FLIGHT BRIEFING NOTES

FOR RPP/PPL/CPL FLIGHT TRAINING IN C-150M & C-172M
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LIST OF PPL FLIGHT TRAINING EXERCISES

1) Familiarization - introduction to flying
2) Aircraft familiarization & preparation for flight
3) Ancillary controls
4) Taxiing
5) Attitudes and movements
6) Straight & level flight
7) Climbing
8) Descending
9) Turning
10) Flight for range, and flight for endurance
11) Slow flight
12) Stalling
13) Spinning
14) Spiral dives
15) Side-slipping
16) Take-off
17) Circuit flying
18) Approach & landing
19) FIRST SOLO
20) Illusions of drift & low flying
21) Precautionary landings
22) Forced landings
23) Navigation
24) Instrument flying

THE PHASES OF LEARNING TO FLY

Phase 1 - Introduction & basic flying skills	Exercises 1,2,3,4,5,6,7,8,9
Phase 2 - Understanding the limitations of flight	Exercises 10,11,12,13,14,15
Phase 3 - Circuit work, takeoffs & landings - Solo!	Exercises 15,16,17,18,22, 19!
Phase 4 - More Circuits, Special techniques, Building solo time	Exercises 16,17,18
Phase 5 - Travelling & coping with problems on the way	Exercises 10,20,21,22,23,24
Phase 6 - Review - Preparation for Flight Test	Exercises 2-24 ‘polish up’

A GENERAL FLIGHT TRAINING PLAN

This shows an outline of a possible ideal progression through the PPL syllabus in the minimum possible time. If each lesson is assumed to be 1.5 hrs, then this plan will just cover the required minimum flight time of 45 hours. The long cross-country flights are counted as double lessons. Actual time required may be much greater than 45 hours. The purpose of this outline is mainly to show how the flight exercises fit into a typical training plan, and to show how this plan can be divided into six phases of learning to fly.

-Phase 1	
Lesson #1 Dual	Ex. 1,2,3,4,5,6,9 & Medical Examination
Lesson #2 Dual	Ex. 2,3,4,5,6,7,8,9,16
Lesson #3 Dual	Ex. 5,6,7,8,9,16
-Phase 2	
Lesson #4 Dual	Ex. 10,11,12,16 & Start preparation for PSTAR Exam
Lesson #5 Dual	Ex. 11,12,13,16
Lesson #6 Dual	Ex. 12,13,14,15,16,17,18
-Phase 3	
Lesson #7 Dual	Ex. 16,17,18 PSTAR and issue of SPP
Lesson #8 Dual	Ex. 16,17,18
Lesson #9 Dual	Ex. 16,17,18 & pre-solo emergencies
Lesson #10 Dual	Ex. 16,17,18 & pre-solo emergencies
Lesson #11 Dual+Solo	Ex. 16,17,18 ---- 19!
-Phase 4	
Lesson #12 Dual+Solo	Ex. 16,17,18
Lesson #13 Dual+Solo	Ex. 16,17,18 Short field & minimum ground run
Lesson #14 Solo	Ex. 16,17,18
Lesson #15 Dual+Solo	Ex. 16,17,18 Soft/Rough field technique
Lesson #16 Solo	Ex. 16,17,18
-Phase 5	
Lesson #17 Dual	Ex. 6-9,20,21,22,23
Lesson #18 Dual	Ex. 21,22,23,24
Lesson #19 Dual	Ex. 24
Lesson #20 Solo	Ex. 6-9,16-18,23 to practice area
Lesson #21 Dual	Ex. 23 Short cross-country (eg. CYLS)
Lesson #22 Solo	Ex. 23 Short cross-country (eg. CYLS)
Lesson #23,24 Dual	Ex. 23,24 Long x-c (eg. Hanover - Collingwood)
Lesson #25,26 Solo	Ex. 23 Long x-c (eg. Hanover - Collingwood)
-Phase 6	
	PPL written Exam at TC
Lesson #27 Dual	Review - Ex. 1-24 as required for flight test
Lesson #28 Solo	Practice - Ex. 1-24 as required for flight test
Lesson #29 Dual	Review - Ex. 1-24 as required for flight test
Lesson #30 Dual	Complete Practice Flight Test
Lesson #31 ‘Solo’	Flight Test, then Application for PPL

<u>EXERCISE 1 & 2 - FAMILIARIZATION AND PREPARATION FOR FLIGHT</u>

KEY POINTS -
- Flying Club website, booking procedures, status sheets, etc
- Flying Club binder & keys, at Guardhouse
- The Shed - Oil storage, tire pump, pre-heater
- Safety equipment – ELT, Fire extinguisher, First aid kit, seat belts
- Documentation for aeroplane & pilot (see below)
- Preflight inspection procedure

DOCUMENTS TO BE CARRIED ON BOARD

A) AEROPLANE DOCUMENTS – 2 Certificates, 2 Reports, 2 Books, 2 Others (I&I)

(1) Certificate of Registration (C of R), CAR 202.26, Check category, maintenance standards depend on whether the aeroplane is registered for PRIVATE or COMMERCIAL use.
(2) Certificate of Airworthiness (C of A), CAR 507.01, check issue date (aeroplane's ‘birthday’)
(3) Annual Airworthiness Information Report (AAIR), CAR 501.01, Sent by TC to our club, about 6 weeks before the anniversary date, or ‘birthday’. It must be completed for TC by the due date (usually done online). Not mandatory to carry copy onboard, but good for reference.
(4) Weight & Balance Report, for original configuration, supplemented by amendment pages detailing weight changes due to minor changes in equipment, and new reports after re-weighing. Ref CAR 605 Schedule I for W&B recording in Journey Log, and also CAR 605.92(1)(c)
(5) Journey log book (CAR 605.95). Check for snags, a match in times with Tach Sheets, and :-
- compass calibration within past 12 months, and
- ELT recertification within past 12 months, and
- annual inspection in last 12 months (we do 50 & 100 hr checks, as commercial operators)

(6) Pilot’s Operating Handbook (POH) Ref CAR 605.04
(7) Interception Orders (these are also contained in the CFS). CAR 602.144
(8) Insurance : Proof of liability insurance coverage (Private aircraft only). CAR 606.02 (9)

B) PILOT DOCUMENTS

(1) Pilot licence or permit, plus medical certificate.
(2) Radio operators licence.

C) OTHER DOCUMENTS NORMALLY ON BOARD

(1) Tach Sheets : mainly for billing. Prior to flight, two numbers should be checked; the air time until the next 100 hr inspection, and the tach time at shutdown recorded by the previous pilot (so you only pay for what you use). Check for any reports of minor defects or snags.
(2) VTA & VNC aeronautical charts (not mandatory for day VFR – CAR 602.60(1)(b))
(3) Copy of CFS (not mandatory for day VFR – CAR 602.60(1)(b))

EXERCISE 3 - ANCILLARY CONTROLS

CARB HEAT

Refer to FTM for background. In flight, as a general rule, carb heat is OFF (selector IN) until you are about to reduce power to below the green arc on the rpm gauge. Carb heat should be selected ON before the throttle is pulled back. When reapplying power to bring rpm back into the green arc, the throttle should be pushed forward before carb heat OFF is selected.

CARB HEAT ON BEFORE THROTTLE BACK
THROTTLE FORWARD BEFORE CARB HEAT OFF

When conditions make ice formation likely in cruise, carb heat should be applied every 20 minutes or so, to check for the presence of ice. If necessary cruise with carb heat on.

MIXTURE

Refer to FTM and aircraft handbook for background. Aircraft handbook climb performance table usually quotes minimum altitude for leaning. When leaning at high altitude, adjust for peak rpm or a little richer if engine smoothness improves. Leaning to peak rpm will give best power, and provide most of the potential fuel consumption savings.
A mixture that is too lean will tend to cause overheating and so this control should be used sparingly.

PRIMER

Injects fuel into the intake manifold, downstream of carb. If primer is not properly closed and locked after use then fuel will seep through to manifold while engine is running, causing an excessively rich mixture. Check securely locked by pulling.

TRIM

The elevator trim tab is a device to relieve the pilot of elevator control forces. In flight, it should be used when the aircraft is steady at the desired attitude and speed, with the desired rpm. It should not cause any change in the pitch attitude or speed when it is used, the only change should be a reduction of the elevator control force to zero.

HEATING & VENTILATION

See aircraft handbook for description of system. Be aware of the possibility of Carbon Monoxide problems.

EXERCISE 4 - TAXIING

Refer to FTM and aircraft handbook for background.

OBJECTIVE - To learn how to safely control the aircraft on the ground in all conditions.

KEY POINTS -

- Speed, keep it low, especially near obstacles and when turning
- Brakes, do not 'ride the brakes', heels should be normally down on the floor, do not rely on the brakes when you don't have to (eg very slow taxi to fuel tank)
- Column normally fully aft when turning tightly, for less weight on nosewheel
- Can use one brake to turn tightly
- Wind, extra care required, especially with tailwinds, deflect control surfaces to reduce chance of wind lifting tail and/or wing.
- Slipstream considerations for parking, run-up
- Soft field / snow considerations, how not to get stuck
- Ice formation on warm brakes, may freeze in flight.
- ATC procedures and clearances at controlled airports, holding points, runway crossing.

- Instrument checks, while turning.
  Turn & slip, compass, directional gyro & artificial horizon can be checked (& ADF if fitted).

  Eg, when turning to the left
  Needle left, ball right, numbers decreasing (compass & DG), Artificial Horizon steady.

EXERCISE 5 - ATTITUDES AND MOVEMENTS

OBJECTIVE - To learn how to recognise aircraft ATTITUDE by reference to the horizon, and how control movements are used to PRODUCE changes in attitude and CONTROL or maintain an attitude. To gain an understanding of the YAWING motion and how it can be controlled.

KEY POINTS -

ATTITUDES -

- 3 axes : lateral, longitudinal & vertical.
- 3 rotational movements : pitching, rolling & yawing.
- ATTITUDE relates to pitch and roll, not yaw.
- 3 pitch attitudes, cruise datum (nose level), nose high & nose low, demonstrating range of pitch attitudes.
- 1 banked attitude - left and right versions, which can be combined with any pitch attitude.
- Basic instruments : altimeter and ASI (also rpm).
- Typical cruise datum C-150M = 2300 rpm & 90 mph
C-172M = 2250 rpm & 105 mph.
- Nose high ; normally means climb (75-85 mph) but not always.
- Nose low ; normally means descent, (65-120 mph) but not always.

MOVEMENTS -

- ELEVATOR : used to PRODUCE chances in pitch attitude, and to CONTROL (or hold) a pitch attitude.
  No major secondary effects, but a minor yaw effect of P-factor.
- AILERON : used to PRODUCE changes in bank attitude, and to CONTROL bank attitude.
  Secondary effect of banked attitude is the generation of YAWING motion (turning).
  Frise aileron effect, also lift inclination causes sideslip, then fin causes yaw.
- RUDDER : can produce yawing motion, but is normally used only to CONTROL yaw.
  Secondary effect of yawing is the generation of rolling motion, because the faster 'outside' wing has more lift.

INTRODUCTORY NOTE ON LOOK-OUT

Look-out means scanning the sky for other aircraft. It is not the same procedure as when driving a car because aircraft move in all directions. In flight it is important to divide the sky into sections, and pause for a few seconds in each section. If the pause is omitted, and the sky is scanned in a continuously moving sweep, then it is much harder for the eye to detect other traffic.

EXERCISE 6 - STRAIGHT & LEVEL FLIGHT

OBJECTIVE - To learn to smoothly control the aircraft in :-
(i) Straight Flight, and (ii) Straight & Level Flight.
Also, how to change airspeed in S & L Flight.

KEY POINTS -
STRAIGHT FLIGHT -

- Defined by three criteria :- Constant pitch attitude; wings level; no yawing motion.
- Achieved by visual reference to the horizon (for pitch & roll) and visual reference for constant heading, no instruments required.
- control movements (elevator, aileron, rudder) should be gentle corrections to maintain pitch & roll attitude & prevent yaw. Keep the 'picture' the same, in the windscreen.

