EASA ATPL(A) · THEORY REVISION

The ATPL Cheat Sheet
061 General Navigation

The facts that actually get tested, stripped to the bone: definitions, key numbers, formulas, mnemonics and the classic exam traps for each subject. Built for the night before, the commute, and the last scroll before you walk into the exam hall.

061 General Navigation | **58** memory items

One of 14 subjects; the full set is free at skystudyatpl.com/atpl-cheat-sheet

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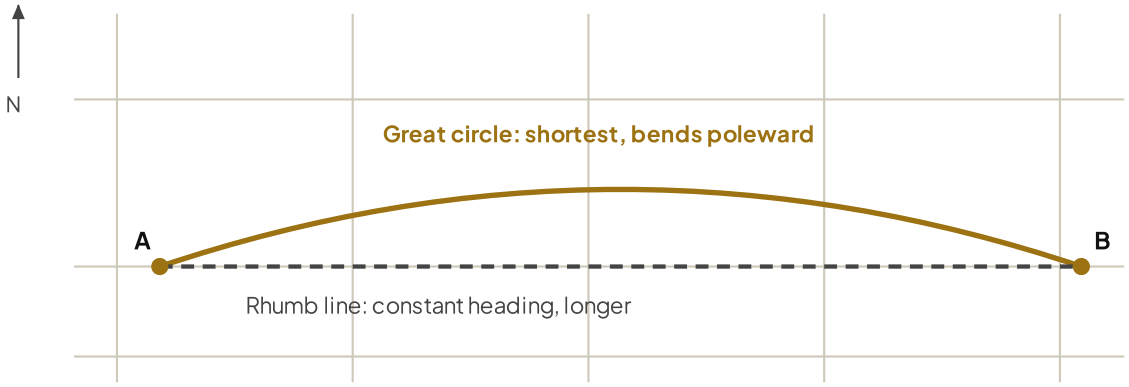
061 General Navigation

The Earth, great circles, charts and projections, dead reckoning, the compass.

GREAT CIRCLE VERSUS RHUMB LINE (MERCATOR)



Meridians drawn parallel here; in reality they converge poleward.

Great circle is the shortest path and cuts each meridian at a changing angle; the **rhumb line** holds one heading but is longer. They coincide only along the equator or a meridian. Convergency = d.long x sin(mean lat); conversion angle is half of it.

MUST-KNOW DEFINITIONS AND CONCEPTS

- A **great circle** has its plane through the Earth's centre and is the shortest distance between two points on a sphere.
- A **rhumb line** (loxodrome) crosses every meridian at the same angle; it is not the shortest route except along the equator or a meridian.
- **Convergency** is the angle between two meridians at a given latitude; **conversion angle** is the angle between the great circle and the rhumb line joining the same two points.
- **Latitude** is 0 to 90 N/S; **longitude** is 0 to 180 E/W from Greenwich.
- 1 nautical mile equals **1 minute of arc of latitude**; 1 degree of latitude equals 60 nm.
- 1 minute of longitude equals 1 nm **only at the equator**, decreasing with cos(latitude).
- **Departure** is the east-west distance in nm between two meridians at a given latitude.
- **Variation** is the angle between true and magnetic north (changes slowly, secular change); **deviation** is between magnetic and compass north (aircraft-specific, varies with heading).
- **IAS to CAS to EAS to TAS**: instrument/position, then compressibility, then density corrections.
- **Groundspeed** is TAS combined with wind; **track** is the actual path over the ground.
- The **triangle of velocities** relates the air vector (heading and TAS), the wind, and the ground vector (track and groundspeed).
- **1-in-60 rule**: a 1 degree displacement subtends about 1 nm after 60 nm.
- **Dead reckoning** finds position from heading, TAS, wind and time from a known start; a **fix** corrects the DR position from external references.
- **GMT/UTC** is based on the Greenwich meridian; **LMT** is based on the observer's own meridian.
- **Grid navigation** uses a fixed grid north instead of true/magnetic north at high latitudes where meridians converge fast.
- **Isogonals** are lines of equal variation; the **agonic** line is zero variation. **Magnetic dip** is 0 at the magnetic equator and 90 at the magnetic poles.
- **GNSS** fixes position by satellite ranging; **INS** integrates sensed accelerations from a known start and drifts over time.

