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Chapter 5 **Operations**

Preface

Welcome to ASA's Test Prep Series. ASA's test books have been helping pilots prepare for the FAA Knowledge Tests for more than 60 years with great success. We are confident that with proper use of this book, you will score very well on the Remote Pilot certificate test for the small unmanned aircraft system (sUAS) rating.

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The FAA Unmanned Aircraft Systems questions have been arranged into chapters based on subject matter. Topical study, in which similar material is covered under a common subject heading, promotes better understanding, aids recall, and thus provides a more efficient study guide.

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 If in their ongoing review, the FAA authors decide a question has no correct answer, is no longer applicable, or is otherwise defective, your answer will be marked correct no matter which one you chose.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

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

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

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

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PO Box 25082
Oklahoma City, OK 73125
Email: afs630comments@faa.gov

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Knowledge Exam References

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

14 CFR Part 47 Aircraft Registration
14 CFR Part 48 Registration and Marking Requirements for Unmanned Aircraft Systems
14 CFR Part 71 Designation of Class A, B, C, D and E Airspace Areas; Air Traffic Service Routes; and Reporting Points
14 CFR Part 107 Operation and Certification of Small Unmanned Aircraft Systems

FAA-H-8083-2 *Risk Management Handbook*
FAA-H-8083-25 *Pilot's Handbook of Aeronautical Knowledge*
FAA-H-8083-3 *Airplane Flying Handbook*
FAA-G-8082-22 *Remote Pilot sUAS Study Guide*

AC 00-6 *Aviation Weather*
AC 00-45 *Aviation Weather Services*
AC 91-57 *Model Aircraft Operating Standards*
AC 150-5200-32 *Reporting Wildlife Aircraft Strikes*
AC 107-2 *Small Unmanned Aircraft Systems (sUAS)*

Aeronautical Information Manual (AIM)

Chart Supplement U.S. (formerly *Airport/Facility Directory* or A/FD)

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*

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Visit the Reader Resource for this book (**www.asa2fly.com/reader/TPUAS**) for additional resources useful to both remote pilots and manned pilots operating in the presence of unmanned aircraft systems.

ASA Test Prep Layout

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

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

Some Questions refer to Figures or Legends immediately following the question number, i.e., "1201. (Refer to Figure 2.)." These are FAA Figures and Legends which can be found in the FAA *Airman Knowledge Testing Supplement* (CT-8080-2G). This supplement is bundled with the Test Prep and is the exact material you will have access to when you take your computerized test. We provide it separately, so you will become accustomed to referring to the FAA Figures and Legends as you would during the test.

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

EXAMPLE:

Chapter text

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

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

ALL

1201. (Refer to Figure 2.) The four forces acting on an airplane in flight are

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

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

Question and answer choices

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

Explanation

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

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

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

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

ALL = Initial Unmanned Aircraft test

UGR = Recurrent Unmanned General test.

Chapter 3
Weather

Introduction

As with any flight, the remote PIC should check and consider the weather conditions prior to and during every sUAS flight. Even though sUAS operations are often conducted at very low altitudes, weather factors can greatly influence performance and safety of flight. Specifically, factors that affect sUAS performance and risk management include:

- Atmospheric pressure and stability;
- Wind and currents;
- Uneven surface heating;
- Visibility and cloud clearance; and
- Precipitation.

The major source of all weather is the sun. Every physical process of weather, change or variation of weather patterns is accompanied by or is a result of unequal heating of the Earth's surface. The heating of the Earth (and therefore the heating of the air surrounding the Earth) is imbalanced around the entire planet. Both north and south of the equator, due to the different angle sunlight hits the Earth, one square foot of sunrays is not concentrated over one square foot of the surface, but over a larger area. This lower concentration of sunrays produces less radiation of heat over a given surface area; therefore, less atmospheric heating takes place in that area. The unequal heating of the Earth's atmosphere creates a large air-cell circulation pattern (wind) because the warmer air has a tendency to rise (associated with low pressure systems) and the colder air has a tendency to settle or descend (associated with high pressure systems) and replace the rising warmer air. This unequal heating, which causes pressure variations, will also cause variations in barometric altimeter settings between weather reporting points.

