UNKNOWN x STAR

Similar Ques:- OCT 2023 No. 167 Date 09.05.2025

① On 23rd August 1992 in DR 34° 30's 003° 30'w at PM at ship, the sextant altitude of a star through a break in the cloud was measured as 45° 26' when GMT was 23D 18H 17M 20S. If I.E was 2' on the arc, HE = 10m, and the true bearing of the star was 291°(T). Identify the star.

For:

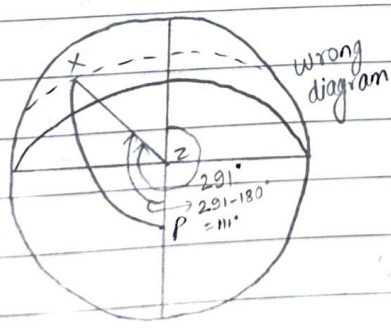
GMT : 23D 18H 17M 20S

GHA ♈ (23d 18h) : 242° 16·6'
Increment (17M 20S) : 4° 20·7'
GHA ♈ : 246° 37·3'
Long (W) : 003° 30'W
LHA ♈ : 243° 7·3'

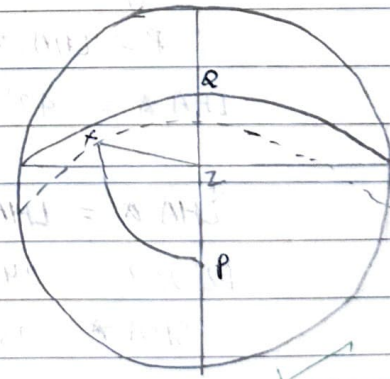
Long W, GHA best

Sextant Altitude : 45° 26'
IE (ON) : (-) 2'
Observed altitude : 45° 24'
Dip (HE - 10m) : (-) 5·6'
Apparent altitude : 45° 18·4'
Total corn : (-) 1·0'
True altitude : 45° 17·4'
TZD : 44° 42·6'

AZ = Latitude
PZ = 90 - Lat
PX = 90 - dec



wrong diagram

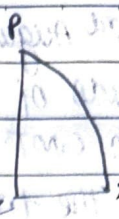


since PX value is less than 90° This diagram is correct & name dec 's'

LZ = 291° - 180° = 111°
PZ = 90° - Lat
= 90° - 34° 30'
= 55° 30'
ZX = 90° - T. alt
= 90° - 45° 17·4'
= 44° 42·6'

No. 168 Date 09.05.202

$$\cos Z = \frac{\cos PX - \cos PZ \cdot \cos ZX}{\sin PZ \cdot \sin ZX}$$



$\cos Z \cdot \sin PZ \cdot \sin ZX = \cos PX - \cos PZ \cdot \cos ZX$

$\cos PX = \cos Z \cdot \sin PZ \cdot \sin ZX + \cos PZ \cdot \cos ZX$

$\cos PX = \cos 111^\circ \cdot \sin 55^\circ 30' \cdot \sin 44^\circ 42.6' + \cos 55^\circ 30' \cdot \cos 44^\circ 42.6'$

$\cos PX = 0.19475$

$PX = 78^\circ 46.2'$

Declination = $90^\circ - PX$

$= 90^\circ - 78^\circ 46.2'$

$= 11^\circ 13.8' S$ (refer to nautical almanac)

$$\cos P = \frac{\cos ZX - \cos PZ \cdot \cos PX}{\sin PZ \cdot \sin PX}$$

$$\cos P = \frac{\cos 44^\circ 42.6' - \cos 55^\circ 30' \cdot \cos 78^\circ 46.2'}{\sin 55^\circ 30' \cdot \sin 78^\circ 46.2'}$$

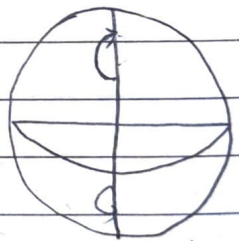
$\cos P = 0.74271$

$P = 42^\circ 02.2'$

Body west of meridian (decide from brg)

