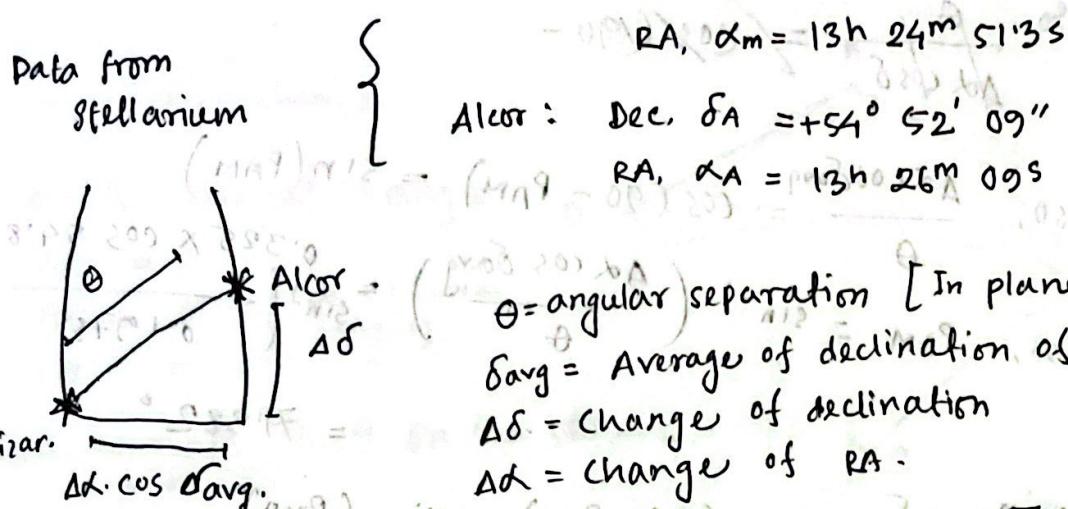


## Problem 1:

Coordinates of the stars: Mizar: Dec.  $\delta_m = +54^\circ 48' 22.3''$ 

$$\text{so, } \theta^2 = \Delta\delta^2 + (\Delta\alpha \cos \delta_{\text{avg}})^2 \quad [\text{Pythagoras theorem}]$$

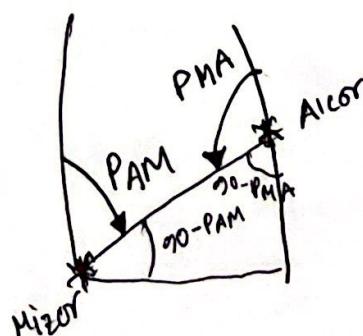
$$\Delta\delta = |\delta_A - \delta_m| = (54^\circ 869 - 54^\circ 806)^\circ = 0^\circ 063^\circ = 0.0011 \text{ rad.}$$

$$\Delta\alpha = |\alpha_A - \alpha_m| = (201^\circ 538 - 201^\circ 213)^\circ = 0^\circ 325^\circ = 0.0057 \text{ rad.}$$

[Small separation, plane geom. valid]

$$\delta_{\text{avg}} = \frac{\delta_A + \delta_m}{2} = \left( \frac{54^\circ 869 + 54^\circ 806}{2} \right)^\circ = 54^\circ 838^\circ = 0.0511 \text{ rad.}$$

$$\text{so, } \theta = \sqrt{\Delta\delta^2 + (\Delta\alpha \cos \delta_{\text{avg}})^2} = \sqrt{(0.063)^2 + (0.325 \times \cos 54^\circ 838^\circ)^2} = 0.1975^\circ = 0.0034 \text{ rad.}$$



PMA = Position angle of Mizar in respect to Alcor

PAM = Position angle of Alcor in respect to Mizar

$$\delta_m = 54^\circ 48' 22.3'' = \left( \frac{22.3}{60} + 48 \right) + 54^\circ$$

$$= 54^\circ 806^\circ$$

$$\delta_A = 54^\circ 52' 09'' = \left( \frac{52}{60} + 54 \right) + 54^\circ$$

$$= 54^\circ 869^\circ$$

$$\alpha_m = 13h 24m 51.3s = \left( \frac{51.3}{60} + 24 \right) + 13h$$

$$= \left( \frac{13.414}{24} \times 360 \right)^\circ$$

$$= 201^\circ 213^\circ$$

$$\alpha_A = 13h 26m 09s = \left( \frac{26}{60} + 13 \right)h$$

$$= \left( \frac{13.436}{24} \times 360 \right)^\circ$$

$$= 201^\circ 538^\circ$$

$$\text{So, } \frac{\theta}{\Delta \alpha \cos \delta} = \cos(90 -$$

$$\text{So, } \frac{\Delta \alpha \cos \delta \text{ ang}}{\theta} = \cos(90 - \text{PAM}) = \sin(\text{PAM})$$

$$\text{So, } \text{PAM} = \sin^{-1} \left( \frac{\Delta \alpha \cos \delta \text{ ang}}{\theta} \right) = \sin^{-1} \left( \frac{0.325 \times \cos 54.838}{0.1975} \right) = 71.382^\circ$$

$$\text{Again, } \frac{\Delta \delta}{\theta} = \cos(90 - \text{PMA}) = \sin(\text{PMA})$$

$$\text{So, } \text{PMA} = \sin^{-1} \left( \frac{\Delta \delta}{\theta} \right) = \sin^{-1} \left( \frac{0.063}{0.1975} \right) = \cancel{18.602^\circ} \quad \begin{array}{l} \text{Should} \\ \text{be between} \\ \pi/2 \end{array}$$

Required answer:

$$\theta = 0.1975^\circ$$

$$\text{PAM} = 71.382^\circ$$

$$\text{PMA} = \cancel{18.602^\circ} \quad 18.602^\circ$$

[using HANAC]

$$(82 + \frac{0.063}{0.1975}) = 82$$

$$82.828^\circ = \left( \frac{808.42 + 0.2842}{8} \right) = \frac{810.703}{8} = 101.3375^\circ$$

$$(803.205/80) + 18.602^\circ = \theta \quad .02$$

Problem 2: Deriving the law of cosine

Here,  $A, B, C$  are spherical angles.

