PART 107 MADE EASY

161 Question and Answer Study Guide.

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Purpose of this Study Guide

Unmanned Aerial Vehicles (UAVs), Small Unmanned Aerial Systems (sUAS) and "drones" are aircraft that have rapidly increased in popularity from being a hobby to a multimillion-dollar business. Almost every news station has drone operators with cameras to capture all manner of events and breaking news. Drones can also be used to inspect tall structures, aid in police operations, monitor events, survey property, advertise real estate, and much more. Basic UAV operation is easy to learn, and many popular drone models are not terribly expensive, making this technology accessible to almost everyone.

UAVs have inherent capabilities that were previously unavailable at such a huge scale and can be perceived to be improper or illegal (i.e., "spying" on neighbors) or hazardous (flying over crowds of people and stadiums). Moreover, just like any vehicle, drones can pose hazards to people and property if not safely operated and maintained.

As a result, the Federal Aviation Administration (FAA) has formulated rules that permit the commercial use of UAVs in a manner that is safe and does not endanger people, property, and other aircraft while allowing the widest possible use of this technology. The FAA does not apply this regulation to hobbyists or hobby UAVs, provided they are operated in the spirit of recreational activities.

The FAA views UAVs in commercial operations as "aircraft," their operators as pilots, and their operation subject to FAA oversight and regulations just as they are responsible for manned aircraft operations.

UAV operators are regarded as "pilots" who are expected to understand the National Airspace System (NAS) in which UAVs are operated, and certain rules and regulations are implemented to ensure the safe operation of UAVs.

The key to this safe operation is the pilot operating the UAV. This individual is operating an aircraft in US airspace and is expected to follow a set of rules similar to those that apply to any pilot. This requires not only the ability to fly and maneuver the UAV competently, but also a certain level of knowledge on factors that affect the operation of UAVs. These factors include the different features of the NAS, safety, weather, coordination with local airports, air traffic control, potential hazards, and occasional emergencies.

As a result, the FAA promulgated the Small Unmanned Aircraft Regulations (sUAS) (Part 107 of the Federal Aviation Regulations), similar to Parts 61 and 91 that are applicable to manned aircraft.

Note: We have created this guide to help you pass the Part 107 guide. We have spent hundreds of hours on this guide and we have tried to make it accurate. However, it's your responsibility to keep up-to-date and verify the contents of this guide before flying your drone.

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KNOWLEDGE TEST DESCRIPTION

A key aspect of Part 107 for commercial UAV pilots is the requirement to demonstrate sufficient knowledge to operate a UAV safely and in accordance with applicable Federal Aviation Regulations (FARs). To demonstrate the necessary knowledge, a UAV operator must either have a current pilot's certificate (including a biennial review) or pass an FAA knowledge test to qualify as a UAV Pilot-in-Command and obtain a Remote Pilot Certificate with a small Unmanned Aircraft System (sUAS) rating.

Note: the term "pilot" in this study guide refers to or includes operators of unmanned aircraft unless it is defined by a specific pilot role or rating such as "private" pilot or "airline" pilot.

The certification knowledge test consists of objective, multiple-choice questions. There is a single correct response for each test question. Each test question is independent of other questions. A correct response to one question does not depend upon, or influence, the correct response to another. The knowledge test applicant has up to two hours to complete the test.

LIST OF RESOURCES

This is a study guide, not a textbook. The information needed to successfully pass the FAA test for the Remote Pilot Certificate is contained in the following documents:

1. FAR Part 107 – In Effect since August 29, 2016 (or Latest Revision): This regulation defines the requirements to become an sUAS certified pilot. It does NOT contain all of the information needed to pass the required test. https://www.faa.gov/uas/media/Part_107_Summary.pdf
or electronic: https://www.ecfr.gov/cgi-bin/text-idx?SID...mc=true&node=pt14.2.107.

2. Remote Pilot – Small Unmanned Aircraft Systems (Certification and Recurrent Knowledge Testing) - Airman Certification Standards FAA-S-ACS-10A (June 2018 or most recent version)
https://www.faa.gov/training_testing/testing/acs/media/uas_acs.pdf

3. AC 107-2 - Small Unmanned Aircraft Systems (sUAS) – FAA
https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_107-2.pdf

4. AC 60-22 - Aeronautical Decision Making – FAA https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/.../22624

5. Aeronautical Information Manual (AIM) https://www.faa.gov/air_traffic/publications/media/AIM_Basic_dtd_10-12-17.pdf

6. Aeronautical Charts (Hardcopy):)http://faacharts.faa.gov/ or Aeronautical Charts (Digital): http://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/: (You will be required to demonstrate the ability to interpret symbols and information on Aeronautical Charts).

7, Pilot/Controller Glossary: http://www.faa.gov/air_traffic/publications/

8. Pilot's Handbook of Aeronautical Knowledge: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/ pilot handbook

9. General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making: www.faa.gov/nextgen/update/media/ga_weather_decision_making.pdf.\

10. Risk Management Handbook: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/faa-h- 8083-2.pdf.

11. Airman Knowledge Testing (AKT) Centers: https://www.faa.gov/training_testing/testing/media/test_centers.pdf

All of these documents are available online free to download. You may, however, want to purchase copies of the Aeronautical Information Manual and copies of Sectional Charts for the areas in which you expect to operate an sUAS. Additional references may be cited in each section.

Airman Knowledge Testing Centers

The FAA has authorized hundreds of airman knowledge testing center locations that offer a full range of airman knowledge tests. For information on authorized airman knowledge testing centers and to register for the knowledge test, contact one of the providers listed on the Airman Knowledge Testing Center List.

Knowledge Test Registration

When you contact an Airman Knowledge Testing Center to register for a test, be prepared to select a test date, choose a testing center, and make financial arrangements for test payment. You may register for the test(s) several weeks in advance, and you may cancel in accordance with the testing center's cancellation policy. The fee for the test is $150.00.

UAS Topics for Knowledge Testing

The following table lists the general areas of required aeronautical knowledge, understanding, or proficiency required to obtain the small Unmanned Aircraft System (sUAS) rating.

Area of Operation	Task	Percentage of Items on Test
I	A. General B. Operating Rules C. Remote Pilot Certification with an sUAS rating D. Waivers	30-40%
II	A. Airspace Classification B. Airspace Operational Requirements	30-40%
V	B. Airport Operations C. Emergency Procedures D. Aeronautical Decision-Making F. Maintenance and Inspection Procedures	20-30%

The information in this study guide was arranged according to the knowledge areas that are covered on the airman knowledge test for a Remote Pilot Certificate with a Small Unmanned Aircraft Systems Rating as required by Title 14 of the Code of Federal Regulations (14 CFR) part 107, section 107.73(a). The knowledge areas are as follows:

1. Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation

2. Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft

3. Unmanned aircraft operations

4. Aviation weather sources and effects of weather on small unmanned aircraft performance

5. Small unmanned aircraft loading

6. Emergency procedures

7. Crew resource management

8. Radio communication procedures

9. Determining the performance of small unmanned aircraft

10. Physiological effects of drugs and alcohol

11. Aeronautical decision-making and judgment

12. Airport operations

13. Maintenance and preflight inspection procedures.

Holders of Pilot Certificates issued under Part 61

No Pilot Certificate or No Current Flight Review

- Knowledge Test + Online Application
- Knowledge Test + Paper Application

or

Part 61 Pilot Certificate with Current Flight Review

- Online Course + Online Application
- Knowledge Test + Online Application
- Online Course OR Knowledge Test + Paper Application

To act as a remote pilot in command under Part 107, a person must have a remote pilot certificate. However, part 61 pilot certificate holders who have completed a flight review within the past 24 months may elect to take an online training course focusing on UAS-specific areas of knowledge instead of the aeronautical knowledge test. The online training for current pilot certificate holders is available at www.faasafety.gov (ALC-451: Part 107 Small Unmanned Aircraft Systems). All other members of the public must take and pass the initial aeronautical knowledge test to obtain a remote pilot certificate.

GLOSSARY OF TERMS

The following terms are used throughout this document and can be considered equivalent and usually referring to a small unmanned aerial vehicle.

1. "Drone" is a generic term applied, in this case, to any unmanned aircraft.

2. Unmanned Aerial Vehicle (UAV) - UAVs may be either fixed-wing airplanes or rotary wing aircraft.

3. Small Unmanned Aerial System (sUAS) – A UAV weighing 55 lb. or less. The term sUAS recognizes that most UAVs also include a control station, support equipment, and an operator or even a team that make up the whole "system."

4. Unmanned Aircraft (UA)

5. Remotely Piloted Vehicle (RPV)

NOTES

Some sections of this study guide consist solely of example test questions, usually with brief explanations of the answers. In some cases, brief sections of text are provided. However, users should read and study the text references relating to the subject and not rely solely on studying the test questions.

These questions were not taken from the official FAA tests. They are to assist and guide you in studying to prepare for the test. FAA tests will cover this same material, but the questions may be worded differently. Therefore, you must learn and understand why each answer is correct.

CHAPTER 1:
APPLICABLE REGULATIONS

INTRODUCTION

Federal Aviation Regulations (FARs) cover almost every aspect of any flight operations. FAA tests are heavily weighted toward the applicant's knowledge and understanding of FARs applicable to the type of operations the individual is applying for. FARs are organized by topics and each major topic area is assigned a number. For example, FAR Part 91 covers general operating and flight rules for all pilots. FAR Part 61 covers the requirements for various levels of pilot certificates including student pilots, private pilots, commercial pilots, etc. FAR Part 107 is dedicated to regulations relating to the operation of the Small Unmanned Aerial Vehicles (sUAV)

STUDY RESOURCES

FAA sUAS Part 107: The Small UAS Rule – An overview of FAA Part 107

This document briefly announces the publication of FAR Part 107.

FAR **Part 107**

In Effect since August 29, 2016 (or Latest Revision): This regulation defines the requirements to become an sUAS certified pilot. It does NOT contain all of the information needed to pass the required test. Applicants are advised to obtain a copy of FAR-107 and read and study it carefully (a total of 9 pages).

Suggested study method: Read a section, e.g., "§107.3 Definitions," and then look at the sample question(s). Text set off in "quotation marks" is text transcribed from the applicable FAA source documents.

§**107.3**

Definitions.

The maximum allowable weight of a small unmanned aircraft system (sUAS) is:

Question:

The maximum allowable weight of a small unmanned aircraft system (sUAS) is:

A. 0.55 lb.

B. 55.0 lb.

C. 100 lb.

The correct answer is B. The sUAS can weight no more than 55 pounds, including all attached equipment and batteries or fuel.

Another definition of interest relates to a Visual Observer (VO).

Question:

A Visual Observer:

A. Must also hold a remote pilot certificate.

B. Must be in radio contact with the local Air Traffic Control agency.

C. Must be in a position to assist the sUAS operator to see and avoid other air traffic.

The correct answer is C. The VO should be in position to help the operator "see and avoid other air traffic or objects aloft or on the ground."

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§**107.5**

Falsification, reproduction or alteration

Question:

A person who makes a duplicate copy of his remote pilot certificate and changes the name so that someone else can act as a sUAS pilot would be subject to:

A. Suspension of revocation of his sUAS piloting privileges

B. Subject to a civil penalty

C. Both of the above.

The correct answer is C. "No person may make or cause to be made any reproduction or alteration to any certificate for fraudulent purposes. Suspension of certificate and civil penalties may apply."

§107.7

Inspection, testing, and demonstration of compliance

Question:

The FAA has the authority to make any test or inspection of:

A. The small unmanned aircraft.

B. The remote pilot in command and the visual observer

C. Both of the above.

The correct answer is C. The FAA can test or inspect the unmanned aircraft, and/or any personnel involved in the operation of that aircraft.

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§107.9

Accident Reporting

Question:

When an sUAS is involved in an accident, when must a report be made to the FAA?

A. Any accident must be reported to the FAA.

B. An accident involving more than $500 damage to the UAV (unmanned aircraft) must be reported.

C. An accident that involves loss of consciousness of any person must be reported.

The correct answer is C: Any accident involving serious injury to any person or any loss of consciousness must be reported, and any accident that involves more than $500 damage to any property other than the sUAS.

Question:

When a sUAS is involved in a reportable accident, the report must be filed with the FAA within:

A. 24 hours

B. 1 week

C. 10 days

The correct answer is C.

Subpart A. **Summary**

Subpart A focuses on what the FAA considers important aspects of at sUAS pilot. These are not operational aspects of sUAS operations and must simply be learned or memorized. Note that questions will be worded to test you on fine distinctions—two or more answers will very similar, but with one single correct answer.

§**107.12**

Requirement for a remote pilot certificate with a small UAS rating

This section spells out the requirements under which an individual may operate an sUAS. The FAA uses a term familiar to other pilots - "pilot in command" or PIC. By definition, the PIC is responsible for the safe operation of the aircraft and adherence to all FARs applicable to that operation. "Pilot in command" is a term and responsibility that pilots and the FAA take seriously.

Question:

May an individual who does not hold a current remote pilot certificate operate the controls of a sUAS?

A. No.

B. Yes, if the pilot has 10 hours of instruction that is recorded in a logbook.

C. Yes, when under the direct supervision of a Certified Remote Pilot in Command (PIC) who could take immediate control if necessary.

The Correct Answer is C (see §107.12, (2)).

§**107.13**

Registration

This is one of those regulations that has already been written for other aircraft operations and Part 107 directs you to that regulation, in this case, FAR Part 91, §91.203(a)(2) that reads that an aircraft in the United States must be issued: *An effective U.S. registration certificate issued to its owner for operation within the United States….*

Question:

You plan to operate an unmanned aircraft as part of your photography business. The aircraft weighs approximately three pounds. With respect to registration:

A. It does not need to be registered due to its light weight

B. It must be registered, and the registration number must be on the aircraft.

C. Only unmanned aircraft weighing more than 55 pounds must be registered.

The correct answer is B: Unmanned aircraft operated under Part 107, which includes any commercial use of an aircraft, must be registered with the FAA, and the registration number should be displayed somewhere on the aircraft. The operator should have the aircraft's registration certificate available when operating the aircraft. That is part of the inspection in §107.7.

§107.15

Condition for Safe Operation

This section refers to the condition of the aircraft,and simply requires that the aircraft must be in safe operating condition for flight. If it becomes unsafe for any reason, the flight is to be terminated. "Safe flight" means all installed equipment needed for safe operation and/or required by regulation for safe operation are in good working condition.

Question:

You are flying the aircraft 15 minutes after official sunset when you realize that the anti-collision light is not operating. You:

A. Carefully scan the sky to ensure no other aircraft are operating in the vicinity, then continue to fly the mission.

B. Immediately terminate the mission and recover the aircraft.

C. Continue flying because you still have 15 minutes of civil twilight.

The correct answer is B: Anti-collision lights are required for operation during the period of civil twilight which begins 30 minutes before sunrise or ends 30 minutes after sunset.

Question:

Ten minutes into a video flight, the camera stops functioning. You:

A. Must terminate the flight because the camera is required for your mission.

B. May continue the mission as a training exercise in aircraft control.

C. May continue flying but must provide a report of the failure to the FAA.

The correct answer is B: The camera is not essential equipment for the safe operation of the aircraft, so the aircraft can continue to be flown. No report is necessary since this is not an emergency situation.

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§**107.17**

Medical Condition

While there is no requirement for a medical certificate to operate an unmanned aircraft, pilots and other crew members are expected to be physically and mentally able to perform their duties. This includes not only the pilot in command, but anyone operating the aircraft controls and visual observers. (See AC 107-2 , Section 5.6, Medical Condition)

Question:

As you prepare for a flight scheduled later in the morning, you realize that you do not feel well, and determine that you have a fever. Still, while you do not feel well, you decide you feel well enough to fly the mission.

A. You should not fly the mission because you are not well.

B. This is a judgement call and you will probably be okay.

C. You will just stay in the truck and let the other pilot fly. He does not have his remote pilot certificate, but you have trained him and decide he his competent to fly the mission.

The correct answer is A. You are now a member of an elite group of individuals—pilots. Pilots do not fly when they are not well. Even seemingly minor colds can create distractions during a flight, nor would you be considered well enough to supervise a non-certified operator.

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§**107.19**

Remote pilot in command

This is the foundation of the term "pilot in command" (PIC). Basically, it means that the PIC is in command of the operation and is responsible for the operation and safety of the UAV as well as people and structures within the operating area. This includes making sure that any support personnel—another operator and/or a visual observer have the knowledge and understanding to execute their responsibilities.

Question:

Who has the responsibility and final authority for the safe operation of a UAV?

A. A competent but uncertified (unlicensed) pilot.

B. The pilot in command

C. A visual observer closer to the aircraft

The correct answer is B: The PIC holds the ultimate responsibility for the safe and regulatory compliant operation of the UAV.

Question:

A UAV PIC is working with a visual observer (VO). The VO indicates that the aircraft should turn left to avoid an obstacle, but the VO is facing the pilot, and the pilot turns the aircraft to his left, not the observer's left, and the aircraft strikes a building causing damage. Who is responsible?

A. Neither since it was a simple accidental mistake.

B. The VO for not realizing which direction to turn or using the wrong terminology.

C. The Pilot in command for not clarifying the direction of the turn.

The answer is C: Basically, the PIC is responsible for everything, even when a crew member makes an error.

§**107.21**

In-flight emergency

In the event of an emergency, such as a fire on the aircraft or partial loss of control or power, the PIC is expected to do whatever is possible/necessary to protect and avoid damage or injury to structures, equipment, or people on the ground. This may require deviating from one or more requirements that would be required during normal, non-emergency flight.

Question:

The PIC may deviate from any rule to the extent necessary to handle an emergency. Assuming the aircraft is recovered from an emergency situation without damaging property or injuring any person, the PIC:

A. Needs to do nothing.

B. Should submit a report on the emergency only if requested by the Administrator of the FAA.

C. Should submit a report on the emergency to the FAA.

The correct answer is B: The PIC holds the ultimate responsibility for the safe and regulatory compliant operation of the UAV.

§**107.23**

Hazardous operation

It goes without saying—but just to make sure, the FAA says that "no person may operate an sUAS in a careless or reckless manner" that would endanger persons or property of another. This includes intentionally dropping objects from the aircraft.

Question:

You have been asked to drop candy at a picnic. This is:

A. Not permissible

B. Permissible if the candy pieces are equipped with little parachutes so as not to injure anyone.

C. Permissible if the drop zone can be cleared of persons so there is no chance of injury.

The correct answer is C: Dropping objects from the UAV is permissible provided precautions are taken to not damage property or structures on the ground and to not provide a hazard to persons on the ground.

§107.25

Operation from a moving vehicle or aircraft

Operating a UAV from an aircraft is prohibited. Operation of a UAV from a moving land or water-borne vehicle is permitted only over sparsely populated areas and is not transporting another person's property for hire.

Question:

Operating a UAV from a moving boat over a broad expanse of marsh is:

A. Prohibited.

B. Permitted.

C. Permitted only when necessary to deliver cargo.

The correct answer is B: The marsh would likely be a "sparsely populated area."

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§107.27

Alcohol or drugs

This regulation refers you to FARs §91.17 and §91.19. FAR §91.17 prohibits operation as a "crewmember" of an aircraft within 8 hours after the consumption of alcohol, or, while under the influence of alcohol, and under the influence of drugs. Having a blood alcohol level of 0.04 or greater is considered "under the influence."

Question:

You attended a New Year's Eve party, and your last drink was at 1:00 am on New Year's Day. You planned accordingly, and are scheduled to fly your sUAS at 9:00 am, 8 hours later. You are:

A. Absolutely legal to fly since it has been 8 hours since your last drink.

B. May not be legal to fly if your blood alcohol level is still above 0.04.

C. You have had several cups of coffee and are good to fly in any case.

The correct answer is B. Blood alcohol levels do not necessarily drop below 0.04 in 8 hours, and you may still have a blood alcohol level that, if tested would result in operating under the influence of alcohol. This also applies to any operator of VO involved in the operation of the sUAS.