$P = LHA \star$

$LHA \star = 42^\circ 02.2'$



In N' Hemisphere LHA is measured westerly clockwise

In S Hemisphere, anticlockwise

$LHA \star = LHAY + SHA \star$

$42^\circ 02.2' = 243^\circ 7.3' + SHA \star$

$SHA \star = 158^\circ 54.9'$

↓

check on 23rd August

i.e. SPICA

Ans

GMT : 14d 03H 56M 58S
LIT(W): 09H 02m 48S (GMT best)
LMT: 13d

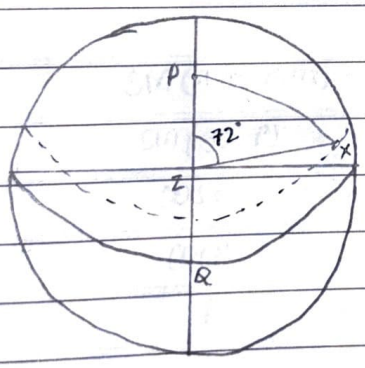
No. 169 Date 09·05·2025

② ON 13th SEPT 1992 PM at ship in DR 46°30'N 135°42'W the sextant altitude of an unknown star when bearing 072°(T) was 23°57·1'. AT GMT 03H 56M 58S. Identify the unknown star. I.E = 2·9' OFF THE ARC, H.E: 31m.

Sol:

GHAY (13d 03H)	38° 20·7'
Increment (56M 58S)	14° 16·8'
GHA Y	52° 37·5'
Long (W)	135° 42' Long W, GHA best
LHA Y	276° 55·5'

Sextant altitude	23° 57·1'
IE (OFF)	(+) 2·9'
Observed altitude	24° 00·0'
Dip (HE - 31m)	(-) 9·8'
Apparent altitude	23° 50·2'
Total corr^	(-) 2·2'
True altitude	23° 48·0'



$\angle Z = 72°$

$PZ = 90° - \text{Lat}$

$= 90° - 46°30'$

$= 43°30'$

$ZX = 90° - \text{T. alt}$

$= 90° - 23°48'$

$= 66°12'$

$$\cos Z = \frac{\cos PX - \cos PZ \cdot \cos ZX}{\sin PZ \cdot \sin ZX}$$

$\cos Z \cdot \sin PZ \cdot \sin ZX = \cos PX - \cos PZ \cdot \cos ZX$

$\cos PX = \cos Z \cdot \sin PZ \cdot \sin ZX + \cos PZ \cdot \cos ZX$

$\cos PX = \cos 72° \times \sin 43° 30' \cdot \sin 66° 12' + \cos 43° 30' \cdot \cos 66° 12'$

$\cos PX = 0.487345$

$PX = 60° 50'$

Declination $= 90° - PX$

$= 90° - 60° 50'$

$= 29° 10' (N)$ → bcz PX is less than 90° (refer diagram)

$$\cos P = \frac{\cos ZX - \cos PZ \cdot \cos PX}{\sin PZ \cdot \sin PX}$$

$$\cos P = \frac{\cos 66° 12' - \cos 43° 30' \cdot \cos 60° 50'}{\sin 43° 30' \cdot \sin 60° 50'}$$

$\cos P = 0.083$

$P = 85° 13.5'$

body east of meridian

LHA = 360° − P

LHA ★ $= 360° - 85° 13.5'$

$= 274° 46.4'$

LHA ★ = LHAY + SHA ★ LHAY + SHA★ = LHA★

$274° 46.4' = 276° 55.5' + SHA ★$

$SHA ★ = 357' 50.9'$

↓

check 14 August

i.e. ALPHERATZ

③ On 29th NOV 1992 in Lat 57°04.4'N, the star alioth was on the prime vertical, east of the meridian and at the same time another star bore SOUTH with true altitude of 47°32.4'. Identify the unknown star.

