PTS-BASED LESSON PLANS - PRIVATE PILOT

PRIVATE PILOT
I. AREA OF OPERATION: PREFLIGHT PREPARATION
A. TASK: CERTIFICATES AND DOCUMENTS

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to certificates and documents by:

1. Explaining:
    a. Private Pilot certificate privileges, limitations and recent flight experience requirements.
    b. Medical certificate class and duration.
    c. Pilot logbook or flight records.
2. Locating and explaining:
    a. Airworthiness and registration certificates.
    b. Operating limitations, placards, instrument markings, and POH / AFM.
    c. Weight and balance data and equipment list.

ELEMENTS

1. To act as PIC, a pilot must carry a pilot certificate, current medical certificate, and photo ID.
2. Student Pilot certificate (airplane) (back of first medical certificate):
    a. Must be 16, R/S/W/U English (expires in 24 calendar months).
    b. No passengers, compensation, or international flights allowed.
    c. Limited solo flights (per CFI endorsements).
    d. Also must carry logbook, which contains CFI endorsements.
    e. Basic VFR conditions only:
        i. Ceilings 3000' AGL or more.
        ii. Visibility 5 statues miles or more.
3. Private Pilot certificate (ASEL rating - Airplane Single Engine Land):
    a. Must be 17, R/S/W/U English (no specific expiration date).
    b. Flight review within 24 months.
    c. To take passengers:
        i. At least 3 takeoffs and 3 landings in last 90 days (same category / class / type), to a full stop if in a tail-wheel airplane or flying passengers at night.
        ii. Sole manipulator of the flight controls.
    d. No compensation allowed.
    e. Marginal VFR conditions:
        i. 1000' AGL < Ceilings < 3000' AGL.
        ii. 3 statute miles < Visibility < 5 statute miles.
    f. Special VFR conditions with ATC clearance:
        i. Clear of clouds.
        ii. Visibility > 1 statute mile
4. Medical certificates:
    a. First-class valid for 6 months (airline transport pilots).
        i. Expires at the end of the sixth calendar month after the month in which it was issued or renewed.
    b. Second-class valid for 1 year (commercial pilots).
        i. Expires at the end of the twelfth calendar month after the month in which it was issued or renewed.
    c. Third-class valid for 3 years (age < 40) or 2 years (age > 40) (private pilots).
        i. Expires at the end of the thirty-sixth (age < 40) or twenty-forth (age > 40) calendar month after the month in which it was issued or renewed.
    d. After third- or second-class medical certificates expire, they allow the privileges of the next lower class:
        i. After 6 months, a first-class medical certificate still allows the privileges of a second-class medical certificate, and after 1 year, a first-class medical certificate still allows the privileges of a third-class medical certificate.
        ii. After 1 year, a second-class medical certificate still allows the privileges of a third-class medical certificate.

5. Pilot logbook:
    a. Must log all time required by certificate or rating.
    b. Must include date, total flight time, location, aircraft type and ID, type of flight (i.e. solo), conditions of flight (i.e. day).
6. Within the airplane must be A.R.R.O.W.:
    a. Airworthiness certificate: In effect as long as required maintenance is performed.
    b. Registration certificate: Indicates ownership.
    c. Radio station license: Needed in some countries (but not the U.S.).
    d. Operating limitations: POH / AFM or placards with operating limitations aboard.
    e. Weight and balance data (current).

REFERENCES

1. 14 CFR Part 43, Maintenance, Preventative Maintenance, Rebuilding and Alteration.
2. 14 CFR Part 61, Certification: Pilots, Flight Instructors and Ground Instructors.
3. 14 CFR Part 91, General Operating and Flight Rules.
4. FAA-H-8083-3A, Airplane Flying Handbook, Chapters 1 and 2.
5. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapters 7 and 8.
6. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
I. AREA OF OPERATION: PREFLIGHT PREPARATION
B. TASK: AIRWORTHINESS REQUIREMENTS

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to airworthiness requirements by:

1. Explaining:
    a. Required instruments and equipment for day / night VFR.
    b. Procedures and limitations for determining airworthiness with and without an MEL.
    c. Requirements and procedures for obtaining a special flight permit.
2. Locating and explaining:
    a. Airworthiness directives.
    b. Compliance records.
    c. Maintenance / inspection requirements.
    d. Appropriate record keeping.

ELEMENTS

1. Required equipment for day VFR: <u>G.O.O.S.E.A.C.A.T.</u>:
    a. Gas (fuel) gauge.
    b. Oil temperature gauge.
    c. Oil pressure gauge.
    d. Seat belt and shoulder harness.
    e. ELT - Emergency locator transmitter.
    f. ASI - Airspeed indicator.
    g. Compass.
    h. Altimeter.
    i. Tachometer (engine RPM gauge).
2. Additional required equipment for night VFR: <u>P.A.L.E.S.</u>:
    a. Position lights (right or starboard = green, left or port = red, aft or stern = white).
    b. Anti-collision light (flashing red or white light).
    c. Landing light (for compensation or hire only).
    d. Electrical source (i.e. battery).
    e. Spare fuses, or alternative electrical source (i.e. alternator or generator).
3. Determining airworthiness without a Minimum Equipment List (MEL):
    a. All aircraft instruments and equipment operative prior to departure, unless…
    b. Deferral provision of 14 CFR Part 91, Section 91.213(d).
    c. PIC determines if inoperative equipment is required by type design, CFR's or AD's.
    d. If deferral is made, item is deactivated or removed and placarded INOPERATIVE.
4. Determining airworthiness with a Minimum Equipment List (MEL):
    a. All aircraft instruments and equipment operative prior to departure, unless…
    b. An FAA-Approved Minimum Equipment List (MEL) exists for a specific N-number.
    c. MEL must be in the airplane when operating.
    d. Inoperative equipment not required must be noted in aircraft records if deferred.
    e. If deferral is made, item is deactivated or removed and placarded INOPERATIVE.
5. Special flight permits (SFP's):
    a. Without an approved airworthiness certificate, contact FSDO for application form.
    b. Requires an FAA inspector to inspect or assign inspection to an A&P mechanic.
    c. Inspection to be recorded in aircraft records.
6. Airworthiness Directives (AD's):
    a. Defines FAA-required corrective action for aircraft, engines, propellers, or appliance.
    b. Two categories: Emergency (prior to flight) and less urgent (specified period of time).

7. Compliance records for AD's:
    a. It is the aircraft's owner or operator's responsibility to ensure compliance with AD's.
    b. 14 CFR Part 91, Section 91.417 requires the owner or operator maintain a record of the status of each AD, including:
        i. Method of compliance.
        ii. AD number and revision date, if recurring.
        iii. Time and date when due again.
        iv. Signature.
        v. Kind of certificate.
        vi. Certificate number of the repair station or mechanic who performed the work.
8. Maintenance / inspection requirements:
    a. Annual inspection.
    b. 100-hour inspection (aircraft under 12,500 lbs used to carry passengers for hire).
    c. Altimeter inspection every 24-months.
    d. Transponder inspection every 24-months.
    e. Preflight inspection by the pilot in command (PIC).
9. Appropriate record keeping:
    a. A current Airworthiness Certificate and Aircraft Registration must be in the aircraft.
    b. Maintain compliance with all applicable AD's.
    c. Assure maintenance is properly recorded.
    d. Keep abreast of current regulations concerning operation and maintenance of the aircraft.
    e. Notify the FAA Civil Aviation Registry immediately of any change of permanent mailing address, or of the sale or export of the aircraft, or of the loss of eligibility to register an aircraft.
    f. Have a current FCC radio station license if required outside the U.S.

REFERENCES

1. 14 CFR Part 91, General Operating and Flight Rules.
2. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 7.
3. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
I. AREA OF OPERATION: PREFLIGHT PREPARATION
C. TASK: WEATHER INFORMATION

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to weather information by analyzing weather reports, charts, and forecasts from various sources with emphasis on:
    a. METAR, TAF, and FA
    b. Surface analysis chart.
    c. Radar summary chart.
    d. Winds and temperature aloft chart.
    e. Significant weather prognostic charts.
    f. AWOS, ASOS, and ATIS reports.
2. Makes a competent “go / no-go” decision based on available weather information.

ELEMENTS

1. Aviation Routine Weather Report (METAR):
    a. Hourly observation of current surface weather reported in ICAO format.
    b. Includes type of report, ICAO station identifier, date and time or report, modifier, wind, visibility, weather, sky condition, temperature and dewpoint, altimeter setting and remarks.
2. Terminal Aerodrome Forecast (TAF):
    a. Report forecasting weather for a 5-statue mile radius from an airport in ICAO format.
    b. Covers a 24-hour period and is updated at 0000Z, 0600Z, 1200Z and 1800Z.
    c. Includes type of report, ICAO station identifier, date and time or origin, valid period date and time, forecast wind, forecast visibility, forecast significant weather, forecast sky condition, forecast change group, and probability forecast.
3. Area Forecast (FA):
    a. Report forecasting weather over a large area encompassing several states (6 areas in the contiguous United States).
    b. Issued 3 times a day and valid for 18 hours.
    c. Includes header, precautionary statements, synopsis, VFR clouds and weather.
4. Surface Analysis Chart:
    a. Graphically depicts analysis of the current weather for the contiguous United States.
    b. Computer-generated report transmitted every 3 hours.
    c. Each surface weather reporting point is illustrated by a station model.
    d. Included in a station model are symbols depicting the type of observation, sky cover, clouds, sea level pressure, pressure change / tendency, precipitation, dewpoint, present weather, temperature and wind.
5. Radar weather report (SD):
    a. Report describing areas of precipitation and thunderstorms.
    b. Issued by radar stations hourly at 35 minutes past the hour.
    c. Includes location identifier, echo pattern, area coverage, type and intensity, location, cell movement, and maximum tops.
6. Radar summary chart:
    a. Graphically depicted collection of radar weather reports (SD’s).
    b. Published hourly at 35 minutes past the hour.
    c. Includes precipitation intensity contours, height of tops, movement of cells, type of precipitation, echo configuration, weather watches.
7. Winds and temperature aloft forecast (FD):
    a. Provides winds and temperatures at constant altitudes for specific locations.
    b. Published twice daily at 0000Z and 1200Z.
    c. Reports at 3000’, 6000’, 9000’ and 12,000’ are true altitudes.
    d. Reports at 18,000’, 24,000’, 30,000’, 34,000’ and 39,000’ are pressure altitudes.
    e. Wind direction is referenced to true north and wind speed is in knots.
    f. Temperature is in degrees Celsius.

8. Winds and temperature aloft chart:
    a. Graphically depicted collection of wind and temperature aloft forecasts (FD's).
    b. Published twice daily at 0000Z and 1200Z.
    c. Eight separate panels (all altitudes of FD except 3000').
    d. Arrows with pennants and barbs show wind direction and speed.
9. Significant weather prognostic chart (low level):
    a. Four-panel chart depicting significant weather forecasts:
        i. Left two charts: 12-hour forecast.
        ii. Right two charts: 24-hour forecast.
        iii. Top two charts: Weather aloft forecasts up to FL240.
        iv. Bottom two charts: Surface weather forecasts.
    b. Issued 4 times daily at 0000Z, 0600Z, 1200Z and 1800Z.
    c. Includes non-convective turbulence, freezing levels, areas of MVFR and IFR weather, pressure system locations, fronts and precipitation.
10. Automated weather or surface observation system reports (AWOS or ASOS):
    a. AWOS: Real-time weather observations reported by local sensors and transmitted on frequency by a computer generated voice.
    b. ASOS: Real-time surface observations reported by local sensors and transmitted on frequency by a computer generated voice.
11. Automatic Terminal Information Service (ATIS):
    a. A continuous broadcast of recorded information in selected terminal areas.
    b. Recorded by tower controllers and reviewed by pilots to reduce frequency congestion.

REFERENCES

1. 14 CFR Part 91, General Operating and Flight Rules.
2. AC 00-06, Aviation Weather.
3. AC 00-45, Aviation Weather Services.
4. AC 61-84, Role of Preflight Preparation.
5. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 11.
6. AIM, Aeronautical Information Manual.

PRIVATE PILOT
I. AREA OF OPERATION: PREFLIGHT PREPARATION
D. TASK: CROSS-COUNTRY FLIGHT PLANNING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to cross-country flight planning by presenting and explaining a pre-planned VFR cross-country flight, as previously assigned by the examiner. On the day of the practical test, the final flight plan shall be to the first fuel stop, based on maximum allowable passengers, baggage, and / or cargo loads using real-time weather.
2. Uses appropriate and current aeronautical charts.
3. Properly identifies airspace, obstructions, and terrain features.
4. Selects easily identifiable en route checkpoints.
5. Selects most favorable altitudes considering weather conditions and equipment capabilities.
6. Computes headings, flight time, and fuel requirements.
7. Selects appropriate navigation systems / facilities and communication frequencies.
8. Applies pertinent information from NOTAM's, AF/D, and other flight publications.
9. Completes a navigation log and simulates filing a VFR flight plan.

ELEMENTS

1. 14 CFR Part 91, Section 91.103: Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight, to include:
    a. Weather reports and forecasts.
    b. Fuel requirements.
    c. Alternates available if the planned flight cannot be completed.
    d. Known traffic delays.
    e. Runway lengths at airports of intended use.
    f. Takeoff and landing distance determinations.
2. Assemble the necessary material:
    a. Appropriate current sectional charts and terminal area charts (TAC's).
    b. Appropriate current airport / facility directories (A/FD's).
    c. Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.
    d. Flight computer or electronic calculator.
    e. Plotter.
    f. Flight log / flight plan form.
3. Get an outlook weather briefing (over 6 hours from departure), including local NOTAM's.
4. Study available information about each airport at which a landing is intended (in the appropriate current A/FD's).
5. Determine proper loading and center of gravity of the airplane (weight and balance data).
6. Determine takeoff and landing distances based on the calculated load.
7. Compare takeoff and landing distances with runway lengths at airports of intended use.
8. Check the POH / AFM fuel consumption charts to determine fuel burn at estimated altitude and power settings. Compare to estimated flight time to determine refueling points.
9. Start charting the course by drawing a straight line from each point of departure to the next point of arrival.
10. Check both sides of the course for hazards or special operational requirements, including:
    a. Controlled airspace and special use airspace.
    b. Hazardous terrain such as mountains, forests, swamps and large water masses.
    c. Obstructions such as towers and antennas (note each maximum quadrant altitude).
11. Consider alternate airports and navigational aids along the route which could be useful.
12. If a more efficient or safer route can be found without significant detour, consider that route.
13. Select prominent checkpoints (large towns, other airports, major highways, lakes, rivers, etc.) 15 or 20 minutes apart and note them on the flight log.
14. With the plotter, determine the true course of each leg.
15. Add the variation to the true course to get the magnetic course and choose a VFR altitude well above all obstructions (MC 0°-179°: odd thousands + 500', MC 180°-359°: even thousands + 500').

16. Measure the distance of each leg and the total distance of the course and note them in the flight log.
17. Get a standard weather briefing, including local NOTAM's.
18. Calculate the wind correction angle for each leg using a flight computer and note them in the flight log.
19. Starting with the true course, calculate the compass heading for each leg in three steps and note on the flight log:
    a. True heading = true course +/- wind correction angle (TH = TC +/- WCA).
    b. Magnetic heading = true heading +/- variation (MH = TH +/- VAR).
    c. Compass heading = magnetic heading +/- deviation (CH = MH +/- DEV).
20. Calculate the ground speed, resulting flight time and resulting fuel burn for each leg using a flight computer and note them in the flight log.
21. Fill out the flight plan form and file the flight plan with the Flight Service Station (FSS).
22. Consider the flight conditions and the area over which the flight will take place:
    a. Bring white and red flashlights if flight is to take place at night.
    b. Bring warm clothes if flight is over a mountain.
    c. Bring water if flight is over a dessert.

REFERENCES

1. 14 CFR Part 91, General Operating and Flight Rules.
2. AC 61-84, Role of Preflight Preparation.
3. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 14.
4. Navigation charts.
5. A/FD, Airport Facility Directory.
6. AIM, Aeronautical Information Manual.
7. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

I. AREA OF OPERATION: PREFLIGHT PREPARATION
E. TASK: NATIONAL AIRSPACE SYSTEM

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to the National Airspace System by explaining:

1. Basic VFR weather minimums – for all classes of airspace.
2. Airspace classes – their operating rules, pilot certification, and airplane equipment requirements for the following:
    a. Class A.
    b. Class B.
    c. Class C.
    d. Class D.
    e. Class E.
    f. Class G.
3. Special use and other airspace areas.

ELEMENTS

1. “Basic VFR weather”: Ceilings > 3000’, visibility > 5 sm.
2. “Marginal VFR weather”: 1000’ < ceilings < 3000’, 3 sm < visibility < 5 sm.
3. “IFR weather”: Ceilings < 1000’, visibility < 3 sm.
4. “Special VFR weather”: Clear of clouds. Visibility > 1 sm.
5. Class A airspace:
    a. Airspace from 18,000’ MSL up to and including FL600 (60,000’ MSL).
    b. All operations conducted under instrument flight rules (IFR).
    c. Entry requirement: ATC clearance.
    d. Equipment required: IFR equipped.
    e. Minimum pilot qualifications: Instrument Rating.
6. Class B airspace:
    a. Airspace from the surface up to and including 10,000’ AGL.
    b. Surrounds the nation’s busiest airports.
    c. Configuration is individually tailored with two or more layers, usually resembling an upside-down wedding cake.
    d. Basic VFR visibility minimum: 3 sm.
    e. Basic VFR distance from cloud minimums: Clear of clouds.
    f. Entry requirement: ATC clearance.
    g. Equipment required: Two-way radio, transponder with altitude reporting capability.
    h. Minimum pilot qualifications: Private Pilot certificate (or student pilot with training and endorsement).
7. Class C airspace:
    a. Airspace from the surface up to and including 4000’ AGL.
    b. Surrounds airports with large operational control towers.
    c. Configuration includes a 5-nm radius core from the surface to 4000’ AGL and a 10-nm shelf from 1200’ AGL to 4000’ AGL and a 20-nm radius outer area from the surface to 4000’ AGL.
    d. Basic VFR visibility minimum: 3 sm.
    e. Basic VFR distance from cloud minimums: 500’ below, 1000’ above, 2000’ horizontal.
    f. Entry requirement: Two-way radio communications prior to entry.
    g. Equipment required: Two-way radio, transponder with altitude reporting capability.
    h. Minimum pilot qualifications: No specific requirement.
8. Class D airspace:
    a. Airspace from the surface up to and including 2500’ AGL.
    b. Surrounds airports serviced by radar approach control.
    c. Configuration is tailored to meet the operational needs of the area.
    d. Basic VFR visibility minimum: 3 sm.
    e. Basic VFR distance from cloud minimums: 500’ below, 1000’ above, 2000’ horizontal.
    f. Entry requirement: Two-way radio communications prior to entry.
    g. Equipment required: Two-way radio, transponder with altitude reporting capability.
    h. Minimum pilot qualifications: No specific requirement.

9. Class E airspace:
    a. Controlled airspace that is not designated A, B, C or D.
    b. Airspace above the surface or above the underlying airspace, extending to Class A airspace, which begins at 18,000' MSL.
    c. Unless designated at a lower altitude, class E airspace begins at 14,500' AGL.
    d. Basic VFR visibility minimum:
        i. Less than 10,000' MSL: 3 sm.
        ii. At or above 10,000' MSL: 5 sm.
    e. Basic VFR distance from cloud minimums:
        i. Less than 10,000' MSL: 500' below, 1000' above, 2000' horizontal.
        ii. At or above 10,000' MSL: 1000' below, 1000' above, 1 sm horizontal.
    f. Entry requirement: None for VFR.
    g. Equipment required: No specific requirement.
    h. Minimum pilot qualifications: No specific requirement.
10. Class G airspace:
    a. Uncontrolled airspace (airspace not designated A, B, C, D or E).
    b. Airspace above the surface, extending to the base of the overlying Class E airspace.
    c. Basic VFR visibility minimum (1200' AGL or lower):
        i. Day: 1 sm.
        ii. Night: 3 sm.
    d. Basic VFR visibility minimum (over 1200' AGL but less than 10,000' MSL):
        i. Day: 1 sm.
        ii. Night: 3 sm.
    e. Basic VFR visibility minimum (over 1200' AGL and at or above 10,000' MSL):
        i. 5 sm.
    f. Basic VFR distance from cloud minimums (1200' AGL or lower):
        i. Day: Clear of clouds.
        ii. Night: 500' below, 1000' above, 2000' horizontal.
    g. Basic VFR distance from cloud minimums (over 1200' AGL but less than 10,000' MSL):
        i. 500' below, 1000' above, 2000' horizontal.
    h. Basic VFR distance from cloud minimums (over 1200' AGL and at or above 10,000' MSL):
        i. 1000' below, 1000' above, 1 sm horizontal.
    i. Entry requirement: None.
    j. Equipment required: No specific requirement.
    k. Minimum pilot qualifications: No specific requirement.
11. Special Use Airspace:
    a. Prohibited areas: Established for national welfare. Depicted on charts.
    b. Restricted areas: Unusual hazards. Must obtain permission. Depicted on charts.
    c. Warning areas: May contain hazards. Depicted on charts.
    d. Military Operations Areas (MOA's): Separates military traffic. Depicted on charts.
    e. Alert areas: High volume of training or unusual aerial activity.
    f. Controlled firing area: Activities suspended when aircraft presence is indicated.
    g. Temporary Flight Restrictions (TFR's): Designated by FDC NOTAM. Wide variety of reasons for establishing TFR's.

REFERENCES

1. 14 CFR Part 71, Designation of Class A, Class B, Class C, Class D and Class E Airspace Areas, Airways, Routes, and Reporting Points.
2. 14 CFR Part 91, General Operating and Flight Rules.
3. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 13.
4. Navigation charts.
5. AIM, Aeronautical Information Manual.

PRIVATE PILOT
I. AREA OF OPERATION: PREFLIGHT PREPARATION
F. TASK: PERFORMANCE AND LIMITATIONS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to performance and limitations by explaining the use of charts, tables, and data to determine performance and the adverse effects of exceeding limitations.
2. Computes weight and balance. Determines the computed weight and center of gravity is within the airplane's operating limitations and if the weight and center of gravity will remain within its limits during all phases of flight.
3. Demonstrates use of appropriate performance charts, tables and data.
4. Describes the effects of atmospheric conditions on the airplane's performance.