STRAIGHT & LEVEL FLIGHT -

- Defined as Straight Flight at CONSTANT ALTITUDE, thus depends on reference to ALTIMETER (and VSI).
- Avoid staring at instruments, should be looking outside most of the time, with glances at the instruments.
- Both the ELEVATOR and THROTTLE controls are relevant for maintaining altitude. The elevator controls the pitch attitude and the throttle controls power.
- TECHNIQUE - In smooth air, aircraft can fly S & L 'hands-off' when trimmed, but with normal turbulence some pilot action is required to hold altitude. This could be done with throttle adjustment alone, pitch attitude being constant; or by elevator alone, with constant power. In practice, the latter is preferred because the elevator is quicker and easier to use.
- ELEVATOR : quick-acting and used often, but gently.
- THROTTLE : not so quick-acting, adjusted occasionally.
- If away from assigned altitude, make a small but visible adjustment to the pitch attitude, using elevator. Hold new pitch attitude until assigned altitude is regained.
- Introduction to Compass & Directional Gyro (or Heading Indicator).
- Introduction to trim wheel, to reduce elevator force to zero, without changing pitch attitude
- Introduction to 'crooked' Straight & Level, constant heading & altitude, but wings not level

SPEED CONTROL IN STRAIGHT & LEVEL FLIGHT

- To reduce speed, move throttle back, and as speed decreases, ease back with elevator control to increase Angle of Attack (AoA). If pitch attitude is not adjusted, aircraft will descend. Trim.
- To increase speed, move throttle forward, and as speed increases, ease forward progressively with elevator control to reduce AoA, to prevent climb. Trim.

NOTE ON LOOK-OUT CONSIDERATIONS
Scanning the sky for other traffic should be becoming a habit by now. It is good airmanship to maintain a constant awareness of the possibility of conflicting traffic. During this exercise, it is important to note the reduced forward visibility when flying at lower than normal speed, with the nose higher than normal.

EXERCISE 7 - CLIMBING

OBJECTIVE - To learn how to start a climb from level flight, and how to level-off from a climb and return to level flight.

KEY POINTS -

- 3 actions : Attitude : Power : Trim - 'APT'.
  for both entering & ending a climb.

- To start a climb; LOOKOUT ahead & above;
  Attitude - raise the nose and hold (speed reduces)
  Power - throttle fully forward (keep straight)
  Trim - adjust attitude for desired speed, then trim as reqd.
- To level off;
  Attitude - Anticipate, lower the nose, hold ALTITUDE
  Power - allow speed to increase, then throttle back
  Trim - adjust AoA & rpm as speed increases, then trim as reqd.

- Keeping straight with rudder, use visual cues, D.G. & slip ball.
  When entering a climb in C-150 or 172, nose tends to drift left, ball drifts right.
  Right rudder needed, 'tread on the ball'.
- P-factor means downgoing prop blade (on right) creates more thrust than upgoing blade (on left) due to higher AoA than normal cruise flight
- Slip ball is not 100% reliable when thrust line deviates laterally from drag line, but is still a pretty good guide
- Speeds from Aircraft Handbook must be known,
  Best ANGLE = 70 mph @ SL for QKX ; 75 mph @ SL for CZJ
  Best RATE = 78 mph @ SL, 71 mph @ 10,000' for QKX ; 91 & 80 mph for CZJ
  Normal speed = 75 mph in QKX & 80 mph in CZJ
- Flaps, not normally used for climb in C-150 or C-172, except after a take-off with flaps 10 degrees, or during an overshoot, & these cases will be covered later in Exercises 16-18.
- Carb heat, should normally be OFF for climb, engine performance & climb rate are degraded with it ON.

LOOKOUT DURING THE CLIMB

The view ahead is restricted, so during a long climb it is important to maintain the lookout ahead by changing heading, or by 'nodding' the nose down briefly.

EXERCISE 8 - DESCENDING

OBJECTIVE - To learn how to start a descent from cruise, and how to level-off from a descent and return to level flight.

KEY POINTS -

- 3 actions : Power : Attitude : Trim - ‘PAT’.
  for both entering & ending a descent.
  (NOT THE SAME SEQUENCE AS CLIMB, WHICH IS ‘APT’)

- To start a descent; LOOKOUT ahead & below;
  Power - throttle back to desired rpm (keep straight)
  Attitude - hold till desired speed reached; lower nose
  Trim - adjust, when fully settled at desired speed.

- To level off;
  Power - Anticipate, increase rpm to cruise power
  Attitude - raise the nose to cruise point, hold ALTITUDE
  Trim - adjust AoA & rpm as speed settles, then trim as reqd.

- Keeping straight with rudder, use visual cues, D.G. & slip ball. When entering a low power descent, nose may drift right, ball drifts left. Left rudder needed. ‘Tread on the ball’.
- Types of descent, Power may vary from cruise rpm to Idle,
  Desired speed may vary from about 70 mph to 120 mph,
  Typical descent in C-150 & 172 is with 1500 rpm,
  with airspeed of 70 mph in QKX & 75 mph in CZJ.
  This type of descent relates to later circuit work, Exercise 17.

- Flaps, may be used for descent in C-150 & 172, if airspeed is within the white arc on ASI. With flaps down more than about 10 degrees, extra drag causes increase in rate of descent.
- If flaps are down you have more camber, so need less AoA for a given speed, this means that the nose is lower.
- Carb heat, should always be selected ON, BEFORE rpm is reduced below the green arc on rpm gauge (ie below 2000 in QKX or 2200 in CZJ) when starting a descent ; and carb heat should be selected OFF, AFTER rpm is restored to within green arc. See Exercise 3.
- Carb heat not necessary for an ‘enroute’ type of descent, with rpm in the green arc.

EXERCISE 9 - TURNING

OBJECTIVE - To learn how to perform well-coordinated Gentle, Medium & Steep level turns, and climbing & descending turns.

KEY POINTS -
- Definition :- Gentle = up to 15 degrees of bank;
  Medium = 15 to 30;   Steep = more than 30 (normally 45).
- Bank angle assessed visually, & with Artificial Horizon.
- The slip ball must be understood, acts like a pendulum.
- Turn needle must be understood, Rate 1 = 3 deg/second.

GENTLE LEVEL TURNS -
- Lookout - very important for turning.
- Begin by rolling to desired bank angle and holding.
- 'OUTSIDE' check pitch & bank attitude, continue lookout.
- 'INSIDE' check AH, ball, altimeter (VSI), ASI, (TN).
- Slightly more AoA required than in S & L flight.
- Slight reduction in speed expected, (more induced drag).
- 'Press on ball' to centre it.
- Different view in left & right turns due to side-by-side seating.
- To roll out, use DG, anticipating required heading.
- Reduce AoA as wings become level.

MEDIUM LEVEL TURNS -
- Same as above only more so.
- More bank angle, more extra AoA to maintain height, more induced drag, more g, more speed loss, more turn rate.
- To roll out, more anticipation & more reduction in AoA.

STEEP LEVEL TURNS -
- Same principles as above, but increase in stall speed due to g, coupled with speed loss due to induced drag mean that power should be added. Roll out is followed by power reduction.
- Use landmarks for accurate roll-out direction, it is not practical to use DG to roll out from a steep turn.
- Avoid spiral dive tendencies, if diving reduce bank before pulling back on elevator control.

CLIMBING & DESCENDING TURNS -
- Principles are similar, but ASI more important than Altimeter.
- Angle of Attack is different for Left & Right wings (Spiral Staircase analogy). In a climbing turn the outer wing has greater AoA, in a descending turn the inner wing has greater AoA.
- Thus, aircraft tends to 'roll-in' during climbing turns, and tends to 'roll-out' during descending turns, so different amounts of aileron are required to hold bank angle.

EXERCISE 10 - FLIGHT FOR RANGE & ENDURANCE

OBJECTIVE - To learn how to cover the most distance per gallon of fuel, and how to make a gallon of fuel last as long as possible.

KEY POINTS -
- Refer to FTM & Aircraft Handbook for background.
- If leaning the mixture, it's safer to err on the rich side to avoid overheating the engine (Ref Exercise 3).
- Must have no slip (ball centred) for minimum drag.

BEST RANGE -
- Best range depends on winds; if no wind then higher is generally slightly better. Check cruise chart of Ex 23 - 64% power at 2,500' vs 10,000', 110 vs 118 mph TAS (but cruise chart does not consider climb fuel and lower speed during climb).
- Altitude effects are different with turbocharged engines, or turbine engines
- Optimum altitude & rpm should be selected in pre-flight planning, rather than in flight.
- Cruise performance data are based on DENSITY altitude (unless temperatures are quoted), so Nav Computer & temperature forecast will be required, to find Density Altitude.
- With power off, the best gliding range is obtained at the best L/D ratio, which means (as L = W) that drag must be a minimum, so the best speed is the minimum drag speed Vmd. This speed is shown on the gliding range chart in Aircraft Handbook (70 mph for QKX, 80 mph for CZJ). This best-glide IAS cannot be used universally for best range in cruise because of engine & propeller performance effects with power on.

BEST ENDURANCE -
- One reason to fly for endurance is to wait for a storm to clear an airfield before landing.
- Best endurance does not depend on wind.
- Minimum fuel flow rate = minimum rpm = minimum power.
- Experimentation can be used to find minimum rpm for straight & level flight. The minimum rpm depends on weight & density altitude, but is about 2000 rpm for QKX & less for CZJ.
- The endurance IAS should be less than the IAS for best range, and is about 65 mph for QKX & similar for CZJ.
- A few degrees of flap can be used to improve visibility ahead (not more than 10 degrees), at some small penalty to endurance
- Altitude is not very significant for endurance, see Cruise Performance chart of Ex 23 See 64% power at 2,500' vs 10,000', both have same gph and endurance (but cruise chart does not consider climb fuel, so lower altitude is slightly better).
- Altitude effects are different with turbocharged engines, or turbine engines
- With power off, the best endurance is obtained when the rate of sink on VSI is a minimum. This corresponds to the minimum power speed. Gliding range will be less than optimum.

EXERCISE 11 - SLOW FLIGHT

OBJECTIVE - To learn how to :-
- recognize slow flight
- perform coordinated manoeuvres with confidence during slow flight
- smoothly recover to normal cruise.

KEY POINTS -
- Review FTM for background.
- Definition : Slow Flight is defined as flight at speeds below the endurance speed, and above the stalling speed.
  65 mph is a good speed for initial slow flight practice on QKX & CZJ, with 60 or 55 mph used later as skill develops.
- Situations when this knowledge will be required include
  i) landing bounce recovery
  ii) soft field takeoff
  iii) inadvertent speed loss (possibly on approach).
- Visibility ahead is reduced, so change heading often.
- Experimentation can be used to show how the rpm required for level flight varies with speed. The rpm required will reduce as speed reduces until the endurance speed is reached, then any further reduction in speed will cause an increase in rpm required for level flight. The endurance speed is the minimum power speed, not the minimum drag speed.
- Ailerons, Elevator & Rudder become less responsive as speed reduces, particularly ailerons which are out of prop slipstream and have reduced effectiveness at low speeds ; but in slow flight with power off (eg forced landing) elevator & rudder will feel sloppier as well, because there's no slipstream.
- Recognition of slow flight is important, if uncorrected may lead to a stall and/or spin. The feel of the controls is one cue, also the pitch attitude and the difference in sounds.
- HASELL checks are required, see Exercise 12 for details.
- To begin slow flight smoothly, after the HASELL lookout, pull carb heat on and select about 1500 rpm, increasing AoA as speed reduces (to maintain altitude), keep straight, as speed drops close to desired speed, restore rpm to about 2000 and select carb heat off. Adjust attitude to get desired speed and adjust rpm to get level flight, then trim.
- Quite a lot of rudder may be needed to keep straight.
- Adverse yaw can be apparent (especially in QKX) when turning. Frise aileron effect does not work properly (designed for higher speed), so a coordinated turn has to be handled differently, with rudder input being used, with aileron, to enter a turn.
- 'Reversed Effects' – In slow flight, power effect on speed is 'reversed', ie more power required to fly at reduced speed. Also, moving elevator control aft tends to cause a descent, and moving elevator forward tends to cause a climb, which is a 'reversed' effect, compared to normal cruise. Some effects are not reversed – elevator aft still causes pitch up and reduced speed; and at same speed more power causes a climb, as in 'normal' flight.
- Recovery from slow flight - smoothly apply full power and progressively reduce AoA as speed increases, to maintain altitude. Keep straight. As speed increases, reduce rpm and finally, retrim.