JULY 17

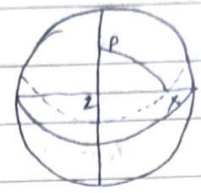
Soln:-

On 29th Nov,

Lat : 57°04.4'N

SHA Alioth: 166°34.4'

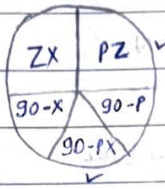
Dec Alioth : 55°59.6' N

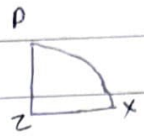


In ΔPZX,

∠Z = 90°

Using napier's rule





PZ = 90° - Lat

= 90° - 57°04.4'

= 32°55.6'

PX = 90° - dec

= 90° - 55°59.6'

= 34°0.4'

Sin(mid part) = Tan(adj) × Tan(adj)

Sin(90-P) = Tan PZ × Tan(90-PX)

Cos P = Tan 32°55.6' × Tan(90° - 34°04')

Cos P = 0.95985

P = 16°17.5'

body east of meridian

LHA = 360° - P

LHA ★ = 360° - 16°17.5'

= 343°42.5'

LHA ★ = LHAY + SHA ★

343°42.5' = LHAY + 166°34.4'

LHAY = 177°08.1'

No. 172 Date 09.05.25

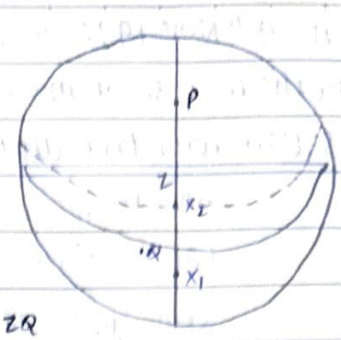
For unknown star:

True alt: 47° 32.4'

$ZX = 90° - T.alt$

$= 90° - 47° 32.4'$

$= 42° 27.6'$



If we take X_1, ZX_1 should be more than lat, ZQ

But, ZX_2 is less than lat, ZQ

$42° 27.6'$ $57° 04.4'$

Dec, $QX_2 = ZQ - ZX_2$

$= 57° 04.4' - 42° 27.6'$

$= 14° 36.8' N$

Since, body is on meridian

LHA ★ = 0° or 360°

LHA ★ = LHAY + SHA ★

0° or 360° = 177° 38.1' + SHA ★

SHA ★ = 182° 21.9'

↓

on 29th NOV

i.e. Denebola

No. 173 Date 09·05·25

(5) On 13th Oct in Lat 63°44·3'N, star vega bore 270°(T) and at the same time an unknown star bore North with altitude 13°08'. Identify the star

Dec 14

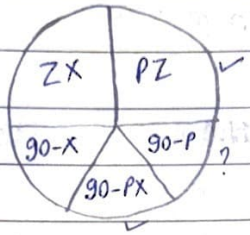
Soln: For vega: On 13th Oct

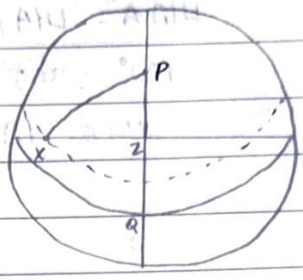
Lat 63°44·3'N

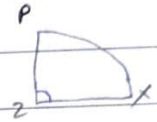
SHA vega : 80°49·5'

Dec vega : 38°46·9'N

In ΔPZX,







∠Z = 90°

PZ = 90° − Lat
= 90° − 63°44·3'
= 26°15·7'

PX = 90° − dec
= 90° − 38°46·9'
= 51°13·1'

sin(mid part) = Tan(adj) × Tan(adj)

sin(90−P) = Tan PZ × Tan(90−PX)

cos P = Tan 26°15·7' × Tan 38°46·9'

cos P = 0·39644

P = 66°38·6'

body west of meridian

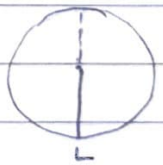
LHA = P

LHA = 66°38·6'

