Private Single Engine Quick-Review Sheets

Eligibility Requirements (14 CFR 61.103)

"To be eligible for a private pilot certificate, a person must:"

1. Be at least 17 years old for a rating in other than a glider or balloon. (a)
2. Be able to read, speak, write, and understand the English language. (c)
3. Receive a logbook endorsement from an authorized instructor for knowledge test. (d)
4. Pass a knowledge test. (e)
5. Receive flight training and logbook endorsement from an authorized instructor. (f)
6. Meet the aeronautical experience requirements. (g)
7. Pass a practical test (h)
8. Comply with sections that apply to the aircraft category and class rating sought (i)
9. Hold a U.S. student pilot certificate, sport pilot certificate, or recreational pilot certificate (j)

Aeronautical Experience (14 CFR 61.109)

"For an airplane single-engine rating."

- ❖ 40 Total Flight Hours
  - a. 20 Dual Hours
    - 3 hours of X/C in Airplane Single Engine Land
    - 3 hours of night in Airplane Single Engine Land
      - Night X/C of over 100 nautical miles; and
      - At least 10 takeoffs and landings to a full stop at night
    - 3 hours solely in reference to instruments
    - 3 hours of checkride prep within the preceding 2 calendar months of the test
  - b. 10 solo hours in single engine airplane
    - 5 hours of solo X/C
      - One solo cross-country flight of 150 nautical miles total distance, with full-stop landings at 3 points, and one segment of the flight consisting of a straight-line distance of more than 50 nautical miles between the takeoff and landing locations
      - 3 takeoff and landings to a full stop (with each landing involving a flight in the traffic pattern) at an airport with an operating control tower.

Recent Flight Experience (14 CFR 61.57)

"no person may act as a pilot in command of an aircraft carrying passengers—unless"

- ❖ Passenger Carry Requirements
  - a. General Experience (a)
    - In order to carry passengers during daytime
      - 3 takeoffs and landings as PIC in the preceding 90 days prior to carrying passengers
        - i. For day currency, touch and goes are permitted in tricycle gear aircraft
        - ii. Acted as sole manipulator of the flight controls (i)
        - iii. If tailwheel the landings must be to a full stop (ii)
        - iv. Must be in the same category, class, and type (if type rating is required) (ii)
  - b. Night Takeoff and Landing Experience
    - In order to carry passengers during 1 hour after sunset to 1 hour before sunrise
      - 3 takeoffs and landings as PIC in the preceding 90 days prior to carrying passengers
        - i. For night currency and landings must be to a full stop
        - ii. Acted as sole manipulator of the flight controls (i)
        - iii. Must be in the same category, class, and type (if type rating is required)

Record Keeping (14 CFR 61.51)

- ❖ "Each person must document and record the following time in a manner acceptable to the Administrator:" (a)
  - a. Required times to record:
    - Aeronautical experience required to meet recency (§61.57)
    - Aeronautical experience and training required for a pilot certificate, rating, or flight review

Privileges and Limitations (14 CFR 61.113)

- ❖ Privileges
  - a. May act as PIC
  - b. May act as PIC while carrying passengers
  - c. May, for compensation or hire, act as PIC of an aircraft in connection with any business or employment, if: (b)
    - The flight is only incidental to that business or employment; and
    - The aircraft does not carry passengers or property for compensation or hire
  - d. A pilot who meets §61.69 may act as PIC of aircraft towing a glider or unpowered ultralight vehicle (g)
  - e. May act as PIC conducting a production flight test under §21.190 (h)
  - f. Aircraft salesmen who has logged at least 200 hours may demonstrate an aircraft to a prospective buyer (f)
  - g. May act as PIC of a charitable, nonprofit, or community event flight described in §91.146 (d)
  - h. May be reimbursed for operating expenses directly related to search and location operations
- ❖ Limitations
  - a. May not pay less than the pro rata share of the operating expenses of a flight with passengers, provided the expenses involve: (c)
    - Fuel
    - Oil
    - Airport expenditures
    - Rental Fees
  - b. Cannot act as PIC for compensation or hire (a)
  - c. Cannot act as PIC while carrying passengers or property for compensation or hire (a)

Medical Certificates (14 CFR 61.23)

- ❖ Medical Privileges
  - a. After designated time medical does not downgrade but keeps its original issued class but has the privileges of a lower class.
    - i.e. If you are under 40 years old and have a 1st class medical, after 12 calendar months it does not downgrade to a 3rd class medical. It becomes a 1st class medical with 3rd class privileges.
- ❖ Must hold a first-class medical certificate:
  - a. When exercising the pilot-in-command privileges of an airline transport pilot certificate
  - b. When exercising the second-in-command privileges of an airline transport pilot certificate in a part 121 operation that requires three or more pilots
  - c. When serving as a required pilot flightcrew member in an operation conducted under part 121 of this chapter if the pilot has reached his or her 60th birthday.
- ❖ Must hold a second-class medical certificate:
  - a. When exercising second-in-command privileges of an airline transport pilot certificate in part 121
  - b. When exercising privileges of a commercial pilot certificate
- ❖ Must hold a third-class medical:
  - a. When exercising the privileges of a private pilot certificate, recreational pilot certificate, or student pilot certificate, except when operating under the conditions and limitations set forth in §61.113(i);
  - b. When exercising the privileges of a flight instructor certificate and acting as the pilot in command or as a required flightcrew member, except when operating under the conditions and limitations set forth in §61.113(i);
  - c. When taking a practical test in an aircraft for a recreational pilot, private pilot, commercial pilot, or airline transport pilot certificate, or for a flight instructor certificate, except when operating under the conditions and limitations set forth in §61.113(i); or
  - d. When performing the duties as an Examiner in an aircraft when administering a practical test or proficiency check for an airman certificate, rating, or authorization

	Under 40	40 and Older
1st Class	12 Calendar Months	6 Calendar Months
2nd Class	12 Calendar Months	12 Calendar Months
3rd Class	60 Calendar Months	24 Calendar Months

*The durations all start at the beginning of the medical received. i.e. If you get a first-class medical and are under 40, the third-class privileges last for 60 calendar months from the start of the first class medical.

Documents required to exercise private pilot privileges (14 CFR 61.3)

- ❖ Pilot Certificate
- ❖ Government Issued Photo ID
- ❖ Medical Certificate

BasicMed Privileges and Limitations (14 CFR 68)(AC 68-1A)

- ❖ Privileges and Limitations (AC 68-1A 3.2)
  - a. You can conduct any operation that you would otherwise be able to conduct using you pilot certificate and a third-class medical certificate, except you are limited to:
    - Fly with no more than five passengers
    - Fly an aircraft with a maximum certificated takeoff weight of no more than 6,000lbs.
    - Fly an aircraft that is authorized to carry no more than 6 occupants
    - Flight within the United States, at an indicated airspeed of 250 knots or less, and at an altitude at or below 18,000 ft MSL.
    - You may not fly for compensation or hire

Proficiency vs. Currency

- ❖ Currency means that you have met the requirements by the FAA to act as PIC within a certain time period (i.e.§61.57). Flying skills are lost over time and even though you may be legal to fly, you must determine if you are safe to fly. Proficiency is being ready to handle any reasonable situation.

