

Zenith in São Carlos

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Solution: *The zenith of the sun oscillates sinusoidally with a period of one year and an amplitude α_{trop} . Hence,*

$$\alpha(t) = \alpha_{trop} \cos \frac{2\pi t}{365d} .$$

The sun is vertical in São Carlos ($\alpha_{sc} = 21.92^\circ$) when $\alpha(t) = \alpha_{sc}$, that is,

$$\alpha_{trop} \cos \frac{2\pi t}{365d} = \alpha_{sc} .$$

or

$$t = \frac{365d}{2\pi} \arccos \frac{\alpha_{SC}}{\alpha_{WK}} = 17.9 d .$$