ELEMENTS

1. The Performance section of the POH / AFM contains operational data pertaining to takeoff, climb, range, endurance, descent and landing performance for a range of conditions.
2. Some manufactures use data tables, others use graphical data.
3. At sea level, the average pressure exerted by the atmosphere is approximately 14.7 PSI (pounds per square inch).
4. International Standard Atmosphere (ISA):
    a. Sea level temperature = 15°C (59°F) with a 2°C (3.5°C) per 1000' standard lapse rate.
    b. Sea level pressure = 29.92" Hg (1013.2 millibars) with a 1" Hg (33.9 millibars) per 1000' standard lapse rate.
5. Adjustments for non-standard conditions are found in the POH / AFM data.
6. Pressure altitude (PA) is determined by:
    a. Setting the altimeter to 29.92" Hg., or
    b. Applying the lapse rate to the reported altimeter setting.
7. Water vapor is lighter than air, so moist air is lighter, and density ↓, DA ↑, performance ↓.
8. Density altitude (DA) = PA corrected for non-standard temperature (use flight computer).
    a. Temp ↑, density ↓, DA ↑, performance ↓.
    b. Temp ↓, density ↑, DA ↓, performance ↑.
9. At lower pressure (higher DA), the air becomes less dense (use POH / AFM data):
    a. Power is reduced because the engine takes in less air.
    b. Thrust is reduced because the propeller is less efficient in thin air.
    c. Lift is reduced because the thin air exerts less force on the airfoils.
10. In straight-and-level unaccelerated flight, lift equals weight (L=W) and thrust equals drag (T=D).
11. Total drag = induced drag (from wing lift) and parasite drag (everything but wings).
    a. High speed results in mostly parasite drag, low speed results in mostly induced drag.
    b. Minimum total drag results when induced drag and parasite drag are equal.
12. V_X (max angle of climb) is also the speed that maximizes excess thrust available.
13. V_Y (max rate of climb) is also the speed that maximizes excess power available.
14. At the absolute ceiling, $V_X = V_Y$ and produces zero feet per minute rate-of-climb.
15. Weight ↑, required lift ↑, required angle of attack ↑, drag ↑, required power ↑.
16. Power loading = total weight / total horsepower. Affects takeoff and climb capabilities.
17. Wing loading = total weight / wing area. Affects landing speed.
18. Ground effect is due to the interference of the surface with the flow pattern around the airplane.
    a. Reduces the amount of induced drag by reducing wingtip vortices.
    b. Affects flight within approximately one wing span of the surface (flare and touchdown).
19. Maximum range (distance) results from maximizing speed per fuel flow rate (also L/D max).
20. Maximum endurance (time) results from minimizing fuel flow rate.
21. Region of reverse command ("behind the power curve"):
    a. Airspeed below the best endurance airspeed.
    b. Higher airspeed requires less power and lower airspeed requires more power.
22. Runway surface and gradient (consult AF/D and POH / AFM for specifics):
    a. Runway gradient ↑: Retarding force ↑, time to accelerate to V_R ↑, takeoff distance ↑.
    b. Runway roughness ↑: Retarding force ↑, time to accelerate to V_R ↑, takeoff distance ↑.

23. Water reduces runway friction and produces hydroplaning dangers.
    a. Minimum initial dynamic hydroplaning speed = 9 x square root of tire pressure (in PSI).
    b. Once begun, dynamic hydroplaning can continue below the minimum initial dynamic hydroplaning speed.
24. Takeoff performance (consult AF/D and POH / AFM for specifics):
    a. Gross weight ↑: Mass to accelerate ↑, retarding force (friction) ↑, lift-off speed ↑.
    b. Headwind ↑: Groundspeed required ↓. Tailwind ↑: Groundspeed required ↑.
    c. Density altitude ↑: Engine power ↓, propeller efficiency ↓, takeoff speed required ↑.
25. Landing performance (consult AF/D and POH / AFM for specifics):
    a. Gross weight ↑: Landing speed ↑, mass to decelerate ↑, retarding force (inertia) ↑.
    b. Headwind ↑: Groundspeed required ↓. Tailwind ↑: Groundspeed required ↑.
    c. Density altitude ↑: Landing true airspeed required ↑ (indicated airspeed stays the same).
26. Performance speeds (consult POH / AFM for specifics):
    a. Indicated airspeed (IAS): Uncorrected speed observed on the airspeed indicator.
    b. Calibrated airspeed (CAS): IAS corrected for static port position and installation errors.
    c. Equivalent airspeed (EAS): CAS corrected for adiabatic compressible flow at altitude.
    d. True airspeed (TAS): Airspeed relative to undisturbed air, TAS = EAS($\rho_o/\rho)^{1/2}$.
    e. Groundspeed (GS): Airspeed relative to the surface of the earth.
    f. V_{SO}: Power-off stalling speed in the landing configuration.
    g. V_{S1}: Power-off stalling speed in a specified configuration (usually cruise).
    h. V_Y: Best rate-of-climb speed (unit of altitude per unit time).
    i. V_X: Best angle-of-climb speed (unit of altitude per unit of horizontal distance).
    j. V_{LE}: Maximum speed with landing gear extended.
    k. V_{LO}: Maximum speed for extending or retracting (operating) the landing gear.
    l. V_{FE}: Maximum speed with flaps extended.
    m. V_A: Design maneuvering speed. Maximum load limit can be imposed without damage.
    n. V_{NO}: Maximum structural cruising speed. Exceed only in smooth air.
    o. V_{NE}: Never exceed speed. Structural damage can occur even in smooth air.
27. Performance charts and tables (consult POH / AFM for specifics):
    a. Developed during flight tests with new airplanes.
    b. Requires interpolation for specific flight conditions.
    c. Density altitude charts: Find density altitude from airport elevation, outside air temperature (OAT) and altimeter setting (inches Hg).
    d. Takeoff distance charts: Find takeoff roll and distance over a 50' obstacle from pressure altitude, OAT, takeoff weight and headwind.
    e. Climb and cruise charts: Find climb and cruise performance from pressure altitude, OAT, cruise altitude, cruise OAT and power settings.
    f. Crosswind and headwind component chart: Find crosswind and headwind components from wind speed and direction.
    g. Landing distance charts: Find landing roll and distance over a 50' obstacle from pressure altitude, OAT, landing weight and headwind.
    h. Stall speed performance charts: Find adjusted stall speeds from power setting, flap setting, landing gear setting and angle of bank.

REFERENCES

1. AC 61-84, Role of Preflight Preparation.
2. FAA-H-8083-1, Aircraft Weight and Balance Handbook.
3. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 9.
4. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

I. AREA OF OPERATION: PREFLIGHT PREPARATION
G. TASK: OPERATION OF SYSTEMS

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to the operation of systems on the airplane provided for the flight test by explaining at least three (3) of the following systems:

1. Primary flight controls and trim.
2. Flaps, leading edge devices, and spoilers.
3. Water rudders (ASES).
4. Engine and propeller.
5. Landing gear.
6. Fuel, oil and hydraulic.
7. Electrical.
8. Avionics.
9. Pitot-static vacuum / pressure and associated flight instruments.
10. Environmental.
11. Deicing and anti-icing.

ELEMENTS

1. Primary flight controls:
    a. Ailerons: Mounted on outboard trailing edges of wings and connected to the control column via mechanical linkages to control roll about the longitudinal axis.
    b. Elevator or stabilator: Mounted on the tail horizontally and connected to the control column via mechanical linkages to control pitch about the lateral axis.
    c. Rudder: Mounted on the tail vertically and connected to rudder pedals via mechanical linkages to control yaw about the vertical axis.
2. Secondary flight controls:
    a. Flaps: Attached on inboard trailing edges of wings. The can be extended for high lift (landing) and retracted when not needed (cruise). Types include plain, split, slotted and Fowler flaps.
    b. Trim tabs: Elevator trim tabs relieve control column pressure in pitch.
3. Powerplant:
    a. The airplane engine and propeller work together to provide thrust and drive systems.
    b. Reciprocating engines' cylinder arrangement can be radial, in-line, v-type or opposed.
    c. Four-stroke operating cycle: Intake, compression, power and exhaust:
        i. Intake: Piston travels down and fuel/air mixture is drawn in the cylinder.
        ii. Compression: Intake valves close and piston is driven up.
        iii. Power: The pressurized fuel/air mixture is ignited and piston is driven down.
        iv. Exhaust: Intake valves open and cylinder moves up, purging the cylinder.
    d. Each cylinder operates on a different stroke, causing continuous crankshaft rotation.
4. Propeller:
    a. A rotating airfoil, subject to induced drag, stalls and other aerodynamic principles.
    b. Propeller is twisted to produce uniform lift from the hub (high twist) to tip (low twist).
    c. Fixed-pitch propeller: Pitch set by the manufacturer. Usually a compromise of:
        i. Climb propeller: Low pitch, high RPM, high HP, best takeoff performance.
        ii. Cruise propeller: High pitch, low RPM, low HP, best cruise performance.
    d. Adjustable-pitch propeller (modern version is the constant-speed propeller):
        i. Converts high % of brake HP into thrust HP over a wide range of RPM.
        ii. Allows selection of most efficient RPM (high for takeoff, low for cruise).
        iii. Throttle controls manifold pressure (MP), propeller control regulates RPM.
        iv. For power ↑: RPM ↑, then MP ↑. For power ↓: MP ↓, then RPM ↓.
5. Landing gear system:
    a. Principle support of the airplane on the surface (may be wheels, floats or skis).
    b. Conventional landing gear: Two main wheels and a rear-mounted wheel. Provides better propeller ground clearance – desirable on unimproved fields.
    c. Tricycle landing gear: Two main wheels and a nose-mounted wheel. Allows more forceful application of brakes, permits better forward visibility and tends to prevent ground-looping.

6. Fuel system:
    a. Provides an uninterrupted flow of clean fuel from the tanks to the engine.
    b. Flows through a fuel selector valve and strainer to either a carburetor or fuel injector.
    c. May be a gravity-feed or fuel-pump system.
7. Oil system:
    a. Includes an oil sump, oil pump and oil filter.
    b. Lubricates the engine's moving parts and provides cylinder-piston seal, cools the engine by reducing friction and removing heat and carries away contaminants.
    c. Dry sump: Separate oil tank. Wet sump: Oil sump is integral part of engine.
    d. Oil pressure and oil temperature gauge readings indicate health of oil system.
8. Hydraulic system:
    a. Operates wheel brakes, retractable landing gear, and constant-speed propellers.
    b. Includes a fluid reservoir, pump, filter and relief valve.
9. Carburetor system:
    a. Brings in air (through filter), mixes with fuel, and delivers fuel/air mixture to cylinders.
    b. Usually float-type (but could be pressure-type with a fuel pump).
    c. Air flows through a venturi, creating a partial vacuum and pulling in fuel.
    d. Mixture control decreases fuel flow, compensating for low air density at altitude and maintains the correct fuel/air mixture.
    e. Carburetor ice occurs due to fuel vaporization and venturi air pressure decrease.
    f. Carburetor heat uses preheated air to prevent formation of carburetor ice.
10. Fuel injection system:
    a. Fuel is injected directly into cylinders (or just ahead of the intake value).
    b. Usually incorporates both an engine driven fuel pump and auxiliary pump.
    c. Advantages of fuel injection: Reduction in evaporative icing, better fuel flow and distribution, faster throttle response, precise mixture control, and easier cold starts.
    d. Disadvantages of fuel injection: Difficult hot starts (vapor locks) and problems starting after fuel starvation.
11. Ignition system:
    a. Made up of starter, magnetos, spark plugs, high-tension leads and ignition switch.
    b. Starter provides initial sparks ("START"), then magnetos take over ("BOTH").
    c. A magneto uses a permanent magnet to generate an electric current from the crankshaft rotation by electromagnetic induction.
    d. Detonation is an uncontrolled, explosive ignition of the fuel/air mixture.
    e. Preignition occurs when the fuel/air mixture ignites prior to the normal time.
12. Electrical system:
    a. Includes alternator, battery, alternator/battery switch, alternator switch, bus bar, circuit breakers, voltage regulator, ammeter or loadmeter and electrical wiring.
    b. Engine driven alternators supply electric current and maintain battery charge.
    c. A voltage regulator controls the rate of charge to the battery.
    d. An ammeter shows if the alternator is producing adequate electrical power.
        i. A negative amp value indicates current is being drawn from the battery.
        ii. A positive amp value indicates the battery is being charged by the alternator.
        iii. A full-scale negative deflection indicates an alternator malfunction.
        iv. A full-scale positive deflection indicates a voltage regulator malfunction.

Note: For all systems, the airplane's POH / AFM should be consulted for specifics.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapters 4 and 5.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
I. AREA OF OPERATION: PREFLIGHT PREPARATION
J. TASK: AEROMEDICAL FACTORS

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to aeromedical factors by explaining:

1. The symptoms, causes, effects, and corrective actions of at least three (3) of the following:
    a. Hypoxia.
    b. Hyperventilation.
    c. Middle ear and sinus problems.
    d. Spatial disorientation.
    e. Motion sickness.
    f. Carbon monoxide poisoning.
    g. Stress and fatigue.
    h. Dehydration.
2. The effects of alcohol, drugs, and over-the-counter medications.
3. The effect of excess nitrogen from SCUBA dives upon a pilot or passenger in flight.

ELEMENTS

1. Hypoxia (reduced amount of oxygen). Symptoms include blue fingernails and lips, headache, decreased reaction time, impaired judgment, euphoria, visual impairment, drowsiness, lightheaded or dizzy sensation, tingling in fingers and toes, and numbness.
    a. Hypoxic hypoxia: Insufficient oxygen available to the lungs (high altitude).
    b. Hypemic hypoxia: Blood cannot transport oxygen to the body's cells (CO poisoning).
    c. Stagnant hypoxia: Oxygen-rich blood in the lungs isn't moving (G-forces).
    d. Histotoxic hypoxia: Inability of the body's cells to use the oxygen (alcohol, meds).
2. Hyperventilation:
    a. Occurs during emotional stress, fright or pain.
    b. Breathing rate and depth increases resulting in excessive carbon dioxide loss.
    c. Can lead to unconsciousness.
    d. Symptoms include headache, decreased reaction time, impaired judgment, euphoria, visual impairment, drowsiness, lightheaded or dizzy sensation, tingling in fingers and toes, numbness, pale/clammy appearance and muscle spasms.
    e. Preventative actions should include breathing normally, talking aloud or breathing into a paper bag.
3. Middle ear and sinus problems:
    a. Climbs and descents produce pressure changes which can cause ear and sinus pain.
    b. During a climb, local pressure is reduced and the eardrum bulges outward.
    c. During a descent, local pressure increases and the eardrum bulges inward.
    d. The Eustachian tube normally allows air pressure to equalize in the middle ear, but sometimes it can be constricted due to a partial vacuum.
    e. Like clearing the ears, air pressure in the sinuses normally equalizes through nasal passages, but can be blocked due to a sinus block or respiratory infection.
4. Spatial disorientation:
    a. Three systems working to ascertain orientation and movement in space:
        i. Eyes
        ii. Kinesthesia (perception through nerves muscles and tendons).
        iii. Vestibular (sensations through semicircular canals and fine hairs of inner ear).
    b. Flying sometimes causes one of the three systems to supply conflicting information.
    c. Acceleration due to gravity and maneuvering cannot be separated, causing illusions:
        i. False horizon: Eyes convince kinesthesia and vestibular systems of level flight.
        ii. Landing illusions:
            1. Runway appears narrower-than-usual when higher-than-normal.
            2. Upsloping terrain makes airplane appear higher.
        iii. Flicker vertigo: Flashing lights at certain frequencies causing nausea.
        iv. Autokinesis: When focused on, stationary points appear to move.

5. Motion sickness:
    a. Caused by the brain receiving conflicting signals from perception systems.
    b. Symptoms include discomfort, nausea, dizziness, paleness, sweating, and vomiting.
    c. Preventative actions include opening air vents and focusing outside the airplane.
6. Carbon monoxide poisoning:
    a. CO is a colorless and odorless gas produced by all internal combustion engines.
    b. When breathed, it prevents blood hemoglobin from carrying oxygen.
    c. Heater manifolds and defrost vents may leak CO into the passenger cabin.
    d. If exhaust gas is detected or CO detector activates, assume CO is present.
    e. Corrective actions: Turn off heater, open air vents, terminate flight.
7. Stress:
    a. Results in the body releasing adrenaline and increasing metabolism.
    b. Examples of stressors can be physical, physiological or psychological.
    c. Acute stress (short term stress) results in "fight or flight" response mechanism and can be overcome by a trained pilot.
    d. On-going acute stress can develop into chronic stress and be debilitating.
    e. Pilots experiencing chronic stress should not fly and should see a physician.
8. Fatigue:
    a. Degrades attention and concentration. Impairs coordination and decision-making.
    b. Timing disruption: Pilot performs tasks separately instead of as an integrated activity.
    c. Disruption of perceptual field: Concentrating only on the center of vision.
    d. Causes: Lack of sleep, mild hypoxia, physical or psychological stress.
    e. No amount of training or experience can overcome the effects of fatigue.
9. Dehydration:
    a. A critical loss of water from the body which causes fatigue.
    b. Symptoms are dizziness, weakness, nausea, tingling, cramps and extreme thirst.
    c. Can disable the body's control of temperature and cause heatstroke.
    d. Water should be carried and used on long flights.
10. Alcohol:
    a. Can impair judgment, even in small amounts.
    b. Bloodstream absorbs almost all alcohol in a drink within 30 minutes.
    c. Altitude multiplies the effect of alcohol on the brain.
    d. Pilots should be more conservative than the "8 hours after" and "0.04%" rules.
    e. Impairments in vision and hearing occur at alcohol blood levels as low as 0.01%.
11. Drugs:
    a. Prescription and over-the-counter drugs can impair judgment, memory, alertness, coordination, vision and the ability to make calculations.
    b. Frequently taken drugs should be discussed with the Aviation Medical Examiner (AME) at the time of medical certificate renewal.
12. Excess (residual) nitrogen from SCUBA dives:
    a. Increased pressure allows more nitrogen to dissolve in body tissues.
    b. Reducing the pressure by ascending to the surface too quickly (or flying) too quickly after diving allows small bubbles of nitrogen to form in the body.
    c. The escaping nitrogen causes a harmful and painful condition called "the bends."
    d. The recommended minimum time between SCUBA diving and flying:
        i. 12 hours for dives not requiring decompression stops.
        ii. 24 hours for dives requiring decompression stops.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 15.
2. AIM, Aeronautical Information Manual.

PRIVATE PILOT

II. AREA OF OPERATION: PREFLIGHT PROCEDURES
A. TASK: PREFLIGHT INSPECTION

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to preflight inspection. This shall include which items must be inspected, the reasons for checking each item, and how to detect possible defects.
2. Inspects the airplane with reference to an appropriate checklist.
3. Verifies the airplane is in a condition for safe flight.

ELEMENTS

1. Use the manufacturer's recommended preflight inspection checklist.
2. Purpose is twofold: Establish legal airworthiness and ensure a condition for safe flight.
3. Required certificates and documents are present:
   a. Airworthiness certificate.
   b. Registration certificate.
   c. Radio license (if required by type of operation).
   d. Operating limitations (POH / AFM or placards).
   e. Weight and balance records.
4. Inside the cockpit:
   a. Door alignment and ease of opening / closing - CHECK.
   b. Windshield and windows free of cracks and crazing - CHECK.
   c. Seats, seat rails, lock pins and attach points free from wear or cracks - CHECK.
   d. Alternator, battery and ignition switches - OFF.
   e. Control column locks - REMOVED.
   f. Landing gear control - DOWN AND LOCKED.
   g. Fuel selectors - CHECK EACH POSITION.
   h. Primer - EXERCISE.
   i. Primer - LOCK.
   j. Engine control - MOVE THROUGH FULL RANGE.
   k. Airspeed indicator reading - ZERO.
   l. Vertical speed indicator reading - ZERO (pilot can zero only this instrument).
   m. Compass securely mounted - CHECK.
   n. Compass deviation card in place - CHECK.
   o. Compass full of fluid - CHECK.
   p. Gyro-driven attitude indicator condition - CHECK.
   q. Altimeter reading versus field elevation with current altimeter setting - CHECK (if altitude if off by more than 75 feet, its accuracy is questionable).
   r. Battery master switch - ON.
   s. Fuel quantity indicators - CHECK (a visual inspection of the tanks is also required).
   t. Required lights - CHECK.
   u. Electric stall warning indicator (if installed) - CHECK.
   v. Battery master switch - OFF.
5. Outer wing surfaces and tail section:
   a. Skin free of deterioration, distortion and loose / missing rivets or screws - CHECK.
   b. Wingtips (usually fiberglass) free from damage - CHECK.
   c. Crack drill stops free of further crack propagation - CHECK.
   d. Bottom of wing free of fuel stains - CHECK.
6. Fuel and oil:
   a. Fuel level of each tank - VISUALLY CHECK.
   b. Fuel type and grade of each tank and sump (identified by color) - CHECK.
   c. Fuel of each tank and sump free of water and sediment contamination - CHECK.
   d. Fuel tank caps of each tank - SECURED.
   e. Fuel tank vent free of damage - CHECK.
   f. Engine oil level - CHECK.
   g. Dipstick, oil cap, oil access door - SECURED.

7. Landing gear tires and brakes:
    a. Tires properly inflated and free from damage - CHECK.
    b. Brakes free of rust, corrosion, loose nuts / bolts, brake pad wear / cracks, signs of hydraulic fluid leaks and abrasion - CHECK.
    c. Nose gear shimmy damper and torque link - CHECK.
    d. Shock struts properly inflated - CHECK.
8. Engine and propeller:
    a. Engine cowling free of damage - CHECK.
    b. Spinner free of dents and bends - CHECK.
    c. Propeller free of nicks, cracks, pitting, corrosion and faulty security - CHECK.
    d. Propeller hub free of oil leaks - CHECK.
    e. Alternator belt at proper tension - CHECK.
    f. Inside cowling free of fuel and oil leak indications - CHECK.
    g. General condition inside cowling (including ensuring lack of FOD) - CHECK.
    h. Exhaust stacks free from cracking - CHECK.
    i. Cowling fasteners secure - CHECK.