EXERCISE 12 - STALLING

OBJECTIVE - To understand the phenomenon of stalling, how to deliberately stall the aircraft and how to recover from stalls efficiently. Also, how to recognize the approach to the stall in order to eliminate accidental stalls.

KEY POINTS -
- Review FTM for background.
- This lesson is practised at a safe altitude but it really relates to potential dangers in the take-off & landing phases of flight.
- Safety checks required before stalling and spinning,

‘HASELL’
Height sufficient – 3,000' AGL or more
Airframe - flaps as required (may be down for stalls but not spins)
Security - no hazardous loose articles, belts tight
Engine - mixture rich, T & P in green, fuel
Location - known, not over a town etc.
Lookout - especially below - clearing turn

STALL ENTRY -
- Many types of stall will be examined during flight training.
  Whether the entry is from straight & level flight or from turning and/or climbing or descending flight the basic cause of the stall is the same, too much Angle of Attack.
- Although stalling SPEEDS are often quoted, an aeroplane can stall at almost any speed (because of g).
- For a typical power-off stall entry from level flight, select carb heat on, close throttle, maintain altitude and heading with wings level as speed reduces. As IAS drops through 70 mph, move the elevator control fully back to the stop.
- Notice buffeting and natural pitch down at the stall.
- Notice very low IAS and high sink rate on VSI.

STALL RECOVERY -
- First action is always to MOVE ELEVATOR CONTROL FORWARD to REDUCE ANGLE OF ATTACK which unstalls the wings.
  This is the PRIMARY RECOVERY ACTION which must become automatic.
- Aileron is ineffective for ‘lifting a wing’ and may make things worse (Ref Ex. 11, adverse yaw) so keep ailerons neutral and use rudder to lift a wing that has dropped.
  If the left wing drops apply full right rudder and centralize rudder as wing lifts.
- Apply all remaining power (and push carb heat off) to minimize height loss.
- Avoid lowering the nose excessively, which leads to a dive and unnecessary height loss.
- Observe height loss and as skill develops, aim for the minimum loss of height.
- Recovery should be completed above 2,000’ AGL.

EXERCISE 13 - SPINNING

OBJECTIVE - To understand the phenomenon of spinning, and to recognize the conditions which can lead to a spin. Also, how to enter a spin deliberately and how to recover promptly at any stage of the spin development.

KEY POINTS -

- Spins at a safe altitude are FUN.   Refer to FTM for background.
- Two phases of development of the spin
  - i) incipient stage, before autorotation is established
  - ii) fully developed stage, with stable continuous rotation
- Safety checks ‘HASELL’ as for stalling, except :-
  - Height sufficient – 4,000' AGL or more
  - Airframe - flaps MUST be UP   (recovery exceeds white arc speed)
- Many aeroplanes are not certified for spins! Do not spin them!
- Beware of exceeding weight & aft cg limit, especially for C-172

SPIN ENTRY -

- Can be entered from climbing/descending and/or turning flight but for training is normally entered from straight & level flight.
- Similar to stall entry, after lookout pull carb heat on and reduce power to idle. Keep straight with wings level as speed reduces. Increase AoA to maintain altitude. As speed drops through 70 mph, move elevator control fully back to the stop, and hold, also apply full rudder and hold. In C-172 a brief burst of power helps the spin entry.
- Use left rudder for a spin to the left & vice versa.
- The rudder input causes yaw, and roll. Roll at high AoA tends to stall the downgoing wing.
- Instrument indications when in a spin - ASI reads low (about 50 mph), turn needle fully deflected in direction of spin (use as an aid in recovery if disorientated).

SPIN RECOVERY -

- During early part of incipient stage, when wing drop is less than 90 degrees, recovery is similar to that used when a wing drops during a stall. Procedure is - move elevator control forward to reduce AoA, ailerons neutral, full rudder to lift the wing. As wings become level, apply full power to minimize height loss.
- If spin has fully developed, full recovery procedure is
  1) check power off & ailerons neutral
  2) apply full opposite rudder & hold
  3) move elevator control forward to unstall wings
  4) as rotation stops, centralize the rudder
  5) ease out of the dive, do not reapply power until you have stopped the dive
- Note height loss during recovery (more than a typical stall).
- One danger area at low level is the turn onto final approach, at low speed, with too much rudder used. Inner wing tends to drop (Spiral Staircase analogy + rolling motion gives higher AoA on lower wing).
- Another danger area at low level is a climbing turn (eg obstacle clearance). Even if the ball is perfectly centred, the outer wing has higher AoA and tends to stall first and often drops abruptly (Spiral Staircase analogy).
- Recovery should be completed above 2,000’ AGL.

EXERCISE 14 - SPIRAL DIVES

OBJECTIVE - To learn to recognize the first signs of a spiral dive and how to recover promptly.

KEY POINTS -

- Review Exercise 5, secondary effects of aileron and rudder.
- The C-150 & 172 are spirally unstable (like most aeroplanes).
- In a sideslip, dihedral tries to raise low wing ; but fin tries to swing the nose in the direction of the slip, to eliminate the slip. The fin wins.
- If an aeroplane is made spirally stable (like a free-flight model aeroplane, with lots more dihedral, and/or less directional stability) it would be hard to make it turn.
- Spiral dive is unlike a spin because a spiral gets progressively worse at an ever-increasing rate, whereas a spin is stable.
- Because of the spiral dive nature, recovery must be prompt.
- Symptoms of a spiral dive are :- one wing dropping slowly, nose dropping slowly, speed increasing, rpm increasing, turning, lower wing dropping more, nose dropping more, increasing descent rate & turn rate, etc.
- There is a danger of exceeding aircraft speed limits and/or rpm limits if not corrected promptly.
- Spiral dive can be entered in many ways, from S&L, from steep turn which goes wrong, or stall/spin entry that goes wrong. Recovery procedure is the same in all cases.

- Recovery procedure is :-
    1) Throttle back (fully back in severe cases)
    2) Level the wings
    3) Ease out of the dive

  Put another way, the recovery sequence is :- THROTTLE, AILERON, ELEVATOR

- Because of the natural spiral instability a C-150 or C-172 will not fly with hands and feet off for long periods.
- Pilots who are not experienced in flying by instruments alone can get into serious trouble when they lose visual references, such as by entering cloud. The aircraft usually enters a spiral dive sooner or later. Don't enter cloud during solo training, it’s too dangerous.

EXERCISE 15 - SIDE-SLIPPING

OBJECTIVE - To learn what side-slipping is, what it should be used for, and how to fly it.

KEY POINTS -
- Definition : the aircraft is side-slipping if the airflow is coming from the side, not head-on.
- Not the same as a sideways drift, in which the airflow is approaching head-on, the wings are level and the ball is centred, but the wind happens to be blowing the aircraft slightly sideways over the ground. This is known as crabbing, and does not mean the aircraft is side-slipping.
- There are two main reasons to side-slip
  1) to lose excess height
  2) to land in a cross-wind
- In a side-slip the aircraft produces more drag, because it is ‘flying sideways’ slightly, or ‘flying crooked’.
- In a sideslip, ASI may be unreliable because static port is on one side only. Pitch attitude becomes important to judge speed.
- In a sideslip, one wing is partially shielded so stall speed may be slightly greater. Avoid getting too slow.
- In a side-slip the slip ball will not be in the centre.
- Slip ball relies on thrust being along fuselage centreline, to read accurately.
- If ball is not centred, you’re slipping ‘towards it’.
- ‘Tread on the ball’ to centre it, or if turning can also alter bank angle to centre it.

SIDE-SLIPPING TO LOSE HEIGHT -
- Can be used during straight flight (constant heading) or during turns. In the latter case, turn is called a slipping turn.
- Side-slip can be stopped quickly and easily, so sometimes better than lowering flaps.
- Can be used with flaps extended in C-150 & C-172, may get light tail buffet.
- Typical usage includes during a forced approach (Ex 22), on downwind, base or final leg. Also during a normal circuit, usually during early part of final approach.
- To begin, apply aileron one way together with opposite rudder and hold. Adjust pitch attitude with elevator to maintain speed. Aileron and rudder controls are ‘crossed’, eg left aileron + right rudder. Amount of deflection sets sideslip angle, and rate of height loss.
- To recover, ‘uncross’ controls, by centralizing aileron and rudder. Check speed and correct pitch attitude.

SIDE-SLIPPING FOR CROSS-WIND LANDINGS
- A crosswind tends to make you drift laterally downwind, away from the centreline. Side-slip is used to cancel out this lateral drift, while keeping the wheels lined up with the runway.
- On approach, lower the upwind wing to slip into the wind. Use opposite rudder to keep wheels lined-up with runway and to prevent a turn. If still drifting to downwind side of runway, use more side-slip, and vice versa.
- There is a whole spectrum of possible ways to side-slip along a runway centreline, but only ONE way that keeps the wheels perfectly lined up with the runway
- Crosswind velocity usually changes with altitude, so sideslip angle must change too
- Keep upwind wing low throughout approach and flare.
- Keep aileron applied after touchdown.

EXERCISE 16 - TAKE-OFF

OBJECTIVE - To learn how to get airborne safely under various runway & wind conditions. Also, how to select the best technique for each situation.

KEY POINTS -
- Review FTM & Aircraft Handbook for background.
- Each type of take-off is described below.

NORMAL TAKE-OFF
- Flaps up. Column slightly aft of neutral. Lift nose at 55 mph in QKX or at 60 in CZJ
- Normal climb speed is 75-85 mph for both aircraft. Good to aim for 75 in QKX & 80 in CZJ

CROSSWIND TAKE-OFF (Long, smooth, hard runway, no obstacle)
- Flaps up. Keep ailerons deflected during ground roll to stop wind lifting upwind wing. Delay rotation by about 5 mph (60 in QKX, 65 in CZJ) lift off briskly and avoid sinking back down to earth because aircraft will be drifting (not good for the undercarriage). Turn into wind slightly, then wings level, to keep tracking along runway centreline, ‘crabbing’.

SHORT FIELD (Smooth hard surface)
- ‘Field length’ is normally defined as distance to a 50' obstacle, & ‘short field’ take-off implies an obstacle. Flaps up. Maximum backtrack. Use brakes while full power is applied, release brakes, accelerate with nose raised slightly, to normal rotation speed, but to slightly higher pitch attitude. Climb at 70 mph in QKX, or 68 in CZJ, until obstacles cleared, then lower nose for normal climb.

SOFT/ROUGH/SNOW-COVERED RUNWAY (Long runway, no obstacle)
- Flaps 10 deg. Don't use brakes, rolling start, apply full power and accelerate with nose held moderately high (transfer weight to wings early for less wheel drag), rotate early at about 50 mph. After liftoff at very low speed, keep low (in ground effect region) to accelerate to normal climb speed (75 in QKX & 80 in CZJ). Flap up at 200' AGL minimum.

MINIMUM GROUND RUN (Smooth hard surface, no obstacle)
- Flaps 10 deg. Maximum backtrack. Use brakes while full power is applied. Release brakes, accelerate with nose raised slightly, rotate early at about 50 mph, for liftoff at very low speed, then use soft field technique.

ADDITIONAL CONSIDERATIONS
- A quick check of engine instruments, after full power has been applied, is good airmanship.
- Be aware of the option to abort the take-off if something seems wrong.
- Hot and/or high conditions (Density Altitude) – Koch Chart.
- ‘Wheelbarrowing’ & nosewheel shimmy, keep column aft of neutral.
- ATC clearances eg ‘immediate’, or ‘without delay’, when and how to refuse a clearance.
- Runway slope, Tailwind, Weight variations, Wake avoidance, Crosswind limits.

