found in the separate booklet: Computer Testing Supplement (CT-8080-XX). This supplement is bundled with the Test Prep and is the exact material you will have access to when you take your computerized test. We provide it separately, so you will become accustomed to referring to the FAA Figures and Legends as you would during the test.

**Figures referenced by the Explanation** and pertinent to the understanding of that particular question are labeled by their corresponding Question number. For example: the caption “Questions 4245 and 4248” means the figure accompanies the Explanations for both Question 4245 and 4248.

**Answers** to each question are found at the bottom of each page.

---

**EXAMPLE:**

Four aerodynamic forces are considered to be basic because they act upon an aircraft during all flight maneuvers. There is the downward-acting force called WEIGHT which must be overcome by the upward-acting force called LIFT, and there is the rearward-acting force called DRAG, which must be overcome by the forward-acting force called THRUST.

4201. (Refer to Figure 14.) The four forces acting on an airplane in flight are

A— lift, weight, thrust, and drag.
B— lift, weight, gravity, and thrust.
C— lift, gravity, power, and friction.

Lift, weight, thrust, and drag are the four basic aerodynamic forces acting on an aircraft in flight.

Answer (B) is incorrect because the force of gravity is always the same number and reacts with the airplane’s mass to produce a different weight for almost every airplane. Answer (C) is incorrect because weight is the final product of gravity, thrust is the final product of power, and drag is the final product of friction. Power, gravity, and friction are only parts of the aerodynamic forces of flight.

---

**Note:** The FAA does not identify which questions are on the different ratings’ tests. Unless the wording of a question is pertinent to only one rating category, it may be found on any of the tests.

ALL = All aircraft  AIR = Airplane  RTC = Rotorcraft (helicopter)
Chapter 1
Weather

The Earth’s Atmosphere 1–3
High Altitude Weather 1–4
Temperature 1–4
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Stable and Unstable Air 1–9
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Air Masses and Fronts 1–14
Turbulence 1–16
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Microbursts 1–20
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  Structural and Induction Icing 1–21
  Hazards of Structural Icing 1–22
  Frost and Snow 1–22
  Deice and Anti-Ice 1–22
Wind Shear 1–28
The Earth’s Atmosphere

We classify the atmosphere into layers, or spheres, by characteristics exhibited in these layers. The troposphere is the layer from the surface to an average altitude of about 7 miles (37,000 feet). It is characterized by an overall decrease of temperature with increasing altitude. The height of the troposphere varies with latitude and season. It slopes from about 20,000 feet over the poles to about 65,000 feet over the Equator; and it is higher in summer than in winter.

At the top of the troposphere is the tropopause, a very thin layer marking the boundary between the troposphere and the layer above. It is characterized by an abrupt change in temperature lapse rate.

Above the tropopause is the stratosphere. This layer is typified by relatively small changes in temperature with height except for a warming trend near the top. See Figure 1-1.

ALL 4097. A characteristic of the stratosphere is
A— an overall decrease of temperature with an increase in altitude.
B— a relatively even base altitude of approximately 35,000 feet.
C— relatively small changes in temperature with an increase in altitude.

Above the tropopause is the stratosphere. This layer is typified by relatively small changes in temperature with height except for a warming trend near the top. (PLT203) — AC 00-6A, page 2
Answer (A) is incorrect because temperature increases (not decreases) with an increase in altitude. Answer (B) is incorrect because the stratosphere fluctuates in altitude, as the base is higher at the equator compared to the poles.

ALL 4154. The average height of the troposphere in the middle latitudes is
A— 20,000 feet.
B— 25,000 feet.
C— 37,000 feet.

The height of the troposphere varies with latitude and seasons. It slopes from about 20,000 feet over the poles, to an average of 37,000 feet over the mid-latitudes, to about 65,000 feet over the Equator, and it is higher in summer than in winter. (PLT203) — AC 00-6A, page 2

ALL 4227. Which feature is associated with the tropopause?
A— Absence of wind and turbulent conditions.
B— Absolute upper limit of cloud formation.
C— Abrupt change in temperature lapse rate.