Airworthiness Documents

- ❖ **D**-Documents (ARROW-PEC)
  - **A**irworthiness Certificate (§91.203)
    - Does not expire if aircraft is kept airworthy
    - Must be visible and legible
  - **R**egistration (§91.203)
    - Expires after 3 years
    - Must be visible and legible
  - **R**adio Operator's License (international only FCC Form 605)
  - **O**perating Limitations & AFM (§21.5)
  - **W**eight and Balance (§91.103)
  - **P**lacards (§91.9)
  - **E**xternal Data Plate (§45.11)
  - **C**ompass Deviation Card (§23.2610)
- ❖ **I**-Inspections (AAV1ATE)
  - **A**irworthiness Directives (§39)
    - Legally enforced safety recalls, and applicable to aircraft, engines, propellers, and appliances
  - **A**nnual Inspection every 12 calendar months (§91.409)
  - **V**OR Check within the preceding 30 days (§91.171)
  - **1**00 Hour Inspection (§91.409)
    - Can exceed by up to 10hrs if en route to a place where the inspection can be done
  - **A**ltimeter, Altitude Reporting Encoder, and Static System every 24 calendar months (§91.411)
  - **T**ransponder every 24 calendar months (§91.413)
  - **E**LT every 12 calendar months (§91.207)
    - Batteries must be replaced or recharged:
      - Has been in use for more than 1 hour
      - When 50% of the battery life is expired
- ❖ **E**-Equipment (ATOMATOFLAMES, FLAPS)
  - a. Day VFR (b)
    - **A**irspeed Indicator
    - **T**achometer for each engine
    - **O**il Pressure Gauge for each engine using pressure system
    - **M**anifold Pressure Gauge (altitude engines)
    - **A**ltimeter
    - **T**emperature Gauge (liquid-cooled engines)
    - **O**il Temperature Gauge (air-cooled engines)
    - **F**uel Gauge
    - **L**anding Gear Position Lights
    - **A**nti-collision Lights (after March 11, 1996)
    - **M**agnetic Direction Indicator
    - **E**LT
    - **S**afety Belts
  - b. Night VFR (c)
    - **F**uses (spares or circuit breakers)
    - **L**anding Light (if for hire)
    - **A**nti-collision Lights (after August 11, 1971)
    - **P**osition Lights
    - **S**ource of adequate electrical energy
- ❖ Airplane Logbook Documentation (§91.417)
  - a. Annual, 100hr, and any other required Inspections
  - b. Maintenance, Preventive Maintenance, and Alterations
  - c. Records must include:
    - Description of the work performed
    - Date of Completion
    - Signature and Certificate Number of person approving the aircraft for return to service
- ❖ Pilot-Performed Preventative Maintenance (§43 Appendix A(c))
  - a. Small or minor maintenance, including: servicing landing gear tires, replacing bulbs, and repairing upholstery
- ❖ Special Flight Permit (§21.197)
  - a. Used to fly an unairworthy aircraft:
    - To a repair station, storing, delivering, testing, demonstrating, and evacuating
    - Online or Form 8130-6

Aeronautical Decision Making (ADM) (PHAK Chapter 2)

- ❖ Systematic approach that is used to determine the best course of action
- ❖ PAVE Checklist – Identify Hazards & Personal Minimums
  - a. **P**ilot (IMSAFE)
    - **I**llness
    - **M**edications
    - **S**tress
    - **A**lcohol
    - **F**atigue
    - **E**xternal Factors
  - b. **A**ircraft (AAVIATE, ARROWPEC, Weight & Balance, Performance)
  - c. En**V**ironment (NWKRAFT, Pre-flight Planning)
  - d. **E**xternal Pressure ("get-there-itis", impress someone, meetings)
- ❖ 3P Model – used during all phases of flight
  - a. **P**erceive – the given set of circumstances for a flight
  - b. **P**rocess – by evaluating their impact on flight safety
  - c. **P**erform – by implementing the best course of action
- ❖ DECIDE Model
  - a. **D**etect the problem
  - b. **E**stimate the severity
  - c. **C**hoose a course of action
  - d. **I**dentify solutions
  - e. **D**o the course of action
  - f. **E**valuate the course of action

Hazardous Attitudes & Antidotes (PHAK Chapter 2)

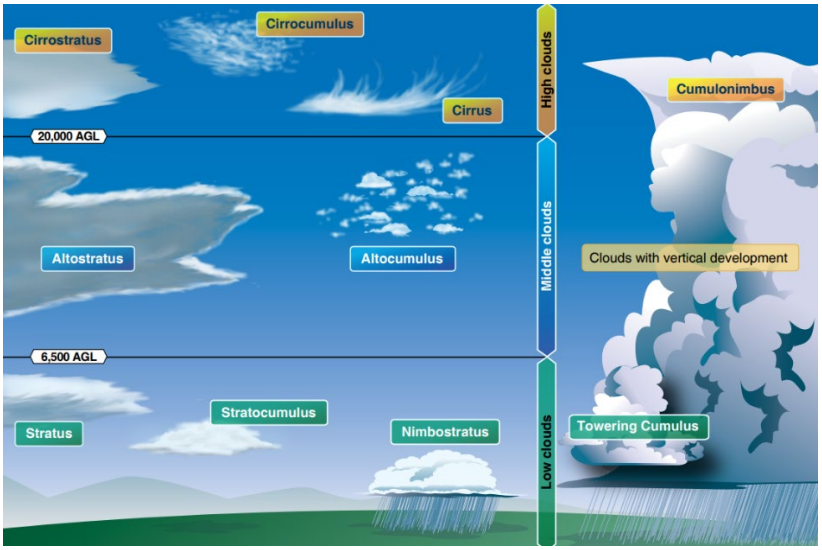
- ❖ Anti-Authority
  - a. "Don't tell me."
  - b. Follow the rule. They are usually right.
- ❖ Impulsivity
  - a. "Do it quickly."
  - b. Not so fast. Think first.
- ❖ Invulnerability
  - a. "It won't happen to me"
  - b. It could happen to me.
- ❖ Macho
  - a. "I can do it."
  - b. Taking chances is foolish.
- ❖ Resignation
  - a. "What's the use?"
  - b. I'm not helpless. I can make a difference

Aviation Weather Services (PHAK Chapter 13, AC 00-45H, AIM Chapter 7)