Different surfaces radiate heat in varying amounts. The resulting uneven heating of the air creates small areas of local circulation called convective currents. Convective currents can cause turbulent air that has the potential to dramatically affect the remote PIC's ability to control unmanned aircraft at lower altitudes. For example:

- Plowed ground, rocks, sand, barren land, pavement, and urban areas give off a large amount of heat and are likely to result in updrafts.
- Water, trees, and other areas of vegetation tend to absorb and retain heat and are likely to result in downdrafts.

ALL

1135. Which of the following considerations is most relevant to a remote PIC when evaluating unmanned aircraft performance?

A—Current weather conditions.
B—The number of available ground crew.
C—The type of sUAS operation.

Weather factors can greatly influence sUAS performance and safety of flight. (PLT510) — AC 107-2

ALL

1136. Every physical process of weather is accompanied by, or is the result of, a

A—movement of air.
B—pressure differential.
C—heat exchange.

Every physical process of weather is accompanied by, or is a result of, unequal heating of the Earth's surface. (PLT510) — AC 00-6

Answers

1135 [A] 1136 [C]

ALL
1137. What causes variations in altimeter settings between weather reporting points?

A— Unequal heating of the Earth's surface.
B— Variation of terrain elevation.
C— Coriolis force.

All altimeter settings are corrected to sea level. Unequal heating of the Earth's surface causes pressure differences. (PLT173) — AC 00-6

ALL
1138. The development of thermals depends upon

A— a counterclockwise circulation of air.
B— temperature inversions.
C— solar heating.

Thermals are updrafts in convective currents dependent on solar heating. A temperature inversion would result in stable air with very little, if any, convective activity. (PLT494) — AC 00-6

ALL
1139. (Refer to Figure 20.) Over which area should a Remote Pilot expect to find the highest amount of thermal currents under normal conditions?

A— 2.
B— 7.
C— 5.

Dry areas get hotter than moist areas. Dry fields or dry ground of any nature are better thermal sources than moist areas. This applies to woods or forests, which are poor sources of thermals because of the large amount of moisture given off by foliage. (PLT064) — AC 00-6

ALL
1272. Clouds, fog, or dew will always form when

A— water vapor condenses.
B— water vapor is present.
C— relative humidity reaches 100 percent.

As water vapor condenses or sublimates on condensation nuclei, liquid or ice particles begin to grow. Some condensation nuclei have an affinity for water and can induce condensation or sublimation even when air is almost, but not completely, saturated. (PLT345) — AC 00-6

Answer (B) is incorrect because the presence of water vapor does not result in clouds, fog, or dew unless condensation occurs. Answer (C) is incorrect because it is possible to have 100% humidity without the occurrence of condensation, which is necessary for clouds, fog, or dew to form.

Wind

Wind and currents can affect sUAS performance and maneuverability during all phases of flight. Be vigilant when operating sUAS at low altitudes, in confined areas, near buildings or other manmade structures, and near natural obstructions (such as mountains, bluffs, or canyons). Consider the following effects of wind on performance:

- Obstructions on the ground affect the flow of wind, may create rapidly changing wind speed and direction, and can be an unseen danger.
- High winds may make it difficult to maintain a geographical position in flight and may consume more battery power or preclude aircraft control and recovery.

Local conditions, geological features, and other anomalies can change the wind direction and speed close to the Earth's surface. For example, when operating close to a building, winds blowing against the building could cause strong updrafts that can result in ballooning or a loss of positive control. On the other hand, winds blowing over the building from the opposite side can cause significant downdrafts that can have a dramatic sinking effect on the unmanned aircraft that may exceed its climb performance.

