While you may not hear about it on weather reports, density altitude is a concept all pilots should be familiar with. Get a better grasp of how this unseen danger affects your flight with this safety quiz from the Air Safety Institute.

1. Density altitude can be defined as _________________ (Select all that apply, then click Submit)

(Multiple Response Question, 10 points, 1 attempt permitted).

- Pressure altitude corrected for nonstandard temperature
- The altitude the aircraft “feels” like it is flying at

Correct!/Sorry. Density altitude, defined as the pressure altitude corrected for nonstandard temperature, is the altitude at which the airplane performs, regardless of the altitude shown on the altimeter. High temperature, high humidity and even a moderate airport elevation can combine to cause the airplane’s performance to equal that of a higher elevation. In other words, your engine’s output will make you feel as though you are flying higher than you really are.

2. Assuming a constant air temperature, as relative humidity increases, the density of the air also increases. (Select the correct response, then click submit.)

(True/False question, 10 points, 1 attempt permitted)

False

Correct!/Sorry For a given temperature, when the amount of water vapor in the air (humidity) increases, air density decreases since water vapor is lighter than air. The more water vapor you add, the less dense the air becomes in order to accommodate the additional water molecules. While higher temperatures impact density altitude more than increased humidity, the combination creates a lower density parcel of air which translates into decreased aircraft performance.

3. Prior to departing a high density altitude airport in a normally-aspirated piston aircraft, you should _________________ (Drag the proper response to the answer box, then click Submit)

(Word Bank question, 10 points, 1 attempt permitted)

Lean the engine for maximum RPM to achieve the optimal fuel/air mixture

Correct!/Sorry. As the air becomes less dense (higher density altitude), you should consider leaning your engine for maximum RPM per the POH recommendations. A full-rich mixture in a high density altitude environment means your airplane will not have the appropriate fuel-air mixture to develop full power for takeoff. Some operating handbooks recommend deploying the first notch of flaps, but full flaps will create more drag than lift during departure.
4. Assuming calm winds, your landing distance at a high density altitude airport will be ________ compared to an airport at sea level. (Drag the appropriate response to the answer box, then click Submit)

(Word Bank Question, 10 points, 1 attempt permitted)

Longer

Correct!/Sorry. As the density of the air decreases (higher density altitude), a wing needs to fly at a higher true airspeed to maintain the same indicated airspeed. At high density altitude, therefore, a given indicated airspeed equates to a faster groundspeed than it does at sea level (assuming the same wind conditions). Plan for a longer landing distance to compensate for the additional groundspeed. Speeds listed in the POH (best glide speed, best rate of climb, best angle of climb, etc.) are based upon indicated, not true, airspeed. So while the ground may be moving by faster than you’re used to at a high altitude airport, fly the same indicated airspeeds you normally would.

5. You’ve landed for fuel at La Junta Municipal (KLHX) in La Junta, Co. on a hot, summer afternoon. The aircraft performance charts tell you that you will require 5,500 feet of runway to depart safely. The 8 knot winds are favoring runway 30 which is 5,803 feet long. Runway 26 is 6,849 feet long. What are some of your options to depart safely? (Select all that apply, then click Submit)

(Multiple Response Question, 10 points, 1 attempt permitted)

- Depart runway 26 despite the crosswind since it gives you 1300 feet of runway beyond your calculations
- Wait until later in the day when the temperatures drop and depart runway 26
- Reduce your fuel load and plan on making an extra fuel stop

Correct!/Sorry. Given the conditions, you’ll increase your chances for a safe departure by using the longest runway despite the crosswinds, lowering your takeoff weight by reducing the amount of fuel you are carrying, or waiting out the heat and departing later in the evening or even the next morning. Even if your performance charts indicate you can depart the favored runway, you are only leaving yourself 300 feet of runway.

6. Which of the following aircraft components are adversely affected by high density altitude? (Select all that apply, then click Submit)

(Multiple Response Question, 10 points, 1 attempt permitted)

- Wings
- Propeller
- Engine
- Control surfaces
High density altitude affects aircraft performance in multiple ways. Normally aspirated (i.e., non-turbocharged) engines develop significantly less power. The airplane’s control surfaces become less effective (relative to groundspeed) since there are fewer air molecules to push against. This can affect control responsiveness during takeoff and landing. The wings and propeller have the same fundamental issue: In the “thin” air, they have to move faster in order to generate the same lift/thrust. Read the attached accident report about the pilot who lost control of his tailwheel airplane while departing a high density altitude airport. (Link to PDF)

7. High density altitude is only a concern in mountainous regions or high elevation airports.

(True/False question, 10 points, 1 attempt permitted)

False

Correct!/Sorry. The effects of density altitude are most pronounced at high elevation airports, but that doesn’t mean pilots who fly at lower altitudes are off the hook. Even at sea level, hot humid weather conditions can mean serious trouble for heavily loaded aircraft (particularly on short runways). Careful preflight planning is essential, and you should add a safety cushion to your calculations—ASI recommends adding 50% to the POH takeoff distance over a 50-ft obstacle.

8. On a hot, windless summer afternoon you decide to fly to Truth or Consequences, N.M. (KTCS, field elevation 4,853). Your preflight calculations indicate you will be able to land in the available 3,301 feet of gravel runway. While on base for Runway 01 you notice the end of the runway approaching faster than expected. What dangerous situation are you potentially setting yourself up for?

(Multiple Choice Question, 10 points, 1 attempt permitted)

A base-to-final stall scenario

Correct!/Sorry. In a high density altitude environment, your true airspeed is faster than it would be at a lower elevation. This will increase your groundspeed while the indicated airspeed is normal. Unless you compensate for the faster groundspeed in the traffic pattern, you run the risk of overshooting the base-to-final turn—which often leads to the temptation to “crank it around” to correct. This is a classic setup for a low altitude stall-spin. Better to fly a wider pattern and rely on the indicated airspeed regardless of how much faster the ground is moving under you.

9. Which of the following performance metrics is most relevant to your ability to clear terrain and obstructions?

(Multiple choice Question, 10 points, 1 attempt permitted)

Feet-per-nautical-mile

Correct!/Sorry. While your vertical speed indicator will give you your rate of climb in feet-per-minute, the most important number when determining your ability to outclimb terrain or obstacles is feet-per-nautical-mile. With the higher true airspeeds/groundspeeds and slower climb rates of high density
altitude ops, it’s easy to misjudge the distance required to climb. Map out the distance you need to travel, and how much elevation you have to gain in that distance. Once you have that figure, the rate of climb table in instrument approach publications is helpful for translating to feet-per-minute. Keep in mind your aircraft may not perform as well as when the POH was written, so leave yourself a safety margin.

10. **What are some reasons your aircraft performance may not match the POH performance charts?**
(Select all that apply, then click Submit)

*Multiple Response question, 10 points, 1 attempt permitted*

- Temperatures at the surface are hotter than reported
- The engine does not develop the same power as when new
- You (probably) are not a test pilot
- Your tires are underinflated
- You’ve underestimated your takeoff weight

Correct!/Sorry. All of the answers are correct. Engine air intakes are often just a foot or two from the ground, so during the takeoff roll they may be ingesting air that is significantly hotter than what the AWOS/ASOS is sensing. Performance charts are computed by professional test pilots flying a brand new engine from the factory, and your engine is probably a bit more tired than when new, and odds are your skills aren’t quite up to the level of the test pilot’s. Underinflated tires will not accelerate as quickly, therefore your ground roll will be longer than calculated, and a mistake on weight and balance calculations will impact performance as well.