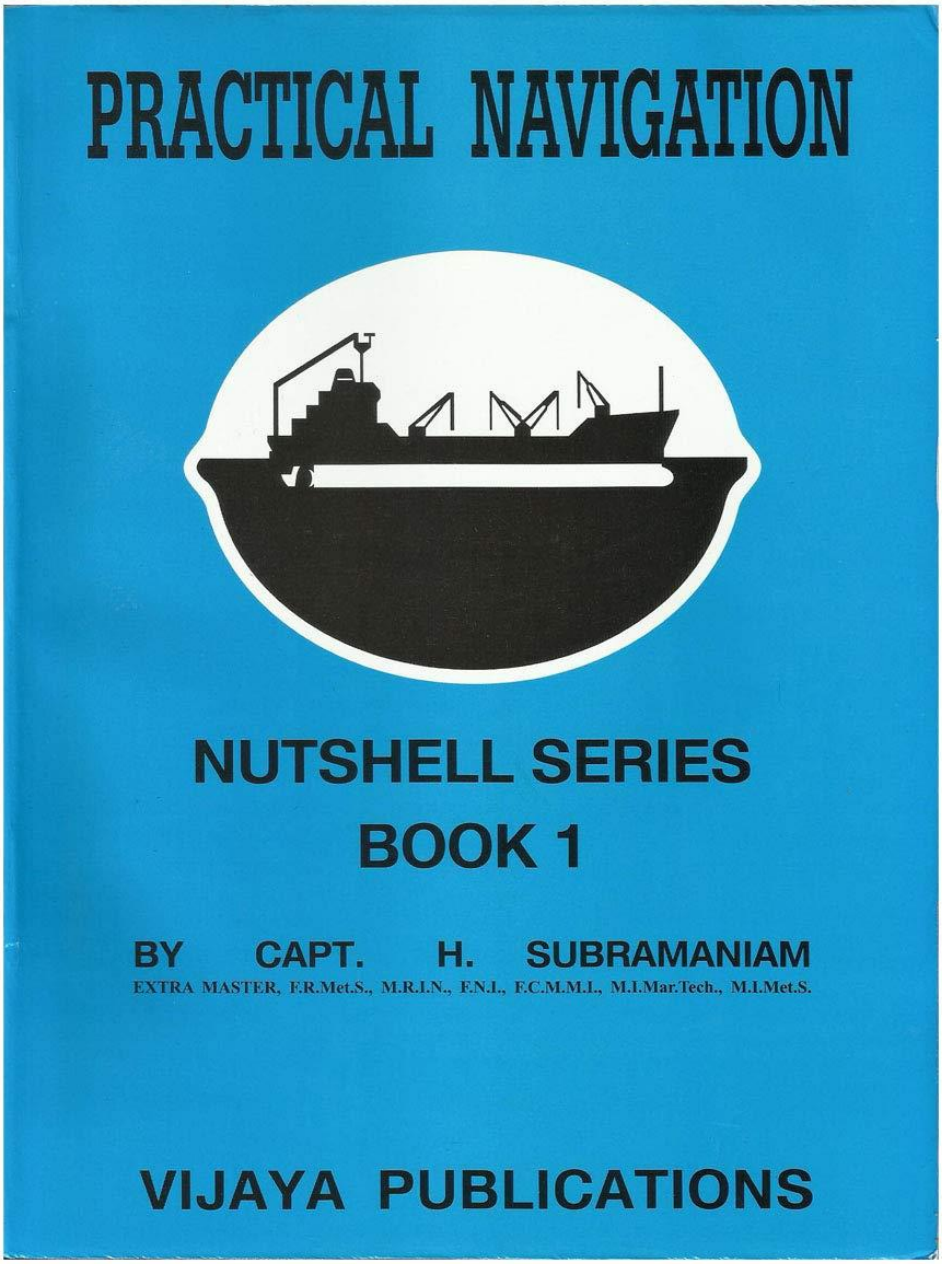
PRACTICAL NAVIGATION BOOK SOLUTION



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No. Date

SECTION - II - PRACTICAL NAVIGATION (140 MARKS)

Q.NO. 4 is compulsory. Attempt any 3 questions out of remaining four.

4. STAGGERED/SIMULTANEOUS PLOTS (35 MARKS)

5. LONG BY CHRON SUN/MOON (35 MARKS)

6. INTERCEPT METHOD (35 MARKS)

7. COMPASS ERROR BY ABC TABLE &/OR ERROR BY AMPLITUDE &/OR TIMES OF RISING/SETTING/MERIDIAN PASSAGE/MERIDIAN ALTITUDE OF SUN (35 MARKS)

8. POLARIS/COMPUTATION OF ALTITUDE/EX-MERIDIAN (35 MARKS)

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CHAPTER 27: LOP BY THE SUN

Exercise-28 (Azimuth sun)

(1) If chron time is given & its error is given, then this is how we get GMT

Chron	01h 08m 10s	OR (+12)	13h 08m 10s
Error slow-	(+) 02m 12s		(+) 02 12s
GMT	01h 10m 22s	this or this?	13h 10m 22s
LIT(W)	(+) 03h 09m 12s	so we find LMT As this is a sun problem, so sun will not there at 22h, it is at 10h	(+) 03h 09m 12s
LMT	22h 01m 10s	SO GMT is	13d 10h 01m 10s

GMT = 13d 13h 10m 22s

Q.NO(1)

Chron	04h 01m 52s		16h 01m 52s
Chron slow- (+)	04m 20s		(+) 04m 20s
GMT	20d 04h 06m 12s	OR	16h 06m 12s
LIT(E)- (+)	04h 38m 48s		04h 38m 48s
LMT	20d 08h 45m 00s		20h 45m 00s

GMT = 20d 04h 06m 12s

GHA (20d 04h)	238° 24.6'	Dec (20d 04h)	20° 35.9' N
Increment (06m 12s)	1° 33.0'	d (0.5)	0.1'
GHA sun	239° 57.6'	Declination sun	20° 36.0' N
Long (E)	(+) 69° 42.0'		
LHA sun	309° 39.6'	Lat	44° 31' N

P = 360° - LHA

P = 360° - 309° 39.6'

P = 50° 20.4'

$A = \frac{\tan lat}{\tan P}$ $B = \frac{\tan dec}{\sin P}$

$A = \frac{\tan 44° 31'}{\tan 50° 20.4'}$ $B = \frac{\tan 20° 36'}{\sin 50° 20.4'}$

A = 0.815 (S) named opp to lat, expect when LHA is b/w 090 to 270°

B = 0.488 (N) same as declination

C = A ± B (same name add, diff name substract)

C = 0.815 - 0.488

C = 0.327 S

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$\text{Tan Az} = 1/C \times \cos lat$

$\text{Tan Az} = \frac{1}{0.327 \times \cos 44^\circ 31'}$

$\text{Tan Az} = 4.289$

$Az = \text{S } 76.8 \text{ E}$ → LHA is 0° to 180° − W

Same as C → LHA is 180° to 360° − E

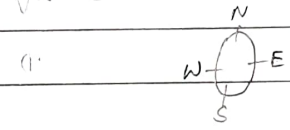
$T\,Az = 103.2^\circ (180^\circ - 76.8^\circ)$

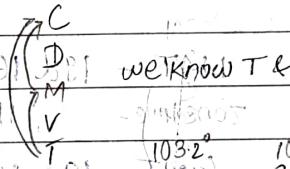
$C\,Az = 100^\circ$

$C\,Error = 3.2^\circ E$

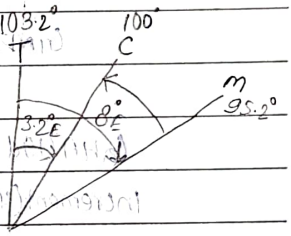
$V = 8^\circ E$

$D = 4.8^\circ W$





we know T & C



bcz E & less in right

② $GPS = 22d\ 10h\ 09m\ 38s$

GHA Sun (22d 10h) : 331° 51.4′ — Dec (22d 10h) : 0° 5.6′ N

Increment (09m 38s) : 2° 24.5′ — d (1.0) : 0.2′

GHA Sun : 334° 15.9′ — Declination Sun : 0° 5.8′ N

Long (E) : (+) 185° 40.0′

LHA Sun : 519° 55.9′ — Lat : 18° 20′ N

P = 59° 55.9′

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ — $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 18^\circ 20'}{\text{Tan } 59^\circ 55.9'}$ — $B = \frac{\text{Tan } 0^\circ 5.8'}{\sin 59^\circ 55.9'}$

$A = 0.192\,S$ — $B = 0.002\,N$

$C = A - B$

$C = 0.192 - 0.002$

$C = 0.190\,S$

$\text{Tan Az} = 1/C \times \cos lat$

$\text{Tan Az} = 1/0.190 \times \cos 18^\circ 20'$

Tan Az = 5·5446

Az = S79·8°W

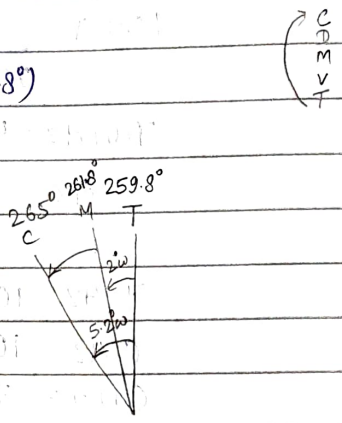
T Az = 259·8° (180° + 79·8°)

C Az = 265°

Compass Error = 5·2°W

V = 2°W

D = 3·2°W



(3) LMT – 19d 16h 18m 00s

zonetime – 11h 30m 00s

GMT – 19d 04h 48m 00s

GHA (19d 04h) : 237° 22·8'

Increment (48m 00s) : 12° 00·0'

GHA sun : 249° 22·8'

Long (E) : (+)175° 31·0'

LHA sun : 64° 53·8'

P = 64° 53·8'

Dec (19d 04h) : 20° 28·4'S

d (0·5) : 0·4'

Declination sun : 20° 28·8'S

Lat – 40° 16'S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 40°16'}{\text{Tan } 64°53·8'}$ $B = \frac{\text{Tan } 20°28·8'}{\sin 64°53·8'}$

A = 0·397N B = 0·412S

C = B – A

C = 0·412 – 0·397

C = 0·015S

Tan Az = 1/C x cos lat

Tan Az = 1/0·015 x cos 40°16'

Tan Az = 87·369

Az = S89·3°W

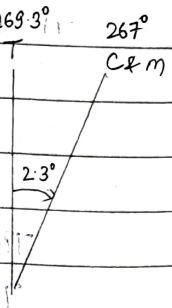
T Az = 269·3°

C Az = 267°

C Error = 2·3°E

V = 2·3°E

D = 0°



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(4) GPS = 30d 11h 00m 52s

GHA (30d 11h) - 345° 42.5'
Increment (00m 52s) - 0° 13.0'
GHA Sun : 345° 55.5'
Long (W) : (-) 60° 12.0'
LHA Sun : 285° 43.5'

Dec (30d 11h) - 14° 57.8' N
d (0.7) - 0.0
Declination Sun : 14° 57.8' N
Lat - 00° 00.0'

P = 360° - LHA
P = 360° - 285° 43.5'
P = 74° 16.5'

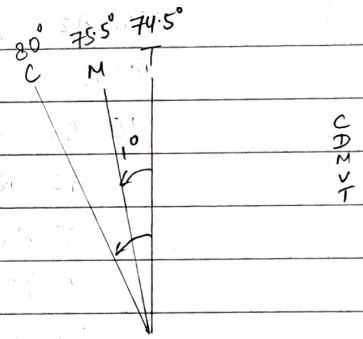
$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 00° 00.0'}{\text{Tan } 74° 16.5'}$ $B = \frac{\text{Tan } 14° 57.8'}{\sin 74° 16.5'}$

A = 0 B = 0.278 N

C = 0.278 N

Tan Az = Y/C x cos lat
Tan Az = 1/0.278 x cos 00° 00.0'
Tan Az = 3.597
Az = N 74.5° E
T Az = 74.5°
C Az = 80°
C Error = 5.5° W
V = 1° W
D = 4.5° W



(5)

Chron -	05h 10m 25s	17h 10m 25s
Error fast - (-)	00m 05s	00m 05s
GMT -	05h 10m 20s	17h 10m 20s
LT -	00h 00m 00s	00h 00m 00s
LMT -	05h 10m 20s	17h 10m 20s

GMT = 31d 17h 10m 20s

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GHA(31d 17h) : 74° 58.4' | Dec(31d 17h) : 8° 19.6' N
Increment(10m 20s) : 2° 35.0' | d(0.9) : 0.2'
GHA Sun : 77° 33.4' | Dec Sun : 8° 19.8' N
Long : 00° 00.0'
LHA : 77° 33.4' | Lat - 10° 11's
P = 77° 33.4'

$A = \frac{\tan lat}{\tan P}$ | $B = \frac{\tan dec}{\sin P}$

$A = \frac{\tan 10° 11'}{\tan 77° 33.4'}$ | $B = \frac{\tan 8° 19.8'}{\sin 77° 33.4'}$

A = 0.039 N | B = 0.149 N

C = A + B

C = 0.039 + 0.149

C = 0.188 N

Tan Az = 1/C x cos lat

Tan Az = 1/0.188 x cos 10° 11'