$ABC$  be a spherical triangle.

Sides,  $\begin{cases} AB = c \\ BC = a \\ CA = b \end{cases}$  all are in angles.

We draw tangents to  $A$  on the sphere. (DA & DE)

Then join  $OD$  and  $OE$  [The went through  $B$  and  $C$ ].

In  $\triangle DAE$ ,  $DE^2 = AD^2 + AE^2 - 2AD \cdot AE \cos A$  [Plane cosine formula] — ①

In  $\triangle DDE$ ,  $DE^2 = OD^2 + OE^2 - 2OD \cdot OE \cos a$  — ②

$$\text{So, } DE^2 = DE^2 \text{ or, } AD^2 + AE^2 - 2AD \cdot AE \cos A = OD^2 + OE^2 - 2OD \cdot OE \cos a$$

$$\Rightarrow 2OD \cdot OE \cos a = (OD^2 - AD^2) + (OE^2 - AE^2) + 2AD \cdot AE \cos A \quad - ③$$

$\triangle DAO$  is plane triangle right-angled at  $A$ . because.

$DA$  is a tangent to  $AB$  at  $A$  and  $OA$  is radius.

$$OD^2 - AD^2 = AO^2 \quad \text{By Pythagoras,}$$

$$\text{Similarly in } \triangle OAE, \quad OE^2 - AE^2 = AO^2$$

$$\text{So, Eqn } ③, \quad 2OD \cdot OE \cos a = AO^2 + AO^2 + 2AD \cdot AE \cos A$$

$$\Rightarrow OD \cdot OE \cos a = AO^2 + AD \cdot AE \cdot \cos A$$

$$\Rightarrow \cos a = \frac{OA}{OD} \cdot \frac{OA}{OE} + \frac{AD}{OD} \cdot \frac{AE}{OE} \cos A$$

$$\text{In } \triangle OAD, \quad \frac{OA}{OD} = \cos \angle DOA$$

$$\frac{AD}{OD} = \sin \angle DOA \quad \text{Also, } \angle DOA = C$$

$$\text{So, } \frac{OA}{OE} = \cos \angle AOE \quad \angle AOE = b$$

$$\frac{AE}{OE} = \sin \angle AOE$$

$$\text{So, } \cos a = \cos b \cdot \cos c + \sin b \cdot \sin c \cos A$$

Suppose, the stars are Alcor and Mizar,  
If we consider the figure on the right,

We need to find out BC,

which is the angular separation.

$$\text{Jd. } BC = \theta = a$$

$$AC = 90 - \delta_M = b$$

$$AB = 90 - \delta_A = c$$

$$\angle CAB = \Delta RA = (\alpha_M - \alpha_A) = A$$

so. in the cosine formula,  $\cos a = \cos b \cos c + \sin b \sin c \cos A$

It can be written as,  $\cos \theta = \cos(90 - \delta_M) \cos(90 - \delta_A) + \sin(90 - \delta_M) \sin(90 - \delta_A) \cdot \cos(\alpha_M - \alpha_A)$

$$\text{or, } \cos \theta = \sin \delta_M \cdot \sin \delta_A + \cos \delta_M \cdot \cos \delta_A \cdot \cos(\alpha_M - \alpha_A)$$

$$\text{or, } \theta = \cos^{-1} (\sin \delta_M \cdot \sin \delta_A + \cos \delta_M \cdot \cos \delta_A \cdot \cos(\alpha_M - \alpha_A))$$

from problem ①,  $\theta = \sqrt{(\delta_M - \delta_A)^2 + (\alpha_M - \alpha_A) \cdot \cos\left(\frac{\delta_M + \delta_A}{2}\right)^2}$

