80 YEARS

Instructor

2020 TEST PREP

5 FREE ONLINE PRACTICE TESTS
ACTIVATION CODE INCLUDED

Study & Prepare

Pass your test and know what is essential to become a safe, competent flight or ground instructor—from the most trusted source in aviation training

Instructor
2020 TEST PREP

Study & Prepare

Pass your test and know what is essential to become a safe, competent flight or ground instructor—from the most trusted source in aviation training

READER TIP

The FAA Knowledge Exam Questions can change throughout the year. Stay current with test changes; sign up for ASA's free email update service at **asa2fly.com/testupdate**

AVIATION SUPPLIES & ACADEMICS
NEWCASTLE, WASHINGTON

Instructor Test Prep
2020 Edition

Aviation Supplies & Academics, Inc.
7005 132nd Place SE
Newcastle, Washington 98059-3153
425.235.1500 | asa2fly.com

Important: This Test Prep should be sold with and used in conjunction with *Airman Knowledge Testing Supplement for Flight Instructor, Ground Instructor, and Sport Pilot Instructor* (FAA-CT-8080-5G). ASA reprints the FAA test figures and legends contained within this government document, and it is also sold separately and available from aviation retailers nationwide. Order #ASA-CT-8080-5G.

Cover photo: Heritage Image Partnership Ltd/Alamy Stock Photo/The Print Collector

ASA-TP-CFI-20-PD

PDF eBook ISBN 978-1-61954-787-2

Print Book ISBN 978-1-61954-786-5

About the Contributor

Jackie Spanitz
Director of Curriculum Development
Aviation Supplies & Academics, Inc.

As General Manager of Aviation Supplies & Academics, Jackie Spanitz oversees maintenance and development of more than 1,000 titles and pilot supplies in the ASA product line. Ms. Spanitz has worked with airman training and testing for more than 25 years, including participation in the ACS development committees. Jackie holds a Bachelor of Science degree in aviation technology from Western Michigan University, a Masters degree from Embry Riddle Aeronautical University, and Instructor and Commercial Pilot certificates. She is the author of *Guide to the Flight Review*, and the technical editor for ASA's *Test Prep* and *FAR/AIM* 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, aviation maintenance technicians, and drone operators. We manufacture and publish more than 1,000 products, and have been providing trusted and reliable training materials to the aviation industry for 80 years. Visit **asa2fly.com** for a free catalog.

Contents

Instructions

Preface vii
Updates and Practice Tests viii
Description of the Tests ix
Knowledge Test Eligibility Requirements x
Process for Taking a Knowledge Test x
Use of Test Aids and Materials xiii
Retesting Procedures xiv
Cheating or Other Unauthorized Conduct xiv
Eligibility Requirements for the Flight Instructor Certificates xv
Knowledge Exam References xix
ASA Test Prep Layout xx

Chapter 1 **Fundamentals of Instructing**

The Learning Process 1–3
Human Behavior 1–22
Effective Communications 1–27
The Teaching Process 1–30
Teaching Methods 1–31
The Instructor as a Critic 1–39
Evaluation 1–41
Instructional Aids 1–48
Flight Instructor Characteristics and Responsibilities 1–50
Techniques of Flight Instruction 1–57
Planning Instructional Activity 1–61

Chapter 2 **Aerodynamics and the Principles of Flight**

The Axes of an Aircraft 2–3
Airfoils and Aerodynamic Shapes 2–4
The Aerodynamic Forces 2–6
The Balance of Forces 2–11
Maneuverability, Controllability, and Stability 2–15
Aerodynamic Efficiency 2–20
Load Factors and Maneuvering Speed 2–21
Stalls and Spins 2–24
Wing Shapes 2–27
High-Lift Devices 2–30
Ground Effect 2–31
Principles of Rotorcraft Flight 2–33
Gyroplane Aerodynamics 2–38
Glider Aerodynamics 2–43
Balloon Aerodynamics 2–45
Weight-Shift Control Aerodynamics 2–50
Powered Parachute Aerodynamics 2–52