Temperature over the tropical tropopause increases with height, but temperatures over the polar tropopause remain almost constant. An abrupt change in temperature lapse rate characterizes the tropopause. (PLT203) — AC 00-6A, page 136
Answer (A) is incorrect because the winds are usually very strong in the tropopause. Answer (B) is incorrect because clouds can form above the tropopause.

Answers
4097 [C] 4154 [C] 4227 [C]
High Altitude Weather

The jet stream is a river of high speed winds (50 knots or more) associated with the tropopause. The location of the jet stream changes seasonally. In the winter, the jet stream moves south and increases in velocity. During the summer, the jet stream moves north and slows.

ALL

4155. A jet stream is defined as wind of
A— 30 knots or greater.
B— 40 knots or greater.
C— 50 knots or greater.

A jetstream occurs in an area of intensified temperature gradients characteristic of the break in the tropopause. The concentrated winds, by arbitrary definition, must be 50 knots or greater to classify as a jetstream. (PLT302) — AC 00-6A, page 136

ALL

4168. The strength and location of the jet stream is normally
A— stronger and farther north in the winter.
B— weaker and farther north in the summer.
C— stronger and farther north in the summer.

In mid-latitudes, wind speed in the jetstream averages considerably stronger in winter than in summer. Also the jet shifts farther south in winter than in summer. (PLT302) — AC 00-6A, page 137

Temperature

The major source of all weather is the sun. Changes or variations of weather patterns are caused by the unequal heating of the Earth’s surface. In aviation, surface and aloft temperature is measured in degrees Celsius (°C).

Standard temperature is 15°C at sea level. To calculate International Standard Atmosphere (ISA), use the average lapse rate of 2°C per 1,000 feet.

ALL

4095. How much colder than standard temperature is the forecast temperature at 9,000 feet, as indicated in the following excerpt from the Winds and Temperature Aloft Forecast?

FT 6000 9000
0737-04 1043-10

A— 3°C.
B— 10°C.
C— 7°C.

According to the winds and temperatures aloft forecast, the temperature is -10°C at 9,000 feet. Using the average lapse rate of 2°C per 1,000 feet, the temperature change from sea level to 9,000 feet is 18°C. Standard sea level temperature is 15°C. Subtract 18°C from 15°C to get -3°C. Compared to the winds and temperatures aloft forecast for 9,000 feet, the difference is 7°C (10 – 3). (PLT492) — AC 00-45

Answer (A) is incorrect because 3°C is the standard temperature at 9,000 feet, which is not what the question is asking for. Answer (B) is incorrect because 10°C is the given temperature at 9,000 feet, which is not what the question is asking for.

ALL

4096. The primary cause of all changes in the Earth’s weather is
A— variation of solar energy received by the Earth's regions.
B— changes in air pressure over the Earth’s surface.
C— movement of the air masses.

Every physical process of weather is accompanied by or is the result of a heat exchange. Differences in solar energy create temperature variations. These temperature variations create forces that drive the atmosphere in its endless motion. (PLT510) — AC 00-6A, page 7

Answer (B) is incorrect because changes in air pressure are due to temperature variations. Answer (C) is incorrect because movement of air masses is a result of varying temperatures and pressures.

Answer (A) is incorrect because variation of solar energy is not the primary cause of all changes in the Earth’s weather. Answer (C) is incorrect because movement of air masses is a result of varying temperatures and pressures.
4113. If the air temperature is +8°C at an elevation of 1,350 feet and a standard (average) temperature lapse rate exists, what will be the approximate freezing level?
A—3,350 feet MSL.
B—5,350 feet MSL.
C—9,350 feet MSL.