This regulation also requires a crewmember to: (1) submit to a blood alcohol or related test when requested by an authorized law enforcement officer, (2) submit blood alcohol test results to the FAA, and (3) the results of the test may result in the person's loss of qualifications for any airman certificate and other legal proceedings.

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§107.29

Daylight Operation

Key points of this part are (1) operation of a UAV during night time is prohibited, (2) operations during civil twilight requires that the UAV be equipped with anti-collision lighting, and (3) "civil twilight" is defined.

Question:

The sun has just set, but visibility is still good during the twilight. As the pilot of an sUAS you:

A. May operate your aircraft for up to 30 minutes after official sunset

B. May operate your aircraft for up to 30 minutes after sunset provided it is equipped with an operating anti-collision light.

C. May not operate the aircraft after official sunset.

The correct answer is B. The anti-collision light is required during the period of civil twilight.

Question:

Your sUAS does not have an anti-collision light; how early in the morning may you begin to operate your sUAS.

A. At sunrise.

B. 30 minutes before official sunrise

C. One hour before sunrise.

The correct answer is A. An anti-collision light is required for operation during the period of civil twilight that begins 30 minutes before official sunrise.

Question:

By definition, except for Alaska, morning civil twilight begins:

A. 30 minutes before official sunrise.

B. At a time determined by reference to the Air Almanac

C. 30 minutes after sunrise.

The correct answer is A. Civil twilight, except for Alaska, is defined as the period beginning 30 minutes before official sunrise and ending 30 minutes after official sunset.

§**107.31**

Visual line of sight aircraft operation

It is reasonable to expect that the operator of a sUAS should be able to see the aircraft throughout its flight, but this regulation makes it official. It also recognizes that a visual observer may be needed at times when the aircraft would otherwise be out of sight of the operator.

Question:

The operator of an unmanned aircraft must be able to maintain visual contact of the aircraft:

A. With unaided eyesight (except corrective lenses).

B. With the use of handheld binoculars.

C. Except brief periods when the aircraft's view is blocked by obstructions.

The correct answer is A: The operator is required to be able to see the aircraft at all times if a visual observer is not available. Corrective lenses are permitted.

Question:

The operator of an unmanned aircraft:

A. Must maintain eye contact with the UAV at all times.

B. Must be able to maintain contact with the UAV at all times but may briefly divert his vision to look for other aircraft, obstructions, or the controls as needed.

C. Must have a VO to be permitted to break eye contact with the UAV.

The correct answer is B: You may, and are expected to, briefly scan the area around the UAV to ensure continued safe operations. However, you must be **able** to maintain visual contact. Do not allow it to fly out of sight where you would not be able to see it without the aid of a VO.

Question:

You are flying your sUAS over a small wildfire adjacent to a small community airport. A column of smoke rises up and obscures your view of the aircraft you:

A. Must reverse course immediately to regain visual contact with the aircraft.

B. Must regain sight of the aircraft within 90 seconds or activate auto return or auto land.

C. Since the circumstances of each flight vary, it is the PIC's responsibility to determine how long to wait before making the decision to recall the aircraft, hover, or land the aircraft.

The correct answer is C. Reference AC 107, VLOS Aircraft Operation.

§**107.33**

Visual Observer

When the mission may require periods when the aircraft will not be visible to the pilot in command or operator of the aircraft, a visual observer (VO) may be used. The VO should be in a position to maintain visual contact with the aircraft when it is not visible to the operator. More than one VO may be used.

Question:

You are planning an unmanned flight for a client. Circumstances require that the aircraft pass behind a billboard sign to reach the desired vantage point. You know that you can direct the aircraft to maintain direction and altitude until it becomes visible on the other side of the obstruction so that you can continue the mission, therefore:

A. You may complete the mission on your own.

B. You cannot accept the mission because you cannot maintain visual contact with the aircraft as it passes behind the obstruction.

C. You place a visual observer in a position to maintain visual contact with the aircraft who can report the aircraft's safe progress to you until it is visible to you again.

The correct answer is C: Throughout the entire flight of the small unmanned aircraft, the ability described in paragraph (a) of this section must be exercised by either: (1) the remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system; or (2) a visual observer. (§107.31(b)(1)(2))

§**107.35**

Operation of multiple small unmanned aircraft.

Simply put, no individual or team of individuals (PIC, operator, and VO) may operate more than one unmanned aircraft at the same time. If an assignment required two or more aircraft for complete coverage, there must a separate PIC and team if required, dedicated to each unmanned aircraft.

Question:

You have been asked to provide aerial coverage of an event and the client wants two simultaneous perspectives from two aircraft. You advise the client that:

A. As the PIC, you can supervise two operators to cover the event.

B. You will have two complete teams, one for each aircraft, to cover the event.

C. That regulations do not permit multiple UAVs to operate over a single event.

The correct answer is B: No person may operate as a remote PIC or VO in the operation of more than on sUAS.

§**107.36**

Carriage of hazardous materials

A small unmanned aircraft may not carry hazardous materials. Hazardous material means a substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and has been designated as hazardous under section 5103 of Federal hazardous materials transportation law (49 U.S.C. 5103). The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, and other materials designated as hazardous (See 49 CFR 171.8 for further guidance).

§107.37

Operation near other aircraft; right-of-way rules

Right-of-way rules are among the most critical in aviation. For manned aircraft, the basic rule is that the more maneuverable category aircraft should yield the right-of-way to less maneuverable aircraft. Small unmanned aircraft are generally more maneuverable than manned aircraft. The FARs specifically require the operators of an sUAV to yield the right-of-way to all other aircraft, airborne vehicles, and launch and reentry vehicles.

Yielding the right of way means that the unmanned aircraft must "give way" to the other aircraft or air vehicle, and that the unmanned vehicle not pass over, under, or ahead of the other aircraft unless well clear.

Question:

While photographing a group of buildings near the approach end of a small private airport, you see small manned airplane approaching. You:

A. Maneuver your UAV away from the approach path to the runway and not continue your mission until the other aircraft is well clear.

B. Continue your mission. Your UAV is to the right of the other aircraft's path and he should yield to you since you are to his right.

C. Maneuver your UAV up and down rapidly to make it more visible to the other pilot.

The correct answer is A. The UAV must always yield the right-of-way to the manned aircraft. You may also be required to advise the FAA, the airport operator, or a Flight Service Station of your requirement to operate within five miles of an airport. More details will be covered in the sections on Controlled Airspace.

§107.39

Operation over human beings

You may not operate an unmanned vehicle over a human being (or group of human beings) unless that person is participating in the operation of the UAV (such as the VO), or the human beings are protected under a shelter or in a vehicle.

Question:

You have been commissioned to take photos of the local seafood festival taking place at the local boat docks. There are typically hundreds of people attending the festival. You may:

A. Not accept the assignment since it will almost certainly involve flying over people.

B. Accept the assignment because you know you can take photos quickly while overhead the crowd, and retreat to a position away from people.

C. Accept the assignment because you know you may request a waiver for operation over people if you can demonstrate it can be done safely.

The correct answer is C. Hovering over the crowd, even briefly, would be in violation of this regulation unless you applied for and were granted a waiver to allow you to fly over people.

Note: FAR 107 Part D, §107.200, Waiver policy and requirements, allows operators to request a waiver to any part of these regulations provided you can demonstrate that the UAV operations can be conducted safely. Waivers require advance applications and nature of the operations that require the waiver.

§**107.41**

Operation in certain airspace

No person may operate a small unmanned aircraft in Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person has prior authorization from Air Traffic Control (ATC).

The definitions and descriptions of various types of airspace, including controlled airspace, and the operation of UAVs therein, will be covered in a later section. Note: violation of airspace rules will almost certainly result in loss of UAV piloting privileges.

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§**107.43**

Operation in the vicinity of an airport

No person may operate a small unmanned aircraft in a manner that interferes with operations and traffic patterns at any airport, heliport, or seaplane base.

Question:

Assume the county commission wants an aerial photograph of their municipal airport terminal. If the airport is not in a control zone you:

A. Take the photos, adhering to the rule to see and yield to any manned aircraft operating at the airport.

B. Request a waiver from local Air Traffic Control to conduct the photo flight.

C. Get permission from the airport operator for the photo flight.

The Correct answers are: A and C. C is the better answer. Whenever operating near or on an airport, advise the local operator of your intentions. If the airport has radio service, the operator may advise pilots of your activity. If the airport is located in a control zone (which you can identify on the aeronautical chart), then you will need authorization from ATC.

This would be an easy task for a sUAS. Note that this is not an absolute prohibition: the regulation says "in a manner that interferes with operations and traffic patterns." Keep in mind that according to §107.37, small unmanned aircraft must always yield the right of way, although it is possible for you to simply talk to the airport operator and get permission to take the photos. There are several possible scenarios and workarounds. If the airport is located in controlled airspace, you would have to get a waiver from the FAA with specific guidelines to fly the unmanned aircraft anywhere over the airport.

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§**107.45**

Operation in prohibited or restricted areas

Restricted or prohibited areas include airspace set aside for specific purposes by different government agencies, including the military, and may involve weapons and munitions test and training, low-level aircraft flight operations. These areas may also be restricted for national security reasons. Prohibited and restricted areas are marked on aerial navigation charts.

Question:

You wish to photograph a heron rookery located 100 yards inside a restricted area marked on the Sectional Chart. You could easily launch your aircraft from outside the restricted area and fly your unmanned vehicle over the area to get the desired photos. You:

A. Fly the mission early in the morning and get the photos you want.

B. Advise the area authorities that you are going to make the flight.

C. You must get permission from the area's operating authority to make the flight.

The correct answer is C: You must get permission, from the operating authority before conducting any UAV flight activities in prohibited or restricted areas. Photography of any kind is a very sensitive subject in any prohibited or restricted area, as is the overflight of any unauthorized aircraft, and may result in serious penalties.

§**107.47**

Flight restrictions in the proximity of certain areas designated by notice to airmen

A person acting as a remote pilot in command must comply with temporary flight restrictions that may be in effect for a few hours to extended periods of time. Such flight restrictions include airspace over the President of the United States if he is visiting an event to airspace over a disaster area, especially if it involves search and rescue aircraft activities. UAS operators can request waivers to overfly some of these events.

Question:

There is major flooding in a local town. Search and rescue helicopters are flying over the area. A local television station wants you to use your sUAS to capture video of the flooding. You:

A. Immediately pack your gear and look for a good place to launch to take the video for the TV station.

B. Immediately contact the local FAA facility or the agency conducting rescue activities to request a waiver or permission to fly over the area.

C. Tell the station you are not permitted to fly over a disaster area when there are emergency search and rescue flying over the area.

The correct answer is B. See the provisions of FAR §91.137 through 91.145 and 99.7. Review the regulations cited in this paragraph regarding obtaining permission for unmanned vehicle flights

§**107.49**

Preflight familiarization, inspection, and actions for aircraft operation

Every aircraft flight, even a quick hop around the airport for a sport pilot, involves some preflight activities, including a preflight inspection of the aircraft, a check of the weather for the time of the flight, etc. The same is true for unmanned aircraft.

Question:

Which of the following is NOT required if you are going take photographs of a barn that is located 6 miles from, but not on, a local, uncontrolled airport.

A. A check of local weather conditions.

B. Advise the nearest FAA facility or airport of your planned operating times.

C. Determine the locations of persons or other property in the area.

The correct answer is B. There is no reuirement to contact an FAA facility or the airport if you are not operating in controlled airspace.

Question:

For the flight described above, the aircraft will be flown from a field about 75 yards from the barn. You will be the PIC and you will be assisted by an operator who will actually fly the aircraft from the launch site, and a visual observer near the barn. You must ensure that everyone participating in the flight operations are informed about:

A. Each person's roles and responsibilities

B. Emergency procedures

C. Potential hazards

D. Contingency Plans

E. All of the above

The Correct answer is E, all of the above: This is not a valid FAA test question with five choices, but is used here to emphasize that the PIC is responsible for making sure that each member of the team, is aware of his or her duties and responsibilities, and each member should be aware of what roles other team members are responsible for.

Question:

Which of the following is NOT required if you are going take photographs of a barn that is located 6 miles from, but not on, a local, uncontrolled airport.

A. The unmanned vehicle has sufficient fuel or adequately charged batteries to complete the flight as planned (takeoff to recovery)

B. Ensure that equipment to be carried by the UAV is securely attached and that it does not adversely affect the flight of the aircraft, including weight and balance.

C. Contact the airport to let them know you are about to launch the aircraft.

The correct answer is C. The local airport is six miles away. There is no requirement to alert the airport. Still, operators should be alert for aircraft in the area and always yield the right-of-way.

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§**107.51**

Operating limitations for small unmanned aircraft.

A remote pilot in command and the person manipulating the flight controls of the small unmanned aircraft system must comply with operating airspeed limitations when operating a small unmanned aircraft system:

Question:

What is the maximum speed at which an unmanned vehicle may be operated?

A. An airspeed of 87 mph

B. A ground speed of 100 mph

C. A ground speed of 100 knots

The correct answer is B. The regulations limit speed to 87 knots (100 mph) **groundspeed**. (AC 107-2, Para. 5.10) When reading airspeeds, always determine whether the speed is stated in knots (kt) or miles-per-hour (mph), and whether the speed is referring to airspeed or ground speed.

Question:

The maximum altitude above ground level that a UAV may be flown is:

A. 500 feet above ground level

B. 400 feet above the highest point on the structure within 400 feet horizontal distance from the UAV

C. 800 feet above ground level

The answer is B. (AC 107-2, Para. 5.10)

Question:

You know that the local elevation where you are going to operate your sUAS is 1635 feet above mean sea level (MSL). What would be the maximum altitude you could legally fly:

A. 2035 feet MSL

B. 400 feet MSL

C. 2435 feet AGL

The correct answer is A. Ground level is 1635 feet MSL. The aircraft can be flown up to 400 AGL, therefore the maximum altitude is 2035 feet MSL (AC 107-2, Para. 5.10).

Question: You are surveying a building that is 55 ft high above the local terrain (AGL). What is the maximum altitude you may operate the unmanned vehicle?

A. 400 ft AGL

B. 455 ft MSL

C. 455 ft AGL

The Correct answer is C. The building is 55 ft AGL and you may fly up to 400 feet above the top of that building, therefore the maximum permissible altitude is 455 ft AGL (AC 107-2, Para. 5.10).

Question: There is a solid layer of clouds above where you are going to fly. The weather service says the base of the clouds—the "ceiling"—is 800 feet above ground level (AGL). What is the maximum altitude you may legally fly the unmanned vehicle?

A. 300 ft AGL

B. 400 ft AGL

C. 500 ft AGL

The correct answer is A. You must remain 500 feet below the base of the clouds. That means you can fly no higher than 300 ft AGL or you will be too close to the cloud layer (AC 107-2, Para. 5.10).

Question: You are surveying a tower that is 1200 feet high. There is a layer of clouds moving in. How far do have to stay horizontally from the clouds?

A. 400 feet

B. 1,000 feet

C. 2,000 feet

The Correct answer is 2,000 feet horizontally away from clouds (AC 107-2, Para. 5.10).

Question: You arrive at the site where you are scheduled to photograph a building early in the morning. There is fog in the area and visibility is no more than one mile. You:

A. Know that you will be able to see the UAV adequately, so you prepare to launch the aircraft.

B. Delay the launch until the visibility is 3 statute miles.

C. Activate the anti-collision light on the aircraft to be legal to fly.

The correct answer is B. The minimum visibility from the control station must not be less than 3 statute miles (AC 107-2, Para. 5.10). Note that visibility is always reported in statute miles.

Subpart B. **Summary**

Unlike Section A, questions in section B apply directly to rule applicable to the operation of sUAVs. These may be considered "rules of the road," and a knowledge of the content of Subpart B is essential for both safe and compliant operation of your aircraft.

§**107.53**

Applicability

This subpart prescribes the requirements for issuing a remote pilot certificate with a small UAS rating.

§**107.57**

Offenses Involving Alcohol or Drugs

Note that this rule directs you to FAR Part 91.17 for blood alcohol levels. The basic rule is no person may act as a required crewmember within 8 hours of the consumption of any alcoholic beverage, nor while under the influence of alcohol. The maximum blood alcohol level is 0.04 in blood or breath.

The FAA also prohibits acting as a required crewmember—this applies to the PIC, person operating the controls, and the VO—while using any drug that affects a person's faculties in any way. This includes just about everything, including cold medicines, pain killers, and most prescription drugs unless specifically permitted by a physician qualified to authorize use of medications for crewmembers during flight.

Question:

You attended a New Year's party and finished your last alcoholic drink just before one o'clock in the morning. At what time later that morning can you legally exercise your PIC privileges?

A. 8:00 AM

B. 9:00 AM

C. 12:00 Noon

The correct answer is 9:00 AM, eight hours after your last drink at 1:00 AM, provided your blood alcohol does not exceed 0.04% (AC 107-2, Para. 5.15).

This section of the FAR also deals with drug related activity and offenses. Conviction on any Federal or State statute relating to drugs in any way (growing, processing, manufacturing, sale, distribution, possession, transportation, or importation) is grounds for denial or suspension of any FAA airman's certificate.

Question:

A person convicted of an act prohibited by 91.179(a) or (b) is grounds for:

A. Denial of an application for up to 1 year from the date of final conviction the applicant

B. Suspension or revocation of the remote pilot certificate with a small UAS rating.

C. Both are correct statements.

The correct answer is C. Both statements A and B, are correct. Note that there is no mention of a "1 year" period of suspension or revocation for pilots who already hold the certificate.

§107.59 Refusal to submit to an alcohol test or to furnish test results

Refusal to submit to, or furnish the results of, a blood alcohol test is grounds for denial of an application for up to 1 year or suspension or revocation of a remote pilot certificate with a small UAS rating.

§107.61

Eligibility

An applicant for a remote pilot certificate with a small UAS rating must meet certain minimum requirements, and then demonstrate a defined level of aeronautical knowledge.

Question:

To obtain a remote pilot with a sUAS rating, a person must be how old?

A. 15 years old

B. 16 years old.

C. 17 years old.

The correct answer is B: 16 years old.

Question:

Which of the following is NOT required to obtain a remote pilot certification with small UAS rating:

A. Must demonstrate aeronautical knowledge through the knowledge test.

B. Have no known physical or mental conditions that would interfere with the safe operation of a small unmanned aircraft.

C. Must be able to obtain a Third-Class Medical Certificate.

The correct answer is C: No physical exam is required for the remote pilot certificate with a small UAS rating.

There are two ways to obtain the remote pilot certificate. The first is to satisfactorily complete and pass an initial knowledge test. Or, a pilot with a valid airman's certificate issued under Part 61 and a certificate of completion of Part 107 and has completed all currency requirements for the certificate (biennial review, etc.) may add the remote pilot certificate to his certificate after completing a special training course and exam.

Question:

A person holds a Private Pilot Certificate and wants to add a small UAS rating to his privileges. Which statement below is correct:

A. A private pilot who is current on all requirements may simply add the remote pilot certificate.

B. A private pilot who is current may add the remote pilot certificate by completing an initial training course and test covering the areas of knowledge required.

C. A private pilot must complete the same training and testing as any non-pilot to obtain the remote pilot certificate.

The correct answer is B: The pilot must complete the applicable initial training course and knowledge test for Part 61 pilots for the remote pilot certificate (AC 107-2, 6.3).

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§107.63

Issuance of a remote pilot certificate with a small UAS rating

Question:

After completing the test requirements for a remote pilot certificate, a Private Pilot should submit the application to:

A. The responsible Flight Standards office.

B. A designated pilot examiner.

C. An airman certification representative for a pilot school.

D. All of the above.

The correct answer in this case is D, "all of the above." Applications may also be submitted to a certified flight instructor or other person acceptable to the administrator.

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§107.64

Temporary certificate

Upon successful completion of the knowledge test, a temporary remote pilot certificate will be issued, valid for a period of 120 days.