- Service Outlets
  a. Flight Service Station (FSS) – a primary source for preflight weather information. A preflight weather briefing can be obtained from 1-800-WX BRIEF. It also provides inflight weather briefing services and weather advisories to flights within the FSS area of responsibility.
  b. Telephone Information Briefing Service (TIBS) – an automated telephone recording of meteorological and aeronautical information. Designed to be a preliminary briefing tool and does not replace a standard briefing. Phone numbers for TIBS are listed in the Chart Supplement.
- Weather Briefings
  a. Standard Briefing – this provides the most information and should be obtained before each flight. It provides information pertaining to your flight:
    - Adverse conditions
    - If VFR flight is recommended or not
    - Synopsis – the larger weather picture
    - Current Conditions – not included if departure is more than 2 hours away
    - En Route Forecast – summary of weather forecast for route of flight
    - Destination Forecast – expected weather for destination airport at ETA
    - Winds and Temperatures Aloft
    - Notices to Airmen (NOTAM)
    - ATC Delays
    - Other Information – any additional information requested
  b. Abbreviated Briefing – a shortened version of a standard briefing. Used to update previous briefings if flight is delayed.
  c. Outlook Briefing – should be used when departure is 6 or more hours away. Good source for flight planning.
- Aviation Weather Reports
  a. Aviation Routine Weather Report (METAR) – surface weather observations posted in a standard international code, usually updated hourly. If significant changes occur between scheduled times a METAR SPECI will be issued.
  b. Pilot Weather Reports (PIREPs) – observations from pilots about the actual current conditions in the air. Pilots are encouraged to report unexpected weather conditions to FSS or ATC.
- Aviation Weather Forecasts
  a. Terminal Aerodrome Forecasts (TAF) – weather report for a five-statute mile radius around an airport. Valid for 24- or 30-hour time periods and updated four times a day or every 6 hours.
  b. Area Forecasts (FA) – gives an idea of the general weather conditions, clouds, and visual meteorological conditions over large areas including several states. There are 6 areas for the continental US.
  c. Inflight Weather Advisories – provided to aircraft while en route. They are also available to pilots before departure for flight planning
    - AIRMET – adverse weather conditions that may affect the safety of flight
      - Issued as needed and valid for 6 hours
      - S (IFR) – Extensive mountain obscuration, ceilings less than 1000 feet and/or visibility less than 3 statute miles affecting over 50% of the area at one time
      - T (Turbulence) – Moderate Turbulence, surface winds of 30 knots or more
      - Z (Icing) – Moderate icing, and freezing levels
    - SIGMET – adverse weather conditions that will likely affect the safety of flight
      - Issued as needed and valid for 4 hours (Hurricanes are valid for 6 hours)
      - Severe icing not associated with thunderstorms
      - Severe or extreme turbulence or clear air turbulence (CAT) not associated with thunderstorms
      - Dust storms or sandstorms reducing visibility below 3 statute miles
      - Volcanic ash
    - Convective SIGMET – adverse weather conditions that will affect the safety of flight
      - Issued as needed and valid for 2 hours
      - Implies severe or greater turbulence, severe icing, and low-level wind shear
      - Severe thunderstorms due to:
        i. Surface winds 50 knots or greater
        ii. Hail ¾ inches or greater at the surface
      - Embedded Thunderstorms
      - Squall Lines
      - Tornadoes
      - Thunderstorms covering 40% or more of 3,000 square miles or greater
  d. Winds and Temperature Aloft Forecast (FB) – provide wind and temperature forecasts in thousand-foot increments at specific locations. Forecasts are made twice a day.
    - Above FL240 temperatures are always negative
    - If winds are greater ≥100 knots, then 50 is added to the wind direction, and you have to add 100 to the wind speed
      - i.e. 845043
        i. 84 = 340 degrees (Wind direction based on true North)
        ii. 50 = 150 knots (Wind speed)
        iii. 43 = -43 degrees (Temperature is Celsius)
    - Winds not reported at levels that are within 1,500 feet of station
    - Temperatures are not reported at levels within 2,500 feet of station
- Weather Charts
  a. Surface Analysis Chart – it depicts the current surface weather. Shows areas of high and low pressure, fronts, temperatures, dew points, wind directions and speeds, local weather, and visual obstructions. Updated every 3 hours
  b. Weather Depiction Chart – details surface conditions from METARs and other surface observations. Provides graphical display of where IFR, VFR, and MVFR weather is. Updated every 3 hours.
  c. Low-Level Significant Weather Prognostic Chart – forecast of aviation weather hazards, used to give guidance to VFR pilots. Includes fronts, isobars, cloud coverage, and precipitation areas. Provides information from the surface to FL240. Issued 4 times a day and is divided into a 12- and 24-hour forecast.
  d. Radar Summary Chart – observation derived from national radar network that shows a graphic display of radar weather reports. Issued hourly.

Weather Theory (PHAK Chapter 12, AC 00-6B, AIM Chapter 7)

- Atmosphere – blanket of air made up of a mixture of gases
  a. 78% Nitrogen
  b. 21% Oxygen
  c. 1% Trace gases (Argon, Carbon Dioxide)
- Atmospheric Pressure
  a. Measured in inches of mercury (“Hg) or millibars (mb)
  b. Standard Sea Level Pressure (SLP) is 29.92”Hg or 1,013.2 mb
  c. Standard Temperature is 15°C or 59°F
  d. Generally atmospheric pressure decreases 1 “Hg per 1,000 feet of increase in altitude
- Atmospheric Stability
  a. Stability depends on the atmospheres ability to resist vertical motion
  b. Average rate of temperature change is 2°C (3.5°F) per 1,000 feet
  c. Dry adiabatic lapse rate is 3°C (5.4°F) per 1,000 feet
  d. Moist adiabatic lapse rate is from 1.1°C to 2.8°C (2°F to 5°F) per 1,000 feet
  e. Combination of moisture and temperature determine the stability of air
  f. Inversion – anomaly where there is an increase in temperature with altitude
- Moisture – Every 20°F increase in temperature doubles the amount of moisture the air can hold. Every decrease of 20°F cuts the capacity in half
- Humidity – amount of water vapor present in the atmosphere
- Relative Humidity – actual amount of moisture in the air compared to the total amount of moisture the air could hold at that temperature
- Temperature/Dew Point – this relationship defines the concept of relative humidity
  a. Dew Point – temperature at which the air can no longer hold moisture
  b. When temperature reaches the dew point the air is completely saturated and moisture begins to condense in the form of fog, dew, frost, clouds, rain, or snow
- Fog – cloud on the surface
  a. Radiation Fog – cool air over warm surface
  b. Advection Fog – warm, moist air over cool surface
  c. Upslope Fog – warm, moist, stable air forced upslope and cools
  d. Steam Fog – cold, dry air over warm water
  e. Ice Fog – water sublimates to ice in the air



