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2011, December 1

Circumpolarity

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The Declination of a celestial object and the observer's Latitude determine whether a particular star is circumpolar. Suppose we are observing from Leeds, Latitude + 53°. This means that Polaris is 53° above the horizon. It follows that the angular distance between Polaris and the observer's zenith is $(90 - 53)^\circ = \underline{37^\circ}$

To an observer in the Northern Hemisphere, the lowest point of a star is when it lies due North. Any star which is below the Pole by an angular amount just equal to one's Latitude will just skirt the Northern horizon at its lowest point. If it is nearer the pole than 53° (in our case) it will never set. That is, it will be circumpolar. The Declination of the Star is measured from the Equator towards the Pole. Remember that the Declination of Polaris is + 90°.

So, it follows that the angular distance of a star from Polaris is $(90 - D)^\circ$, where D is the Declination. We can calculate the "limiting" Declination for a circumpolar star by subtracting our Latitude from 90°, which gives us the angle downwards from the Pole. From Latitude + 53° (Leeds), a star will be circumpolar if its Declination is $(90 - 53)^\circ = 37^\circ$, or greater.

The condition can be written as:

$$\text{Declination} \geq 90^\circ - L$$

Where L is the observer's Latitude.

Similar reasoning leads us to realise that a star which lies at any Declination south of -39° will never rise from Leeds.

Location	Latitude (°)	Altitude of Polaris (°)	Star	Its Declination (°)	Cirumpolar? Yes	Cirumpolar? No
Penzance	+50		Choose any six stars from the list on which you were working last week. Using your estimated values for the Declinations, look for circumpolarity			
Rome	+ 42					
Athens	+ 38					
Leeds	+ 53					
Lerwick	+ 60					