Tan Az = 5.404

Az = N 79.5 W

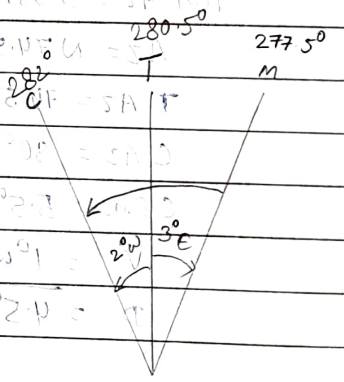
T Az = 280.5°

C Az = 282°

C Error = 1.5° W

V = 3° E

D = 4.5° W



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$\cos RAz/SAz = \frac{\sin dec}{\cos lat}$

Long E, GMT least
Long W, GMT best

Sep

Latitude : 40°28'N

(1) LMT Sunrise : 02d 05h 28m 00s
LIT(E) : (-) 04h 17m 20s
GMT Sunrise : 02d 01h 10m 40s

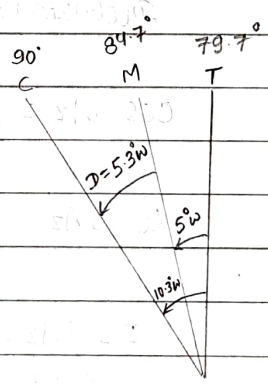
Dec(02d 01h) : 7° 50·5'N
d(0·9) : 0·2'
Declination Sun : 7° 50·7'N

$\cos RAz = \frac{\sin dec}{\cos lat}$

$\cos RAz = \frac{\sin 7°50·7'}{\cos 40°28'}$

$\cos RAz = 0·179$

RAz = (N)79·7(E)
↓ Same as dec
↳ bcz it is rising sun



TAz = 79·7°
CAz = 90°
C Error = 10·3°W
var = 5°W
Dev = 5·3°W

(2) LMT Sunset : 01d 18h 38m 00s
LIT(W) : (+) 11h 59m 00s
GMT Sunset : 02d 06h 37m 00s

Dec(02d 06h) : 15° 30·8'N
d(0·7) : 0·4'
Declination Sun : 15° 31·2'N

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$$\cos SAz = \frac{\sin dec}{\cos lat}$$

$$\cos SAz = \frac{\sin 15^\circ 31.2'}{\cos 30^\circ 06'}$$

$\cos SAz = 0.309$

$SAz = N72.0^\circ W$

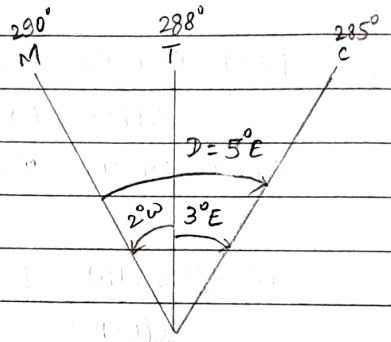
$T\ Az = 288^\circ$

$C\ Az = 285^\circ$

$C\ Error = 3^\circ E$

$Var = 2^\circ W$

$Dev = 5^\circ E$



③

LMT sunset : 20d 20h 19m 00s

LIT(W):(+) 03h 05m 48s

GMT sunset: 20d 23h 24m 48s

Dec(20d 23h) : 20° 5.7' S

d(0.5): 0.2'

Declination sun : 20° 5.9' S

$$\cos SAz = \frac{\sin dec}{\cos lat}$$

$$\cos SAz = \frac{\sin 20^\circ 5.9'}{\cos 54^\circ 20'}$$

$\cos SAz = 0.58935$

$SAz = S53.9^\circ W$

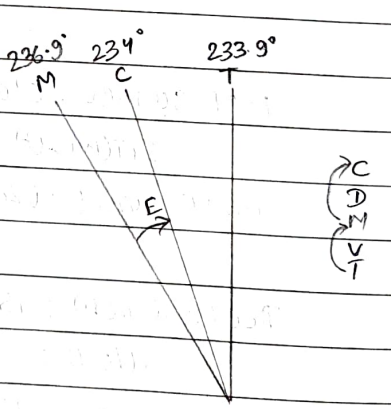
$T\ Az = 233.9^\circ$

$C\ Az = 234^\circ$

$C\ Error = 0.1^\circ W$

$Var = 3^\circ W$

$Dev = 2.9^\circ E$



④

Chron time: 30d 00h 10m 00s | 30d 12h 10m 00s
Error (slew): (+) 05m 10s | (+) 05m 10s
GMT: 30d 00h 15m 10s (OR) (+12) | 30d 12h 15m 10s
LIT (E): (+) 07h 20m 48s | (+) 07h 20m 48s
LMT: 30d 07h 35m 58s | 30d 19h 35m 58s

LMT Sunrise: 30d 06h 16m 46s
LIT (E): (+) 07h 20m 48s
GMT sunrise: 29d 22h 55m 58s

Dec (29d 22h): 21° 39 2's
d (0.4): 0.4'
Declination sun: 21° 39.6's

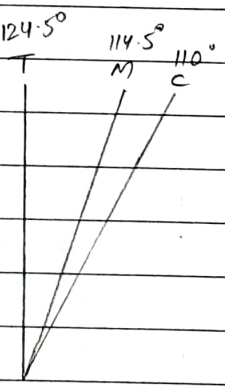
$$\cos RAz = \frac{\sin dec}{\cos lat}$$

$$\cos RAz = \frac{\sin 21° 39.6'}{\cos 49° 18'}$$

$\cos RAz = 0.566$

RAz S 55.5 E
T Az = 124.5°
C Az = 110°
C Error = 14.5° E
Var = 10° E
Dev = 4 5° E

C D M V T



⑤

LMT sunrise: 23d 05h 49m
LIT (W): (+) 08h 01m 48s
GMT: 23d 13h 50m 48s

Declination (23d 13h): S° 0° 20.7'
d (1.0): 0.8
Declination sun: S 0° 21.5'

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$$\cos RAz = \frac{\sin dec}{\cos lat}$$

$$\cos RAz = \frac{\sin 0^\circ 21.5'}{\cos 00^\circ 00'}$$

RAz = S89.6E

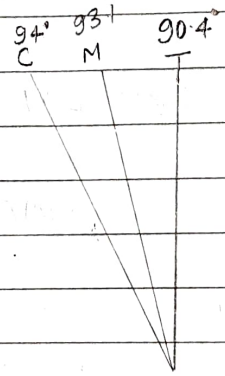
T Az = 90.4

C Az = 94°

Error = 3.6°W

Var = 2.7°W

Dev = 0.9°W



Latitude - position of observer

Dec - position of body (sun)

If Lat is 10°N, Dec is 12°N, T alt will be N	Lat < Dec, same as lat
Lat - 10°N, Dec - 8°N, T alt will be S	Lat > Dec, opp. to lat
Lat - 10°S, Dec - 8°S, T alt will be N	
Lat - 10°S, Dec - 12°S, T alt will be S	

Sun

No. 17 Date 24.12.2024

LOP is always E-W

bcz mer. alt is the true altitude of a celestial body when it is on the observer's meridian. Its azimuth at that time will be either N(000°) or S(180°).

So LOP in both the cases be 090° ⟷ 270°

* Thumb rules

1) IE(on) :- (-) ; IE(off) :- (+)
2) Dip : (-)
3) Name of T. alt - (see in previous page)
4) MZD = 90° - T Alt & named opposite to T. alt
5) MZD & dec :- same name add, retain the name
different name substract, Keep the name of larger one.

Exercise-30 - Lat by mer alt sun

(1)

LMT mer. pass - 21d 12h 11m 00s
LIT(W) - (+) 07h 21m 20s
GMT mer. pass - 21d 19h 32m 20s

Dec(21d 19h) : 19° 54.7' S
d(0.5) : 0.3'
Declination sun : 19° 55.0' S

Sextant altitude : 85° 03.5'
IE(Off) : (+) 1.6'
Observed altitude : 85° 5.1'
Dip (HE-10m) : (-) 5.6'
Apparent altitude : 84° 59.5'
Total corr. LL : (+) 16.1'
True Altitude : 85° 15.6' N
MZD : 4° 44.4' S
Dec : 19° 55.0' S
Lat : 24° 39.0' S
LOP : E-W

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② LMT mer. pass = 01d 12h 00m 00s
LIT(E) = (-) 03h 21m 48s
GMT mer. pass = 01d 08h 38m 12s

Dec(01d 08h) : 8° 06·0' N
d(0·9) : (-) 0·6'
Declination Sun : 8° 05·4' N

Sextant altitude : 82° 10·4'
IE(on) : (-) 2·4'
Observed altitude : 82° 8·0'
Dip(HE-17m) : (-) 7·3'
Apparent altitude : 82° 0·7'
Total corr. UL : (-) 16·0'
True Altitude 81° 44·7' N
MZD : 08° 15·3' S
Dec : 08° 05·4' N
Lat : 00° 09·9' S
PL - E-W

③ LMT mer. pass : 01d 11h 57m 00s
LIT(E) : (-) 11h 59m 52s
GMT mer. pass : 30d 23h 57m 08s

Dec(30d 23h) : 15° 06·9' N
d(0·7) (+) 0·7'
Declination Sun : 15° 07·6' N

Sextant Altitude : 64° 35·9'
Dip(HE-15m) : (-) 6·8'
Apparent altitude : 64° 29·1'
Total corr. UL : (+) 15·5'
True altitude : 64° 44·6' S
MZD : 25° 15·4' N
Dec : 15° 07·6' N
Lat : 40° 23·0' N LOP : E-W

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(14)

LMT mer. pass: 14d 11h 55m 00s
LIT(W): (+) 07h 45m 48s
GMT mer. pass: 14d 19h 40m 48s

Dec(14d 19h): 3° 2·8' N
d(1·0): (-) 0·7'
Dec sun: 3° 2·1' N

Sextant altitude: 70° 29·8'
IE (Off): (+) 3·2'
Observed altitude: 70° 33·0'
Dip(HE-12m): (-) 6·1'
Apparent altitude: 70° 26·9'
Total corr UL: (-) 16·2'
True altitude: 70° 10·7' N
MZD : 19°49·3's
Dec : 3° 2·1'N
Lat : 16°47·2's
PL :- E-W

(5)

LMT mer. pass :- 01d 11h 49m 00s
LIT(W) :- (+) 04h 17m 12s
GMT mer pass : 01d 16h 06 m 12s
Dec(01d 16h): 21° 55·6's
d(0·4): 0·0'
Declination sun: 21° 55·6'S
Sextant altitude : 61° 27·5'
IE (On) : (-) 2·4'
Observed altitude: 61° 25·1'
Dip(HE-14m): (-) 6·6'
Apparent altitude: 61° 18·5'
Total corr. LL : (+) 15·4'
True altitude : 61° 33·9' S
MZD : 28° 26·1'N
Dec : 21° 55·6'S
Lat : 06° 30·5'N
LOP :- E-W

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The intercept formula

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec \pm \sin lat \sin dec$

If lat & dec are of same name (+), opposite name (-)

Exercise-31- Intercept sun

① Since, sun is saying that LMT is 5d AM so, we take Chron time in 04d to get LMT 05d AM

Chron time	10h 54m 54s	04d 22h 54m 54s
Error(slow)	(+) 00m 46s	(+) 00m 46s
GMT	05d 10h 55m 40s (OR)	04d 22h 55m 40s ✓
LIT(E)	(+) 10h 04m 40s	(+) 10h 04m 40s
LMT	05d 21h 00m 20s	05d 09h 00m 20s

GMT = 04d 22h 55m 40s

GHA Sun (04d 22h)	147° 06.9'	Sex. Alt	35° 59.1'
Increment (55m 40s)	13° 55.0'	IE (off)	1.3'
GHA Sun	161° 1.9'	Obs. Alt	36° 0.4'
		Dip (HE 30m)	(-) 9.6'
Declination (04d 22h)	06° 1.3'	App. alt	35° 50.7'
d (1.0)	(-) 0.9'	Tot. corr. LL	(+) 14.9'
Declination Sun	06° 0.4' S	True alt	36° 5.6'
		TZD	53° 54.3'

GHA Sun	161° 1.9'	P = 360° - LHA	
LONG (E)	(+) 151° 10.0'	P =	47° 48.1'
LHA Sun	312° 11.9'	Lat =	38° 11' S

Lat & dec are same name, so (+)

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec + \sin lat \cdot \sin dec$

$\cos CZD = \cos 47°48.1' \cdot \cos 38°11' \cdot \cos 06°0.4' + \sin 38°11' \cdot \sin 06°0.4'$

$\cos CZD = 0.58978$

$CZD = 53°51.6'$

$TZD = 53°54.3'$

2.7' AWAY

$A = \frac{\tan lat}{\tan P}$ $\quad$ $B = \frac{\tan dec}{\sin P}$

$A = \frac{\tan 38°11'}{\tan 47°48.1'}$ $\quad$ $B = \frac{\tan 06°0.4'}{\sin 47°48.1'}$

$A = 0.713\ N$ $\quad$ $B = 0.142\ S$

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$C = A + B$

$C = 0.713 - 0.142$

$C = 0.571 N$

$\text{Tan } Az = 1/C \times \cos lat$

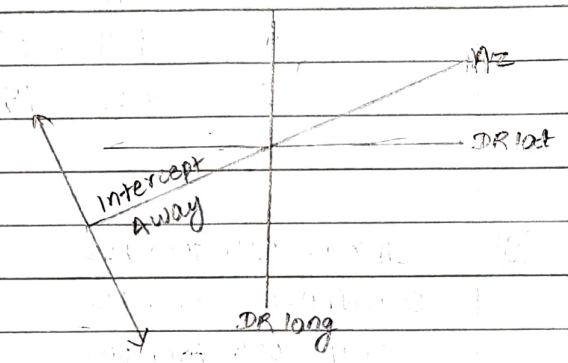
$\text{Tan } Az = 1/0.571 \times \cos 38°11'$