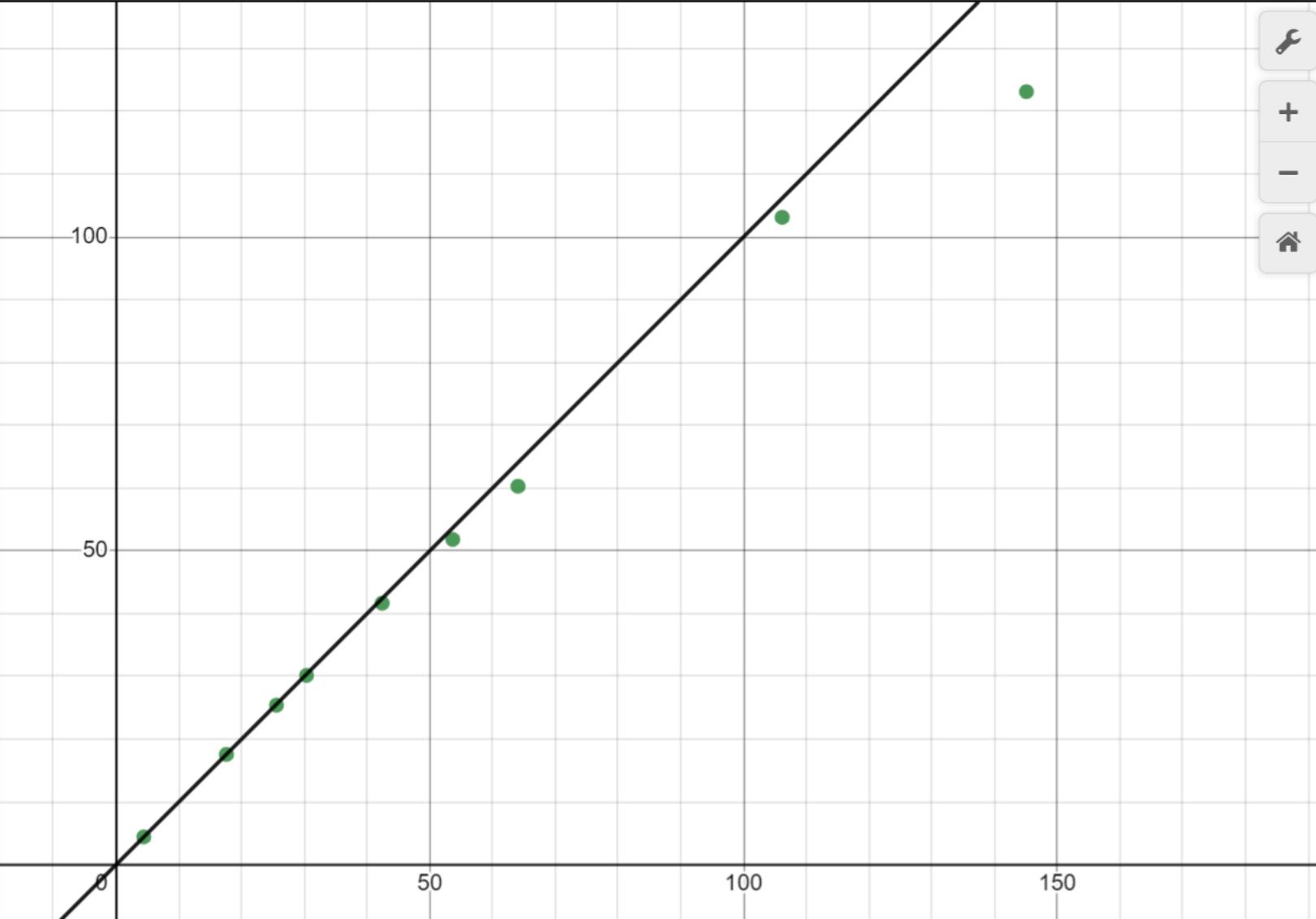
Now, if we make plot of both of them.

Table:

$\delta_M$	$\delta_A$	$\alpha_M$	$\alpha_A$	$\theta_{\text{plane}}$	$\theta_{\text{SPver}}$
30	31	180	175	4° 42' 26"	4° 42' 22"
30	35	150	160	17° 59' 33"	17° 55' 80"
30	40	180	145	30° 36' 42"	30° 13' 66"
30	45	180	130	42° 40' 90"	41° 65' 34"
30	50	180	115	53° 65' 04"	51° 80' 92"
30	55	180	100	64° 06' 17"	60° 27' 53"
32	81	175	87.5	145° 08' 38"	123° 12' 26"
32	65	175	130	126° 20' 00"	121° 49' 41" 103° 11' 12"
32	90	175	145	25° 55' 50"	25° 41' 37"



$x_1$	$y_1$
4.4226	4.4222
17.5933	17.5580
30.3642	30.1366
42.4090	41.6534
53.6594	51.8092
64.0617	60.2753
145.0838	123.1226
106.1633	103.1112
25.5550	25.4137



x = y



If we compare  $\theta_{\text{plane}}$  and  $\theta_{\text{sphere}}$  like the graph above, we can see for larger  $\theta$  (angular separation), the difference will be larger. or both  $\delta(\text{Dec})$  is 0, But when both  $\alpha(\text{RA})$  will be equal, or both  $\delta(\text{Dec})$  will be 0, then the  $\theta_{\text{plane}}$  and  $\theta_{\text{sphere}}$  will be same. These are the special cases.

Problem 3:

The tools we are using will convert from Galactic coordinates to Equatorial coordinates. So we need the Galactic coordinates of all these points in the sky at first.

★ Point in the sky

~~1280° 8S - 16° 50' 45" E~~

Galactic Center

Galactic Anticenter

North Pole

South Pole

Point of intersection of ecliptic and galactic plane

\* Longitude can be anything for North pole and South pole.

\*\* We know that the galactic center is at sagittarius which is a zodiac, means it's also on the ecliptic. So, sagittarius should be one point. Another point should be  $180^\circ$  away from sagittarius.