Chapter 3 **Aircraft Systems**

Magnetic Compass 3–3
Pitot-Static Instruments 3–5
Gyroscopic Instruments 3–10
Automation Management 3–11
The Electrical System 3–12
Oxygen Systems 3–13
Cold Weather Operation 3–14
The Powerplant 3–14
The Ignition System 3–17
Fuel Systems 3–18
Fuel-Air Mixture Control 3–24
Induction Systems 3–27
Detonation 3–28
Propeller Design 3–29
Propeller Forces 3–31
Critical Engine of a Multi-Engine Airplane 3–33
Constant-Speed Propellers 3–34
Rotorcraft Systems 3–35
Glider Instrumentation 3–37
Balloon Fuel Systems 3–38
Light-Sport Aircraft Systems 3–40

Chapter 4 **Aircraft Performance**

Altitude.............. 4–3
Effect of Density Altitude on Aircraft Performance.............. 4–3
Takeoff Performance 4–7
Climb Performance.............. 4–12
Range Performance 4–13
Glide Distance 4–14
Stall Speed Performance.............. 4–15
Landing Performance 4–16
Multi-Engine Performance 4–18
Wind Components.............. 4–20
Helicopter Performance.............. 4–24
Balloon Performance.............. 4–25
Principles of Weight and Balance.............. 4–27
The Law of the Lever.............. 4–32
Finding the Center of Gravity.............. 4–35
Weight to be Added or Removed.............. 4–39
Weight to be Shifted 4–42
Helicopter Weight and Balance 4–44

Chapter 5 **Weather and Weather Services**

The Earth's Atmosphere.............. 5–3
Temperature, Pressure and Density.............. 5–4
Wind 5–6
Moisture and Precipitation.............. 5–8
Stable and Unstable Air.............. 5–10
Clouds 5–11
Air Masses and Fronts.............. 5–13
Turbulence.............. 5–16
Icing.............. 5–18
Thunderstorms 5–20
Fog 5–22
High-Altitude Weather 5–24
Soaring Weather.............. 5–24
Aviation Routine Weather Report (METAR) 5–28
Pilot Reports (UA).............. 5–31
Terminal Aerodrome Forecast (TAF) 5–32
Graphical Forecasts for Aviation (GFA).............. 5–34
Winds and Temperatures Aloft Forecast (FB).............. 5–34
In-Flight Weather Advisories (WA, WS, WST).............. 5–35
Surface Analysis Chart 5–36
Constant Pressure Analysis Charts.............. 5–38
Convective Outlook Chart.............. 5–39

Chapter 6 **Enroute Flight and Navigation**

Enroute Flight 6–3
The Wind Triangle 6–10
The Flight Computer.............. 6–11
Finding Time, Distance, Ground Speed 6–11
Finding Magnetic Heading and Ground Speed 6–14
Finding Wind Direction and Velocity 6–16
Finding Distance Traveled 6–17
Finding Fuel Required.............. 6–18
Finding Range Available.............. 6–19
Finding the Required Airspeed.............. 6–20
Off-Course Correction 6–22
Very High Frequency Omni-Directional Range (VOR) 6–24
Time and Distance to the Station Using VOR 6–25
VOR Test (VOT).............. 6–27
VORTAC.............. 6–27
Distance Measuring Equipment (DME) 6–28

Chapter 7 **Procedures and Airport Operations**

Airspace.............. 7–3
Chart Supplements U.S. 7–13
Runway Gradient.............. 7–13
Control Tower Operating Hours 7–13
Notices to Airmen (NOTAM) 7–14
Communications.............. 7–15
Airport Lighting 7–17
Airport Marking Aids and Signs 7–20
Airport Operation 7–24
Wake Turbulence.............. 7–26
Flight Plans.............. 7–28