The intensity of the turbulence associated with ground obstructions depends on the size of the obstacle and the primary velocity of the wind. This same condition is even more noticeable when flying

Answers

1137 [A] 1138 [C] 1139 [A] 1272 [A]

in mountainous regions. While the wind flows smoothly up the windward side of the mountain and the upward currents help to carry an aircraft over the peak of the mountain, the wind on the leeward side does not act in a similar manner. As the air flows down the leeward side of the mountain, the air follows the contour of the terrain and is increasingly turbulent. This tends to push an aircraft into the side of a mountain. The stronger the wind, the greater the downward pressure and turbulence become. Due to the effect terrain has on the wind in valleys or canyons, downdrafts can be severe. Even small hills or odd shaped terrain can have similar effects on local wind conditions. Remote pilots should be aware that terrain/object wind effects may exist for some distance downwind of the actual terrain or object.

ALL
1140. While operating around buildings, the remote PIC should be aware of the creation of wind gusts that

A—change rapidly in direction and speed causing turbulence.
B—enhance stability and imagery.
C—increase performance of the aircraft

Local conditions, geological features, and other anomalies can change the wind direction and speed close to the Earth's surface, making it difficult to control and maneuver the sUAS. (PLT198) — FAA-H-8083-25

ALL
1141. A strong steady wind exists out of the north. You need to photograph an area to the south of your location. You are located in an open field with no obstructions. Which of the following is not a concern during this operation?

A—Strong wind conditions may consume more battery power at a faster rate than in calm conditions.
B—Turbulent conditions will likely be a significant factor during the operation.
C—Strong wind may exceed the performance of the sUAS making it impossible to recover.

Unmanned aircraft often have limited performance and therefore in high wind conditions, it may consume more power to maintain position or other maneuvers than in calm air. If the wind is strong enough, the sUAS's performance might not be able to adequately counter the wind, making it difficult or impossible to fly back to you for recovery. (PLT198) — FAA-H-8083-25, 14 CFR §107.49

ALL
1278. Wind shear can exist

A—at all altitudes.
B—at low altitudes.
C—at high altitudes.

Wind shear is a sudden, drastic change in wind speed and/or direction over a very small area. Wind shear can subject an aircraft to violent updrafts and downdrafts, as well as abrupt changes to the horizontal movement of the aircraft. While wind shear can occur at any altitude, low-level wind shear is especially hazardous due to the proximity of an aircraft to the ground. (PLT192) — AC 00-6

Air Masses and Fronts

When a body of air comes to rest on, or moves slowly over, an extensive area having fairly uniform properties of temperature and moisture, the air takes on these properties. The area over which the air mass acquires its identifying distribution of temperature and moisture is its "source region." As this air mass moves from its source region, it tends to take on the properties of the new underlying surface. The trend toward change is called air mass modification. When an air mass that is different in such properties advances upon a dissimilar air mass, the division line is referred to as a front.

A ridge is an elongated area of high pressure. A trough is an elongated area of low pressure. All fronts lie in troughs. A cold front is the leading edge of an advancing cold air mass. Cold fronts are often accompanied by poor weather ahead of the front, which passes relatively quickly. Once the front has passed, there is a wind shift and, due to the increased wind speeds, turbulence is common for a period of time. More severe cold fronts can also produce thunderstorms, hail, and tornadoes.