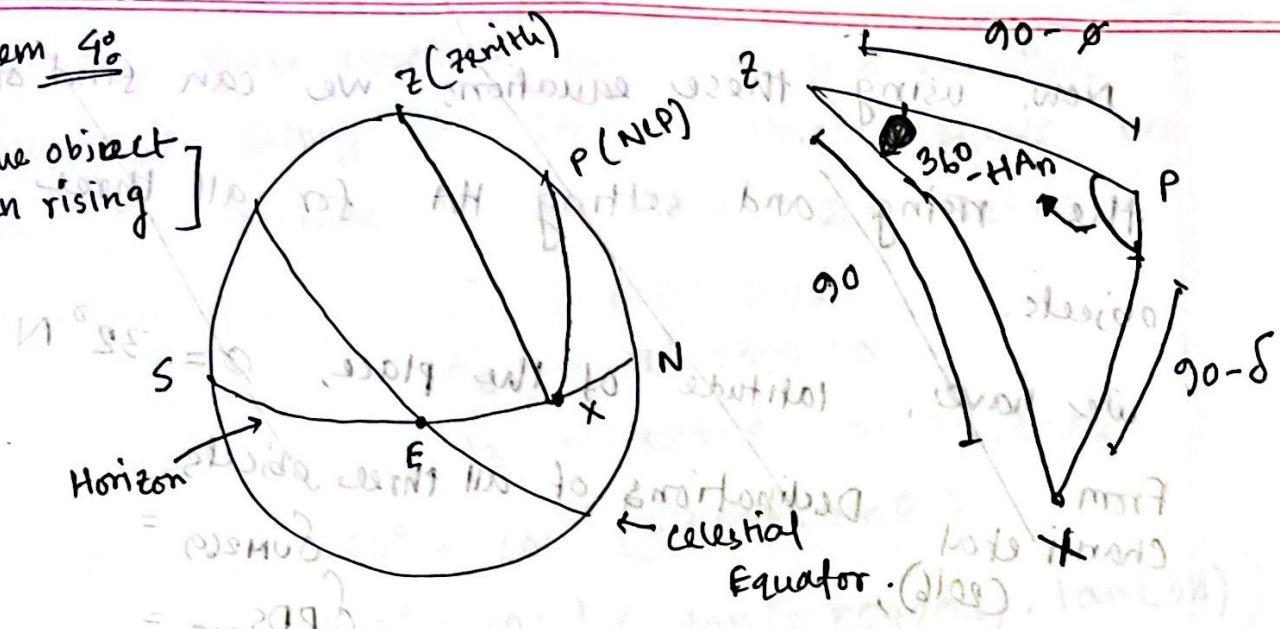
Now using the tools, we can find out the RA and DEC of these points:

Galactic longitude (l)	Galactic latitude (b)
$0^\circ$ Sagittarius	$0^\circ$
$180^\circ$ Aries	$0^\circ$
$0^\circ$	$+90^\circ$
$0^\circ$	$-90^\circ$
$0^\circ, 180^\circ$	$0^\circ$

Points in the sky	RA ( $\alpha$ )	DEC ( $\delta$ )
Galactic center	$17^h 45^m 37^s.21$	$-28^\circ 9361^\circ$
Galactic Anticenter	$05^h 45^m 37^s.17$	$+28^\circ 9361^\circ$
Gal. North Pole	$12^h 51^m 26^s.28$	$+27^\circ 1284^\circ$
Gal. South Pole	$00^h 51^m 26^s.27$	$-27^\circ 1283^\circ$
Points of intersection of ecliptic and galactic plane.	$17^h 45^m 37^s.21$ $05^h 45^m 37^s.17$	$-28^\circ 9361^\circ$ $+28^\circ 9361^\circ$
		[NASA/IPAC Extragalactic database]

Problem  $4^{\circ}$

[X is the object when rising]



Using cosine equation in the spherical triangle  $PZX$ ,

$$\cos 90^{\circ} = \cos(90-\delta) \cos(90-\phi) + \sin(90-\delta) \sin(90-\phi).$$

[solving for HA],

$$\cos(360^{\circ} - HA_r)$$

or,

$$\frac{\cos 90^{\circ} - \cos(90-\delta) \cos(90-\phi)}{\sin(90-\delta) \sin(90-\phi)} = \cos(360^{\circ} - HA_r)$$

or,

$$\frac{0 - \sin \delta \sin \phi}{\sin \delta \cdot \cos \phi} = \cos(360^{\circ} - HA_r)$$

$$\text{or, } -\tan \delta \tan \phi = \cos(360^{\circ} - HA_r)$$

$$\text{or, } 360^{\circ} - HA_r = \cos^{-1}(-\tan \delta \tan \phi)$$

$$\text{or, } HA_r = 360^{\circ} - \cos^{-1}(-\tan \delta \tan \phi)$$

At the time of setting

it will be,

$$HA_s = 360^{\circ} - HA_r$$

$$= \cos^{-1}(-\tan \delta \tan \phi)$$

[~~HA~~ is the HA at the time of rising]

Now using these equation we can find out the rising and setting HA for all three objects. We have, the latitude of the place,  $\phi = 32^\circ N$

and declinations  $\delta_1 = 0^\circ 8542910$

$$\delta_2 = 34^\circ 5304110 = 82^\circ AH$$

$$\delta_3 = 21^\circ 3277778$$

$$so, HA_{R_1} = 360^\circ - \cos^{-1}(-\tan \delta_1 \tan \phi)$$

$$so (A_1) = 360^\circ - \cos^{-1}(-\tan(0^\circ 8542910) \cdot \tan(32))$$

$$(A_1) = 17^\circ 9644$$

$$HA_{R_2} = 360^\circ - 26^\circ 4661324$$

$$HA_{R_3} = 360^\circ - 26^\circ 4661324$$

$$= 90^\circ 53386755^\circ$$

$$[omit 26^\circ 4661324] = 6^\circ 0356^\circ \text{ WAH}$$

$$HA_{S_1} = 360^\circ - \cos^{-1}(-\tan(34^\circ 5304110) \cdot \tan(32))$$

$$HA_{S_2} = 244^\circ 5356566, T_2$$

$$= 16^\circ 3024^\circ$$

$$HA_{S_3} = 360^\circ - 244^\circ 5556566$$

$$= 115^\circ 4643434^\circ$$

$$= 7^\circ 6076^\circ$$

$$=$$

$$\begin{aligned}
 \text{HA}_{r_3} &= 360^\circ - \cos^{-1}(-\tan(-21.327778) \tan(32)) \\
 &= 284^\circ 121.2936^\circ \\
 &= 18.0414^\circ
 \end{aligned}$$