$\text{Tan } Az = 2.228$

$Az = N65.8E$

$T\,Az = 65.8(T)$

$LOP = 155.8 - 335.8$



② GMT : 22d 10h 09m 38s

GHA (22d 10h) : 331°51.4'

Increment (09m38s) : 2° 24.5'

GHA sun : 334°15.9'

Long (E) : (+)85° 40.0'

LHA Sun : 59° 55.9'

P = 59°55.9'

Dec (22d 10h) : 0°5.6' N

d (1.0) : (-) 0.2'

Declination sun : 0°5.4' N

Sextant altitude : 20°04.9'

IE (on) : (-) 2.2'

Observed altitude : 20° 2.7'

Dip (HE-25m) : (-) 8.8'

Apparent alt : 19°53.9'

Total corr. UL : (-) 18.4'

True Alt : 19°35.5'

TZD : 70° 24.5'

Lat : 48°20'N

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec + \sin lat \cdot \sin dec$

$\cos CZD = \cos 59°55.9' \cdot \cos 48°20' \cdot \cos 0°5.4' + \sin 48°20' \cdot \sin 0°5.4'$

$\cos CZD = 0.334258$

$CZD = 70°28.4'$

$TZD = 70°24.5'$

Intercept = 3.9' Towards

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $\quad B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 48°20'}{\text{Tan } 59°55.9'}$ $\quad B = \frac{\text{Tan } 0°5.6'}{\sin 59°55.9'}$

$A = 0.651\ S$ $\quad B = 0.002\ N$

$C = 0.649\ S$

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Tan Az = 1/c x cos lat

Tan Az = 1/0.649 x cos 48°20'

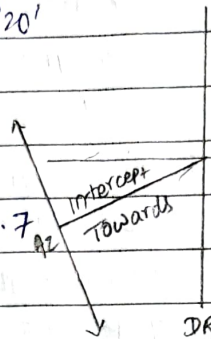
Tan Az = 2.318

Az = S 66.7 W

T Az = 246.7 (T)

DP lat

DP long



DR long

③

Chron - 03h 50m 12s

Error (fast) - (-) 02m 12s

GMT - 03h 48m 00s

LIT (E) - (+) 11h 42m 04s

LMT - 15h 30m 04s

So, GMT = 19d 03h 48m 00s

GHA (19d 03h) : 222° 23.0'

Increment (48m 00s) : 12° 00.0'

GHA Sun : 234° 23.0'

LONG (E) : (+) 75° 31.0'

LHA Sun : 49° 54.0'

P = 49° 54.0'

Dec (19d 03h) = 20° 28.9' S

d (0.5) = (-) 0.4'

Declination Sun - 20° 28.5' S

Sextant Alt - 43° 27.4'

IE (on) - (-) 1.5'

Observed Alt - 43° 25.9'

Dip (HE - 22m) - (-) 8.3'

Apparent alt : 43° 17.6'

Total corr LL : (+) 15.2'

True altitude : 43° 32.8'

TZD : 46° 27.2'

Lat : 40° 16.0' S

cos CZD = cos lat · cos P · cos dec + sin lat · sin dec

cos CZD = cos 40°16' · cos 49°54.0' · cos 20°28.5' + sin 40°16' · sin 20°28.5'

cos CZD = 0.686

CZD = 46° 38.6'

TZD = 46° 27.2'

Intercept = 11.4' TOWARDS

A = Tan lat / Tan P

A = Tan 40°16.0' / Tan 49°54.0'

A = 0.713 N

B = Tan dec / sin P

B = Tan 20°28.5' / sin 49°54.0'

B = 0.488 S

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C = A - B

C = 0.713 - 0.488

C = 0.225 N

Tan Az = 1/C x cos lat

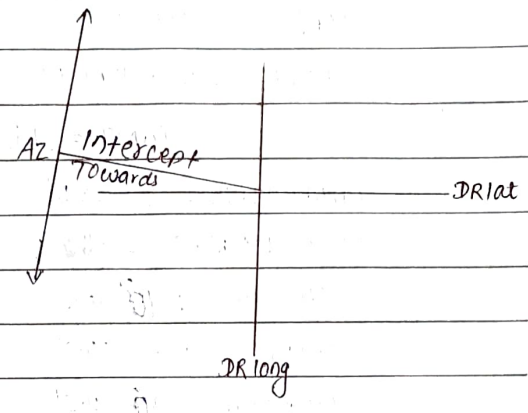
Tan Az = 1/0.225 x cos 40°16'

Tan Az = 5.825

Az = N80.2 W

T Az = 279.8 (T)

LOP = 9.8° - 189.8°



④ GPS = 30d 13h 00m 52s

GHA (30d 13h) : 15° 42.7'	Sex Alt - 44° 13.4'
Increment (00m 52s) : 0° 13.0'	IE (off) - (+) 3.1'
GHA Sun : 15° 55.7'	Obs. Alt - 44° 16.5'
Long (W) : (+) 60° 12.0'	Dip (HE - 20m) - (-) 7.9'
LHA Sun : 315° 43.7'	App. Alt - 44° 8.6'
P = 44° 16.3'	Total corr. UL - (-) 16.8'
Dec (30d 13h) : 14° 59.3' N	True alt - 43° 51.8'
d (0.7) : (+) 0.0'	TZD - 46° 8.2'
Declination Sun : 14° 59.3' N	Lat - 00° 20' N

Cos CZD = cos lat · cos P · cos dec + sin lat · sin dec

Cos CZD = cos 00°20' · cos 44°16.3' · cos 14°59.3' + sin 00°20' · sin 14°59.3'

Cos CZD = 0.693

CZD = 46° 07.1'

TZD = 46° 8.2'

Intercept = 1.1' AWAY

A = Tan lat / Tan P

A = Tan 00°20' / Tan 44°16.3'

A = 0.006 S

B = Tan dec / sin P

B = Tan 14°59.3' / sin 44°16.3'

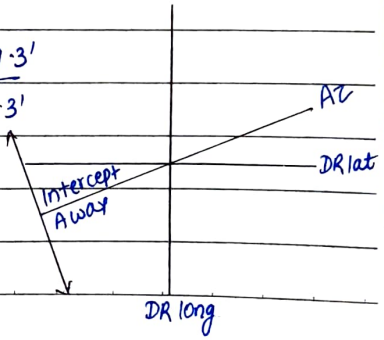
B = 0.383 N

C = 0.383 - 0.006

C = 0.377 N

Tan Az = 1/0.377 x cos 00°20'

Az = N69.3 E TAz - 69.3° LOP = 159.3 - 339.3



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⑤

Chron time	03h 11m 30s		15h 11m 30s
Error (fast)	(-) 01m 20s		(-) 01m 20s
GMT	03h 10m 10s	(OR)	15h 10m 10s ✓ (bcz question says PM)
LITE	00h 00m 00s		00h 00m 00s
LMT	03h 10m 10s		15h 10m 10s

GMT = 31d 15h 10m 10s

GHA (31d 15h)	44° 58·0'	Sextant Alt	34° 54·0'
Increment (10m 10s)	2° 32·5'	IE (on)	(-) 1·5'
GHA sun	46° 30·5'	Observed Alt	34° 52·5'
Long	00° 00·0'	Dip (HE-17m)	(-) 7·3'
LHA sun	46° 30·5'	Apparent alt	34° 45·2'
P	= 46° 30·5'	Total corr. LL	(+) 14·6'
Dec (31d 15h)	8° 21·4' N	True alt	34° 59·8'
d (0·9)	(-) 0·2'	TZD	55° 0·2'
Dec sun	8° 21·2' N	Lat	10° 15' S

$\cos CZD = \cos lat \cdot \cos P \cdot \cos dec - \sin lat \cdot \sin dec$

$\cos CZD = \cos 10°15' \cdot \cos 46°30.5' \cdot \cos 8°21.2' - \sin 10°15' \cdot \sin 8°21.2'$

$\cos CZD = 0.644$

$CZD = 49° 53.5'$

$TZD = 5$

question is wrong

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LONG BY CHRON (SUN)

Using a formula, we calculate "observed long" which is the longitude where LOP crosses the DR lat

Long by chron formula :- $\cos P = \frac{\sin T \text{ alt} \mp \sin \text{lat} \cdot \sin \text{dec}}{\cos \text{lat} \cdot \cos \text{dec}}$

& if lat & dec are same name (−)
different name (+)

In long by chron, sign is opposite to intercept. Hence in formula it is $\mp$ not $\pm$ (remember like this)

Exercise- 32 - long by chron Sun

(1) GMT = 19d 03h 48m 00s

GHA (19d 03h) : 222° 23.0'	Sex Alt- 43° 27.4'	GMT- 03h 48m 00s
Increment (48m 00s) : 12° 00.0'	IE (ON) - (−) 1.5'	LIT(E) - (+)11h 42m 04s
GHA Sun : 234° 23.0'	Obs. Alt - 43° 25.9'	LMT - 15h 30m 04s
Declination (19d 03h) : 20° 28.9's	Dip(HE-22m) - (−) 8.3'	↓ question says pm toh GMT is correct
d(0.5) : (+) 0.4'	App. alt - 43° 17.6'	
Declination Sun : 20° 28.5's	Total corr. LL - (+) 15.2'	
Lat : 40° 16's	True alt 43° 32.8'	

$$\cos P = \frac{\sin T \cdot \text{alt} - \sin \text{lat} \cdot \sin \text{dec}}{\cos \text{lat} \cdot \cos \text{dec}}$$

$$\cos P = \frac{\sin 43°32.8' - \sin 40°16' \cdot \sin 20°28.5'}{\cos 40°16' \cdot \cos 20°28.5'}$$

$\cos P = 0.647$

$P = 49°38.8'$

(Mer. pass : 12h 11m
Sight is taken PM at ship, that means, sight is after mer. pass
SO, LHA = P)

LHA = P . . ?

LHA = 49° 38.8'

GHA = 234° 23.0'

Obs. long = 175° 15.8' E

LHA - GHA = Obs. long E

LHA - GHA = Obs. long & if it exceed 180°, substract from 360°

$A = \frac{\tan \text{lat}}{\tan P}$

$A = \frac{\tan 40°16'}{\tan 49°38.8'}$

$A = 0.720\,N$

$B = \frac{\tan \text{dec}}{\sin P}$

$B = \frac{\tan 20°28.5'}{\sin 49°38.8'}$

$B = 0.490\,S$

$C = A - B$

$C = 0.720 - 0.490$

$C = 0.230 N$

$\text{Tan } Az = 1/C \times \cos lat$

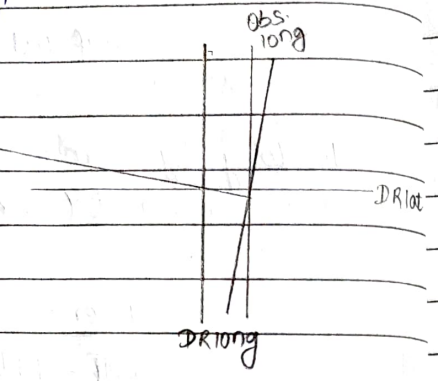
$\text{Tan } Az = 1/0.230 \times \cos 40°16'$

$\text{Tan } Az = 5.698$

$Az = N\,80.1'\,W$

$T\,Az = 279.9°(T)$

$LOP = 9.9° - 189.9°$



(2)

Chron time	03h 11m 30s	15h 11m 30s
Error (fast)	(-) 01m 20s	(-) 01m 20s
GMT	03h 10m 10s	15h 10m 10s ✓ bcz question says PM at ship
LITE	00h 00m 00s	00h 00m 00s
UNT	03h 10m 10s	15h 10m 10s

GMT = 31d 15h 10m 10s

GHA Sun (31d 15h) :	44° 58.0'
Increment (10m 10s) :	2° 32.5'
GHA Sun :	47° 30.5'
Declination (31d 15h) :	8° 21.4' N
d (0.9) :	(-) 0.2'
Declination Sun :	8° 21.2' N
Lat :	10° 15' S

Sex. alt -	34° 54.0'
IE (on) -	(-) 1.5'
Obs. alt -	34° 52.5'
Dip (HE-17M) -	(-) 7.3'
App. alt -	34° 45.2'
Total corr. (1) -	(+) 14.6
True alt -	34° 59.8'

$\cos P = \dfrac{\sin T\,alt + \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$

$\cos P = \dfrac{\sin 34°59.8' + \sin 10°15' \cdot \sin 8°21.2'}{\cos 10°15' \cdot \cos 8°21.2'}$

$\cos P = 0.616$

$P = 52°0.1'$

Wrong question

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③ GPS = 22d 10h 09m 38s

GHA Sun (22d 10h)	: 331° 51.4'	Sex. Alt	- 20° 4.9'
Increment (09m 38s)	: 2° 24.5'	IE (on)	- (-) 2.2'
GHA Sun	: 334° 15.9'	Obs. Alt	- 20° 2.7'
Declination (22d 10h)	: 0° 5.6' N	Dip (HE-25m)	- (-) 9.0'
d (1.0)	: (-) 0.2'	App. alt	- 19° 53.8'
Declination Sun	: 0° 5.4' N	Total corr. UL	- (-) 18.4'
Latitude	: 48° 20' N	True alt	- 19° 35.4'

$$\cos P = \frac{\sin T\,alt - \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 19°35.4' - \sin 48°20' \cdot \sin 0°5.4'}{\cos 48°20' \cdot \cos 0°5.4'}$$