Temperature normally decreases with increasing altitude throughout the troposphere. This decrease of temperature with altitude is defined as lapse rate. The average decrease of temperature (average lapse rate) in the troposphere is 2°C per 1,000 feet. An 8°C loss is necessary to reach 0°C, or freezing, in this situation. At 2°/1,000 feet the amount of altitude gain necessary would be:
1. $8°C ÷ 2 = 4$ or 4,000 ft
2. $1,350$ ft MSL (altitude at +8°C) + $4,000$ ft (altitude gain necessary to reach 0°C) = 5,350 ft MSL (approximate freezing level)

4094. A common type of ground or surface based temperature inversion is that which is produced by
A—radiation on a clear, relatively still night.
B—warm air being lifted rapidly aloft in the vicinity of mountainous terrain.
C—the movement of colder air under warm air, or the movement of warm air over cold air.

An inversion often develops near the ground on clear, cool nights when wind is light. The ground radiates and cools much faster than the overlying air. Air in contact with the ground becomes cold while the temperature a few hundred feet above changes very little. Thus, temperature increases with height.

4112. The most frequent type of ground- or surface-based temperature inversion is that produced by
A—radiation on a clear, relatively still night.
B—warm air being lifted rapidly aloft in the vicinity of mountainous terrain.
C—the movement of colder air under warm air, or the movement of warm air over cold air.

An inversion often develops near the ground on clear, cool nights when wind is light. The ground radiates and cools much faster than the overlying air. Air in contact with the ground becomes cold while the temperature a few hundred feet above changes very little. Thus, temperature increases with height.

4114. What feature is associated with a temperature inversion?
A—A stable layer of air.
B—An unstable layer of air.
C—Air mass thunderstorms.

A temperature inversion occurs when the temperature increases with altitude. A stable layer of air is characterized by warmer air lying above colder air. With an inversion, the layer is stable and convection is suppressed.

4125. A temperature inversion will normally form only
A—in stable air.
B—in unstable air.
C—when a stratiform layer merges with a cumuliform mass.

If the temperature increases with altitude through a layer (an inversion), the layer is stable and convection is suppressed. Air may be unstable beneath the inversion.

Answers
Wind

The rules in the Northern Hemisphere are:

1. Air circulates in a clockwise direction around a high pressure system.
2. Air circulates in a counterclockwise direction around a low pressure system.
3. The closer the isobars are together, the stronger the wind speed.
4. Due to surface friction (up to about 2,000 feet AGL), surface winds do not exactly parallel the isobars, but move outward from the center of the high toward lower pressure.
5. Coriolis force is at a right angle to wind direction and directly proportional to wind speed. The force deflects air to the right in the Northern Hemisphere.

ALL

4200. Which weather conditions should be expected beneath a low-level temperature inversion layer when the relative humidity is high?

A—Smooth air and poor visibility due to fog, haze, or low clouds.
B—Light wind shear and poor visibility due to haze and light rain.
C—Turbulent air and poor visibility due to fog, low stratus-type clouds, and showery precipitation.

A ground-based inversion favors poor visibility by trapping fog, smoke, and other restrictions into low levels of the atmosphere. Wind just above the inversion may be relatively strong. A wind shear zone develops between the calm and the stronger winds above. Eddies in the shear zone cause airspeed fluctuations as an aircraft climbs or descends through the inversion. (PLT301) — AC 00-6A, pages 10 and 88

Answer (B) is incorrect because wind shear may be expected within (not beneath) a low-level temperature inversion. Answer (C) is incorrect because inversions cause steady precipitation and create a stable layer of air, thus making it smooth (not turbulent).

ALL

4105. What causes surface winds to flow across the isobars at an angle rather than parallel to the isobars?

A—Coriolis force.
B—Surface friction.
C—The greater density of the air at the surface.

Friction between the wind and the surface slows the wind. As frictional force slows the wind speed, Coriolis force decreases. However, friction does not affect pressure gradient force. Pressure gradient and Coriolis forces are no longer in balance. The stronger pressure gradient force turns the wind at an angle across the isobars toward lower pressure until the three forces balance. The angle of surface wind to isobars is about 10° over water, increasing with roughness of terrain. (PLT516) — AC 00-6A, page 30

Answer (A) is incorrect because as wind decreases, so does the Coriolis force. Answer (C) is incorrect because the density of the air has little effect on the relation to the winds and the isobars.