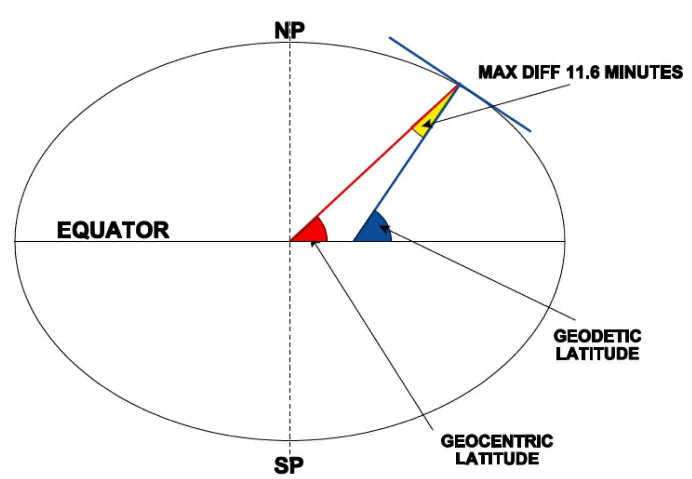
GNAV

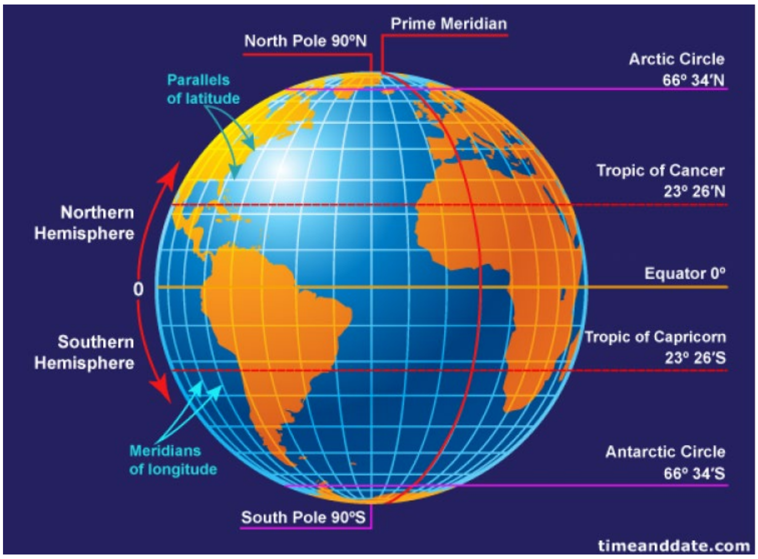
Geodetic (or geographic) latitude is the angle that the surface normal makes when it intersects the equatorial plane.

Geocentric latitude is the angle of the line from the center of the figure to a specific point on the surface of the figure, measured with respect to the equatorial plane.

On a sphere, the surface normal intersects the equatorial plane at the center of the sphere. So the geodetic latitude and the geocentric latitude are the same in all cases.

On an ellipsoid, the surface normal does not, in general, intersect the equatorial plane at the center of the Earth. So the geodetic latitude will be measured from the equatorial plane to the surface point.





- Sunset and sunrise occur every day for latitudes < 66,5°
- Going to the north, summer has longer days, winter has shorter days
- Rate of change of **duration of daylight** is **greater during equinoxes** and is **directly proportional to declination** of the sun (in reality is inversely proportional to declination, but EASA…)
- **Twilight last less at lower latitudes** (last more going away from equator)
- **Distance** between **geodetic parallel of latitude** on WGS84 **increases with latitude**
- Rate of movement north pole – geographic north is 1° every 5 years
- Sunrise occurs earlier every day at 33,5°N parallel of latitude
- Sunset and sunrise occur earlier at high altitudes due to increased visual horizon
- Geoid: irregular shape influenced by gravity and centrifugal force
- Ecliptic: apparent path of the sun around the earth.
- Seasons are due to the inclination of the polar axis with the ecliptic plane
- Tropic of cancer: 26°N | Tropic of Capricorn: 26°S
- True North: direction of the observer's meridian to the North Pole

Direction

DME are oriented to true north, so any angle is true

VOR is oriented to magnetic north, so any angle (radial) is magnetic

Definitions

A = 0	Agonic = 0 variation
Iso = ''=''	Isogonal = same variation
Go = variation	Aclinic = 0 deviation
Clin = deviation	Isoclinal = same deviation

Deviation depends on: magnetic latitude, aircraft HDG, electronic equipment

The agonic line follows separate paths out of the North polar regions, one currently running through western Europe and the other through the USA.

