Flight Lesson: Performance Takeoffs and Landings

Objectives:

1. exhibits relating to performance takeoffs and landings
2. able to perform short field and soft field takeoffs and landings
3. able to perform forward-slip-to-landing landings

Justification:

1. develops students ability to judge takeoffs and landings accurately
2. required elements for the private pilot checkride

Schedule:

Activity	Est. Time
Ground	0.0
Preflight/Taxi	0.0
Flight	0.0
Debrief	0.0
Total	0.00

Elements Ground:

- soft field takeoff
- soft field landing
- short field takeoff
- short field landing
- forward-slip-to-landing

Elements Air:

- soft field takeoff
- soft field landing
- short field takeoff
- short field landing
- forward-slip-to-landing

Completion Standards:

1. student exhibits knowledge relating to performance takeoffs and landings
2. student is able to perform short and soft field takeoffs and landings
3. student is able to perform a forward-slip-to-landing

Common Errors:

- common error 1
- common error 2

Presentation Ground:

soft field takeoff

PTS Standards	
Δ airspeed	Vx or Vy +10/-5 kts

1. object of a soft field takeoff is to transfer the weight from the wheels to the wings as soon as possible, and to achieve a short ground run.
   (1) optimum power setting and maximum power should be used
2. as much as practical, the pilot should try not to stop while on the soft surface as it may cause the nose of the plane to sink into the ground
3. procedure
   (1) flaps set per POH or 10°
   (2) taxi onto the takeoff surface without stopping
   (3) once aligned, apply power smoothly to full
   (4) keep weight off the nose wheel as much as possible by holding back pressure on the elevator
   (5) the nose will come off the ground, and the pilot must pivot the main gear to keep the plane in the optimal position
      i. as the nose comes up, release back pressure to reduce the chance of a tail strike
   (6) maintain positive direction control with the use of the rudder
      i. significant right rudder pressure will be necessary
   (7) plane will lift off at a slower than normal airspeed
   (8) accelerate to the appropriate climb airspeed close to the surface in ground effect
      i. ground effect *:phenomenon where an aircraft can fly at slower than typical airspeeds while near to the ground due to the disruption of the regular air patterns around the aircraft*
      ii. with obstacle, Vx, otherwise Vy
      iii. since a plane can fly at a slower airspeed in ground effect, it is important to stay close to the surface until a safe airspeed has been attained, otherwise there is a chance of sinking back down
   (9) maintain extended centerline as with any takeoff.
   (10) at 200 ft AGL (and clear of obstacle) bring up flaps (after accelerating to Vy)
   (11)continue normally

soft field landing

PTS Standards			
approach speed	≈ 1.3 Vso	**Δ airspeed**	+10/-5 kts

1. since a plane's nose wheel (and to a lesser extent the main gear) will have a tendency to dig into the soft surface on a soft field, the goal of a soft field landing is to transition the weight load from the wing to the wheels as slowly as possible to reduce the "dig in" of the wheels
   (1) land with some power, and slowly reduce

(2) keep nose held up as long as possible during the landing roll

2. approach is normal, with full flaps and normal approach speed (C152 - 65kts)

3. flare and touchdown

(1) at flare, keep some power left on

i. will result in a nose high flare and a prolonged float

(i) note, runway length is not of concern, and there is no specified touchdown point

(2) object is to

i. touchdown as smoothly as possible

ii. minimum descent rate

iii. airspeed as slow as possible

(3) after main wheels touchdown, hold back elevator to keep the nose wheel off the surface as long as possible

i. having only two wheels reduces ground friction

ii. high AoA provides the most possible lift from the wings

(4) maintain directional control with rudder

(5) brakes are not usually necessary during a soft field landing, as the surface will slow the plane down

i. braking will just cause more stress to the gear, and may cause the wheels to dig in.