Continued

Answers

1140 [A] 1141 [B] 1278 [A]

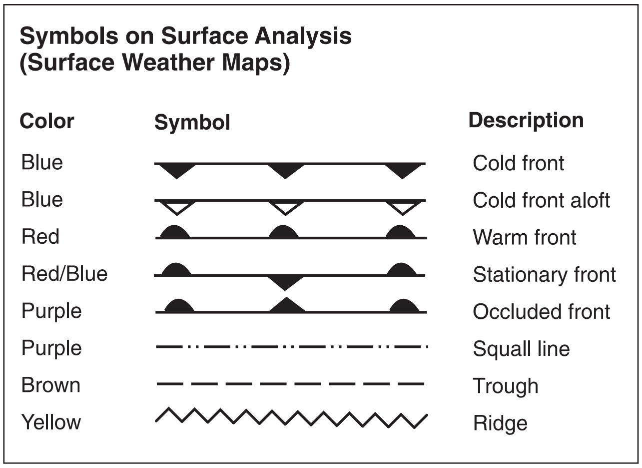

Figure 3-1. Weather map symbols

A warm front is the leading edge of an advancing warm air mass. Warm fronts move about half as fast as cold fronts and have more widespread impact on weather. They are often preceded by lowered ceilings, increased precipitation, and reduced visibilities. Remote PICs should be aware of ambient and approaching weather systems as they can significantly impact their operations and safety of flight. Frontal waves and cyclones (areas of low pressure) usually form on slower-moving cold fronts or stationary fronts. These types of systems are often accompanied by conditions that may be unfavorable to sUAS operations. Figure 3-1 shows the symbols that would appear on a weather map.

The physical manifestations of a warm or cold front can be different with each front. They vary with the speed of the air mass on the move and the degree of stability of the air mass being overtaken. A stable air mass forced aloft will continue to exhibit stable characteristics, such as stratus clouds, calm air, steady precipitation, and poor visibility, while an unstable air mass forced to ascend will continue to be characterized by cumulus clouds, turbulence, showery precipitation, and good visibility.

Frontal passage will be indicated by the following discontinuities:

1. A temperature change (the most easily recognizable discontinuity);
2. A continuous decrease in pressure followed by an increase as the front passes; and
3. A shift in the wind direction, speed, or both.

ALL
1142. One of the most easily recognized discontinuities across a front is

A—a change in temperature.
B—an increase in cloud coverage.
C—an increase in relative humidity.

Temperature is one of the most easily recognized discontinuities across a front. (PLT511) — AC 00-6

Answer (B) is incorrect because cloud coverage is not always present across a front. Answer (C) is incorrect because relative humidity is not an easily recognized discontinuity across a front.

ALL
1143. One weather phenomenon which will always occur when flying across a front is a change in the

A—wind direction.
B—type of precipitation.
C—stability of the air mass.

Wind direction always changes across a front. (PLT511) — AC 00-6

Answer (B) is incorrect because precipitation does not always exist with a front. Answer (C) is incorrect because the stability on both sides of the front may be the same.

ALL
1144. Which type of weather phenomenon that may concern a remote pilot is common among cold fronts?

A—Long-term periods of reduced visibility.
B—Long periods of steady precipitation.
C—Thunderstorms and heavy rain.

Thunderstorms and heavy rain are common, although not always, associated with cold fronts. (PLT511) — AC 00-6

Answers (A) and (B) are incorrect because these characteristics would most typically be associated with warm fronts.

Answers

1142 [A] 1143 [A] 1144 [C]

ALL
1286. What weather provides the best flying conditions?

A—Warm, moist air.
B—Cool, dry air.
C—Turbulence.

The combination of moisture and temperature determine the stability of the air and the resulting weather. Cool, dry air is very stable and resists vertical movement, which leads to good and generally clear weather. (PLT345) — AC 00-6

ALL
1277. The zone between different temperature, humidity, and wind is called

A—A front.
B—An air mass.
C—Wind shear.

The zone between two different air masses is a frontal zone or front. Across this zone, temperature, humidity and wind often change rapidly over short distances. (PLT345) — AC 00-6

Atmospheric Stability

Atmospheric stability is defined as the resistance of the atmosphere to vertical motion. A stable atmosphere resists any upward or downward movement. An unstable atmosphere allows an upward or downward disturbance to grow into a vertical (convective) current.