Question:

Which statement is NOT correct:

A. A temporary remote pilot certificate expires on the date shown on the certificate.

B. A temporary remote pilot certificate expires upon issuance of the permanent certificate.

C. The permanent remote pilot certificate expires two years after the date issued. It must be renewed every two years.

The correct answer is C. Permanent certificates are permanent unless revoked. Also, note that the temporary remote pilot certificate may expire earlier upon receipt of a notice that the certificate sought is denied or revoked.

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§107.65

Aeronautical knowledge recency.

The remote pilot certificate is issued without an expiration date—it is, in effect, a permanent certificate unless revoked for cause. However, this does not mean that the holder can operate a remote vehicle under the terms of the license indefinitely. The privilege to continue operating under the certificate must be renewed every 24 months (biennially).

Question:

Which of the following is NOT correct regarding the continued exercise of unmanned vehicle privileges:

The Pilot must have:

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A. Passed a recurrent aeronautical knowledge test within the previous 24 calendar months.

B. Passed an initial aeronautical knowledge test within the past 24 months.

C. Demonstrated a minimum of 50 hours of small UAV PIC time within the past 24 months.

The correct answer is C: UAV Flight time alone, logged or otherwise does not satisfy the biennial requirement to demonstrate continued proficiency. The pilot must pass an initial or recurrent training course for operating privileges to be current.

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§**107.67**

Knowledge tests: General procedures and passing grades.

Question:

Which of the following is NOT correct: On the application to take the knowledge test the applicant is required to provide:

A. Full Name

B. Date of Birth

C. Either a residential address or a mailing address

The correct answer is C: The applicant must provide both a residential and mailing address. They may be the same.

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§**107.69**

Knowledge tests: Cheating or other unauthorized conduct

Cheating is not tolerated in connection with the taking of knowledge tests. In this case, cheating includes: copying or removing a copy of the test, giving a copy of the test to another applicant, giving or receiving assistance while taking the test, taking a test for another person, and using any material during the test that is not provided by the test administrator.

Question:

Anyone found to be cheating during a FAA knowledge test:

A. Will be prohibited from applying for that aeronautical rating for a period of 2 years.

B. Will be prohibited from applying for any test under Part 91 for a period of 1 year.

C. May have any rating held by the individual suspended or revoked.

The correct answer is B: The applicant who cheats may not apply to take the test for a period of 1 year. That same individual is also barred from taking any other aeronautical knowledge test for any other certificate or rating during the same period.

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§107.71

Retesting after failure.

Question:

If an applicant fails the knowledge test, how long must the applicant wait to reapply to retake the test?

A. 7 days

B. 14 days

C. 30 days

The correct answer is 14 days before the applicant may apply to retake the test.

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§107.73

Initial and recurrent knowledge tests.

The following topics will be covered on the initial aeronautical test:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Airspace classification, operating requirements, and flight restrictions affecting small unmanned aircraft operation;

(3) Aviation weather sources and effects of weather on small unmanned aircraft performance;

(4) Small unmanned aircraft loading;

(5) Emergency procedures;

(6) Crew resource management;

(7) Radio communication procedures;

(8) Determining the performance of small unmanned aircraft;

(9) Physiological effects of drugs and alcohol;

(10) Aeronautical decision-making and judgment;

(11) Airport operations

(12) Maintenance and preflight inspection procedures.

The following topics will be covered on recurrent aeronautical knowledge testing:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Airspace classification and operating requirements and flight restrictions affecting small unmanned aircraft operation;

(3) Emergency procedures;

(4) Crew resource management;

(5) Aeronautical decision-making and judgment;

3DINSIDER

(6) Airport operations;

(7) Maintenance and preflight inspection procedures.

These are the topics that are covered in this study guide.

§**107.75**

Initial and recurrent training courses.

(a) An initial training course covers the following areas of knowledge:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Effects of weather on small unmanned aircraft performance;

(3) Small unmanned aircraft loading;

(4) Emergency procedures;

(5) Crew resource management;

(6) Determining the performance of small unmanned aircraft;

(7) Maintenance and preflight inspection procedures.

(b) A recurrent training course covers the following areas of knowledge:

(1) Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation;

(2) Emergency procedures;

(3) Crew resource management

(4) Maintenance and preflight inspection procedures.

§**107.77**

Change of name or address

Question:

Which of the following is NOT required to file a name change for the unmanned pilot certificate:

A. The Remote pilot certificate

B. A copy of the marriage license or other official document verifying the name change.

C. A copy of individuals driver's license.

The correct answer is C. The driver's license is not required.

Question:

If a pilot moves and his/her permanent address has changed, the remote pilot certificate holder must notify the FAA:

A. Within 20 days.

B. Within two calendar months

C. Within 30 days

The correct answer is C: within 30 days.

Question:

What restriction is placed on the remote pilot if notice of change of address is not submitted within the allotted time?

A. None.

B. The pilot may not exercise the privileges of the remote pilot certificate after allotted time (30 days) has elapsed.

C. The pilot must retake the recurrent aeronautical knowledge test.

The correct answer is B.

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§**107.79**

Voluntary surrender of certificate

Question:

To voluntarily surrender the remote pilot certificate, a pilot must:

A. Simply return the certificate to the FAA

B. Must destroy the certificate.

C. Return the certificate to the FAA with a signed statement of surrender as specified under §107.79 (b).

The correct answer is C.

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§**107.200**

Waiver Policy and requirements

The Administrator may issue a certificate of waiver authorizing a deviation from any regulation specified in § 107.205 if the Administrator finds that a proposed small UAS operation cn safely be conducted under the terms of that certificate of waiver.

§107.205

List of regulations subject to waiver

A certificate of waiver issued pursuant to § 107.200 may authorize a deviation from the following regulations of this part:

(a) Section 107.25 - Operation from a moving vehicle or aircraft.*
(b) Section 107.29 - Daylight operation.
(c) Section 107.31 - Visual line of sight aircraft operation.*
(d) Section 107.33 - Visual observer.
(e) Section 107.35 - Operation of multiple small unmanned aircraft systems.
(f) Section 107.37(a) - Yielding the right of way.
(g) Section 107.39 - Operation over people.
(h) Section 107.41 - Operation in certain airspace.
(i) Section 107.51 - Operating limitations for small unmanned aircraft.

* However, no waiver of this provision will be issued to allow the carriage of property of another by aircraft for compensation or hire.

Question:

You have been asked to video events of a local air show. You would probably want to request waivers for:

A. Operations over People and in Certain Airspace.

B. Daylight operations

C. Yielding the right of way.

The best correct answer is A: You are not likely to be covering an airshow in other than daylight hours, and you certainly will have to be conscious of yielding the right of way to participating aircraft. There are certainly going to be people attending, and it is very possible that the airport may be in a controlled airspace.

Subpart C. **Summary**

Subpart C is administrative in nature, indicating the requirements to obtain and maintain the sUAS pilot certification. In addition to basic requirements to qualify for the sUAS pilot certification, there are regulations that apply to the maintenance and renewal of those pilot privileges.

Chapter 1. Summary

Federal Aviation Administration tests always comprise a significant portion of FAA knowledge tests. Many questions will be situational in nature, testing your ability to both recall the language of a regulation and apply it correctly in a situation. Pay particular attention to the wording of each question—in some cases there are similar situations or rules that each have specific application. Questions will be written to ensure you demonstrate knowledge of these distinctions.

CHAPTER 2:
AIRSPACE CLASSIFICATION, OPERATING REQUIREMENTS, AND FLIGHT RESTRICTIONS

INTRODUCTION

UAV operators are regarded as "pilots" who are expected to understand the National Airspace System (NAS) in which UAVs are operated, and the rules and regulations that apply to different designations of airspace to ensure the safe operation of unmanned aircraft.

STUDY RESOURCES

The **Aeronautical Information Manual** (AIM) (formerly the Airman's Information Manual) is the nation's official guide to basic flight information and Air traffic control procedures.
https://www.faa.gov/air_traffic/publications/media/AIM_Basic_dtd_10-12-17.pdf
Pilot's Handbook of Aeronautical Knowledge, FAA-H-8038-25

https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/phak/

Suggested study method: Read a section, e.g., "AIM Chapter 3. Airspace," and then look at the sample question(s). Text set off in "quotation marks" is text transcribed from the applicable FAA source documents.

Air Traffic Control and the National Airspace System Descriptions and Definitions

(Ref. AIM Chapter 3. Airspace)

Additional Resources: Sectional Aeronautical Chart (SAC or Terminal Aeronautical Chart (TAC) Note: a complete SAC chart of the United States can be found at http://vfrmap.com/.

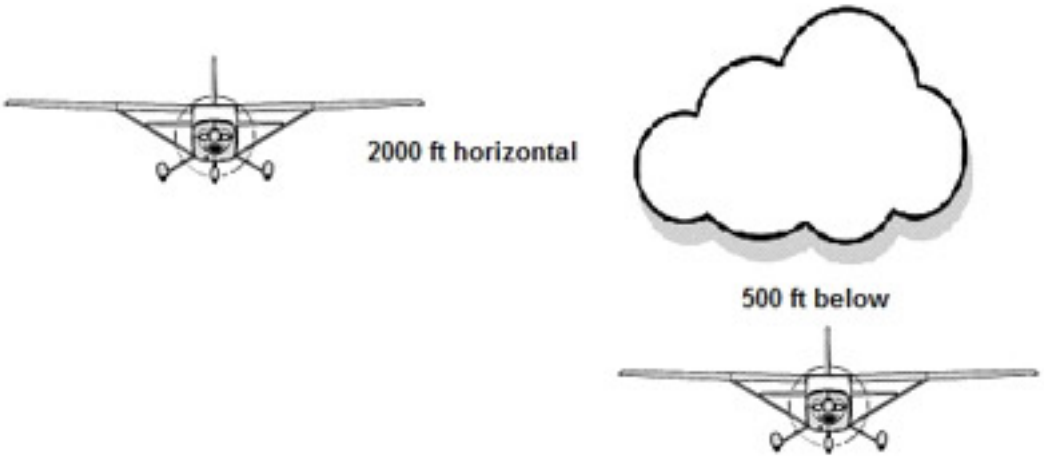
FAA Aeronautical Chart User's Guide – Explains chart terms and symbols. It is available only as a digital download (.pdf):
https://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/aero_guide/

The National Airspace System (NAS) is divided into layers of regulated and unregulated airspace, including uncontrolled and several categories of controlled airspace. Each individual classification of airspace has specific requirements for pilots and air traffic control (ATC) to ensure safe and efficient flight operations for all users, including operators of unmanned aircraft. These different classifications of airspace directly influence UAV operations and Remote Pilot Certificate holders must understand how different categories and classifications of airspace affect the operation of UAVs.

Figure 1. Diagram of different designations of controlled airspace within the National Airspace System. Note that classes E and G are uncontrolled airspace. (Source: FAA)

Visual Flight Rules (VFR)

Most unmanned aircraft operations take place under VFR conditions because the UAV PIC, operator and/or the VO must be able to maintain visual contact with the aircraft. Furthermore, unmanned aircraft are not permitted to operate out of sight in clouds or foggy conditions—in fact, unmanned aircraft are required to remain at least 500 feet below any layer of clouds, and at least 2000 feet laterally away from any clouds. VFR flight conditions also require a minimum of 3 statute miles (SM) visibility.



Question:

When flying an sUAS, you need to maintain this distance below clouds:

A. 1,000 feet

B. 500 feet

C. 2,000 feet

The correct answer is B.

Question:

What is the minimum visibility for unmanned aircraft operations:

A. 1 SM

B. 3 SM

C. 3 NM

The correct answer is B: 3 statute miles visibility.

Airspace Definitions

sUAS pilots must be familiar with airspace classifications.

There are two broad types of airspace: regulatory airspace and non-regulatory airspace.

Non-Regulatory Airspace
Non-regulatory airspace includes uncontrolled airspace, Military Operating areas (MOAs), Warning Areas, Alert Areas, and Controlled Firing Areas.

Regulatory Airspace

sUAS pilots must be familiar with airspace classifications.

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Non-regulatory airspace includes uncontrolled airspace, Military Operating areas (MOAs), Warning Areas, Alert Areas, and Controlled Firing Areas.

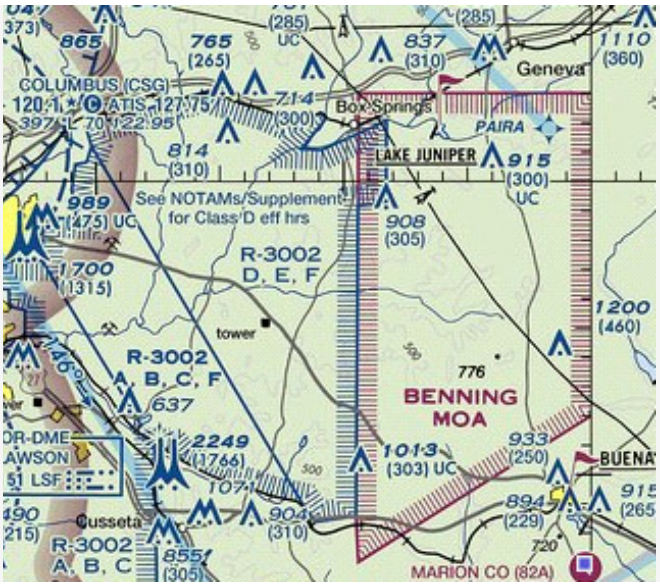

Figure 2. Regulatory Airspace

MOA NAME	ALTITUDE*	TIME OF USE	CONTROLLING AGENCY/ CONTACT FACILITY
Beaufort 3	100 AGL to 2000	"4 DAYLT HRS PER DAY 2 DAYS PER MONTH BY NOTAM INTERMITTENT "	Jacksonville CNTR
Benning	500 AGL to 8000	0700-2000 MON-FRI Occa-sionally Sat-Sun By NOTAM	ATLANTA TRACON

A

R-3002 A	TO 4000	0600-0200 Intermittent 6 Hours in Advance	ATLANTA TRACON
R-3002 B	4000 to 8000	0600-0200 Intermittent 6 Hours in Advance	ATLANTA TRACON
R-3002 C, E	8000 to 14000	By NOTAM 6 hours in Advance Intermittent	ATLANTA TRACON
R-3002 D	To 8000	0600-0200 Intermittent 6 Hours in Advance	ATLANTA TRACON
R-3002 F	14000 to FL 250	By NOTAM 6 hours in Advance Intermittent	ATLANTA TRACON
R-3002 G	To 14000	0600-0200 Intermittent 6 Hours in Advance	ATLANTA TRACON

B

Regulatory airspace includes restricted and prohibited airspace as well as various classes of controlled airspace (Class A, B, C, D, and E). Controlled airspace is subject to some level of FAA and Air Traffic Control (ATC) control. Aircraft operating under IFR rules in Class E airspace are also controlled by ATC, making this controlled airspace.

Uncontrolled airspace is airspace where Air Traffic Control (ATC) service is deemed not necessary or cannot be provided for practical reasons. Both class E and class G airspace are uncontrolled for VFR operations. Flight in Class G airspace is uncontrolled airspace and typically conducted under VFR rules. Uncontrolled airspace begins at ground level and extends upward to any overlying controlled airspace (see Figure 1).

Question:

What class of airspace is strictly uncontrolled airspace?

A. A

B. E

C. G

The correct answer is C: Class G airspace is uncontrolled.

Military Operations Areas (MOA)

(AIM 3-4-5, page 144)

A Military Operations Area (MOA) is for certain nonhazardous military activities for routine training or testing maneuvers including both high altitude areas and low-level areas beginning at or close to ground level. MOAs are identified by name and surrounded by magenta lines with hash marks (see the Benning MOA in Figure 2).

Unmanned vehicle operators must be aware of any overhead MOA. Low level MOAs often extend down to 100 feet AGL or less. MOA hours of operation and altitudes are posted in the top margins of Sectional Charts and other hours of operation may also be found in NOTAMs.

Question:

Which statement is correct:

A. Unmanned vehicles are restricted from operating in MOAs.

B. Pilots of unmanned aircraft operating beneath a MOA should be alert for aircraft flying below the floor of the MOA.

C. Flying an unmanned aircraft beneath a MOA is prohibited.

The correct answer is B. Both military and civil aircraft may be flying below the floor of the MOA.

Question:

In Figure 2 What is the floor of the Benning MOA.

A. The Surface

B. 500 feet AGL

C. 500 feet MSL

The correct answer is B: 500 feet AGL as described in the chart legend (legend Arrow A).

Question:

In Figure 2, what is the elevation of the highest point of land (not obstruction) within the Benning MOA?

A. 776 feet MSL

B. 776 feet AGL

C. No elevation data is given

The correct answer is A: 776 feet above mean sea level. Surface terrain levels are always given in feet MSL. The elevations point is the black dot just above the words "Benning MOA" with black numerals "776" nearby.

Question:

What is the controlling agency for the Benning MOA?

A. Jacksonville Center

B. Atlanta TRACON

C. Marion County Airport

The correct answer is B: Atlanta TRACON (legend Arrow A).

Warning Areas (AIM 3-4-4, page 143)

A warning area is airspace of defined dimensions, beginning three nautical miles outward from the coast of the U.S., that contains activity that may be hazardous to nonparticipating aircraft. Warning areas may extend from the surface. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both. The only time an unmanned aircraft would encounter a Warning Area is if it is being flown from a vessel more than three miles offshore. If the warning area is "active," the drone could pose a hazard to aircraft operating in the area (or be interpreted as a "target" during live fire exercises from both vessels and aircraft).

Question:

Warning areas:

A. Begin 3 NM offshore and extend outward from the coast of the United States or over large bodies of water, e.g., the Great Lakes.

B. Are closed to all aircraft except those authorized by the controlling agency.

C. Warning areas extend upward from 500 ft MSL.

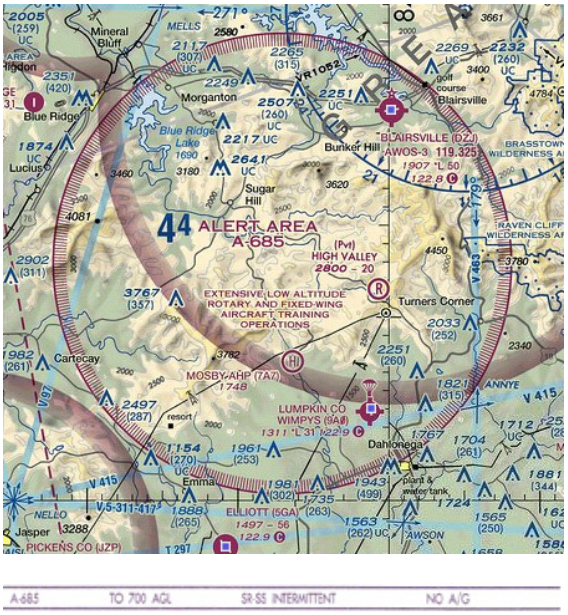

Figure 3. Alert Area

The correct answer is A. Warning areas extend upward from the surface. Operation in a warning area is not prohibited, but pilots should exercise extreme caution and could pose a hazard to other aircraft assigned to the area.

Alert Areas (AIM 3-4-6, page 144):

The AIM defines Alert areas as: "Areas depicted on aeronautical charts to inform nonparticipating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity." Alert areas are similar to a MOA, but usually operate at lower altitudes. Alert Area A-685 is an example of Alert Area as shown on an aeronautical chart. Unmanned vehicle operators should exercise extreme caution when operating in, near, or beneath an Alert Area.

Question:

What is the floor of Alert Area A-685?

A. 700 feet AGL

B. The surface

C. 200 feet AGL

The correct answer is B. The legend reads "To 700 AGL" indicating that the area extends from the surface up to 700 AGL (legend excerpt under map graphic).

Question:

What is the purpose of Alert Area A-685?

A. Activity around Blairsville Airport.

B. High, rugged terrain.

C. Extensive low altitude rotorcraft and fixed wing training operations.

The correct answer is C: See notice inside the alert area.