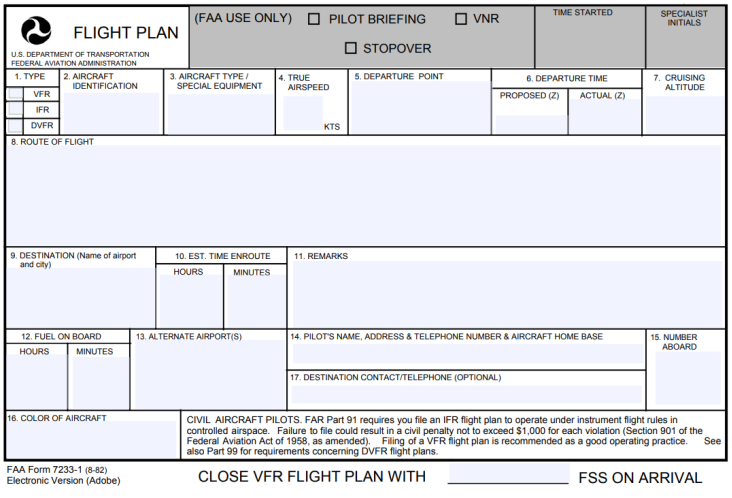
❖ Ceiling – lowest layer of clouds reported as broken or overcast, or vertical visibility into an obscuration like fog or haze
❖ Visibility – greatest horizontal distance at which prominent objects can be viewed with the naked eye
❖ Wind – motion of air relative to Earth's surface
  a. Three forces that affect wind
    - Pressure Gradient Force – pressure difference, wind speed is directly related to the pressure gradient force. Closely space together isobars indicate strong winds
    - Coriolis Force – due to rotation of the earth it causes a force at a right angle to the wind direction and directly proportional to wind speed. As windspeed increases, Coriolis force increases.
    - Friction – Between the wind and the surface there is friction that acts opposite the wind direction.
  b. Patterns
    - High-Pressure (OCD) – associated with cold air masses, fast moving, unstable with good visibility
      - Outward
      - Clockwise (clock high, counter low)
      - Descending
    - Low-Pressure (ICU) – associated with warm air masses, slow moving, stable, and poor visibility
      - Inward
      - Counter-clockwise (clock high, counter low)
      - Upward
❖ Windshear – sudden, dramatic shift in windspeed, direction or both. Can cause severe changes in aircraft performance
❖ Air Masses – large bodies or air that take on characteristics of an area
❖ Fronts – boundary layer between two different air masses
  a. Warm Front – occurs when a warm air mass of air moves and replaces a body of colder air
    - Slow moving (10-25mph)
    - Steady precipitation
    - Stable air – poor visibility, stratus clouds
    - Slides over the top of the colder air mass
  b. Cold Front – occurs when a cold air mass moves and replaces a body of warmer air
    - Fast moving (25-30mph)
    - Showery precipitation
    - Unstable air – good visibility, vertical movement, cumulous clouds
    - Plows under the warmer air mass
  c. Stationary Front – cold and warm air mass don't move and have characteristics of both warm and cold fronts
  d. Occluded Front – when a fast-moving cold front catches up with a slow-moving warm front
    - Cold Front Occlusion – when the cold front is colder than the air mass ahead of the warm front
      - Characteristics of both warm and cold fronts
    - Warm Front Occlusion – when the cold front is warmer than the air mass ahead of the warm front
      - Most violent, embedded thunderstorms, squall lines
❖ Thunderstorms – contain most hazards to flight, flight within 20 miles should be avoided, and do not fly under them
  a. Recipe: moisture, unstable air, and lifting action
  b. Stages:
    - Cumulous – updrafts
    - Mature – rain begins to fall, updrafts and downdrafts
    - Dissipating – downdrafts, anvil formation
  c. Hazards:
    - Lighting, squall lines, tornadoes, turbulence, icing, hail, engine water ingestions, ceiling and visibility
❖ Microbursts – small scale intense downdrafts that cause both vertical and horizontal Windshear
    - Usually less than 1 mile in diameter as it descends from the cloud base to about 1,000 to 3,000 feet above the ground, then it transitions to horizontal outflow to approximately 2 ½ miles in diameter
    - Up to 6,000 feet per minute (fpm) downdrafts
    - Up to 45 knot horizontal winds, resulting in up to 90 knot shear
    - Virga is an indication of a microburst
    - Blowing dust is also an indication
    - Seldom last longer than 15 minutes
❖ Frost – formation of thing ice crystals. Can significantly reduce lift and cause the boundary layer to separate at a lower angle of attack (AOA). Do not fly when frost is present on the aircraft.
❖ Icing (IFH 4-13) – one of the greatest hazards to flight
  a. Types:
    - Structural – accumulation on the exterior of the aircraft
      - Clear Ice – glossy, transparent
      - Mixed Ice – combination of clear and rime
      - Rime – rough, milky, opaque

Outside Air Temperature	Icing Type
0°C to -10°C	Clear
-10°C to -15°C	Mixed (clear and rime)
-15°C to -20°C	Rime

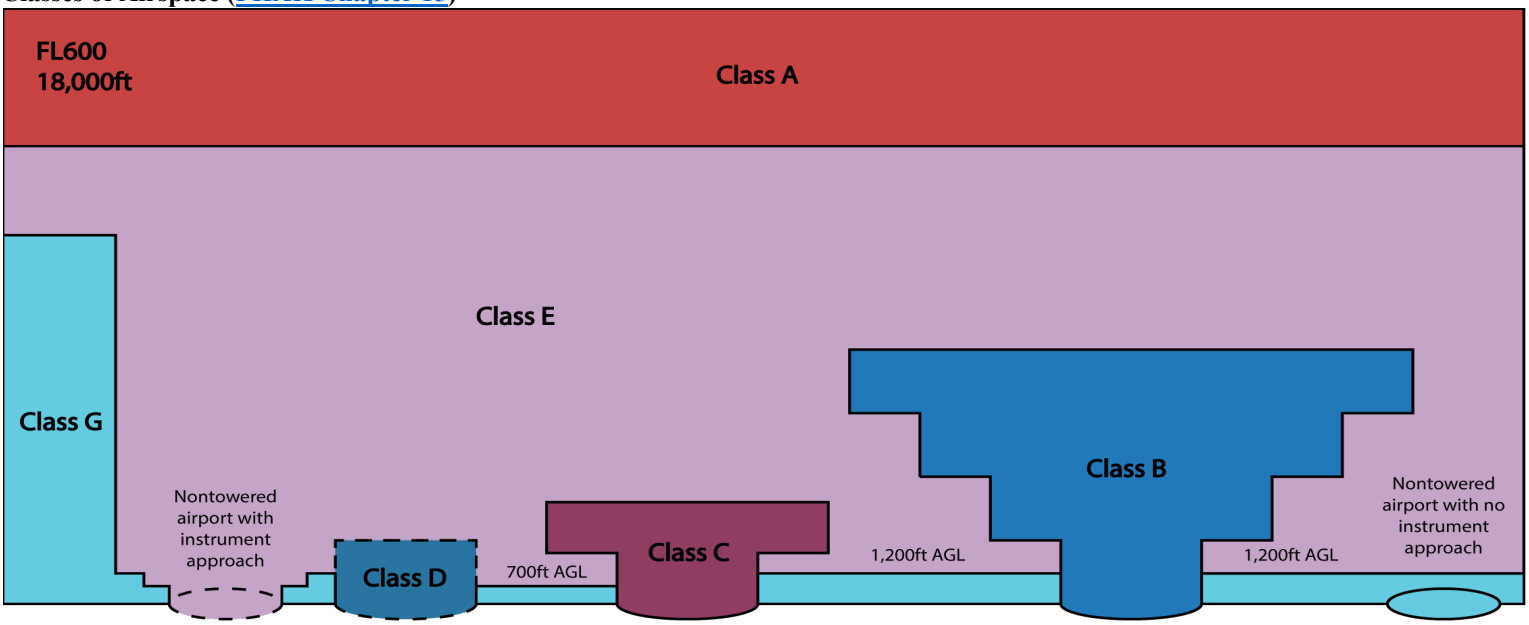
❖ Turbulence – flow of wind changing from its equilibrium
  a. Maintain pitch attitude at or below VA