EXERCISE 17 - CIRCUIT FLYING

OBJECTIVE - To learn how to fly smooth and accurate circuits under various conditions. How to fit in with other traffic, how to leave a circuit & enter a circuit.

KEY POINTS -

- Review FTM and AIM RAC 4 for background, on controlled & uncontrolled aerodromes.
- Lookout is very important, at uncontrolled fields there may be NORDO traffic (unless MF)
- Good habit to use landing lights (turn off on ground).
- Circuit height, normally 1,000' AGL, is not legally binding, reduce height if necessary (eg low cloud). 500' AGL minimum.
- Use DG to establish headings, avoiding mental math. Allow for wind as necessary, so on crosswind & base leg, runway heading is normally 'above' the 3 & 9 o'clock positions.
- Left hand circuit is standard, and means all turns are to the left.
- First turn normally at 500' AGL. Start the second turn when at (or almost at) circuit altitude.
- Third turn position is normally when aiming point is about 45 degrees behind wingtip, but varies with wind, traffic, and type of approach.
- Fourth turn, onto final, should be gentle not sharp. Ideally, turn will finish at about 500' AGL.

LEAVING THE CIRCUIT (UNCONTROLLED AIRFIELD)

- Don't turn against circuit direction until well clear.
- Make a radio call, so circuit traffic will not follow you.

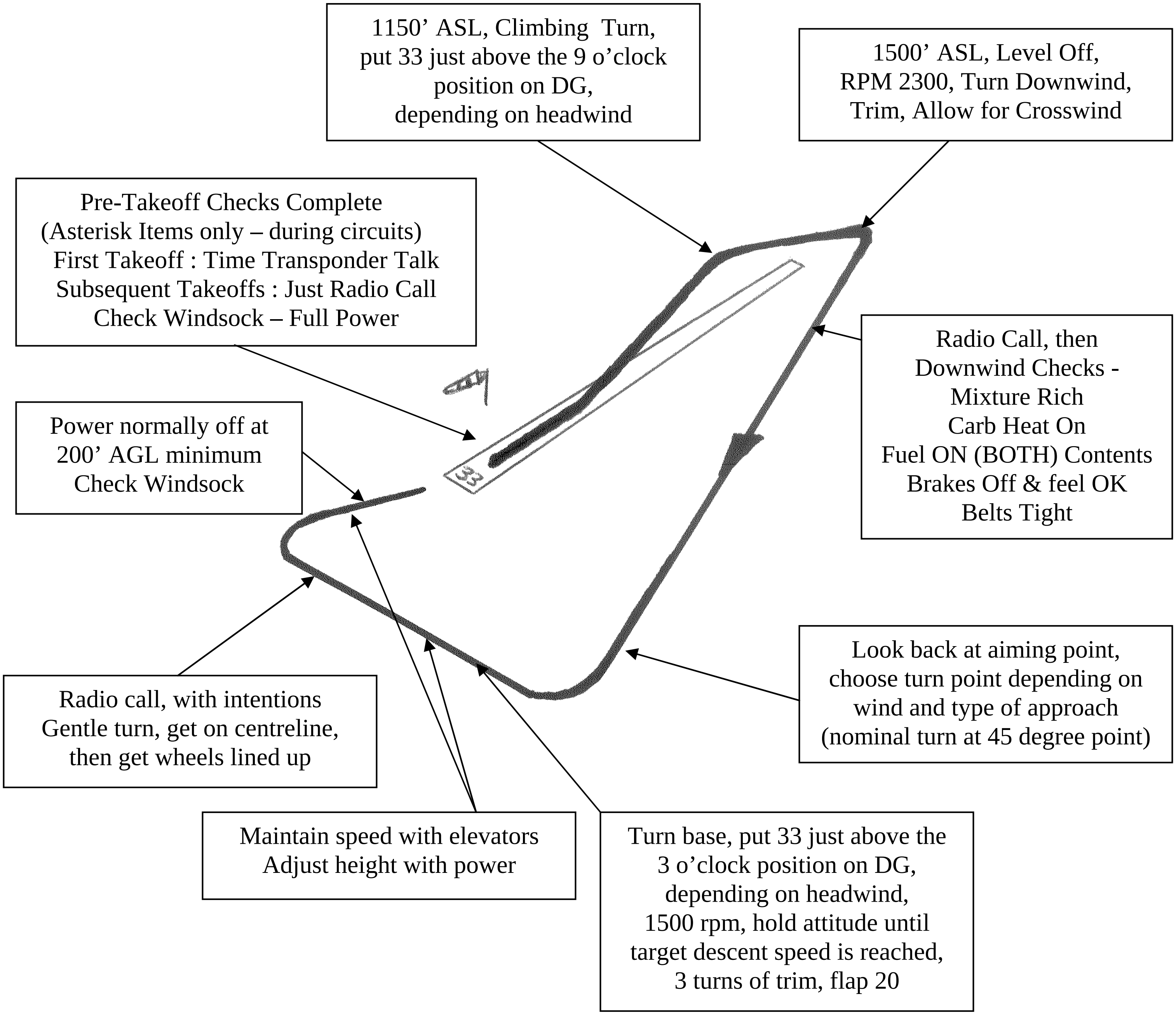
ENTERING THE CIRCUIT (UNCONTROLLED AIRFIELD)

- Listen out, well before arrival, anticipate runway, plan ahead. Call UNICOM for information if necessary (if available). Lookout & make radio call(s) before joining. May need to check windsock before joining, from above circuit height.
- Join circuit with crosswind leg over middle of runway, or S & L into downwind leg. AIM RAC 4 gives other options if an MF & advisory are both active.
- May need to slow down, and/or change course, before joining downwind leg, to fit in with other traffic.

ADDITIONAL CONSIDERATIONS

- Procedures at controlled airports, special VFR, wake turbulence, runway change, radio failure.
- When to overshoot :- obstruction on runway, too high/fast/long, too much crosswind, or too far out of position laterally on approach
- How to overshoot :- Full power, carb heat off, avoid pitch-up, reduce flap to 20 degrees. At 200' AGL, if speed is OK (70 mph minimum) bring flap up in two stages. Also move to the right of runway if there is traffic beneath you, for a better view of it.
- At Downsview, we have some non-standard procedures due to the proximity of Pearson airport. We also add altitude on most radio calls (mainly because of the traffic spotters).

EXERCISE 17 - CIRCUIT ILLUSTRATION



General Radio Call Format : -
Who you are talking to
Who you are
Where you are (including height)
What you want to do

Circuit Speeds QKX
Rotate 55 mph
Climb 75 mph
Base 70 mph
Final 65 mph (min 60 mph)

Circuit Speeds CZJ
Rotate 60 mph
Climb 80 mph
Base 75 mph
Final 70 mph (min 65 mph)

EXERCISE 18 - APPROACH & LANDING

OBJECTIVE - To learn how to land under various conditions. Also how to judge the best technique for particular circumstances.

APPROACH -

- Final approach leg is basically a constant speed descent (normally 65 mph in QKX, 70 in CZJ) tracking along the extended runway centreline. Ref. Ex. 5,8,15.
- Good speed control is important. If too slow, possible stall & also poorer flare ability.
- Elevators control speed during approach, and power controls height (or rate of descent).
- Flaps, normally 20 degrees, used to add drag (for steeper approach and less float), and to reduce stall speed.
- Judge descent progress (high or low) by perspective of runway edges, and whether aiming point moves up or down in relation to windscreen. Aiming point should just ‘grow’, not move up or down.
- Be aware of wind gradient, usually less wind closer to ground (& often a direction shift).

FLARE, HOLD-OFF, AND TOUCHDOWN - NORMAL LANDING

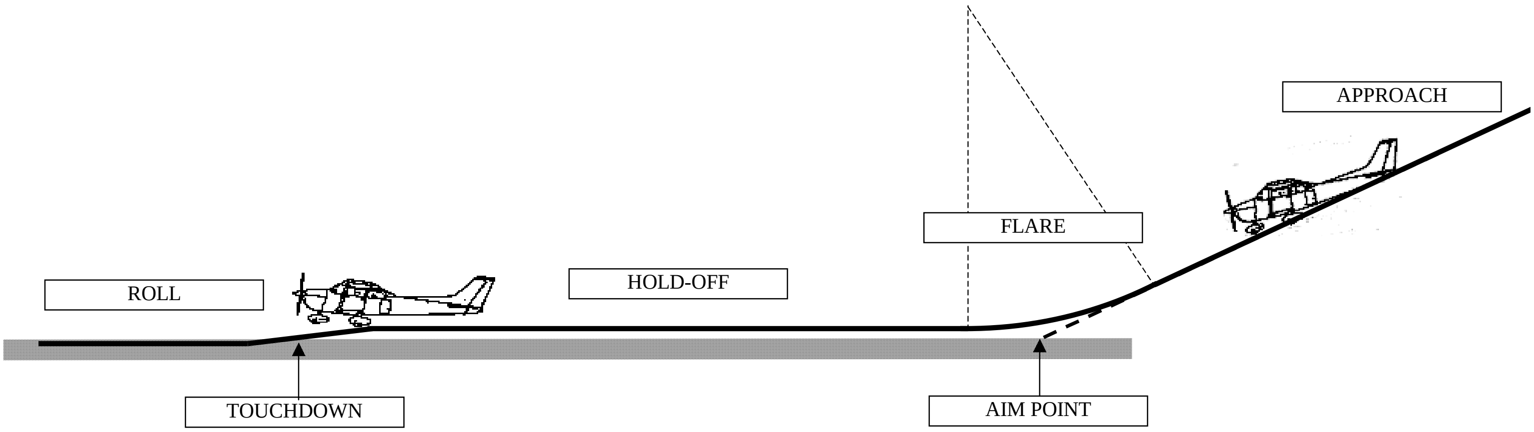
- At flare entry, shift attention totally to outside. Concentrate on Attitude, Height, Speed.
- Flare should be gradual and progressive, not abrupt.
- Aim to level off just above the ground, and then ‘hold-off’ just clear of the ground with speed reducing. Watch out for height increasing again. As speed drops into slow flight, drag increases, and aircraft should sink gently onto runway with column almost fully back
- Power should be off before touchdown. Touchdown should always be on main wheels only.
- Greater control deflections as speed reduces, Ref. Ex. 11.
- After touchdown, keep straight, hold nosewheel off as long as possible, less wear & tear.

