Private Pilot Ground Lesson:

Systems And Equipment Malfunctions

Objectives:

1. To understand the a variety of potential emergency situations, and possible remedies/ actions to take

Justification:

1. PIC responsibilities require a thorough knowledge of one's systems, problems that may occur, and possible actions to take.
2. Private Pilot checkride requires an understand of potential system and equipment malfunctions.

Schedule:

Activity	Est. Time
Ground	1.5
Total	1.50

Recommended Readings:

AFH	Ch 16: 16-8 to 16-16

Elements Ground:

- engine emergencies
  - fuel starvation
  - carburetor / induction icing
  - loss of oil pressure
  - engine compartment fire
- vacuum malfunction
- pitot/static blockage
- electrical malfunction
- other emergencies
  - structural icing
  - flap malfunction
  - smoke/fire
- emergency equipment/survival gear

Completion Standards:

1. when the student exhibits knowledge related to systems and equipment malfunctions

Presentation Ground:

Emergencies Overview

1. in an emergency, the most important responsibility is to maintain control of the aircraft.
2. secondary is to resolve or respond to the emergency

Engine malfunctions/emergencies

1. roughness
   (1) could be caused by a variety of things including detonation, preignition, icing, incorrect mixture setting, faulty ignition or magneto, etc
   (2) applying carb heat, adjusting mixture, cooling the engine may help
   (3) if problem persists, the aircraft should be landed asap
2. fuel starvation
   (1) fuel starvation is different from fuel exhaustion in that there is still fuel available, it just can't get to the engine
   (2) *symptoms* include rough running engine followed by engine failure
   (3) *causes* can include incorrectly adjusted fuel tank selector, improper switching procedures for tanks, fuel vaporization
   (4) *actions* to take include checking fuel selector, switching tanks, turning on fuel pump, increasing mixture
   (5) if situation isn't corrected, follow engine failure procedures
3. carburetor icing
   (1) carburetor and induction icing can occur above freezing temperatures due to acceleration of the air
   (2) symptoms are a drop in RPM or manifold pressure with a constant pitch propeller.
      i. eventually the engine will stop due to lack of air for the fuel air mixture
   (3) carburetor heat should be applied until engine is running normally
      i. you will see an immediate drop in engine RPM, but then a gradual rise
4. induction icing (impact icing)
   (1) caused as below freezing water droplets impact the inlet air scoop.
   (2) *symptoms* will be similar to carburetor icing as the effect is the same (lack of air)
   (3) an alternate air source can be manually or automatically open to bypass the cold air, with warm air from the engine compartment
5. loss of oil pressure
   (1) can be caused by lack of oil, oil leak, broken pressure relief valve, burnt out bearings
   (2) this is very serious, and the aircraft should be landed as soon as possible.
      i. if oil pressure is low enough, engine seizure could occur
6. engine compartment fire
   (1) POH procedures should be understood and followed in an engine fire situation
   (2) during start up
      i. continue cranking to keep air moving
      ii.if engine starts up,
         (i) set at high RPM for a few minutes to try putting out the fire
         (ii) mixture - idle cutoff, fuel - off, switches - off, evacuate plane
      iii. if engine doesn't start
         (i) mixture - idle cutoff, throttle - full open, fuel - off, switches - off, evacuate plane

(3) during flight

i. ensure fire actually exists - usually smoke can be seen if you slip the aircraft

(i) flames won't necessarily be visible

ii. turn off fuel, allowing engine to run dry

iii. proceed with forced landing procedures

Vacuum malfunction

1. overview

(1) vacuum malfunction isn't critical in VFR flight, but flight should be terminated as soon as practicable

(2) knowing the instruments that rely on vacuum pressure can help eliminate instruments for use (heading indicator, attitude indicator usually)

(3) if the only indication is a suction gauge reading zero, ensure it isn't a gauge failure by noting the instrument response verse expected behavior

2. air filter block

(1) this may cause the vacuum instruments to behave erratically or respond slowing

(2) lower suction reading

3. vacuum pump failure

(1) gyros may continue to spin for a few minutes, but will eventually run down and no longer read correctly