COMMON ERRORS

a. Failure to use or the improper use of checklist.
b. Allowing distractions to interrupt a visual inspection.
c. Inability to recognize discrepancies to determine airworthiness.
d. Failure to ensure servicing with the proper fuel and oil.
e. Failure to ensure proper loading and securing of baggage, cargo, and equipment.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 2.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

II. AREA OF OPERATION: PREFLIGHT PROCEDURES

B. TASK: COCKPIT MANAGEMENT

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to cockpit management procedures.
2. Ensures all loose items in the cockpit and cabin are secured.
3. Organizes material and equipment in an efficient manner so they are readily available.
4. Briefs occupants on the use of safety belts, shoulder harnesses, doors and emergency procedures.

ELEMENTS

1. Ensure all necessary equipment, documents, checklists and navigation charts are on board.
2. Ensure the routing of headset cables and other wires do not interfere with the motion or operation of any control.
3. Organize materials so they are readily available.
4. Check cockpit for items that might be tossed about if turbulence is encountered.
5. Secure loose items (seatbelts from open seats work well).
6. Adjust seat for proper view both inside and outside the cockpit (use cushion if needed).
7. Ensure the safety belts and shoulder harnesses are comfortable and snug.
8. Ensure the seat is locked in position after adjustment (a seat moving during takeoff or landing can cause a pilot to lose control of the airplane).
9. Ensure that each person on board is briefed on how to fasten and unfasten the safety belts and shoulder harnesses (required by 14 CFR part 91).
10. Conduct a passenger briefing - explain the proper use of safety equipment and exit routes.

COMMON ERRORS

a. Failure to place and secure essential materials and equipment for easy access during flight.
b. Failure to properly adjust cockpit items, such as safety belts, shoulder harnesses, rudder pedals and seats.
c. Failure to provide proper adjustment of equipment and controls.
d. Failure to provide occupant briefing on emergency procedures and use of safety belts.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 2.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
II. AREA OF OPERATION: PREFLIGHT PROCEDURES
C. TASK: ENGINE STARTING

OBJECTIVE
To determine that the applicant:
1. Exhibits knowledge of the elements related to recommended engine starting procedures. This shall include the use of an external power source, hand propping safety, and starting under various atmospheric conditions.
2. Positions the airplane properly considering structures, surface conditions, other aircraft, and the safety of nearby persons and property.
3. Utilizes the appropriate checklist for starting procedure.

ELEMENTS
1. Use the manufacturer's recommended preflight inspection checklist.
2. Ensure the tail of the airplane is not pointed toward something that would be affected by propeller blast.
3. When ready to start the engine, look in all directions to be sure nothing is or will be in the vicinity of the propeller.
4. Ensure the anticollision light is on prior to engine start (as an indication of airplane operation).
5. Prior to engine start, open the window, call "CLEAR," and listen for a response.
6. When activating the starter, place the other hand on the throttle (allowing prompt response).
7. Set a low engine RPM setting immediately after start (usually 1000 RPM).
8. As soon as engine RPM is set, ensure the oil pressure is in the green (if not, the engine should be shut down immediately to avoid serious damage).
9. Check the ammeter for a very high current draw indicating the starter has failed to disengage (if such an indication is found, the engine should be immediately shut down).
10. Avoid continuous starter operation for periods longer than 30 seconds without a cool down period of at least 30 seconds to a minute.

COMMON ERRORS
a. Failure to properly use the appropriate checklist.
b. Failure to use safety precautions related to starting.
c. Improper adjustment of engine controls during start.
d. Failure to assure proper clearance of the propeller.

REFERENCES
1. AC 91-13, Cold Weather Operation of Aircraft.
2. AC 91-55, Reduction of electrical System Failures Following Aircraft Engine Starting.
3. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 2.
4. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge.
5. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
II. AREA OF OPERATION: PREFLIGHT PROCEDURES
D. TASK: TAXIING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to safe taxi procedures.
2. Performs a brake check immediately after the airplane begins moving.
3. Positions the flight controls properly for the existing wind conditions.
4. Controls direction and speed without excessive use of brakes.
5. Complies with airport / taxiway markings, signals, ATC clearances, and instructions.
6. Taxies so as to avoid other aircraft and hazards.

ELEMENTS

1. Keep aware of other aircraft taking off, landing or taxiing.
2. Keep eyes focused outside the airplane while taxiing, to the sides as well as front.
3. Be aware of the entire area to ensure the airplane will clear all obstructions and other aircraft.
4. When in doubt about clearance, stop the airplane and have someone check the clearance.
5. Taxi at a cautious speed on congested or busy ramps.
6. Do not use the brakes unless engine power is first set at a minimum.
7. Slow down before attempting a turn (sharp, high-speed turns place undesirable side loads on the landing gear and may result in an uncontrollable swerve or ground loop).
8. In high-wind conditions, the airplane will tend to weathervane (turn to face the wind).
9. Steering is accomplished with rudder pedals (bungeed to nose wheel).
10. Differential braking should be used only when bungeed nose wheel and rudder do not provide enough control authority.
11. More engine power may be required to start the airplane moving forward or to start a turn.
12. Power should be immediately reduced when movement begins to prevent excessive acceleration.
13. When first beginning to taxi, the brakes should be tested for proper operation.
14. If braking action is unsatisfactory, the engine should be shut down immediately.
15. Downwind taxiing will usually require less engine power after the initial ground roll is begun, since the wind will be pushing the airplane forward.
16. When taxiing with a quartering headwind, raise the upwind aileron, or “turn into wind.” This will reduce the tendency for the wind to lift the upwind wing.
17. When taxiing with a quartering tailwind, raise the downwind aileron and lower the elevator, or “dive away from the wind.” This will reduce the tendency for the wind to lift the upwind wing and tail.

COMMON ERRORS

a. Improper use of brakes.
b. Improper positioning of the flight controls for various wind conditions.
c. Taxiing too fast.
d. Failure to comply with airport / taxiway surface marking, signals, and ATC clearances or instructions.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 2.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
II. AREA OF OPERATION: PREFLIGHT PROCEDURES
F. TASK: BEFORE TAKEOFF CHECK

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to the before takeoff check. This shall include the reasons for checking each item and how to detect malfunctions.
2. Positions the airplane properly considering other aircraft / vessels, wind and surface conditions.
3. Divides attention inside and outside the cockpit.
4. Ensures that engine temperature and pressure are suitable for run-up and takeoff.
5. Accomplishes the before takeoff checklist and ensures the airplane is in safe operating condition.
6. Reviews takeoff performance airspeeds, takeoff distances, departure and emergency procedures.
7. Avoids runway incursions and / or ensures no conflict with traffic prior to taxiing into takeoff position.

ELEMENTS

1. Use the manufacturer's recommended before takeoff checklist.
2. The before takeoff check is normally performed in a "runup" area near the takeoff end of the runway.
3. Position the airplane clear of other aircraft and ensure there is no debris below the airplane and nothing behind the airplane that could be damaged by prop blast.
4. The airplane should be headed as nearly as possible into the wind to minimize engine heating during runup.
5. After positioning, ensure the nose or tailwheel is aligned (not turned to one side).
6. While performing the engine runup, divide attention inside and outside the airplane (the airplane can more forward unnoticed if attention is fixed inside the airplane.

COMMON ERRORS

a. Failure to properly use the appropriate checklist.
b. Improper positioning of the airplane.
c. Improper acceptance of marginal engine performance.
d. Improper check of flight controls.
e. Failure to review takeoff and emergency procedures.
f. Failure to avoid runway incursions and to ensure no conflict with traffic prior to taxiing into takeoff position.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 2.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

III. AREA OF OPERATION: AIRPORT AND SEAPLANE BASE OPERATIONS
A. TASK: RADIO COMMUNICATIONS AND ATC LIGHT SIGNALS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to radio communications and ATC light signals.
2. Selects appropriate frequencies.
3. Transmits using recommended phraseology.
4. Acknowledges radio communications and complies with instructions.

ELEMENTS

1. A radio license is not required of pilots operating in the United States, but an FCC restricted radiotelephone permit and station license may be required to operate internationally.
2. VHF (very high frequency) aviation communications radios operate on frequencies between 118.0 MHz (cycles per second) and 136.975 MHz.
3. VHF radios are limited to line of sight transmissions.
4. The phonetic alphabet is described on page 12-10 of the Pilot's Handbook of Aeronautical Knowledge.
5. Examples of proper phraseology and procedures are given in the AIM, Chapter 4-2.
6. Radio technique:
    a. Listen before transmitting.
    b. Think of what is to be said before keying the transmitter.
    c. Ensure the microphone is close to the lips.
    d. Wait before repeating a call – the controller may be busy.
    e. Be alert to the sounds or lack of sounds from the transmitter (volume, stuck mic, etc.)
    f. Ensure adequate range to the station.
7. Contact procedures:
    a. Name of the facility being called.
    b. The make or model, followed by the full aircraft identification number.
    c. The aircraft position.
    d. The request.
8. Examples of contacts:
    a. "Renton Ground, Cessna Seven-Zero-Four-Mike-Lima, at BEFA with alpha, taxi for downwind departure."
    b. "Renton Tower, Skyhawk Five-Three-Four-Four-Kilo, ready for takeoff, runway three-three, northbound departure."
    c. "Renton Tower, Cessna Seven-Zero-Four-Mike-Lima, over Lake Youngs at two thousand five hundred, inbound with bravo."
    d. "Renton Ground, Skyhawk Five-Three-Four-Four-Kilo, at foxtrot, taxi to BEFA."
9. Facility names and "call signs":
    a. UNICOM = "Auburn UNICOM."
    b. FAA Flight Service Station = "Seattle Radio."
    c. FAA Flight Service Station (while airborne calling for weather) = "Seattle Flight Watch."
    d. Airport Traffic Control Tower = "Renton Tower."
    e. Clearance Delivery Position (IFR) = "Seattle Clearance Delivery."
    f. Ground Control Position in Tower = "Renton Ground."
    g. Radar or Nonradar Approach Control Position = "Seattle Approach."
    h. Radar Departure Control Position = "Seattle Departure."
    i. FAA Air Route Traffic Control Center (ARTCC) = "Seattle Center."
10. Do not abbreviate the full aircraft identification number (few exceptions).
11. A heading of 195 degrees is referred to as "heading one niner five."
12. All local times should be converted to 24-hour Coordinated Universal Time (UTC) or "Zulu" time (example: 1:30PM = 1330 hours, add 8 hours for PST time-zone adjustment to UTC = 2130 hours UTC pronounced "two one three zero Zulu").
13. A speed of 105 knots is referred to as "one zero five knots."
14. Use "affirmative" for yes and "negative" for no.

15. To correct a radio call, simply stop talking, say “correction,” and then complete the transmission with the corrected information.
16. Some facilities use Remote Communications Outlets (RCO’s) which can enable communications while still out of range of the “parent” facility.
17. If a receiver becomes inoperative and a pilot needs to land at a controlled airport, it is advisable to remain outside or above Class D airspace until the direction of traffic flow is determined and watch for light signals from the tower.
18. If the transmitter is operative, the pilot should give a position report.
19. If the receiver is operative but the transmitter is inoperative, the pilot can acknowledge control transmissions by rocking wings (day) or blinking the landing light (night).
20. Control Tower light signals:
    a. Steady green: Cleared for takeoff (on ground), cleared to land (in flight).
    b. Flashing green: Cleared for taxi (on ground), return for landing (in flight).
    c. Steady red: Stop (on ground), give way to other aircraft and continue (in flight).
    d. Flashing red: Taxi clear of runway in use (on ground), Airport unsafe, do not land (in flight).
    e. Flashing white: Return to starting point on airport (on ground).
    f. Alternating red and green: Exercise extreme caution (on ground and in flight).

COMMON ERRORS

a. Use of improper frequencies.
b. Improper procedure and phraseology when using radio communications.
c. Failure to acknowledge, or properly comply with, ATC clearances and instructions.
d. Failure to understand, or to properly comply with, ATC light signals.

REFERENCES

1. 14 CFR Part 91, General Operating and Flight Rules.
2. AC 61-23 / FAA-H-8083-25, Pilot’s Handbook of Aeronautical Knowledge, Chapter 12.
3. FAA-H-8083-15, Instrument Flying Handbook, Chapter 7.
4. AIM, Aeronautical Information Manual, Chapter 4-2.

PRIVATE PILOT

III. AREA OF OPERATION: AIRPORT AND SEAPLANE BASE OPERATIONS
B. TASK: TRAFFIC PATTERNS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to traffic patterns. This shall include procedures at airports with and without operating control towers, prevention of runway incursions, collision avoidance, wake turbulence avoidance, and wind shear.
2. Complies with proper traffic pattern procedures.
3. Maintains proper spacing from other aircraft.
4. Corrects for wind drift to maintain the proper ground track.
5. Maintains orientation with the runway / landing area in use.
6. Maintains traffic pattern altitudes, +/- 100 feet, and the appropriate airspeed, +/- 10 knots.

ELEMENTS

1. The standard airport traffic pattern is rectangular in shape with directions and altitudes based on local conditions (population density, obstructions, etc.).
2. As a default, all turns are made to the left unless right turns are indicated.
3. With a control tower, the pilot receives a clearance to approach and depart.
4. Without a control tower, the pilot determines direction of traffic.
5. The tower operator may instruct pilots to enter the traffic pattern at any point or to make a straight-in approach.
6. Jets or heavy airplanes fly wider and higher patterns and make mostly straight in approaches.
7. Compliance with the basic rectangular traffic pattern reduces the possibility of conflicts at airports without an operating control tower.
8. Without a control tower, inbound pilots are expected to observe other aircraft already in the pattern and to conform to the traffic pattern in use.
9. The standard traffic pattern altitude (TPA) is 1000’ AGL.
10. If possible, airspeed should be adjusted to match that of other airplanes in the pattern.
11. Without a control tower, inbound pilots are expected to observe other aircraft already in the pattern and to conform to the traffic pattern in use.
12. If there is no traffic at an airport without a control tower, traffic and wind indicators on the ground should be checked as well as automated surface weather transmissions.
13. Some airports have a segmented circle with L-shaped pattern indicators and windsocks. These indicators can be checked at a safe height above the highest TPA.
14. When the proper traffic pattern direction has been determined, the pilot should then proceed to a point well clear of the pattern before descending to TPA.
15. The standard traffic pattern entry is on a 45° angle to the downwind leg abeam the midpoint of the runway to be used for landing.
16. The traffic pattern altitude should be established well before entering the pattern (usually descend to TPA on the 45° angle to the downwind leg).
17. Entering traffic patterns while descending creates collision hazards and should be avoided.
18. The 45° entry leg should be long enough to provide a clear view of the entire traffic pattern.
19. The downwind leg is a course flown parallel but opposite in direction to the landing runway.
20. The downwind leg should be flown until ½ to 1 mile out from the landing runway.
21. During the downwind leg, the before landing check should be completed and the landing gear extended if retractable.
22. TPA is maintained on the downwind leg until abeam the approach end of the landing runway.
23. Abeam the approach end of the runway, power is reduced and descent begun.
24. At a point approximately 45° from the end of the runway, a medium bank turn (20° to 25°) is made onto the base leg (altitude ~800’ AGL).
25. The ground track of the airplane while on the base leg should be perpendicular to the extended centerline of the landing runway.
26. While descending on the base leg, the pilot should ensure there is no collision danger with another aircraft on final approach (an airplane on a straight-in approach).
27. A medium bank (20° to 25°) base-to-final turn is made to line up on the extended centerline of the landing runway on a final approach (altitude ~500’ AGL).

28. The final approach is the point of highest pilot workload, as accurate control of airspeed and descent angle must be maintained while visually judging the approach to the intended touchdown point.
29. Aircraft on final approach have the right-of-way over other aircraft in flight or on the surface.
30. When two of more aircraft are approaching an airport, the lower has the right-of-way.
31. The upwind leg is flown on the extended centerline of the takeoff runway over the departure end of the runway after a go-around or takeoff.
32. A medium bank turn (20° to 25°) is made onto the crosswind leg (altitude ~700’ AGL).
33. The ground track of the airplane while on the crosswind leg should be perpendicular to the extended centerline of the takeoff runway.
34. At a point approximately 45° from the end of the runway, a medium bank turn (20° to 25°) is made onto the downwind leg (altitude ~TPA).
35. If departing the traffic pattern, continue straight out on the upwind leg or exit with a 45° turn (to the left when in a left-hand traffic pattern, to the right when in a right-hand traffic pattern) after reaching pattern altitude.

COMMON ERRORS

a. Failure to comply with traffic pattern instructions, procedures and rules.
b. Improper correction for wind drift.
c. Inadequate spacing from other traffic.
d. Poor altitude or airspeed control.

REFERENCES

1. AC 90-66, Recommended Standard Traffic Patterns and Practices for Aeronautical Operations at Airports without Operating Control Towers.
2. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 7.
3. AC 61-23 / FAA-H-8083-25, Pilot’s Handbook of Aeronautical Knowledge.
4. AIM, Aeronautical Information Manual.

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to airport / seaplane base, runway, and taxiway operations with emphasis on runway incursion avoidance.
2. Properly identifies and interprets airport / seaplane base, runway, and taxiway signs, markings, and lighting.

ELEMENTS

1. Runway markings are white and taxiway markings are yellow.
2. The three categories of markings are visual, nonprecision instrument, and precision instrument.
3. Runway designators:
   a. The runway number is the whole number nearest one-tenth of the magnetic azimuth.
   b. For parallel runways, “L” (left), “C” (center) and “R” (right) follow the runway number.
4. Runway centerline marking: Uniformly spaced white stripes and gaps providing alignment guidance.
5. Runway aiming point marking:
   a. Broad white rectangular stripe on each side of the runway centerline approximately 1000 feet from the landing threshold.
   b. Serves as a visual aiming point for landing aircraft.
6. Runway touchdown zone marking:
   a. Three, two, and then one pair of white rectangular bars symmetrically arranged about the runway centerline to convey 500-foot increments.
   b. Identifies the touchdown zone for landing.
7. Runway side stripe marking: Continuous white stripes delineating the edges of the runway and providing for visual contrast between the runway and abutting terrain or shoulders.
8. Runway shoulder markings: 45° white stripes to supplement runway side stripes in identifying pavement areas not intended for use by aircraft.
9. Runway threshold markings:
   a. Longitudinal white stripes of uniform disposed symmetrically about the runway centerline.
   b. Number of stripes can designate runway width (4=60’, 6=75’, 8=100’, 12=150’, 16=200’).
   c. Helps identify the beginning of the runway (threshold bar) that is available for landing.
   d. In some cases the runway threshold may be relocated or displaced.
10. Relocated threshold: A threshold that has been moved due to construction, maintenance, etc.
11. Displaced threshold:
    a. A ten-foot wide white stripe across the width of the runway located at a point other than the physical beginning of the runway.
    b. White arrows are located along the centerline in the area between the beginning of the runway and the displaced threshold.
    c. White arrowheads are located across the width of the runway prior to the threshold bar.
    d. Runway behind a displaced threshold is available for takeoffs in either direction or landing roll from the opposite direction.
12. Runway threshold bar: A ten-foot wide white stripe across the width of the runway identifying the beginning of the runway that is available for landing
13. Demarcation bar: A three-foot wide yellow stripe delineating a runway with a displaced threshold from a blast pad, stopway or taxiway that precedes the runway.
14. Chevrons: Yellow markings used to show pavement areas aligned with the runway that are unusable for landing, takeoff and taxiing.
15. Taxiway centerline marking: A single continuous yellow line providing alignment guidance.
16. Continuous taxiway edge marking: A continuous double yellow line used to define the taxiway edge from areas not intended for use by aircraft.
17. Dashed taxiway edge marking: A broken double yellow line used to define the taxiway edge from areas that are intended for use by aircraft (aprons, run-up areas, etc.).

18. Taxi shoulder markings: Perpendicular yellow lines covering areas not intended for use by aircraft.
19. Surface painted direction signs: Surface signs with yellow background and black inscription (letter or number and arrow) provided when direction signs are not practical.
20. Surface painted location signs: Surface signs with black background and yellow inscription (letter or number) provided when location signs are not practical.
21. Geographic position markings: Pink circles on taxiways allowing pilots to report position.
22. Runway hold position markings:
    a. Four yellow lines, two solid and two dashed across the width of taxiway / runway.
    b. The two solid lines are always on the side where the aircraft is to hold (think “a solid citizen stops before a solid line”).
    c. On taxiways: Locations at which aircraft are supposed to stop until cleared.
    d. On runways: Locations at which aircraft are to stop (“land and hold short”).
23. ILS critical area markings: Two solid yellow lines connected by pairs of solid yellow lines protecting an ILS critical area. Aircraft is to stop prior to such markings until cleared.
24. Surface painted holding position signs: Surface signs with red background and white inscription used to supplement hold position markings.
25. Vehicle roadway markings: Defines a path for vehicle operations on areas intended for aircraft.
26. VOR receiver checkpoint markings:
    a. A painted circle with an arrow in the middle (like a compass rose).
    b. Allows the pilot to check aircraft instruments with navigational aid signals.
27. Nonmovement area boundary markings:
    a. Two yellow lines, one solid and one dashed denoting the boundary of a movement area (i.e. under air traffic control / ground control).
    b. The solid line is always on the side where the aircraft is to hold (like the hold position markings, think “a solid citizen stops before a solid line”).
28. Permanently closed runways and taxiways: Yellow crosses are placed at each end of the runway and at 1000-foot intervals.
29. Temporarily closed runways and taxiways: Yellow crosses or raised yellow crosses are placed on the runway only at each end.
30. Helicopter landing area markings: A square containing a black “H” aligned with the intended direction of approach.
31. Mandatory instruction signs: Red background with white inscription. Includes runway hold position signs, runway approach area holding position signs, ILS critical area holding position signs and no entry signs.
32. Location signs: Black (or yellow) background with yellow (or black) inscription. Includes taxiway location signs (yellow on black), runway location signs (yellow on black), runway boundary signs (black on yellow) and ILS critical area boundary signs (black on yellow).
33. Direction signs: Yellow background with black inscription.
34. Destination signs: Yellow background with black inscription with arrow(s).
35. Information signs: Yellow background with black inscription.
36. Runway distance remaining signs: Black background with white inscription showing distance (in thousands of feet) of runway remaining.

COMMON ERRORS

a. Failure to comply with airport / seaplane base, runway and taxiway signs and markings.
b. Failure to comply with airport / seaplane base, runway and taxiway lighting
c. Failure to use proper runway incursion avoidance procedures.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot’s Handbook of Aeronautical Knowledge, Chapter 12.
2. AIM, Aeronautical Information Manual, Chapter 2.