$$\text{HA}_{s_3} = 360^\circ - 284^\circ 121.2936^\circ$$

$$= 75^\circ 87870638^\circ$$

$$= 5^\circ 0586^\circ$$

We also have the right ascension (RA) of all three objects, ~~not~~ (Chamisi et al (2016))

$$\begin{aligned}
 \text{which are } \alpha_1 &= 10^\circ 832440^\circ = 0^\circ 7221^\circ \\
 \alpha_2 &= 234^\circ 2429720^\circ = 15^\circ 6162^\circ \\
 \alpha_3 &= 331^\circ 6725000^\circ = 22^\circ 1115^\circ
 \end{aligned}$$

$$\text{We know, } \text{LST} = \text{HA} + \text{RA} \quad [\text{LST is local sidereal time}]$$

$$\begin{aligned}
 \text{so, for } \text{UM 269} & \\
 \text{Rising time, } \text{LST}_{\text{r},1} &= \text{HA}_{r_1} + \alpha_1 = 0^\circ 7221^\circ \\
 &= 17^\circ 9644 + 0^\circ 7221^\circ \\
 &= 18^\circ 6865^\circ
 \end{aligned}$$

Setting sidereal time,

$$\begin{aligned}
 \text{LST}_{\text{s},1} &= \text{HA}_{s_1} + \alpha_1 \\
 &= 6^\circ 0356^\circ + 0^\circ 7221^\circ \\
 &= 6^\circ 7577^\circ
 \end{aligned}$$

For PDS 808, ~~21~~ small circle with point and dot

Rising sidereal time, ~~21~~  $\text{LST}_{r2} = \text{HA}_{r2} + \alpha_2$   
 $\text{LST}_{r2} = 16.3024^h + 15.6162^h$   
 $\text{LST}_{r2} = 31.9186^h$  [The time repeats after 24h]

Setting sidereal time,  $\text{LST}_{s2} = \text{HA}_{s2} + \alpha_2$   
 $\text{LST}_{s2} = 7.6976^h + 15.6162^h$   
 $\text{LST}_{s2} = 23.3138^h$

For ~~PKS~~

PKS 2203-215, ~~21~~ small circle with point and dot

Rising sidereal time, ~~21~~  $\text{LST}_{r3} = \text{HA}_{r3} + \alpha_3$

$$\text{LST}_{r3} = 18.20414^h + 22.1115^h$$
$$= 17.0529^h$$

Setting sidereal time,  $\text{LST}_{s3} = \text{HA}_{s3} + \alpha_3$

$$\text{LST}_{s3} = 5.0586^h + 22.1115^h$$
$$= 3.17012^h$$

We know, Local Mean Solar time (LMST)  $\text{LMST} = \text{HA}_{\text{mean}} + 12^{\text{h}}$

Comparing this with equation,  $\text{LST}_0 = \text{HA}_0 + \text{RA}_0$

We get to know that  $\text{LMST} = \text{LST}_0$  will

be true when Sun's RA is  $12^{\text{h}}$ .

So, at September 23<sup>rd</sup>, Sun's local time

and local sidereal time will be same.

September 21, 22 days before,  
or,  $(365.25 - 22) = 343.25$  days after  
September 23<sup>rd</sup>.

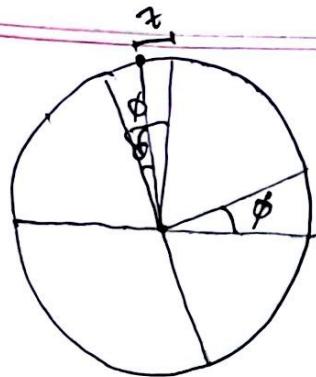
So, the difference between local time and local sidereal time on September 23<sup>rd</sup> will be,  $(24^{\text{h}} - 24^{\text{h}}) \times \frac{343.25}{365.25}$

$$= 1.4456^{\text{h}}$$

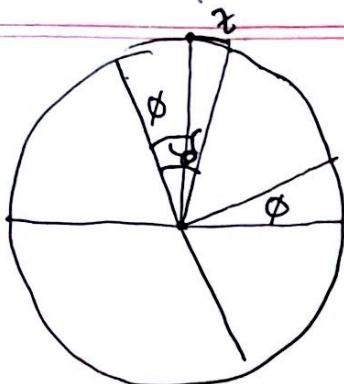
for each of the LST that we got, we need to subtract  $1.4456^{\text{h}}$  to get the local time.

We can make the following table based on this.