$\cos P = 0.5026$

$P = 59° 49.7'$

$P = LHA$ — Sight is taken after mer. pass so, LHA = P

$LHA = 59° 49.7'$

$GHA = 334° 15.9'$ — LHA − GHA = Obs. long E

Obs. long = 85° 33.8' E

$$A = \frac{Tan\ lat}{Tan\ P} \qquad B = \frac{Tan\ dec}{\sin P}$$

$$A = \frac{Tan\ 48°20'}{Tan\ 59°49.7'} \qquad B = \frac{Tan\ 0°5.4'}{\sin 59°49.7'}$$

$A = 0.653\,S$ $\qquad B = 0.002\,N$

$C = 0.651\,S$

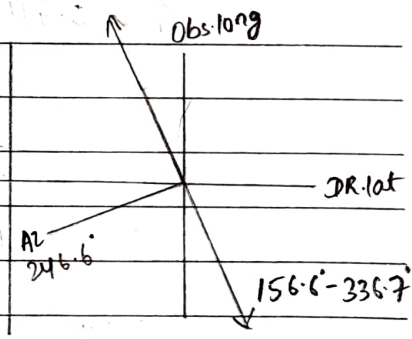
$Tan\ Az = 1/0.651 \times \cos 48°20'$

$Tan\ Az = 2.311$

$Az = S\ 66.6'\ W$

$T\ Az = 246.6°\ (T)$

$LOP = 156.6° - 336.6°$



④

Chron time	- 10h 54m 54s	04 ~~05~~d 22h 54m 54s	
Error (slow)	- (+) 00m 46s	(+) 00m 46s	
GMT	- 10h 55m 40s	04 ~~05~~d 22h 55m 40s	- bcz question say 05d AM on ship, so we take 04d as chron time
LIT (E)	- (+) 10h 04m 40s	(+) 10h 04m 40s	
LMT	- 21h 00m 20s	(05 ~~06~~d 09h 00m 20s) 05 March, AM	

DR long

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GMT = 04d 22h 55m 40s

GHA sun (04d 22h) : 147° 06.9'	Sex. alt - 35° 59.1'
Increment (55m 40s) : 13° 55.0'	IE (off) - (+) 1.3'
GHA sun : 161° 1.9'	Obs. alt - 36° 0.4'
Declination (04d 22h) : 6° 1.3' S	Dip (HE-30m) - (-) 9.6'
d (1.0) : (-) 0.9'	App. alt - 35° 50.8'
Declination sun : 6° 0.4' S	Total corr.n - (+) 14.9'
Latitude : 38° 11' S	True alt - 36° 05.7'

$$\cos P = \frac{\sin T\,alt - \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 36°5.7' - \sin 38°11' \cdot \sin 6°0.4'}{\cos 38°11' \cdot \cos 6°0.4'}$$

$\cos P = 0.671$

$P = 47°51.9'$

LHA = 360 - P

Sight is taken before mer. pass
SO, LHA = 360 - P

LHA = 312° 8.1'

GHA = 161° 1.9'

LHA - GHA = Obs. long E

Obs. long = 151° 06.2' E

$$A = \frac{Tan\ lat}{Tan\ P} \qquad B = \frac{Tan\ dec}{Sin\ P}$$

$$A = \frac{Tan\ 38°11'}{Tan\ 47°51.9'} \qquad B = \frac{Tan\ 6°0.4'}{Sin\ 47°51.9'}$$

A = 0.711 N B = 0.142 S

C = 0.711 - 0.142

C = 0.569 N

Tan Az = 1/C x cos lat

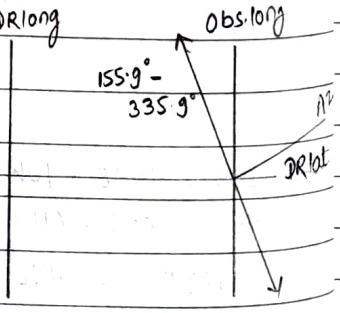
Tan Az = 1/0.569 x cos 38°11'

Tan Az = 2.236

Az = N65.9E

T Az = 65.9° (T)

LOP = 155.9° - 335.9°



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⑤ GMT = 30d 13h 00m 52s ✓

GHA Sun (30d 13h) : 15° 42.7'	Sex. alt - 44° 13.4' GMT 13h 00m 52 s
Increment (00m 52s) : 0° 13.0'	IE (off) - (+) 3.1' LIT (+) (-) 04h 00m 48 s
GHA Sun : 15° 55.7' ✓	Obs. alt - 44° 16.5' GMT - 13h 00m 52 s
Declination (30d 13h) : 14° 59.3' N	Dip (HE - 20m) - (-) 7.9'
d (0.7) : (+) 0.0'	App. alt - 44° 8.6'
Declination Sun : 14° 59.3' N	Total corr UL - (-) 16.8'
Latitude : 00° 20' N	True alt - 43° 51.8' ✓

$$\cos P = \frac{\sin T\,alt - \sin 00°20' \cdot \sin 14°59.3'}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 43°51.8' - \sin 00°20' \cdot \sin 14°59.3}{\cos 00°20' \cdot \cos 14°59.3}$$

$\cos P = 0.716$

$P = 44°17.5'$

LHA = 360 − P (Sight is taken before mer. pass so, LHA = 360 − P)

LHA = 315° 42.5'

GHA = 15° 55.7'

Obs. long = 60° 13.2' W

GHA − LHA = Obs. long W

Bada Chota

$A = \frac{Tan\ lat}{Tan\ P}$ $B = \frac{Tan\ dec}{Sin P}$

$A = \frac{Tan\ 00°20'}{Tan\ 44°17.5'}$ $B = \frac{Tan\ 14°59.3'}{Sin\ 44°17.5'}$

A = 0.006 S B = 0.383 N

C = 0.383 − 0.006

C = 0.377 N

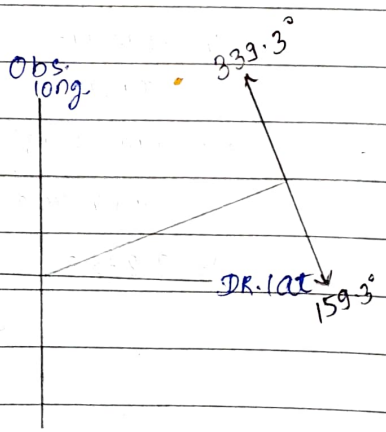
Tan Az = 1/0.377 × cos 00°20'

Tan Az = 2.653

Az = N69.3E

TAz = 69.3°

LOP = 159.3° − 339.3°



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EX-MERIDIAN ALT. SUN

No. 30 Date 05.01.24

The ex-meridian formula

COS MZD = COS TZD + [(1 − COS P) · COS DR lat · Cos dec]

①

Chron time - 00h 45m 51s

Error (SLOW) - (+) 03m 21s

GMT - 00h 49m 12s ✓ (OR) (+12)

LMT (E) - (+) 11h 00m 08s

LMT - 11h 49m 20s

LMT - 23h 49m 20s

GMT = Old 00h 49m 12s

GHA Sun (Old 00h) : 179° 59.8'	Sextant alt - 75° 01.7'
Increment (49m 12s) : 12° 18.0'	IE (Off) - (+) 3.2'
GHA Sun : 192° 17.8'	Observed alt - 75° 04.9'
Long (E) : (+) 165° 02.0'	Dip (HE - 20m) - (-) 7.9'
LHA : 357° 19.8'	Apparent alt - 74° 57'
P : 02° 40.2'	Total corr. UL - (-) 16.1'
Dec Sun (Old 00h) : 8° 13.3' N	True alt - 74° 40.9' S
d (0.9) : (-) 0.7'	TZD - 15° 19.1' S N
Declination Sun : 8° 12.6' N	DR Lat - 23° 18' N

observer 23°
dec 8°
SAME Name

COS MZD = COS TZD + [(1 − COS P) · COS DR lat · cos dec]

COS MZD = cos 15°19.1 + [(1 − cos 02°40.2') · cos 23°18' · cos 8°12.6']

COS MZD = 0.964 + 0.00099

COS MZD = 0.965

MZD = 15° 12.2' N

Dec = 8° 12.6' N

Obs lat = 23° 24.8' N

A = Tan lat / Tan P

B = Tan dec / sin P

A = Tan 23°18' / Tan 02°40.2'

B = Tan 8°12.6' / sin 02°40.2'

A = 9.235 S

B = 3.097 N

C = 9.235 − 3.097

= 6.138 S

Tan AZ = 1/C x cos lat

= 1/6.138 x cos 23°18'

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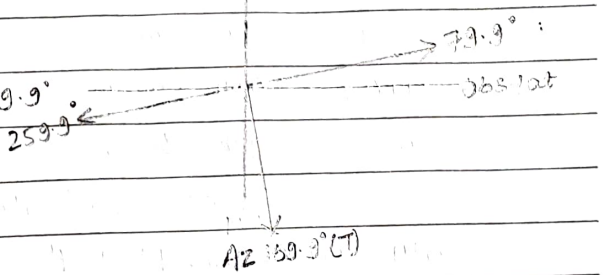
Tan Az = 0·177

Az = S10·1°E

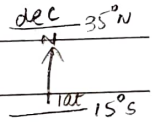
TAz = 169·9°

LOP = 79·9° – 259·9°



② GPS = 02d 17h 37m 48s

GHA Sun (02d 17h) : 75°46·3'	Sextant alt- 58°22·6'
Increment (37m 48s) : 9° 27·0'	IE (on) : (-) 1·6'
GHA Sun : 85°13·3'	Observed alt : 58 21·0'
Long (W) : 080° 11·0'	DIP (HE-15m) : (-) 6·8'
LHA Sun : 05°02·3'	Apparent alt : 58° 14·2'
P : 05°02·3'	Total corr. (L) : (+) 15·4'
Declination (02d 17h) : 15°38·2'N	True alt : 58° 29·6'N
d (0·7) : (+) 0·4'	TZD : 31°30·4' S (opp to T. alt)
Declination Sun : 15°38·6'N	DR lat : 15°36'S



Cos MZD = Cos TZD + [(1-cosP) · cos DR.lat · cos dec]

Cos MZD = Cos 31°30.4' + [(1-cos 05°02·3') · cos 15°36' · cos 15°38·6']

Cos MZD = 0·8526 + 0·0036

Cos MZD = 0·8562

MZD = 31°6·4' S (same as TZD)

Dec = 15°38·6'N

Obs. Long = 15°27·8'S (diff. name substract, retain the name of larger one)

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $\quad B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 15°36'}{\text{Tan } 05°2·3'}$ $\quad B = \frac{\text{Tan } 15°38·6'}{\text{Sin } 05°02·3'}$

A = 3·167N $\quad$ B = 3·188N

C = 3·167 + 3·188

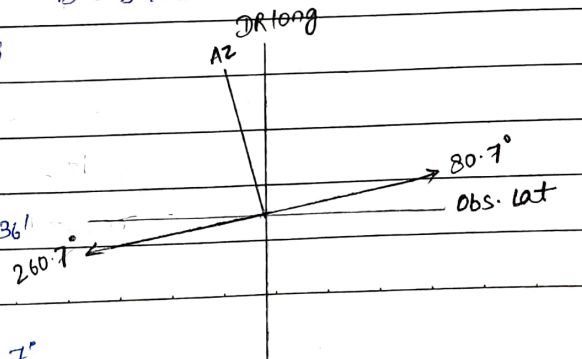
C = 6·355N

Tan Az = 1/C x cos lat

Tan Az = 1/6·355 x cos 15°36'

Az = N 9·3 W

TAz = 350·7°(T)



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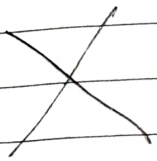
③

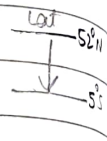
Chron time - 01h 29m 20s
Error (fast) - (-) 01m 50s
GMT - 01h 27m 30s ✓
LIT(E) - (+)11h 22m 40s
LMT - 12h 50m 10s



22h 50m 10s

GMT = 06d 01h 27m 30s

GHA Sun (06d 01h) : 192°10.7'	Sextant alt - 31° 59.8'
Increment (27m 30s) : 6°52.5'	IE (on) - (-) 2.3'
GHA Sun : 199° 3.2'	Observed alt - 31° 57.5'
Long (E) : (+)170° 40.0'	Dip (HE-40m) - (-) 11.1'
LHA Sun : 09° 43.2'	Apparent alt - 31° 46.4'
P : 09° 43.2'	Total cor-VL- (-) 17.6'
Declination (06d 01h) : 5° 35.2' S	True alt - 31° 28.8' S
d (1.0) : (-) 0.5'	TZD - 58° 31.2' N
Declination Sun : 5° 34.7' S	EP Latitude - 52° 12.0' N



$\cos MZD = \cos TZD + [(1-\cos P).\cos lat.\cos dec]$

$\cos MZD = \cos 58°31.2' + [(1-\cos 09°43.2').\cos 52°12'.\cos 5°34.7']$

$\cos MZD = 0.531$

MZD = 57° 55.8' N

Dec = 5° 34.7' S

Obs Lat = 52° 21.1' N

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $\quad A = \frac{\text{Tan } 52°12'}{\text{Tan } 09°43.2'}$ $\quad A = 7.526\,S$

$B = \frac{\text{Tan dec}}{\text{Sin P}}$ $\quad B = \frac{\text{Tan } 5°34.7'}{\text{Sin } 9°43.2'}$ $\quad B = 0.578\,S$

C = 7.526 + 0.578

C = 8.104 S

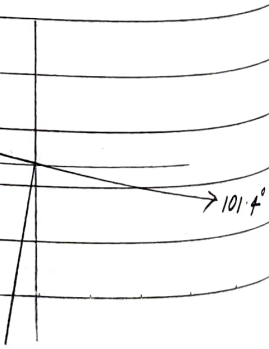
Tan Az = 1/C x cos lat

Tan Az = 1/8.104 x cos 52°12'