Controlled Firing Areas: (AIM 3-4-7, page 144):

CFA is "airspace designated to contain activities that if not conducted in a controlled environment would be hazardous to nonparticipating aircraft." CFAs are not identified on aerial navigation charts. It is possible that unmanned aircraft operators might not even be aware of a nearby CFA.

Question:

Which statement is correct?

A. Unmanned aircraft should not be operated within 5 statute miles of a CFA

B. Operational hours will be published in NOTAMs

C. Unmanned aircraft operators may not even be aware of a CFA in the area.

The correct answer is C. There is no formal identification or notification of the location or operation of CFAs.

Regulatory Airspace

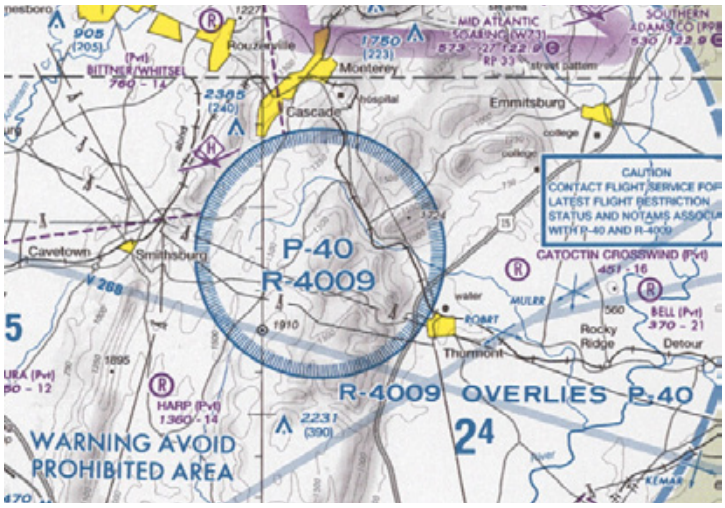

Figure 4. Prohibited and Restricted Areas

Regulatory airspace includes restricted and prohibited airspace as well as various classes of controlled airspace (Class A, B, C, D, and E) airspace. Controlled airspace is airspace subject to some level of FAA air traffic control.

Prohibited Airspace (AIM 3-4-2, AIM page 143):

Airspace designated within which flight of aircraft is not allowed, usually due to security concerns or potential hazards to aircraft. Prohibited airspace, identified by "P" on charts, typically extends from the surface to 3000 feet or as indicated by a legend on the chart) above the surface (AGL) and are permanent. ATC is not permitted to provide clearance though prohibited airspace.

Prohibited Airspace is identified on aeronautical charts by blue borders with interior hash marks (Figure 4). Each area has an identifier code.

Restricted Airspace (AIM 3-4-3, AIM page 143):

Restricted airspace is similar to Prohibited Airspace except that entry into Restricted airspace is only prohibited when the area is in effect or "active." Identified by the same blue line as a Prohibited area, the areas are identified by the letter "R" and an identifying number (refer to Figure 4). Pilots will be notified by NOTAMs and usually by ATC when the area is active. When it is active, entry into the airspace is prohibited. When restricted airspace is not "active," the airspace reverts to its original airspace class without the restriction. The altitude and dimensions of restricted areas vary. Restricted airspace dimensions will be described in chart legends.

Question:

What class of regulatory airspace over land is prohibited by notice such as by NOTAMs:

A. Prohibited Airspace

B. Restricted Airspace

C. Warning Airspace

The correct answer is B: Prohibited airspace is always closed airspace and Warning areas are only over water.

Question:

What is the floor of Restricted 3002E (Figure 4 Legend)?

A. Surface

B. 8000 MSL

C. 8000 AGL

The correct answer is B: R3002E begins at 8000 feet MSL. Altitudes without the "AGL" are MSL altitudes.

Other Airspace Areas

"Other airspace areas" is a general term referring to the majority of the remaining airspace. It includes:

Local airport advisory (LAA) **(AIM 3-5-1, AIM page 145)**

Military training route (MTR) **(AIM 3-5-2, AIM page 145)**

Temporary flight restriction (TFR) **(AIM 3-5-3, AIM page 146)**

Parachute jump aircraft operations **(AIM 3-5-4, AIM page 149)**

Published VFR routes **(AIM 3-5-5, AIM page 146)**

Terminal radar service area (TRSA) **(AIM 3-5-6, AIM page 153)**

National security area (NSA) **(AIM 3-5-6, AIM page, 144)**

Air Defense Identification Zones (ADIZ) land and water based and need for Defense VFR (DVFR) flight plan to operate VFR in this airspace

Flight Restricted Zones (FRZ) in vicinity of Capitol and White House (**ADIZ/FRZ Advisory Updated (070731)**)

Wildlife Areas/Wilderness Areas/National Parks

National Oceanic and Atmospheric Administration (NOAA) Marine Areas off the coast with requirement to operate above 2,000 AGL

Tethered Balloons for observation and weather recordings that extend on cables up to 60,000

Most national parks have strict restrictions on operating UAVs from or over parks and flight may either be prohibited or restricted to certain altitudes. Pilots must obtain permission for any flights over national parks, and this may also apply to other areas such as wilderness areas, state parks, etc.

Question:

Local Airport Advisory (LAA) service is provided at an airport with:

A. An Operating Control Tower

B. An operating Flight Service Station (FSS)

C. A fixed base operator.

The correct answer is B: The LAA is provided by an FSS on the airport.

Question:

Where might you expect to find temporary flight restrictions in effect:

A. Over a disaster area such as an area hit by a severe hurricane.

B. Over an area to be visited by the President of the United States.

C. Over an area to provide safe space launch activities.

The correct answer is all of the above.

Question:

Would operation of a small UAV be prohibited in an area covered by a TFR?

A. Yes.

B. Yes, unless the operator of the UAV was granted a waiver or permission by the responsible FAA facility.

C. No.

The correct answer is B.

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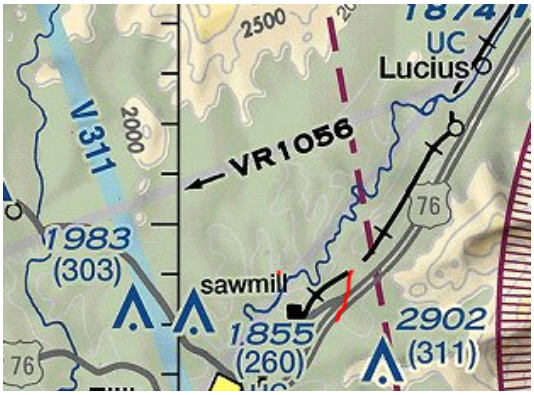


Figure 5. Military Training Route (VR1056)

Military training routes are identified on sectional charts by a gray line with the route identifier in black or gray print (Figure 5).

Question:

There are both VFR and IFR Military Training Routes (MTR). What altitudes are VFR MTRs intended to be flown at:

A. 1200 feet AGL and below

B. 1200 feet AGL and above

C. 3000 feet MSL and below

The correct answer is A: VFR military low level training routes may be flown at 1200 AGL or lower, at speeds in excess of 250 knots.

Question:

A military training route is identified as VR1007. This indicates that there may be high-speed military aircraft flying along this route:

A. Above 1200 AGL feet or higher under IFR conditions

B. At or below 1200 feet AGL when visibilities are 3 sm or more

C. At or below 1200 feet AGL when visibilities are 5 sm or more.

The correct answer is C: Visibilities must be 5 sm or greater for aircraft to use their VFR training routes.

Controlled Airspace

Controlled airspace is a generic term that covers the different classifications of airspace with defined dimensions within which air traffic control (ATC) service is provided in accordance with the airspace classification. The level of **control** varies with each class of controlled **airspace**.

Pilots of Unmanned vehicles must be aware of and know the requirements when operating in and under different classes of controlled airspace.

Classes of Controlled Airspace

Class A Airspace is generally the airspace from 18,000 feet MSL up to and including FL 600, including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska within which domestic ATC apply. Any operation of an unmanned vehicle in Class A airspace would require FAA approval and a waiver.

Other Controlled Airspace

The following applies to all the following classes of airspace except Class G airspace. No person may operate a small unmanned aircraft in Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person has prior authorization from Air Traffic Control (ATC). VFR operations, when permitted, require VFR minimums of 3 sm horizontal visibility cloud clearances of 1000 feet above, 2000 feet horizontally away, and 500 feet below clouds (i.e., VFR minimums for controlled airspace).

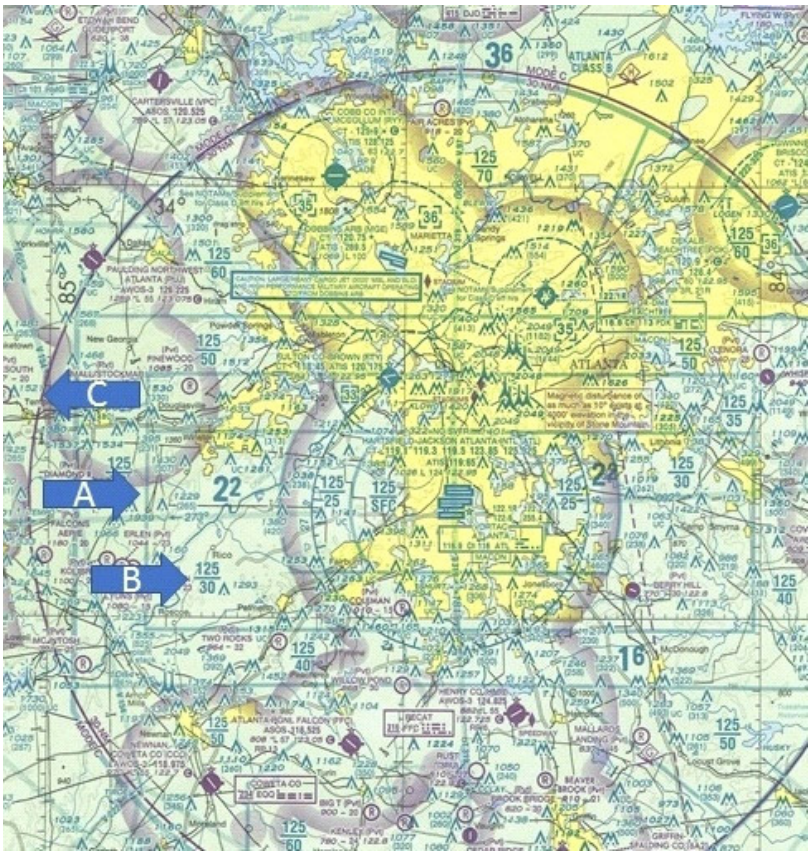


Figure 6. Controlled Airspace

Class B Airspace is that airspace from the surface to 10,000 feet MSL surrounding the nation's **busiest airports in terms of IFR operations or passenger enplanements.** The configuration of each Class B airspace area is individually tailored and consists of a surface area and two or more layers and is designed to contain all published instrument procedures once an aircraft enters the airspace.

Atlanta Hartsfield Airport is surrounded by both Class B and Class C airspace (Figure 6). The A-arrow indicates a blue line of one section of Class B airspace, and B in that figure indicates the floor (3000 ft MSL) and ceiling (12,500 ft MSL) of that airspace. Arrow C indicates the perimeter of Class C airspace (magenta circle).

Question:

Refer to Figure 6: The blue line indicated by the A-arrow in the figure identifies:

A. Class A Airspace

B. Class B Airspace

C. Class C Airspace

The correct answer is B: Class B airspace.

Question:

The numbers indicated by the B-arrow in Figure 6 show:

A. The floor and ceiling of the entire complex of Class B airspace within the TCA.

B. The height and width of the obstruction next to the numbers.

C. The floor and ceiling of the airspace within that section of the TCA.

The correct answer is C

Question:

The C-arrow is pointing at the magenta arc around the airport. This line indicates the lateral limits of:

A. Class A Airspace

B. Class B Airspace

C. Class C Airspace

The correct answer is C: Class C airspace.

Any operation of an unmanned aircraft in Class B airspace would require advanced coordination with ATC and permission or a waiver. Class B airspace is surrounded by narrow blue lines. Multiple such lines may surround busy airports.

Class C Airspace:

Although the configuration of each Class C airspace area is individually tailored, the airspace usually consists of a 5 NM radius core surface area that extends from the surface up to 4,000 feet above the airport elevation, and a 10 NM radius shelf area that extends no lower than 1,200 feet up to 4,000 feet above airport elevation. All aircraft pilots must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter must maintain communications while within the airspace.

Operation of an unmanned aircraft in Class C airspace would require prior coordination and approval or waiver from the local ATC authority.

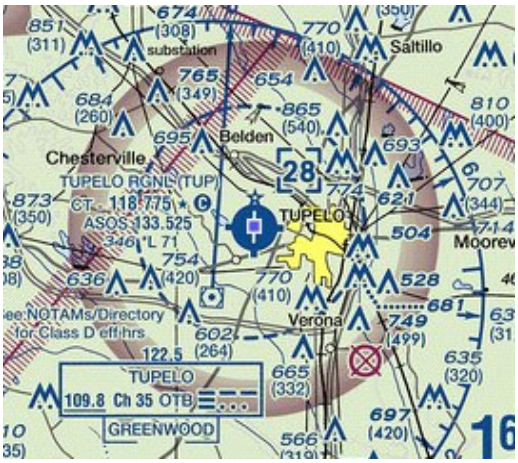


Figure 7. Class C Airspace

Class D Airspace is generally airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an **operational control tower.** Class D airspace is indicated on charts by dashed blue lines.

Operation of an unmanned aircraft in Class D airspace would require prior coordination and approval from the local ATC authority.

Question:

The blue dashed circle surrounding the airport in Figure 7 indicates:

A. A terminal control area (TCA).

B. An airport with a full-time operational control tower.

C. A control zone that is operational at least part time.

The correct answer is C: The blue dashed control zone line indicates an airport with a control tower operating at least at part time.

Class E Airspace:

Figure 8. Class E Airspace

Class E airspace is the controlled airspace not classified as Class A, B, C, or D airspace. A large amount of the airspace over the United States is designated as Class E airspace. Federal (Victor) airways (Figure 8) and low-altitude RNAV routes are Class E airspace areas and, unless otherwise specified, extend upward from 1,200 feet AGL to, but not including,18,000 feet MSL. The controlled airspace around the airway is not marked, but the width of the airway, and the Class E airspace, is 4 miles either side of the centerline of the airway, out to a distance of 51 nautical miles from nearest navigation station that defines the airway.

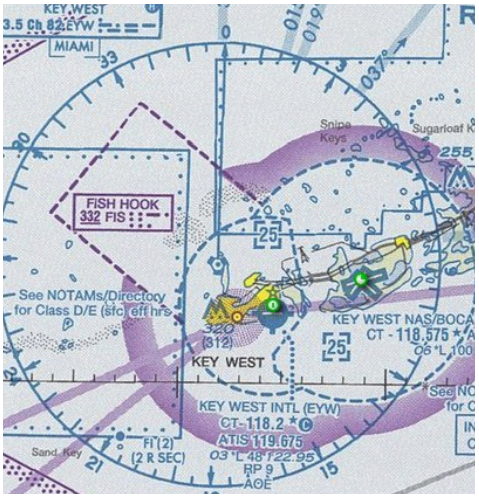


Figure 9. Class E Airspace

In most areas, the Class E airspace base is 1,200 feet AGL. In other areas, the Class E airspace base is either the surface (indicated by dashed magenta line on charts (Figure 9)) or 700 feet AGL (indicated by magenta circles/arcs). Some Class E airspace begins at an MSL altitude depicted on the charts, instead of an AGL altitude. Class E airspace typically extends up to, but not including, 18,000 feet MSL (the lower limit of Class A airspace). All airspace above FL 600 (approximately 60,000 ft) is Class E airspace.

Question:

What is the base of controlled airspace inside the magenta shaded arc, but outside of the blue dashed arc around Key West International airport (Figure 9):

A. Surface

B. 700 feet

C. 1200 feet

The correct answer is B: The magenta shaded arc indicates Class E controlled airspace beginning at 700 feet. The blue dashed arc indicates Class D controlled airspace beginning at ground level.

Question:

The squared dashed magenta line extending northwest from the blue dashed control zone (Figure 9) indicates:

A. Class E controlled airspace extending upward from the surface.

B. Class B controlled airspace extending upward from the surface.

C. Uncontrolled airspace through which aircraft may have to fly an instrument approach to the airport.

The correct answer is A. Magenta indicates class E airspace. The dashed line indicates it begins at ground level.

Class G Airspace

is the uncontrolled "govern-free" airspace that is void of Air Traffic Control (ATC) jurisdiction. Class G airspace supports both Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) operations.

Other Chart Information

The following are items shown on navigation charts or software that are of particular interest to the operators of unmanned aircraft. Remote Pilots should study and be familiar with the graphic items as shown in the legend panel of Sectional Area Charts (SAC) and Terminal Area Charts (TAC).

Airport Symbols

The following are items shown on navigation charts or software that are of particular interest to the operators of unmanned aircraft. Remote Pilots should study and be familiar with the graphic items as shown in the legend panel of Sectional Area Charts (SAC) and Terminal Area Charts (TAC).

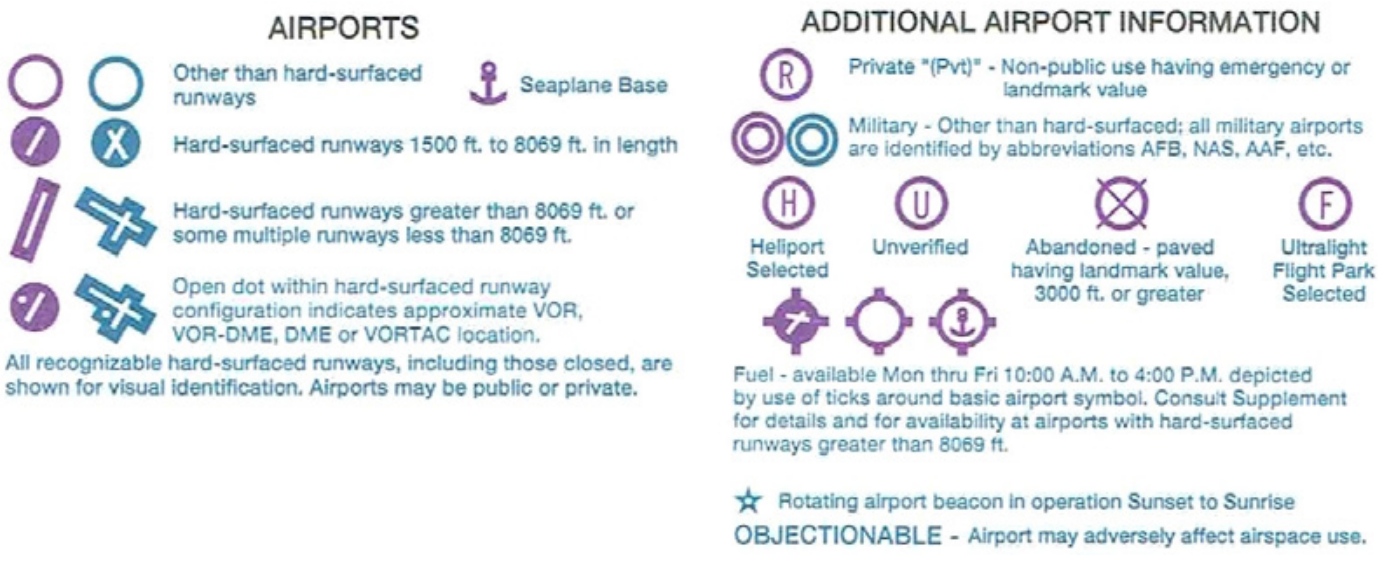


Figure 10. Airport Symbols on Sectional Chart

Pilots of unmanned aircraft may be required to operate near airports and should be able to determine the nature of the flight operations of an airport by its symbol on a navigation chart (Figure 10). Most airport symbols are round circles. These are airports with runways no longer than 8069 feet. Airports with longer paved runways show a profile of the runway layout.