Chapter 8 **Regulations**

Definitions and Abbreviations 8–3
Accident Reports 8–4
Required Documents.. 8–6
Medical Certificates 8–8
Student Pilot Certification 8–10
Recreational Pilot Certification 8–14
Private Pilot Certification 8–15
Commercial Pilot Certification 8–17
Ground and Flight Instructor Certification........... 8–19
Flight Instructors with a Sport Pilot Rating 8–20
Flight Instruction, Reviews and Records 8–24
Required Endorsements.................................... 8–26
Pilot Tests 8–28
Presolo Requirements 8–31
Recency of Experience...................................... 8–31
Change of Permanent Mailing Address 8–33
Glider Towing... 8–33
Emergency Deviation from Rules 8–34
Preflight Planning 8–35
Use of Seatbelts 8–36
Alcohol and Drugs 8–36
Parachutes 8–37
Safety Pilot Requirements 8–38
Fuel Reserve Requirements.............................. 8–38
Transponder Requirements............................... 8–39
Minimum Equipment Lists 8–40
Supplemental Oxygen 8–40
Lighting Requirements....................................... 8–41
Emergency Locator Transmitter 8–43
Formation Flights and Right-of-Way.................. 8–44
Maximum Authorized Speeds............................ 8–45
Distance from Obstructions 8–45
Flight Plan Airspeed... 8–46
Flight from Noncontrolled Airports 8–46
VFR Cruising Altitudes....................................... 8–47
Maintenance, Preventive Maintenance and Alterations 8–47
Rotorcraft Regulations....................................... 8–50
Gyroplane Regulations...................................... 8–53
Glider Regulations 8–53
Balloon Regulations... 8–55

Chapter 9 **Flight Instruction and Maneuvers**

Taxiing 9–3
Takeoffs 9–4
Turns 9–5
Turbulence and Wind Correction......................... 9–8
Approaches and Landings.................................. 9–9
Rectangular Course.. 9–13
Turns Around a Point.. 9–14
S-Turns... 9–16
Eights-On-Pylons.. 9–17
Stalls and Slow Flight 9–19
Steep Turns 9–21
Chandelles.. 9–22
Lazy Eights 9–24
Flight by Reference to Instruments................... 9–26
Helicopter Operation... 9–38
Helicopter Controls... 9–38
Takeoffs and Hovering.................................... 9–42
Autorotation 9–42
Retreating Blade Stall..................................... 9–46
Settling with Power 9–47
Slope Operation 9–48
Rapid Decelerations 9–49
Pinnacle Approaches 9–50
Running Landings 9–50
Gyroplane Flight Operation 9–51
Glider Flight Operation 9–52
Balloon Flight Operation................................... 9–56

Chapter 10 **Flight Physiology**

Principles of Flight Instruction........................... 10–3
Fitness for Flight 10–9
Supplemental Oxygen 10–10
Spatial Disorientation, Vertigo, and Visual Illusions 10–13
Motion Sickness 10–15
Collision Avoidance 10–15

Cross References

A: Question Number and Page Number A–1
B: Learning Statement Code and Question Number...................................... B–1

Preface

Welcome to ASA's Test Prep Series. ASA's test books have been helping pilots prepare for the FAA Knowledge Tests for more than 60 years with great success. We are confident that with proper use of this book, you will score very well on any of the flight instructor certificate tests.

Begin your studies with a classroom or home-study ground school course, which will involve reading a comprehensive textbook. Fundamentals of Instructing (FOI) applicants should thoroughly review the most current edition of the *Aviation Instructor's Handbook* (FAA-H-8083-9). 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 Flight Instructor 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 above each question). For example: a candidate preparing for the Flight Instructor–Airplane test would focus on the questions marked "ALL" and "AIR," and a candidate preparing for the Flight Instructor–Rotorcraft test would focus on the questions marked "ALL" and "RTC." Those preparing for the add-on tests (people who hold a Flight Instructor certificate in one category and are transitioning to another) would focus on the questions marked with that category (AIR, RTC, GLI, LSA, WSC, or PPC). Ground Instructors are responsible for all aircraft categories, and therefore need to study all the questions in the database (other than Chapter 1, Fundamentals of Instructing — this is a separate test).