Determining the stability of the atmosphere requires measuring the difference between the actual existing (ambient) temperature lapse rate of a given parcel of air and the dry adiabatic (3°C per 1,000 feet) lapse rate. Because sUAS operate at low altitudes, it may seem as though lapse rate may not be a factor, but the stability of the local air mass can have significant impact on ambient conditions. Unstable air can often result in weather conditions unfavorable to sUAS operations.

A stable layer of air would be associated with a temperature inversion (a condition in which warm air is situated above cool or cold air). Warming from below, on the other hand, would decrease the stability of an air mass. The conditions shown in Figure 3-2 can be characteristic of stable or unstable air masses.

Unstable Air	Stable Air
Cumuliform clouds	Stratiform clouds and fog
Showery precipitation	Continuous precipitation
Rough air (turbulence)	Smooth air
Good visibility except in blowing obstructions	Fair to poor visibility in haze and smoke

Figure 3-2. Characteristics of stable and unstable air masses

ALL
1145. A stable air mass is most likely to have which characteristic?

A—Showery precipitation.
B—Turbulent air.
C—Poor surface visibility.

Characteristics of a stable air mass include stratiform clouds and fog, continuous precipitation, smooth air, and fair to poor visibility in haze and smoke. (PLT511) — FAA-H-8083-25

ALL
1146. What are characteristics of a moist, unstable air mass?

A—Turbulence and showery precipitation.
B—Poor visibility and smooth air.
C—Haze and smoke.

Characteristics of a moist, unstable air mass include cumuliform clouds, showery precipitation, rough air (turbulence), and good visibility (except in blowing obstructions). (PLT511) — AC 00-6

Answers

1286 [B] 1277 [A] 1145 [C] 1146 [A]

ALL

1147. What are characteristics of stable air?

A—Good visibility and steady precipitation.
B—Poor visibility and steady precipitation.
C—Poor visibility and intermittent precipitation.

Characteristics of a stable air mass include stratiform clouds and fog, continuous precipitation, smooth air, and fair to poor visibility in haze and smoke. (PLT511) — FAA-H-8083-25

ALL

1148. What measurement can be used to determine the stability of the atmosphere?

A—Atmospheric pressure.
B—Actual lapse rate.
C—Surface temperature.

The difference between the existing lapse rate of a given mass of air and the adiabatic rates of cooling in upward moving air determines if the air is stable or unstable. (PLT173) — AC 00-6

ALL

1149. What would decrease the stability of an air mass?

A—Warming from below.
B—Cooling from below.
C—Decrease in water vapor.

When air near the surface is warm and moist, suspect instability. Surface heating, cooling aloft, converging or upslope winds, or an invading mass of colder air may lead to instability and cumuliform clouds. (PLT173) — AC 00-6

Answer (B) is incorrect because cooling from the air below would increase the stability of the air. Answer (C) is incorrect because an increase in water vapor will result in a decrease in stability.

ALL

1150. Upon your preflight evaluation of weather, the forecasts you reference state there is an unstable air mass approaching your location. Which would not be a concern for your impending operation?

A—Thunderstorms.
B—Stratiform clouds.
C—Turbulent conditions.

Unstable conditions are characterized by cumulus clouds, turbulence, showery precipitation, and good visibility. (PLT511) — AC 00-6

ALL

1285. You have received an outlook briefing from flight service through 1800wxbrief.com. The briefing indicates you can expect a low-level temperature inversion with high relative humidity. What weather conditions would you expect?