Magenta airports do not have operating control towers. Blue airport symbols indicate airports with at least part-time operating control towers. The name of the airport will be printed on the chart adjacent to the airport symbol where ever space permits.

Applicants for the remote pilot operating certificate should be able to identify airport symbols based on the chart depictions (Figure 10).

Refer to Figures 10 and 11 for the following questions:

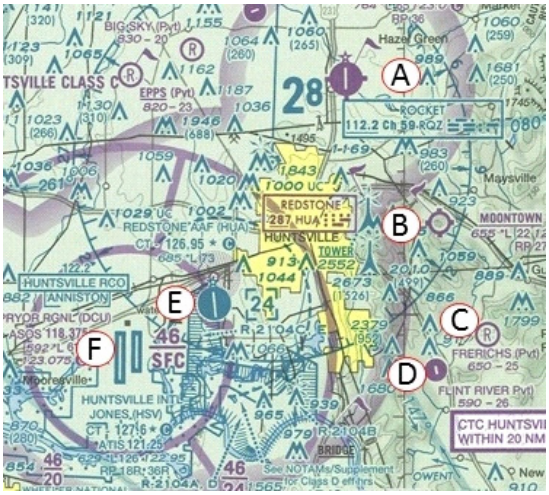


Figure 11. Airports and Controlled Airspace

Question:

Which of the airport in Figure 11 is a controlled airport?

A. Airport A

B. Airport B

C. Airport E

The correct answer is C: Airport E is printed in blue indicating it has an operational control tower.

Question:

Which two airports provide fuel service?

A. A and D

B. B and C

C. A and B

The correct answer is C. Airports A and B have tick marks on the circle.

3DINSIDER

Question:

Which airports have operating control towers?

A. A and B

B. A and D

C. E and F

The correct answer is C. Airports E and F are printed in blue indicating control towers.

Question:

What do we know about the runway at airport E?

A. It is not paved.

B. It has a paved runway no more than 8069 feet long

C. It is open only during daylight hours.

The correct answer is B. The white line in the blue circle indicates a paved runway and the fact that it does not extend beyond the limits of the blue circle indicates a length of not more than 8069 feet.

Question:

Which airport is located under Class E airspace that begins at 700 ft AGL?

A. Airport A

B. Airport C

C. Airport D

The correct answer is A. Airport A is surrounded by a magenta circle indicating airspace that begins at 700 feet AGL. Airports C and D are under controlled airspace that begins at 1200 ft AGL or higher.

Tall obstructions, including tall buildings, antenna towers, and other tall structures are indicated on Sectional Charts (see Figure 11).

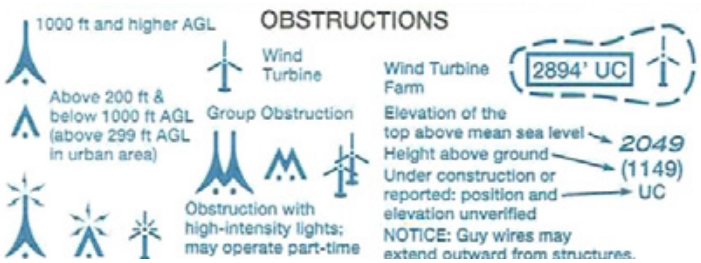


Figure 12. Obstruction Symbols on Sectional Chart

Question:

There are two towers just to the left of Airport B. What do you know based on what is depicted on the chart based on Figure 12?

A. One tower is more than 1000 AGL and one tower is less than 1000 AGL, but more than 200 feet AGL.

B. The tallest tower is 1000 feet above sea level.

C. Neither tower has high intensity obstruction lighting.

The correct answer is A. B is not correct. The height above sea level of the tallest obstruction in a group is indicated by the blue numbers under the obstruction; in this case 1935 (feet MSL).

Aeronautical charts, especially Sectional Charts and Terminal Control Area charts, provide valuable information regarding the types and dimensions of airspace, as well as obstructions, that may be encountered during the operation of an unmanned aircraft. Pilots of UAVs should familiarize themselves with these charts and review the area of intended operations for elevation and terrain, obstructions, possible aircraft operations, and other possible hazards.

Notices to Airmen (NOTAMs)

NOTAMs are notices or advisories distributed by means of telecommunication that contain information concerning the establishment, conditions, or changes in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel and systems concerned with flight operations. NOTAMs can also be located online. Every user of the NAS is affected by NOTAMs because they indicate the real-time status of features and services within the NAS.

All NOTAMs follow a specific format, which includes several required elements. Table 1 shows a typical NOTAM and explanations for typical components of a NOTAM.

Table 1. A Typical NOTAM

!BNA **11/246** MBT OBST TOWER LGT (ASR 1229462) 354817.80N 0862841.50W (6.7NM SW MBT) 902.6FT (270.0FT AGL) OUT OF SERVICE 1811091257-1811231300

NOTAM Element	**Explanation**
BNA **11/246**: BNA	Nashville, TN, the 246th NOTAM issued in November (11)
ASR 1229462	Antenna Structure Registration
MBT	Affected Facility: Murfreesboro Apt, TN
354817.80N 0862841.50W	Latitude and longitude of structure
TOWER LGT	Key Word: Subject of NOTAM (Tower lighting)
(6.7NM SW MBT)	Location: 6.7 nautical miles southwest of MBT
902.6FT (270.0 FT AGL)	Height MSL (AGL)
OUT OF SERVICE:	The message or condition: Lighting is out of service.
1811091257-1811231300	Effective date and time (YYMMDDHHMM)

BNA is a three-letter facility identifier (Nashville, Tennessee), in this case BNA is the FAA facility that issued the NOTAM. MBT is the identifier for the affected airport, Murfreesboro, Tennessee, and the tower is 6.7 nautical miles southwest of MBT.
NOTAMS may be sorted by keywords, so a pilot of an unmanned vehicle could search for NOTAMS for a specific airport (AD for aerodrome) or OBST for obstructions.

One online source of FAA NOTAMs can be found at: https://notams.aim.faa.gov/notamSearch/

As a pilot of an unmanned aircraft operating in the vicinity of 6 – 7 NM southwest of Murfreesboro airport, especially during a period of civil twilight, it would be important to know that the nearby radio antenna tower was unlighted.

Use the following NOTAM to answer the questions below Note: ULH is Tullahoma Airport.
!BNA 05/648 ULH NAV NDB OUT OF SERVICE 1805301429-PERM

Question:

What is the keyword in the above NOTAM:

A. Airport Lighting

B. Airport Services

C. NDB (Non-directional beacon)

The correct answer is C: The NDB

Question:

What does the term "PERM" at the end of the NOTAM indicate:

A. This is permanent NOTAM

B. The status of the NDB is permanent

C. There are no navigation aids available at ULH

The correct answer is B: the non-directional beacon is out of service permanently.

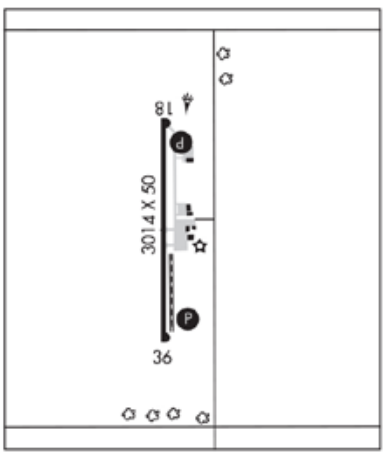
Airport Facility Directory Examples

Airport facility directories provide useful information for UAV pilots, including communications frequencies, runway directions, whether there is a tower or FSS on the field, etc.

ARKANSAS

FORREST CITY

HUTFLY–FCY (FCY)(KFCY) 4 S UTC–6(–5DT) N34°56.52′ W90°46.50′ **MEMPHIS L–18F**
249 B NOTAM FILE JBR
RWY 18–36: H3014X50 (ASPH) S–20 MIRL
RWY 18: REIL. PAPI(P2L)—GA 4.0° TCH 36′.
RWY 36: REIL. PAPI(P2R)—GA 4.0° TCH 36′. Trees.
SERVICE: S4 **FUEL** 100LL, JET A **LGT** Dusk–Dawn. ACTIVATE MIRL Rwy 18–36 and PAPI Rwy 18 and Rwy 36—CTAF. Rotating bcn OTS indef. Rwy 18–36 REIL OTS indef. Rwy 18–36 PAPI OTS indef.
AIRPORT REMARKS: Attended Mon–Fri 1400–2300Z‡. Fuel 100LL avbl 24 hrs self svc with credit card, Jet A avbl during attended hrs only. Rwy 36 ditch 201′ from south end of rwy. 494′ lgtd twr 3 miles north on centerline.
AIRPORT MANAGER: 870-633-4511
COMMUNICATIONS: CTAF/UNICOM 122.8
Ⓡ **MEMPHIS CENTER APP/DEP CON** 135.3
COMM/NAV/WEATHER REMARKS: For Clnc Del ctc MEM Apch at 901–842–8457.



Question:

What is the runway orientation (directions) for Forrest City Municipal airport:

A. 07-25

B. 18-36

C. 09-27

The correct answer is B: RWY: 18-36 indicates the runway directions.

Question:

During what hours is the Forrest City Municipal airport operational during winter?

A. Monday through Friday, 2:00 pm to 11;00 pm

B. Daily, 8:00 am to 5:00 pm

C. Monday through Friday, 8:00 am to 5:00 pm

The correct answer is C. It is open only Monday through Friday, 1400Z (8:00 am Local) to 2300Z (5:00 pm Local)—the time difference from UTC is -6 hours.

Chapter 2. Summary

Unmanned aircraft share the National Airspace System with manned aircraft, and therefore, each sUAS Pilot-In-Command applicant must demonstrate understanding of airspace distinctions and operating rules, and how each different type of airspace affects flight operations. The key principle to remember is that manned aircraft always have the right-of-way. The other key reality is that different categories of airspace have different, specific operational requirements and restrictions. Violations of airspace operating requirements and limitations are probably the quickest way to lose sUAS operating privileges.

CHAPTER 3:
AVIATION WEATHER SOURCES

INTRODUCTION

Weather conditions are an essential part of any aviation activity. Even a simple flight around the airport on a mild sunny and still day acknowledges that the weather conditions are ideal. Most flying, including planned operation of an unmanned aircraft, require an understanding of what weather conditions are to be expected at the time and location of the flight, and how the weather will affect the operation of the aircraft and the success of the mission.

In aviation, weather reports are the result of the combined efforts of the National Weather Service (NWS), Federal Aviation Administration (FAA), Department of Defense (DOD), other aviation groups, and individuals.

The resulting reports and forecasts enable UAV pilots to make informed decisions regarding weather and flight safety before and during UAV flight operations. Consequently, obtaining a preflight "weather briefing" is an essential responsibility of unmanned vehicle flight operations.

Surface aviation weather observations

are reports of current weather at individual ground stations. Surface observations provide local weather conditions and other relevant information for a specific airport. These localized reports cover a small area and are beneficial to the remote pilot.
Observations may be automated such as the Automated Weather Observing Systems (AWOS), Automated Surface Observing Systems (ASOS), as well as direct observations by trained personnel. Pilots may also report weather conditions. Observations reported by pilots, called PIREPs, may be included in official meteorological reports that are made available as part of various weather reporting products.

Airports with Flight Service Stations (FSS) provide Local Airport Advisory (LAA). Each report provides current information that is updated as changes in conditions warrant. Some typical reports are METARs and PIREPs. To view a weather report, go to http://www.aviationweather.gov/.

Question:

Which of the following is NOT an automated service to provide current weather observations:

A. Automated Surface Observing Systems (ASOS)

B. Automated Weather Observing Systems (AWOS)

C. PIREP

The correct answer is C: A PIREP is an observation reported by a pilot.

Question:

What airports provide Local Airport Advisories (LAA)?

A. Airports with operating control towers.

B. Airports with a Unicom

C. Airports with a Flight Service Station on the field.

The correct answer is C.

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vAerodrome Reports (METARs):

A METAR is an "observation" of current surface weather conditions reported at a specific location. The report is prepared in a standard international format. METARs are issued on a regularly scheduled basis unless significant weather changes occur. A special METAR (SPECI) can be issued at any time between routine METAR reports.

Table 2 provides an explanation of a METAR. For complete information, refer to Federal Meteorological Handbook No. 1, Surface Weather Observations and Reports (FCM-H1-2017 (or latest edition) (https://www.ofcm.gov/publications/fmh/FMH1/FMH1_2017.pdf).

METAR: KBNA 191453Z 21008KT G18KT 10SM BKN045 OVC060 13/06 A3009 RMK AO2	
NOTAM Element	**Explanation**
1. METAR	Type of Report METAR = Regular, SPEI = Special
2. KBNA	The reporting station identifier: Nashville, TN. "K" is the international code for airports in the contiguous United States.
3. 191453Z	DDHHMM Date (current month) and time (Z = Zulu = UTC)
4. 21008KT G18KT	Wind: 210 = true direction[1]; 08[2] = speed in knots, G = Gusts
5. 10SM	Horizontal visibility = 10 statute miles[3]
6. BKN045 OVC060	Sky Conditions = Broken clouds with a base at 4,500 ft AGL, Overcast at 6000 ft. AGL
7. 13/06	Temperature and Dewpoint in °C, ("M" if used, means below 0°)
8. A3009	Altimeter Setting (the local barometric pressure corrected to sea level)
9. RMK AO2	Remarks AO2 = This site has an automated precipitation sensor. Note: many remarks will be in clear language. Consult the Federal Meteorological Handbook FCM-H1-2017 for a complete list of remarks and abbreviations.

Notes

[1] Wind direction varying more than 60o indicated by "V" (variable) and direction and speed of extreme differences.

[2] If wind is greater than 99KT this entry will be three digits

[3] A report of 10 miles means 10 miles or more, visibilities less than 10 miles are reported in statute miles and fraction of a mile, e.g., 3 ¾ miles

A note on "time": All times are Universal Coordinated Time (UCT), previously referred to as Greenwich Mean Time—the time zone of the Greenwich (England) observatory. That time zone is also identified as the "Z" or Zulu time zone. UCT times are reported with four digits followed by "Z" or UCT. Users of these reports must know their own time zones and make the adjustment in hours to convert UCT into Local time.

Question:

You are interested in the weather at Nashville, TN and read the above report. Assume the current month is December. What was the local time when the METAR was posted (Nashville is in the Central Time zone of the United States)? Central Standard Time is Z – 6 hours.

A. 0253 L

B. 0853 L

C. 2053 L

The correct answer is B. Central Standard Time (CST) is 6 hours behind Z (UCT). When it is 0800 at BNA, it is 1400 in Greenwich, England. To make the adjustment, subtract 6 (-6) hours from the Z time for CST. Daylight Savings Time (DST), the difference is -5 hours.

The following is the METAR for Richmond International Airport, Richmond, Virginia (KRIC) (located in the Eastern Time Zone). The month is November: -5 hours from UCT.

KRIC 20**0706**Z 20005KT 1SM R34/P6000FT BR **SCT003** BKN100 **09**/08 A2992 RMK AO2

Question:

What time was this METAR issued:

A. 1507 EST

B. 0206 EST

C. 0206 Z

The correct answer is B: The standard time difference between Eastern Standard Time and UCT is -5 hours. The UCT is the last four digits in the date/time string (0706).

Question:

What is the lowest layer of clouds reported in the Richmond METAR?

A. 300 feet scattered

B. 3000 feet scattered

C. 10,000 feet broken

The correct answer is A: SCT003 indicates scattered clouds at 300 feet (3000 would be "030").

Question:

What is the temperature at the airport:

A. 8 degrees C

B. 9 degrees F

C. 9 degrees C

The correct answer is C: In the temperature block, 09/08, 09 is the temperature C, 08 is the dewpoint in C.

Question:

What is the visibility at the airport?

A. 1 nautical mile

B. 1 statute mile

C. 6000 yards

The correct answer is B: Visibility is reported in statute miles. Note R34/6000FT is the measured visibility on runway 34.

Question:

Does KRIC have the capability to measure moisture (rain, etc.) automatically?

A. Yes

B. No

C. Unable to determine

The correct answer is A. A02 in the remarks (RMK) section is the code for this capability

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Aviation Forecasts

Unlike observations, forecasts project the likely weather that will occur. Forecasting is reasonably accurate for a period of 24 to 36 hours. Forecasts that go beyond that are referred to as outlooks. Outlooks are anticipated trends in weather and are subject to change. A variety of different forecast products are produced and designed to be used in the preflight planning stage. The printed forecasts that sUAS pilots need to be familiar with are the terminal aerodrome forecast (TAF), aviation area forecast (FA), and Airman's Meteorological Information (AIRMET).

Terminal Aerodrome Forecasts (TAF)

A TAF is a forecast prepared for the five statute miles radius around an airport. TAF reports, usually valid for 24-30 hours, are given for larger airports. The TAF is updated four times a day and uses the same descriptors and abbreviations as the METAR. These weather reports can be useful to the remote pilot for flight planning purposes.

The following is the Aviation Digital Data Service (ADDS) raw TAF for KRIC:

Data at: 1549 UTC 20 Nov 2018
KRIC **201137Z 2012/2112** 25007KT P6SM BKN090
FM201400 30008KT P6SM SCT060
FM201700 31010G18KT P6SM SCT060
FM202200 33005KT P6SM SKC

The following is the decoded TAF for KRIC:

TAF for:	KRIC (Richmond Intl, VA, US) issued at 1137 UTC 20 Nov 2018
Text:	**KRIC 201137Z 2012/2112 25007KT P6SM BKN090**
Forecast period:	1200 to 1400 UTC 20 November 2018
Forecast type:	FROM: **standard forecast** or significant change
Winds:	from the WSW (250 degrees) at 7 knots (8 MPH; 3.6 m/s)
Visibility:	6 or more sm (10+ km)
Ceiling:	9000 feet AGL
Clouds:	broken clouds at 9000 feet AGL
Text:	**FM201400 30008KT P6SM SCT060**
Forecast period:	1400 to 1700 UTC 20 November 2018
Forecast type:	FROM: **standard forecast** or significant change
Winds:	from the WNW (300 degrees) at 8 knots (9 MPH; 4.1 m/s)
Visibility:	6 or more sm (10+ km)
Ceiling:	at least 12,000 feet AGL
Clouds:	scattered clouds at 6000 feet AGL
Text:	**FM201700 31010G18KT P6SM SCT060**

3DINSIDER

Note: These data were obtained from the Aviation Weather Center and provided by NOAA and the National Weather Service: Go to https://www.aviationweather.gov/taf/data?ids=KBNA&format=decoded&metars=off&layout=on and enter the airport identifier (preceded by the letter "K" in the "IDs" box on the first line under "TAF Text Data."

The following questions are based on the raw data forecast below for KBNA (Nashville, TN (CST)). Note, the letters SKC indicates that the "sky is clear."

Data at: 1603 UTC 20 Nov 2018
KBNA 201435Z 2015/2112 36006KT P6SM FEW025 OVC035
FM201600 33010KT P6SM SCT015 OVC023
FM202300 34005KT P6SM SKC

Question:

At what date and time was forecast issued?

A. The 20th of the month at 1435Z

B. The 20th of the month at 2015Z

C. The 20th of the month at 1600Z

The answer is A. 201435Z is the date 20th (20) and time (1435Z) that the forecast was issued.

Question:

At what local time are the winds forecast to be 330 at 10 knots?

A. 1000Z

B. 1000 CST

C. 1700 CST

The answer is B: The winds are forecast to be from (33010KT). BNA is CST and the difference 1600Z – 6 or 1000 CST.

Question:

What are the sky conditions supposed to be after 2300Z?

A. Overcast at 2300 feet

B. Clear

C. Not indicated.

The correct answer is B: The notation "SKC" indicates that the "Sky will be clear."

Question:

What is the forecast visibility at the airport for 1200 local time (CST)?

A. 6000 ft

B. Unable to tell

C. Greater than 6 statute miles

The correct answer is C: The visibility was more than (P) at 6 statute miles (6SM). Note the forecast period is from 1600 to 2300; includes 1200 CST / 1800Z.