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 question variations 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 exams are "closed tests" which means the exact database of questions is not available to the public. ASA combines more than 60 years of experience with expertise in airman training and certification tests to prepare the most effective 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**

Knowledge Exam References

The FAA references the following documents to write the FAA Knowledge Exam questions. You should be familiar with all of these as part of your ground school studies, which you should complete before starting test preparation:

FAA-G-8082-7 *Flight and Ground Instructor Test Guide*

FAA-H-8083-9 *Aviation Instructor's Handbook*

FAA-H-8083-25 *Pilot's Handbook of Aeronautical Knowledge*

FAA-H-8083-2 *Risk Management Handbook*

FAA-H-8083-3 *Airplane Flying Handbook*; FAA-H-8083-13 *Glider Flying Handbook*; FAA-H-8083-21 *Helicopter Flying Handbook*; FAA-H-8083-11 *Balloon Flying Handbook*; FAA-H-8083-5 *Weight-Shift Control Handbook*; FAA-H-8083-29 *Powered Parachute Handbook*

FAA-H-8083-1 *Aircraft Weight and Balance Handbook*

FAA-H-8083-15 *Instrument Flying Handbook*

FAA-S-8081-6 *Flight Instructor Airplane Practical Test Standards*; FAA-S-8081-29 *Sport Instructor Airplane Practical Test Standards*; or FAA-S-8081-7 *Flight Instructor Helicopter Practical Test Standards*

FAA-S-ACS-6 *Private Pilot Airplane Airman Certification Standards*

FAA-S-ACS-7 *Commercial Pilot Airplane Airman Certification Standards*; or FAA-S-8081-16 *Commercial Pilot Helicopter Practical Test Standards*

Chart Supplements U.S. (previously Airport/Facility Directory or A/FD)

Sectional Aeronautical Chart (SAC)

AC 00-6 *Aviation Weather*

AC 00-45 *Aviation Weather Services*

AC 20-43 *Aircraft Fuel Control*

AC 61-65 *Certification: Pilots, Flight and Ground Instructors*

AC 61-67 *Stall and Spin Awareness Training*

AC 61-107 *Operations of Aircraft at Altitudes Above 25,000 MSL*

AC 68-1 *BasicMed*

AC 90-48 *Pilots' Role in Collision Avoidance*

AC 91-13 *Cold Weather Operation of Aircraft*

AC 91-43 *Unreliable Airspeed Indications*

AC 91-51 *Effect of Icing on Aircraft Control and Airplane Deice and Anti-Ice Systems*

Aeronautical Information Manual (AIM)

14 CFR Parts 1, 43, 61, 68, 71, 91, 121

49 CFR Part 830

Visit the ASA website for these and many more titles and pilot supplies for your aviation endeavors: **www.asa2fly.com**

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., "6201. (Refer to Figure 14.)." These are FAA Figures and Legends which can be found in the separate booklet: *Airman Knowledge 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 6245 and 6248" means the figure accompanies the Explanations for both Question 6245 and 6248.

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

EXAMPLE:

Chapter text

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.

Category rating. This question may be found on tests for these ratings.*

ALL, AIR, RTC, GLI, LTA, FOI, PPC, WSC, LSA, MCI

6201. (Refer to Figure 14.) The four forces acting on an airplane in flight are

See separate book: *Airman Knowledge Testing Supplement* (CT-8080-XX)

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

Question and answer choices

Lift, weight, thrust, and drag are the four basic aerodynamic forces acting on an aircraft in flight.
(PLT235) — FAA-H-8083-25

Explanation

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.

Code line. FAA Learning Statement Code in parentheses, followed by references for further study.

Incorrect answer explanation. Reasons why answer choices are *incorrect* explained here.