SPECIAL CASES -

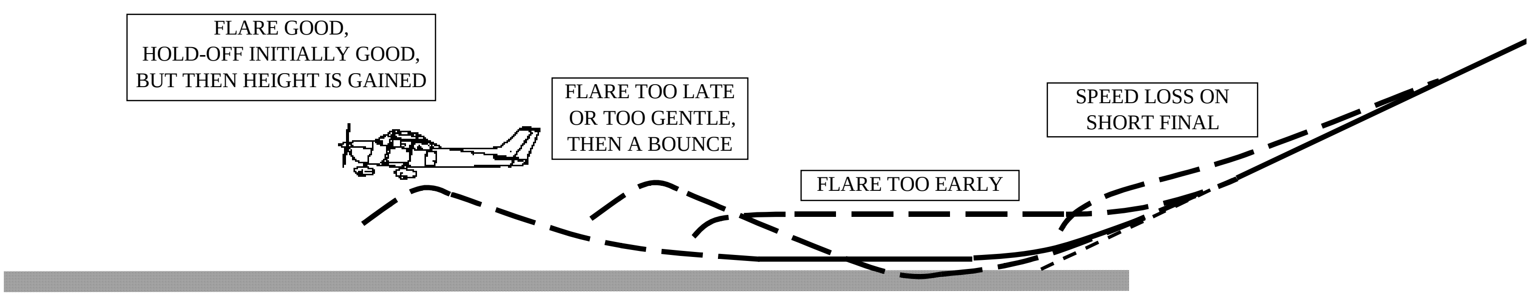
- CROSSWIND. Ref. Ex. 15. Keep upwind wing low throughout flare & hold-off, with opposite rudder to keep fuselage lined up with runway. OK to land on one main wheel first, don't prolong ‘hold-off’. Keep ‘into-wind’ aileron applied after touchdown.
- FLAPLESS – Good technique in strong winds, and practised in case they fail. Use approach speed of 70 mph in QKX, 75 in CZJ. Pitch attitude on approach is more nose-high. More distance than normal required.
- SHORT FIELD. ‘Field length’ is normally defined as distance from a 50' obstacle, & ‘short field’ landing implies an obstacle. Set aiming-point on the ‘button’. Full flap. Approach at 60 mph in QKX, 65 in CZJ (more if gusty). Power should be off prior to ‘obstacle’, but beware of large abrupt power cut at low altitude. Keep ‘hold-off’ short, firm touchdown, brakes.
- SOFT/ROUGH/SNOW-COVERED FIELD (plenty of distance, no obstacle). Use full flap, for minimum touchdown speed. Approach at 65 mph in QKX, 70 in CZJ (no need for steep approach). Keep some power on (~1300-1500 rpm) throughout flare & hold-off, to help in making a gentle touchdown. Avoid firm landing which may lead to ‘digging-in’ & possible nose-over. Cut power after touchdown & hold nose up with full back elevator.
- MINIMUM GROUND RUN (no obstacle). Set aiming-point a bit short of the ‘button’. Use full flap to permit minimum touchdown speed. Approach at 65 mph in QKX, 70 in CZJ (no need for steep approach). Power off on final, but beware of large abrupt power cut at low altitude. Keep ‘hold-off’ short, firm touchdown, brakes.

EXERCISE 18 - LANDING ILLUSTRATIONS

The right way



Some of the ways to go wrong



EXERCISE 19 - FIRST SOLO & PIC NOTES

OBJECTIVE - To safely fly a normal circuit without an instructor on board

KEY POINTS -

- In the climb, reduced weight will mean that pitch attitude will be more nose-high, for same airspeed, with a greater rate of climb, which is OK. If uncomfortable with the higher pitch attitude, lower the nose and climb at a higher airspeed.
- After reducing power on base leg, the reduced weight will mean the descent rate is also reduced (for same power, flap & airspeed). During flare & hold-off, aircraft tends to 'float' more, and is more likely to 'balloon' upwards.
- Landing long is OK at Downsview, within reason, but if not down at intersection, overshoot
- Never be too proud to overshoot and go around again, it is good practice
- Flap 20 maximum, to make overshoot easier, if required
- Dispatch approval is for one circuit, but as PIC you always have full authority to overshoot as required, and even to take any other action necessary for safety (eg divert to YKZ)

PILOT-IN-COMMAND NOTES – FOR LATER SOLO FLIGHTS

On solo flights, you are not only responsible for operating the flying controls, you are also responsible for the overall management of the aircraft systems, as well as for decision-making during the flight, based on your training and judgement. This FEEGI checklist is recommended (typically every 20 mins, or more frequently if required), for good monitoring of the 'status' of the flight. This will help in detecting any problem in the early stages. It is also a good idea to do these checks after manoeuvres (stalls, steep turns etc), and before entering a circuit to land.

F	Fuel	- ON, contents as expected & still sufficient
E	Engine	- oil temp and pressure in the green, CHT & Vacuum OK, Mixture as reqd.
E	Electrics	- over-voltage light out, ammeter OK, switches as reqd.
G	Gyro	- reset DG to compass heading
I	Ice	- check rpm, carb heat on 5-10 seconds, carb heat off, re-check rpm

Other items to keep in mind are :-

- Weather. Watch out for bad weather, plan for a diversion if necessary. Never try to fly in IFR conditions. If you wish you can use the radio to get weather info from various ATIS or AWOS services, or call London Flight Information Centre on the appropriate frequency.
- Airspace boundaries. When returning from North, must descend (3500', 2500', 2000', 1700').
- Time. Keep track of the time, should not exceed the period booked.
- Paperwork. Remember TTT before takeoff (Time-Transponder-Talk) and note time of last landing before shutdown. Use these times to get AIR TIME, and add 0.2 hr typical taxi time, to get FLIGHT TIME; or, record the times at start & end of the flight ('chock to chock').
- The AIR TIME is for the aircraft Journey Log
- The FLIGHT TIME is for pilot log(s) (not needed in Journey Log)
- The TACHOMETER TIME is only for calculating flying fees
- If you land and shut the engine down at another airfield, and then fly back to YZD, this counts as TWO flights in the Journey Log & Pilot's Log (but tach time at first shutdown is not needed). If you land at another field, and return without shutting the engine down, then this counts as only one flight in all logs.

EXERCISE 20 - ILLUSIONS OF DRIFT & LOW FLYING

OBJECTIVE - To learn how to handle the aircraft at low level in strong winds. Also to understand the illusions that are caused by drift and why these may be hazardous.

KEY POINTS -
- Review FTM for background.
- Refer to CAR 602.15(2)(b)(iv) for low flying exemption relating to flight training

- Possible situations when this knowledge will be useful include
  1) low level circuit due to reduced ceiling
  2) precautionary landing & forced landing
  3) normal circuit after wind speed has increased greatly

- It may help to imagine the aircraft flying in a large box of air, the wind moves the whole box across the earth, not just the aeroplane.

- When in properly coordinated flight (ball centred) the sensation of drift across the ground can make you think you are slipping and are not coordinated. Trust the slip ball. Potential danger here is that visual impressions may cause erratic & wrong use of rudder and aileron. Possible stall/spin.

- The sensation of speed (ie groundspeed) will depend on whether travelling upwind or downwind, for a constant airspeed.

- During a turn to head downwind, there will be a strong sensation of accelerating, and this may cause an instinctive pull-up on elevator control. Possible stall/spin. Trust the ASI.

- During a turn to head upwind, there will be a strong sensation of slowing down, which may cause an instinctive nosedive to prevent an imagined stall. Trust the ASI.

EXERCISE 21 - PRECAUTIONARY LANDINGS

OBJECTIVE - To learn how to prepare for a landing where the runway condition is doubtful, or at an unfamiliar field.

KEY POINTS -
- Reasons for deciding to take this action include
  1) trapped by bad weather, becoming worse
  2) fuel becoming exhausted
  3) becoming dark
  4) sickness, fatigue, mechanical situation.
- Two types of precautionary landing
  A) Unfamiliar aerodrome (unpaved) of doubtful condition
  B) Ordinary field
- Refer to Aircraft Handbook – Emergency Procedures - for background & checklist
- Refer to CAR 602.15(2)(b)(iv) for low flying exemption relating to flight training
- Usually good airmanship to use a 'loiter' configuration (especially with low visibility and/or ceiling) while diverting to an airstrip or looking for a field. Set 2200 rpm and 10 degrees flap. More endurance, better view. Sometimes however it is best not to 'loiter', if time is short.

UNFAMILIAR AERODROME (UNPAVED) OF DOUBTFUL CONDITION
- Procedure is similar to normal arrival at any uncontrolled deserted airfield, but a low level inspection must be done.
- Many airstrips are not shown on the map (& CFS) and have no published data (no official name, frequency etc) but they are still 'aerodromes' and correct circuit procedure is required.
- From the map/CFS, find or estimate the field elevation ASL.
- If ceiling allows, circle about 500' above circuit height for high level inspection of runway(s) length & condition, also wind velocity. Orbit above circuit height as necessary till you decide how to proceed.
- Radio calls are essential if there is an MF, and should be done if there is an ATF, but usually not required for fields with no published frequency
- Select runway for landing, descend on 'dead' side and join circuit using crosswind leg directly over the field.
- Join mid-downwind leg, normal checks, go about 1/2 mile further downwind than normal (takes about 15 seconds).
- Turn base, set 70 mph & 20 degrees flap, as normal.
- Turn 'final' and continue descent, below approach path.
- Apply about 2100 rpm for a low level inspection at 70 mph along the whole length of the field, to the right of intended landing path (for better view). Carb heat off if rpm in green.
- Apply full power to climb out, at minimum 200' AGL retract flap in 2 stages.
- If conditions suitable, fly normal circuit using appropriate landing technique (PAN call? Amend/Cancel Flight Plan? Passenger Briefing?)
- On final, consider full checks from Aircraft Handbook, Master Off, Door unlatched etc.

ORDINARY FIELD
- Ref. FTM for this type of situation (but do not use FTM procedure at an aerodrome!).
- Select field based on size, wind velocity, obstacles (in field, on approach, on overshoot), surface condition.
- Procedure similar to that above, except that it is not essential to follow standard circuit joining procedure as field is not an Aerodrome. But, it's OK to treat all fields as aerodromes.
- If field does not appear suitable after low level inspection then find another, if time permits.

EXERCISE 22 - FORCED LANDINGS

OBJECTIVE - To learn how to safely handle an engine failure.

KEY POINTS - Two types of situation
1) Failure in circuit 2) Failure at altitude
Refer to Aircraft Handbook – Emergency Procedures - for background & checklist

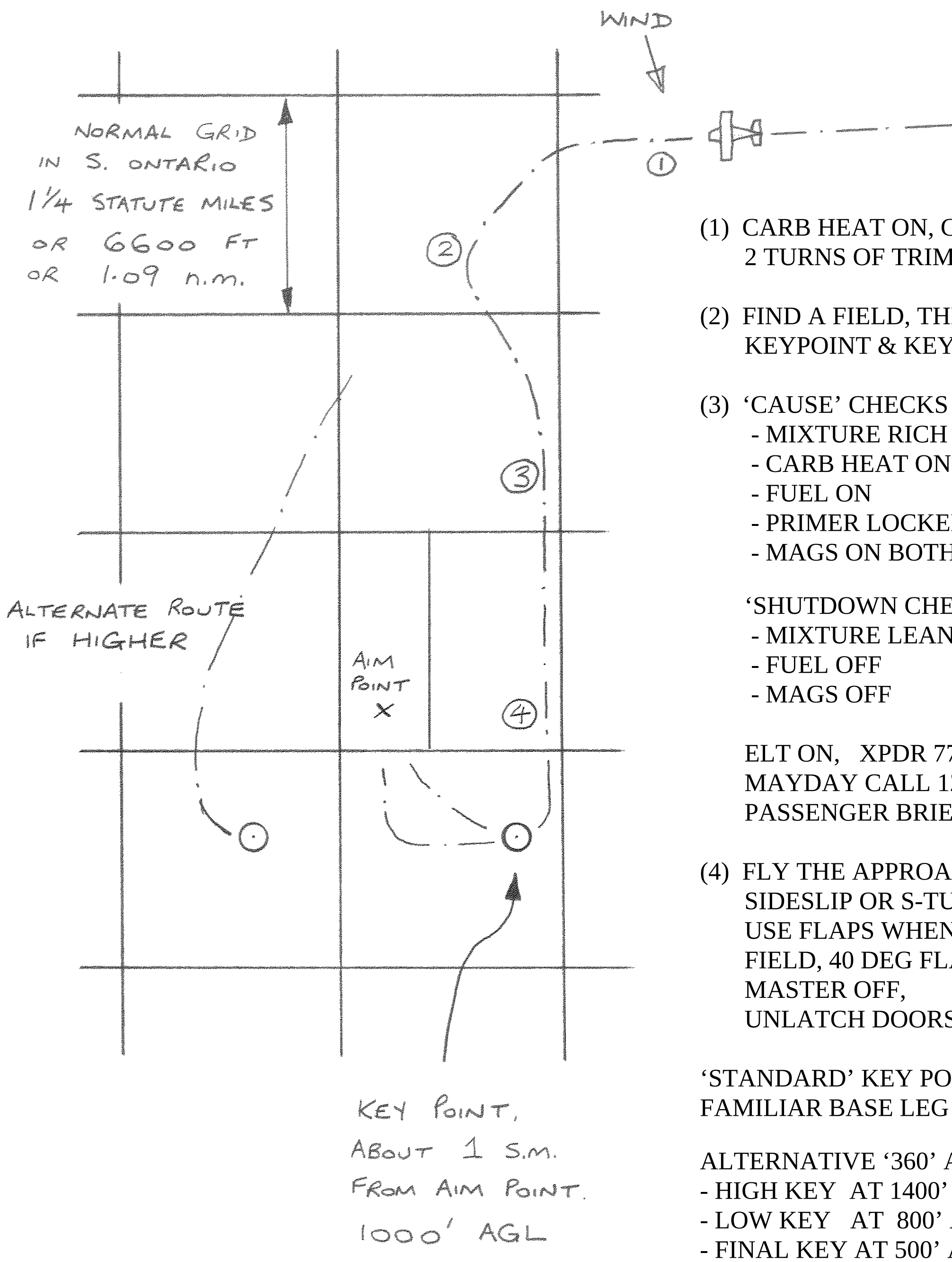
ENGINE FAILURE IN CIRCUIT - DURING CLIMB
- First action is to lower nose, aim for 75 mph.
- Pick a landing area ahead, some turning possible depending on height, but it's usually not possible to return to the airfield.
- If time permits, pull CARB HEAT ON & check FUEL ON. If engine does not restart, pull MIXTURE LEAN, FUEL OFF, MAGS OFF.
- Use full flap for touchdown if possible.