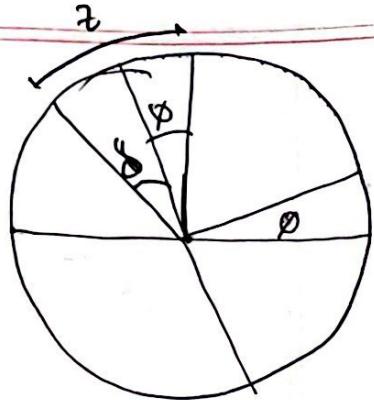
Object Name	Local Rising time	Local setting time
UM 269	$17.2409^h = 17^h 14^m 27^s$	$5.3121^h = 5^h 18^m 44^s$
PDS 898	$6.473^h = 6^h 28^m 23^s$	$21.8682^h = 21^h 52^m 6^s$
PKS 2203-215	$15.6073^h = 15^h 36^m 26^s$	$1.7245^h = 1^h 43^m 28^s$



UM 269



~~PDS 898~~  
~~PKS 2203-215~~  
 PDS 898



~~PKS 2203-215~~  
~~PDS 2203-215~~  
 PDS 2203-215

For each of the cases zenith angle  $z = |\phi - \delta|$

$$\text{For. UM 269, } z = |\phi - \delta| = |32 - 0.85420101|^\circ = 31.145709^\circ$$

$$\text{Minimum Airmass} = \frac{1}{\cos z} = \frac{1}{\cos(31.145709)} = 1.1684$$

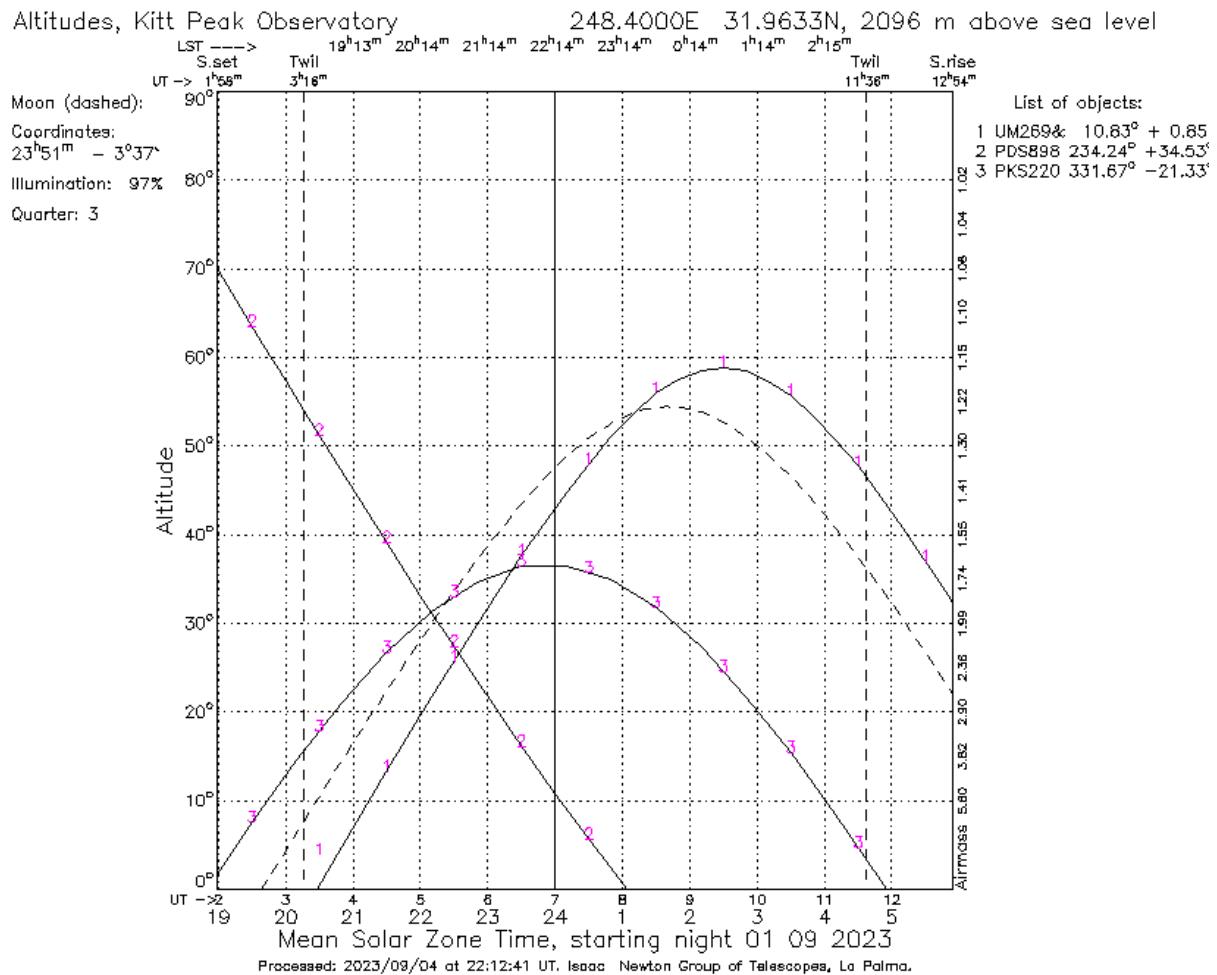
$$\text{For } \cancel{\text{PKS 2103-215}}, \cancel{\text{PDS 898}}, \text{ PDS 898, } z = |\phi - \delta| = |32 - 34.53041101|^\circ = 2.5304^\circ$$

$$\text{Min. airmass} = \frac{1}{\cos z} = \frac{1}{\cos(2.5304)} \approx 1$$

$$\text{for } \cancel{\text{PKS 2203-215}}, \cancel{\text{PDS 898}}, \text{ PKS, 2203-215, } z = |\phi - \delta| = |32 - (-21.3277778)|^\circ = 53.3277778$$

$$\text{Min. airmass} = 1.6744$$

**Problem 5:**



I plotted them through the following website: <http://catserver.ing.iac.es/staralt/index.php>