* **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   GLI = Glider   LTA = Lighter-Than-Air   FOI = Fundamentals of Instructing
RTC = Rotorcraft (applies to both helicopter and gyroplane)   PPC = Powered Parachute   WSC = Weight-Shift Control
LSA = Light-Sport Aircraft Airplane   MCI = Military Competency Instructor

Chapter 5
Weather and Weather Services

The Earth's Atmosphere *5–3*

Temperature, Pressure and Density *5–4*

Wind *5–6*

Moisture and Precipitation *5–8*

Stable and Unstable Air *5–10*

Clouds *5–11*

Air Masses and Fronts *5–13*

Turbulence *5–16*

Icing *5–18*

Thunderstorms *5–20*

Fog *5–22*

High-Altitude Weather *5–24*

Soaring Weather *5–24*

Aviation Routine Weather Report (METAR) *5–28*

Pilot Reports (UA) *5–31*

Terminal Aerodrome Forecast (TAF) *5–32*

Graphical Forecasts for Aviation (GFA) *5–34*

Winds and Temperatures Aloft Forecast (FB) *5–34*

In-Flight Weather Advisories (WA, WS, WST) *5–35*

Surface Analysis Chart *5–36*

Constant Pressure Analysis Charts *5–38*

Convective Outlook Chart *5–39*

The Earth's Atmosphere

The earth's atmosphere is a mixture of gases made up primarily of nitrogen and oxygen. The atmosphere is in layers, with each layer having its own characteristics:

Troposphere — This is the layer nearest the surface. It extends upward for about 7 miles, and it has all of our weather because it contains water vapor. Temperature decreases steadily with altitude in the troposphere.

Tropopause — This is the boundary between the troposphere and the stratosphere. The tropopause 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.

Stratosphere — This is the layer above the troposphere in which there is relatively little change of temperature with altitude, except for a warming trend near the top.

Energy received from the sun is the primary driving force of the weather on the earth. The earth receives energy from the sun in the form of solar radiation. The earth and its atmosphere reflect about 55% of the radiation and absorb the remaining 45%, converting it to heat. The earth in turn radiates energy, and this outgoing radiation is called "terrestrial radiation."

The standard temperature of the atmosphere at mean sea level is 15°C and 59°F. The standard pressure at mean sea level is 29.92 inches of mercury, 1013.2 millibars, and 14.69 pounds per square inch.

ALL

6161. In what part of the atmosphere does most weather occur?

A — Tropopause.
B — Troposphere.
C — Stratosphere.

Most of the weather occurs in the lower layer of our atmosphere, which is called the troposphere. (PLT203) — AC 00-6

ALL

6162. Which is the primary driving force of weather on the Earth?

A — The Sun.
B — Coriolis.
C — Rotation of the Earth.

Energy received from the sun is the primary driving force of the weather on the earth. (PLT492) — AC 00-6

ALL

6173. What are the standard temperature and pressure values for mean sea level?

A — 15°F and 29.92" Hg.
B — 59°C and 29.92 mb.
C — 59°F and 1013.2 mb.

The standard sea level temperature is 15°C (59°F), and the standard sea level atmospheric pressure is 29.92 inches of mercury, or 1013.2 millibars. (PLT206) — AC 00-6

Answers

6161 [B]   6162 [A]   6173 [C]

Temperature, Pressure and Density

Almost all weather is caused by heat transferred to the earth by the sun, through solar radiation. Much of this energy is reradiated, but that which is retained is converted into heat.

The temperature of the air in the troposphere decreases with altitude at a rate of 2°C per 1,000 feet. This is called the **average lapse rate**. There are two other lapse rates that are of interest to pilots: dry adiabatic lapse rate and moist adiabatic lapse rate. The dry adiabatic lapse rate is the change in temperature with altitude for unsaturated air; it is 3°C per 1,000 feet. Moist adiabatic lapse rate is the change in temperature with altitude for saturated air. Because of the condensation of moisture from this air, the moist adiabatic lapse rate is less than the dry adiabatic lapse rate. The actual rate depends upon the dew point of the air. When we know the temperature at any given level and the lapse rate, we can find the freezing level:

1. Find the difference between the existing temperature and freezing temperature (0°C).
2. Divide this difference in temperature by 2 to find the number of thousand feet above the existing level at which the temperature will be 0°C.