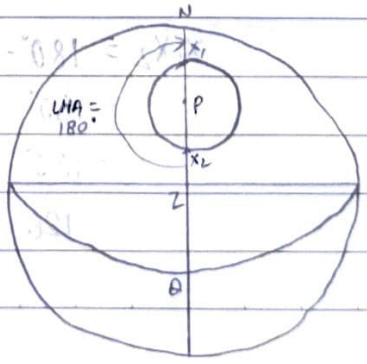
LHA ✱ = LHA Y + SHA ✱

66°38·6' = LHA Y + 80°49·5'

LHA Y = 345°49·1'



For unknown star,



Latitude, NP = 63°44·3'N

NX_1 = 13°08'

↓

cannot be NX_2

bcz if NP = 63°44 3'

so 13°08' is NX_1

$PX_1 = NP - NX_1$

$= 63° 44.3' - 13° 08'$

$= 50° 36.3'$

* $\star$ LHA = 180° bcz bore North in NH

LHA ★ = LHA ♈ + SHA ★

$180° = 345° 49.1' + SHA \star$

$SHA \star = 194° 10.9'$

↓

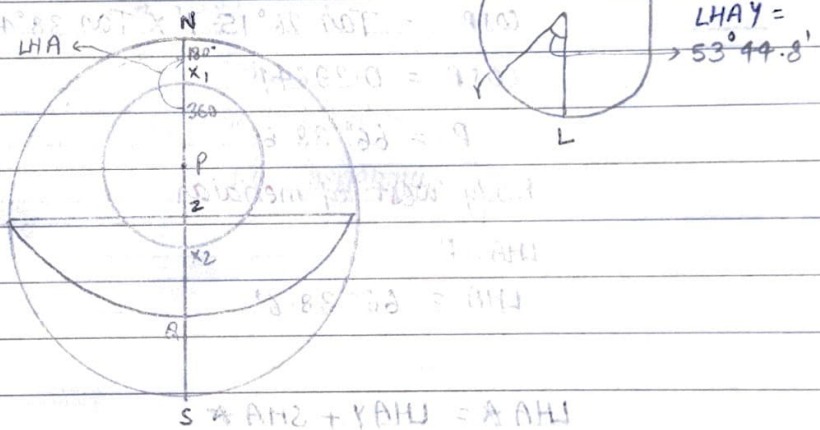
Dubhe

④ During morning twilight an unknown star bore south will altitude 40°20'. During evening twilight AT LST 03h 34m 24s, The same star bore north with altitude 13° 08'. Identify the star.

Soln:- LST = 3h 34m 24s

1 hr = 15.041°

i.e. 53° 44.8' i.e. LHA ♈



$NX_1 = 13° 08'$

$SX_1 = 40° 20'$

$X_1X_2 = 180° - (NX_1 + SX_2)$

$= 180° - (13° 08' + 40° 20')$

$= 180° - 53° 28'$

$= 126° 32'$

PX_1 or $PX_2 = \frac{X_1X_2}{2}$

$= \frac{126°32'}{2}$

$= 63°16'$

Declination = $90° - PX_1$ or PX_2

$= 90° - 63°16'$

$= 26°44'(N)$ → pole is N

that mean Lat is N
in circumpolar, Lat & dec same name

At LST, star bore north i.e. at X_1

So, LHA ★ = 180°

LHA ★ = LHAY + SHA ★

$180° = 53°44.8' + SHA$ ★

SHA ★ = $126°15.2'$

By referring in Nautical Alamanac

SHA ★ = $126°15.2'$

& Dec = $26°44'$

we find

star = ALPHECCA

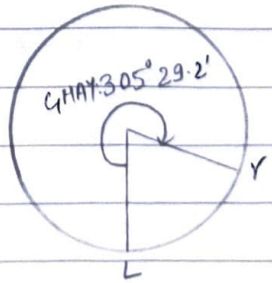
(7) On 10th October 1992 in position Long 085° 20'E, during morning twilight a unknown star bore south with altitude 65° 19.6'. About 12 hours later at GST 20h 18m 37s same star bore south again with altitude 06° 0.4'. Find the latitude of the observer and identify the unknown star.