ENGINE FAILURE IN CIRCUIT - ON DOWNWIND OR BASE LEG
- First action is to turn towards the airfield and set up a descent, trim. Aim for 75 mph.
- Plan an improvised approach to a runway or other area.
- Pull CARB HEAT ON, check FUEL ON (primer locked, mags on). If engine does not restart, pull MIXTURE LEAN, FUEL OFF, MAGS OFF. If time permits, make radio call.
- Don't lower flaps until absolutely sure of reaching the field.

ENGINE FAILURE AT ALTITUDE
Four stage plan of action. INSIDE-OUTSIDE-INSIDE-OUTSIDE
1) CARB HEAT ON, check FUEL ON & contents OK, set up a descent, trim. 75 mph.
2) Find a field (wind, size, obstacles, condition) and identify keypoint(s) & key height. Plan route to keypoint.
3) 'CAUSE' check, MIXTURE RICH, CARB HEAT ON, FUEL ON, PRIMER LOCKED, MAGS ON BOTH. Consider using starter. If no restart, do 'SHUT-DOWN' checks, MIXTURE LEAN, FUEL OFF, MAGS OFF. ELT ON & Transponder 7700 MAYDAY call if time permits. Passenger briefing if time permits.
4) As descent progresses, correct the route and glidepath as necessary. Sideslip and/or use 'S' turns to lose excess height. Don't lower flaps until absolutely sure of reaching field. Use full flap if possible. Master switch OFF after flaps down. Unlatch doors.

- During practice forced landings it is important to 'clear' the engine with a burst of power every 500' during the descent, even if using the cold weather technique of 10 degrees flap & 1200-1300 rpm. Give the engine about 3 seconds above 2,000 rpm.
- Radio call, 121.5 MHz (or if time is short, on current frequency). Typical message "MAYDAY MAYDAY MAYDAY, GQKX ENGINE FAILURE NEAR….. GQKX."
- During training this exercise will normally be terminated on 'final' with flaps fully down. The overshoot from this position is good practice for Exercise 17 & 18. See procedure in notes on Ex. 17.
- Refer to CAR 602.15(2)(b)(iv) for low flying exemption relating to flight training

EXERCISE 22 - FORCED LANDINGS : ILLUSTRATION



(1) CARB HEAT ON, CHECK FUEL
2 TURNS OF TRIM

(2) FIND A FIELD, THEN
KEYPOINT & KEY HEIGHT

(3) 'CAUSE' CHECKS
- MIXTURE RICH
- CARB HEAT ON
- FUEL ON
- PRIMER LOCKED
- MAGS ON BOTH

'SHUTDOWN CHECKS'
- MIXTURE LEAN
- FUEL OFF
- MAGS OFF

ELT ON, XPDR 7700
MAYDAY CALL 121.5
PASSENGER BRIEFING

(4) FLY THE APPROACH, MAKE IT WORK.
SIDESLIP OR S-TURN IF REQUIRED.
USE FLAPS WHEN SURE OF REACHING
FIELD, 40 DEG FLAP IF POSSIBLE.
MASTER OFF,
UNLATCH DOORS

'STANDARD' KEY POINT SHOWN, AT
FAMILIAR BASE LEG TURNING POINT

ALTERNATIVE '360' APPROACH USES
- HIGH KEY AT 1400' AGL OVER AIM POINT
- LOW KEY AT 800' AGL ABEAM AIM POINT
- FINAL KEY AT 500' AGL WITH 90 DEG TO GO

NOTES
1) POHs for QKX & CZJ show 600' height loss in 1 sm distance (flaps up) which is the main factor in setting height at key point
2) You should always keep your chosen field in sight, so you don't lose it. If you need to lose a lot of height, circle overhead, not away from the field
3) You should not normally go downwind of your key point (or go downwind of 'final key' when using '360' approach technique)

EXERCISE 23 - NAVIGATION

OBJECTIVE - To learn how to prepare for cross country flights and how to carry out such flights, Also, how to divert to a new destination while airborne.

KEY POINTS -
- Review ground school, AIM RAC 3 and FTM for background.
- Two stages - 1) Pre-flight planning 2) In-flight procedures

PRE-FLIGHT PLANNING
- Weather along route required. Ceiling affects cruise altitude, check for crosswind problems.
- Choose convenient ‘set-heading point’ for each leg.
- Prepare chart, draw track line(s), 10 degree drift lines (from set-heading point & destination).
- Select checkpoints enroute for assessing ETA and direction (eg every 1/4 or 1/5 of distance).
- Scan route for obstructions, find MOCA.
- Consider possible diversion airfields, within fuel range.
- Select cruise altitude, remembering regulations
  3500, 5500 etc Eastbound, 4500, 6500 etc Westbound.
- Select cruise rpm, considering range required, max 75% power.
- Fill in planning form, see supplementary notes.
- Consider flight plan, or itinerary.

IN-FLIGHT PROCEDURES
- Use log to record times and ETAs, from start of flight.
- Plan to be at correct altitude and on heading (approx) BEFORE reaching set-heading point. Set DG. Note time and write on log. Calculate ETA and write on log.
- Hold heading for several minutes before trying to assess direction error. If a revised heading is necessary, note time when turn to new heading is made.
- With ‘Double-error correction method’ think ahead & note time for second heading correction, and what the new heading will be.
- Revise ETA as flight progresses, write new ETA on log.
- Every 20 minutes or so do periodic checks (FEEGI – see Ex. 19).
- Consider leaning mixture if density altitude > 5000 ft.

DIVERSION
- Typically made necessary by deteriorating weather.
- For more endurance, or in poor visibility, slow down (eg 2200 rpm & 10 degrees flap).
- Diversion procedure consists of 4 stages
  1) Mark present location on map, mark new destination on map. Draw a track line.
  2) Estimate heading reqd, note time (write it on map at present position) and proceed enroute.
  3) Estimate distance (8 sm per inch for 1/500,000 maps) get rough ETA and write it down on map. On 1/500,000 map, 80 mph = 6 mins per inch & 96 mph = 5 mins per inch.
  4) monitor progress, by writing times on map alongside landmarks as they are passed, using map as a log. Revise heading & ETA as required. Follow line features (road, river, railway, pylons) if appropriate. Don't exceed ETA without a plan.

EXERCISE 23 - SUPPLEMENTARY NOTE ON FLIGHT PLANNING

PURPOSE OF THIS NOTE
To clarify the calculation sequence for completing the standard flight planning form. A typical flight is used as an example, towards the North-East, from Downsview to Smiths Falls, using King City as the Set-Heading point. See Navigation Exercise on the following pages.

STEP 1 : OBTAIN WEATHER INFORMATION - including -
METAR : Current altimeter setting, to calculate pressure altitude
TAF (& FA) : To get cloud ceilings to help select cruise altitude
FD : Average wind aloft, for wind triangle calcs, Temperatures for density altitude

STEP 2 : LEG FROM SET-HEADING POINT TO DESTINATION
Scan the track for obstacles, to find Minimum Obstacle Clearance Altitude (MOCA), use the cloudbase and/or ceiling data & winds aloft, and the air regulations, to choose a good cruise altitude. Assume 3500' in this case. This is the Indicated Altitude (IA) which is approximately the same as the actual or true altitude.

Find Pressure Altitude (PA) using current altimeter setting. If altimeter setting is 30.02 then difference from standard (29.92) is 0.10" Hg. One inch of mercury = 1000'. If altimeter setting is LESS than standard, then PA > IA. In this case, PA = 3500 - (0.10 x 1000) = 3400'.
No need to be too precise, rounding off to nearest 100' is more than good enough.

Now find Density Altitude (DA) by using an estimate of the air temperature at the actual cruise altitude of 3500' from forecast winds aloft. In Nav Exercise, get a rough estimate of -1C at 3500'from YYZ & YOW FDs. Use Nav Computer and set -1C against PA of 3400' to get DA of about 2500'. This is a cold day, so DA is low. On a hot day, DA can be much higher than PA.

Now, knowing DA, use cruise chart from aircraft handbook (Fig 6-4) to select cruise rpm (not more than 75% power). For QKX, at 2500' we could use 2500 rpm which would give 64% BHP & 108 mph TAS (110 - 2 mph without wheel fairings). Then convert TAS mph to knots for flight planning form, for use in wind triangle work which will lead to estimated ground speed.

Convert TAS mph to CAS mph by using computer. Then use correction table (POH Fig. 6-1) to convert CAS mph to IAS mph. No need to convert IAS to knots. Write IAS on form, this will be compared with observed IAS in flight, at planned RPM & Altitude, as a sanity check.

Use Nav Computer to do wind triangle, and get True Heading & Groundspeed, then Magnetic Heading. Knowing ground speed, calculate time and fuel for this leg, assuming it's all flown at 3500' Indicated Altitude. BUT, in real life, you have to fly the first part at 2400' IA and about 2300 rpm, to stay clear of the Class C airspace so add an allowance (say 1 minute & 0.5 gallons).

STEP 3 : FROM DOWNSVIEW TO SET-HEADING POINT
Use rate of climb data from handbook (Fig. 6-3), interpolate for 2500' to get 1.1 gallons. Use cruise performance chart (Fig. 6-4) at 2500' for this short leg to King City (2300 rpm, 99 mph TAS, 3.8 gph). Distance is small so full treatment (drift etc) is not necessary. It takes about 7 mins to get to King City, so about 0.4 gallons is added to the 1.1 above, to get 1.5 gallons.

CRUISE PERFORMANCE

— COMMUTER —

Gross Weight - 1600 Lbs.
Standard Conditions
Zero Wind
Lean Mixture

NOTES: 1. Maximum cruise is normally limited to 75% power.
2. Cruise speeds for the standard Model 150 (without speed fairings) are approximately 2 MPH lower than shown.
3. No allowances for take-off, climb or reserve.