A **temperature inversion** is a change in temperature in which the air gets warmer as the altitude increases. A surface inversion occurs when terrestrial radiation on a clear night cools the surface of the land and lowers the temperature of the air immediately above the surface. The air temperature increases with altitude for a few hundred feet. An inversion aloft occurs when a current of warm air aloft overruns cold air near the surface. A low-level temperature inversion with high relative humidity will trap fog, smoke, low clouds, and other restrictions to visibility. The air will normally be smooth in an inversion.

Pressure altitude is the altitude measured above the standard pressure level at sea level of 29.92" of mercury (Hg), or 1013.2 millibars (mb). In the lower levels of the troposphere, the atmospheric pressure decreases approximately 1" Hg for each 1,000-foot increase in altitude. We can find the pressure altitude by setting the barometric scale of the altimeter to 29.92" Hg, or 1013.2 mb, and reading the altimeter indication. We can also compute the approximate pressure altitude by using this standard lapse rate of 1" Hg per 1,000 feet. If the altimeter indicates 1,850 feet when the barometric scale is set to 30.18 inches of mercury, it would indicate 260 feet lower if it were set to the standard sea level pressure of 29.92" Hg.

The density of the air is affected by its temperature, pressure, and moisture content. It is the density of the air that determines the performance of an aircraft engine and the aerodynamic forces that are produced by an airfoil. **Density altitude** is the altitude in standard air where the density is the same as that of the existing air. It is found by correcting pressure altitude for nonstandard temperature. As the density of the air decreases because of an increase in temperature or water vapor, or a decrease in pressure, the density altitude increases. An airspeed indicator is a differential pressure indicator which measures the dynamic pressure of the air. When the density of the air decreases, the static pressure will decrease and the true airspeed will increase.

ALL

6163. The average lapse rate in the troposphere is

A— 2.0°C per 1,000 feet.
B— 3.0°C per 1,000 feet.
C— 5.4°C per 1,000 feet.

The average lapse rate (change in temperature with altitude) is 2°C per 1,000 feet. (PLT203) — AC 00-6

Answers

6163 [A]

ALL

6166. If the air temperature is +6°C at an elevation of 700 feet and a standard (average) temperature lapse rate exists, what will be the approximate freezing level?

A— 6,700 feet MSL.
B— 3,700 feet MSL.
C— 2,700 feet MSL.

The air temperature is +6°C at an elevation of 700 feet, and the air cools 2°C each thousand feet. For the moisture to freeze, the air must cool to a temperature of 0°C. Its temperature must drop 6°, which will require 3,000 feet. The freezing level will be 3,000 + 700 feet, or 3,700 feet MSL. (PLT492) — AC 00-6

ALL

6167. If the air temperature is +12°C at an elevation of 1,250 feet and a standard (average) temperature lapse rate exists, what will be the approximate freezing level?

A— 7,250 feet MSL.
B— 5,250 feet MSL.
C— 4,250 feet MSL.

The air temperature is +12°C at an elevation of 1,250 feet, and the air cools 2°C each thousand feet. For the moisture to freeze, the air must cool to a temperature of 0°C. This will be 12 ÷ 2 = 6,000 feet above the surface of 1,250 feet (6,000 + 1,250). Therefore, the freezing level is 7,250 feet MSL. (PLT492) — AC 00-6

ALL

6167-1. An increase in temperature with an increase in altitude

A— is indication of an inversion.
B— denotes the beginning of the stratosphere.
C— means a cold front passage.

An increase in temperature with altitude is defined as an inversion; i.e., the lapse rate is inverted. (PLT512) — AC 00-6

ALL

6167-2. A surface inversion can

A— indicate the chance of gusty winds.
B— produce poor visibility.
C— mean an unstable air mass.

A surface inversion can place a strong "lid" above smoke and haze. The result is poor visibility in the lower levels of the atmosphere, especially near industrial areas. (PLT512) — AC 00-6

ALL

6164. The most frequent type of ground- or surface-based temperature inversion is that produced by

A— terrestrial 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.