Flight Planning

❖ Planning (NWKRAFT §91.103)
  a. **N**OTAMs
  b. **W**eather
  c. **K**nown ATC Delays
  d. **R**unway Lengths
  e. **A**lternatives Available
  f. **F**uel Requirements
  g. **T**akeoff and Landing Distances
❖ VFR Flight Plan
  a. Use Foreflight, Garmin Pilot, FSS, Flight Service Website, or 1-800-WX-BRIEF to open a flight plan
  b. Use FSS or an ATC facility to close a flight plan


FLIGHT PLAN
U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION
(FAA USE ONLY) ☐ PILOT BRIEFING ☐ VNR ☐ STOPOVER
TIME STARTED
SPECIALIST INITIALS
1. TYPE: VFR / IFR / DVFR
2. AIRCRAFT IDENTIFICATION
3. AIRCRAFT TYPE / SPECIAL EQUIPMENT
4. TRUE AIRSPEED KTS
5. DEPARTURE POINT
6. DEPARTURE TIME: PROPOSED (Z) / ACTUAL (Z)
7. CRUISING ALTITUDE
8. ROUTE OF FLIGHT
9. DESTINATION (Name of airport and city)
10. EST. TIME ENROUTE: HOURS / MINUTES
11. REMARKS
12. FUEL ON BOARD: HOURS / MINUTES
13. ALTERNATE AIRPORT(S)
14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE
15. NUMBER ABOARD
17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)
16. COLOR OF AIRCRAFT
CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.
FAA Form 7233-1 (8-82) Electronic Version (Adobe)
CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL

Classes of Airspace (PHAK Chapter 15)



Airspace	Class A	Class B	Class C	Class D	Class E	Class G
Entry Requirements	ATC Clearance	ATC Clearance	Prior Two-Way Communications	Prior Two-Way Communications	None For VFR	None
Minimum Pilot Qualifications	Instrument Rating	Private	Student	Student	Student	Student
Equipment Required	IFR Equipped	Two-Way Radio ADSB-Out Transponder & Automatic Altitude Reporting	Two-Way Radio ADSB-Out Transponder & Automatic Altitude Reporting	Two-Way Radio	No Specific Requirement	No Specific Requirement
Traffic Advisories	Yes	Yes	Yes	Workload Permitting	Workload Permitting	Workload Permitting

VFR Cloud Clearance Requirements

Up to but not including 18,000ft MSL

1,000ft Above
5 SM Visibility
1 SM Horizontal
1,000ft Below

10,000ft MSL

Class B, C, D, E

1,000ft Above
3 SM Visibility
2,000ft Horizontal
500ft Below

Class B
3SM Clear of Clouds

Class G

1,000ft Above
1 SM
2,000ft Horizontal
500ft Below

Night: 3SM - 1,000ft Above - 500ft Below - 2,000ft Horizontal

1,200ft AGL

1SM Clear of Clouds

Special Use Airspace (PHAK Chapter 15)

❖ MCPRAWN

a. **M**ilitary Operation Areas (MOA)
b. **C**ontrolled Firing Areas (CFA)
c. **P**rohibited Areas (P-204)
d. **R**estricted Areas (R-2310A)
e. **A**lert Areas (A-631)
f. **W**arning Areas (W-518)
g. **N**ational Security Areas (NSA)

Military Operation Areas (MOA)
Defined lateral & vertical limits
Separates military training from IFR traffic
VFR traffic does need prior authorization
i.e. "OUTLAW MOA"

Prohibited Areas
Defined lateral & vertical limits
Established for security or national welfare
Flight of aircraft is prohibited
i.e. "P-204"

Alert Areas
Exercise caution
Inform nonparticipating pilots of high volume of pilot training or aerial activity
i.e. "A-631"

Restricted Areas
Defined lateral & vertical limits
Allowed to fly through with prior authorization from controlling agency
Flight hazardous by nonparticipating aircraft
i.e. "R-2310A"

National Security Areas (NSAs)
Defined lateral & vertical limits
Established for increased safety & security of ground facilities
May be temorarily prohibited airspace
Pilots are asked to voluntarily avoid overflying

Warning Areas
Similar in nature to restricted areas, however US government does not have sole jurisdiction
Extends from 3NM outward from the coast of the US
Warns nonparticipating pilots of potential danger

Temporary Flight Restrictions (TFR)
Established by FDC NOTAMs
Defined by time periord, statute miles, and affected altitudes

Controlled Firing Areas (CFA)
No chart markings
Spotter on ground responsible for suspending activities

Performance & Limitations

❖ Performance

a. Definition – Operational ability of an aircraft defined by the Aircraft Flight Manual or Pilot's Operating Handbook (AFM/POH)
b. Effects of High Density Altitude
- High Density Altitude (less dense air) reduces performance
  - Power – reduced because less air intake for the engine
  - Thrust – reduced because the propeller exerts less force with less air
  - Lift – reduced because the airfoils exert less force with less air
- Increased Landing Distance
- Increased Takeoff Distance
- Same Indicated Airspeed, but Higher True Airspeed/Groundspeed
- Increased Performance Calculations

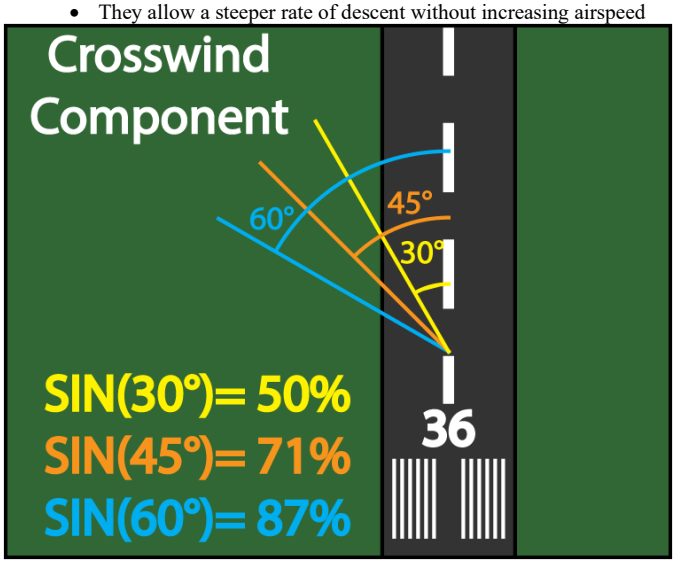
c. Effects of Pressure on Density
- Directly proportional, double the pressure = double the density (only true at constant temperature)

d. Effects of Temperature on Density
- Inversely Proportional, increase in temperature = decrease in density (only true at constant pressure)