KEY NUMBERS, LIMITS AND VALUES

- 1 international nautical mile = **1852 m** exactly, about 6076 ft.
- 1 degree of latitude = **60 nm**; 1 minute of latitude = 1 nm.
- Mean radius of the Earth about **3440 nm** (6371 km) VERIFY.
- Convergency is **0 at the equator** and equals the change of longitude **at the pole** (factor 1 at the pole).
- The sun moves **15 degrees of longitude per hour**, so 1 degree of longitude = 4 minutes of time.
- **Lambert** standard parallels are typically at about 1/6 and 5/6 of the chart's latitude span VERIFY; scale is correct only along them.
- A rhumb line and great circle coincide only along the **equator or a meridian**.
- **Mercator** scale expands with sec(latitude); it is correct only at the chart's construction latitude (or the equator).
- **Polar stereographic** charts are conformal and can show the pole; a standard Mercator cannot.
- TAS rises roughly **2% above CAS per 1000 ft** as a quick estimate VERIFY.
- A 3 degree glidepath is about **300 ft per nm** (a rule of thumb: roughly 100 ft per nm for each degree of glide angle) VERIFY.

FORMULAS AND RELATIONSHIPS

- `Convergency (deg) = change of longitude (deg) x sin(mean latitude).`
- `Conversion angle = 1/2 x convergency.`
- `Departure (nm) = change of longitude (minutes) x cos(latitude).`
- `Difference of latitude (minutes) = distance in nm along a meridian.`
- `1-in-60 rule: angle (deg) is about (distance off track / distance run) x 60.`
- `Chart scale (representative fraction) = chart length / earth distance, same units.`
- `Mach number = TAS / local speed of sound (LSS depends on temperature only).`
- `True heading = Magnetic heading + Variation (East positive, West negative).`
- `Compass heading = Magnetic heading - Deviation (East positive, West negative, from the deviation card).`
- `LMT = GMT + longitude in time (add East, subtract West).`
- `On a Lambert chart the constant of the cone n is about sin(standard-parallel latitude); chart convergency = change of longitude x n.`

MNEMONICS AND MEMORY ITEMS

- **CADET**: Compass, Add East, to get True (add easterly deviation and variation; subtract westerly).
- **Variation West, Magnetic Best (add); Variation East, Magnetic Least (subtract)** for True to Magnetic.
- **Error West, Compass Best; Error East, Compass Least** for Magnetic to Compass via deviation.
- **Longitude East, GMT least (subtract); Longitude West, GMT best (add)** for GMT to LMT.
- Conversion angle is always **half** the convergency: a quick sanity check.
- **Mercator**: straight line is a rhumb line; **Lambert**: straight line is about a great circle.

COMMON EXAM TRAPS

- Do not swap **convergency** (full angle) with **conversion angle** (half of it).
- Departure uses **cos(latitude)**, not sin.
- Use the **mean latitude** for departure, convergency and conversion angle over a significant distance.
- 1 minute of **longitude** is 1 nm only at the equator; only 1 minute of **latitude** is always 1 nm.
- **CADET** applies Compass to True; the reverse direction reverses the sign logic.
- **Variation** is geographic (same for all aircraft at a place); **deviation** is aircraft-specific and changes with heading.
- A rhumb line is shortest **only** along the equator or a meridian; otherwise the great circle is shorter.
- On a **Lambert** chart great circles are only near-straight, best between the standard parallels.
- A **Mercator** cannot sensibly show or navigate the poles.
- Correct CAS to **EAS** (compressibility) before the density correction to TAS at high speed/altitude.
- Do not use the 2%-per-1000-ft rule for a precise calculation; use the flight computer or ISA tables.
- The **agonic** line is zero variation; an **isogonal** is any line of constant variation.
- Compass indications are unreliable through dip errors near the poles and on headings near north/south.