Terrestrial radiation on a clear night cools the surface of the land and lowers the temperature of the air immediately above the surface. This causes a surface inversion in which the air temperature increases with altitude for a few hundred feet. (PLT301) — AC 00-6

Answer (B) is incorrect because this describes how upslope fog is produced. Answer (C) is incorrect because this describes temperature inversions aloft.

ALL

6165. Which weather conditions should be expected beneath a low-level temperature inversion layer when the relative humidity is high?

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

A low-level temperature inversion with high relative humidity will trap fog, smoke, low clouds, and other restrictions to visibility. The air will normally be smooth in an inversion. (PLT301) — AC 00-6

ALL

6168. An altimeter indicates 1,850 feet MSL when set to 30.18. What is the approximate pressure altitude?

A— 1,590 feet.
B— 1,824 feet.
C— 2,110 feet.

In the lower levels of the troposphere, the atmospheric pressure decreases approximately 1" Hg for each 1,000-foot increase in altitude, and pressure altitude is based on a sea level pressure of 29.92" Hg. If the altimeter indicates 1,850 feet MSL when it is set to 30.18" Hg, it will indicate 260 feet lower when it is set to 29.92" Hg (30.18 – 29.92 = .26). Therefore, the pressure altitude is 1,590 feet (1,850 – 260 = 1,590). (PLT041) — AC 00-6

Answers

6166 [B]	6167 [A]	6167-1 [A]	6167-2 [B]	6164 [A]	6165 [B]
6168 [A]					

ALL

6169. An aircraft is flying at a constant power setting and constant indicated altitude. If the outside air temperature (OAT) increases, true airspeed will

A— increase and true altitude will decrease.
B— increase and true altitude will increase.
C— decrease and true altitude will increase.

True airspeed and true altitude are based on the existing outside air temperature, which affects the density of the air. While flying at a constant power setting and a constant indicated altitude, an increase in OAT will cause the air to become less dense. Both the true airspeed and the true altitude will increase. (PLT127) — AC 00-6

ALL

6170. An aircraft is flying at a constant power setting and constant indicated altitude. If the outside air temperature (OAT) decreases, true airspeed will

A— decrease, and true altitude will decrease.
B— increase, and true altitude will increase.
C— increase, and true altitude will decrease.

True airspeed and true altitude are based on the existing outside air temperature, which affects the density of the air. While flying at a constant power setting and a constant indicated altitude, a decrease in OAT will cause the air to become more dense, and the true airspeed will decrease and the true altitude will be lower than indicated altitude. (PLT206) — AC 00-6

ALL

6171. As density altitude increases, which will occur if a constant indicated airspeed is maintained in a no-wind condition?

A— True airspeed increases; groundspeed decreases.
B— True airspeed decreases; groundspeed decreases.
C— True airspeed increases; groundspeed increases.

True airspeed is based on the density of the air, which is affected by pressure, temperature, and humidity which together determine air density. While flying at a constant indicated airspeed, an increase in density altitude will indicate that the air has become less dense, and the true airspeed as well as ground speed will increase. (PLT127) — AC 00-6

ALL

6172. Density altitude may be determined by correcting

A— true altitude for nonstandard temperature.
B— pressure altitude for nonstandard temperature.
C— indicated altitude for temperature variations.

Density altitude is the altitude in the standard atmosphere where the air density is the same as where you are. Density altitude is found by correcting pressure altitude for nonstandard temperature. (PLT127) — AC 00-6

Wind

Differences in temperature create differences in pressure, and these pressure differences cause winds to blow. We can tell a lot about the wind by studying weather maps that show lines of equal barometric pressure, called **isobars**. When isobars are close together on a surface weather map, the pressure gradient is steep. There is a large amount of pressure change in a small distance, and the wind velocities are strong. Wind blows from an area of high pressure into an area of low pressure, but it does not cross the isobars at right angles.

The **Coriolis Force**, caused by the rotation of the earth, acts at right angles to the wind, and in the Northern Hemisphere it deflects the wind to the right until it blows parallel to the isobars.