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

When the temperature of the air rises with altitude, a temperature inversion exists. Inversion layers are commonly shallow layers of smooth, stable air close to the ground. The temperature of the air increases with altitude to a certain point, which is the top of the inversion. The air at the top of the layer acts as a lid, keeping weather and pollutants trapped below. If the relative humidity of the air is high, it can contribute to the formation of clouds, fog, haze, or smoke resulting in diminished visibility in the inversion layer. (PLT301) — AC 00-6

Visibility and Clouds

As in manned aircraft operations, good visibility and safe distance from clouds enhances the remote PIC's ability to see and avoid other aircraft. Similarly, good visibility and cloud clearance may be the only means for other aircraft to see and avoid the unmanned aircraft. Prior to flight, the remote PIC must determine that visibility from the control station (CS) is at least 3 SM and that the sUAS is kept at least 500 feet below a cloud and at least 2,000 feet horizontally from a cloud. These standards must be maintained throughout flight operations.

One of the ways to ensure adherence to the minimum visibility and cloud clearance requirements is to obtain local aviation weather reports that include current and forecast weather conditions. If there is more than one local aviation reporting station near the operating area, the remote PIC should choose the closest one that is also the most representative of the terrain surrounding the operating area. If local

Answers

1147 [B] 1148 [B] 1149 [A] 1150 [B] 1285 [A] aviation weather reports are not available, then the remote PIC may not operate the small UA if he or she is unable to determine the required visibility and cloud clearances by other reliable means.

The remote pilot can determine local visibility by verifying that a known point at least 3 SM away is visible. Similarly, an object with a known height can be observed to have clouds above that object, providing information about how much operational altitude is available for use. For example, you know a nearby tower extends to 1,000 AGL (referencing a Sectional Chart). The clouds are above the top. Thus you know that even if you climb to the maximum altitude of 400 AGL, you have more than the required 500 feet of separation from the clouds. When in doubt always choose the most conservative and safest option, which sometimes may be to delay the operation. It is imperative that the UA not be operated above any cloud, and that there are no obstructions to visibility, such as smoke or a cloud, between the UA and the remote PIC.

ALL, UGR
1151. What minimum visibility is required for sUAS operations?

A—1 miles.
B—3 miles.
C—4 miles.

Crewmembers must operate sUAS Part 107 operations with a minimum visibility, as observed from the location of the control station, no less than 3 statute miles. (PLT163) — 14 CFR §107.51

ALL, UGR
1152. The minimum distance from clouds required for sUAS Part 107 operations is

A—clear of clouds.
B—500 feet below, 2,000 feet horizontally.
C—500 feet above, 1,000 feet horizontally.

Part 107 sUAS operations require the minimum distance of the small unmanned aircraft from clouds must be no less than 500 feet below the cloud and 2,000 feet horizontally from the cloud. (PLT163) — 14 CFR §107.51

ALL, UGR
1288. (Refer to Figure 69.) You are inspecting the lighted towers approximately 8 NM SW of the Corpus Christi Intl airport (CRP). What is the lowest cloud cover that will enable you to inspect the top of the tower?

A—1,104 feet MSL.
B—1,604 feet MSL.
C—1,054 feet MSL.

Part 107 requires that the minimum distance of the sUAS from clouds must be no less than 500 feet below the cloud. The towers depicted 8 NM SW of CRP are 1,104 feet MSL. 1,104 + 500 = 1,604 feet MSL. (PLT163) — 14 CFR §107.51

ALL, UGR
1271. The weather report lists the ceiling at 800 feet. What is the highest you can operate your sUAS?

A—200 feet AGL.
B—800 feet AGL.
C—300 feet AGL.

Part 107 requires that the minimum distance of the sUAS from clouds must be no less than 500 feet below the cloud. 800 cloud – 500 = 300 feet AGL. (PLT163) — 14 CFR §107.51

ALL, UGR
1289. (Refer to Figure 23.) What are the VFR minimum visibility requirements over Plantation Airport?

A—1 SM.
B—5 SM.
C—3 SM.

Regardless of the location, crewmembers must conduct sUAS Part 107 operations with a minimum visibility, as observed from the location of the control station, no less than 3 statute miles. (PLT163) — 14 CFR §107.51

Answers

1151 [B] 1152 [B] 1288 [B] 1271 [C] 1289 [C]