PRIVATE PILOT

IV. AREA OF OPERATION: TAKEOFFS, LANDINGS AND GO-AROUNDS
A. TASK: NORMAL AND CROSSWIND TAKEOFF AND CLIMB

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to a normal and crosswind takeoff, climb operations and rejected takeoff procedures.
2. Positions the flight controls for the existing wind conditions.
3. Clears the area; taxies into takeoff position and aligns the airplane on the runway centerline.
4. Retracts the water rudders as appropriate (ASES) and advances the throttle smoothly to takeoff power.
5. Establishes and maintains the most efficient planning / lift off attitude and corrects for porpoising and skipping (ASES).
6. Lifts off at the recommended airspeed (V_R or V_{LO}) and accelerations to V_Y.
7. Establishes a pitch attitude that will maintain V_Y +10/-5 knots.
8. Retracts the landing gear and flaps as appropriate after a positive rate of climb is established and no usable runway remains.
9. Maintains takeoff power and V_Y +10/-5 knots to a safe maneuvering altitude.
10. Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
11. Complies with noise abatement procedures.
12. Completes the appropriate checklist.

NOTE: If a crosswind condition does not exist, the applicant's knowledge of crosswind elements shall be evaluated through oral testing.

ELEMENTS

1. Know the predicted takeoff performance figures from the FAA-Approved AFM/POH.
2. Be familiar with airport layout, including runway lengths and hold short operations.
3. Use FAA-Approved AFM/POH takeoff configurations.
4. Use the Before Takeoff Checklist.
5. Select runway based on wind for slowest groundspeed and shortest groundroll.
6. Clear the takeoff path of other aircraft.
7. Announce intentions on CTAF or receive takeoff clearance from the tower controller.
8. Taxi onto the runway, line up on the centerline with the nosewheel centered and set HI or HSI.
8. Select a ground reference point aligned with runway for directional control.
9. Fully turn the yoke in the direction of the wind.
10. Add maximum power smoothly and monitor the engine instruments for malfunctions
11. Use whatever rudder pressure is required to counteract the left turning tendencies.
12. Gradually roll out the full aileron as control surfaces become more effective.
13. Pitch up at or above V_R. Lift downwind wheel (lower upwind wing) and roll on upwind wheel using coordinated aileron (upwind aileron up) and opposite rudder (deflected downwind).
14. Establish sideslip with the upwind wing lowered until positive rate of climb is attained.
15. Establish the pitch attitude for V_Y and maintain V_Y +10/-5 knots during the climb.
16. Retract the landing gear and flaps (as appropriate) after a positive rate of climb is established and no usable runway remains.
17. As positive rate of climb is established, transition to a wings-level wind correction (crab) angle.
18. Maintain takeoff power until at least 500 feet above the surrounding terrain or obstacles.
19. Complete the After Takeoff Checklist or the Climb Checklist.

COMMON ERRORS

a. Improper runway incursion avoidance procedures.
b. Improper use of controls during a normal or crosswind takeoff.
c. Inappropriate liftoff procedures.
d. Improper climb attitude, power setting and airspeed (V_Y).
e. Improper use of checklist.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 5.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

IV. AREA OF OPERATION: TAKEOFFS, LANDINGS AND GO-AROUNDS
B. TASK: NORMAL AND CROSSWIND APPROACH AND LANDING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to a normal and crosswind approach and landing.
2. Adequately surveys the intended landing area (ASES).
3. Considers the wind conditions, landing surface and obstructions, them selects a suitable touchdown point.
4. Establishes the recommended approach and landing configuration and airspeed, and adjusts pitch attitude and power as required.
5. Maintains a stabilized approach and recommended airspeed, or in its absence, not more than 1.3 VSO +10/-5 knots with wind gust factor applied.
6. Makes smooth, timely and correct control application during the roundout and touchdown.
7. Contacts the water at the proper pitch attitude (ASES).
8. Touches down smoothly at approximate stalling speed (ASEL).
9. Touches down at or within 400 feet (120 meters) beyond a specified point, with no wind drift, with the airplane's longitudinal axis aligned with and over the runway center / landing path.
10. Maintains crosswind correction and directional control throughout the approach and landing sequence.
11. Completes the appropriate checklist.

NOTE: If a crosswind condition does not exist, the applicant's knowledge of crosswind elements shall be evaluated through oral testing.

ELEMENTS

1. Know the predicted landing performance figures from the FAA-Approved AFM/POH.
2. Be familiar with airport layout, including runway lengths and hold short operations.
3. Use FAA-Approved AFM/POH landing configurations.
4. Use Before Landing Checklist.
5. Select runway based on wind for slowest groundspeed and shortest groundroll.
6. Announce intentions on CTAF or receive landing clearance from the tower controller.
7. Enter traffic pattern by the approved method.
8. Clear the landing path of other aircraft.
9. Turn onto base leg with reduced power and airspeed approximately $1.4V_{SO}$.
10. Turn onto final approach with enough time to ensure a stabilized descent with a wings-level (crab) angle allowing the airplane's ground track to be aligned with the runway centerline.
11. On short final, transition to a wing-low (sideslip) attitude, aligning the airplane centerline with the runway centerline, by lowering the upwind wing (upwind aileron up) and applying opposite rudder (rudder deflected downwind).
12. Maintain drift control with aileron and heading control with rudder.
13. For strong crosswinds, reducing the amount of flap deflection and increasing approach speed can be helpful in maintaining heading control.
14. If the crosswind is so strong that maximum rudder authority cannot maintain runway heading, another runway (or airport) more aligned with the wind must be used.
15. Upon roundout (flare), gradually increase the deflection of the rudder and aileron to maintain the proper amount of drift correction and to keep the upwind wing down.
16. Land on the upwind wheel and gradually lower the nosewheel. Continue to increase the deflection of the rudder and aileron to maintain heading and drift correction.
17. As the ground roll slows and control surface deflections are maximized, lower the downwind wheel. Drift will be counteracted by ground friction on the wheels.
18. Continue aileron and rudder wind drift corrections while taxiing off the runway.
19. Complete the After Landing Checklist.

COMMON ERRORS

a. Improper use of landing performance data and limitations.
b. Failure to establish approach and landing configuration at appropriate time or in proper sequence.
c. Failure to maintain a stabilized slip.
d. Inappropriate removal of hand from throttle.
e. Improper procedure during transition from the slip to the touchdown.
f. Poor directional control after touchdown.
g. Improper use of brakes (ASEL).

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 8.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
IV. AREA OF OPERATION: TAKEOFFS, LANDINGS AND GO-AROUNDS
C. TASK: SOFT FIELD TAKEOFF AND CLIMB

OBJECTIVE
To determine that the applicant:
1. Exhibits knowledge of the elements related to soft-field takeoff and climb.
2. Positions the flight controls for existing wind conditions and to maximize lift as quickly as possible.
3. Clears the area; taxies onto the takeoff surface at a speed consistent with safety without stopping while advancing the throttle smoothly to takeoff power.
4. Establishes and maintains a pitch attitude that will transfer the weight of the airplane from the wheels to the wings as rapidly as possible.
5. Lifts off at the lowest possible airspeed and remains in ground effect while accelerating to V_X or V_Y, as appropriate.
6. Establishes a pitch attitude for V_X or V_Y, as appropriate, and maintains selected airspeed +10/-5 knots, during the climb.
7. Retracts the landing gear, if appropriate, and flaps after clear of any obstacles or as recommended by the manufacturer.
8. Maintains takeoff power and V_X or V_Y +10/-5 knots to a safe maneuvering altitude.
9. Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
10. Completes the appropriate checklist.

ELEMENTS
1. Know the recommended power / flap settings, V_X and V_Y from the POH / AFM.
2. Ensure flaps are extended to the recommended setting.
3. When taxiing a tricycle gear airplane, maintain full up elevator to transfer as much of the weight as possible to the main landing gear (unloading the nose gear).
4. Keep the airplane in continuous motion while lining up for the takeoff roll.
5. Apply full power smoothly and rapidly.
6. Get the nose gear off the ground as soon as possible and maintain a positive angle of attack during the takeoff roll by applying the appropriate elevator pressure.
7. Allow the airplane to fly itself off the ground and into ground effect.
8. Lower the nose gently to allow the airplane to accelerate to V_X in ground effect.
9. Climb at V_X to avoid obstacles then lower the nose and accelerate to V_Y.
10. If departing from an airstrip with wet snow or slush on the takeoff surface, do not retract the gear too soon – allow time for the gear to be air-dried.
11. Retract the gear (if equipped) and flaps (in increments) after the airplane is stabilized at V_Y.
12. At 500 feet AGL, reduce to normal recommended climb power or a recommended noise abatement power setting.
13. Lower the nose to a pitch attitude that will result in V_Y until reaching a safe altitude.
14. Complete the After Takeoff Checklist or the Climb Checklist.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Improper runway incursion avoidance procedures.
c. Insufficient back-elevator pressure during initial takeoff roll resulting in an inadequate angle of attack.
d. Failure to cross-check engine instruments for indications of proper operation after applying power.
e. Improper use of controls during a soft-field takeoff.
f. Poor directional control.
g. Improper liftoff procedures.
h. Abrupt and/of excessive elevator control while attempting to level off in ground effect and accelerate after liftoff.
i. Allowing the airplane to “mush” or settle resulting in an inadvertent touchdown after lift-off.
j. Attempting to climb out of ground effect area before attaining sufficient climb speed.
k. Climbing too steeply after reaching V_X.
l. Failure to anticipate an increase in pitch attitude as the airplane climbs out of ground effect.
m. Improper climb attitude, power setting, and airspeed (V_Y) or (V_X).
n. Improper use of checklist.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 5.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

D. TASK: SOFT FIELD APPROACH AND LANDING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to soft-field approach and landing.
2. Considers the wind conditions, landing surface and obstructions, and selects the most suitable touchdown area.
3. Establishes the recommended approach and landing configuration, and airspeed; adjusts pitch attitude and power as required.
4. Maintains a stabilized approach and recommended airspeed, or in its absence not more than 1.3 V_{SO}, +10/-5 knots, with gust factor applied.
5. Makes smooth, timely, and correct control application during the roundout and touchdown.
6. Touches down softly with no drift, and with the airplane's longitudinal axis aligned with the runway / landing path.
7. Maintains crosswind correction and direction control throughout the approach and landing sequence.
8. Maintains proper position of the flight controls and sufficient speed to taxi on the soft surface.
9. Completes the appropriate checklist.

ELEMENTS

1. Know the recommended power / flap settings, V_X and V_Y from the POH / AFM.
2. Complete the Before Landing Checklist.
3. Establish a stabilized approach.
4. Extend full flaps at least 500 feet AGL from the touchdown area.
5. Use power to level off in ground effect.
6. Hold the airplane 1 to 2 feet off the surface in ground effect as long as possible while slowing.
7. Touchdown gently at the lowest possible airspeed with the airplane in a nose-high pitch attitude.
8. Using back-elevator pressure and engine power gently transfer the weight of the airplane from the wings to the wheels.
9. In nosewheel-type airplanes, hold sufficient back-elevator pressure to keep the nosewheel off the surface as long as possible.
10. Gently lower the nosewheel when turning off the runway.
11. Avoid using brakes and stay in continuous motion while taxiing.
12. Complete the After Landing Checklist.

COMMON ERRORS

a. Improper use of landing performance data and limitations.
b. Failure to establish approach and landing configuration at proper time or in proper sequence.
c. Failure to establish and maintain a stabilized approach.
d. Excessive descent rate on final approach.
e. Excessive airspeed on final approach.
f. Failure to consider the effect of wind and landing surface.
g. Improper procedure in use of power, wing flaps, or trim.
h. Inappropriate removal of hand from throttle.
i. Improper procedure during roundout and touchdown.
j. Roundout too high above the runway surface.
k. Poor power management during roundout and touchdown.
l. Hard touchdown.
m. Inadequate control of the airplane weight transfer from wings to wheels after touchdown.
n. Failure to hold back elevator pressure after touchdown.
o. Closing the throttle too soon after touchdown.
p. Poor directional control after touchdown.
q. Allowing the nosewheel to “fall” to the runway after touchdown rather than controlling its descent.
r. Improper use of brakes.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 8.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

IV. AREA OF OPERATION: TAKEOFFS, LANDINGS AND GO-AROUNDS

E. TASK: SHORT-FIELD TAKEOFF (CONFINED AREA – ASES) AND MAXIMUM PERFORMANCE CLIMB

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to short-field (confined area – ASES) takeoff and maximum performance climb.
2. Positions the flight controls for the existing wind conditions; sets the flaps as recommended.
3. Clears the area; taxies into takeoff position utilizing maximum available takeoff area and aligns the airplane on the runway center / takeoff path.
4. Selects and appropriate take off path for the existing conditions (ASES).
5. Applies brakes (if appropriate), while advancing the throttle smoothly to takeoff power.
6. Establishes and maintains the most efficient planning / lift-off attitude and corrects for porpoising and skipping (ASES).
7. Lifts off at the recommended airspeed, and accelerates to the recommended obstacle clearance airspeed or V_X.
8. Establishes a pitch attitude that will maintain the recommended obstacle clearance airspeed, or V_X +10/-5 knots, until the obstacle is cleared, or until the airplane is 50 feet (20 meters) above the surface.
9. After clearing the obstacle, establishes the pitch attitude for V_Y, accelerates to V_Y, and maintains V_Y +10/-5 knots, during the climb.
10. Retracts the landing gear, if appropriate, and flaps after clear of any obstacles or as recommended by the manufacturer.
11. Maintains takeoff power and V_Y +10/-5 knots to a safe maneuvering altitude.
12. Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
13. Completes the appropriate checklist.

ELEMENTS

1. Know the recommended power / flap settings, V_X and V_Y from the POH / AFM.
2. Ensure flaps are extended to the recommended setting.
3. Begin the takeoff roll from the very beginning of the takeoff area, aligned with the takeoff path.
4. Hold the brakes until the maximum obtainable engine RPM is achieved before takeoff run.
5. Release the brakes and accelerate, keeping neutral elevator control in nosewheel-type airplanes (resulting in lowest drag and quickest acceleration). Avoid application of down elevator to keep the nosewheel on the runway since this may result in "wheelbarrowing."
6. Apply back pressure and rotate at the recommended V_R speed. If the airplane begins lifting off prior to V_R due to ground effect, reduce pitch attitude to level and remain in ground effect until V_X is attained.
7. Lift-off smoothly and firmly to a pitch attitude that will result in V_X.
8. Maintain a wings-level climb at V_X until obstacles have been cleared or 50-feet AGL.
9. Lower the nose to a pitch attitude that will result in V_Y until reaching a safe altitude.
10. Retract the gear (if equipped) and flaps (in increments) after the airplane is stabilized at V_Y.
11. At 500 feet AGL, reduce to normal recommended climb power or a recommended noise abatement power setting.
12. Lower the nose to a pitch attitude that will result in V_Y until reaching a safe altitude.
13. Complete the After Takeoff Checklist or the Climb Checklist.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Improper runway incursion avoidance procedures.
c. Failure to use all available runway / takeoff area.
d. Failure to have the airplane properly trimmed prior to takeoff.
e. Improper use of controls during a short-field takeoff.
f. Improper lift-off procedures.
g. Premature lift-off resulting in high drag.
h. Holding the airplane on the ground unnecessarily with excessive forward elevator pressure.
i. Inadequate rotation resulting in excessive speed after lift-off.
j. Improper initial climb attitude, power setting, and airspeed (V_X) to clear obstacle.
k. Inability to attain / maintain best angle of climb airspeed (V_X).
l. Improper use of checklist.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 5.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

IV. AREA OF OPERATION: TAKEOFFS, LANDINGS AND GO-AROUNDS

F. TASK: SHORT-FIELD APPROACH (CONFINED AREA – ASES) AND LANDING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to short-field (confined area – ASES) approach and landing.
2. Adequately surveys the intended landing area (ASES).
3. Considers the wind conditions, landing surface, obstructions, and selects the most suitable touchdown point.
4. Establishes the recommended approach and landing configuration and airspeed; adjusts pitch attitude and power as required.
5. Maintains a stabilized approach and recommended approach airspeed, or in its absence not more than 1.3 V_{SO} +10/-5 knots, with wind gust factor applied.
6. Makes smooth, timely and correct control application during the roundout and touchdown.
7. Selects the proper landing path, contacts the water at the minimum safe airspeed with the proper pitch attitude for the surface conditions (ASES).
8. Touches down smoothly at minimum control airspeed (ASEL).
9. Touches down at or within 200 feet (60 meters) beyond a specified point, with no side drift, minimum float and with the airplane's longitudinal axis aligned with and over the runway center / landing path.
10. Maintains crosswind correction and directional control throughout the approach and landing sequence.
11. Applied brakes (ASEL), or elevator control (ASES), as necessary, to stop in the shortest distance consistent with safety.
12. Completes the appropriate checklist.

ELEMENTS

1. Know the recommended power / flap settings, V_X and V_Y from the POH / AFM.
2. Complete the Before Landing Checklist.
3. Establish a stabilized approach.
4. Extend full flaps at least 500 feet AGL from the touchdown area.
5. Fly a wider-than-normal pattern in order to get the airplane properly configured and trimmed.
6. Fly the manufacturer's recommended approach speed, or 1.3 VSO if not provided.
7. In gusty conditions, no more than one-half the gust factor (gust speed minus steady wind speed) should be added.
8. Simultaneously make minor adjustments to power and pitch attitude to establish proper angle of descent at the recommended airspeed to the recommended aiming point.
9. Avoid allowing slow airspeed and high power to put the airplane in the region of reverse command (back side of the power curve).
10. Roundout and flare for touchdown at the recommended aiming point – proper short field approach airspeed will ensure the airplane will not fly into the ground or stall prematurely.
11. Touchdown at the minimum controllable airspeed with the airplane at the pitch attitude that will result in a power-off stall when the throttle is closed.
12. After touchdown, hold the airplane in the positive pitch attitude as long as the elevators remain effective. This aerodynamic braking assists in deceleration.
13. Apply appropriate braking to minimize the after landing roll.
14. Stop within the shortest possible distance consistent with safety and controllability.
15. Complete the After Landing Checklist.

COMMON ERRORS

a. Improper use of landing performance data and limitations.
b. Failure to establish approach and landing configuration at appropriate time or in proper sequence.
c. Failure to allow enough room on final to set up the approach, necessitating an overly steep approach and high sink rate.
d. Failure to establish and maintain a stabilized approach.
e. Undue delay in initiating glidepath corrections.
f. Improper procedure in use of power, wing flaps, and trim.
g. Inappropriate removal of hand from throttle.
h. Improper procedure during roundout and touchdown.
i. Too low an airspeed on final resulting in an inability to flare properly and landing hard.
j. Too high an airspeed resulting in floating on roundout.
k. Prematurely reducing power to idle on roundout resulting in landing hard.
l. Touchdown with excessive airspeed
m. Poor directional control after touchdown.
n. Excessive and/or unnecessary braking after touchdown.
o. Failure to maintain directional control.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 8.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
IV. AREA OF OPERATION: TAKEOFFS, LANDINGS AND GO-AROUNDS
K. TASK: FORWARD SLIP TO A LANDING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to a forward slip to a landing.
2. Considers the wind conditions, landing surface, obstructions, and selects the most suitable touchdown point.
3. Establishes the slipping attitude at a point from which a landing can be made using the recommended approach and landing configuration and airspeed; adjusts pitch attitude and power as required.
4. Maintains a ground track aligned with the runway center / landing path and an airspeed, which results in minimum float during the roundout.
5. Makes smooth, timely, and correct control application during the recovery from the slip, the roundout and the touchdown.
6. Touches down smoothly at the approximate stalling speed, at or within 400 feet (120 meters) beyond a specified point, with no side drift, and with the airplane's longitudinal axis aligned with and over the runway center / landing path.
7. Maintains crosswind correction and directional control throughout the approach and landing sequence.
8. Completes the appropriate checklist.

ELEMENTS

1. Slips result from intentionally cross-controlled rudder / aileron deflections. Slips can be very useful for dissipating altitude on final approach without increasing airspeed and/or adjusting a ground track during a crosswind.
2. An airplane in a slip is flying partially sideways, experiencing a relative wind striking the side of the fuselage and producing more drag than usual.
3. A slip is entered by lowering a wing and applying enough opposite rudder to prevent a turn. Rate of sideward movement (slip) and sink is determined by the amount of bank (balanced with opposite rudder).
4. Side slip:
    a. The airplane no longer flies straight ahead. Instead, the airplane moves sideways toward the low wing.
    b. The airplane's longitudinal axis does not change angle.
5. Forward slip:
    a. The airplane remains on the original ground track.
    b. The airplane's longitudinal axis is at an angle to its original flightpath.
6. The amount of slip is limited by the amount of rudder authority (which can be increased with higher airspeed). This is called the practical slip limit.
7. The wing-low landing technique is a combination of a side slip (longitudinal axis does not change) and a forward slip (the airplane remains on the original ground track).

COMMON ERRORS

a. Improper use of landing performance data and limitations.
b. Failure to establish approach and landing configuration at appropriate time or in proper sequence.
c. Failure to maintain stabilized slip.
d. Inappropriate removal of hand from throttle.
e. Improper procedure during transition from the slip to the touchdown.
f. Poor directional control after touchdown.
g. Improper use of brakes (ASEL).

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 8.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

L. TASK: GO-AROUND / REJECTED LANDING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to a go-around / rejected landing.
2. Makes a timely decision to discontinue the approach to landing.
3. Applies takeoff power immediately and transitions to climb pitch attitude or V_Y, and maintains V_Y +10/-5 knots.
4. Retracts the flaps as appropriate.
5. Retracts the landing gear, if appropriate, after a positive rate of climb is established.
6. Maneuvers to the side of the runway / landing area to clear and avoid other traffic.
7. Maintains takeoff power V_Y +10/-5 knots to a safe maneuvering altitude.
8. Maintains directional control and proper wind-drift correction throughout the climb.
9. Completes the appropriate checklist.