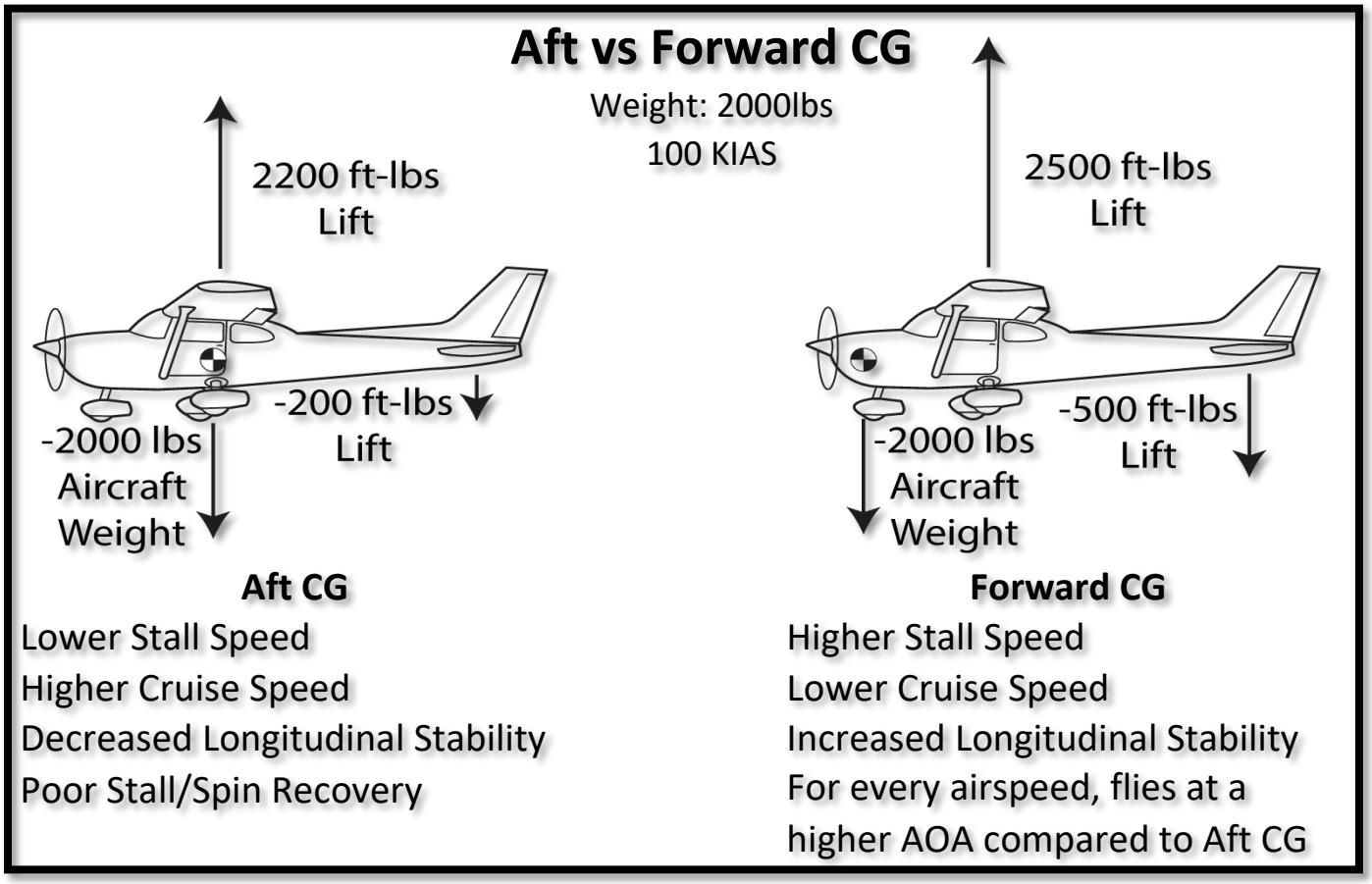
e. Effects of Humidity on Density
- Water vapor is light than air. Increase in humidity = decrease in density

f. Pressure Changes
- High to Low – Lookout Below
  - Indicated Altitude will be higher than True Altitude
  - True Altitude will be lower than Indicated Altitude
- Low to High – Look to the Sky
  - Indicated Altitude will be lower than True Altitude
  - True Altitude will be higher than Indicated Altitude

g. How flaps effect performance
- Increase lift and induced drag
- They allow a steeper rate of descent without increasing airspeed



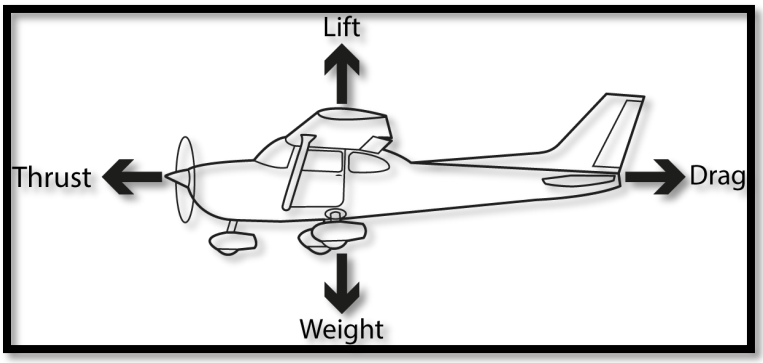
h. Weight & Balance
- Datum – an imaginary vertical plane from which all horizontal distances are measured for balance purposes
- Station – a location along the airplane fuselage given in terms of the distance from the reference datum
- Arm – the horizontal distance from the reference datum to the center of gravity or station (C.G.) of an item
- Moment – the product of the weight of an item multiplied by its arm
- Center of Gravity – the point at which an airplane, or equipment, would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane



i. Heavy vs Light Performance
- Heavy
  - Faster Takeoff Speed
  - Longer Takeoff Roll
  - Shallower Climb
  - Faster Touchdown Speed
  - Longer Landing Roll
- Light
  - Slower Takeoff Speed
  - Shorter Takeoff Roll
  - Steeper Climb
  - Slower Touchdown Speed
  - Shorter Landing Roll