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The forecast information format is similar to the METAR. The following is a more complex example in raw text with an explanation (Source: Weather: A Handbook).

Example:
TAF KPIR 111130Z 1112/1212 TEMPO 1112/1114 5SM BR FM1500 16015G25KT P6SM SCT040 BKN250
FM120000 14012KT P6SM BKN080 OVC150 PROB30 1200/1204 3SM TSRA BKN030CB FM120400 1408KT P6SM SCT040 OVC080 TEMPO 1204/1208 3SM TSRA OVC030CB

Explanation: Routine TAF for Pierre, South Dakota...on the 11th day of the month, at 1130Z... valid for 24 hours from 1200Z on the 11th to 1200Z on the 12th...wind from 150° at 12 knots... visibility greater than 6 SM...broken clouds at 9,000 feet... temporarily, between 1200Z and 1400Z, visibility 5 SM **in mist**...from 1500Z winds from 160° at 15 knots, gusting to 25 knots visibility greater than 6 SM...clouds scattered at 4,000 feet and broken at 25,000 feet... from 0000Z wind from 140° at 12 knots...visibility greater than 6 SM...clouds broken at 8,000 feet, overcast at 15,000 feet...between 0000Z and 0400Z, there is 30 percent probability of visibility 3 SM...thunderstorm with moderate rain showers...clouds broken at 3,000 feet with cumulonimbus clouds...from 0400Z...winds from 140° at 8 knots...visibility greater than 6 miles... clouds at 4,000 scattered and overcast at 8,000... temporarily between 0400Z and 0800Z... visibility 3 miles... thunderstorms with moderate rain showers...clouds overcast at 3,000 feet with cumulonimbus clouds...end of report (=). (Source: Weather: A Handbook)

Question:

Reading through the explanation, what do the following abbreviations mean:

	Answers:
A. BR =	**A.** BR = "Mist"
B. PROB =	**B.** PROB = Probability
C. BKN =	**C.** BKN = Broken (clouds broken covering .1 to .5 of the sky)
D. TSRA =	**D.** TSRA = Thunderstorms with rain showers
E. CB =	**E.** CB = Cumulonimbus clouds
F. P6SM =	**F.** P6SM = Visibility greater than 6 statute miles

Convective Significant Meteorological (SIGMET) Information

Convective SIGMETs are issued for severe thunderstorms with surface winds greater than 50 knots, hail at the surface greater than or equal to ¾ inch in diameter, or tornadoes. They also advise pilots of embedded thunderstorms, lines of thunderstorms, or thunderstorms with heavy or greater precipitation. A remote pilot will find these weather alerts helpful for flight planning.

Question:

Which of the following Terminal Area Forecast (TAF) items would be a reason to postpone an unmanned aerial vehicle flight if forecast for your area?

A. TSRA

B. P6SM

C. BKN

The answer is A: Thunderstorms, accompanied by rain showers are always a reason for concern, especially since strong, gusty winds can occur unexpectedly.

Question:

Which of the following weather reports would immediately create the greatest concern regarding weather not favorable for operating a UAV?

A. SIGMET

B. TAF

C. METAR

The correct answer is A: A SIGMET alerts pilots to the possibility of thunderstorms and strong winds—that is its only purpose. The other two are routine reports and forecasts.

SECTION 3A

METEOROLOGICAL INFORMATION SOURCES AND UNDERSTANDING SUMMARY

Weather conditions are an essential part of any aviation activity. Section A covers official sources of weather information available to sUAS pilots, which the FAA expects all pilots to understand and be able to use. Current weather conditions and forecasts also will have a major influence on a pilot's decision whether to fly. The FAA expects all pilots to know the official sources of weather information and how to use them.

CHAPTER 3B:

EFFECTS OF WEATHER ON SMALL UNMANNED AIRCRAFT PERFORMANCE

Day-to-day changes in weather and aircraft weight affect aircraft performance and the fundamental physical laws governing the forces acting on an aircraft. Since the characteristics of the atmosphere have a major effect on performance, it is necessary to review pressure, temperature, and density altitude.

Density Altitude (AIM, page 7-5-3)

Density altitude is a measure of air density. It is not to be confused with pressure altitude, true altitude or absolute altitude. It is not a height reference but is used to determine the performance capability of an aircraft.

Atmospheric Pressure: A column of dry air one inch square at its base at mean sea level (MSL) (the average level of "the sea" accounting for tides, etc.), that extends to the upper limits of the atmosphere weighs the same as a column of mercury one-inch square at its base and 29.92 inches high, hence atmospheric pressure is measured in inches of Mercury or in. Hg (the symbol for the element Mercury). Atmospheric pressure is also reported in millibars (mb), with 1" Hg equal to approximately 34 mb. Standard sea level pressure is 1,013.2 mb. Surface charts, high and low-pressure centers, and hurricane data are reported using mb.

Temperature is the other factor that determines density altitude. The average temperature at MSL is defined as 59°F (or 15°Celcius or C). The combination of 29.92 in Hg and 59°F MSL define the density of "standard day" conditions. Aircraft manufacturers base the projected performance of an aircraft on standard day conditions.

Effects of Pressure and Temperature on Atmospheric Density

Atmospheric density is a critical concept in aviation. Wings and propellers provide more lift or thrust when the air is dense and provide less lift and thrust as the density decreases. Therefore, the density of the atmosphere (density altitude) has a direct influence on the performance of aircraft. An aircraft climbs when it can produce excess thrust and lift—that is it can produce more power than is needed to maintain level flight.

As altitude increases, atmospheric pressure, temperature, and density altitude all decrease. For the first 10,000 feet of altitude, the pressure drops roughly one inch per thousand feet of altitude, therefore a station at 5,000 feet above sea level would have a barometric pressure of 24.92 in. Hg. Pilots of all aircraft are expected to use the reported altimeter setting, temperature, and elevation (or altitude) to determine the local density altitude and use that to determine aircraft performance.

Atmospheric density decreases with increase in altitude. The wings or rotors will generate less and less excess lift or thrust. A climbing aircraft at full available power will reach a point where the density of the atmosphere is only sufficient to maintain altitude and the aircraft can climb no higher—there is no excess lift or power at this point. This is the aircraft's **absolute** ceiling.

Question:

What factor would NOT reduce aircraft climb performance:

A. Lower temperature

B. High density altitude

C. Increased weight of the aircraft due to added load.

The correct answer is A: A lower temperature would increase air density.

Question:

There is a high-pressure system in the area where you will be flying a UAV. The altimeter setting is reported as 28.95. Regarding the operation of your UAV you might expect it to:

A. Climb more slowly than usual.

B. Climb more quickly than usual.

C. No change in performance since UAVs are a special class of aircraft.

The correct answer is A. The barometric pressure is less than as the pressure in a "standard day" (increasing the density altitude) causing the aircraft to not climb as quickly.

Question:

What effect would low atmospheric density have on the rotors of a UAV.

A. Rotor efficiency would increase

B. Rotor efficiency would decrease

C. Density altitude has no effect on the efficiency of VTOL rotors.

The correct answer is B. Rotors are simply rotating wings, and changes in atmospheric density directly affect the performance of the rotors.

Question:

A TAF is forecasting a strong low-pressure system to move in overnight before a planned sUAS mission. How might this low-pressure system affect the weather for the next day?

A. Low pressures systems frequently bring precipitation and reduced visibilities

B. You can expect better climb performance.

C. Ignore it, it is not likely to affect flying conditions.

The correct answer is A. Low pressure systems are frequently—but not always—associated with rain, low visibilities, and possible storms. Check the forecasts on the day of the flight to make final fly/no fly decision.

Winds and currents

(Pilots Handbook of Aeronautical Knowledge, Section 10)

Pressure and temperature changes produce two kinds of motion in the atmosphere—vertical movement of ascending and descending currents, and horizontal movement in the form of wind. It is caused by uneven heating of the Earth's surface and upsets the equilibrium of the atmosphere, creating changes in air movement and atmospheric pressure.

Wind Patterns

(Pilots Handbook of Aeronautical Knowledge, Section 10)

Air flows from areas of high pressure into areas of low pressure. In the Northern Hemisphere, this flow of air from high to low pressure produces a clockwise circulation around an area of high pressure. The opposite is true of low-pressure areas; the air flows toward a low and creates a counter-clockwise or cyclonic circulation.

Different surfaces radiate heat in varying amounts. Plowed ground, rocks, sand, and barren land radiate a large amount of heat, while water, trees, and other areas of vegetation tend to absorb and retain heat. The resulting uneven heating of the air creates areas of local circulation called convective currents. At lower altitudes this may cause "bumpy" flying conditions and affect UAV operations.

Convective currents are particularly noticeable in areas with a landmass directly adjacent to a large body of water, such as an ocean, large lake, or other appreciable area of water.

Question:

You are operating your UAV over the shoreline of a lake adjacent to a recently plowed field. As you turn to fly out over the water you might expect:

A. The UAV may begin to descend

B. The UAV may begin to climb

C. No change in the flight of the UAV.

The correct answer is A. As the UAV transitions from the warm rising air over the plowed field it will enter cooler air descending over the cooler water.

Atmospheric Stability, Pressure and Temperature

By tracking barometric pressure trends across a large area, weather forecasters can more accurately predict movement of pressure systems and the associated weather. For example, tracking a pattern of rising pressure at a single weather station generally indicates the approach of fair weather. Conversely, decreasing or rapidly falling pressure usually indicates approaching bad weather and, possibly, severe storms.

Air Masses and Fronts

An air mass is an extensive body of air having fairly uniform properties of temperature and moisture. As air masses move across bodies of water and land, they eventually come in contact with another air mass with different characteristics. The boundary layer between two types of air masses is known as a **front.**

Warm Front

A warm front is the boundary between two air masses where a warm mass advances and replaces a body of colder air. Warm fronts move slowly, typically 10 to 25 mph. Warm fronts are characterized by light winds, often hazy and reduced visibilities, and layered or flat shaped stratiform clouds.

Cold Front

A cold front is the boundary between two air masses where cold, dense, and stable air advances and replaces a body of warmer air. Cold fronts move more rapidly than warm fronts, progressing at a rate of 25 to 30 mph. As the cold front passes, towering cumulus or cumulonimbus clouds continue to dominate the sky. Depending on the intensity of the cold front, heavy rain showers form and might be accompanied by lightning, thunder, and/or hail. More severe cold fronts can also produce tornadoes.

Stationary Front

A stationary front is the boundary between two air masses that are relatively balanced. Stationary fronts produce hazy conditions, with steady rain or drizzle, and skies are often overcast.

Question:

Thunderstorms are most likely to be associated with a:

A. Warm front

B. Cold front

C. Stationary front

The correct answer is B: Cold fronts, especially strong cold fronts can produce rain showers to severe thunderstorms.

Effect of Obstructions on Wind

Another atmospheric hazard that can create problems, especially for pilots of sUAS, is the effect of obstructions on the ground on wind that can create unseen danger. Ground topography and large buildings can break up the flow of the wind and create wind gusts and turbulence that change rapidly in direction and speed. Obstructions range from man-made structures, like hangars, to large natural obstructions, such as mountains, bluffs, or canyons.

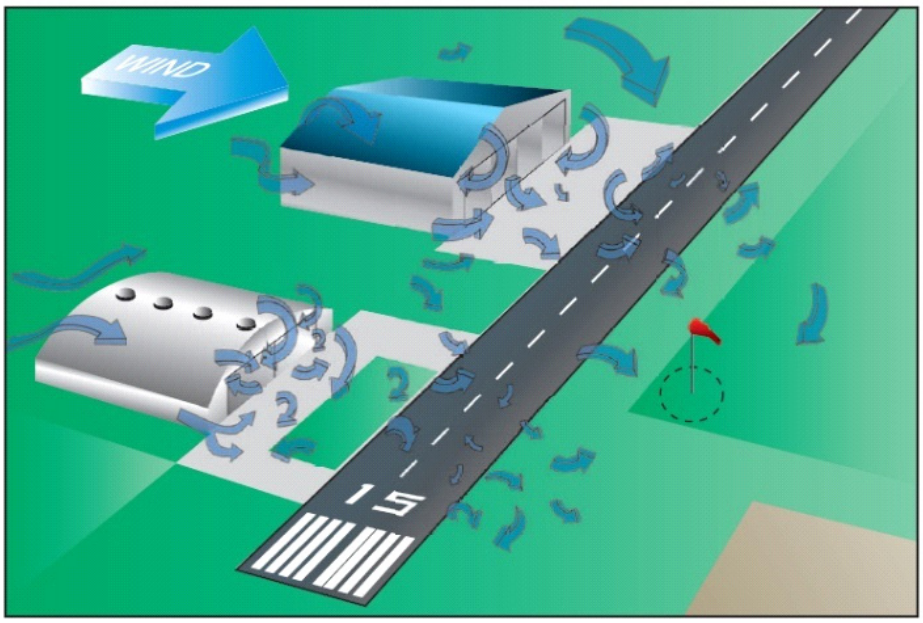


Figure 14. Wind and Turbulence Around Buildings

For example, wind blowing across a building may tend to descend rapidly on the downwind side of the structure (Figure 14), and may even create a rolling air mass. Flying near the downwind side, a small UAV may encounter strong downward gusts or turbulent air, making it hard to control.

Question:

You have been hired to use your sUAV to examine the exterior of a six-story office building. The winds are brisk from the west and forecast to increase in intensity. What might you expect as you fly along the east side of the building?

A. Calmer winds since the building will block the winds

B. Possible downdrafts and turbulence due to winds blowing over and down on the east side of the building.

C. Calmer farther away from the building.

The correct answer is B: The west wind flowing over the building is likely to flow downward on the east side of the building, possibly with strong rolling turbulence that may extend well away from the building. Use extreme caution.

Low-Level Wind Shear

Wind shear is a sudden, drastic change in wind speed and/or direction over a very small area. Low-level wind shear is commonly associated with passing frontal systems, thunderstorms, temperature inversions, and strong upper level winds (greater than 25 knots). A pilot must be prepared to react immediately to these changes to maintain control of the aircraft.

Question:

A thunderstorm begins to develop and move in your direction as you operate your UAV. What conditions might you anticipate?

A. A gradual increase in winds, providing a warning in advance of the storm.

B. A strong, but steady wind.

C. The possibility of unpredictable rapid changes in wind speed and direction that could be hazardous to operation of a UAV.

The correct answer is C: Expect sudden turbulent winds, with the possibility of rapid changes in speed and direction either horizontally or vertically.

Note: Wind shear is especially hazardous for small unmanned vehicles. Their lighter weight, lower airspeeds, especially operating near structures makes them more subject to turbulent winds. Always be alert to the possibility of wind shear anywhere and rolling downdrafts on the lee side of a building.

Atmospheric Stability

The combination of moisture and temperature determine the stability of the air and the resulting weather. The stability of the atmosphere depends on its ability to resist vertical motion. A stable atmosphere makes vertical movement difficult, and small vertical disturbances dampen out and disappear. Cool, dry air is very stable and resists vertical movement, which leads to good and generally clear weather.

Inversion

As air rises and expands in the atmosphere, the temperature decreases. However, an atmospheric anomaly can occur that changes the typical pattern of atmospheric behavior. When the temperature at a higher altitude is warmer than the air below, a temperature inversion exists. Inversion layers are commonly shallow layers of smooth, stable air close to the ground.

Temperature/Dew Point Relationship

The relationship between dew point and temperature defines the concept of relative humidity. The dew point, given in degrees, is the temperature at which the air can hold no more moisture. If air reaches the saturation point while temperature and dew point are close together, it is highly likely that fog, low clouds, and precipitation will form.

Question:

You check the forecast for the airport near where you will be operating your UAV. You are planning to fly late in the day. The forecast for the time you will be flying includes a temperature/dewpoint forecast of "20/19" and winds are forecast to be light and variable. What might you expect?

A. Clear, stable conditions.

B. Winds to increase

C. The possibility of reduced visibility due to formation of fog.

The correct answer is C. If the air temperature cools even a little to the point where the temperature and dew point are the same, fog and reduced visibilities are likely.

Dew and Frost

On cool, clear, calm nights, the temperature of the ground and objects on the surface can cause the temperature to drop below the dew point and can produce frost. Frost disrupts the flow of air over the wing and can drastically reduce the production of lift. It also increases drag, which when combined with lowered lift production, can adversely affect the ability to take off. A small UAV must be thoroughly cleaned free of frost prior to beginning a flight.

Question:

What effect can frost have on the wings and rotors of UAVs:

A. Front on the wing and blades can disrupt the flow of air over the airfoils, reducing effectiveness.

B. Frost on the surface of the aircraft can increase drag.

C. Both of the above could combine to affect the ability of the aircraft to fly.

The best correct answer is C. Both A and B can occur to affect the ability of the aircraft to fly.

Clouds

There are two types of cloud formation; stratiform clouds and cumulus clouds.

Stratiform clouds are typically thinner layered and form in stable air masses with little or no vertical air movement. They are generally associated with fair weather.

Cumulous clouds are formed by the vertical movement of unstable warm moist air up into cooler air where the moisture condenses into vertical, puffy, cumulus cloud formations. Cumulonimbus clouds are clouds that continue to grow and produce rain and may have the potential to grow into thunderstorms. Heating of the air near the Earth's surface creates an air mass thunderstorm, while the upslope motion of air in the mountainous regions causes orographic thunderstorms. Cumulonimbus clouds that form in a continuous line are non-frontal bands of thunderstorms or squall lines.

Since rising air currents cause cumulonimbus clouds, they are extremely turbulent and pose a significant hazard to flight safety. For example, if a small UAV enters a thunderstorm, the small UAV could experience updrafts and downdrafts that exceed 3,000 fpm. In addition, thunderstorms can produce large hailstones, lightning, tornadoes, and large quantities of water, all of which are potentially hazardous to any aircraft.

Question:

The development of cumulus clouds in the area indicates:

A. Unstable atmospheric conditions.

B. Stable atmospheric conditions

C. Generally good flying weather conditions

The correct answer is A: The development of cumulus clouds is the result of unstable atmospheric conditions.

Question:

You observe a thin layer of flat stratiform clouds approximately 3,000 feet AGL. Based on this you:

A. Continue to plan your UAV flight activities for the day

B. Reschedule your planned flight.

C. Check with weather services for any sign of convective activity.

The correct answer is A: Stratiform clouds indicate a stable airmass and fair conditions. It is unlikely that there would be any convective activity in the immediate future.

Question:

There is a layer of clouds in the area reported to be 800 feet AGL where you plan to operate your UAV. What is the maximum altitude at which you may fly your UAV?

A. 300 ft AGL

B. 400 ft AGL

C. 500 ft AGL

The correct answer is A. You must remain 500 feet below the cloud layer. Since the clouds are reported at 800 ft AGL, you must stay 500 feet below, or no higher than 300 ft AGL.

Thunderstorm Life Cycle

The life cycle of a thunderstorm progresses through three stages: (1) cumulus, (2) mature, and (3) dissipating. The cumulus stage is the very early development stage of all thunderstorms, but most cumulus clouds eventually dissipate and do not develop further. They may produce some rain.

If development continues, the storm develops in the mature stage. This can be a violent process with vertical updrafts of 3000 feet per minute. Static electricity is created within the storm and is discharged in the form of lightning. During this process, moisture is carried high up into the cloud. It may freeze into hail, and small hailstones may be carried back up into the cloud and more ice added creating large hailstones. Also, cooler air will begin to flow rapidly downward creating strong down drafts that reach the surface producing strong winds, creating gust fronts and possibly microbursts of strong violent winds moving out from the storm along the surface.

Typically, these strong thunder storms last only a few minutes and then enters the dissipating state. The storm activity dies rapidly. If strong thunderstorm activity continues, it is because subsequent cumulonimbus clouds are going through this cycle, one after the other.

Question:

Which statement is true:

A. All cumulus clouds develop into thunderstorms.

B. All thunderstorms develop from cumulus clouds.

C. All thunderstorms produce large hail.

The correct answer is B: Most cumulus clouds do not develop into thunderstorms, and not all thunderstorms produce hail.