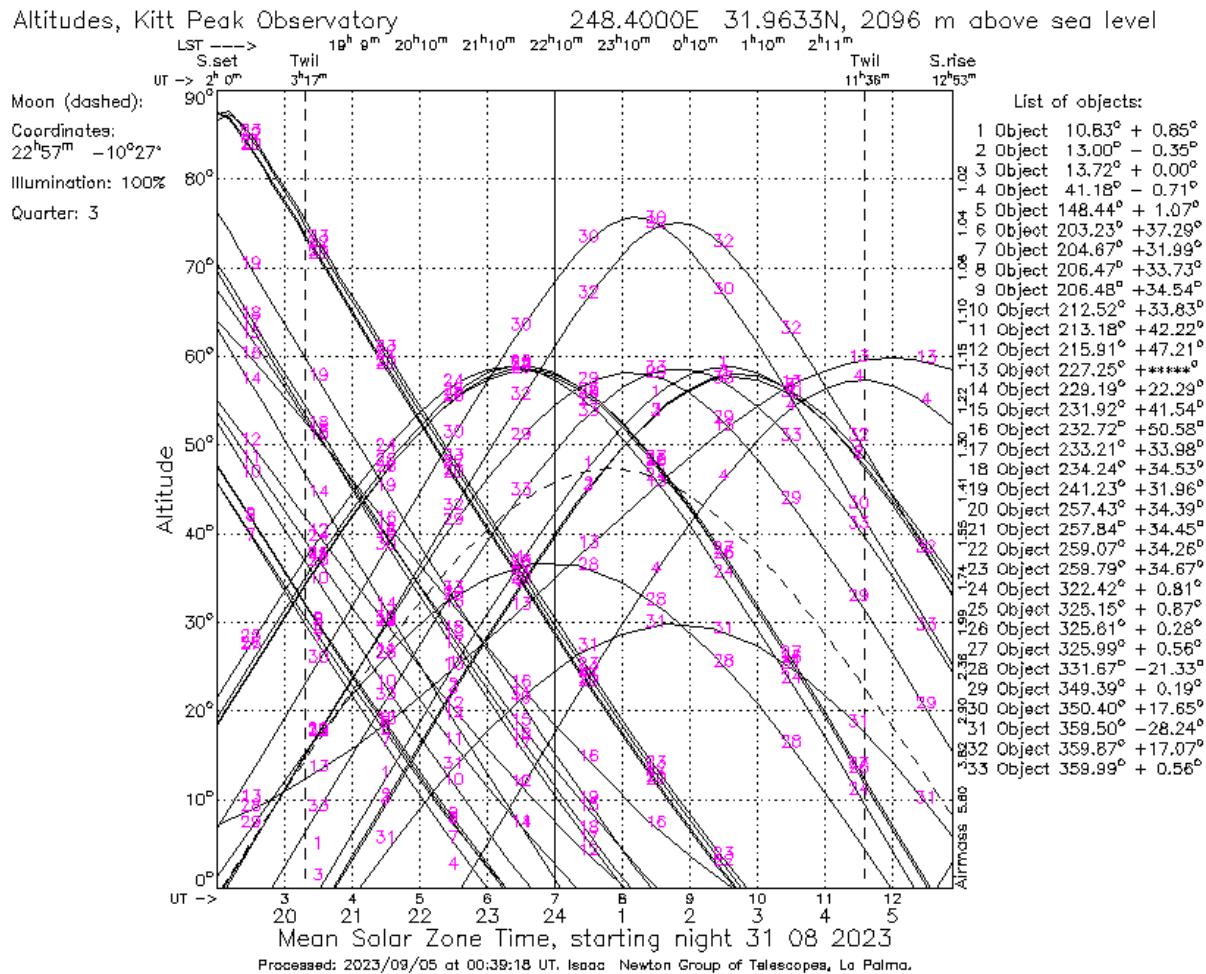
The highest air mass for all these objects will be,

UM269, X = 1.18 (I got 1.1684 in the previous problem)

PDS898, X = 1.08 (I got 1 in the previous problem)

PKS2203-215, X = 1.7 (I got 1.6744 in the previous problem)

Plot for all the bold letter objects will be as the following:



Object Name	RA	DEC	No. designated in the plot
UM 269*	10.8322440	0.8542910	1
SDSS J005158.83-002054.1	12.9951310 *	-0.3483820	2
SDSS J005453.30-003258.3	13.7221040	-0.05495320	3
SDSS J024442.77-004223.2	41.1782445	-0.7064567	4
2QZ J095344.7+010354	148.4366915	1.0651954	5
SDSS J133254.51+371735.5	203.2271569	37.2932211	6

SDSS J133840.66+315936.4	204.6694431	31.9934505	7
SDSS J134553.57+334336.0	206.4732442	33.7266720	8
SDSS J134556.16+343224.5	206.4840056	34.5401540	9
SDSS J141004.41+334945.5	212.5184030	33.8293160	10
SDSS J141244.09+421257.6	213.1837413	42.2160210	11
SDSS J142339.44+471240.8	215.9143459	47.2113337	12
SDSS J150900.70+175114.3	227.2529518	117.8539974	13
SDSS J151646.10+221724.7	229.1921240	22.2902190	14
SDSS J152739.97+413234.6	231.9165420	41.5429560	15
SDSS J153051.79+503440.1	232.7158316	50.5778224	16
SDSS J153251.06+335852.2	233.2127605	33.9811873	17
PDS 898	234.2429720	34.5304110	18
SDSS J160454.57+315733.5	241.2273914	31.9593278	19
SDSS J170942.58+342316.2	257.4274310	34.387850	20
SDSS J171122.67+342658.9	257.8444609	34.4497191	21
SDSS J171617.49+341553.3	259.0728780	34.2648190	22
SDSS J171909.93+344001.3	259.7914157	34.6670451	23
SDSS J212939.60+004845.5	322.4150072	0.8126513	24
SDSS J214036.77+005210.1	325.1532346	0.8694920	25
SDSS J214225.29+001643.2	325.6054161	0.2786872	26
SDSS J214357.98+003349.6	325.9916181	0.5638052	27
PKS 2203-215	331.6725000	-21.3277778	28
SDSS J231733.66+001128.3	349.3902730	0.1912120	29
SDSS J232135.73+173916.5	350.3988982	17.6546025	30
2QZ J235800.2-281429	359.5011112	-28.2413889	31
SDSS J235928.99+170426.9	359.8708046	17.0741612	32
SDSS J235958.72+003345.3	359.9946880	0.5625920	33