Max value of variation = 180°

TKE = planned track – actual track

True North: The direction along the surface of the earth towards the geographic North Pole along the meridian on which you are located

If the question state ''along the route'', that means TKE is not to be used because we are parallel to the planned track

Distance

NGM > NAM in higher altitude and headwind

When calculating shortest distance between 2 points that have 180° in longitude, use polar route:

Distance [NM] = $[(90-Lat_1) + (90-Lat_2)]*60$

1 minute of arc along a meridian = 1NM = 1852 m at ~ 45° latitude

Speed

Compressibility factor only used from CAS/IAS to TAS

ROD (3°) = GS*5 ft/min for glide path angle > 3° use proportion | GS = Groundspeed

ROD = GS*Gradient (%)

Gradient (%) = 100*tan(glide path angle)

TAS = CAS ±2% of CAS for each ±1000ft altitude

Calculate ΔTAS from ΔCAS. Find ΔCAS. Now just find TAS with CR3 with all the other info we have:
1. Align Pressure altitude and OAT,
2. ΔCAS on the inner scale and read off ΔTAS on the outer scale

Speed during descent = 1/2 altitude

Speed during climb = 2/3 altitude

ICET --> PCD [Pressure and position; Compressibility; Density]

VFR

Power lines are a threat when crossing valley and less when along the ridge

Fruit farms are never a good reference point.

If the feature is crossing the intended track, it's a good reference point

EASA loves high tension lines as reference point

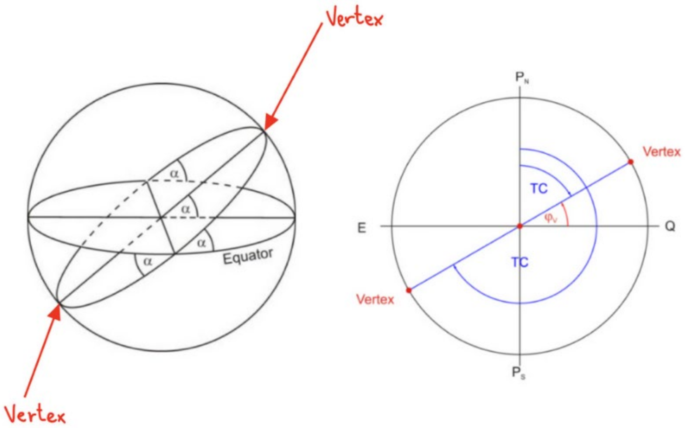
If not lost, proceed to next checkpoint according to time; if lost, start lost procedure

Track plot requires 2 pinpoints or fixes

Relief portrayed as a combination of = you Can Sit Do Shit
- Contour line
- Shading
- Different colour
- Spot height

Great circle [GC] and Rhumb line [RL]

Vertex = position where the GC track is nearest to the pole (highest latitude). The track at vertex is 090° or 270°. The 2 vertices are 180° longitude apart and opposite hemisphere same latitude



Convergency = $\Delta long * \sin(mean\ lat)$ | it is the difference between the initial and final GC track and is the angle between meridians passing through 2 points at a given latitude

Conversion angle = convergency/2 | it is used to convert a RL to a GC

GC initial track = Rhumb line track [RLT] ± conversion angle = RLT ± convergency/2

If they say initial true track / final true track = GC track

Final GC track use DIID

Initial GC track use IDDI

Lambert chart: Convergency = $\Delta long * \sin(parallel\ of\ origin)$

If we follow a constant track (constant true or magnetic heading) = RL
If we follow a constant (gyro) heading = GC | That is because if we have no precession, the gyro will follow a straight line on earth, which is a GC

VOR follow a GC track

If we follow a rhumb line, it will spiral toward the nearest pole.

Average GC track = RL track

Charts

Chart convergence is the angle of inclination between meridians on the chart

Conformal chart: preserve angles (right angles between parallels and meridians)

Small scale = small zoom | Big denominator ---> bad details ---> large area
Large scale = big scale = big zoom | Small denominator ---> good details ---> small area

To achieve the ICAO requirement of a straight line on an enroute chart approximating to a GC track on Earth chart convergence has to approximate to earth convergence.