ELEMENTS

1. Whenever landing conditions are not satisfactory, a go-around is warranted.
2. Know the recommended flap settings and speeds from the POH / AFM.
3. Either the pilot or a tower controller can call for a go-around for reasons such as:
   a. Unexpected appearance of hazards on the runway.
   b. Overtaking another airplane.
   c. Wind shear.
   d. Wake turbulence.
   e. Mechanical failure.
   f. Unstabilized approach.
   g. Any other reason determined by the pilot or tower controller.
   h. Practice (prior permission from tower controller is courteous).
4. The go-around is a normal maneuver that can be used under normal conditions or in an emergency situation.
5. The three cardinal principles of the procedure are power, attitude and configuration.
6. Power:
   a. Apply full or maximum allowable takeoff power smoothly and without hesitation the instant a go-around decision is made.
   b. The airplane's downward inertia must be overcome before a climb may take place, requiring more power and time than a takeoff.
7. Attitude:
   a. A pitch attitude must be maintained that will permit a buildup of airspeed well beyond the stall point before any effort is made to gain altitude or turn.
   b. In some situations, it may be desirable to lower the nose briefly to gain airspeed.
8. Configuration:
   a. After full power is applied, the go-around attitude is set and the descent is halted, the flaps may be partially retracted or placed in the takeoff position as recommended by the manufacturer.
   b. Raising flaps in increments will allow the airplane to accelerate after each flap setting.
   c. Additional right rudder will be needed to counteract torque and P-factor.
   d. Trim should be applied to relieve adverse control pressures.
   e. Landing gear should be retracted only after trimming and when it is certain the airplane will remain airborne.

COMMON ERRORS

a. Failure to recognize a situation where a go-around / rejected landing is necessary.
b. Not knowing the hazards of delaying a decision to go-around / reject landing.
c. Improper power application.
d. Failure to control pitch attitude.
e. Failure to compensate for torque effect.
f. Improper trim procedure.
g. Failure to maintain recommended airspeeds.
h. Improper wing flaps or landing gear retraction procedure.
i. Failure to maintain proper track during climb-out.
j. Failure to remain well clear of obstructions or other traffic.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 8.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
V. AREA OF OPERATION: PERFORMANCE MANEUVER
TASK: STEEP TURNS

OBJECTIVE
To determine that the applicant:
1. Exhibits knowledge of the elements related to steep turns.
2. Establishes the manufacturer's recommended airspeed or if one is not stated, a safe airspeed not to exceed V_A.
3. Rolls into a coordinated 360° turn; maintains a 45° bank.
4. Performs the task in the opposite direction, as specified by the examiner.
5. Divides attention between airplane control and orientation.
6. Maintains the entry altitude +/-100 feet (30 meters), airspeed +/-10 knots, bank +/-5°, and rolls out on the entry heading +/-10°.

ELEMENTS
1. A steep turn is a maximum performance turn when the airplane is near its performance limits.
2. The bank beyond 45° causes an overbanking tendency during which maximum turning performance is attained.
3. Because of high loads, steep turns should not be flown at any airspeed over V_A.
4. Steep turn performance limits (fastest rate or turn and smallest radius of turn) are determined by available engine power, limit load factor and aerodynamic characteristics.
5. A coordinated angle of bank produces the same load factor regardless of airspeed, but a faster airspeed will result in a larger radius of turn.
6. Clear the area of traffic before starting a steep turn.
7. Establish the manufacturer's recommended entry speed.
8. Roll into a bank of 45° and simultaneously increase back-elevator pressure (to offset the increased load and the loss of vertical lift to horizontal lift) and power (to offset the increase in drag).
9. To maintain altitude and orientation, refer to the relative position of the nose, the horizon, the wings and the amount of bank.
10. Altitude and speed changes can be neutralized by adjusting the amount of back-elevator pressure and power.
11. A small increase or decrease of 1° to 3° of bank angle may be used to control small altitude deviations.
12. The rollout should be timed to end the turn in a full 360° turn. Half the bank angle of 45° = 22.5°. Start the rollout 22.5° from the entry heading.

COMMON ERRORS
a. Failure to adequately clear the area.
b. Improper pitch, bank, and power coordination during entry and rollout.
c. Attempts to start recovery prematurely.
d. Uncoordinated use of flight controls.
e. Inadequate power management.
f. Inadequate airspeed control.
g. Poor coordination.
h. Gaining altitude in right turns and/or losing altitude in left turns.
i. Failure to maintain constant bank angle.
j. Attempting to perform the maneuver by instrument reference rather than visual reference.
k. Improper procedure in correcting altitude deviations.
l. Excessive rudder during recovery, resulting in skidding.
m. Failure to stop the turn on a precise heading.
n. Loss of orientation.

REFERENCES
1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 9.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
VI. AREA OF OPERATION: GROUND REFERENCE MANEUVERS
A. TASK: RECTANGULAR COURSE

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to a rectangular course.
2. Selects a suitable reference area.
3. Plans the maneuver so as to enter a left or right pattern, 600 to 1000 feet AGL (180 to 300 meters) at an appropriate distance from the selected reference area, 45° to the downwind leg.
4. Applies adequate wind-drift correction during straight-and-turning flight to maintain a constant ground track around the rectangular reference area.
5. Divides attention between airplane control and the ground track while maintaining coordinated flight.
6. Maintains altitude +/-100 feet (30 meters), and maintains airspeed +/-10 knots.

ELEMENTS

1. The maneuver simulates the conditions encountered in an airport traffic pattern.
2. Altitude and airspeed should be held constant.
3. Develops division of attention.
4. Develops ability to recognize drifts toward or away from an airport runway during the various legs of the airport traffic pattern.
5. Select a square or rectangular field with sides about one mile in length (roads work well).
6. Fly to the outside of the rectangle field boundaries by ¼ to ½ mile. This aids visibility.
7. All turns should be started when the airplane is abeam the corner of the field boundaries.
8. Bank normally should not exceed 45°.
9. Choose the downwind leg to be with the wind (tailwind) and the upwind leg to be against the wind (headwind).
10. Enter the downwind leg from a 45° angle (a standard traffic pattern entry).
11. The tailwind results in the maximum groundspeed on the downwind leg, so the turn to the base leg is with the fastest roll rate and steepest bank. As the turn progresses, gradually reduce the bank angle.
12. To compensate for drift, make the turn to the base leg more than 90° (the airplane will be turned slightly toward the field).
13. The side wind results in decreasing groundspeed on the base leg, so the turn to the upwind leg is with a medium roll rate and medium bank. As the turn progresses, gradually reduce the bank angle.
14. The headwind results in the minimum groundspeed on the upwind leg, so the turn to the crosswind leg is with the slowest roll rate and shallowest bank. As the turn progresses, gradually increase the bank angle.
15. To compensate for drift, make the turn to the base leg less than 90° (the airplane will be turned slightly away the field).
16. The side wind results in increasing groundspeed on the upwind leg, so the turn to the downwind leg is with a medium roll rate and medium bank. As the turn progresses, gradually increase the bank angle.

NOTE: Since the selected rectangular field will not be exactly lined up with the wind, small crab angles on the downwind and upwind legs will also be needed.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Failure to establish proper altitude prior to entry (typically entering the maneuver while descending).
c. Poor planning, orientation, or division of attention.
d. Failure to establish appropriate wind correction angle resulting in drift.
e. Uncoordinated flight control application.
f. Poor coordination (typically skidding in turns from a downwind heading and slipping in turns from an upwind heading).
g. Abrupt control usage.
h. Failure to maintain selected altitude or airspeed.
i. Inability to adequately divide attention between airplane control and maintaining ground track.
j. Improper timing in beginning and recovering from turns.
k. Inadequate visual lookout for other aircraft.
l. Selection of a ground reference where there is no suitable emergency landing area within gliding distance.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 6.

PRIVATE PILOT

VI. AREA OF OPERATION: GROUND REFERENCE MANEUVERS
B. TASK: S-TURNS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to S-turns.
2. Selects a suitable ground reference line.
3. Plans the maneuver so as to enter at 600 to 1000 feet (180 to 300 meters) AGL, perpendicular to the selected reference line.
4. Applies adequate wind-drift correction to track a constant radius turn on each side of the selected reference line.
5. Reverses the direction of turn directly over the selected reference line.
6. Divides attention between airplane control and the ground track while maintaining coordinated flight.
7. Maintains altitude +/-100 feet (30 meters), and maintains airspeed +/-10 knots.

ELEMENTS

1. The airplane's ground track should describe semicircles of equal radii on each side of a selected straight line on the ground by correcting for changing wind drift in turns.
2. Select straight ground reference line that lies 90° to the wind direction.
3. Approach from the upwind side, at selected altitude, on a downwind heading (fastest groundspeed for the airspeed flown).
4. When crossing the reference line, start the turn.
5. Roll rate and bank angle should be the greatest during the first turn since the groundspeed (and the rate of departure from the reference line) is the greatest.
6. Reduce the bank angle as the 180° turn is flown, arriving at a minimum bank angle (at the minimum groundspeed) when over the reference line.
7. Once over the reference line, start the turn in the opposite direction.
8. Roll rate and bank angle should be the least during the second turn since the groundspeed (and the rate of departure from the reference line) is the least.
9. Increase the bank angle as the opposite 180° turn is flown, arriving at a maximum bank angle (at the maximum groundspeed) when over the reference line.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Faulty entry procedure.
c. Poor planning, orientation, or division of attention.
d. Poor coordination.
e. Poor timing in beginning and recovering from turns.
f. Uncoordinated flight control application.
g. Improper correction for wind drift.
h. An unsymmetrical ground track.
i. Failure to maintain selected altitude or airspeed.
j. Inadequate visual lookout for other aircraft.
k. Selection of a ground reference line where there is no suitable emergency landing area within gliding distance.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 6.

PRIVATE PILOT
VI. AREA OF OPERATION: GROUND REFERENCE MANEUVERS
C. TASK: TURNS AROUND A POINT

OBJECTIVE
To determine that the applicant:
1. Exhibits knowledge of the elements related to turns around a point.
2. Selects a suitable ground reference point.
3. Plans the maneuver so as to enter left or right at 600 to 1000 feet (180 to 300 meters) AGL, at an appropriate distance from the reference point.
4. Applies adequate wind-drift correction to track a constant radius turn around the selected reference point.
5. Divides attention between airplane control and the ground track while maintaining coordinated flight.
6. Maintains altitude +/-100 feet (30 meters), and maintains airspeed +/-10 knots.

ELEMENTS
1. The airplane's ground track should describe a circle of uniform radius by correcting for changing wind drift while turning.
2. Essentially the same as S-turns with the opposite 180° turn now in the same direction as the first.
3. Select a small but prominent point.
4. Approach abeam the point from the upwind side, at selected altitude, on a downwind heading (fastest groundspeed for the airspeed flown).
5. When abeam, start the turn around the point.
6. Roll rate and bank angle should be the greatest when starting the downwind half-circle since the groundspeed is the greatest.
7. Reduce the bank angle as the downwind half-circle is flown, arriving at a minimum bank angle (at the minimum groundspeed) after 180° when ending the downwind half-circle and beginning the upwind half-circle.
8. Increase the bank angle as the upwind half-circle is flown, arriving again at a maximum bank angle (at the maximum groundspeed) after another 180° when ending the upwind half-circle and beginning another downwind half-circle.

COMMON ERRORS
a. Failure to adequately clear the area.
b. Faulty entry procedure.
c. Failure to establish appropriate bank on entry.
d. Failure to recognize wind drift.
e. Poor planning, orientation, or division of attention.
f. Excessive bank and/or inadequate wind correction angle on the downwind side of the circle resulting in drift towards the reference point.
g. Uncoordinated flight control application.
h. Inadequate bank angle and/or excessive wind correction angle on the upwind side of the circle resulting in drift away from the reference point.
i. Failure to maintain selected altitude or airspeed.
j. Skidding turns when turning from downwind to crosswind.
k. Slipping turns when turning from upwind to crosswind.
l. Inadequate visual lookout for other aircraft.
m. Inability to direct attention outside the airplane while maintaining precise airplane control.
n. Selection of a ground reference point where there is no suitable emergency landing area within gliding distance.

REFERENCES
1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 6.

PRIVATE PILOT

VII. AREA OF OPERATION: NAVIGATION
A. TASK: PILOTAGE AND DEAD RECKONING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to pilotage and dead reckoning.
2. Follows the preplanned course by reference to landmarks.
3. Identifies landmarks by relating surface features to chart symbols.
4. Navigates by means of pre-computed headings, groundspeeds and elapsed time.
5. Corrects for and records the difference between preflight groundspeed and heading calculations and those determined en route.
6. Verifies the airplane's position within three (3) nautical miles of the pre-planned route.
7. Arrives at the en route checkpoints within five (5) minutes of the initial or revised ETA and provides a destination estimate.
8. Maintains the appropriate altitude, +/-200 feet (60 meters), and headings, +/-15°.

ELEMENTS

1. Pilotage is navigation by reference to landmarks or checkpoints.
    a. Can be used on any course that has adequate checkpoints.
    b. Commonly used in conjunction with dead reckoning and VFR radio navigation.
    c. The checkpoints selected should be prominent features such as towns, airports, water masses, unique geological features, etc.
    d. Never place complete reliance on any single checkpoint.
    e. Choose ample checkpoints for the airplane to be flown:
        i. Consider airplane's groundspeed.
        ii. Consider scale of sectional charts: 1" = ~8 sm = ~7 nm.
    f. If a checkpoint is missed, look for the next one while maintaining heading.
    g. Only well-traveled roads are shown on charts.
    h. Some structures, like antennas, while tall, can be difficult to see.
    i. Sometimes TV antennas are grouped together in an area near a town.
    j. Never approach an area of antennas less than 500' above the tallest one.
    k. Most tall structures are marked with strobe lights making them more visible to pilots.
    l. Aeronautical charts display the best information available at the time of printing, but a pilot should be cautious for new structures or changes that have occurred since the chart was printed (6 months pass between updates). NOTAM's can be helpful in visualizing major changes to charts.
2. Dead reckoning is navigation solely by means of computations based on time, airspeed, distance, and direction.
    a. Inputs are time, airspeed, distance and direction.
    b. Inputs are adjusted for windspeed and wind direction.
    c. Outputs are heading and groundspeed.
    d. The predicted heading will guide the airplane along the intended path and the groundspeed will establish the time to arrive at each checkpoint.
    e. Dead reckoning is usually used in conjunction with pilotage for cross-country flights.
    f. The heading groundspeed as calculated are constantly monitored and corrected by pilotage as observed from checkpoints.
3. The wind triangle or vector analysis.
    a. With no wind, true course (TC) = true heading (TH), and groundspeed (GS) = true airspeed (TAS).
    b. With wind, TC and GS are found be the vector addition of wind velocity (speed and direction) and airplane velocity (TAS and TH).
    c. This vector addition can be accomplished using a flight computer or a wind triangle.
    d. A wind triangle is a graphic explanation of the effect of wind on flight.
    e. Experienced pilots are so familiar with the wind triangle concept that the diagram can be visualized mentally to the accuracy needed for visual flight

4. Definitions related to pilotage and dead reckoning:
    a. True course (TC): Direction of the line connecting two desired points, drawn on the aeronautical chart and measured clockwise in degrees from true north.
    b. Wind correction angle (WCA): Determined from the flight computer or wind triangle (added to TC if the wind is from the right, subtracted if the wind is from the left).
    c. True heading (TH): The direction measured in degrees clockwise from true north, in which the nose of the airplane should point to fly the TC. TH = TC +/- WCA.
    d. Variation (VAR): The difference in angle between the direction to the true North Pole and the magnetic North Pole. Obtained from the isogonic lines on an aeronautical chart (added to TH if west, subtracted from TH if east).
    e. Magnetic heading (MH): The direction measured in degrees clockwise from magnetic north, in which the nose of the airplane should point to fly the TC. MH = TH +/- VAR.
    f. Deviation (DEV): The difference between actual magnetic heading and the magnetic heading indicated on the compass resulting from interference by the airplane's structure and electromagnetic fields. Obtained from the deviation card on the airplane compass (usually compiled with radios on). "For 180°, steer 178°," DEV = -2.
    g. Compass heading (CH): The reading on the compass (found by applying DEV to MH) to be followed to fly the TC. CH = MH +/- DEV.
    h. Total distance: Obtained by measuring the length of the TC line on the aeronautical chart (using the scale at the bottom of the chart or a plotter).
    i. Groundspeed: Obtained by measuring the length of the TC line on the wind triangle (using the scale employed for drawing the diagram).
    j. Estimated time en route (ETE): Total distance divided by groundspeed.
    k. Fuel rate: Predetermined gallons per hour used at cruising speed.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 14.

PRIVATE PILOT
VII. AREA OF OPERATION: NAVIGATION
B. TASK: NAVIGATION SYSTEMS AND RADAR SERVICES

OBJECTIVE
To determine that the applicant:
1. Exhibits knowledge of the elements related to navigation systems and radar services.
2. Demonstrates the ability to use an airborne electronic navigation system.
3. Locates the airplane's position using the navigation system.
4. Intercepts and tracks a given course, radial or bearing, as appropriate.
5. Recognizes and describes the indication of station passage, if appropriate.
6. Recognizes signal loss and takes appropriate action.
7. Uses proper communication procedures when utilizing radar services.
8. Maintains the appropriate altitude, +/-200 feet (60 meters), and headings, +/-15°.

ELEMENTS
1. Advances in radio navigation allow pilots to determine their exact position and to navigate almost anywhere with precision.
2. Beginning pilots should use this equipment to supplement navigation by visual reference to the ground – the use of pilotage will safeguard against disorientation in the event of a navigation radio malfunction.
3. There are four radio navigation systems available for VFR navigation:
    a. VHF Omnidirectional Range (VOR).
    b. Nondirectional Radiobeacon (NDB).
    c. Long Range Navigation (LORAN-C).
    d. Global Positioning System (GPS).
4. Very High Frequency (VHF) Omnidirectional Range (VOR) Station and VOR Receiver:
    a. Three types:
        i. VOR.
        ii. VOR/DME (VOR with distance measuring equipment, or DME)
        iii. VORTAC (VOR with military tactical air navigation, or TACAN).
    b. Provides magnetic bearing (in degrees) to and from the VOR station.
    c. VOR/DME and VORTAC stations provide distance from the station.
    d. Line courses based on magnetic north, or radials, are projected from the station.
    e. A compass rose is superimposed on aeronautical charts at the station location.
    f. VOR stations use the very high frequency (VHF) band of 108.0 - 117.95 MHz.
    g. Reception of signal is subject to line-of-sight restrictions.
    h. Three classes based on power: T (terminal), L (low altitude), and H (high altitude).
    i. Normal usable altitudes and radius distances:
        i. T: (12,000' and below) 25 nm.
        ii. L: (below 18,000') 40 nm
        iii. H: (below 14,500') 40nm, (14,500–17,999) 100nm, (18,000-FL450) 130, (FL450-FL600) 100.
    j. The accuracy is generally +/- 1°.
    k. The station is identified via transmitted Morse code or recorded voice identification.
    l. If the station is out of service for maintenance, the coded identifier is removed.
    m. The VOR receiver includes an alarm flag to indicate weak or no signal reception.
    n. The VOR receiver also includes:
        i. A rotating omnibearing selector (OBS) knob.
        ii. A course deviation indicator (CDI) needle (left-right needle).
        iii. TO - FROM indicator flags.
    o. The OBS is rotated to select a radial ("FROM" the station) or course ("TO" the station).
    p. Moving the OBS rotates the face of the instrument and moves the CDI needle to indicate the position of the course or radial relative to the airplane.
    q. If centered, the CDI will move off-center if the airplane drifts off the course or radial.
    r. If flying to the station with a "TO" indication or from the station with a "FROM" indication, a corrective turn toward the CDI will get back on the course or radial.

   s. Station passage is indicated by the "TO" flag changing to a "FROM" flag.
   t. If flying to the station with a "FROM" indication or from the station with a "TO" indication, the instrument will exhibit reverse-sensing:
      i. Flying away from the deflected needle will turn toward the course or radial.
      ii. Flying toward the deflected needle will turn away from the course or radial.
      iii. To remedy reverse-sensing, turn the OBS 180°.
   u. Distance measuring equipment (DME) uses the ultra high frequency (UHF) band.
   v. DME measures the nautical mile slant range distance from the station to the airplane.
   w. The DME signal is also identified via transmitted Morse code identification.
   x. Most DME receivers also provide groundspeed and time-to-station features.
5. Nondirectional Radiobeacon (NDB) Station and Automatic Direction Finder (ADF) Receiver:
   a. The pilot can tune an ADF receiver to an NDB frequency.
   b. An NDB marker is superimposed on aeronautical charts at the station location.
   c. NDB stations use the low to medium frequency band of 200 - 415 kHz.
   d. The lower frequency band is not limited by line-of-sight - signals follow the curvature of the Earth, but are susceptible to atmospheric disturbances. Reception distances:
      i. "Compass Locator" NDB's (under 25 watts) reception is about 15nm.
      ii. "MH" NDB's (under 50 watts) reception is about 25 nm.
      iii. "H" NDB's (50-1999 watts) reception is about 50 nm.
      iv. "HH" NDB's (2000 watts or more) reception is about 50 nm.
   e. The NDB station is identified via transmitted Morse code identification.
   f. Standard broadcast AM radio stations (KOMO, KVI, etc.) can also be received.
   g. Relative bearing (RB) to the station = value indicated by the needle (relative to airplane).
   h. Magnetic bearing (MB) to the station = magnetic heading (MH) + relative bearing (RB).
   i. Magnetic bearing (MB) from the station = magnetic bearing (MB) to the station +/- 180°.
6. Long Range Navigation (LORAN-C):
   a. LORAN-C operates from chains of LF transmitters maintained by the U.S. Coast Guard.
   b. Aeronautical charts do not show the location of LORAN stations.
   c. LORAN transmitters are scheduled to be decommissioned.
7. Global Position System (GPS):
   a. GPS is a satellite-based radio navigation system with global coverage.
   b. Composed of three major elements:
      i. Space segment: 26 satellites orbiting 10,900 nm above the Earth.
         1. Each GPS constellation satellite orbits once every 12 hours.
         2. Satellites contain highly stable atomic clocks.
         3. Each satellite transmits a unique code and navigation message.
         4. To be usable for navigation, satellites must be above the horizon.
      ii. Control segment: Master control station at Falcon AFB, Colorado.
         1. Augmented with five monitor stations and three ground antennas distributed around the Earth.
         2. Updates and corrections are uplinked to satellites via ground stations.
      iii. User segment: The GPS receiver
         1. Can be panel-mounted or hand-held.
         2. Receiver matches the satellite signal by shifting its own identical signal in a matching process, precisely measuring the time and thus distance.
   c. Receivers use at least four of the best-positioned satellites to yield a 3-dimensional fix.
   d. After selecting a destination, a GPS unit can provide a direct route and track progress.
   e. Not all GPS receivers are suitable for use in aviation.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 14.
2. Navigation Equipment Operations Manuals.
3. AIM, Aeronautical Information Manual.