DENSITY ALTITUDE	RPM	% BHP	TAS MPH	GAL/ HOUR	22.5 GAL (NO RESERVE) ENDR. HOURS	22.5 GAL (NO RESERVE) RANGE MILES	35.0 GAL (NO RESERVE) ENDR. HOURS	35.0 GAL (NO RESERVE) RANGE MILES
2500	2750	87	124	6.6	3.4	425	5.3	665
	2700	82	121	6.1	3.7	445	5.7	690
	2600	72	116	5.4	4.2	480	6.5	745
	2500	64	110	4.8	4.7	515	7.3	800
	2400	56	105	4.3	5.2	550	8.2	855
	2300	50	99	3.8	5.9	585	9.2	910
	2200	44	94	3.4	6.5	615	10.2	955
	2100	38	88	3.1	7.3	640	11.3	990
5000	2750	80	123	6.0	3.8	460	5.8	720
	2700	75	120	5.6	4.0	480	6.2	745
	2600	67	115	5.0	4.5	515	7.0	800
	2500	59	109	4.5	5.0	550	7.8	855
	2400	52	104	4.0	5.6	585	8.7	905
	2300	46	98	3.6	6.2	615	9.7	955
	2200	41	92	3.2	6.9	640	10.8	995
7500	2750	73	122	5.5	4.1	500	6.4	775
	2700	69	119	5.2	4.3	515	6.7	800
	2600	62	114	4.7	4.8	550	7.5	855
	2500	55	108	4.2	5.4	585	8.4	905
	2400	49	103	3.8	6.0	615	9.3	955
	2300	43	97	3.4	6.6	640	10.3	995
	2200	39	90	3.1	7.2	655	11.3	1015
10000	2700	64	118	4.8	4.7	550	7.3	860
	2600	57	112	4.3	5.2	585	8.1	910
	2500	51	107	3.9	5.8	615	8.9	960
	2400	45	101	3.5	6.3	645	9.9	1000
	2300	41	95	3.2	6.9	660	10.8	1025
12500	2650	56	114	4.3	5.3	605	8.2	940
	2600	53	111	4.1	5.6	620	8.6	965
	2500	47	105	3.7	6.1	645	9.5	1005
	2400	43	99	3.4	6.7	660	10.4	1030
	2300	39	91	3.1	7.2	660	11.2	1025

Figure 6-4.

EXERCISE 23 – AIRCRAFT DATA FOR NAVIGATION EXERCISE : PAGE 2 of 2

AIRSPEED CORRECTION TABLE

FLAPS UP										
IAS-MPH TAS	50	60	70	80	90	100	110	120	130	140
CAS-MPH	53	60	69	78	87	97	107	117	128	138
FLAPS DOWN										
IAS-MPH	40	50	60	70	80	90	100			
CAS-MPH	40	50	61	72	83	94	105			

Figure 6-1.

MAXIMUM RATE-OF-CLIMB DATA

GROSS WEIGHT LBS.	AT SEA LEVEL & 59° F.			AT 5000 FT. & 41° F.			AT 10000 FT. & 23° F.		
	IAS, MPH	RATE OF CLIMB FT./MIN.	FUEL USED, GAL.	IAS, MPH	RATE OF CLIMB FT./MIN.	FUEL USED FROM S.L., GAL.	IAS, MPH	RATE OF CLIMB FT./MIN.	FUEL USED FROM S.L., GAL.
1600	78	670	0.6	74	470	1.6	71	260	2.8

NOTES:
1. Flaps retracted, full throttle, mixture leaned to smooth operation above 5000 ft.
2. Fuel used includes warm-up and take-off allowances.
3. For hot weather, decrease rate of climb 15 ft./min. for each 10°F above standard day temperature for particular altitude.

WEATHER DATA TO BE USED

ASSUME YOU ARE PLANNING THIS FLIGHT AT 2230Z FOR A DEPARTURE AT 2330Z

OTTAWA

METAR CYOW 202200Z 30011KT 25SM BKN054 BKN091 11/03 A2998 RMK CU5AC2 VIRGA SLP138

TAF CYOW 202216Z 202323 31015KT P6SM SCT050 TEMPO 2301 4SM -SHRA BKN050
FM0700Z 33010KT 5SM BR SCT050 TEMPO 0713 2SM BR PROB30 0811 1/2SM FG
FM1500Z 30008KT P6SM SCT050
FM2000Z 28010KT P6SM BKN080 RMK NXT FCST BY 02Z=

TORONTO PEARSON

METAR CYYZ 202200Z 32010KT 20SM FEW045 OVC065 11/00 A3005 RMK SC2SC6 SLP163

TAF CYYZ 202216Z 202323 31010KT P6SM BKN050 BECMG 2301 33008KT SCT050
FM1300Z 33005KT P6SM BKN080 RMK NXT FCST BY 02Z=

FDs - low level
FCST BASED ON 201800 DATA VALID 202200 FOR USE 21-05

	3000	6000	9000	12000	18000
YOW	3115	3118-05	3120-11	3226-17	3227-28
YYZ	3217	3217-05	3318-11	3321-16	3331-26

SMITHS FALLS AIRPORT INFORMATION

CYSH ELEV 416' RWY 06/24 4000'x75' ASPHALT

EXERCISE 23 - NAVIGATION EXERCISE : PAGE 2 of 5

DOWNSVIEW TO SMITHS FALLS : USING KING CITY AS SET HEADING POINT

CALCULATION PAGE

PART 1 : FROM KING CITY TO SMITHS FALLS

Indicated Altitude	=	3500	ft	Ref MOCA, Air Regs, Weather, etc
Wind Direction	=		deg True	Ref FD, for drift calcs
Wind Speed	=		kts	Ref FD, for drift calcs
Temp at 3500’	=		°C	Ref FD, for D.A. calcs
PRESSURE ALTITUDE	=		ft	Ref METAR Altimeter Setting
DENSITY ALTITUDE	=		ft	Ref FD Temperatures & P.A.
SELECT RPM (Max 75%)	=	2500	rpm	Ref Cruise Performance Chart
FUEL CONSUMPTION	=		gph	Ref Cruise Performance Chart
TAS = mph	=		kts	Ref Cruise Performance Chart
CAS = mph	=		kts	Ref Nav Computer
IAS = mph				Ref Airspeed Correction Chart
Track Direction	=		deg True	Ref map (measure at mid-track)
Ground Speed	=		kts	Ref Nav Computer
Drift Correction	=		deg	Ref Nav Computer
True Heading	=		deg True	From Track & Drift Correction
Magnetic Heading	=		deg M	Using Variation from map
Track Distance	=		nm	From map (check scale)
Est Time En-route	=		min	From Nav Computer
Est Fuel Burn	=		USgall	From Nav Computer

Add an allowance to time & fuel because of the initial need to stay under Class C airspace, then copy data to flight planning form.

PART 2 : FROM DOWNSVIEW TO KING CITY

Climb Fuel	=	USgall	From Climb Performance Chart
Cruise Time	=	min	Approx 99 mph TAS
Cruise Fuel	=	USgall	Approx 3.8 gph @ 2300 rpm
Est Fuel Burn	=	gall	Total fuel to King City

Copy to flight planning form

PART 3 : CROSSWIND CALCULATIONS

X-W at YZD Rwy ______	=	kts	From Crosswind Chart
X-W at YSH Rwy ______	=	kts	From Crosswind Chart

EXERCISE 23 - NAVIGATION EXERCISE : PAGE 3 of 5

Cross Country Planning Form : For New Flight or Large Track Change, use New Form

PA (ft)	DA (ft)	RPM	TAS (mph)	GPH	TAS (kts)	TRACK (^{0}T)	WIND (^{0}T / kts)	HDG (^{0}T)	VAR (^{0})	FUEL (USg)
Reserve Fuel (30 minutes)										
Contingency Fuel (10%)										
Total Fuel Required for this flight										
Total Fuel Required - in terms of % tank capacity										

FROM - TO	ALT (IA)	IAS (mph)	HDG (^{0}M)	GS (kts)	DIST (nm)	ETE (hr:min)
From Takeoff to SHP						

Notes on Weather, Runways & Crosswinds etc

FLIGHT LOG

REMARKS	TIME (hr:min)	HDG (^{0}C)	ETA (hr:min)	GS (kts)
START OF FLIGHT				
TAKE OFF				
SET HEADING POINT (SHP)				
CHECK POINT #1				
CHECK POINT #2				
LANDING				
END OF FLIGHT				

Time between check pts (mins)						
Groundspeed (kts)						

EXERCISE 24 - INSTRUMENT FLYING : PAGE 1 OF 5

OBJECTIVE - for 5 hour PPL syllabus - To learn the basic skills of flying by instruments, including how to recover from unusual attitudes, as a precaution against getting into bad weather.
Also, to learn the basics of VOR navigation.

KEY POINTS for the two aspects are covered separately
1) Instrument flying   2) VOR navigation   Review FTM for background

INSTRUMENT FLYING
- Need to understand each instrument, what it measures
  Artificial Horizon (AH) (or attitude indicator)
  Turn Needle (TN) Rate 1 = 3 deg/sec; 180 deg in 1 minute
  Directional Gyro (DG) (or heading indicator)
  Slip Ball (or bank indicator, which is misnomer)
  Also Altimeter, ASI, VSI, Compass, rpm gauge
- Need to develop a scanning technique to encompass all relevant instruments, avoid fixing on one or two.
- Relax and be patient, get comfortable and use trim
- Don't cheat by looking out, it delays learning
- If confused, revert to Straight and Level
- Pitch instruments are AH, ALT, ASI, VSI
- Turn/bank instruments are AH, TN, Ball, DG
- Gyros are imperfect due to friction
- Bank angle for rate 1 turn = 10% of mph IAS + 5 (10% of kts + 7). Eg at 100 mph use 15 degrees.
  (Really depends on TAS not IAS).
- Unusual attitudes, use trends of ASI (and ALT) to decide whether nose is high or low.
  Nose high ; apply power, lower nose till ASI needle ‘freezes’, level wings using TN & Ball
  Nose low ; reduce power, level wings using TN & Ball, & raise nose till ASI needle ‘freezes’
  (Ref Ex 14 Spiral Dive recovery – Throttle, Aileron, Elevator)
  AH may be unreliable in unusual attitudes (and in some aeroplanes you may not have one)

VOR NAVIGATION
- Must identify signal, use morse symbols on map
- Radials are defined as FROM beacon, not TO,
  eg 090 radial is to the East of the beacon, along 090 Magnetic line.
- To find which radial you are on, turn OBS knob to centre the CDI needle,
  while checking the flag says FROM.
- CDI needle is unaffected by aircraft heading (unlike ADF)
- CDI needle does not compensate for wind
- To find position, triangulate using two beacons
- To intercept a Radial OUTBOUND, eg 090, you MUST set 090 at the TOP of dial (the flag says FROM). Turn to heading 090 (make top of DG match top of VOR) then alter heading by (say) 45 degrees to left or right depending on CDI. !! 270 at top gives REVERSE INDICATIONS !!
- To intercept a Radial INBOUND, eg 090, you MUST set 090 at the BOTTOM of dial (so 270 at the top) check the flag says TO. Turn to heading 270 (make the tops match) then change heading 90 degrees left or right depending on CDI. Intercepting radial at 90 degrees avoids missing beacon.

Instrument Flying : Private Pilot Licence Manoeuvres

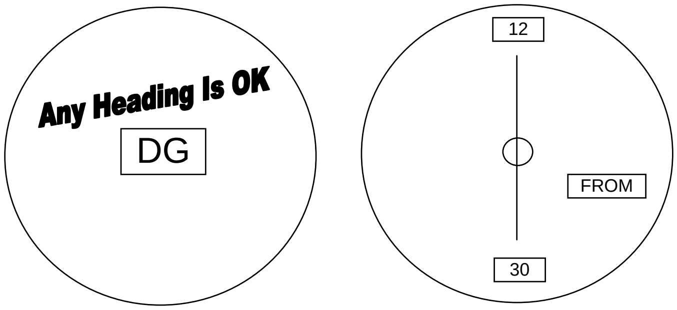
Straight & Level Flight		
	Primary Instrument	Primary Control
Pitch	Altimeter	Elevator
Roll	DG	Aileron
Yaw	Slip Ball	Rudder
Power	ASI	Throttle

Level Turns using Limited Panel
No Artificial Horizon & No DG
Turns must be Rate 1 and timed
Rate 1 = 3 degrees of turn per second
Technique is similar to full panel turns
but Primary Instrument is Turn Needle
(with clock or watch)

Level Rate 1 Turns - Full Panel		
Estimate bank angle : (mph / 10) + 5		
	To begin Turn	**To end Turn**
Initiate with	Aileron (& rudder)	Aileron (& rudder)
Primary Instruments	AH to set bank then Turn Needle	AH for wings level then DG
Primary Control	Aileron (& Rudder)	Aileron (& Rudder)
Secondary Instrument	Altimeter	Altimeter
Secondary Control	Elevator	Elevator
Tertiary Instrument	ASI	ASI
Tertiary Control	Throttle	Throttle

EXERCISE 24 - INSTRUMENT FLYING : PAGE 3 OF 5

Task : You believe you are South East of the VOR station, and you want to fly inbound on the 090 radial

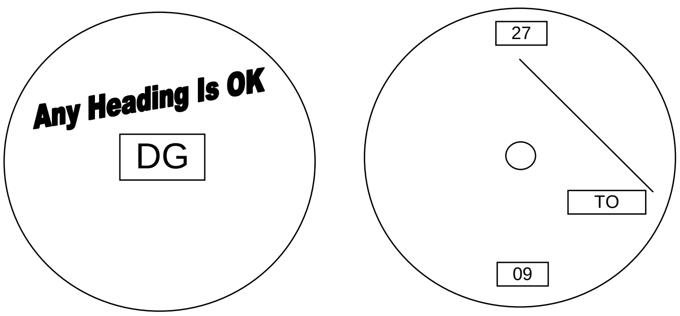


1) Find out what radial you are on

How : Turn OBS to centre the needle with a FROM flag, read radial at the TOP

Why : To confirm where you are in relation to the station

Example shows that you are on the 120 radial
This helps you make a mental picture
You are South East of the station
To fly inbound on the 090 radial, you MUST be East of the station, and you are.