Mercator

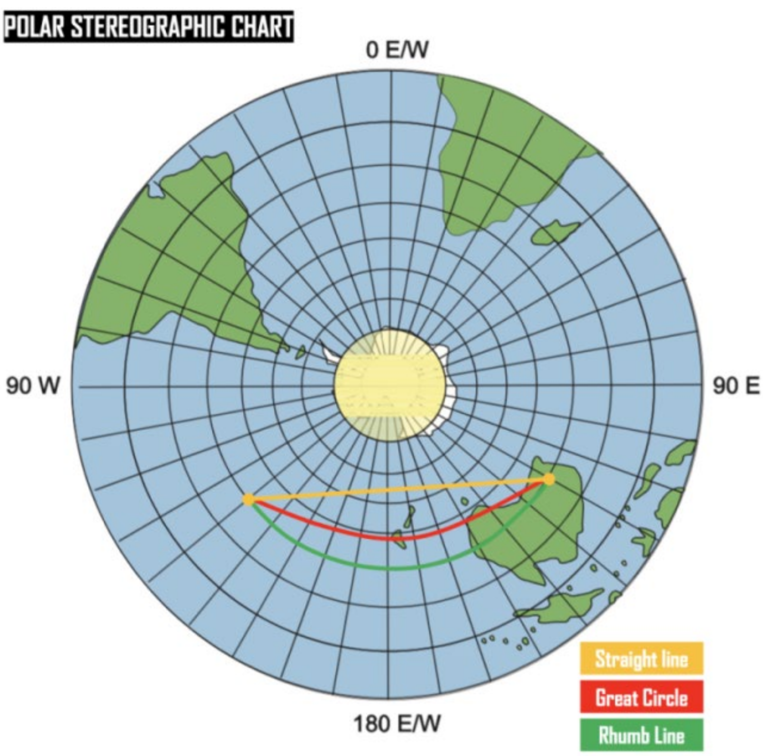
New Distance : New Latitude = Old Distance : Old Latitude

Lambert

Same scale = Standard Parallels
Same convergency = Parallel of Origin

Polar stereographic

Convergency = $\Delta long$ | latitude to be used is always 90°, so sin(90°) = 1



Time

Sidereal day takes reference to a star so it’s constant during the year

Standard Time [ST]: time defined by the country authority

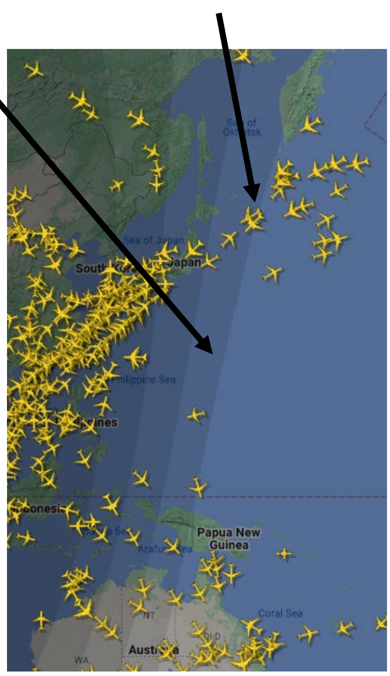
In a country each minute of latitude would require a different LMT, but for practical purposes this is not used and instead a ST is used, where the authority decide that in the entire country a defined UTC ± X time is used.

Daylight saving time: the daylight is shifted 1h towards later in the day

Factors influencing day and night duration: location latitude, elevation and time of the year:

- 2 places at same longitude but same distance N/S from the equator have different sunrise/sunset time
- Higher altitude = earlier sunrise and later sunset