PRIVATE PILOT

VII. AREA OF OPERATION: NAVIGATION

C. TASK: DIVERSION

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to diversion.
2. Selects an appropriate alternate airport and route.
3. Makes and accurate estimate of heading, groundspeed, arrival time, and fuel consumption to the alternate airport.
4. Maintains the appropriate altitude, +/-200 feet (60 meters), and heading, +/-15°.

ELEMENTS

1. If a pilot flies long enough, a diversion from a planned destination is inevitable.
2. The causes for diversions include unpredicted weather conditions, system malfunctions and poor pre-flight planning.
3. When situations warrant, a pilot must be able to safely and efficiently divert to an alternate destination.
4. Included in the pre-flight planning should be a check for:
    a. Airports or suitable landing areas near the planned route of flight.
    b. Navigational aids that can be used during a diversion.
5. Alternate airports and navigational aids should be used to execute a diversion.
6. Rough calculations should be used (relative to the detailed flight-planning methods used during the pre-flight planning) while flying the airplane and scanning for other traffic.
7. Consider the terrain before deciding on an alternate – the closest field might not be the safest.
8. The magnetic course to an alternate can be approximated using a straightedge (or finger) and a compass rose superimposed on an aeronautical chart.
9. After the final alternate selection, approximate the magnetic course to the alternate.
10. In an emergency, turn the airplane onto the approximated magnetic course immediately.
11. In a non-emergency with time available, try to start the diversion over a prominent ground feature.
12. Once established on course, note the location and time of diversion.
13. Use the winds aloft nearest the point of diversion to make rule-of-thumb adjustments to heading and groundspeed.
14. Using the new groundspeed, determine the arrival time to the alternate and the fuel consumption required.
15. Give priority to flying the airplane and scanning for traffic while diverting.
16. When determining an altitude to use while diverting, consider cloud heights, winds, terrain and radio reception.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot’s Handbook of Aeronautical Knowledge, Chapter 14.
2. AIM, Aeronautical Information Manual.

PRIVATE PILOT
VII. AREA OF OPERATION: NAVIGATION
D. TASK: LOST PROCEDURES

OBJECTIVE

To determine that the applicant:
1. Exhibits knowledge of the elements related to lost procedures.
2. Selects an appropriate course of action.
3. Maintains an appropriate heading and climbs, if necessary.
4. Identifies prominent landmarks.
5. Uses navigation systems / facilities and/or contacts an ATC facility for assistance, as appropriate.

ELEMENTS

1. Getting lost in an airplane is potentially dangerous, especially if low on fuel.
2. If a town or city cannot be seen, establish a climb (being mindful of traffic and weather).
3. Greater altitude widens the horizon and increases radio and navigation reception range.
4. If the airplane has VOR and/or ADF receivers, the airplane position can be determined by plotting a magnetic course from two or more navigational facilities.
5. If GPS is installed or on board, it can be used to find the airplane position and the location of the nearest airport.
6. A pilot can communicate with any available facility using frequencies shown on an aeronautical chart.
7. If contact is made with a controller, radar vectors can be offered or requested. The airplane is seen on the controller’s scope by either secondary radar (using the airplane’s transponder) or primary radar (using a beam reflected off the airplane).
8. If the situation becomes threatening, transmit the situation on the emergency frequency 121.5 MHz and set the transponder to 7700. Most facilities, and even airliners, monitor the emergency (or “guard”) frequency.

REFERENCES

1. AC 61-23 / FAA-H-8083-25, Pilot’s Handbook of Aeronautical Knowledge, Chapter 14.
2. AIM, Aeronautical Information Manual.

A. TASK: MANEUVERING DURING SLOW FLIGHT

OBJECTIVE

To determine that the applicant:
1. Exhibits knowledge of the elements related to maneuvering during slow flight.
2. Selects and entry altitude that will allow the task to be completed no lower than 1,500 feet (460 meters) AGL.
3. Establishes and maintains an airspeed at which any further increase in angle of attack, increase in load factor, or reduction in power, would result in an immediate stall.
4. Accomplishes coordinated straight-and-level flight, turns, climbs, and descents with landing gear and flap configurations specified by the examiner.
5. Divides attention between airplane control and orientation.
6. Maintains the specified altitude +/-100 feet (30 meters), specified heading +/-10°, airspeed +10/-0 knots, and specified angle of bank +/-10°.

ELEMENTS

1. A certain minimum airspeed is required to maintain lift and control of an airplane, and is dependent on factors such as gross weight, load factors, and existing density altitude.
2. Minimum controllable airspeed: A speed at which any further increase in angle of attack or load factor, or reduction in power will cause an immediate stall.
3. Slow flight results in sloppy controls, ragged response to control inputs and difficulty in maintaining altitude.
4. Maneuvering at minimum controllable airspeed should be performed using both instrument indications (especially the ASI) and outside reference.
5. A “feel” for the airplane at very low airspeeds must be developed to avoid inadvertent stalls and to operate the airplane with precision.
6. Transition from cruise to minimum controllable airspeed:
    a. Gradually reduce the throttle from cruise power.
    b. While airspeed decreases, raise the nose to maintain altitude.
    c. After reaching V_{LOE}, extend the landing gear and perform gear down checks.
    d. After reaching V_{FE}, extend the full flaps allowable.
    e. Adjust pitch attitude to maintain altitude (especially during flap extension).
    f. Approaching V_{SO}, increase power to that required for minimum controllable airspeed.
    g. Note the elevator feel and the sound of the reduced airflow around the airplane.
    h. Note the increased need for right rudder to counter left turning tendencies.
    i. Retrim the airplane as often as necessary to compensate for control pressure changes.
7. Maintaining minimum controllable airspeed:
    a. Continually cross-check the AI, altimeter and ASI as well as outside references.
    b. Flight slower than the minimum drag airspeed (maximum lift-to-drag ratio, L/D_{MAX}) results in “speed instability,” causing further reductions of airspeed with even slight turbulence.
    c. As airspeed reduces slower than L/D_{MAX}, drag increases and further exacerbates airspeed reduction unless additional power is applied (or the nose is lowered).
    d. Flight slower than L/D_{MAX} is in the “area of reverse command” (slower airspeed requires more power, faster airspeed requires less power) or “behind the power curve.”
    e. Unless more power is applied (or the nose lowered) after entering the area of reverse command, the airspeed will continue to decay and the airplane will stall.
    f. During turns, power and pitch need to be increased to maintain altitude at the minimum controllable airspeed.
    g. At any airspeed, the tendency to stall increases when the bank is increased. While banking at minimum controllable airspeed, an accelerated stall can be entered with little or no warning.
    h. A stall can also occur as a result of abrupt or rough control movements when flying at minimum controllable airspeed.
    i. Descend or climb at minimum controllable airspeed by adjusting power.

8. Transition from minimum controllable airspeed to cruise:
    a. Gradually increase the throttle.
    b. As airspeed increases lower the nose to maintain altitude.
    c. Gradually retract the flaps prior to V_{FE} (abruptly raising the flaps while at minimum controllable airspeed will result in lift suddenly being lost, causing the airplane to lose altitude ("that sinking feeling") or possibly stall.
    d. Adjust pitch attitude to maintain altitude (especially during flap retraction).
    e. Retract the landing gear prior to V_{LOR}.
    f. Approaching cruise, set power to normal cruise setting.
    g. Note the return of normal elevator feel and the sound of increased airflow around the airplane.
    h. Note the reduced left turning tendencies and reduced need for right rudder.
    i. Retrim the airplane for cruise flight.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Inadequate back-elevator pressure as power is reduced, resulting in altitude loss.
c. Excessive back-elevator pressure as power is reduced, resulting in a climb, followed by a rapid reduction in airspeed and "mushing."
d. Failure to establish specified gear and flap configuration.
e. Improper entry technique.
f. Failure to establish and maintain the specified airspeed.
g. Excessive variations in altitude and heading when a constant altitude and heading are specified.
h. Rough or uncoordinated control technique.
i. Improper correction for torque effect.
j. Inadequate rudder compensation for adverse yaw during turns.
k. Fixation on the airspeed indicator.
l. Failure to anticipate changes in lift as flaps are extended or retracted.
m. Improper trim technique.
n. Inadequate power management.
o. Inability to adequately divide attention between airplane control and orientation.
p. Unintentional stalls.
q. Inappropriate removal of hand from throttle.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 4.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

VIII. AREA OF OPERATION: SLOW FLIGHT AND STALLS
B. TASK: POWER-OFF STALLS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to power-off stalls.
2. Selects and entry altitude that allows the task to be completed no lower than 1,500 feet (460 meters) AGL.
3. Establishes a stabilized descent in the approach or landing configuration, as specified by the examiner.
4. Transitions smoothly from the approach or landing attitude to a pitch attitude that will induce a stall.
5. Maintains a specified heading +/-10° in straight flight; maintains a specified angle of bank not to exceed 20° +/-10° in turning flight, while inducing the stall.
6. Recognizes and recovers promptly after the stall occurs by simultaneously reducing the angle of attack, increasing power to maximum allowable and leveling the wings to return to a straight-and-level flight attitude with a minimum loss of altitude appropriate for the airplane.
7. Retracts the flaps to the recommended setting; retracts the landing gear, if retractable, after a positive rate of climb is established.
8. Accelerates to V_X or V_Y speed before the final flap retraction; returns to the altitude, heading, and airspeed specified by the examiner.

ELEMENTS

1. A stall occurs when the wing exceeds its critical angle of attack and the smooth airflow over the airplane's wing is disrupted, rapidly degenerating lift.
2. A stall can occur at any airspeed, in any attitude, and with any power setting.
3. Performing intentional stalls familiarizes the pilot with the conditions that produce stalls and develops the habit of taking prompt preventative or corrective action.
4. Intentional stalls should be performed at an altitude that will provide adequate height about the ground for recovery and return to normal level flight (no less than 1500' AGL).
5. Most training airplanes are designed so the wing roots will stall before the wingtips, allowing aileron control during the stall.
6. Depending on the airplane, stall indications can include stall lights, stall horns, full-up elevator, high descent rate, sudden nose-down pitching, or possible buffeting.
7. Setting up for a power-off stall:
    a. The practice area should be cleared of other traffic prior to practicing power-off stalls.
    b. Power-off stalls are performed with normal landing approach conditions in simulation of an accidental stall occurring during landing approaches.
    c. Airplanes equipped with flaps, landing gear and/or carburetor heat should be in the landing configuration (practicing power-off stalls as a transition from slow flight is common).
    d. Airspeed in excess of the normal approach speed should not be carried into a stall entry since it could result in an abnormally nose-high attitude.
    e. In the landing configuration, retard the throttle to idle (or normal approach power).
    f. Hold the airplane at constant altitude and level flight attitude until the airspeed decreases to that of a normal approach.
    g. Smoothly pitch the nose down into the normal approach attitude to maintain the normal approach airspeed.
8. Performing a power-off stall:
    a. With the approach attitude and airspeed stabilized, smoothly raise the nose to an attitude that will induce a stall.
    b. Maintain directional control with the rudder and wings level with the ailerons.
    c. Maintain a constant pitch attitude with the elevator until the stall occurs (as airspeed is reduced, more back-elevator pressure will be needed to maintain the pitch attitude).
    d. The stall can be recognized by clues such as full-up elevator, high descent rate, sudden nose-down pitching, or possible buffeting.

9. Recovering from a power-off stall:
    a. Simultaneously reduce the angle of attack (lower the nose) release back-elevator pressure, and advance the throttle to maximum.
    b. If the application of carburetor heat was included in the landing configuration, discontinue the use of carburetor heat.
    c. As full power is applied and the nose is lowered, overcome the engine torque effect with right rudder.
    d. Accelerate to the manufacturer's recommended speed for a balked landing (this can be thought of as a best-rate-of-climb speed in the landing configuration).
    e. Maintaining the balked landing speed, smoothly apply back-elevator pressure.
    f. After establishing a positive rate of climb at the balked landing speed, gradually retract the flaps, and retract the landing gear while accelerating to V_Y.
    g. Level off at the desired altitude and set the throttle to an appropriate cruise setting.
10. Recovery from power-off stalls during shallow turns (accelerated stalls) simulates an inadvertent stall during the turn from the base leg to final approach.
11. During accelerated stalls, ensure the turn continues at a uniform rate until the stall occurs.
12. If the airplane is in a skid during an accelerated stall, the inner wing may stall first and abruptly dip down further.
13. If the airplane is in a slip during an accelerated stall, the outer wing may stall first and whip downward abruptly.
14. After the accelerated stall occurs, the recovery should be made straight ahead as normal, with wings being leveled by coordinated use of ailerons.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Failure to establish specified landing gear and flap configuration prior to entry.
c. Improper pitch, heading, and bank control during straight-ahead stalls.
d. Improper pitch and bank control during turning stalls.
e. Rough or uncoordinated control technique.
f. Failure to recognize the first indications of a stall.
g. Failure to achieve a stall.
h. Excessive back-elevator pressure resulting in an exaggerated nose-up attitude during entry.
i. Over-reliance on the airspeed indicator while excluding other cues.
j. Inadequate scanning resulting in an unintentional wing-low condition during entry.
k. Premature recovery.
l. Improper torque correction.
m. Inadequate rudder control.
n. Failure to maintain a constant bank angle during turning stalls.
o. Poor stall recognition and delayed recovery.
p. Excessive forward-elevator pressure during recovery resulting in negative load on the wings.
q. Excessive airspeed buildup during recovery.
r. Excessive altitude loss or excessive airspeed during recovery.
s. Failure to take timely action to prevent a full stall during the conduct of imminent stalls.
t. Inadvertent secondary stall during recovery.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 4.
2. AC 61-67, Stall and Spin Awareness Training.
3. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
VIII. AREA OF OPERATION: SLOW FLIGHT AND STALLS
C. TASK: POWER-ON STALLS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to power-on stalls.
2. Selects and entry altitude that allows the task to be completed no lower than 1,500 feet (460 meters) AGL.
3. Establishes the takeoff or departure configuration. Sets power to no less than 65 percent available power.
4. Transitions smoothly from the takeoff or departure attitude to the pitch attitude that will induce a stall.
5. Maintains a specified heading +/-10° in straight flight; maintains a specified angle of bank not to exceed 20° +/-10° in turning flight, while inducing the stall.
6. Recognizes and recovers promptly after the stall occurs by simultaneously reducing the angle of attack, increasing power as appropriate, and leveling the wings to return to a straight-and-level flight attitude with a minimum loss of altitude appropriate for the airplane.
7. Retracts the flaps to the recommended setting; retracts the landing gear, if retractable, after a positive rate of climb is established.
8. Accelerates to V_X or V_Y speed before the final flap retraction; returns to the altitude, heading, and airspeed specified by the examiner.

NOTE: In some high performance airplanes, the power setting may have to be reduced below the practical test standards guideline power setting to prevent excessively high pitch attitudes (greater than 30° nose up).

ELEMENTS

1. A stall occurs when the wing exceeds its critical angle of attack and the smooth airflow over the airplane's wing is disrupted, rapidly degenerating lift.
2. A stall can occur at any airspeed, in any attitude, and with any power setting.
3. Performing intentional stalls familiarizes the pilot with the conditions that produce stalls and develops the habit of taking prompt preventative or corrective action.
4. Intentional stalls should be performed at an altitude that will provide adequate height about the ground for recovery and return to normal level flight (no less than 1500' AGL).
5. Most training airplanes are designed so the wing roots will stall before the wingtips, allowing aileron control during the stall.
6. Depending on the airplane, stall indications can include stall lights, stall horns, full-up elevator, high descent rate, sudden nose-down pitching, or possible buffeting.
7. Setting up for a power-on stall:
    a. The practice area should be cleared of other traffic prior to practicing power-on stalls.
    b. Power-on stall recoveries are practiced to simulate an accidental stall occurring during takeoffs and climbs.
    c. After establishing the takeoff or climb configuration, the airplane should be slowed to the normal lift-off speed.
    d. Airspeed in excess of the normal lift-off speed should not be carried into a stall entry since it could result in an abnormally nose-high attitude.
    e. Set the throttle to takeoff power for the takeoff configuration or climb power for the climb configuration (less if performed in a high performance airplane).
8. Performing a power-on stall:
    a. After the climb attitude is established, smoothly raise the nose to an attitude obviously impossible for the airplane to maintain.
    b. Maintain directional control with the rudder and wings level with the ailerons.
    c. Maintain a constant pitch attitude with the elevator until the stall occurs (as airspeed is reduced, more back-elevator pressure will be needed to maintain the pitch attitude).
    d. The stall can be recognized by clues such as full-up elevator, high descent rate, sudden nose-down pitching, or possible buffeting.

9. Recovering from a power-on stall:
    a. Simultaneously reduce the angle of attack (lower the nose) release back-elevator pressure, and advance the throttle to maximum.
    b. As full power is applied and the nose is lowered, overcome the engine torque effect with right rudder.
    c. Accelerate to the manufacturer's recommended speed for the given configuration.
    d. Maintaining the recommended speed, smoothly apply back-elevator pressure.
    e. After establishing a positive rate of climb at the recommended speed, gradually retract the flaps (if extended), and retract the landing gear (if extended) while accelerating to V_Y.
    f. Level off at the desired altitude and set the throttle to an appropriate cruise setting.
10. Recovery from power-on stalls during shallow turns (accelerated stalls) simulates an inadvertent stall during the turn from the upwind leg to the crosswind leg.
11. During accelerated stalls, ensure the turn continues at a uniform rate until the stall occurs.
12. If the airplane is in a skid during an accelerated stall, the inner wing may stall first and abruptly dip down further.
13. If the airplane is in a slip during an accelerated stall, the outer wing may stall first and whip downward abruptly.
14. After the accelerated stall occurs, the recovery should be made straight ahead as normal, with wings being leveled by coordinated use of ailerons.

COMMON ERRORS

a. Failure to adequately clear the area.
b. Failure to establish specified landing gear and flap configuration prior to entry.
c. Improper pitch, heading, and bank control during straight-ahead and turning stalls.
d. Improper pitch and bank control during turning stalls.
e. Rough or uncoordinated control technique.
f. Failure to recognize the first indications of a stall.
g. Failure to achieve a stall.
h. Excessive back-elevator pressure resulting in an exaggerated nose-up attitude during entry.
i. Over-reliance on the airspeed indicator while excluding other cues.
j. Inadequate scanning resulting in an unintentional wing-low condition during entry.
k. Premature recovery.
l. Improper torque correction.
m. Inadequate rudder control.
n. Failure to maintain a constant bank angle during turning stalls.
o. Poor stall recognition and delayed recovery.
p. Excessive forward-elevator pressure during recovery resulting in negative load on the wings.
q. Excessive airspeed buildup during recovery.
r. Excessive altitude loss or excessive airspeed during recovery.
s. Failure to take timely action to prevent a full stall during the conduct of imminent stalls.
t. Inadvertent secondary stall during recovery.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 4.
2. AC 61-67, Stall and Spin Awareness Training.
3. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

VIII. AREA OF OPERATION: SLOW FLIGHT AND STALLS
D. TASK: SPIN AWARENESS

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to spin awareness by explaining:

1. Aerodynamic factors related to spins.
2. Flight situations where unintentional spins may occur.
3. Procedures for recovery from unintentional spins.

NOTE: The student will <u>NOT</u> be tested on <u>PERFORMING</u> spins at the Private Pilot level.

ELEMENTS

1. A spin is an aggravated stall that results in "autorotation" – a downward corkscrew path.
2. As the airplane rotates around a vertical axis, the rising wing is less stalled than the descending wing creating a rolling, yawing and pitching motion in a spiral path.
3. The rising wing has a decreased angle of attack and the descending wing has an increasing angle of attack, past the wing's critical angle of attack (stall).
4. An airplane must be stalled in order to enter a spin.
5. If a stall occurs while in a slipping or skidding turn, an inadvertent spin can result.
6. Rudder control to counteract a wing's tendency to drop during a stall averts inadvertent spins.
7. Continued practice in stalls will help the pilot develop a more instinctive and prompt reaction in recognizing an approaching spin.
8. If an inadvertent spin is entered, the pilot should immediately execute spin recovery procedures.
9. Spin procedures:
    a. Before performing intentional spins, the following items should be reviewed for the specific spin-approved airplane to be flown:
        i. AFM / POH limitations section, placards and type certification data.
        ii. Weight and balance limitations.
        iii. Recommended entry and recovery procedures.
        iv. Requirements for parachutes in 14 CFR part 91.307: Exception for spins, but only if required for the certificate or rating sought (not required for Private Pilot certificate, so parachutes for Private Pilot students ARE required).
    b. A thorough airplane preflight should be accomplished with special emphasis on excess or loose items that may affect weight, center of gravity, and controllability.
    c. The flight area, above and below the airplane should be cleared of other traffic.
    d. All spin training should be initiated at an altitude high enough for a completed recovery at or above 1500' AGL.
    e. Carburetor heat should be applied according to the manufacturer's recommendations.
10. Entry phase:
    a. The entry phase is from the time of normal flight to the start of spin rotation.
    b. Reduce the power slowly to idle and simultaneously raise the nose to a pitch attitude that will ensure a stall.
    c. As the airplane approaches a stall, smoothly apply full rudder in the direction of the desired spin rotation while applying full back-elevator to the limit of travel.
    d. Always maintain neutral aileron position unless the AFM / POH specifies otherwise.
11. Incipient phase:
    a. The incipient phase is from the start of spin rotation to the fully developed spin.
    b. This change may take up to two turns for most airplanes.
    c. Incipient spins that are not allowed to develop into a steady-state spin are the most commonly used in the introduction to spin training and recovery techniques.
    d. In the incipient phase, the aerodynamic and inertial forces have not achieved a balance.
    e. As the incipient spin develops, the indicated airspeed should be near or below the stall airspeed.
    f. The turn-and-slip indicator should indicate the direction of the spin (the ball will be deflected in the direction of the turn).

12. Developed phase:
    a. The developed phase is from the fully developed spin to the beginning of the recovery.
    b. The airplane's rotation rate, airspeed and vertical speed are stabilized while in a flightpath that is nearly vertical.
    c. The airplane aerodynamic forces and inertial forces are in balance.
    d. The attitude, angles and self-sustaining motions about the vertical axis are constant.
    e. The spin is in equilibrium.
13. Recovery phase:
    a. The recovery phase is from the beginning of recovery to straight-and-level flight.
    b. The recovery occurs when the angle of attack is reduced below the critical angle of attack and autorotation slows - may last from a quarter turn to several turns.
    c. The pitch angle steepens and rotation stops.
    d. To recover, control inputs are initiated to disrupt the spin equilibrium by stopping the rotation and the stall.
    e. Follow the manufacturer's recommended spin recovery procedures.
    f. In the absence of the manufacturer's recommended procedures, think "P.A.R.E.":
        i. Power - Idle.
        ii. Ailerons - Neutral.
        iii. Rudder - Full deflection opposite to direction of turn.
        iv. Elevator - Forward-elevator pressure to break the stall.
    g. After the spin rotation stops, neutralize the rudder pressure, begin applying back-elevator pressure to raise the nose to level flight, and increase power to a cruise setting.