Ceiling

For aviation purposes, a ceiling is the lowest layer of clouds reported as being broken or overcast, or the vertical visibility into an obscuration like fog or haze. Clouds are reported as broken when 5/8 to 7/8 of the sky is covered with clouds. Overcast means the entire sky is covered with clouds. Current ceiling information is reported by the aviation routine weather report (METAR) and automated weather stations of various types.

Question:

When is a layer of clouds considered a "ceiling":

A. When the clouds are reported as broken or overcast.

B. When cloud cover is more than 7/8 of the sky

C. Only when reported as overcast.

The correct answer is A: Broken or overcast cloud over is considered a ceiling.

Visibility

Closely related to cloud cover and reported ceilings is visibility information. Visibility refers to the greatest horizontal distance at which prominent objects can be viewed with the naked eye.

Visibility is reported in either statute miles or fractions of a mile. In controlled airspace, visual flight rules require 3 statute miles (sm) visibility. In uncontrolled airspace, 1 sm is allowed for visual flight operations. Visibility is determined by observation or an ASOS/AWSS automated system. Note that for UAV operations, the minimum visibility is 3 sm. Airports with an instrument approach may also report the RVR, an automated device consisting of a light and a distant sensor that measure visibility in feet.

Question:

What is the minimum reported visibility in which UAV operation is permitted:

A. 1 sm

B. 3 sm

C. RVR 6000

The correct answer is B: 3 miles in the minimum visibility required for operation of a UAV. A RVR of 6000 feet is only a little more than 1 sm.

CHAPTER 3B:
EFFECTS OF WEATHER ON SMALL UNMANNED AIRCRAFT PERFORMANCE SUMMARY

Unmanned aircraft are as their name indicates, "aircraft," subject to the same aerodynamic and environmental forces as any other aircraft. sUAS pilots are expected to understand the effects of atmospheric temperature and pressure, as well as sources and interpretation of meteorological information, and the application of that information on the performance of the sUAS pilot's aircraft. As an example, winds can have a significant effect on unmanned aircraft. The pilot must access and understand the probable wind conditions for each planned flight, and the FAA expects pilots to obtain that information from official sources used by all pilots.

For some pilots, this section may be the most challenging because it requires not only learning basic facts about weather, but understanding the principles of changing weather conditions and learning to apply that knowledge to ensure the safe operation of an unmanned vehicle. The application of knowledge of weather conditions, both current and forecast, also requires pilots to use judgement in the application of that information to determine when it is safe to fly, and when flight operations should be halted or postponed.

CHAPTER 4:
SMALL UNMANNED AIRCRAFT LOADING

Remote Pilot – Small Unmanned Aircraft Systems Study Guide, Chapter 4

Performance - Weight

Weight has a very pronounced effect on aircraft performance. As indicated, the aircraft wing or rotors produce lift. Just like high density altitude affects performance, increase aircraft weight will also reduce the maximum performance and absolute ceiling of a UAV.

Question:

What aspects of a UAV's operations must be considered when adding equipment or cargo to the aircraft:

A. Center of gravity, takeoff performance, and visibility of the aircraft

B. Takeoff performance, maneuvering performance, center of gravity

C. Visibility of the aircraft, turning performance, takeoff capability.

The correct answer is B: Added weight must be placed to not upset the aircraft center of gravity and added weight may affect both takeoff and maneuvering capabilities.

In addition to the added weight, the location of that weight in the aircraft can affect how—or even if—it flies. An improperly loaded aircraft can be unstable and may become uncontrollable under certain situations, especially at lower speeds. Improperly loaded rotary wing aircraft might not fly in a level attitude, making it difficult to control.

Question:

Which is **NOT** correct: An overloaded or improperly loaded fixed wing UAV:

A. Will be controllable at full power.

B. If loaded with the weight too far aft, may pitch nose up and stall, especially at low speeds.

C. If loaded too far forward, may require much longer takeoff runs, and may not gain altitude at the expected rate of climb.

The correct answer is A: The aircraft may or may not be controllable at full power.

Load Factors

The pilot must be knowledgeable about the effect of weight on the performance of the particular aircraft being flown. Excessive weight in itself reduces the safety margins available to the pilot and becomes even more hazardous when combined with other performance-reducing factors. The pilot must also consider the consequences of an overweight and improperly loaded (balanced) aircraft if an emergency condition arises. A properly loaded aircraft is a stable aircraft that will perform predictably.

Compliance with the weight and balance limits of any aircraft is critical to flight safety. The pilot should always be diligent to both not overload an aircraft and to load it properly. The consequences of an overloaded or improperly loaded aircraft may include:

- Higher takeoff speed
- Longer takeoff run
- Reduced rate and angle of climb
- Lower maximum altitude
- Shorter range
- Reduced cruising speed
- Reduced maneuverability
- Higher stalling speed
- Uncontrollability, especially at lower speeds when improperly loaded
- Higher approach and landing speed
- Longer landing roll

Question:

Although a UAV is not loaded beyond the manufacturer's specified limits, it may not fly as expected because:

A. A high density-altitude may prevent the aircraft from taking off

B. The aircraft may not climb as expected—a problem if there are obstacles that must be cleared.

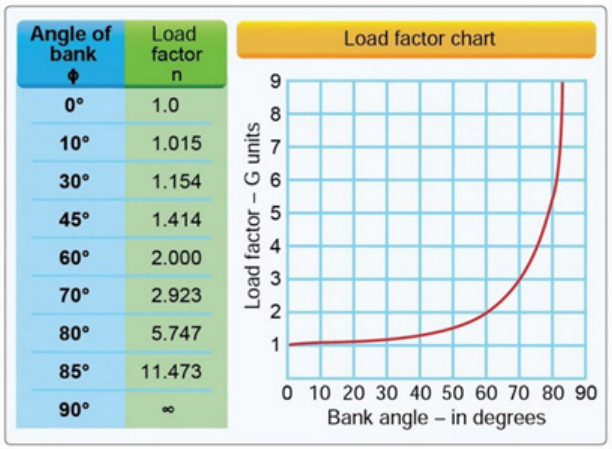
C. The aircraft may not be able to turn without losing altitude.

In this case, the correct answer is "All of the above." An aircraft overloaded for the conditions will not take off in the distance expected, not climb at the rate expected, and may not be able to maintain altitude in turns.

Load Factors Associated with Turning

When an aircraft performs a level turn, this is usually accomplished by banking the aircraft, especially fixed wing aircraft. As the aircraft banks, the load factor on the wing increases, effectively increase in the aerodynamic weight of the aircraft. This increase in load factor, in a level turn, is determined by angle of bank. The chart shows the load factor for increasing angles of bank.

Angle of bank ϕ	Load factor n
0°	1.0
10°	1.015
30°	1.154
45°	1.414
60°	2.000
70°	2.923
80°	5.747
85°	11.473
90°	∞



Question:

If your fixed-wing unmanned aircraft weighs 45 pounds just prior to takeoff—this includes any fuel and added equipment—the total weight of the aircraft. What would be weight or g-force on the aircraft in a 45°-bank turn.

A. Almost 52 pounds

B. More than 63.5 pounds

C. Approximately 90 pounds.

Answer B: Actually, the calculation is 63.63 lb. of force [45 lb. x 1.414 load factor = 63.63 lb.] of effective force on the airframe and components. Why does this matter. Aircraft exposed to excessive g-forces tend to wear out faster, structural elements weaken, and inflight failures occur. This is especially true of fixed-wing UVs—and can induce a stall when not anticipated—but rotorcraft are subjected to the same forces.

CHAPTER 4:
SUMMARY OF LOAD FACTORS

Unlike other operational factors such as weather, airspeeds, and regulations, the weight and balance of an aircraft is not immediately apparent. Pilots must understand the effects of an overloaded or unbalanced aircraft—and the fact that while an aircraft may fly as predicted under most circumstances, an aircraft that is not properly loaded may encounter a combination of speed, maneuvering, winds, etc., where an out-of-balance condition can result in loss of control, loss of the aircraft, and possible injury or damage to persons or property on the ground.

CHAPTER 5:
EMERGENCY PROCEDURES

(Study Resources: 14 CFR part 107, AC 107-2)

An in-flight emergency is an unexpected and unforeseen serious occurrence or situation that requires urgent, prompt action. In case of an in-flight emergency, the remote PIC is permitted to deviate from any rule of 14 CFR part 107 to the extent necessary to respond to that emergency. A remote PIC who exercises this emergency power to deviate from the rules of part 107 is required, upon FAA request, to send a written report to the FAA explaining the deviation. Emergency action should be taken in such a way as to minimize injury or damage to property.

Question:

While performing a photography mission for a real estate agent, a gust of wind catches your UAV causing it to fly out of control and into a picture window in the front of the house. The cost to repair the window is $450.00. Regarding the accident:

A. You are required to file a report with the FAA within 10 days.

B. You are required to file a report only if requested by the Administrator

C. No report is required.

The correct answer is C: The value of the damages was less than $500, so no notification nor report is required.

Question:

While inspecting a tower, using a visual observer (VO) to assist, the UAV contacts a support wire to the tower, and falls, out of control, and strikes the VO and knocks him unconscious. Regarding this accident:

A. You are required to file a report with the FAA within 10 days.

B. You are required to file a report with the FAA within 5 days.

C. Your VO is part of your crew, assumed the risk, recovered quickly and there were no other injuries, therefore no report is required.

The correct answer is A. A report is required within 10 days of the accident involving personal injury to any person.

CHAPTER 5:
SUMMARY

One of the key responsibilities of any Pilot-In-Command is to be able to handle an emergency situation and exercise skill, and apply knowledge, to terminate the flight with as little injury and damage as possible. In this regard, the pilot may deviate for regulations and standard operating procedures to the extent necessary to handle the emergency.

The FAA, however, may require a complete report on the emergency situation and actions taken to resolve the emergency and mitigate injury and/or property damage on the ground—the equivalent of an accident investigation.

CHAPTER 6:
CREW RESOURCE MANAGEMENT - DECISION-MAKING IN A DYNAMIC ENVIRONMENT

Resource: Remote Pilot – Small Unmanned Aircraft Systems Study Guide (FAA-G-8082-22, Chapter 10)

INTRODUCTION

Aeronautical decision-making (ADM) refers to a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances.

Question:

Aeronautical decision-making (ADM) is best described as:

A. A systematic approach to risk assessment and stress management.

B. A computer program to monitor aircraft operations for safety issues.

C. Only applicable to commercial airline operations.

The correct answer is A. ADM is a systematic approach to understanding how personal attitudes can influence decision-making and how those attitudes can be modified to enhance safety in the operation of a small UA.

Question:

What resources are important in implementing ADM:

A. Human resources

B. Equipment

C. Information to support ADM to facilitate crew cooperation.

Actually, the best answer is "all of the above." ADM incorporates all of these resources and more to help flight crew members manage the flow of information and the associated decision making involved. Obviously, an FAA test question would not be structured this way.

Question:

One of the conclusions of ADM is that:

A. ADM can be used to counter good judgement.

B. Through the principles of ADM, good judgement can be taught.

C. ADM is a replacement for good judgement.

The answer is B: Good judgement can actually be taught.

Question:

Risk management:

A. Has been replaced and superseded by ADM.

B. Is an important component of ADM.

C. Is an entirely different subject.

The correct answer is B: Risk management is an important component of ADM. When a pilot follows good decision-making practices, the inherent risk in a flight is reduced or even eliminated. The ability to make good decisions is based upon direct or indirect experience and education.

Question:

Risk assessments and decisions should be made by:

A. Senior management and executives

B. By the operator of the UAV

C. By the person who can develop and implement risk controls.

The correct answer is C. Risk assessments should be made by the one who best understands the challenges, recognizes the risks, and can implement risk controls.

Crew Resource Management (CRM) and Single-Pilot Resource Management

While CRM focuses on pilots operating in crew environments, many of the concepts apply to single-pilot operations.

Question:

Crew Resource Management (CRM) must be integrated into”

A. Only the role of the operator of the UAV

B. Only to the flight portion

C. All phases of the mission.

The correct answer is C.

Many CRM principles have been successfully applied to single-pilot aircraft and led to the development of Single-Pilot Resource Management (SRM). SRM is defined as the art and science of managing all the resources available to a single pilot (prior to and during flight) to ensure the successful outcome of the flight.

Question:

You are the PIC and sole operator of a UAV on a short photo mission. Crew resource management:

A. Is still applicable to single pilot operations.

B. Is unnecessary since there is no one else to manage.

C. Applies only to teams of multiple personnel.

The correct answer is A: Many CRM principles have been successfully applied to single-pilot aircraft and led to the development of Single-Pilot Resource Management (SRM).

Question:

Which statement is most correct with regard to hazard and risk assessment?

A. Attitude affects the quality of decisions.

B. Regardless of attitude, pilots typically make the right risk assessment.

C. All pilots would recognize a risk and respond in a similar manner.

he only correct answer is A: A person’s attitude, as in life, definitely affects pilots’ decisions.

Question:

Being fit to fly:

A. Is simply a matter of physical health.

B. Includes both physical and emotional health and attitudes.

C. Also requires qualities such as anti-authority.

The correct answer is B: Both physical and mental health and attitudes are important.

Question:

In the IMSAFE checklist, what do the letters M and F stand for.

A. Mental attitude and Flight

B. Medication and Fatigue

C. Managing risk and Familiarization with regulations

The answer is B. The letters in IMSAFE stand for Illness, Medication, Stress, Alcohol, Fatigue, and Emotion. Any one of the factors can be sufficiently distracting to affect judgment and decisions, so the proper answer to each IMSAFE item is "no."

Question:

Pilots are known for using checklists, and it is clearly a good—if not essential—practice. PAVE is a simple key to an important checklist. What do the letters stand for:

A. Prompt, Alert, Valiant, Enthusiastic

B. Pilot-in-command, Aircraft, enVironment, External pressure

C. Proud, Alert, Vain, strong Ego.

The correct answer is B: I hope this was obvious, although I have known pilots who looked more like C!

P = Pilot-in-Command (PIC)

This goes back to the IMSAFE checklist, and it would worthwhile to add "current" with regard to the pilot certificate.
A = Aircraft

What limitations does the aircraft pose to the mission, is it airworthy, operational and safe?
V = EnVironment

What limitations apply to the flight. Do I need waivers or permissions, are there any temporary flight restriction; bad weather, etc.?

E = External Pressures.

Are there any external pressures including completing on time, demonstrating capability, customer expectations, etc? Management of external pressure is the single most important key to risk management because it is the one risk factor category that can cause a pilot to ignore all the other risk factors.

One last guide is to use the Perceive, Process, Perform, and Evaluate method as a continuous model for every aeronautical decision that you make. Although human beings will inevitably make mistakes, anything that you can do to recognize and minimize potential threats to your safety will make you a better pilot.

DECISION-MAKING IN A DYNAMIC ENVIRONMENT

Once the power lever or throttle is pushed forward for takeoff, decision making becomes a matter of prompt analysis, training, and practice, and execution. When something goes wrong or fails on an aircraft, a pilot may have only a matter of seconds to recognize the problem and react appropriately to avoid disaster. Dozens, if not more, assessments and decisions may have to be made in a matter of seconds. Successful resolution of the situation will depend on the pilot's knowledge, skills, and the fact that he has practiced or thought through as many situations as he/she can over the time spent flying their aircraft.

CHAPTER 6: SUMMARY

Crew Resource Management is a decision process to ensure that all member of an sUAS flight operation are qualified and fit to perform their duties, understand their duties, and work as a team to complete the objectives of the flight. CRM can be applied to a single pilot operation, beginning with the PIC objectively determining if he or she is fit to fly.

CHAPTER 7:
RADIO COMMUNICATION PROCEDURES

Resource: Remote Pilot – Small Unmanned Aircraft Systems Study Guide (FAA-G-8082-22, Chapter)

INTRODUCTION

Radio communications are an important aspect for the safe operation of aircraft in the NAS. Although small UAV pilots are not expected to communicate over radio frequencies, it is important for the UAV pilot to understand "aviation language" and the different conversations they will encounter if the UAV pilot is using a radio to aid in situational awareness. Although much of the information provided here is geared toward manned aircraft pilots, the UAV pilot needs to understand the unique way information is exchanged in the NAS.

UNDERSTANDING PROPER RADIO PROCEDURES

A review of the Pilot/Controller Glossary contained in the AIM will assist a pilot in understanding standard radio terminology. The AIM also contains many examples of radio communications, including the phonetic alphabet.

AIRPORT OPERATIONS WITHOUT OPERATING CONTROL TOWER

Question:

You are flying near a small airport that has no services, no UNICOM, or does not have an FAA Flight Service Station (FSS) on the field. What frequency should you use to listen for airport traffic in the area:

A. 122.8

B. 122.9

C. 131.9

The correct answer is B. Airports with a UNICOM will use 122.8. There are three ways for pilots to communicate their intention and obtain airport/traffic information when operating at an airport that does not have an operating tower—by communicating with an FSS, a UNICOM operator, or by making a self-announced broadcast, usually on the UNICOM frequency, 12.8.

On SAC charts, next to airport symbols for non-tower airports, will be the radio frequency to listen to. If there are two or three airports within clear radio range, some airports may choose to use another frequency.

Question:

An aircraft calls in at the airport near your location and reports "left downwind for runway 36." What do you immediately know?

A. He is flying parallel to the runway on a heading of north (360°).

B. He is flying parallel to the runway on a heading of south (180°).

C. He is flying perpendicular to the runway on a heading of east (090°).

The correct answer is B. He is planning to land to the north (runway 36 indicates this). Downwind is opposite in direction to the landing direction, therefore he is flying south, parallel to the runway.

Question:

In the question above, he reported "left" downwind to runway 36. Where is the aircraft in relation to the runway?

A. To the west of the runway

B. To the east of the runway

C. North of the runway.

The correct answer is A. The fact that he reported a "left downwind" indicates he is making a standard left-hand pattern, making left turns to get back to the runway. The left downwind to runway 36 would be to the left or west side of the runway.

Pilots do not always report "left" or "right" when reporting positions in the traffic pattern. However, they should be following the traffic pattern, left or right, preferred for use at the airport. You can determine the direction of the traffic pattern by looking at the airport symbol on the navigation chart. The notation "RP" under the airport name and information indicates a righthand pattern and which runway numbers on which to use the righthand pattern.

Question:

What frequency should be used at an airport with a UNICOM unless a different frequency is posted?

A. 122.8

B. 122.9

C. 131.9

The answer is A: Frequency 122.8 is the standard UNICOM frequency.

A sUAS pilot is not expected to communicate with other aircraft in the vicinity of an airport and should not do so unless there is an emergency situation. However, in the interest of safety in the NAS, it is important that a remote pilot understands the aviation language and the types of aircraft that can be operating in the same area as a small UAV.

CHAPTER 7: SUMMARY

Although sUAS pilots may not have many occasions to actually make radio calls, when operating near an airport or other area where low-level flight operations are anticipated, the sUAS operator should monitor an aviation receiver and understand the position of aircraft reporting positions in the area. When operating in the vicinity of an airport, the sUAS pilot should be able to determine the position and intentions of manned aircraft in the area. Also understand that at some uncontrolled airports, it is possible and permissible for manned aircraft to be flown without use of radios, thus unmanned aircraft pilots must also be visually vigilant for other aircraft when operating in the vicinity of small, uncontrolled airports.

CHAPTER 8:

DETERMINING THE PERFORMANCE OF SMALL UNMANNED AIRCRAFT

EFFECT OF TEMPERATURE ON DENSITY

As described in Remote Pilot – Small Unmanned Aircraft Systems Study Guide (FAA-G-8082-22, Chapter 3) related to weather, increasing the temperature, pressure altitude, and humidity (all of which increase density altitude) has a direct impact on the performance of any aircraft including UAVs.