Soln

GST : 20h 18m 37s

1hr = 15.04°

∴ 305° 29.2' i.e. GHAY



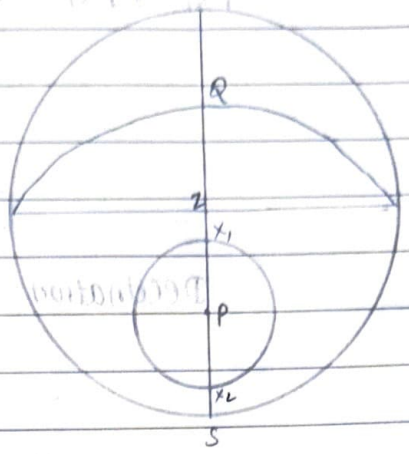
GHAY : 305° 29.2'

Long (E) : 085° 20'

LHAY : 030° 49.2'

$SX_1 = 65° 19.6'$

$SX_2 = 06° 0.4'$



$SX_1 = SX_2 + X_1X_2$

$X_1X_2 = SX_1 - SX_2$

$= 65° 19.6' - 06° 0.4'$

$= 59° 19.2'$

PX_1 or $PX_2 = \frac{X_1X_2}{2}$

$= \frac{59° 19.2'}{2}$

$= 29° 39.6'$

Declination, $QX_1 = 90° - PX_1$

$= 90° - 29° 39.6'$

$= 60° 20.4'$ (S) → bcz pole is S

Lat & dec same name

$LHA ☆ = 180°$

$LHA ☆ = LHAY + SHA ☆$

$180° = 030° 49.2' + SHA ☆$

$SHA ☆ = 149° 10.8'$

Star = Hadar

Ans

No. 177 Date 09.05.25

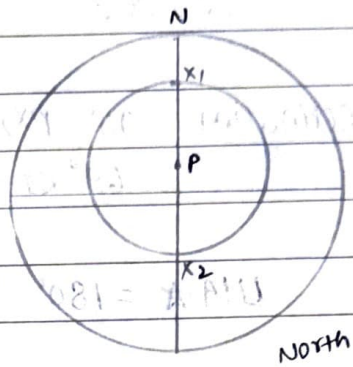
(9) APR 2012 For a stationary observer on 30th November 1992, the true altitude of an unknown star when bearing south was 14° 11.2'. 1 hour 7 min later the true altitude of star Betelgeuse when bearing North was 47° 25.5'. Identify the unknown star.

Soln:- For Betelgeuse, ON 30 NOV

SHA : 271° 17.6'

Dec : 7° 24.4' N

PX_1 or PX_2 = 90° − dec
= 82° 35.6'



If we make this diagram, wrong

as given bearing N, so if NX_1 = 47° 25.5'

& PX_1 = 82° 35.6'

Lat, NP = $NX_1 + PX_1$

= 47° 25.5' + 82° 35.6'

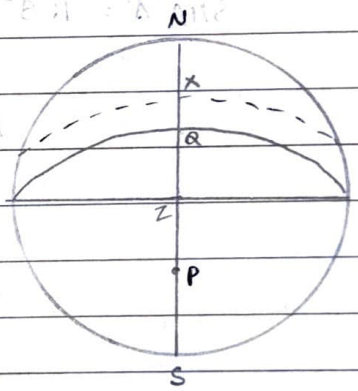
= 130° 1.1' ✗ Not possible

North Lat not possible

Bearing NORTH

NX = 47° 25.5'

QX = 7° 24.4'



Lat, ZQ = 90° − (NX + QX)

= 90° − (47° 25.5' + 7° 24.4')

= 35° 10.1'

LHA ★ = 360°

LHA ★ = LHAY + SHA ★

LHAY of betelgeuse = LHA ★ − SHA ★

= 360° − 271° 17.6'

LHAY (betelgeuse) = 88° 42.4'

(−) 16° 47.7' (1hr 7 min × 15.041°)