COMMON ERRORS

NOTE: These are common errors related to <u>PERFORMING</u> spins – the student will <u>NOT</u> be tested on <u>PERFORMING</u> spins at the Private Pilot level.

a. Failure to establish proper configuration prior to spin entry.
b. Failure to achieve a fully stalled condition prior to spin entry.
c. Failure to apply full rudder pressure in the desired spin direction during spin entry.
d. Failure to apply and maintain full up-elevator pressure during spin entry, resulting in a spiral.
e. Failure to close throttle when a spin entry is achieved.
f. Failure to recognize the indications of an imminent, unintentional spin.
g. Improper use of flight controls during spin entry, rotation, or recovery.
h. Failure to apply full rudder against the spin during recovery.
i. Failure to apply sufficient forward-elevator pressure during recovery.
j. Failure to neutralize the rudder during recovery after rotation stops, resulting in a possible secondary spin.
k. Disorientation during a spin.
l. Slow and overly cautious control movements during recovery.
m. Excessive back-elevator pressure after rotation stops, resulting in a possible secondary spin or excessive G-forces.
n. Insufficient back-elevator pressure during recovery resulting in excessive airspeed.
o. Failure to distinguish between a high-speed spiral and a spin.
p. Excessive speed or accelerated stall during recovery.
q. Failure to recover with minimum loss or altitude.
r. Hazards or attempting to spin an airplane not approved for spins.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 4.
2. AC 61-67, Stall and Spin Awareness Training.
3. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
IX. AREA OF OPERATION: BASIC INSTRUMENT MANEUVERS
A. TASK: STRAIGHT-AND-LEVEL FLIGHT

OBJECTIVE
To determine that the applicant:
1. Exhibits knowledge of the elements related to attitude instrument flying during straight-and-level flight.
2. Maintains straight-and-level flight solely by reference to instruments using proper instrument cross-check and interpretation, and coordinated control application.
3. Maintains altitude +/-200 feet (60 meters), heading +/-20°, and airspeed +/-10 knots.

ELEMENTS
1. With the integrated method of flight instruction, both outside references and flight instruments are used to maintain desired airplane performance.
2. Straight-and-level flight is one of the four fundamental flight maneuvers (straight-and-level flight, turns, climbs and descents – the basic ingredients for all flight maneuvers).
3. Straight-and-level flight is flight in which a constant heading and altitude are maintained.
4. Immediate corrections are made for slight turns, descents and climbs.
5. Level flight is accomplished by fixing the distance between the dash or cowl and the horizon.
    a. Different power settings vary the angles of attack and require different reference distances.
    b. With the reference distance set for a given power setting, trim out control forces.
    c. For level flight by outside references, the reference distance should be cross-checked occasionally with the attitude indicator (AI) and altimeter.
    d. For level flight solely by reference to instruments:
        i. The AI is the control instrument (the center of the scan)
            1. The AI gives a direct indication of pitch attitude.
            2. The pilot's instrument scan radiates out from the AI.
        ii. Restrict the displacement of the AI horizon bar to +/- one full bar width.
            1. For errors less than 100', use a half-bar-width correction.
            2. For errors in excess of 100' use an initial full-bar-width correction.
        iii. The altimeter, vertical speed indicator (VSI) and airspeed indicator (ASI) are the performance instruments for pitch:
            1. The altimeter gives an indirect indication of pitch attitude (assuming constant power). For altitude gain, lower nose, for altitude loss, raise nose.
            2. The VSI gives an indirect indication of pitch attitude. It is a trend and rate instrument. The larger the VSI deviation from zero, the larger the correction. As the needle returns to zero, relax the correction pressure.
            3. The ASI gives an indirect indication of pitch attitude. The larger the ASI difference from normal cruise, the larger the correction. As the needle returns to the desired altitude, relax the correction pressure
            4. The pilot's instrument scan for pitch should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).
6. Straight flight is accomplished by fixing the distance between the wingtips and the horizon.
    a. Both wingtips should be equidistant above or below the horizon.
    b. Adjustments should be made with the ailerons.
    c. Anytime the wings are banked in coordinated flight, even slightly, the airplane will turn.
    d. For straight flight by outside references, the reference distances should be cross-checked occasionally with the heading indicator.
    e. For straight flight solely by reference to instruments:
        i. The AI is the control instrument (the center of the scan)
            1. The AI shows a change in bank angle directly and instantly.
            2. The pilot's instrument scan radiates out from the AI.
        ii. To detect small banks, use the scale pointer and 0° pointer on the top of the AI for bank indication (instead of the artificial horizon bar).

iii. The heading indicator (HI) and the turn coordinator (TC) are the performance instruments for bank:
1. The HI gives an indirect indication of bank attitude. To correct, use a bank angle no larger than the number of degrees to be turned.
2. The TC gives an indirect indication of bank attitude. With either a ball or miniature airplane deflection, the airplane is in a turn. Return to straight flight by smooth coordinated aileron and rudder pressure.
3. The pilot’s instrument scan for bank should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).

7. Straight-and-level flight requires almost no application of control pressures if properly trimmed.
8. For straight and level flight by outside references, the pilot’s attention should be outside the cockpit 90% of the time - no more than 10% of the pilot’s attention should be inside the cockpit (instrument cross-checks).

COMMON ERRORS

a. Attempting to use improper reference points on the airplane to establish attitude.
b. Forgetting the location of preselected reference points of subsequent flights.
c. Attempting to establish or correct airplane attitude using flight instruments rather than outside visual references.
d. Attempting to maintain direction using only rudder control.
e. Habitually flying with one wing low.
f. “Fixation,” “omission,” and “emphasis” errors during instrument cross-check.
g. “Chasing” the flight instruments rather than adhering to the principles of attitude flying.
h. Improper instrument interpretation.
i. Too tight a grip on the flight controls resulting in overcontrol and lack of feel.
j. Pushing of pulling on the flight controls rather than exerting pressure against the airstream.
k. Improper scanning and/or devoting insufficient time to outside visual references (head in the cockpit).
l. Fixation on the nose (pitch attitude) reference point.
m. Unnecessary or inappropriate control inputs.
n. Failure to establish proper pitch, bank or power adjustments during altitude, heading, or airspeed corrections.
o. Failure to make timely and measured control inputs when deviations from straight-and-level flight are detected.
p. Inadequate attention to sensory inputs in developing feel for the airplane.
q. Faulty trim procedure.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 3.
2. FAA-H-8083-15, Instrument Flying Handbook, Chapter 5.

PRIVATE PILOT

IX. AREA OF OPERATION: BASIC INSTRUMENT MANEUVERS
B. TASK: CONSTANT AIRSPEED CLIMBS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to attitude instrument flying during constant airspeed climbs.
2. Establishes the climb configuration specified by the examiner.
3. Transitions to the climb pitch attitude and power setting on an assigned heading using proper instrument cross-check and interpretation, and coordination control application.
4. Demonstrates climbs solely by reference to instruments at a constant airspeed to specific altitudes in straight flight and turns.
5. Levels off at the assigned altitude and maintains that altitude +/-200 feet (60 meters), heading +/-20°, and airspeed +/-10 knots.

ELEMENTS

1. With the integrated method of flight instruction, both outside references and flight instruments are used to maintain desired airplane performance.
2. The constant airspeed climb is one of the four fundamental flight maneuvers (straight-and-level flight, turns, climbs and descents – the basic ingredients for all flight maneuvers).
3. When an airplane enters a climb, it changes its flightpath from level flight to an inclined plane.
4. In a climb attitude, weight no longer acts in a direction near-perpendicular to the flightpath - it now has a rearward component increasing total drag and requiring more thrust.
5. Absolute ceiling: Altitude at which level flight can be maintained.
6. Service ceiling: Altitude at which a 100 feet-per-minute climb can be maintained.
7. Military ceiling: Altitude at which a 500 feet-per-minute climb can be maintained.
8. The best rate of climb airspeed (V_Y):
    a. Depends on excess power available over that required for level flight.
    b. Decreases with altitude and equals V_X at the absolute ceiling.
9. The best angle of climb airspeed (V_X):
    a. Depends on excess thrust available over that required for level flight.
    b. Increases with altitude and equals V_Y at the absolute ceiling.
10. A faster “cruise climb” provides better engine cooling, increased forward visibility and higher groundspeed than V_X or V_Y.
11. A straight climb is entered by gently applying back-elevator pressure to raise the nose of the airplane relative to the horizon and simultaneously increasing engine power to a climb power setting.
12. Slower airspeed and increased angle of attack produce the left turning tendencies from torque and asymmetrical propeller loading (P-factor) - offset these by applying more right rudder.
13. If establishing a climbing turn:
    a. The pitch angle and climb rate must be less since the bank angle creates a horizontal component of lift by reducing the vertical component of lift.
    b. The degree of bank should be shallow and constant. When the bank angle is too large, a climb is no longer possible.
    c. Maintain a coordinated turn at constant airspeed and rate of turn.
    d. Because of the lower airspeed, aileron drag (adverse yaw) will be more prominent than in straight-and-level flight - more correcting rudder pressure will be needed.
14. After the climb is established at the climbing airspeed, trim out control pressures.
15. For climbs solely by reference to instruments:
    a. The AI is the control instrument (the center of the scan)
        i. The AI gives a direct indication of pitch and bank attitude.
        ii. The pilot’s instrument scan radiates out from the AI.
    b. Raise the miniature aircraft to the appropriate nose high indication and simultaneously increase the engine power to a climb power setting (other methods include maintaining cruise power until the desired climb airspeed is attained, or decreasing power in straight-and-level flight to attain climb airspeed before beginning the climb).
        i. Allow the airspeed to stabilize for the selected attitude and power setting.
        ii. If the airspeed is low or high, make a small pitch correction nose-down or nose-up.

c. The altimeter, vertical speed indicator (VSI) and airspeed indicator (ASI) are the performance instruments for pitch:
    i. The altimeter gives an indirect indication of pitch attitude (assuming constant power).
    ii. The VSI gives an indirect indication of pitch attitude. It is a trend and rate instrument. The larger the VSI deviation from the desired climb rate, the larger the correction. As the needle returns to the desired climb rate, relax the correction pressure.
    iii. The ASI gives an indirect indication of pitch attitude. The larger the ASI difference from the desired climb airspeed, the larger the correction. As the needle returns to the desired climb airspeed, relax the correction pressure
    iv. The pilot's instrument scan for pitch should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).

d. The heading indicator (HI) and the turn coordinator (TC) are the performance instruments for bank:
    i. The HI gives an indirect indication of bank attitude. To correct, use a bank angle no larger than the number of degrees to be turned.
    ii. The TC gives an indirect indication of bank attitude. With either a ball or miniature airplane deflection, the airplane is in a turn.
    iii. The pilot's instrument scan for bank should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).

16. To return to straight-and-level flight, lead the level-off by 10% of the climb rate (50' for 500 FPM).
17. Lower the nose gradually to allow airspeed to increase and prevent altitude loss.
18. Retain climb power temporarily to accelerate to cruise airspeed.
19. Reduce engine power to a cruise power setting.
20. After allowing time for engine temperature to stabilize, adjust the mixture control.
21. After straight-and-level flight is established at the desired airspeed, trim out control pressures.
22. For climbs by outside references, the pilot's attention should be outside the cockpit 90% of the time - no more than 10% of the pilot's attention should be inside the cockpit (instrument cross-checks).

COMMON ERRORS

a. "Fixation," "omission," and "emphasis" errors during instrument cross-check.
b. Improper control applications.
c. Attempting to establish climb pitch attitude by referencing the airspeed indicator, resulting in "chasing" the airspeed.
d. Improper entry or level-off procedure.
e. Applying elevator pressure too aggressively, resulting in an excess climb angle.
f. Applying elevator pressure too aggressively during level-off resulting in negative "G" forces.
g. Inadequate or inappropriate rudder pressure during climbing turns.
h. Allowing the airplane to yaw during straight climbs, usually due to inadequate right rudder pressure.
i. Fixation on the nose during straight climbs, resulting in climbing with one wing low.
j. Failure to initiate a climbing turn properly with use of rudder and elevators, resulting in a slip or skid and little or no altitude gain.
k. Inability to keep pitch and bank attitude constant during climbing turns.
l. Attempting to exceed the airplane's climb capability.
m. Improper instrument interpretation.
n. Failure to establish proper pitch, bank or power adjustments during altitude, heading, or airspeed corrections.
o. Faulty trim procedure.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 3.
2. FAA-H-8083-15, Instrument Flying Handbook, Chapter 5.

PRIVATE PILOT
IX. AREA OF OPERATION: BASIC INSTRUMENT MANEUVERS
C. TASK: CONSTANT AIRSPEED DESCENTS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to attitude instrument flying during constant airspeed descents.
2. Establishes the descent configuration specified by the examiner.
3. Transitions to the descent pitch attitude and power setting on an assigned heading using proper instrument cross-check and interpretation, and coordination control application.
4. Demonstrates descents solely by reference to instruments at a constant airspeed to specific altitudes in straight flight and turns.
5. Levels off at the assigned altitude and maintains that altitude +/-200 feet (60 meters), heading +/-20°, and airspeed +/-10 knots.

ELEMENTS

1. With the integrated method of flight instruction, both outside references and flight instruments are used to maintain desired airplane performance.
2. The constant airspeed descent is one of the four fundamental flight maneuvers (straight-and-level flight, turns, climbs and descents – the basic ingredients for all flight maneuvers).
3. When an airplane enters a descent, it changes its flightpath from level flight to an inclined plane.
4. Descents can be made with a wide variety of airspeed, pitch attitude and power combinations.
5. Partial power descent – used for cruise and normal descent.
    a. A nose-low low-power descent condition.
    b. Target descent rate is usually about 500 feet per minute.
    c. Airspeed can range from slow pattern speed to fast cruise.
6. Descent at minimum safe airspeed – used for clearing obstacles on approach to landing.
    a. A nose-high power-assisted descent condition.
    b. Descent rate requirements vary with obstacles and runway lengths.
    c. Excessive power may be needed below V_{SO} (region of reversed command).
7. Glides – used for power-off accuracy landings and forced landings after engine failure.
    a. Forward motion is maintained by gravity pulling the airplane along an inclined path.
    b. Descent rate is controlled by the pilot balancing the forces of gravity and lift.
    c. The absence of propeller slipstream reduces the effectiveness of control surfaces.
    d. The lift-over-drag (L/D) ratio determines the glide ratio (altitude lost over horizontal distance covered).
        i. With a tailwind, groundspeed and horizontal distance covered increase.
        ii. With a headwind, groundspeed and horizontal distance covered decrease.
    e. The heavier the weight, the higher the airspeed must be for the same L/D (the horizontal distance covered will not change).
    f. The best glide speed (V_G) is at an angle producing the highest lift-to-drag ratio (L/D_{MAX}).
    g. The pilot should never attempt to "stretch" a glide by applying back-elevator pressure and reducing the airspeed below the airplane's recommended V_G.
8. A straight descent is entered by reducing power until the recommended descent speed is attained, then gently relaxing back-elevator pressure to lower the nose of the airplane relative to the horizon.
9. If establishing a descending turn:
    a. Either the pitch angle or airspeed must be reduced since the bank angle creates a horizontal component of lift by reducing the vertical component of lift.
    b. The degree of bank should be shallow and constant. When the bank angle is too large, exceeding steep descent angles and airspeeds result.
    c. Maintain a coordinated turn at constant airspeed and rate of turn.
    d. Because of the lower airspeed and power, aileron drag (adverse yaw) will be less prominent than in straight-and-level flight - less correcting rudder pressure will be needed.
10. After the descent is established at the desired airspeed, trim out control pressures.
11. For descents solely by reference to instruments:
    a. The AI is the control instrument (the center of the scan)
        i. The AI gives a direct indication of pitch and bank attitude.
        ii. The pilot's instrument scan radiates out from the AI.

b. Lower the miniature aircraft to the appropriate nose low indication after slowing to the descent airspeed by reducing power.
   i. Allow the airspeed to stabilize for the selected attitude and power setting.
   ii. If the airspeed is low or high, make a small pitch correction nose-down or nose-up.

c. The altimeter, vertical speed indicator (VSI) and airspeed indicator (ASI) are the performance instruments for pitch:
   i. The altimeter gives an indirect indication of pitch attitude (assuming constant power).
   ii. The VSI gives an indirect indication of pitch attitude. It is a trend and rate instrument. The larger the VSI deviation from the desired descent rate, the larger the correction. As the needle returns to the desired descent rate, relax the correction pressure.
   iii. The ASI gives an indirect indication of pitch attitude. The larger the ASI difference from the desired descent airspeed, the larger the correction. As the needle returns to the desired descent airspeed, relax the correction pressure
   iv. The pilot's instrument scan for pitch should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).

d. The heading indicator (HI) and the turn coordinator (TC) are the performance instruments for bank:
   i. The HI gives an indirect indication of bank attitude. To correct, use a bank angle no larger than the number of degrees to be turned.
   ii. The TC gives an indirect indication of bank attitude. With either a ball or miniature airplane deflection, the airplane is in a turn.
   iii. The pilot's instrument scan for bank should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).

12. To return to straight-and-level flight, lead the level-off by 10% of the descent rate (50' for 500 FPM).
13. Raise the nose gradually to maintain airspeed and prevent altitude loss.
14. Set cruise power to attain cruise airspeed.
15. After allowing time for engine temperature to stabilize, adjust the mixture control.
16. After straight-and-level flight is established at the desired airspeed, trim out control pressures.
17. For climbs by outside references, the pilot's attention should be outside the cockpit 90% of the time - no more than 10% of the pilot's attention should be inside the cockpit (instrument cross-checks).

COMMON ERRORS

a. Failure to adequately clear the area.
b. Inadequate back-elevator control during glide entry resulting in too steep a glide.
c. Failure to slow the airplane to approximate glide speed prior to lowering pitch attitude.
d. Attempting to establish / maintain a normal glide solely by reference to instruments.
e. "Fixation," "omission," and "emphasis" errors during instrument cross-check.
f. Improper instrument interpretation.
g. Inability to sense changes in airspeed through sound and feel.
h. Inability to stabilize the glide (chasing the ASI).
i. Attempting to "stretch" the glide by applying back-elevator pressure.
j. Skidding or slipping during gliding turns due to inadequate appreciation of the difference in rudder action as opposed to turns with power.
k. Failure to lower pitch attitude during gliding turn entry resulting in a decrease in airspeed.
l. Excessive rudder pressure during recovery from gliding turns.
m. Inadequate pitch control during recovery from straight glides.
n. "Ground shyness" – resulting in cross-controlling during gliding turns near the ground.
o. Failure to maintain constant bank angle during gliding turns.
p. Faulty trim procedure.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 3.
2. FAA-H-8083-15, Instrument Flying Handbook, Chapter 5.

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to attitude instrument flying during turns to headings.
2. Transitions to the level-turn attitude using proper instrument cross-check and interpretation, and coordination control application.
3. Demonstrates turns to headings solely be reference to instruments, maintains altitude +/-200 feet (60 meters), maintains a standard rate turn and rolls out on the assigned heading +/-10°, and maintains airspeed +/-10 knots.

ELEMENTS

1. With the integrated method of flight instruction, both outside references and flight instruments are used to maintain desired airplane performance.
2. The turn to heading is one of the four fundamental flight maneuvers (straight-and-level flight, turns, climbs and descents – the basic ingredients for all flight maneuvers).
3. A turn is made by banking the wings to a desired angle in the direction of the turn and exerting the control pressures needed to maintain that bank.
4. All four primary controls are used in close coordination:
    a. Ailerons bank the wings and determine the rate of turn at a given airspeed.
    b. The elevator moves the nose of the airplane up or down perpendicular with the wings (sets the pitch attitude in the turn and "pulls" the nose around the turn).
    c. The throttle provides thrust which may be used for airspeed or to tighten the turn.
    d. The rudder offsets adverse yaw developed by other controls (does not turn the airplane).
5. There are three classes of turns: Shallow, medium and steep:
    a. Shallow turns: Bank < 20°, inherent lateral stability acting to level the wings.
    b. Medium turns: Bank = 20° to 45°, neutral lateral stability maintains bank.
    c. Steep turns: Bank > 45°, overbanking tendency acting to increase the bank.
6. As the airplane is banked into a turn, the lift becomes the resultant of two components:
    a. The vertical lift component continues to act perpendicular to the Earth's surface and oppose gravity but is reduced if pitch or power is not increased.
    b. The horizontal lift component (centripetal) acts parallel to the Earth's surface and turns the airplane by opposing inertia.
7. Part of the vertical lift has been diverted to horizontal lift – the total lift must be increased to compensate for this loss:
    a. To maintain altitude, pitch must be increased by applying back elevator pressure.
    b. To maintain airspeed, power must be increased.
8. To counteract the adverse yawing moment caused by the lowered aileron (on the raised wing) producing more drag than the raised aileron (on the lowered wing), rudder is applied in the direction of the turn.
9. In a skid, the rate of turn is too fast for the angle of bank:
    a. The tail of the airplane tends to move up and to the outside of the turn.
    b. The pilot feels a sideways force to the outside of the turn.
    c. The ball in the turn coordinator is "thrown" to the outside of the turn.
10. In a slip, the rate of turn is too slow for the angle of bank:
    a. The tail of the airplane tends to move down and to the inside of the turn.
    b. The pilot feels a sideways force to the inside of the turn.
    c. The ball in the turn coordinator "falls" to the inside of the turn.
11. In a coordinated turn, the rate of turn is correct for the angle of bank:
    a. The tail of the airplane remains in the slipstream directly behind the airplane.
    b. The pilot feels a force straight down into the seat.
    c. The ball in the turn coordinator is centered.
12. The best outside reference for establishing the degree of bank is the angle made by the top of the engine cowling and the horizon.
13. The pilot's posture while seated in the airplane affects the interpretation of visual references – the head should remain upright relative to the engine cowling, not tilted upright relative to the horizon.