There is a third force that acts on the wind to change its direction. This is **friction** between the wind and the surface over which it is blowing. Friction slows the wind. The rougher the terrain and the stronger the wind speed, the greater the frictional effect. As the frictional force slows the windspeed, the Coriolis Force decreases but friction does not affect the pressure gradient force, and the 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 the low pressure area.

Answers

6169 [B]	6170 [A]	6171 [C]	6172 [B]

The winds at altitude pretty much follow the isobars, but because of friction, surface winds flow at an angle across the isobars. In the Northern Hemisphere, the wind flows around a low pressure area in a counterclockwise direction. This is called **cyclonic flow**. When planning a long east to west flight, you can get an advantage from the winds by flying to the north of a low pressure area and to the south of a high pressure area. *See* Figure 5-1. The wind circulation in the Northern Hemisphere is clockwise out of a high and counterclockwise into a low. When flying from a high-pressure area into a low-pressure area, the wind will blow from the left.

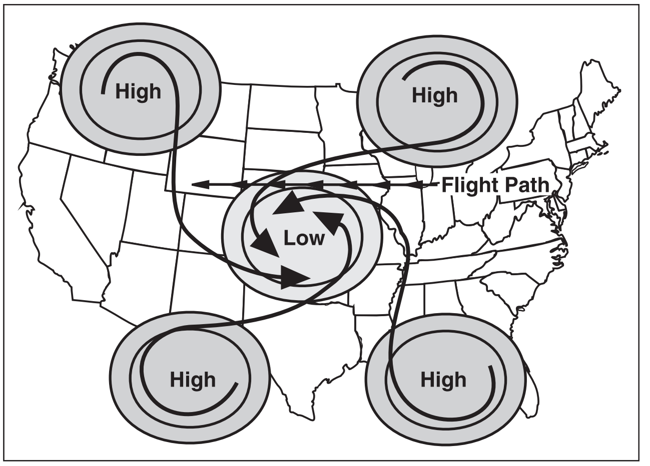

Figure 5-1. Wind circulation in the Northern Hemisphere

The wind velocities are generally greater in a low-pressure area than in a high-pressure area, so when flying from a high pressure into a low, the wind velocities will be increasing. Air flowing counterclockwise into a low-pressure area cannot flow outward against the pressure gradient, nor can it go downward into the ground; it must go upward. Therefore, a low pressure area, or **trough**, is an area of rising air. Air moving out of a high, or **ridge**, flows in a clockwise direction and depletes the quantity of air. Highs and ridges, therefore, are areas of descending air.

Convective circulation patterns associated with sea breezes occur because land surfaces warm and cool more rapidly than do water surfaces. The land is warmer than the sea during the day and wind blows from the cool water to warm land. At night the wind reverses and blows from the cool land to warmer water.

ALL
6174. What causes wind?

A— Coriolis force.
B— Pressure differences.
C— The rotation of the Earth.

Wind, which is the movement of air, is caused by pressure differences in the atmosphere. (PLT516) — AC 00-6

ALL
6175. The windflow around a low pressure is

A— cyclonic.
B— adiabatic.
C— anticyclonic.

Because of the Coriolis Force, the wind flow around a low-pressure area in the Northern Hemisphere is counterclockwise. This direction of flow is called cyclonic flow. (PLT516) — AC 00-6

Answer (B) is incorrect because adiabatic refers to the cooling of air as it rises. Answer (C) is incorrect because anticyclonic refers to a high-pressure system.

ALL
6176. Winds at 5,000 feet AGL on a particular flight are southwesterly while most of the surface winds are southerly. This difference in direction is primarily due to

A— local terrain effects on pressure.
B— stronger Coriolis force at the surface.
C— friction between the wind and the surface.

Friction between the wind and the surface of the earth slows the wind and decreases the effect of the Coriolis Force. Since friction does not decrease the pressure gradient, the Coriolis Force and pressure gradient are not in balance near the surface, and the force of the pressure gradient turns the wind at an angle across the isobars toward the lower pressure. This action explains the shift of wind from southerly near the surface to southwesterly at 5,000 feet. (PLT516) — AC 00-6

Answers

6174 [B] 6175 [A] 6176 [C]