(2) suction gauge will read zero

Pitot-Static malfunction

1. pitot-static malfunctions can occur due to

(1) the static ports

(2) the pitot tube

(3) both

2. the pitot-static instruments will react different depending on the combination of malfunctions that are occurring

	indicated airspeed	indicated altitude	indicated vsi
pitot blocked	incr w/alt gain decr w/all loss	unaffected	unaffected
one static blocked	inaccurate in slips, sensitive in turbulence		
both static blocked	decr w/alt gain incr w/alt loss	remains at blocked altitude	goes to zero and stays there
both static and pitot	freezes at blocked speed	freezes at blocked altitude	goes to zero and stays there

3. actions to take include pitot heat (if blocked by ice), using alternate static air for static port

(1) alternate static air causes a lower static pressure than outside, thus airspeeds will read higher, and altitudes will read higher

Electrical malfunction

1. electrical malfunctions can become serious quickly as the pilot will lose many critical instruments when battery power is lost

2. battery rating define how long a battery can last
   (1) amp hour rating defines how many amps a battery can sustain for an hour
      i. 25 amp hour rating = 25 amps for 1 hour, or 5 amps for 5 hours
3. since time until depletion is directly affected by amps used, all non-critical instruments should be turned off immediately
4. *symptoms* low voltage light and/or discharge reading on ammeter
5. actions to take include:
   (1) turn off all unnecessary equipment immediately
   (2) notify ATC of situation and intentions
   (3) land at nearest airport
6. things to note:
   (1) remember flaps are electrically actuated, so no flap landing may be required
   (2) if landing gear is electrically actuated, manual gear extension will be required

Other Emergencies

1. structural icing
   (1) structural icing can only occur in conditions in which the aircraft is in visible moisture, and the surface of the aircraft is below freezing
      i. note the surface of the aircraft can be below freezing when ambient air is above freezing due to acceleration of air over the wing
   (2) as VFR pilots, we should rarely run into icing conditions as it is usually associated with clouds or bad weather
   (3) if icing does occur, this is a very critical situation as it affects
      i. aircraft performance
      ii. engine power
      iii. CG changes
      iv.pitot static blockage
      v. visibility
   (4) actions to take
      i.remember to fly the aircraft and request assistance from ATC
      ii. turn on carb heat and pitot heat
      iii. if possible descend to an altitude that is significantly above freezing temperature
      iv. land as soon as possible
2. asymmetrical flap deployment
   (1) occurs when one flap deploys and another does not, causing asymmetrical chord lines on each wing, and uneven flying characteristics
   (2) actions to take
      i. if possible, retract flaps to bring in affected flap, otherwise:
      ii. expect roll tendency towards wing with least flaps deployed
         (i) full aileron may be required to counteract roll tendency
      iii. wings will have different stall speeds, so fly a faster approach to land
      iv. avoid landing with crosswind to the deployed flap as that will increase roll tendency
3. smoke/fire in cabin
   (1) usually caused by electrical malfunction, heating system malfunction, or passenger/pilot carelessness

(2) main objectives are to eliminate/reduce the fire and landing asap

(3) after fire has be extinguished, or reduced as able, the cabin should be evacuated of smoke by opening windows or foul weather windows as POH allows

i. if smoke becomes more intense, this may indicate the fire still exists, and more air is feeding the fire. In this case, close windows

(4) in electrical fires,

i.turning off all electrical equipment can help reduce the aggravation of the fire.

ii. this may not stop the fire, but reduce the potential for spreading

iii. if some equipment is absolutely necessary, turn on devices one at a time, and check for odors or smoke to determine if needed equipment was the cause of the fire

Emergency Equipment/Survival Gear

1. ELT - emergency locator transmitter

(1) battery must be replaced or recharged after more than 1 hour of cumulative or 50% of the battery's useful life

(2) tests can be done within the first 5 minutes of any hour for up to 3 cycles

(3) after landing (usually before shutdown) it is good airmanship to check 121.5 to see if the ELT has been activated by a hard landing

(4) ELT's, when active, will transmit on 121.5 and 243.0

2. flotation gear

(1) required when flying beyond power-off gliding distance from land, on a commercial operation