4. after landing

(1) maintain full back elevator during taxi, and minimize braking

short field takeoff

PTS Standards	
Δ airspeed	Vx to 50ft, then Vy +10/-5 kts

1. there are two considerations for a short field takeoff

(1) use of a short ground run

(2) avoidance of obstacles in the takeoff and climb-out path

2. to avoid obstacles, the pilot must hold the pitch attitude that will achieve the steepest climb path

(1) this means

i. recommended short field flap setting

ii.maximum power

iii. best angle of climb speed (if no flaps are used)

iv. recommended climb out speed if flaps are used

(2) in the checkride, there will be a 50 ft theoretical obstacle at the end of the runway

3. note that before ever doing an actual short field takeoff, refer to the appropriate performance charts

4. procedure

(1) position the airplane as close tot he starting end of the runway as possible (for longest runway length), lined up with the centerline, and nose straight

(2) apply full power holding the brakes so the plane does not move, holding elevator back so propeller does not get damaged

(3) check engine instruments to ensure maximum power is being delivered

(4) release brakes when maximum power is achieved

(5) maintain directional control with rudder, and keep wings level with aileron, while maintaining neutral elevator to minimize drag

(6) at recommended airspeed, liftoff using back elevator

i. due to lag in airspeed indicator, and continued acceleration through rotation, positively rotate about 5 kts early, and takeoff will occur at the correct climb out speed

(7) pitch to the attitude that will give Vx (or with flaps, the obstacle clearance speed)

i. with the high power, and high AoA, more right rudder than usual will be required

(8) when obstacle is cleared, pitch to Vy, and when achieved, retract flaps

(9) continue normally

Short Field Landing

PTS Standards			
initial airspeed	≈ 1.3 Vso	**Δ airspeed**	+10/-5 kts
touchdown	-0/+200 ft		

1. as with all landings, land as much as possible into the wind, for steepest approach and shortest landing run

2. the idea is to land with a low airspeed, and an aiming point as close to the touchdown point as possible to reduce the landing distance

(1) in the checkride, there may be a theoretical 50 ft obstacle at the beginning of the runway, thus the touchdown point should be shifted down the runway to allow clearance of the obstacle

3. Procedure

(1) approach

i. with full flaps and reduced airspeed (see POH)

(i) since there is higher AoA, there is higher drag, thus more power is required

(ii) thrust provides a portion of lift

ii. airspeed controlled with Pitch, flight path controlled with power

iii. maintain a stabilized approach

(2) flare and landing

i. aim to cross the airport boundary with power on at the selected airspeed, and at a minimum altitude practical

ii. power off with minimal float with a more positive touchdown

iii. flare will be lower than normal, shorter and faster as well

iv. if a high sink rate develops on flare, add some power to prevent a heavy landing, the plane will settle as soon as the power is off

v. this is partially dude to the fact that the thrust was providing some portion of the lift (since of the high AoA)

vi. apply brakes smoothly and coordinated to maximum

(i) apply brakes smoothly because initially after touchdown, the wings will still be producing lift, and thus not all weight is on the wheels.

(ii) abrupt braking may cause the wheels to lock up

vii. use back elevator to keep weight on main gear, and increase aerodynamic drag

viii. on checkride, come to complete stop on runway or until examiner says otherwise

Forward-Slip-to-Landing

PTS Standards			
touchdown	-0/+400 ft		

1. definitions
   (1) slip *:is a descent with one wing lowered and the airplane's longitudinal axis at an angle to the flight path*
   (2) forward slip *:slip in which the airplane's direction of motion continues the same as before the slip*
   (3) forward-slip-to-landing :*intentional uncoordinated condition where ailerons and rudder are used opposite each other in oder to have the airplane present a greater frontal area to increase drag, and therefore increase descent*
2. slipping is done with the engine idle
   (1) it wouldn't make sense to slip if there was still power that could be reduced
3. in a forward slip to landing, a slip is used to steepen the approach path without increasing airspeed
4. a slip should be made to the left for a crosswind to the right, and to the right for a crosswind to the left
5. to slip:
   (1) the wing on the side toward which the slip is to be made should be lowered by the use of aileron
   (2) while simultaneously the nose must be yawed in the opposite direction by applying opposite rudder to maintain the original flight path
6. if a slip is used during the last portion of the final approach, the longitudinal axis of the aircraft must aligned with the runway prior to touchdown
   (1) otherwise you may get unnecessary side loading of the main gear.
7. discontinuing the slip is accomplished by simultaneous leveling of the wings and release of rudder pressure

Presentation Air:

1. short field takeoffs and landings
2. soft field takeoffs and landings
3. forward slip to a landing