14. When seated in the left seat, parallax makes the nose appear to rise in a left turn (beginning pilots tend to descend) and descend in a right turn (beginning pilots tend to climb).
15. If the nose starts to turn before the bank starts, rudder is being applied too soon.
16. If the bank starts before the nose turns, the rudder is being applied to late.
17. If the nose moves up or down, insufficient back elevator is being applied.
18. Throughout the turn, the pilot should cross-check the ASI. If the airspeed is off by more than 5 knots, an adjustment in power should be applied.
19. Throughout the turn, the pilot should cross-check the altimeter and VSI. If the altitude or vertical speed desired is not being maintained, an adjustment in pitch should be applied.
20. For turns solely by reference to instruments:
    a. The AI is the control instrument (the center of the scan)
        i. The AI gives a direct indication of pitch and bank attitude.
        ii. The pilot's instrument scan radiates out from the AI.
    b. Bank and slightly raise the miniature aircraft to the appropriate indication and simultaneously increase the engine power slightly.
    c. The altimeter, VSI and ASI are the performance instruments for pitch:
        i. The altimeter gives an indirect indication of pitch attitude.
        ii. The VSI gives an indirect indication of pitch attitude. It is a trend and rate instrument. The larger the VSI deviation from zero, the larger the correction. As the needle returns to zero, relax the correction pressure.
        iii. The ASI gives an indirect indication of pitch attitude. The larger the ASI difference from that desired, the larger the required correction.
        iv. The pilot's instrument scan for pitch should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).
    d. The HI and the TC are the performance instruments for bank:
        i. The HI gives an indirect indication of bank attitude and rate of turn.
        ii. The TC gives an indirect indication of bank attitude.
        iii. The pilot's instrument scan for bank should move from the control instrument (AI) to one of the performance instruments then back to the control instrument (AI).
21. For the rollout from a turn, the flight controls are applied in the opposite direction.
22. Normally the lead for rollout is one-half the bank (lead heading by 15° for a 30° bank).
23. For turns by outside references, the pilot's attention should be outside the cockpit 90% of the time - no more than 10% of the pilot's attention should be inside the cockpit (instrument cross-checks).

COMMON ERRORS

a. Failure to adequately clear the area before beginning the turn.
b. Attempting to execute the turn solely by instrument reference.
c. "Fixation," "omission," and "emphasis" errors during instrument cross-check.
d. Improper instrument interpretation.
e. Attempting to sit up straight relative to the ground in turns, rather than riding with the airplane.
f. "Ground shyness" – making "flat turns" (skidding) while operating at low altitudes in a conscious or subconscious effort to avoid banking close to the ground.
g. Holding rudder in the turn, resulting in skidding.
h. Insufficient feel (inability to detect slips or skids without reference to flight instruments).
i. Gaining proficiency in turns in only one direction (usually to the left).
j. Failure to coordinate the use of throttle with other controls.
k. Failure to establish proper pitch, bank, and power adjustments during altitude, bank, and airspeed corrections.
l. Altitude gain or loss during the turn.
m. Improper entry or rollout procedure.
n. Faulty trim procedure (if adjustments to trim are used).

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 3.
2. FAA-H-8083-15, Instrument Flying Handbook, Chapter 5.

PRIVATE PILOT

IX. AREA OF OPERATION: BASIC INSTRUMENT MANEUVERS
E. TASK: RECOVERY FROM UNUSUAL FLIGHT ATTITUDES

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to attitude instrument flying during unusual attitudes.
2. Recognizes unusual flight attitudes solely by reference to instruments, recovers promptly to a stabilized level flight attitude using proper instrument cross-check and interpretation and smooth, coordinated control application in the correct sequence.

ELEMENTS

1. Unusual attitudes (out-of-the-ordinary pitch and/or bank angles) can result from:
    a. Turbulence.
    b. Disorientation.
    c. Instrument failure.
    d. Confusion.
    e. Preoccupation with cockpit duties.
    f. Carelessness in cross-checking.
    g. Errors in instrument interpretation.
    h. Lack of proficiency in aircraft control.
2. An untrained response to an unexpected unusual attitude can be hazardous.
3. The goal when an unusual attitude is noticed is to:
    a. Recognize what the airplane in doing (climbing, descending, banking, etc.).
    b. Determine how to return to straight-and-level flight as quickly and safely as possible.
4. Recognizing unusual attitudes:
    a. Any instrument rate of movement or indication other than those for normal instrument flying should prompt a cross-check to identify an unusual attitude.
    b. Nose-high attitudes are shown directly by the AI (miniature airplane above the artificial horizon) and indirectly by the altimeter (winding up), VSI (positive) and ASI (winding down).
    c. Nose-low attitudes are shown directly by the AI (miniature airplane below the artificial horizon) and indirectly by the altimeter (winding down), VSI (negative) and ASI (winding up).
5. Recovery from unusual attitudes:
    a. Use the recommended recovery procedure in the POH / AFM.
    b. If no recommended procedures are stated, recovery should be based on indications from the ASI, altimeter, VSI and TC.
    c. For nose-high attitudes:
        i. Increase power.
        ii. Lower the nose by applying forward elevator pressure to prevent a stall.
        iii. Correct the bank by applying coordinated aileron and rudder pressure.
    d. For nose-low attitudes:
        i. Reduce power.
        ii. Correct the bank by applying coordinated aileron and rudder pressure.
        iii. Raise the nose by applying smooth back elevator pressure.
    e. After initial control has been applied, conduct a fast cross-check for possible overcontrolling.
    f. As the rate of movement of altimeter and ASI needles decreases, the attitude is approaching level flight.
    g. When the altimeter and ASI needles stop and reverse direction, the aircraft is passing through level flight.
    h. As the indications from the ASI, altimeter and TC stabilize, incorporate the AI into the cross-check.

COMMON ERRORS

a. Failure to recognize an unusual flight attitude.
b. Failure to keep the airplane properly trimmed. A cockpit interruption while holding pressures can easily lead to inadvertent entry into unusual attitudes.
c. Disorganized cockpit. Hunting for charts, logs, computers, etc., can seriously detract attention from the instruments.
d. Slow cross-check and fixations. The impulse is to stop and stare when noting an instrument discrepancy unless enough training has taken place to develop the skill required for immediate recognition.
e. Attempting to recover by sensory sensations other than sight (not trusting instruments).
f. Failure to practice basic instrument skills once you have learned them. All of the errors connected with basic instrument skills are aggravated during unusual attitude recoveries until the elementary skills have been mastered.
g. Inappropriate control applications during recovery.
h. Failure to recognize from instrument indications when the airplane is passing through a level flight attitude.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 3.
2. FAA-H-8083-15, Instrument Flying Handbook, Chapter 5.

<u>**PRIVATE PILOT**</u>

X. AREA OF OPERATION: EMERGENCY OPERATIONS

A. TASK: EMERGENCY APPROACH AND LANDING (SIMULATED)

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to emergency approach and landing procedures.
2. Analyzes the situation and selects an appropriate course of action.
3. Establishes and maintains the recommended best-glide airspeed +/-10 knots.
4. Selects a suitable landing area.
5. Plans and follows a flight pattern to the selected landing area considering altitude, wind, terrain, and obstructions.
6. Prepares for landing, or go-around, as specified by the examiner.
7. Follows the appropriate checklist.

ELEMENTS

1. Upon the beginning of a simulated engine-out emergency landing, immediately establish a wings-level pitch attitude that will result in the best-glide airspeed (V_G).
2. Ensure the flaps and landing gear are in the proper configuration for the existing situation.
3. When the best-glide airspeed (V_G) is attained, lower the nose and trim the airplane to maintain that speed.
4. Select a point of intended engine-out landing considering altitude, obstructions, wind direction, landing direction, landing surface and landing gradient. Identify the area verbally.
5. Turn toward the selected landing area, maintaining the best-glide airspeed (V_G).
6. Follow the appropriate checklist. The checklist should contain steps for checking:
   a. The position of the fuel tank selector.
   b. The quantity of fuel in the selected tank.
   c. The fuel pressure gauge to see if electric fuel pump activation is needed.
   d. The position of the mixture control.
   e. The position of the magneto switch.
   f. The use of carburetor heat.
7. Using any combination of normal gliding maneuvers, from wings-level to spirals, position the airplane at the normal key position at a normal traffic pattern altitude for the selected landing area.
8. Fly a normal power-off approach (higher than a powered approach).
9. Use slips, flaps and varying the position of the base and final legs to adjust the power-off approach.

COMMON ERRORS

a. Improper airspeed control
b. Poor judgment in the selection of an emergency landing area.
c. Failure to estimate the approximate wind speed and direction.
d. Failure to fly the most suitable pattern for existing situation.
e. Failure to accomplish the emergency checklist.
f. Undershooting or overshooting selected emergency landing area.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 8.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
X. AREA OF OPERATION: EMERGENCY OPERATIONS
B. TASK: SYSTEMS AND EQUIPMENT MALFUNCTIONS

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to system and equipment malfunctions appropriate to the airplane provided for the practical test.
2. Analyzes the situation and takes appropriate action for simulated emergencies appropriate to the airplane provided for the practical test for at least three (3) of the following –
    a. Partial or complete power loss.
    b. Engine roughness or overheat.
    c. Carburetor or induction icing.
    d. Loss of oil pressure.
    e. Fuel starvation.
    f. Electrical malfunction.
    g. Vacuum / pressure, and associated flight instruments malfunction.
    h. Pitot / static.
    i. Landing gear or flap malfunction
    j. Inoperative trim.
    k. Inadvertent door or window opening.
    l. Structural icing.
    m. Smoke / fire / engine compartment fire.
    n. Any other emergency appropriate to the airplane.
3. Follows the appropriate checklist or procedure.

ELEMENTS

1. Have available the manufacturers' recommended checklist for any standard emergency procedure.
2. Be able to access any emergency checklist quickly.
3. Be familiar with the reasons behind each step in any emergency checklist.
4. Types of emergency landings:
    a. Forced landing: Immediate landing required - on or off the airport.
    b. Precautionary landing: Premeditated - further flight is possible but not advisable.
    c. Ditching: Force or precautionary landing in water.
5. Psychological hazards:
    a. Reluctance to accept the emergency situation – paralysis by analysis.
    b. Desire to save the airplane - protect assets in the order of skin, tin, then ticket.
    c. Undue concern about getting hurt – survival records favor pilots who maintain composure.
6. Basic safety concepts:
    a. Keep vital structure (cockpit and cabin) intact by using dispensable structure (wings, landing gear, bottom fuselage) to absorb energy during an emergency landing. Also consider using vegetation, trees or even manmade structures to absorb energy – interestingly, cultivated fields with dense crops are almost as effective as emergency arresting devices on runways.
    b. Kinetic energy = $\frac{1}{2}mV^2$, so doubling the groundspeed results in quadrupling the impact energy. Touchdown should be made at the lowest possible *controllable* airspeed. This usually requires the use of full flaps if available. For landing gear, see the AFM / POH.
    c. Avoid excessive nose-low pitch attitude which risks sticking the nose in the ground.
    d. Avoid a high sink rate – such a landing on a hard surface increases the risk of injury.
    e. A well-executed crash landing in poor terrain can be less hazardous than an uncontrolled touchdown on an established field.
    f. It is generally advisable to turn off the electrical system, the engine and the fuel just before touchdown.
    g. Approach governed by 1) wind direction and velocity, 2) dimensions and slope of the selected field, and 3) obstacles in the final approach path.

   h. If contact with tree trunks is unavoidable when on the ground, involve both wings simultaneously by directing the airplane between two properly spaced trees.
   i. When ditching, keep retractable gear up unless the AFM / POH advises otherwise.
   j. In an engine failure after takeoff, it is safer to land directly ahead or slightly to the side.
7. In-flight fires. Treat the fire and land as soon as possible:
   a. Engine fire: Shut off fuel and follow the specific AFM / POH checklist.
   b. Electrical fire: Check and isolate circuit breakers.
   c. Cabin fire: Identify and shut down faulty system. Use extinguisher. Open air vents.
8. Flight control malfunction / failure:
   a. Total flap failure: Execute the no-flap approach and landing per the AFM / POH keeping in mind the increased airspeed and runway required.
   b. Asymmetric (split) flap: Retract functioning flap if possible and execute the no-flap approach and landing. If flaps are set in the split configuration, oppose the drag from the extended flap with opposite rudder and the roll with opposite aileron.
   c. Loss of up-elevator control: Apply nose-up trim, push the control yoke forward to maintain attitude and release to flare for landing.
   d. Loss of down-elevator control: Apply nose-down trim, pull the control yoke aft to maintain attitude and increase to flare for landing.
   e. Landing gear malfunction: Follow the specific AFM / POH checklist. If still retracted:
      i. Dive to V_{NE} (smooth air only) and execute rapid pull-up (within aircraft limits).
      ii. Induce rapid yawing (below V_A) with aggressive alternating rudder pressures.
      iii. Select an airport with crash / foam / rescue facilities. Have them standing by.
      iv. Consider a total gear-up landing instead of a partial gear-up landing.
      v. Land as slow as possible.
9. Systems malfunctions:
   a. Electrical system failure: Follow the specific AFM / POH checklist. Shed non-essential loads, especially high-ampere components. Land at the nearest suitable airport as soon as practicable.
   b. Pitot-static system failure: Blockages affect ASI, VSI and Altimeter. If readings are suspect, use the alternate static source.
   c. Abnormal engine instrument indications: Refer to AFM / POH for specifics.
   d. Door opening in flight: Concentrate on flying. Land and close it on the ground.
   e. Inadvertent VFR flight into IMC: Maintain control, keep the wings level, obtain assistance, and trust the flight instruments (not false sensations). Relax and do not panic. A trimmed airplane is stable with no control input in IMC just like in VMC.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 16.
2. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
X. AREA OF OPERATION: EMERGENCY OPERATIONS
C. TASK: EMERGENCY EQUIPMENT AND SURVIVAL GEAR

OBJECTIVE
To determine that the applicant:

Exhibits knowledge of the elements related to emergency equipment and survival gear appropriate to the airplane and environment encountered during flight. Identifies appropriate equipment that should be aboard the airplane.

ELEMENTS
1. Emergency Locator Transmitter (ELT) per 14 CFR 91.207.
2. Life preservers when beyond gliding distance from shore.
3. Consider a fire extinguisher.
4. Consider warm clothes, food and water in case of an off-airport landing.
5. Consider a hand-held radio for contacting other airplanes to relay for help.

REFERENCES
1. 14 CFR Part 91, General Operating and Flight Rules.
2. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 16.
3. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT
XI. AREA OF OPERATION: NIGHT OPERATION
TASK: NIGHT PREPARATION

OBJECTIVE

To determine that the applicant exhibits knowledge of the elements related to night operations by explaining:

1. Physiological aspects of night flying as it relates to vision.
2. Lighting systems identifying airports, runways, taxiways, obstructions, and pilot controlled lighting.
3. Airplane lighting systems.
4. Personal equipment essential for night flight.
5. Night orientation, navigation, and chart reading techniques.
6. Safety precautions and emergencies unique to night flying.

ELEMENTS

1. Physiology of night vision:
    a. In addition to cones (the primary visual receptors in daylight), the eyes also use rods as the receptors for night vision, sending signals through the optic nerve to the brain.
    b. The rods can take up to 30 minutes to fully adapt to darkness.
    c. Once adapted to darkness, rods are 10,000 times more sensitive to light than cones.
    d. The concentrated cones in the concave fovea produce a night blind spot in the center of the field of vision, requiring a scan 5° to 10° off-center.
    e. A bright light can completely destroy night adaptation. Covering or closing one eye while experiencing a bright light at night can preserve that eye's night adaptation.
    f. Red cockpit lighting helps preserve night vision, but distorts other colors and washes out the color red (including the magenta text and markings on aeronautical charts).
    g. Instrument panel lights should be set at a minimum to enhance outside vision.
    h. Night acuity is further reduced by vitamin A or C deficiencies, carbon monoxide poisoning, smoking, alcohol, certain drugs and the lack of oxygen.
2. Night visual illusions:
    a. Autokinesis:
        i. Caused by staring at a single point of light for more than a few seconds.
        ii. After a time, the light appears to move
        iii. To prevent, keep eyes scanning objects of varying distances.
    b. False horizons:
        i. Caused by stars, shoreline lights or city lights "replacing" the natural horizon.
        ii. To prevent, use multiple visual reference points and backup with instruments.
    c. Flicker vertigo:
        i. Caused by flickering light in the cockpit (anticollision light or strobe lights).
        ii. Can produce nausea, dizziness, unconsciousness, headaches or confusion.
        iii. To prevent, temporarily eliminate the flickering light source.
    d. Night landing illusions:
        i. Above featureless terrain at night, there is a normal tendency to fly a lower-than-normal approach.
        ii. Visual obstructions such as rain, haze, or a dark runway environment can cause low approaches.
        iii. Bright light, steep surrounding terrain and a wide runway can produce the illusion of being too low.
        iv. A set of regularly spaced lights along a road or highway can appear to be runway lights.
        v. To prevent night landing illusions, thoroughly review the airfield layout and boundaries before initiating an approach.
    e. Pilot equipment:
        i. At least one flashlight (preferably red/white swappable) with spare batteries.
        ii. Current aeronautical charts (the lights of cities and towns can be seen at surprising distances at night).

f. Airplane equipment and lighting - remember P.A.L.E.S. as required night equipment:
   i. Position lights (right or starboard = green, left or port = red, aft or stern = white).
   ii. Anti-collision light (flashing red or white light).
   iii. Landing light (for compensation or hire only).
   iv. Electrical source (i.e. battery).
   v. Spare fuses, or alternative electrical source (i.e. alternator or generator).
g. Airport and navigation lighting aids:
   i. A rotating beacon is used to indicate the location of most airports (white + green = civilian land, white + yellow = civilian water, dual-peak white + green = military).
   ii. Steady or flashing red beacons indicate obstructions hazardous to navigation.
   iii. High intensity flashing white lights are used to identify tall towers.
   iv. Runway edge lights are white. Yellow may be substituted 2000' from the far end.
   v. Runway threshold lights are green and runway end lights are red.
   vi. Taxiway edge lights are blue and taxiway centerline lights are green.
h. Preparation and preflight:
   i. Pay particularly close attention to temperature / dewpoint spread.
   ii. Emphasis should also be placed on wind directions and speeds.
   iii. Course lines on charts should be drawn thick and in black.
   iv. Prominently lighted checkpoints and radio navigation aids should be used.
i. Starting, taxiing and runup:
   i. Cockpit materials should be readily available and convenient to use.
   ii. Ensure the propeller area is clear and turn the rotating beacon on.
   iii. Before moving, the taxi or landing light should be turned on (and intermittently off to avoid temporarily blinding other pilots).
   iv. Maintain taxiway centerlines and taxi slower than normal.
j. Takeoff and climb:
   i. Adjust cockpit light to a minimum brightness to enhance outside vision.
   ii. After the airplane is aligned with the centerline, note heading indicator.
   iii. Check the flight instruments during takeoff to ensure centerline heading, pitch attitude and airspeed.
k. Orientation and navigation:
   i. Usually, the first indication of flying into restricted visibility conditions is the gradual disappearance of lights on the ground.
   ii. If light appear to be surrounded by a halo, the pilot should use caution if attempting further flight in the same direction due to ground fog.
   iii. The horizon is difficult to see when crossing large bodies of water at night.
l. Approaches and landings:
   i. Identify runway lights as early as possible. If pilot-controlled lighting (PCL) is available, turn the lights on to maximum capacity (7 microphone clicks).
   ii. Increase emphasis on instruments, especially the altimeter and ASI.
   iii. Use the VASI or PAPI if available.
   iv. At night, the judgment of height, speed and sink rate is impaired.
   v. When tire marks on the runway are visible, begin the rollout and gradually reduce the throttle to idle and let the airplane touch down.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 10.
2. AC 61-23 / FAA-H-8083-25, Pilot's Handbook of Aeronautical Knowledge, Chapter 15.
3. AC 67-2, Medical Handbook for Pilots.
4. AIM, Aeronautical Information Manual.
5. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.

PRIVATE PILOT

XII. AREA OF OPERATION: POST-FLIGHT PROCEDURES
A. TASK: AFTER LANDING, PARKING, AND SECURING

OBJECTIVE

To determine that the applicant:

1. Exhibits knowledge of the elements related to after landing, parking and securing procedures.
2. Maintains directional control after touchdown while decelerating to an appropriate speed.
3. Observes runway hold lines and other surface control markings and lighting.
4. Parks in an appropriate area, considering the safety of nearby persons and property.
5. Follows the appropriate procedure for engine shutdown.
6. Completes the appropriate checklist.
7. Conducts an appropriate post-flight inspection and secures the aircraft.

ELEMENTS

1. After landing:
   a. During the after-landing roll, the airplane should be gradually slowed to normal taxi speed before turning off the landing runway to reduce the chance of ground-looping.
   b. Give full attention to controlling the airplane during the landing roll. The after-landing checks should be performed only after the airplane is brought to a complete stop clear of the active runway.
2. Clear of runway. Use the manufacturers checklist, which should include:
   a. Flaps – identify and retract.
   b. Cowl flaps – open.
   c. Propeller control – full increase.
   d. Trim tabs – set.
3. Parking and shutdown. Use the manufacturers checklist, which should include:
   a. Lean the engine to clean spark plugs.
   b. Check for ELT transmission on 121.5.
   c. Turn radios OFF.
   d. Check magneto "p-lead" wires for grounding by turning the ignition from BOTH to OFF, then back to BOTH when magnetos stop firing.
   e. Set the mixture to IDLE CUT-OFF.
   f. Set the ignition switch to OFF (put the key on the dash).
   g. Switch the master switch (battery and alternator) OFF.
   h. Set the fuel switch as appropriate.
   i. Install the control lock.
   j. Install the Pitot tube cover.
   k. Tie down the airplane.
   l. Place propeller at 3 o'clock and 9 o'clock as a signal to the fuel truck.

COMMON ERRORS

a. Hazards resulting from failure to follow recommended procedures.
b. Poor planning, improper procedure, or faulty judgment in performance of post-flight procedures.

REFERENCES

1. FAA-H-8083-3A, Airplane Flying Handbook, Chapter 2.
2. FAA-S-8081-12, Commercial Pilot - Practical Test Standards for Airplane.
3. FAA-S-8081-14, Private Pilot - Practical Test Standards for Airplane.
4. POH / AFM, Pilot Operating Handbook / FAA-Approved Airplane Flight Manual.