**Problem 6:**

Acronym	Full Name	Location	Aperture Size	Wavelength range or Photometric band	Website link
Nu-STAR	Nuclear Spectroscopic Telescope Array	Outer space	0.064 meters	X-ray	<a href="https://www.nustar.caltech.edu/">https://www.nustar.caltech.edu/</a>
Chandra	Chandra X-ray Observatory	Outer space	0.10 meters	X-ray	<a href="https://chandra.harvard.edu/">https://chandra.harvard.edu/</a>
HST	Hubble Space Telescope	Outer space	2.4 meters	Near IR, Visible light, Ultraviolet	<a href="https://www.nasa.gov/mission_pages/hubble/main/index.htm">https://www.nasa.gov/mission_pages/hubble/main/index.htm</a>
Gemini	Gemini Observatory (Gemini North & Gemini South)	Hawaii & Chile	8.1 meters (aperture for both telescopes)	Optical, Near IR	<a href="https://www.gemini.edu/">https://www.gemini.edu/</a>
SOAR	Southern Astrophysical Research Telescope	Chile	4.1 meters	Near IR, Visible	<a href="https://noirlab.edu/science/programs/ctio/telescopes/soar-telescope">https://noirlab.edu/science/programs/ctio/telescopes/soar-telescope</a>
LCO	Las Cumbres Observatory	Varies (HQ in California)	Varies for different telescopes	Near IR, Visible, Near UV	<a href="https://lco.global/">https://lco.global/</a>
Spitzer	Spitzer Space Telescope	Outer space	0.85 m (aperture)	IR	<a href="https://www.spitzer.caltech.edu/">https://www.spitzer.caltech.edu/</a>
JWST	James Webb Space Telescope	Outer Space (Second Lagrange Point L2)	6.5 meter (aperture)	Orange to mid IR	<a href="https://webb.nasa.gov/">https://webb.nasa.gov/</a>
ALMA	Atacama Large Millimeter Array	Atacama desert, Chile	Array of 66 radio antennas	Millimeter and submillimeter wavelengths	<a href="https://www.almaobservatory.org/en/home/">https://www.almaobservatory.org/en/home/</a>
NOEMA	Northern Extended Millimeter Array	France Alps	Array of 10 radio antennas	Millimeter and submillimeter wavelengths	<a href="https://iram-institute.org/observatories/noema/">https://iram-institute.org/observatories/noema/</a>
VLBA	Very Long Baseline Array	Multiple locations in USA	Array of 10 radio antennas	Radio	<a href="https://science.nrao.edu/facilities/vlba">https://science.nrao.edu/facilities/vlba</a>
VLA	Very Large Array	Socorro, New Mexico, USA	Array of 27 radio antennas	Radio	<a href="https://science.nrao.edu/facilities/vla">https://science.nrao.edu/facilities/vla</a>

**Problem 7:**The Kitt Peak Direct Imaging Manual:

This manual is invaluable for astronomers using the Kitt Peak telescopes for direct imaging observations. It provides detailed instructions on instrument setup, data acquisition, and data reduction specific to these telescopes. The manual covers topics such as telescope and instrument descriptions, observing procedures, calibration, data reduction, and examples of typical observations.

Photometric Standards: Landolt, 1992, AJ, 104, 340:

Landolt's photometric standards paper is essential for astronomers conducting photometric observations. It provides a comprehensive list of standard stars with known magnitudes in various photometric bands. The paper includes tables of standard stars with their equatorial coordinates, magnitudes, and color indices in the UBVRI photometric systems. These standards serve as a reference for calibrating astronomical photometric observations.

A User's Guide to Stellar CCD Photometry with IRAF: Massey & Davis, 1992:

This paper is essential for astronomers using IRAF (Image Reduction and Analysis Facility) for CCD photometry. It offers a step-by-step walkthrough of CCD data reduction and photometry processes. The paper covers topics such as data acquisition, data reduction, aperture photometry, PSF-fitting photometry, and calibration. It provides practical examples and IRAF scripts.

A User's Guide to CCD Reductions with IRAF: Massey, 1997:

This guide complements the previous one and is also crucial for astronomers using IRAF for CCD data reduction. It delves deeper into the reduction techniques and IRAF procedures. The paper provides detailed explanations of CCD data reduction processes, including bias subtraction, flat-fielding, image alignment, and calibration. It includes IRAF commands and scripts for each step.

**Additional Papers:**"Astronomy Principles and Practices" by AE Roy, and D Clarke:

This book offers a broad overview of observational techniques in astronomy. Chapter 6, 7, 8 are the most important to review coordinate systems, spherical trigonometry, and astronomical time systems.

The Astronomical Almanac:

This annually updated publication provides essential astronomical data, including positions of celestial objects, rising and setting times, and lunar information. It's a handy reference for planning observations.