Az = S 11.4 W 281.4°

TAz = 191.4

LOP :- 101.4 - 281.4



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(A) Chron time : 06h 13m 27s
Error(slow) : (+) 12m 05s
GMT : 21d 06h 25m 32s (+12) GMT - 21d 18h 25m 32s
LT(W) : (-) 06h 31m 12s LIT(W) - (-) 06h 31m 12s
LMT - 20d 23h 54m 20s LMT - 21d 11h 54m 20s

GMT = 21d 18h 25m 32s

GHA Sun (21d 18h) : 87° 11.2'	Sextant alt - 69° 28.7'
Increment (25m 32s) : 6° 23.0'	IE (off) : (+) 2.0'
GHA Sun : 93° 34.2'	Observed alt : 69° 30.7'
Long (W) : (-) 97° 48.0'	Dip (HE - 12m) : (-) 6.1'
LHA Sun : 355° 46.2'	Apparent alt : 69° 24.6'
Declination (21d 18h) : 19° 55.2' S	Total corr 'n : (+) 15.8'
d(0.5) : (-) 0.2'	True altitude : 69° 40.4' S
Declination Sun : 19° 55.0' S	TZD : 20° 19.6' N
P : 4° 13.8'	DR lat : 00° 00'

Lat 00° ↓ 19' S

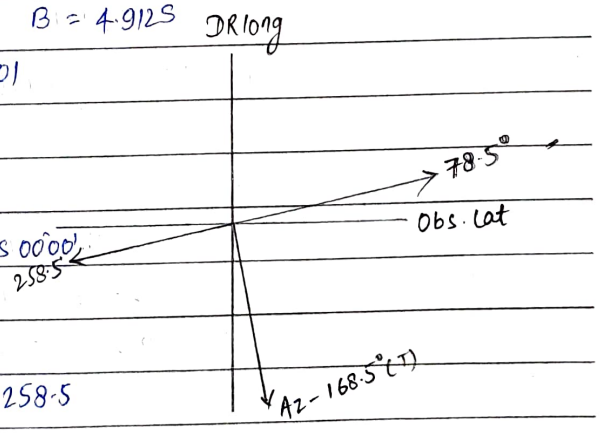
COS MZD = COS TZD + [(1 - COS P) · COS DR Lat · COS dec]
COS MZD = COS 20° 19.6' + [(1 - COS 4° 13.8') · COS 00° 00' · COS 19° 55.0']
COS MZD = 0.94029
MZD = 19° 54' N
Dec = 19° 55.0' S
Obs lat = 00° 01' S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 00°00'}{\text{Tan } 4°13.8'}$ $B = \frac{\text{Tan } 19°55.0'}{\sin 4°13.8'}$

A = 0.001 N B = 4.912 S

C = 4.912 - 0.001
C = 4.911 S
Tan Az = 1/C x cos lat
Tan Az = 1/4.911 x cos 00°00'
Az = S 11.5 E
T Az = 168.5
LOP = 78.5 - 258.5



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(05)

GMT - 01h 00m 12s ✓

LIT(E) - (+)10h 35m 04s

LMT : 11h 35m 16s

GMT : 23d 01h 00m 12s

GHA Sun (23d 01h) : 196° 54.7'	Sextant alt : 41° 36.7'
Increment (00m 12s) : 0° 3.0'	IE (on) : (-) 3.4'
GHA Sun : 196° 57.7'	Observed alt : 41° 40.1'
LONG(E) : (+)158° 46.0'	Dip(HE-17m) : (-) 7.3'
LHA Sun : 355° 43.7'	Apparent alt : 41° 32.8'
P : 04° 16.3'	Total corr 'n : (+) 14.9'
Declination (23d 01h) : 0° 09.0' S	True alt : 41° 47.7' N
d (1.0) : 0.0'	TZD : 48° 12.3' S
Declination Sun : 0° 09.0' S	EP lat : 48° 20' S

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 48°12.3' + [(1-\cos 04°16.3') \cdot \cos 48°20' \cdot \cos 0°9.0']$

$\cos MZD = 0.668$

$MZD = 48° 03.8' S$

$Dec = 0° 09.0' S$

$Obs\ lat = 48° 12.8' S$

$A = \frac{Tan\ lat}{Tan\ P}$ $\quad A = \frac{Tan\ 48°20'}{Tan\ 04°16.3'}$ $\quad A = 15.044N$

$B = \frac{Tan\ dec}{sin\ P}$ $\quad B = \frac{Tan\ 0°9.0'}{sin\ 04°16.3'}$ $\quad B = 0.035\ S$

$C = 15.044 - 0.035$

$C = 15.009\ N$

$Tan\ Az = 1/C \times cos\ lat$

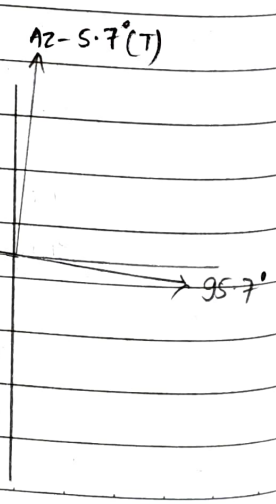
$Tan\ Az = 1/15.009 \times \cos 48°20'$

$Tan\ Az = 6.1002$

$Az = N\ 5.7\ E$

$T\ Az = 5.7°(T)$

$LOP = 95.7° - 275.7°$



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Exercise 34 - Azimuth star No. 35 Date 07.01.2022

① Chron time : 10h 38m 40s 22h 38m 40s
Error (fast) : (-) 03m 24s (-) 03m 24s
GMT : 10h 35m 16s (OR) 05d 22h 35m 16s ✓
LT(E) : (+)05h 35m 04s (+)05h 35m 04s
LMT : 16h 10m 20s 06d 04h 10m 20s – bcz question says 06 AM

GMT : 05d 22h 35m 16s

GHA ♈ (05d 22h) : 134° 01.0'	
Increment (35m 16s) : 8° 50.4'	Dec Altair : 8° 53.2' N
GHA ♈ : 142° 51.4'	
Long (E) : (+)83° 46.0'	Lat : 24° 12'S
LHA ♈ : 226° 37.4'	
SHA Altair : (+)62° 12.4'	
LHA Altair : 288° 49.8'	
P : 71° 10.2'	

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 24°12'}{\text{Tan } 71°10.2'}$ $B = \frac{\text{Tan } 8°53.2'}{\text{Sin } 71°10.2'}$

A = 0.153 N B = 0.165 N

C = 0.153 + 0.165

C = 0.318 N

Tan Az = 1/C x cos lat

Tan Az = 1/0.318 x cos 24°12'

Tan Az = 3.448

Az = N 73.8 E

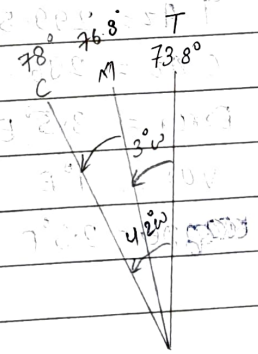
T Az = 73.8° (T)

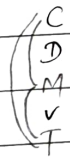
C Az = 78°

C Error = 4.2° W

Var = 3.0° W

Dev = 1.2° W





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②

GPS : 01d 07h 39m 22s

LIT(W) : (+)11h 33m 12s

LMT : 30d 20h 06m 10s

GPS :- 01d 07h 39m 22s

GHA ♈ (01d 07h) : 175° 30·7'

Increment (39m 22s) : 9° 52·1'

GHA Aeries : 185° 22·8' Dec : N38° 47·6'

LONG (W) : (+)173° 18·0'

LHA ♈ : 12° 4·8' Lat : 48° 57' N

SHA vega : (+)80° 41·7'

LHA vega : 92° 46·5'

P : 92° 46·5'

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 48°57'}{\text{Tan } 92°46.5'}$ $B = \frac{\text{Tan } 38°47·6'}{\sin 92°46.5'}$

A = 0·056 N B = 0·805 N

C = 0·056 + 0·805

C = 0·861 N

Tan Az = 1/C × cos lat

Tan Az = 1/0·861 × cos 48°57'

Tan Az = 1·769

Az = N60·5W

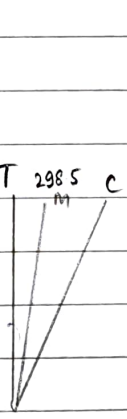
T Az = 299·5°

C Az = 296°

Error = 3·5° E

Var = 1° E

Dev = 2·5° E



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(3)

30d 13h 00m 08s
(+) 11h 59m 52s
LMT : 01d 01h 00m 00s

GMT: April 30d 13h 00m 08s

GHA ♈ (30d 13h)	: 53° 50.6'
Increment (00m 08s)	: 0° 2.0'
GHA ♈	: 53° 52.6'
Long (E)	: (+) 179° 58.0'
LHA ♈	: 233° 50.6'
SHA Spica	: (+) 158° 35.1'
LHA Spica	: 32° 25.7'
P	: 32° 25.7'

Declination SPICA :-
S 11° 12.5'

Lat: 62° 11' S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $\quad B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 62°11'}{\text{Tan } 32°25.7'}$ $\quad B = \frac{\text{Tan } 11°12.5'}{\text{Sin } 32°25.7'}$

A = 2.983 N $\quad$ B = 0.3695 S

C = 2.983 − 0.3695

C = 2.614 N

Tan Az = 1/C x cos lat

Tan Az = 1/2.614 x cos 62°11'

Tan Az = 0.8198

Az = N 39.3° W

T Az = 320.7° (T)

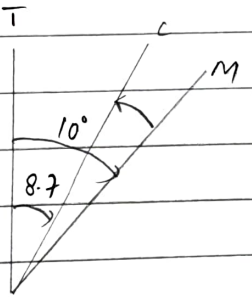
C Az = 312°

C Error = 8.7° E

Var = 10° E

Dev = 1.3° W

C D M V T



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(4) GMT = Sept 14d 04h 36m 00s

GHA ♈ (14d 04h) : 53° 30.5'	
Increment (36m 00s) : 9° 01.5'	Dec RASALHAGUE :-
GHA ♈ : 62° 32.0'	: N 12° 33.3'
Long (W) : (-) 90° 36.0'	
LHA ♈ : 331° 56.0'	Lat : 30° 46' N
SHA RASALHAGUE : 96° 09.7'	
LHA RASALHAGUE : 68° 05.7'	
P : 68° 05.7'	

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $\quad B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 30°46'}{\text{Tan } 68°05.7'}$ $\quad B = \frac{\text{Tan } 12°33.3'}{\text{Sin } 68°05.7'}$

A = 0.2394 S $\quad$ B = 0.240 N

C = 0.240 - 0.2394

C = 0.0006 N

Tan Az = 1/C x cos lat

Tan Az = 1/0.0006 x cos 30° 46'

Tan Az = 129.31

Az = 90° W

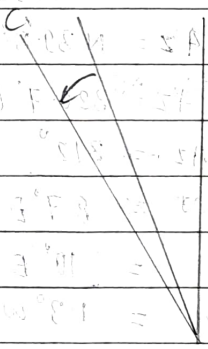
TAz = 270.0° (T)

CAz = 275°

C Error = 5.0° W

Var = 5° W

Der = 0.0°



C D M V T

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(5)

LMT : 03h 20m
Zone time: 07h 00m (ahead of GMT)
GMT : 20h 20m

GMT :- 20d 20h 20m 00s
LONG(E): (+) 07h 29m 12s
LMT : 03h 49m 12s

GMT: Jan 20d 20h 20m 00s

GHA Y (20d 20h)	: 59°34·8'	Declination DENEB :-
Increment (20m 00s)	: 5° 00·8'	N 45° 18·5'
GHA Y	: 64°35·6'	
Long (E)	: (+) 112°18·0'	
LHA Y	: 176°53·6'	Latitude: 64° 12'N
SHA DENEB	: 49°34·9'	
LHA DENEB	: 226°28·5'	
P	: 133°31·5'	

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 64°12'}{\text{Tan } 133°31·5'}$ $B = \frac{\text{Tan } 45°18·5'}{\sin 133°31·5'}$

A = 1.965 N B = 1.394 N

C = 1.965 + 1.394
= 3.359 N

Tan Az = 1/C x cos lat
Tan Az = 1/3.359 x cos 64°12'
Tan Az = 0.684
Az = N 34·4° E
T Az = 34·4°
C Az = 34·5°
Error = 0.1° W
Var = 4° E
Dev = 4.1° W

C D M V T

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* Time of mer. pass star

At mer. pass of *, LHA * = 360°

GHA Y
Long (E or W)
LHA Y
SHA *
LHA *

Hence, GHA Y + E(-W) Long + SHA * = LHA

(one sidereal day = 23h 56m 04s)

① Sextant altitude : 18° 26·2'
IE (off) : (+) 3·2'
Observed altitude : 18° 29·4'
Dip (HE - 10m) : (-) 5·6'
Apparent altitude : 18° 23·8'
Total corr : (+) 2·9'
True altitude : 18° 20·9' S
MZD : 7° 39·1' N
Dec : 26° 27·1' S
Lat : 45° 12·0' N
LOP : E-W

45° N Lat. ↓

GHA Y - Long (W) + SHA Antares = 360°
GHA Y - 120° 30' + 112° 31·2' = 360°
GHA Y = 360° + 120° 30' - 112° 31·2'
GHA Y = 7° 58·8'

GHA Y (4d 13h : 357° 39·7'
Increment (4m 10s) : (+) 10° 19·1
7° 58·8

2	2 + x = 3
(+) x	x = 3 - 2
3	= 1

So GMT mer pass (ANTARES) : March 04d 13h 41m 10s
LIT (W) : (-) 08h 02m 00s
04d 05h 39m 10s ↓