The triangle of velocities: heading/TAS + W/V = track/GS

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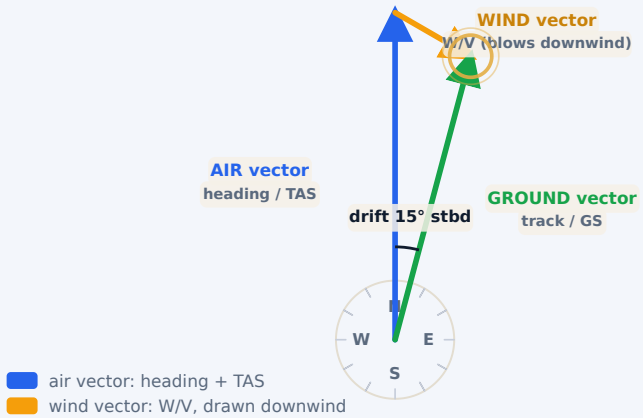

GIVEN -> FIND	
Heading (T)	000°
TAS	150 kt
W/V	300° / 40
Track (T)	015°
GS	135 kt
Drift	15° stbd

1 The three vectors

Air vector (heading and TAS) plus wind vector (the W/V) gives the ground vector (track and GS). It is one vector sum: two knowns fix the third.

2 Draw the wind downwind

The wind vector starts at the head of the air vector and points the way the air is going: a wind FROM 300° is drawn towards 120°.

3 Drift

Drift is the angle between heading and track. A wind from the left gives starboard (right) drift, so the aircraft tracks right of its heading.

4 Heading vs track

To make good a desired track you turn the heading into wind by the wind correction angle, which equals the drift but is applied the opposite way.

Heading/TAS plus W/V equals track/GS: the wind vector, drawn downwind from the head of the air vector, closes the triangle and the drift is track minus heading.

The 1-in-60 rule: track error and the closing angle

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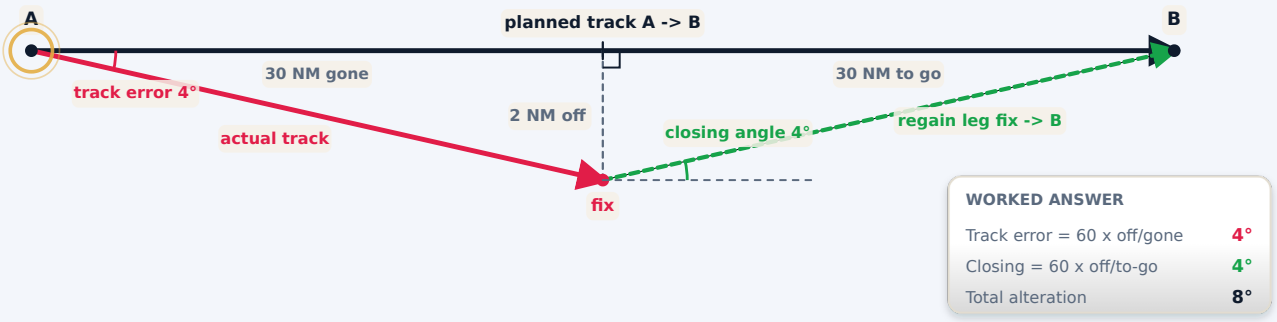

1 Track error
Track error in degrees is 60 times distance off divided by distance gone. Here 60 times 2 over 30 is 4°, the angle already opened up between planned and actual track.

2 Parallel the track
Turn by the track error alone and the aircraft flies parallel to the planned track, holding the same 2 NM offset but no longer diverging.

3 Closing angle
To arrive at the destination add the closing angle, 60 times off divided by distance to go: 60 times 2 over 30 is another 4°.

4 Total correction
Turn by track error plus closing angle, here 8°, to regain track at B. When gone equals to-go, simply double the track error.

Track error equals 60 times distance off over distance gone; add the closing angle, 60 times off over distance to go, to regain track at the destination.

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