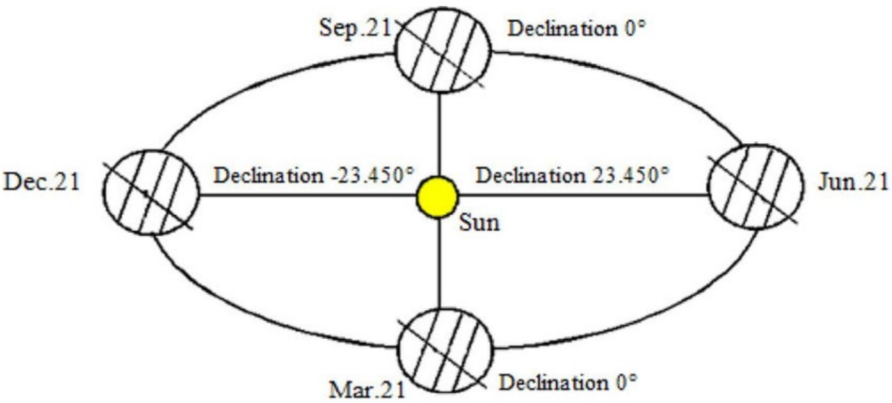
Evening civil twilight is **affected** by **declination** of the sun and **latitude**.
The duration on civil twilight is the time between sunset and when the center of the sun is 6° below the celestial horizon.
Sunrise occurs **earlier** at **lower latitudes than** at **higher latitudes** in **N hemisphere**



Major change in daylight happens during the equinox, so when sun is at the equator (0° declination)

Twilight lasts less at lower latitudes than at higher latitudes

Above 63° N during summer sun doesn’t set, during winter sun doesn’t rise.



- Local Mean Time [LMT]

Positions on the same meridian have the same LMT.

Difference in time $\Delta T = \frac{\Delta long}{15}$ because every hour the sun travels 15° of longitude

- Using the almanac [they use LMT]

Given 2 longitudes in the same hemisphere (both W or E), subtract the smaller from the larger to obtain time.

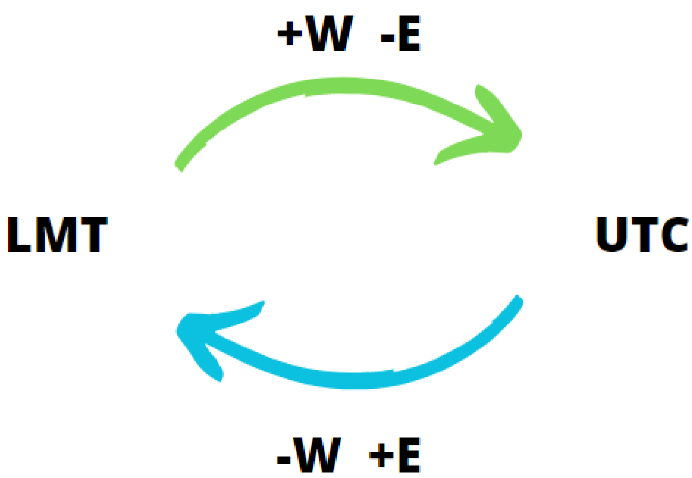
For 2 longitudes in different hemisphere (one W, the other E) sum the time together after obtaining the value of time.

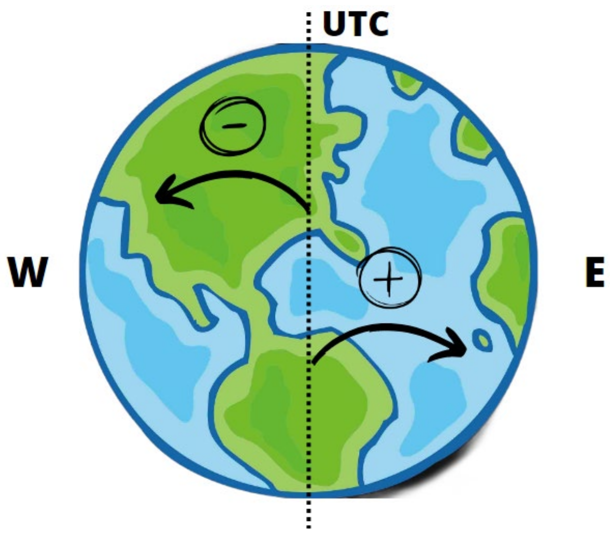
To pass from LMT to ST, convert LMT to UTC and then UTC to ST

- Universal Coordinated Time [UTC]

It is the LMT at Greenwich. Also called Zulu time.

- Converting UTC - LMT





- Converting LMT – LMT

    Take the LMT and convert into UTC for the 1st position.