Question say AM at ship
so this is correct GMT

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(2)

Sextant Altitude: 30°40.2'
IE : 0.0'
Observed altitude: 30°40.2'
Dip(HE-18m) : (-) 7.5'
Apparent altitude: 30°32.7'
Total corr : (-) 1.6'
True altitude : 30°31.1'N
MZD : 59°28.9'S
Dec : 16°31.8'N
Lat : 42°57.1'S
LOP : E-W

GHA Y + Long(E) + SHA Aldebaran = 360°
GHA Y + 72°20' + 290°53.4' = 360°
GHA Y = 360° - 72°20' - 290°53.4'
GHA Y = 356°46.6'
GHA Y (12d 00h) = 351°22.4'
Increment (21m 33s) = 5°24.2'

GHA Y
long
LHA Y
SHA ♈
LHA ♈

GHA Y = Sep 12d 00h 21m 33s
UT(E) = (+) 04h 49m 20s
Sep 12d 05h 10m 53s → this time star is visible

So this GMT of meridian passage is correct
Hence, GMT of mer. pass = Sep 12d 00h 21m 33s

(3)

Sextant altitude: 73°24.2'
IE : 0.0'
Observed altitude: 73°24.2'
Dip (HE-15m) : (-) 6.8'
Apparent altitude: 73°17.4'
Total corn : (-) 0.3'
True altitude: 73°17.1'N
MZD : 16°42.9'S
Dec. RIGEL : 8°11.2'S
Lat : 24°54.1'S
LOP : E-W

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GHAY + Long E + SHA RIGEL = 360°

GHAY + 90° 06' + 281° 15.4' = 360°

GHAY = 360° - 90° 06' - 281° 15.4'

GHAY = 348° 38.6'

GHAY (22d 23h) = 347° 10.4'

Increment (5m 52s) = 1° 28.2'

Hence, GMT mer. pass = Sep 22d 23h 05m 52s

LIT (E) = (+) 06h 00m 24s

LMT mer. pass = 23d 05h 06m 16s

↓

But question says 22 sep.

One sidereal day = (-) 23h 56m 04s

Correct LMT mer. pass: 22d 05h 10m 12s

LIT (E) : (-) 06h 00m 24s

GMT mer. pass : 21d 23h 09m 48s

④

Sextant altitude: 14° 33.7'

IE (on) : (-) 0.6'

Observed altitude : 14° 33.1'

Dip (HE - 14.5m) : (-) 6.7'

Apparent altitude: 14° 26.4'

Total corrn : (-) 3.7'

True altitude : 14° 22.7' S

Lat — 57° N

↓

17° N

MZD : 75° 37.3' N

Dec : 17° 56.6' S

Lat : 57° 40.7' N

LDP : E - W

GHAY - LONG W + SHA DIPHDA = 360°

GHAY - 164° 20' + 349° 00' = 360°

GHAY = 360° - 349° 00' + 164° 20'

GHAY = 175° 20'

GHAY (20d 03h) = 163° 52.9'

Increment (45m 41s) = 11° 27.1'

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GMT at mer pass: 20d 03h 45m 41s
LIT(W): (+) 10h 57m 20s
LMT mer pass: 19d 16h 48m 21s — but ques says 20d
One sidereal day: (+) 23h 56m 04s
Correct LMT mer pass: 20d 16h 44m 25s
LIT(W): (+) 10h 57m 20s
Correct GMT mer pass: 21d 03h 41m 45s

5) Sextant altitude: 71° 46·9'
IE(On): (-) 2·4'
Observed altitude: 71° 44·5'
Dip(HE-14m): (-) 6·6'
Apparent altitude: 71° 37·9'
Total corrn: (-) 0·3'
True altitude: 71° 37·6' S
MZD: 18° 22·4' N
Dec: 11° 55·5' N
Lat: 30° 17·9' N
LDP: E-W

lat 30°
dec 11

GHA ♈ (-) Long(W) + SHA REGULUS = 360°
GHA ♈ - 135° 02' + 207° 47·5' = 360°
GHA ♈ = 360° + 135° 02' - 207° 47·5'
GHA ♈ = 287° 14·5'
GHA ♈ (01d 04h) = 279° 27·6'
Increment(31m 02s) = 07° 46·9'
GMT at mer pass: May 01d 04h 31m 02s
LIT(W): (-) 09h 00m 08s
LMT at mer pass: Apr. 30d 19h 30m 54s → but ques say 01 May
One sidereal day: (+) 23h 56m 04s
Correct LMT at mer pass: May 01d 19h 26m 58s
LIT(W): (+) 09h 00m 08s
Correct GMT at mer pass: May 02d 04h 27m 06s

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Exercise - 36

Intercept stars

1) Chron time : 08h 53m 03s
Error (fast) : (-) 01m 40s
GMT : 08h 51m 23s (+12) 20h 51m 23s → correct GMT
LIT(W) : (+)02h 41m 20s (-) 02h 41m 20s
LMT : 06h 10m 03s → but question says 18h 10m 03s → correct LMT
PM at ship

GMT :- 30d 20h 51m 23s

GHA ♈ (30d 20h) : 159° 07.8'	
Increment (51m 23s) : 12° 52.9'	Declination SIRIUS:
GHA ♈ : 172° 0.7'	16° 43.7' S
Long (W) : (+) 40° 20'	Lat : 34° 18.0' S
LHA ♈ : 131° 40.7'	
SHA SIRIUS : 258° 37.3'	
LHA SIRIUS : 30° 18.0'	
P : 30° 18.0'	

$\cos ZD = \cos P \cdot \cos lat \cdot \cos dec + \sin lat \cdot \sin dec$

$\cos ZD = \cos 30°18.0' \cdot \cos 34°18.0' \cdot \cos 16°43.7' + \sin 34°18.0' \cdot \sin 16°43.7'$

$\cos ZD = 0.845$

$ZD = 32°18.0'$

Sextant altitude : 57° 51.9'
IE (on) : (-) 1.2'
Observed altitude : 57° 50.7'
Dip (HE - 21m) : (-) 8.1'
Apparent altitude : 57° 42.6'
Total corn : (-) 0.6'
True altitude : 57° 42.0'
TZD : 32° 18.0'
CZD : 32° 18.0'
Intercept : 0.0

$A = \frac{Tan\ lat}{Tan\ P}$ $B = \frac{Tan\ dec}{Sin\ P}$

$A = \frac{Tan\ 34°18'}{Tan\ 30°18'}$ $B = \frac{Tan\ 16°43.7'}{Sin\ 30°18'}$

A = 1.167 N B = 0.596 S

$C = A - B$

$C = 1.167 - 0.596$

$C = 0.571 N$

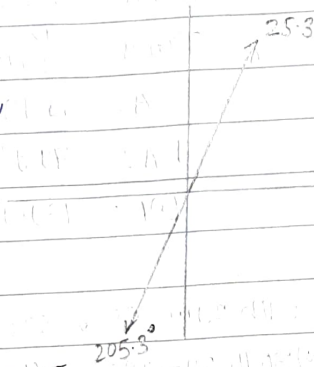
$\text{Tan } Az = 1/C \times \cos lat$

$\text{Tan } Az = 1/0.571 \times \cos 34°18.0'$

$Az = N\,64.7\,W$

$T\,Az = 295.3°$

$LOP = 25.3° - 205.3°$



(2) GMT: 07h 33m 44s ✓ correct GMT

LIT(E): (+)11h 23m 20s

LMT: 18h 57m 04s — question says about 1900 at ship.

GMT:- Jan 19d 07h 33m 44s

GHA Y (19d 07h): 223° 03.7'	Sextant altitude: 43° 11.1'
Increment (33m 44s): 8° 27.4'	IE (off): (+) 1.3'
GHA Y: 231° 31.1'	Observed altitude: 43° 12.4'
Long(E): (+)170° 50.0'	Dip(HE-18m): (-) 7.5'
LHA Y: 42° 21.1'	Apparent altitude: 43° 4.9'
SHA BETELGEUSE: 271° 05.4'	Total correction: (-) 1.0'
LHA BETELGEUSE: 313° 26.5'	True altitude: 43° 3.9'
P: 46° 33.5'	ZD: 46° 56.1'
Declination BETELGEUSE: 7° 24.6' N	
Lat: 00° 02' N	

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec + \sin lat \cdot \sin dec$

$\cos CZD = \cos 46°33.5' \cdot \cos 00°02' \cdot \cos 7°24.6' + \sin 00°02' \cdot \sin 7°24.6'$

$\cos CZD = 0.682$

$CZD = 47\,00.2'$

$TZD = 46°\,56.1'$

Intercept = 4.1' Towards

$A = \dfrac{\text{Tan } lat}{\text{Tan } P}$ $\qquad B = \dfrac{\text{Tan } dec}{\sin P}$

$A = \dfrac{\text{Tan } 00°02'}{\text{Tan } 46°33.5'}$ $\qquad B = \dfrac{\text{Tan } 7°24.6'}{\sin 46°33.5'}$

$A = 0.0006\,S$ $\qquad B = 0.1791\,N$

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C = 0·1791 − 0·0006

C = 0·1785 N

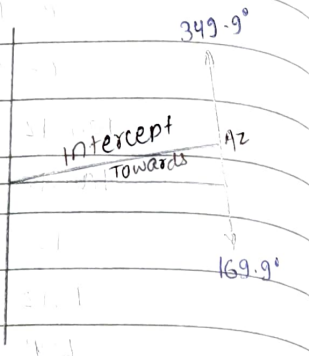
Tan Az = 1/C × cos lat

Tan Az = 1/0·1785 × cos 00°02'

Az = N 79.9° E

T Az = 79·9°

LOP − 169·9° − 349·9°



③ GMT : 11h 29m 20s ✓ so correct GMT

LIT(W) : 07h 09m 20s

LMT :- 04h 20m 00s ✓

↓

question says Am at ship

GMT : 29d 11h 29m 20s

GHA Y (29d 11h) : 233° 42·3'	Sextant altitude : 35° 10·3'
Increment (29m 20s) : 7° 21·2'	IE (On) : (−) 2·8'
GHA Y : 241° 03·5'	Observed altitude : 35° 7·5'
Long (W) : (+) 107° 20·0'	Dip (HE − 12m) : (−) 6·1'
LHA Y : 133° 43·5'	Apparent altitude : 35° 1·4'
SHA RIGEL : 281° 15·0'	Total corr. : (−) 1·4'
SHA RIGEL : 54° 58·5'	True altitude : 35° 00'
P : 54° 58·5'	TZD : 55° 00'
Declination RIGEL : 8° 11·4' S	Lat : 25° 30' S

cos CZD = cos P · cos lat · cos dec + sin lat · sin dec

cos CZD = cos 54°58.5' cos 25°30' · cos 8°11·4' + sin 25°30' · sin 8°11·4'

cos CZD = 0·574

CZD = 54° 57·9'

TZD = 55° 00·0'

Intercept = 2·1' Away

A = Tan lat / Tan P

A = Tan 25°30' / Tan 54°58.5'

A = 0·334 N

B = Tan dec / sin P

B = Tan 8°11·4' / sin 54°58·5'

B = 0·176 S

$C = 0.334 - 0.176$

$C = 0.158\ N$

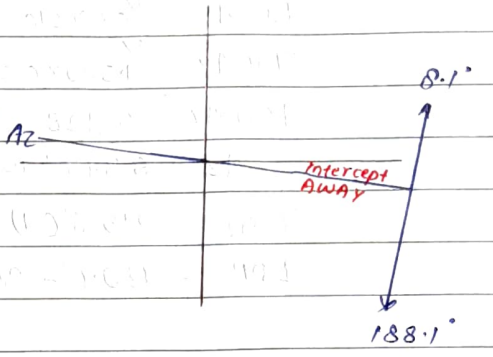
$\text{Tan } Az = 1/C \times \cos lat$

$\text{Tan } Az = 1/0.158 \times \cos 25°30'$

$Az = N\,81.9\,W$

$T\,Az = 278.1°\,(T)$

$LOP = 8.1° - 188.1°$



④ Chron time : 00h 21m 32s ✓

Error (fast) : (-) 01m 06s

GMT : 00h 20m 26s ✓

LMT (E) : (+) 04h 19m 44s

LMT : 04h 40m 10s — question says AM at ship, so this correct LMT

GMT :- 31d 00h 20m 26s

GHA ♈ (31d 00h) : 339° 32.7'	Sextant altitude : 21° 28.4'
Increment (20m 26s) : 5° 07.3'	IE (off) : (+) 0.9'
GHA ♈ : 344° 40.1'	Observed altitude : 21° 29.3'
Long (E) : (+) 64° 56.0'	DIP (HE - 09m) : (-) 5.3'
LHA ♈ : 49° 36.0'	Apparent altitude : 21° 24.0'
SHA DIPHDA : 348° 59.1'	Total correction : (-) 2.5'
SHA DIPHDA : 38° 35.1	True altitude : 21° 21.5'
P : 38° 35.1	TZD : 68° 38.5'
Declination DIPHDA : 17° 56.1's	Lat : 40° 30'N

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec - \sin lat \cdot \sin dec$

$\cos CZD = \cos 38°35.1' \cdot \cos 40°30' \cdot \cos 17°56.1' - \sin 40°30' \cdot \sin 17°56.1'$

$\cos CZD = 0.366$

$CZD = 68°33.6'$

$TZD = 68°38.5'$

4.9' AWAY

$A = \dfrac{\text{Tan lat}}{\text{Tan P}}$ $\qquad$ $B = \dfrac{\text{Tan dec}}{\sin P}$

