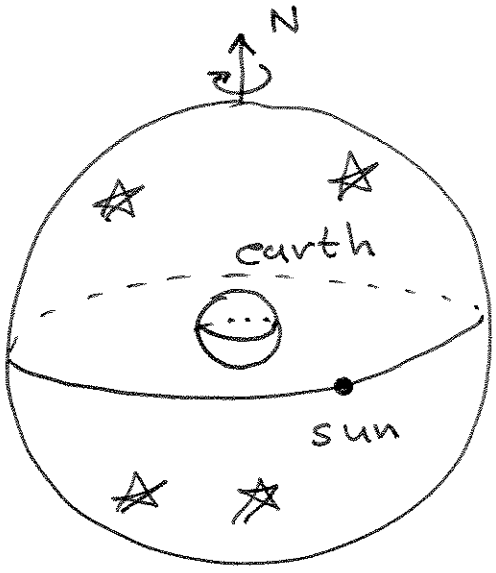
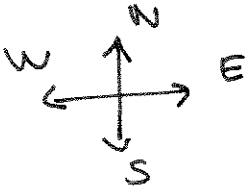
Homework 1

Problem 1

On vernal equinox, sun is on equator of the celestial sphere, so everything is simple:



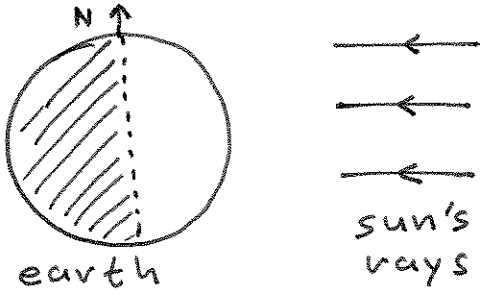
Sun rises due E, sets due W, is directly overhead at noon:



For winter and summer solstice, see problem 2 below.

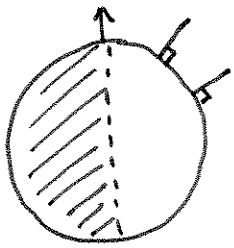
Problem 2:

Vernal equinox: sun on equator

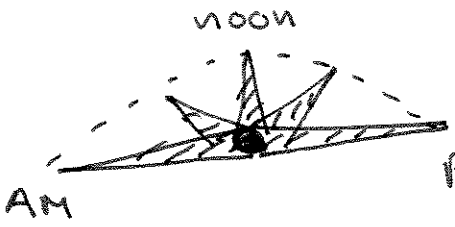


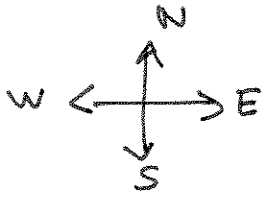
⇒ Sunrise due E for everyone on earth

Anywhere in northern hemisphere at noon:

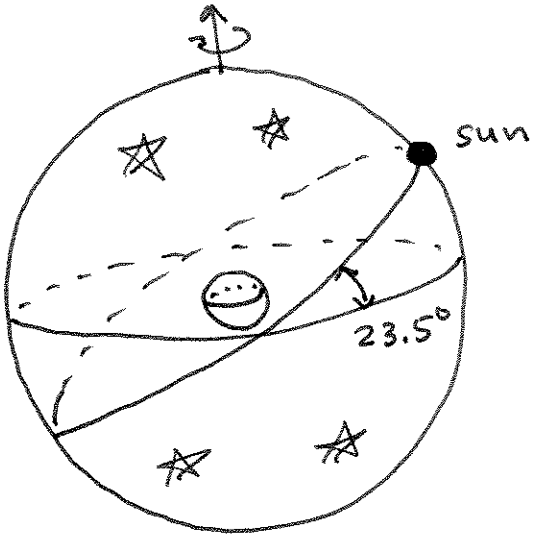


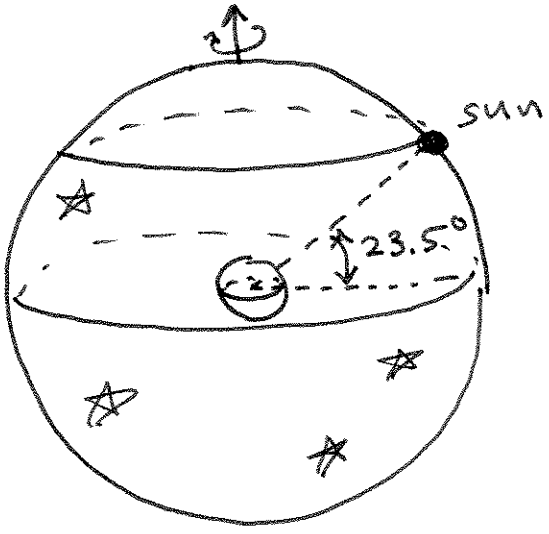
⇒ Gnomon casts shadow N



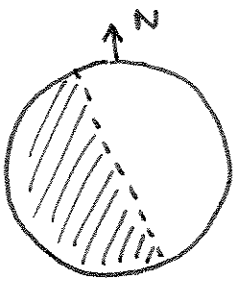


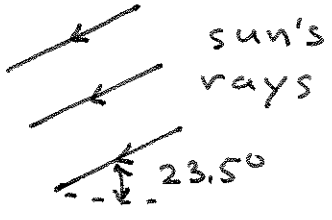
Summer solstice: sun is at northernmost point on ecliptic





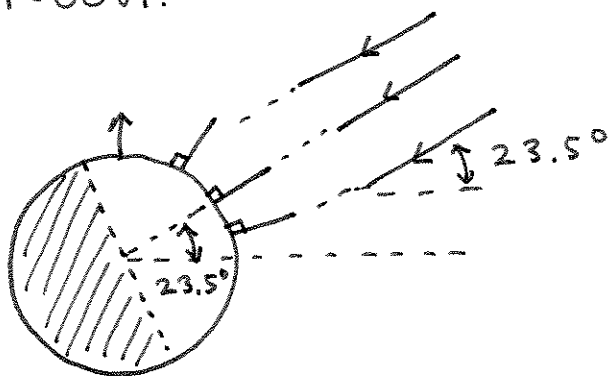
Sunrise:





⇒ Sunrise north of due E for everyone on earth (even in southern hemisphere!)

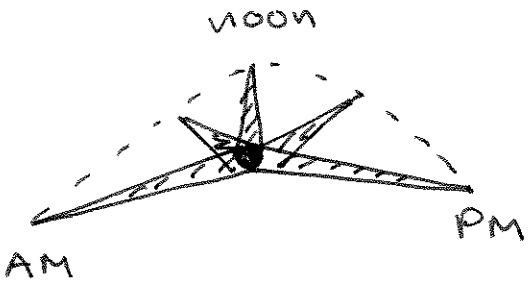
Noon:

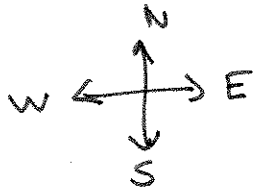


⇒ Gnomon shadow depends on whether observer is north or south of Tropic of Cancer

N of Tropic:
Noon shadow is N

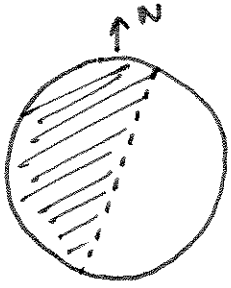
S of Tropic:
Noon shadow is S

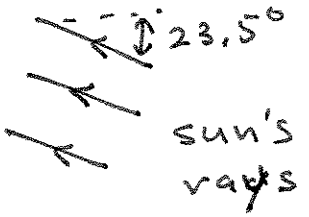




On Tropic: no shadow at noon

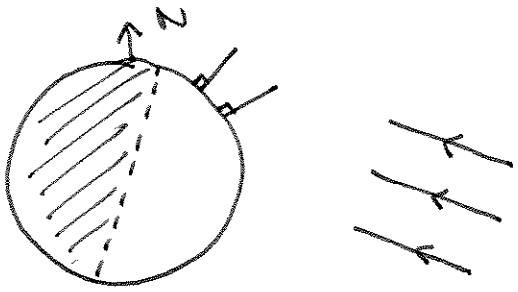
Winter solstice:





⇒ Sunrise is south of E for everyone on earth

Noon:



⇒ Gnomon shadow is N everywhere in northern hemisphere

Problem 3

Assume $365\frac{1}{4}$ days/yr

Predicted vernal equinox $= 365\frac{1}{4}\ \frac{\text{day}}{\text{yr}} \times 145\ \text{yr}$

$= 52,961.3$ days

Actual $= 52,961.3 - 0.5 = 52,960.8$ days

$\Rightarrow$ length of year $= \dfrac{52,960.8\ \text{days}}{145\ \text{yr}} = 365.247\ \frac{\text{day}}{\text{yr}}$

(actual $= 365.2425$ day/yr)

Problem 4

$\dfrac{\theta}{360^\circ} = \dfrac{1}{24} \Rightarrow \theta = 15^\circ$

c = circumphevence

$\dfrac{d}{c} = \dfrac{1}{24} \Rightarrow c = 24d = 24,000$ mi

$c = 2\pi r \Rightarrow r = \dfrac{c}{2\pi} = 3,820$ mi

(actual r = 3,960 mi)