LHAY (UNKNOWN STAR) = 71° 54.7'

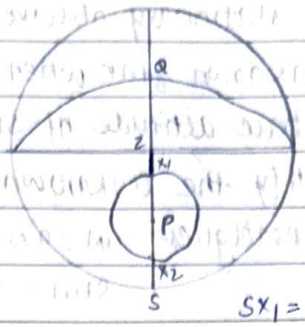
(substract bcz unknown star is before betelgeuse)

No. Date

Bearing SOUTH

$SX_2 = 14°11.2'$

Lat, $SP = 35°10.1'S$ (From 1st diagram)



$SX_1 = 14°11.2$ (Not possible)

$SP = 35°10.1$

Hence, SX_2 is possible

$PX_2 = SP - SX_2$

$= 35°10.1' - 14°11.2'$

$= 20°58.9'$

Declination $= 90° - PX_2$

$= 69°01.1'S$

LHA ★ $= 180°$

LHA ★ = LHAY + SHA ★

$180° = 71°54.7' + SHA$ ★

SHA ★ $= 108°5.3'$

↓

ATRIA

STAR MAGNITUDE

No. 179 Date 14.05.2025

(12) STAR 'A' has a magnitude of -0.8 and it is 30 times brighter than star B. Find the magnitude of star B.

Soln: First check if before 0 or after 0

Case (i) : Before zero

FACTOR = 2.512

$2.512^{0.8} = 2.089$

↓ wrong - it should be 30

Case (ii) : After zero

$2.512^{(0.8+x)} = 30$

$\log 2.512^{(0.8+x)} = \log 30$

$(0.8+x) \log 2.512 = \log 30$

$0.8 + x = \frac{\log 30}{\log 2.512}$

$0.8 + x = 3.693$

$x = 2.893$ Ans

$x \& -0.8$ $\quad -1.6 \& -3.9$

$x - (-0.8) \quad -1.6 - (-3.9)$

$2.512^{x} = 30$ → diff b/w magnitude

$x \log 2.512 = \log 30$

$x = 3.693$

Total magnitude(x) = B - A

$3.693 = B - (-0.8)$

$B = 2.893$

(1) In position 38° 12'N, 119° 38'E, find the stars of 1st and 2nd magnitude and planets if any crossing observer's meridian 1800 hrs and 1900 hrs ships time (Time zone : -0800 Hrs) on 13 sep 1992

Soln: Zone time : -0800 Hrs

SMT : 1800 hrs & 1900 hrs

GMT : 1000 hrs to 1100 hrs

1000 HRS	1100 HRS
GHAY (13d 10h) : 142° 38.8'	GHAY (13d 11h) : 157° 41.3'
Long (E) : 119° 38'	Long (E) : 119° 38'
LHAY : 262° 16.8'	LHAY : 277° 19.3'
LHA ★ = LHAY + SHA ★	LHA ★ = LHAY + SHA ★
360 = 262° 16.8' + SHA ★	360 = 277° 19.3' + SHA ★
SHA ★ = 97° 43.2'	SHA ★ = 82° 40.7'

82° 40.7' - 97° 43.2'

From alamanac, prepare for all 1st & 2nd magnitude star

Note:- Lat & dec same name, always visible & above horizon
Lat & dec diff name, check if Lat + dec < 90° i.e visible
Lat + dec > 90° Not visible

SHA : 82°40.7' - 97°43.2'

No. Date

MAG	NAME	SHA	DEC	LAT	REMARKS
2.0	KAUS AUSTRALIS	84° 04.2'	34°23.4'S	38°12'N	Lat+dec < 90° (available)
2.0	Scorpii (θ)	95° 47.7'	42°59.8'S	38°12'N	Lat+dec < 90° (available)
1.7	Shaula	96° 43.0'	37°06.0'S	38°12'N	Lat+dec < 90° (available)
	NO PLANETS	AVAILABLE			

Ans: Kaus Australis, Scorpii, Shaula.