    Calculate the ΔT from LMT to UTC for the 2nd position | Calculate ΔLong (Initial/Final) and then ΔT

    Add or subtract this time to the UTC of the 1st position

- International Date Line [IDL]

    When crossing the IDL when travelling: Eastbound = -1 day ; +1h | Westbound = +1 day ; -1h

ICAO AERONAUTICAL CHART SYMBOLOGY

AIR TRAFFIC SERVICES

1. Flight Information Region (FIR)
2. Airway (AWY), Control Area (CTA)
3. Control Zone (CTR)
4. Uncontrolled Route
5. Advisory Airspace
6. Reporting point – non compulsory
7. Reporting point –compulsory
8. RNAV Waypoint

OBSTACLES

9. Obstacle
10. Lighted Obstacle
11. Obstacles Group
12. Lighted Obstacles Group
13. Exceptionally High Obstacle
14. Lighted Exceptionally High Obstacle

VISUAL AIDS

15. Aeronautical Ground Light
16. Lightship

ICAO AERONAUTICAL CHARTS
SYMBOLS FOR AERODROME/HELIPORT CHARTS

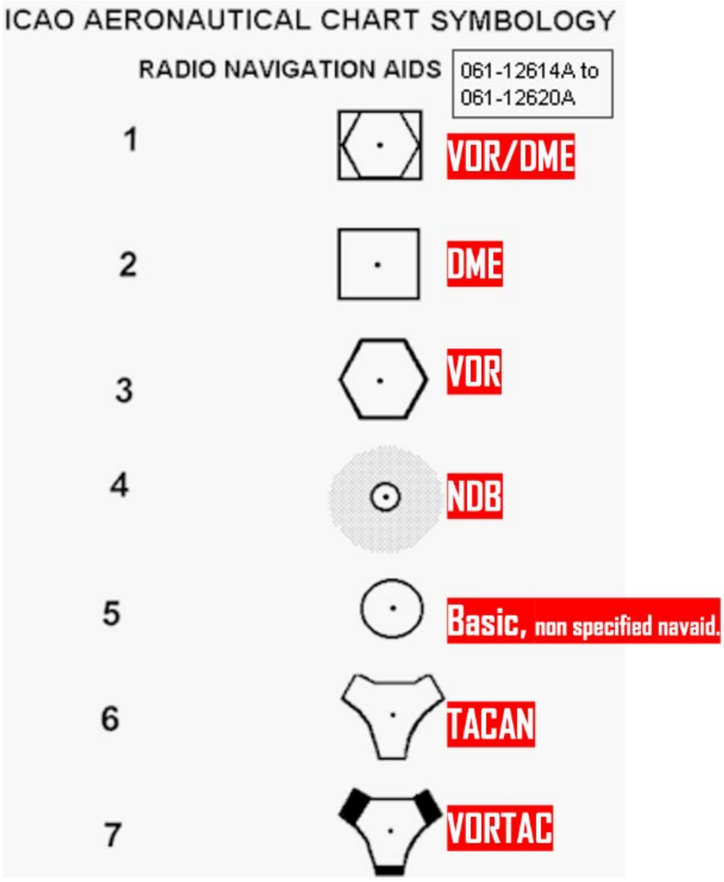
1 Helicopter alighting area on an aerodrome

2 Aerodrome Reference Point (ARP)

3 VOR checkpoint

4 Runway Visual Range (RVR) observation site

Symbol 1	Symbol 5	Symbol 9
Compulsory RP	VOR check-point	FL 70 At or above altitude/FL
Symbol 2	**Symbol 6**	**Symbol 10**
Fly-over on request RP	RVR observation site	FL 50 At or below altitude/FL
Symbol 3	**Symbol 7**	**Symbol 11**
Fly-by WTP	Aerodrome Reference Point (ARP)	FL 30 Mandatory altitude/FL
Symbol 4	**Symbol 8**	**Symbol 12**
Closed/abandoned Aerodrome	Tree/Shrub	FL 50 Recommended altitude/FL



TOPOGRAPHY

1	Contours		5000
2	Approximate contours		5500
3	Relief shown by hachures		
4	Bluff, cliff or escarpment		
5	Lava flow		
6	Sand dunes		
7	Sand area		
8	Gravel		
9	Levee or esker		
		Alternative	
10	Unusual land features appropriately labelled		Many Small Volcanoes
			Rock Outcrop
	Active volcano		
11	Mountain pass		5395
12	Highest elevation on chart		17456
		Alternative	.17456
13	Spot elevation		.6397 .8975
14	Spot elevation (of doubtful accuracy)		.6370±
15	Coniferous trees		
16	Other trees		
17	Palms		