❖ Aerodynamics

a. Four Forces

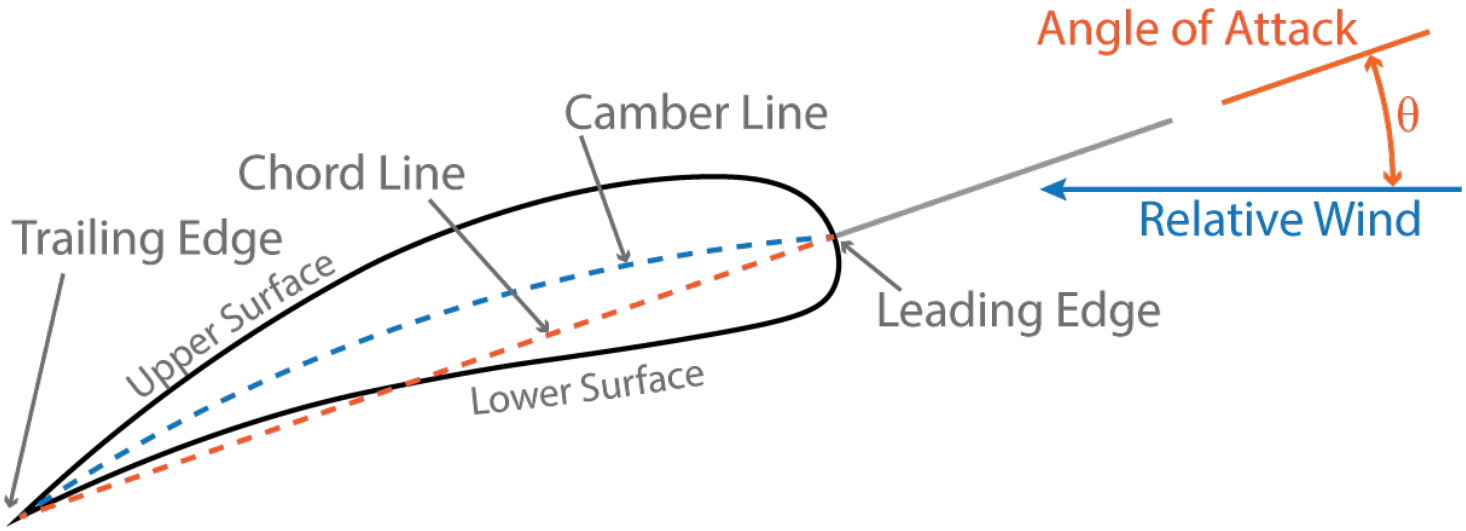


- Thrust – forward force produced by the powerplant/propeller. It opposes the force of drag. It acts parallel to the longitudinal axis.
- Drag – rearward force (retarding force) caused by disruption of airflow by the aircraft structure. It opposes the force of thrust. It acts parallel and rearward to the relative wind.
- Weight –It pulls the aircraft downward due to gravity. Combined load of the aircraft, crew, fuel, and cargo. It opposes the force of lift. It acts vertically downward through the aircrafts center of gravity (CG)
- Lift – Upward force produced by the dynamic effect of air acting on the wing. It opposes the force of weight. It acts perpendicular to the flight path and through the wings center of lift (CL)

b. Load Factor – ratio of lift to the total weight of the aircraft.

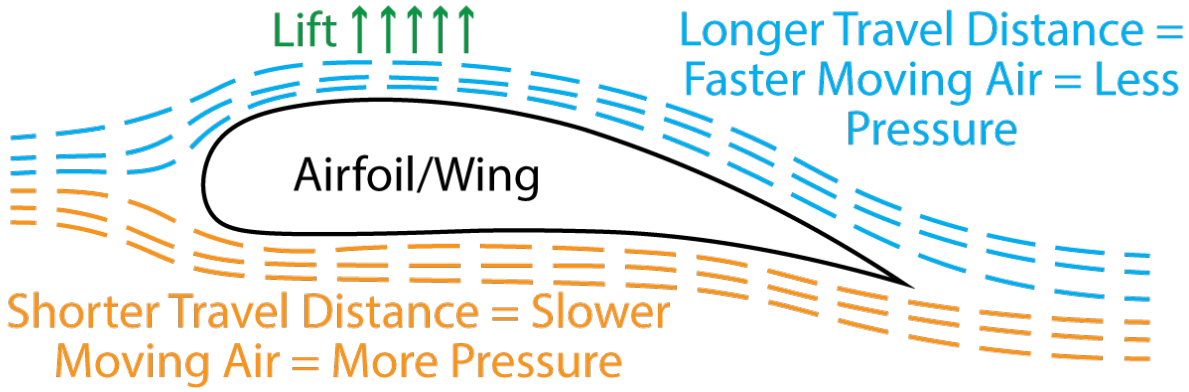
c. Left Turning Tendencies
- P-Factor
  - Descending propeller blade produces more thrust than the ascending blade. Creating asymmetrical thrust across the propeller.
- Spiraling Slipstream
  - Rotation of the propeller sends air in a spiraling rotation toward the rear of the aircraft, striking the vertical stabilizer on the left, pushing the nose of the aircraft left.
- Torque Reaction
  - Involves Newton's Third Law, as the internal parts of the engine revolve in one direction, an equal and opposite force tries to rotate the aircraft in the opposite direction.

d. Drag
- Induced – the byproduct of lift, varies inversely with airspeed.
- Parasite – caused by the friction of air moving over the aircraft structure, varies directly with airspeed.
  - Form Drag – created by the shape of the aircraft or component
  - Interference Drag – created by the collision of different airstreams creating turbulence or restricts smooth airflow
  - Skin Friction Drag – created between air molecules and the surface of the aircraft



- Leading Edge – the part of the airfoil that meets the relative wind first
- Trailing Edge – the part of the airfoil where the airflow of the upper surface and lower surface rejoin
- Chord Line – the imaginary straight line drawn through the airfoil from the trailing edge to the leading edge
- Camber Line – the imaginary line that is equidistant at all points between the upper and lower surfaces

Bernoulli's Principle



- Bernoulli's Principle – as the velocity of a fluid increases, the pressure decreases
- Newton's 3rd Law of Motion – for every action there is an equal and opposite reaction

Human Factors (PHAK Chapter 17)

❖ Hypoxia – means "reduced oxygen" or "not enough oxygen"
a. Symptoms
- Cyanosis
- Headache
- Euphoria
- Impaired Judgement
- Decreased response to stimuli and increased reaction time
- Visual Impairment
- Drowsiness
- Lightheaded or Dizzy
- Tingling Sensations
- Numbness

b. Hypoxia and Hyperventilation have common symptoms, but when in doubt treat for hypoxia first.
c. Hypoxic Hypoxia – lack of oxygen to the body as a whole.
d. Hypemic Hypoxia – means "not enough blood," lack of oxygen in the blood or ability to transport it to the body's cells.
e. Stagnant Hypoxia – means "not flowing," oxygen rich blood is not flowing to a part of the body.
f. Histotoxic Hypoxia – cells inability to effectively use oxygen. Caused by alcohol or drugs.