② On 21st July 1992 PM a ship in DR position 56° 00'N, 042° 10'W, Find 1st and 2nd Magnitude star that will cross the observer's infenor meridian and are suitable for observation from end of Civil twilight to end of Nautical twilight

Ans:-

SUNSET	horizon	SUNRISE
end of civil	CIVIL	start
end of nautical	NAUTICAL	start

end ASTRONOMICAL starting of astronomical.

SUNSET	CIVIL	NAUTICAL
LAT 56°	21h 20m	22h 49m

CIVIL	NAUTICAL
LMT: 21H 20M	LMT: 22h 49m
LT(W): 02H 48M 40S	LT(W): 02h 48m 40s
GMT: 22D 00H 08M 40S	GMT: 22D 01H 37M 40S
GHAY (22d 00h): 299° 59.8'	GHAY (22d 01h): 315° 02.3'
Increment (08m40s): 2° 10.4'	Increment (37m 40s): 9° 26.5'
GHAY: 302° 10.2'	GHAY: 324° 28.8'
Long (W): 042° 10.0'	Long (W): 042° 10.0'
LHAY: 260° 0.2'	LHAY: 282° 18.8'
LHA ★ = LHAY + SHA ★	LHA ★ = LHAY + SHA ★
180° = 260° 0.2' + SHA ★	180° = 282° 18.8' + SHA ★
SHA ★ = 279° 59.8'	SHA ★ = 257° 41.2'

question says infenor meridian

SHA : 257° 41·2' – 279° 59·8'

MAG	NAME	SHA	DEC	LAT	REMARKS
-1·6	SIRIUS	258° 47·8'	16° 42·3' S	56° 00'N	Lat & Dec diff name. Body is not circumpolar. NOT AVAILABLE
1·9	ALHENA	260° 40·8'	16° 24·4'N	56° 00'N	SAME NAME BUT LESS THAN 90° NOT CIRCUMPOLAR. NOT AVAILABLE
-0·9	CANOPUS	264° 3·6'	52° 41·4' S	56° 00'N	LAT & DEC DIFF NAME. BODY IS NOT CIRCUMPOLAR. NOT AVAILABLE
2·0	MIRZAM	264° 24·5'	17° 57·1' S	56° 00'N	"
1·9	ALNITAK	274° 54·3'	1° 56·7' S	56° 00'N	"
1·8	ALNILAM	276° 02·5'	1° 12·3' S	56° 00'N	"
1·8	ELNATH	278° 32·7'	28° 36·1' N	56° 00'N	SAME NAME BUT LESS THAN 90°. NOT CIRCUMPOLAR. NOT AVAILABLE
1·7	BELLATRIX	278° 49·0'	6° 20·6' N	56° 00'N	"

Question says: Inferior meridian

body will be visible only when circumpolar

Answer: None of the star is circumpolar. so not suitable

(11) On 15th June 1992 in Position Lat: 20°N, Long 075° 00'E, which stars and planets of 1st and 2nd magnitude will be within 15° of hour angle from observer's meridian? which of them can be used for ex-meridian observation? The observation is to be made at the end of PM CIVIL TWILIGHT.

Ans:-

SUNSET

Lat 20°N

LMT CIVIL TWILIGHT : 15D 19H 05M

LT(E) : (+) + 05H 00M

GMT CIVIL TWILIGHT : 15D 14H 05M

GHAY (15d 14h) : 114° 06·2'

Increment (05m 00s) : 1° 15·2'

GHAY : 115° 21·4'

Long (E) : (+) 75° 00·00

LHAY : 190° 21·4'

LHA ★ = LHAY + SHA ★

15° = 190° 21·4' + SHA ★

SHA ★ = 184° 38·6'

LHA ★ = LHAY + SHA ★

345 = 190° 21·4' + SHA ★

SHA ★ = 154° 38·6'

360° ± 15°

SHA ★ = 154° 38·6' − 184° 38·6'