$A = \dfrac{\text{Tan } 40°30'}{\text{Tan } 38°35.1'}$ $\qquad$ $B = \dfrac{\text{Tan } 17°56.1'}{\sin 38°35.1'}$

$A = 1.070\,S$ $\qquad$ $B = 0.519\,S$

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C = 1.070 + 0.519

C = 1.589 S

Tan Az = 1/C x cos lat

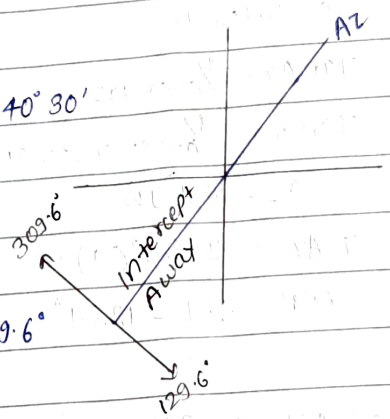
Tan Az = 1/1.589 x cos 40° 30'

Tan Az = 0.828

Az = S 39.6° W

T Az = 219.6° (T)

LOP = 129.6° - 309.6°



⑤ Chron time : 00h 46m 31s

Error (slow) : (+) 05m 01s

GMT : 00h 51m 32s (+12) 12h 51m 32s ← correct GMT

LIT(E) : (+) 06h 09m 48s (+) 06h 09m 48s

LMT : 07h 01m 20s (but question say PM) 19h 01m 20s ← correct LMT

GMT : Sep. 22d 12h 51m 32s

GHA Y (22d 12h) : 181° 43.3'	Sextant altitude : 25° 01'
Increment (51m 32s) : 12° 55.1'	IE (on) : (-) 0.2'
GHA Y : 194° 38.4'	Observed altitude : 25° 00.8'
Long (E) : (+) 92° 27.0'	Dip (HE - 17m) : (-) 7.3'
LHA Y 287° 05.4'	Apparent altitude : 24° 53.5'
SHA ARCTURUS : 145° 59.2'	Total corrn : (-) 2.1'
LHA ARCTURUS : 73° 04.6'	True alt : 24° 51.4'
P : 73° 04.6'	TZD : 65° 08.6'
Dec ARCTURUS : 19° 08.3' N	Lat : 60° 10' N

cos CZD = cos P · cos lat · cos dec + sin lat · sin dec

cos CZD = cos 73° 04.6' · cos 60° 10' · cos 19° 08.3' + sin 60° 10' · sin 19° 08.3'

cos CZD = 0.421

CZD = 65° 05.3'

TZD = 65° 08.6'

Intercept = 3.3' AWAY

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{sin P}}$

$A = \frac{\text{Tan } 60°10'}{\text{Tan } 73°04.6'}$ $B = \frac{\text{Tan } 19°08.3'}{\text{sin } 73°04.6'}$

A = 0.531 S B = 0.363 N

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C = A - B

C = 0·531 - 0·363

C = 0·168 S

Tan Az = 1/c x cos lat

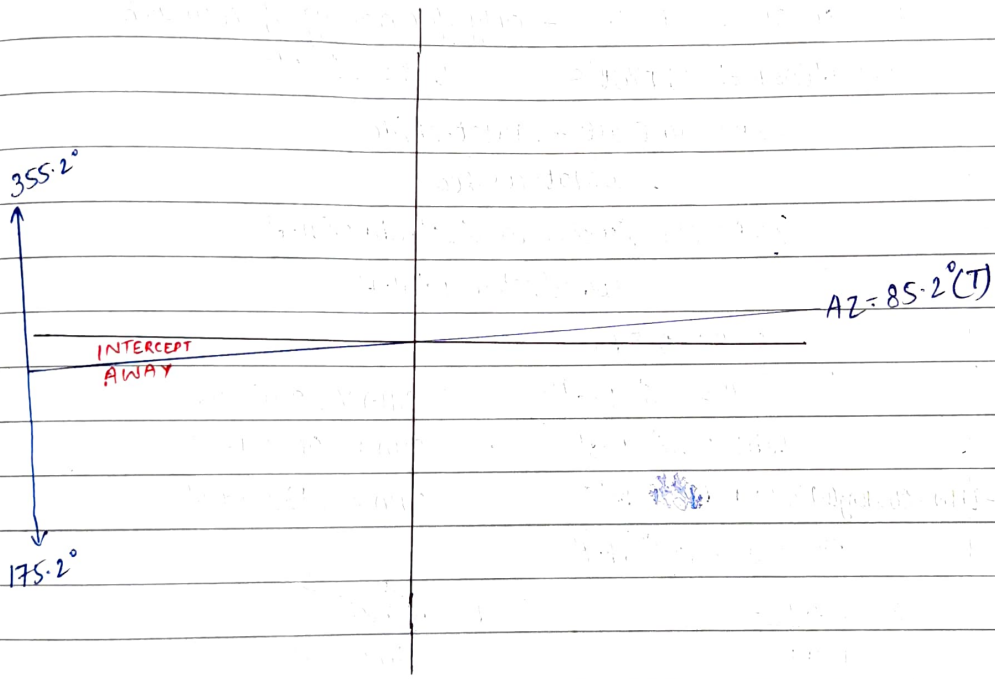
Tan Az = 1/0·168 x cos 60° 10'

Tan Az = 11·965

Az = S 85·2 W

T Az = 265·2° (T)

LOP = 175·2° - 355·2°



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~~EXERCISE-37~~

LONG BY CHRON STARS

No. 50

Date

①

GMT : 11h 29m 20s ✓

LIT(W) : (-)07h 09m 20s

LMT : 04h 20m 00s – question says AM at ship

GMT : Nov. 29d 11h 29m 20s

GHA ♈ (29d 11h) : 233° 42·3'	Sextant altitude : 35° 10·3'
Increment (29m 20s) : 7° 21·2'	IE (on) : (-) 2·8'
GHA ♈ : 241° 03·5'	Observed altitude : 35° 7·5'
Long (W) : (-)107° 20·0'	Dip (HE-12m) : (-) 6·1'
LHA ♈ : 133° 43·5'	Apparent altitude : 35° 1·4'
SHA RIGEL : 281° 15·0'	Total corrn : (-) 1·4'
	True altitude : 35° 0·0'

LHA RIGEL : 54° 58·5' – only for naming of Azimuth

Dec RIGEL : 08° 11·4's Lat : 25° 30's

$$\cos P = \frac{\sin T.alt - \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 35°00·0' - \sin 25°30' \cdot \sin 08°11·4'}{\cos 25°30' \cdot \cos 08°11·4'}$$

$\cos P = 0·573$

$P = 55° 0·8'$

LHA = 55° 0·8'

GHA ★ – LHA = Obs. long (W) GHA ★ = 162° 18·5'

Obs. long = 107° 17·7'

GHA ♈ : 241° 03·5'

SHA ★ : (+) 281° 15·0'

GHA ★ : 162° 18·5'

$$A = \frac{\tan lat}{\tan P} \qquad B = \frac{\tan dec}{\sin P}$$

$$A = \frac{\tan 25°30'}{\tan 55°0·8'} \qquad B = \frac{\tan 08°11·4'}{\sin 55°0·8'}$$

A = 0·334 N B = 0·176 S

C = 0·334 – 0·176

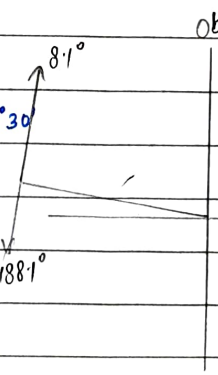
C = 0·158 N

Tan AZ = ½ 0·158 × cos 25°30

Az = N81·9°W

T Az = 278·1° (T)

LOP = 8·1° – 188·1°



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No. 51 Date 14.01.2022

e : 00h 46m 31s
E (SLOW) : (+) 05m 01s
GMT : 00h 51m 32s ✗ 12h 51m 32s ✓ correct GMT
LIT (E) : (+) 06h 09m 48s (+) 06h 09m 48s
LMT : 07h 01m 20s – question say PM at ship 19h 01m 20s

GMT : Sep 22d 12h 51m 32s

GHA Y (22d 12h) : 181° 43.3'
Increment (51m 32s) : 12° 55.1'
GHA Y : 194° 38.4'
SHA ARCTURUS : (+) 145° 59.2'
GHA ARCTURUS : 340° 37.6'
Long (E) : (+) 92° 27.0'
APPX LHA * : 73° 04.6' (for naming of Az)
DEC ARCTURUS : 19° 08.3' N

Sextant altitude : 25° 01'
IE (on) : 0.2'
Observed altitude : 25° 0.8'
Dip (HE – 17m) : (–) 7.3'
Apparent altitude : 24° 53.5'
Total corrn : (–) 2.1'
True altitude : 24° 51.4'
Lat : 60° 10' N

$$\cos P = \frac{\sin T\,alt - \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 24°51.4' - \sin 60°10' \cdot \sin 19°08.3'}{\cos 60°10' \cdot \cos 19°08.3'}$$

$\cos P = 0.289$

$P = 73° 11.2'$

$LHA = 73° 11.2'$

$GHA * = 340° 37.6'$

LHA – GHA * = Obs. long E
(bada – chota)

Obs long : 92° 34.2' E

$$A = \frac{\tan lat}{\tan P}$$

$$A = \frac{\tan 60°10'}{\tan 73°11.2'}$$

$A = 0.527$ S

$$B = \frac{\tan dec}{\sin P}$$

$$B = \frac{\tan 19°08.3'}{\sin 73°11.2'}$$

$B = 0.363$ N

$C = 0.527 - 0.363$

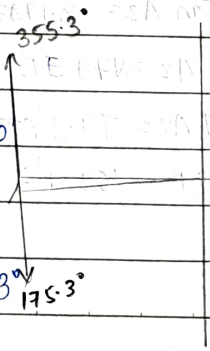
$C = 0.164$ S

$\tan Az = 1/0.164 \times \cos 60°10$

$Az = S\ 85.3'\ W$

$T\,Az = 265.3°\ (T)$

$LOP = 175.3° - 355.3°$



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③ GMT : 07h 33m 44s ✓ correct GMT

LIT(E) : (+) 11h 23m 20s

LMT : 18h 57m 04s — question says about 1900 at ship

GMT : Jan 19d 07h 33m 44s

GHA ♈ (19d 07h) : 223° 03.7'	Sextant altitude : 43° 11.1'
Increment (33m 44s) : 8° 27.4'	IE (Off) : (+) 3'
GHA ♈ : 231° 31.1'	Observed altitude : 43° 12.4'
SHA BETELGEUSE : 271° 05.4'	Dip (HE - 18 m) : (-) 7.5'
GHA BETELGEUSE : 142° 36.5'	Apparent altitude : 43° 4.9'
Long (E) : (+) 170° 50.0'	Total corrn : (-) 1.0'
Approx. LHA : 313° 26.5'	True altitude : 43° 3.9'
Dec BETELGEUSE : 7° 24.6' N	Lat : 00° 02' N

$$\cos P = \frac{\text{sin T. alt} - \sin \text{lat} \cdot \sin \text{dec}}{\cos \text{lat} \cdot \cos \text{dec}}$$

$$\cos P = \frac{\sin 43° 3.9' - \sin 00° 02' \cdot \sin 7° 24.6'}{\cos 00° 02' \cdot \cos 7° 24.6'}$$

$\cos P = 0.689$

$P = 46° 29.3'$

LHA = 313° 30.8° (360° − P ⇒ 360° − 46° 29.3')

GHA ★ = 142° 36.5'

Long = 170° 54.2' E

LHA − GHA ★ = Long E

$$A = \frac{\text{Tan lat}}{\text{Tan P}} \qquad B = \frac{\text{Tan dec}}{\sin P}$$

$$A = \frac{\text{Tan } 00° 02'}{\text{Tan } 46° 29.3'} \qquad B = \frac{\text{Tan } 7° 24.6'}{\sin 46° 29.3'}$$

Obs. long

A = 0.0006S B = 0.1793N

C = 0.1793 − 0.0006

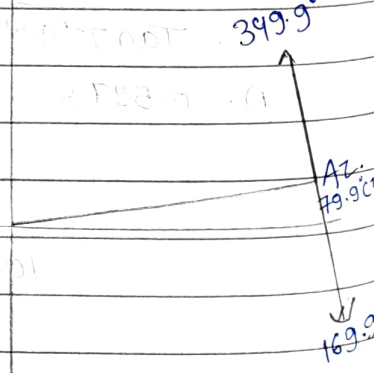
C = 0.1787N

Tan Az = 1/0.1787 × cos 00° 02'

Az = N79.9E DR lat

TAz = 79.9° (T)

LOP = 169.9° − 349.9°



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EXERCISE - 38

EX - MERIDIAN STAR

No. 53 Date 15.01.2022

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos DR\,lat \cdot \cos dec]$

① Chron time : 03h 59m 29s
Error (fast): (-) 05m 03s
GMT : 03h 54m 26s (OR) 12d 15h 54m 26s
LIT(W) : (-)10h 41m 20s (-) 10h 41m 20s
LMT : 11d 17h 13m 06s 05h 13m 06s

GMT : Sept 12d 15h 54m 26s

GHAY (12d 15h) : 216° 59.3'	Sextant altitude : 73° 09.5'
Increment (54m 26s) : 13° 38.7'	IE(On) : (-) 1.2'
GHAY : 230° 38.0'	Observed altitude : 73° 8.3'
Long (W) : (-)160° 20.0'	Dip(HE - 09m) : (-) 5.3'
LHA Y : 70° 18.0'	Apparent altitude : 73° 3.0'
SHA ALDEBARAN : 290° 53.4'	Total corrn : (-) 0.3' — N
LHA ALDEBARAN : 1° 11.4'	True altitude : 73° 2.7' N — S
P : 1° 11.4'	TZD : 16° 57.3' S
Dec ALDEBARAN : 16° 31.8' N	Lat : 00° 30' S