Question:

What combination of atmospheric conditions would be least favorable for the climb performance of a UAV:

A. High altitude and hot temperatures

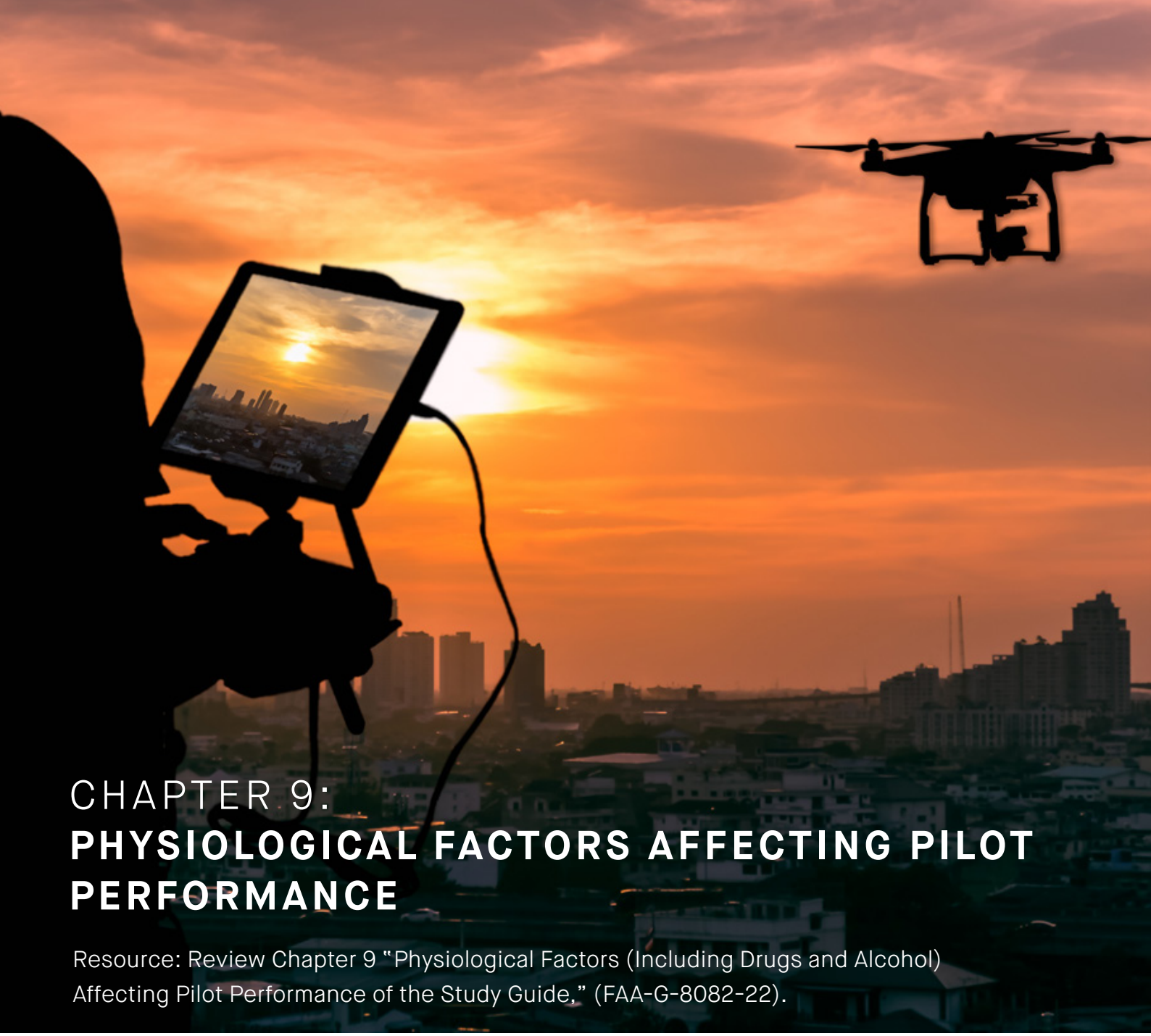
B. Low altitude and low temperatures

C. Low altitude and hot temperatures

The correct answer is A: High altitude and high temperatures mean a high density-altitude, which is less favorable for performance.

CHAPTER 8: SUMMARY

Review Chapter 3 to fully understand the effects that temperature and pressure changes have on an unmanned aircraft. Unmanned aircraft are subject to the same environmental influences as manned aircraft.



CHAPTER 9:
PHYSIOLOGICAL FACTORS AFFECTING PILOT PERFORMANCE

Resource: Review Chapter 9 "Physiological Factors (Including Drugs and Alcohol) Affecting Pilot Performance of the Study Guide," (FAA-G-8082-22).

14 CFR part 107 does not allow operation of small UA if the remote PIC, the person manipulating the controls, or Visual Observer (VO) is in an impaired state.

Question:

You were up late studying for your Remote Pilot Certification exam. You are scheduled to fly the UAV for your friend who is a PIC. You realize you are very tired as you leave the house. You:

A. Go to fly. You will be awake and alert by then.

B. Drink an extra coffee to make you more alert.

C. Recognize that you are in an impaired state and do not fly the UAV

The correct answer is C: You are in an impaired state and may not be able to react correctly or quickly enough in all situations.

Question:

What is true regarding the consumption of alcohol:

A. A small amount of alcohol will relieve the tension of controlling the UAV.

B. It has been six hours since your last drink and you feel fine. You are okay to fly.

C. Judgement can be adversely affected by even small amounts of alcohol.

The correct answer is C: Even small amounts of alcohol can affect judgment.

Question:

A Remote Pilot must not operate a UAV within how many hours since consuming the drink:

A. 8 hours

B. 10 hours

C. 12 hours

The correct answer is A: 8 hours

Question:

Regardless of when you had your last alcoholic drink you would be considered under the influence of alcohol if your blood alcohol is;

A. Greater than 0.04 percent.

B. 0.04 percent or greater

C. Any blood alcohol value that registers on the test.

The correct answer is B. The regulation says "0.04 or greater."

Pilots should be aware of any physiological/medical factors that could affect pilot performance. Important medical factors that a pilot should be aware of include:

- Hyperventilation
- Stress
- Fatigue
- Dehydration
- Heatstroke
- The effects of alcohol and drugs

Question:

Hyperventilation could cause:

A. Lightheadedness or unconsciousness

B. Visual impairment or muscle spasms

C. All of the above

The correct answer is C: Hyperventilation can also cause hot and cold sensations and tingling sensations as well as those listed. The treatment for hyperventilation involves restoring carbon dioxide levels in the body. Breathing normally both prevents and cures hyperventilation.

Question:

Examples of short-term stressors include situations that involve:

A. Fatigue and difficult personal situations

B. Extended exposure to noise and vibration

C. Both of the above.

The correct answer is C: All of the above can create stress—and stress tends to distract the person from concentrating on the task at hand. It is important to recognize and try to eliminate or manage stressful situations so that they do not interfere with piloting activities.

Question:

What type of fatigue may have psychological roots or be associated with an underlying disease:

A. Acute fatigue

B. Chronic fatigue

C. Skill fatigue

The correct answer is B: Chronic fatigue, which can impair one's ability to effectively and safely perform duties associated with the operation of a UAV.

Question:

What factor is not a probable cause of acute fatigue?

A. Mild hypoxia

B. Excessive sleep

C. Psychological stress

The correct answer is B: Mild hypoxia and psychological stress can cause acute fatigue.

Question:

Dehydration can cause headaches, fatigue, cramps, and dizziness. Which fluid will not contribute to dehydration:

A. Coffee and tea

B. Water

C. Caffeinated soft drinks

The (obvious) correct answer is B: Caffeinated drinks to contribute to dehydration. Heat stroke may also be associated with dehydration, and the best remedy for heatstroke is water.

Question:

Which of the following statements best describes the use of medications while acting as member of a UAV flight operation:

A. Do not take any prescription drugs.

B. Do not take any over-the-counter drugs.

C. Do not take any medications of any kind.

The correct answer in this set is C: Do not take any drugs without the advice of a physician who has a knowledge of flight physiology. Even OTC drugs can have adverse effects for anyone involved in the operation of an aircraft including UAVs. There are exceptions. The other aspect of any medication is that if you need medication, you probably have an illness that would make it best if you did not participate any aeronautical activity until well. Even a headache, runny nose, or sneezing can be a distraction at critical moments in a flight operation, and the medications that treat these conditions can affect alertness, reaction times, and judgment.

VISION AND FLIGHT

Question:

Regarding visual contact with the UAV, the person who is operating the UAV should:

A. Maintain constant visual contact with the aircraft

B. Should scan ahead of the aircraft's direction of travel every 5 to 10 seconds.

C. Scan from left to right or right to left to clear the airspace. Scans should last no more than 2 or 3 seconds.

The correct answer is C: Operators are responsible for ensuring the path ahead of the aircraft is clear of obstacles and other aircraft.

CHAPTER 9: SUMMARY

Chapter 9 focuses on the prohibition of acting as a PIC when physically or mentally impaired for any reason. Negative influences include illness or injury that would distract the pilot from focusing his or her attention on flying the aircraft. There are strict prohibitions against operating an aircraft under the influence of alcohol or drugs, including over-the-counter remedies. Also, under certain conditions, the pilot's capabilities may change during the operation of an sUAS such as fatigue or dehydration.

CHAPTER 10: MAINTENANCE AND PREFLIGHT INSPECTION PROCEDURES

Maintenance and Preflight Inspection Procedures can be found in chapter 7 of Advisory Circular 107-2.

SUAS MAINTENANCE, INSPECTIONS, AND CONDITION FOR SAFE OPERATION

Prior to flight, the remote PIC is responsible for conducting a check of the sUAS and verifying that it is in a condition that will allow safe operation.

sUAS maintenance includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the sUAS and its components necessary for flight. Whenever possible, the operator should maintain the sUAS and its components in accordance with manufacturer's instructions. The aircraft manufacturer may provide the maintenance program, or, if one is not provided, the applicant may choose to develop one.

See AC 107-2, paragraph 7.3.5 for suggested benefits of recordkeeping.

Question:

If the UAV manufacturer provides documentation for scheduled maintenance, you:

A. Should follow the manufactures maintenance schedule and procedures for the service life of the sUAS.

B. May adopt your own maintenance schedule and procedures.

C. Should ignore the manufacturer's schedule and adopt an FAA-approved maintenance

The (best) correct answer is A: A person who is a true UAV technical expert might develop a unique maintenance plan. There is no FAA-approved maintenance plan.

Question:

The manufacturer did not provide any maintenance plan or schedule. It is recommended that you:

A. Find a published sUAS maintenance plan on the Internet and apply that.

B. Establish a scheduled maintenance protocol.

C. Fix things when they need fixing.

The correct answer is B. For maximum operational life of your sUAS, scheduled and routine maintenance are recommended.

Question:

Prior to each flight, the PIC or a designated member of the team, should:

A. Activate the power switch to make sure the sUAS is working.

B. Ensure that there are spare, charged batteries.

C. Inspect the sUAS to ensure that it is in condition for safe operation.

The correct answer is C: Reference Advisory Circular 107-2, section 7.3.

Question:

AC 107-2:

A. Suggest that pilots develop a mental preflight checklist and apply it before each flight.

B. Provides a suggested list of items to check prior to each flight.

C. Requires the use of the manufacturer's preflight inspection.

The correct answer is B: See AC 107-2, section 7.3.4, Preflight Inspection Items. This is probably the best guidance if the manufacturer does not provide preflight inspection guidance. Note that not all items in this list will be applicable to every make and model sUAS. Use the items that apply.

BENEFITS OF RECORD KEEPING

As with any aircraft, there are benefits to maintaining an inspection and maintenance log for your sUAS. This record will help establish inspection requirements and periodic maintenance requirements and intervals. It also provides a record of component service life. The maintenance record or log can be maintained in hardcopy (a logbook) or in an electronic logbook.

Question:

Regarding records of maintenance and inspection should be maintained in:

A. An official hardcopy aircraft maintenance logbook

B. In an electronic maintenance logbook

C. Either of the above formats is adequate.

The correct answer is C: In fact, there is no requirement for the use of a formal logbook. Operators could use any form of record, but it should indicate the date of the action, type of action (repair, inspection, etc.), who performed the maintenance, and any important details of the action (comments).

Question:

Regarding keeping formal records of inspections and maintenance records, the FAA:

A. Requires the keeping a hardcopy or electronic log of inspections and maintenance.

B. Recommends the keeping of a record of inspections and maintenance.

C. Offers no recommendation or opinion on record keeping.

The correct answer is B: AC 107-2 states that "owners and operators may find recordkeeping beneficial. There is no formal requirement, however, the detail of discussion provided in section 7.3.5 indicates that the FAA finds such record keeping highly recommended.

OTHER QUESTIONS

Question:

The Remote Pilot Certificate is issued for:

A. For life.

B. For two years

C. Until it is revoked or suspended.

The best correct answer is A, although choice C is also correct. The "two years" applies to operating privileges" the Remote Pilot Certificate holder must complete a knowledge test every two years.

Question:

You are setting up to operate your sUAS when an FAA examiner approaches and asks to see your Remote Pilot Certificate. Which would NOT be an appropriate answer:

A. It is right here in my flight kit.

B. Just a moment, I have to get it out of my vehicle.

C. Can we do this tomorrow, I left it at home.

The correct choice is C: The certificate is supposed to be readily available. "At home" would not be considered "readily available."

CHAPTER 10: SUMMARY

Although the practice of record keeping, especially a log book of hours of operation, aircraft maintenance, and repairs is just "recommended" by the FAA, operators will find this a good practice for continued safe and efficient operation of their UAV. An aircraft flight and maintenance log or file is also a good place to keep any FAA waivers for special operations that may be required.

APPENDIX 1

REGISTRATION AND MARKING REQUIREMENTS FOR SMALL UNMANNED AIRCRAFT

UAS Registration Web site: https://registermyuas.faa.gov/

AIRCRAFT REGISTRATION.

A small UAV must be registered, as provided for in 14 CFR Part 47 or Part 48 prior to operating under Part 107. Part 48 is the regulation that establishes the streamlined online registration option for sUAS that will be operated only within the territorial limits of the United States. The online registration Web address is http://www.faa.gov/uas/registration/. Guidance regarding sUAS registration and marking may be found at http://www.faa.gov/licenses_certificates/aircraft_certification/ aircraft registry/. Alternatively, sUAS can elect to register under Part 47 in the same manner as manned aircraft.

Note that registration requirements are based on the size of the UAV rather than solely on the use of the aircraft. Only small drones weighing less than .55 lb total weight are not required to be registered. Any UAV weighing more than .55 lb must be registered. If the aircraft is to be flown only for recreational purposes, for personal interests, or for enjoyment, the owner/operator does not have to have the Remote Pilot certificate. If the UAV is going to be flown for commercial, government, or non-hobby purposes, including for non-profits, it must be operated under Part 107 rules.

APPENDIX 2

APPLICABLE REFERENCES

14 CFR part 47
Aircraft Registration

14 CFR part 48
Registration and Marking Requirements for Small Unmanned Aircraft Systems

14 CFR part 71
Designation of Class A, B, C, D and E Airspace Areas; Air Traffic Service Rotes; and Reporting Points

14 CFR part 107
Operation and Certification of Small Unmanned Aircraft Systems

AC 00-6
Aviation Weather for Pilots and Flight Operations Personnel

AC 150/5200-32
Reporting Wildlife Aircraft Strikes

AC 107-2
Small Unmanned Aircraft Systems (sUAS)

AIM
Aeronautical Information Manual

FAA-CT-8080-2
Airman Knowledge Testing Supplement for Sport Pilot, Recreational Pilot, and Private Pilot FAA-G-8082-20 Remote Pilot Knowledge Test Guide

FAA-H-8083-1
Weight & Balance Handbook

FAA-H-8083-2
Risk Management Handbook

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

FAA-S-ACS-10
Remote Pilot – Small Unmanned Aircraft Systems Airman Certification Standards

SAFO 09013
Fighting Fires Caused By Lithium Type Batteries in Portable Electronic Devices

SAFO 10015
Flying in the wire environment

SAFO 10017
Risks in Transporting Lithium Batteries in Cargo by Aircraft

SAFO 15010
Carriage of Spare Lithium Batteries in Carry-on and Checked Baggage

Note *Users should check for the current edition of the reference documents listed above.*

Additional Useful Reference Documents

2.1 Related Code of Federal Regulations (CFR) Parts. The following regulations and parts can be found at http://www.faa.gov/regulations_policies/faa_regulations/.

• Title 14 CFR Part 1, Definitions and Abbreviations.

• Title 14 CFR Part 48, Registration and Marking Requirements for Small Unmanned Aircraft.

• Title 14 CFR Part 71, Designation of Class A, B, C, D, and E Airspace Areas; Air Traffic Service Routes; and Reporting Points.

• Title 14 CFR Part 73, Special Use Airspace.

• Title 14 CFR Part 91, General Operating and Flight Rules.

• Title 14 CFR Part 93, Special Air Traffic Rules.

• Title 14 CFR Part 101, Moored Balloons, Kites, Amateur Rockets and Unmanned Free Balloons.

• Title 14 CFR Part 107, Small Unmanned Aircraft Systems.

• Title 47 CFR Part 87, Aviation Services.

2.2 Notices to Airmen (NOTAM). Information on how to obtain NOTAMs can be found at https://pilotweb.nas.faa.gov/PilotWeb/.

2.3 Related Reference Material. The following listed reference materials contain additional information necessary to ensure safe operations in the NAS. An sUAS operator may want to consider seeking out additional publications to supplement the lists below.

2.3.1 FAA ACs, Notices, and Orders (current editions). You can find the current editions of the following publications on the FAA Web sites: http://www.faa.gov/regulations_policies/advisory_circulars/ and http://www.faa.gov/regulations_policies/orders_notices/.

• AC 00-6, Aviation Weather.

• AC 00-45, Aviation Weather Services.

• AC 60-28, FAA English Language Skill Standards Required by 14 CFR Parts 61, 63, and 65.

• AC 120-92, Safety Management Systems for Aviation Service Providers.

• FAA Order JO 7110.10, Flight Services.

• FAA Order JO 7110.65, Air Traffic Control.

• FAA Order JO 7210.3, Facility Operation and Administration.

• FAA Order JO 7400.9, Airspace Designations and Reporting Points.

6/21/16 AC 107-2

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• FAA Order 8130.34, Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft.

• FAA Order 8900.1, Flight Standards Information Management System (FSIMS).

2.3.2 Additional FAA Online/Mobile Sources.

• UAS Web site: https://www.faa.gov/uas/.

• UAS Registration Web site: https://registermyuas.faa.gov/.
• B4UFLY mobile app.

2.3.3 FAA Handbooks, Manuals, and Other Publications. You can find the following handbooks, manuals, and other publications on the FAA Web site at http://www.faa.gov/regulations_policies/handbooks_manuals/.

• Aeronautical Information Manual (AIM): http://www.faa.gov/air_traffic/publications/.

• Aeronautical Charts (Hardcopy): http://faacharts.faa.gov/.

• Aeronautical Charts (Digital): http://www.faa.gov/air_traffic/flight_info/aeronav/digital_products/.

• Pilot/Controller Glossary: http://www.faa.gov/air_traffic/publications/.

• Pilot's Handbook of Aeronautical Knowledge: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/ pilot_handbook/.

• General Aviation Pilot's Guide to Preflight Weather Planning, Weather Self-Briefings, and Weather Decision Making: www.faa.gov/nextgen/update/media/ga_weather_decision_making.pdf.

• Risk Management Handbook: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/faa-h-8083-2.pdf.

• FAA Small Unmanned Aircraft Systems Airman Certification Standards: (TBD).

2.3.4 RTCA, Inc. Documents (current editions). Copies of the current editions of the following RTCA, Inc. documents are available for purchase online at http://www.rtca.org.

• DO-178, Software Considerations in Airborne Systems and Equipment Certification.

• DO-304, Guidance Material and Considerations for Unmanned Aircraft Systems.

2.3.5 Public Law (PL). PL 112-95, Title III, Subtitle B—Unmanned Aircraft Systems.