❖ Hyperventilation – lack of carbon dioxide in the blood caused by excessive breathing
a. Symptoms
- Visual Impairment
- Unconsciousness
- Lightheaded or Dizzy
- Tingling Sensations
- Hot & Cold Sensations
- Muscle Spasms

b. Hypoxia and Hyperventilation have common symptoms, but when in doubt treat for hypoxia first.
c. Treatment
- Descend to a lower altitude
- Use supplemental oxygen

❖ Middle Ear & Sinus
a. Climbs and descents cause a pressure difference from inside the body to the outside. If pressure builds inside the body without equalizing it can cause severe pain
b. Eustachian tube allows for air pressure to equalize in the middle ear
c. Small openings connect sinuses and nasal passages that allow to equalize pressure
d. Do not fly with an upper respiratory infection or nasal allergic condition

❖ Spatial Disorientation – lack of awareness to the position, attitude, or movement of an aircraft
a. Vestibular System – semicircular canals in the inner ear are positioned with three axes to sense yaw, pitch, and roll
- Vestibular Illusions
  - The Leans – occurs when making a sudden return to level flight after a gradual and prolonged turn. After returning to level flight it may cause an illusion that the aircraft is banking in the opposite direction.

- Coriolis Illusion – occurs when in a prolonged turn and the fluid in the inner ear moves at the same speed as the canal, then a movement of the head in a different direction can send that fluid moving creating the illusion of moving, turning, or accelerating in a different direction
- Graveyard Spiral – occurs when in prolonged coordinated constant rate turn pilot may have the illusion of not turning. Returning to level flight, the pilot will then feel a sensation of turning in the opposite direction and incorrectly responds by entering the turn again. With the loss of altitude due to the turn, the pilot compensates by pulling back on the controls. This tightens up the turn into a spiral.
- Somatogravic Illusion – rapid acceleration causes the same sensation as tilting the head backwards. This gives the illusion of being a nose high attitude. The pilot could incorrectly push the nose forward. The opposite is also true for rapid deceleration.
- Inversion Illusion – a sudden change from a climb to straight and level flight can create the illusion of tumbling backwards. The pilot could incorrectly push the aircraft into a nose low attitude which could make the illusion worse.
- Elevator Illusion – a sudden upward vertical acceleration from an updraft gives the illusion of being in climb. The pilot could incorrectly push the aircraft into a nose low attitude. The opposite is also true for a sudden downward vertical acceleration.

Corrective Action: TRUST YOUR INSTRUMENTS, not your body's sensations

b. Somatosensory System – nerves in the skin, muscles, and joints that combined with hearing help sense the body's position based on gravity, feeling, and sound ("flying by the seat of your pants")
- No illusions and typically reliable

c. Visual System – eyes sense the body's position based on what is seen
- Visual Illusions
  - False Horizon – due to several potential causes of obscuring the horizon (fog and night with city lights) it can create the illusion of a false horizon and the pilot could incorrectly align the aircraft with the false horizon and potentially a dangerous attitude.
  - Autokinesis – occurs when flying at night and stationary light appears to start moving when staring at it for long periods of time. The pilot could incorrectly align the aircraft the perceived moving light.

d. Motion Sickness – caused when the brain receives conflicting signals about the orientation of the body.
- Symptoms
  - General Discomfort
  - Nausea
  - Dizziness
  - Paleness
  - Sweating
  - Vomiting

❖ Carbon Monoxide Poisoning

a. Carbon Monoxide is an odorless colorless gas that bonds 200 times more likely to hemoglobin than oxygen.

b. Carbon Monoxide can reach the cockpit through small heaters and exhaust leaks.

❖ Stress – body's response to physical and psychological demands. Causing a release of hormones, increase in metabolism, blood sugar, heart rate, respiration, and blood pressure.

a. Acute
- Short term, "fight or flight"
- Healthy person can usually cope

b. Chronic
- Long Term
- Exceeds the ability for an individual to cope
- Not safe to fly
- Consistent acute stress can develop into chronic stress

❖ Fatigue – associated with pilot error due to the effects that include degradation of attention, concentration, impaired coordination, and decreased ability to communicate

a. Acute
- Short term, normal occurrence is everyday living
- Rest and 8 hours of sleep ordinarily cure acute fatigue
- Skill Fatigue
  - Timing Disruption – performing tasks as usual, but the timing is off.
  - Disruption of the Perceptual Field – focusing on the center of vision and neglecting peripheral vision
- Causes
  - Mild Hypoxia
  - Physical Stress
  - Psychological Stress

b. Chronic
- Long term, usually has psychological roots
- Continuous high stress levels produce chronic fatigue
- Not relieved by proper diet, adequate rest and sleep
- Usually requires treatment by a physician

❖ Hypothermia – critical loss of heat from the body

a. Symptoms
- Cyanosis
- Goosebumps
- Shivering

❖ Optical Illusions

a. Runway Width Illusion
- Narrower than usual runways have the illusion that the aircraft is higher than it actually is, causing a lower than normal approach
- Wider than usual runways have the illusion that the aircraft is lower than it actually is, causing a higher than normal approach

b. Runway & Terrain Slope Illusion
- Upsloping runways have the illusion that the aircraft is higher than it actually is, causing a lower than normal approach
- Down sloping runways have the illusion that the aircraft is lower than it actually is, causing a higher than normal approach

c. Featureless Terrain Illusion
- Absence of ground terrain features has the illusion that the aircraft is at a higher altitude than it actually is, causing a lower than normal approach

d. Water Refraction
- Rain on the windscreen has the illusion of being at a higher altitude than normal, due to the horizon appearing lower than it is

e. Haze
- Has the illusion of being at a greater distance and altitude from the runway, causing a lower than normal approach

f. Fog
- Has the illusion of pitching up, causing the pilot to steepen the approach

g. Ground Lighting Illusions
- Lights in a straight path, such as road lights or moving trains have the illusion of appearing like a runway or approach lights

Corrective Action: Anticipate illusions and TRUST YOUR INSTRUMENTS

❖ Altitude-Induced Decompression Sickness (DCS)

a. Occurs when exposed to low barometric pressures that causes nitrogen to turn into a gas and bubbles form in different areas of the body.

b. Treatment
- Oxygen Mask with 100% oxygen
- Emergency Descent and land as soon as possible
- Areas of joint pain keep still, do not work the pain
- Upon landing seek medical attention

c. Scuba Diving – subjects the body to increased pressure, putting more dissolved nitrogen into the body
- Uncontrolled Ascent
  - Wait 12 hours after diving to fly at altitude up to 8,000ft MSL (not pressurized cabin altitude)
- Controlled Ascent
  - Wait 24 hours after diving to fly at altitudes above 8,000ft MSL (not pressurized cabin altitude)

Drugs & Alcohol (§91.17, §61.15)

❖ Drugs (FAA AME Guide, FAA Over the Counter Med Guide)

a. Must be approved by the FAA for flight activity

b. Must not affect flight performance

c. Always consult an Aviation Medical Examiner (AME)

d. Antihistamine with impairing properties, is the most common drug found in pilots who have died in aviation accidents

❖ Alcohol

a. 8 hours "bottle to throttle"

b. Must have less than 0.04 blood alcohol level

c. Must not be under the influence of alcohol

d. Effects
- Impaired Efficiency
- Deteriorated Performance
- Impaired Judgement
- Decreased Sense of Responsibility
- Impaired Coordination
- Diminished Memory
- Reduced Visual Field
- Lower Attention Span

§91.213 Inoperative Equipment Flow