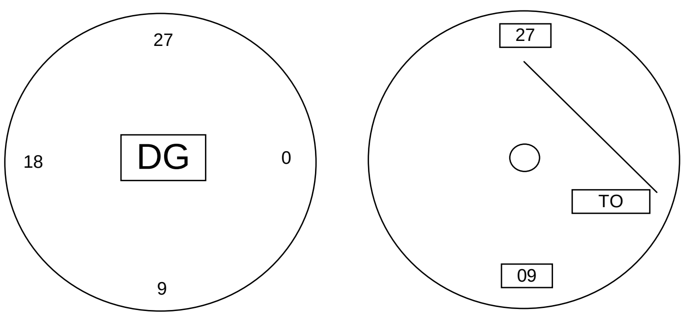


2) Set VOR to fly inbound on 090 radial

How : Turn OBS knob to set the Radial at the BOTTOM (in at the bottom)

Why : So that the VOR will work correctly & help you do what you want to do

Example shows the VOR set correctly.
Do not worry about the CDI needle or the TO/FROM flag, yet

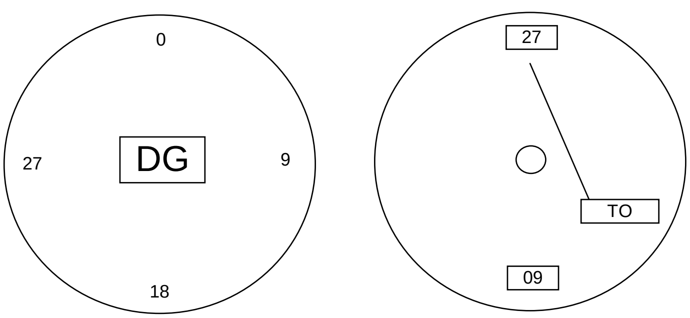


3) Turn the aeroplane, to make "the Tops Match"

How : Turn left or right to make the top of the DG match the top of the VOR

Why : To fly parallel to the radial, so you can properly interpret the CDI needle

Note : During the turn, the VOR display will be virtually unchanged.

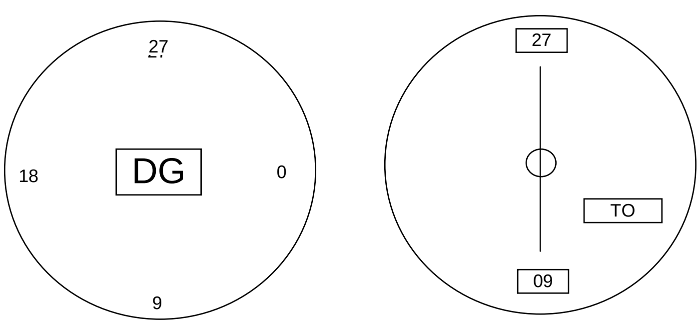


4) Follow the Needle & Turn 90 degrees

How : Turn the aeroplane until the radial appears at 3 or 9 o'clock on the DG

Why : To intercept the desired radial at an angle of 90 degrees

This method avoids having to figure out an intercept heading
No need to add or subtract 90 degrees to get the new heading
Just keep ONE NUMBER in mind, the RADIAL (in this case 090)
Picture shows that you're getting close to the 090 radial (CDI moving to centre)
In this case 90 degree turn was to the RIGHT, because needle was on the right
The CDI needle 'points' toward the heading required



5) Make the Tops Match again

How : Turn 90 degrees to make the top of the DG match the top of the VOR

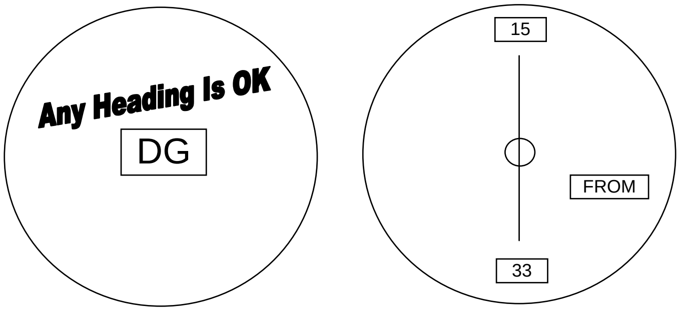
Why : Because when you're tracking on a radial, the tops should match

If you're on the 090 radial heading inbound, then you should be heading 270
The rule about the Tops Matching, works for Inbound & Outbound tracking
The rule about the Tops Matching, works on any radial.
Wind may have a small effect, and prevent an exact match.
This 90 degree turn is ALWAYS in the opposite direction to the one in step 4.

SEE PLAN VIEW FOR AN ILLUSTRATION OF THIS EXAMPLE

EXERCISE 24 - INSTRUMENT FLYING : PAGE 4 OF 5

Task : You believe you are South East of the VOR station, and you want to fly outbound on the 090 radial

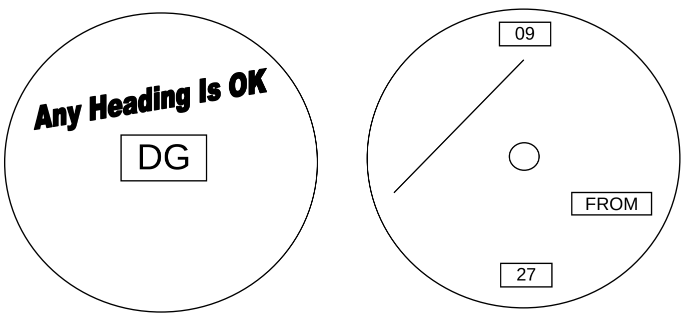


1) Find out what radial you are on

How : Turn OBS to centre the needle with a FROM flag, read radial at the TOP

Why : To confirm where you are in relation to the station

Example shows that you are on the 150 radial
This helps you make a mental picture
You are South East of the station
To fly outbound on the 090 radial, you MUST be East of the station, and you are.

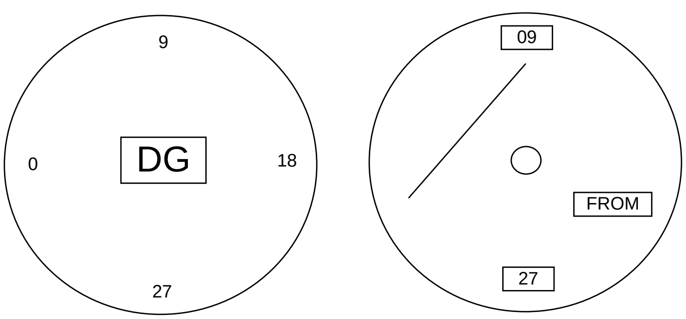


2) Set VOR to fly outbound on 090 radial

How : Turn OBS knob to set the Radial at the TOP (out at the top)

Why : So that the VOR will work correctly & help you do what you want to do

Example shows the VOR set correctly.
Do not worry about the CDI needle or the TO/FROM flag, yet

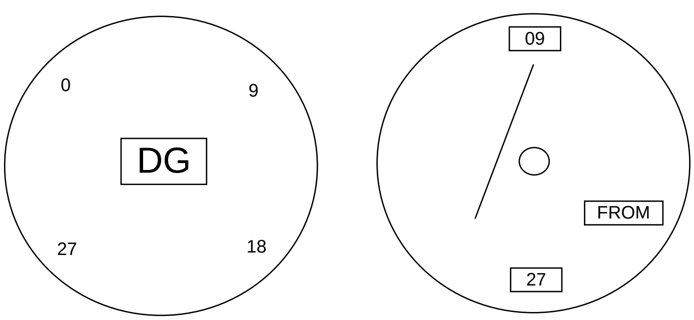


3) Turn the aeroplane, to make "the Tops Match"

How : Turn left or right to make the top of the DG match the top of the VOR

Why : To fly parallel to the radial, so you can properly interpret the CDI needle

Note : During the turn, the VOR display will be virtually unchanged.

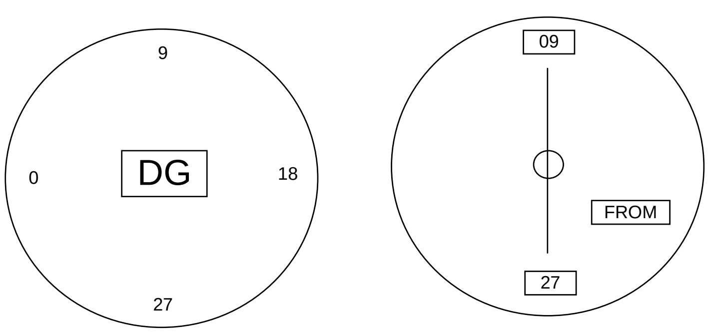


4) Follow the Needle & Turn about 45 degrees

How : Turn the aeroplane until the radial appears at 45 degrees on the DG

Why : To intercept the desired radial at a sensible angle of 45 degrees

This method avoids having to figure out an intercept heading
No need to add or subtract numbers to get the new heading
Just keep ONE NUMBER in mind, the RADIAL (in this case 090)
Picture shows that you're getting close to the 090 radial (CDI moving to centre)
In this case the turn was to the LEFT, because needle was on the left
The CDI needle 'points' toward the heading required



5) Make the Tops Match again

How : Turn 45 degrees to make the top of the DG match the top of the VOR

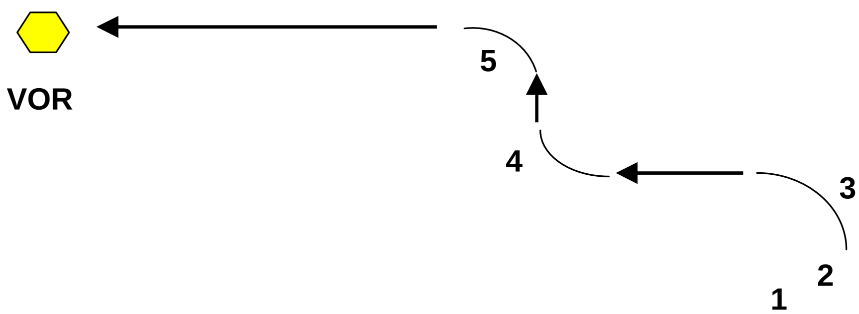
Why : Because when you're tracking on a radial, the tops should match

If you're on the 090 radial heading outbound, then you should be heading 090
The rule about the Tops Matching, works for Inbound & Outbound tracking
The rule about the Tops Matching, works on any radial.
Wind may have a small effect, and prevent an exact match.
This 45 degree turn is ALWAYS in the opposite direction to the one in step 4.

SEE PLAN VIEW FOR AN ILLUSTRATION OF THIS EXAMPLE

VOR NAVIGATION PLAN VIEWS

Intercepting & tracking the 090 Radial Inbound



Intercepting & tracking the 090 Radial Outbound