1hr = 15·041°

MAG	NAME	SHA	DEC	LAT	A Table I	EML Table IV	P	Remarks
1·2	VIRGINIS/ SPICA	158° 47·7'	11° 07·5'S	20° 00'N	3·51	29 min	10·8°	P > EML; Ex-meridian
★						7° 16'		observation not possible
1·7	URSAE MAJORIS/ ALIOTH	166° 34·1'	56° 00·2'N	20° 00'N	1·76	44 min	3·1°	P < EML, Ex-meridian
						11° 1·8'		observation possible
1·5	MIMOSA	168° 10·3'	59° 39·2'S	20° 00'N	0·95	62 min	1·5°	P < EML, Ex-meridian
						15° 32·5'		observation possible
1·6	GACRUX	172° 18·4'	57° 04·7'S	20° 00'N	1·03	60 min	2·7°	P < EML, Ex-meridian
						15·041°		observation possible
1·1	ACRUX	173° 26·9'	63° 03·9'S	20° 00'N	0·84	66 min	3·8°	P < EML, Ex-meridian
			NO PLANET AVAILABLE					observation possible

① LHA ★ = LHAY + SHA ★

FOR SPICA, LHA ★ = 190° 21·4' + 158° 47·7' LHA 180° to 360°

= 349° 09·1' body east of meridian

P = 360° − 349° 09·1' P = 360° − LHA

= 10° 50·9'

② FOR ALIOTH, LHA ★ = 190° 21·4' + 166° 34·1'

= 356° 55·5'

P = 360° − 356° 55·5'

= 3° 4·5'

③ FOR MIMOSA, LHA ★ = 190° 21·4' + 168° 10·3'

= 358° 31·7'

P = 360° − 358° 31·7'

= 1° 28·3'

④ FOR GACRUX, LHA ★ = 190° 21·4' + 172° 18·4' LHA 0° to 180°

= 2° 39·8' body west of meridian

P = LHA P = LHA

P = 2° 39·8'

⑤ FOR ACRUX, LHA ★ = 190° 21·4' + 173° 26·9'

= 3° 48·3'

P = 3° 48·3'

No. 183 Date 16.05.2025

⑧ On 29th NOV 92 in DR 32°00'N 066°34'E, find the first and second magnitude stars suitable for ex-meridian observation at the beginning of civil twilight in the morning.

Soln:

LMT CIVIL TWILIGHT: 29D 06H 15M 36S

LIT(E) : (-) 04H 26M 16S

GMT CIVIL TWILIGHT: 29D 01H 49M 20S

GHAY (29d 01h): 83° 10.3'

Increment (49m 20s) : 12° 22.0'

GHAY : 95° 32.3'

Long(E) : (+) 66° 34.0'

LHAY : 162° 06.3'

If no ex-meridian limit given in question,

Take maxm ex-meridian limit i.e. 71m × 15.041°

17° 47.9'

LHA ★ = 360° ± 17° 47.9'

LHA ★ = LHAY + SHA ★

17° 47.9' = 162° 06.3' + SHA ★

SHA ★ = 215° 41.6'

LHA ★ = LHAY + SHA ★

342° 12.1' = 162° 06.3' + SHA ★

SHA ★ = 180° 5.8'

SHA ★ = 180° 5.8' - 215° 41.6'

MAG	NAME	SHA	DEC	LAT	A Table I	EML Table IV	P	REMARKS
2.0	DUBHE	194° 10.6'	61° 47.0'N	32° 00'N	1.58	47min	3.7°	P < EML, Ex meridian
▶						11° 47'		observation possible
1.3	REGULUS	207° 59.9'	12° 00'N	32° 00'N	4.76	23 min	10.1°	P > EML, Ex meridian
						5° 46'		observation not possible
		NO PLANET AVAILABLE						

① For dubhe, LHA ★ = LHAY + SHA ★

= 162° 06.3' + 194° 10.6'

= 356° 16.9'

P = 360° - 356° 16.9'

= 3° 43.1'

② Regulus : 162° 06.3' + 207° 59.9' = 10° 06.2'

P = 10° 06.2'