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 16°57.3' + [(1-\cos 1°11.4') \cdot \cos 00°30' \cdot \cos 16°31.8']$

$\cos MZD = 0.957$

MZD = 16° 54.9' S (same as TZD)

Dec = 16° 31.8' N

Obs lat = 0° 23.1' S

$A = \frac{Tan\ lat}{Tan\ P}$ $B = \frac{Tan\ dec}{sin\ P}$

$A = \frac{Tan\ 00°30'}{Tan\ 1°11.4'}$ $B = \frac{Tan\ 16°31.8'}{sin\ 1°11.4'}$

A = 0.420 N B = 14.290 N

C = 0.420 + 14.290

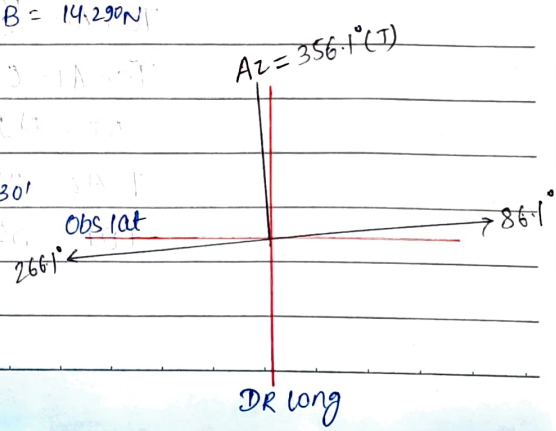
C = 14.71 N

Tan Az = 1/14.71 X cos 00°30'

Az = N3.9°W

T Az = 356.1°(T)

LOP = 86.1 - 266.1°



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Date

②

GMT :- 02d 10h 54m 20s
LIT(E) :- (+) 06h 50m 40s
02d 16h 45m 00s ✓ question says PM

GMT = 02d 10h 54m 20s

GHA Y (02d 10h) : 10° 41.5'	Sextant altitude : 17° 14.6'
Increment (54m 20s) : 13° 37.2'	IE (off) : (+) 3.6'
GHA Y : 24° 18.7'	Observed altitude : 17° 18.2'
Long (E) : (+) 102° 40.0'	Dip (HE - 12) : (-) 6.1'
LHA Y : 126° 58.7'	Apparent altitude : 17° 12.1'
SHA POLLUX : 243° 32.5'	Total corrn : (-) 3.1'
LHA POLLUX : 10° 31.2'	True altitude : 17° 9.0' N
P : 10° 31.2'	TZD : 72° 51.0' S
DEC POLLUX : 28° 00.5' N	Lat : 44° 11' S

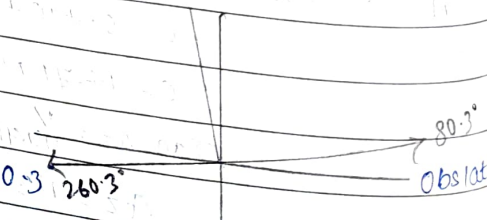
COS MZD = COS TZD + [(1 - COS P) · COS lat · COS dec]
COS MZD = COS 72° 51.0' + [(1 - COS 10° 31.2') · COS 44° 11' · COS 28° 00.5']
COS MZD = 0.306
MZD = 72° 12.6' S (same as TZD)
Dec = 28° 00.5' N
Obs lat = 44° 12.1' S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $\quad B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 44° 11'}{\text{Tan } 10° 31.2'}$ $\quad B = \frac{\text{Tan } 28° 00.5'}{\text{Sin } 10° 31.2'}$

A = 5.234 N $\quad$ B = 2.913 N

C = 5.234 + 2.913
C = 8.147 N
Tan Az = 1/C x cos lat
Tan Az = 1/8.147 x cos 44° 11'
Tan Az = 0.171
Az = N 9.7 W
T Az = 350.3° (T)
LOP = 80.3° - 260.3°



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(2)

Chron time : 20d 02h 04m 54s
Error(slow) : (+) 10m 58s
GMT : 20d 02h 15m 52s ✓ Correct GMT
LIT(E) : (+) 04h 19m 08s
LMT : 20d 06h 35m 00s ✓ bcz question says morning twilight

GMT = 20d 02h 15m 52s

GHA ♈ (20d 02h) : 148° 50·5'	Sextant altitude : 64° 58·8'
Increment (15m 52s) : 3° 58·7'	IE(Off) : (+) 3·1'
GHA ♈ : 152° 49·2'	Observed altitude : 65° 1·9'
Long (E) : (+) 64° 47·0'	Dip (HE - 18 m) : (-) 7·5'
LHA ♈ : 217° 36·2'	Apparent altitude : 64° 54·4'
SHA ARCTURUS : 145° 59·4'	Total correction : (-) 0·5'
LHA ARCTURUS : 3° 35·6'	True altitude : 64° 53·9' S
P : 3° 35·6'	TZD : 25° 06·1' N
Dec ARCTURUS : 19° 08·1' N	Lat : 44° 07' N

$\cos MZD = \cos TZD + [(1-\cos P)\cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 25°06.1' + [(1-\cos 3°35.6')\cdot \cos 44°07' \cos 19°08.1']$

$\cos MZD = 0.907$

MZD = 24° 55·3' N (same as TZD)

Dec : 19° 08·1' N

Obs lat : 44° 03·4' N

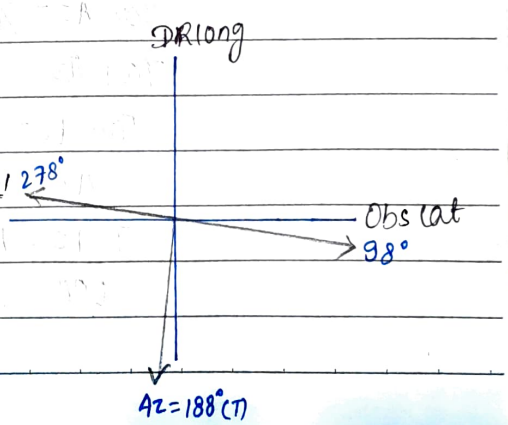
$A = \frac{\tan lat}{\tan P}$ $\quad A = \frac{\tan 44°07'}{\tan 3°35.6'}$ $\quad A = 15.441 S$

$B = \frac{\tan dec}{\sin P}$ $\quad B = \frac{\tan 19°08.1'}{\sin 3°35.6'}$ $\quad B = 5.536 N$

C = A - B
C = 15·441 - 5·536
C = 9·905 S

Tan Az = 1/C x cos lat
Tan Az = 1/9·905 x cos 44°07'
Az = S 8·0° W
T Az = 188·0° (T)

LOP = 98° - 278°



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④

GMT: ~~05~~ 06d 00h 22m 26s
LIT (W): (-) 05h 47m 20s (+12)
LMT: ~~04~~ 05d 18h 35m 06s

05d 12h 22m 26s
(-) 05h 47m 20s
05d 07

→ bcz question says 05 Mar 1835 at ship

GMT = 06d 00h 22m 26s

GHA Y (06d 00h): 164° 05.9'	Sextant altitude: 30° 35.2'
Increment (22m 26s): 5° 37.4'	IE (off): (+) 0.7'
GHA Y: 169° 43.3'	Observed altitude: 30° 35.9'
Long (W): (-) 86° 50'	DIP (HE - 14m): (-) 6.6'
LHA Y: 82° 53.3'	Apparent altitude: 30° 29.3'
SHA BETELGEUSE: 271° 05.5'	Total corrn: (-) 1.6'
LHA BETELGEUSE: 353° 58.8'	True alt: 30° 27.7' S
P: 06° 01.2'	TZD: 59° 32.3' N
Dec BETELGEUSE: 7° 24.5' N	Lat: 66° 40' N

COS MZD = COS TZD + [(1 - COS P) · COS lat · COS dec]

COS MZD = COS 59° 32.3' + [(1 - COS 06° 01.2') · COS 66° 40' · COS 7° 24.5']

COS MZD = 0.509

MZD = 59° 23.6' N (same as TZD)

Dec = 7° 24.5' N

Obs lat = 66° 48.1' N

$A = \frac{\text{Tan lat}}{\text{Tan P}}$

$A = \frac{\text{Tan } 66° 40'}{\text{Tan } 06° 01.2'}$

A = 21.983 S

$B = \frac{\text{Tan dec}}{\text{Sin P}}$

$B = \frac{\text{Tan } 7° 24.5'}{\text{Sin } 06° 01.2'}$

B = 1.240 N

C = 21.983 - 1.240

C = 20.743 S

Tan Az = 1/C x cos lat

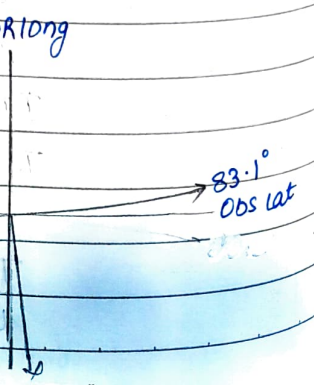
Tan Az = 1/20.743 x cos 66° 40'

Tan Az = 0.122

Az = S 6.9° E

T Az = 173.1° (T)

LOP = 83.1° - 263.1°



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(5)

Chron time : 21d 01h 15m 06s
Error (SlOw) : (+) 00m 04s
GMT : 21d 01h 15m 10s ✓ correct GMT
LIT (E) : (+) 04h 10m 00s
LMT : 21d 05h 25m 10s ✓ question says AM at ship

GMT :- Sept. 21d 01h 15m 10s

GHA Y (21d 01h) : 15° 17.1'	Sextant altitude : 23° 07.1'
Increment (15m 10s) : 3° 48.1'	IE : 0.0'
GHA Y : 19° 05.2'	Observed altitude : 23° 07.1'
Long (E) : (+) 62° 30.0'	Dip (HE - 10m) : (-) 5.6'
LHA Y : 81° 35.2'	Apparent altitude : 23° 1.5'
SHA CAPELLA : 280° 39.6'	Total corrn : (-) 2.3'
LHA CAPELLA : 02° 14.8'	True altitude : 22° 59.2' N
P : 02° 14.8'	TZD : 67° 0.8' S
Dec CAPELLA : 46° 00.4' N	Lat : 20° 50.0' S

$\cos MZD = \cos TZD + [(1 - \cos 02°14.8') \cdot \cos 20°50' \cdot \cos 46°00.4']$

$\cos MZD = \cos 67°0.8' + [(1 - \cos 02°14.8') \cdot \cos 20°50' \cdot \cos 46°00.4']$

$\cos MZD = 0.391$

MZD = 66°58.9' S (same as TZD)

Dec = 46°00.4' N

Obs Lat = 20°58.5' S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$

$A = \frac{\text{Tan } 20°50.0'}{\text{Tan } 02°14.8'}$

A = 9.700 N

$B = \frac{\text{Tan dec}}{\text{Sin P}}$

$B = \frac{\text{Tan } 46°00.4'}{\text{Sin } 02°14.8'}$

B = 26.422 N

C = 9.700 + 26.422

C = 36.122 N

Tan Az = 1/C x cos lat

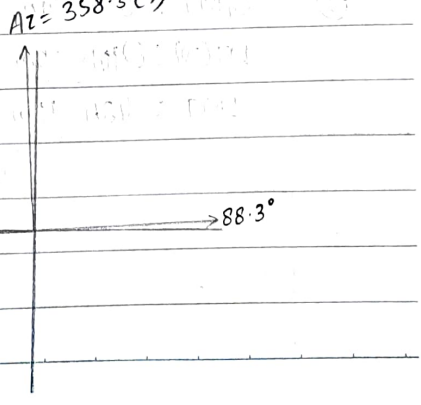
Tan Az = 1/36.122 x cos 20°50.0'

Tan Az = 0.030

Az = N 1.7 W

T Az = 358.3° (T)

LOP = 88.3° − 268.3°



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EXERCISE-39

POLARIS

No. 58 Date 24

① Chron time : 08h 51m 15s
Error slow : (+) 05m 11s
GMT : 08h 56m 26s (+12)
LIT(E) : (+)09h 33m 44s
LMT : 18h 30m 10s

30d 20h 51m 15s
(+) 05m 11s
30d 20h 56m 26s ✓ bcz question say morning of 1st dec.
(+) 09h 33m 44s
Old 06h 30m 10s

GMT = 30d 20h 56m 26s

GHA Y (30d 20h) : 010° 03·6'	Sextant altitude : 46° 50·7'
Increment (56m 26s) : 014° 08·8'	IE (Off) : (+) 2·1'
GHA Y : 024° 12·4'	Observed altitude : 46° 52·8'
Long (E) : (+)143° 26'	Dip (HE-17m) : (-) 7·3'
LHA Y : 167° 38·4'	Apparent altitude : 46° 45·5'
	Total. corrn : (-) 0·9'
	True altitude : 46° 44·6'

True altitude : 46° 44·6'
a_0 : (+)1° 24·2'
a_1 : (+)0° 0·6'
a_2 : (+)0° 0·2'
Sum : 48° 09·5'
Minus 1° : 1° 00·0'
Obs lat : 47° 09·5' (N) ← In polaris, always 'N'

CDMVT

T m C

True Az : 359·2°	
C Az : 005°	
Error : 5·8° W	269·2°
Var : 3·0° W	Obs lat
Dev : 2·8° W	

LOP - 89·2° - 269·2°

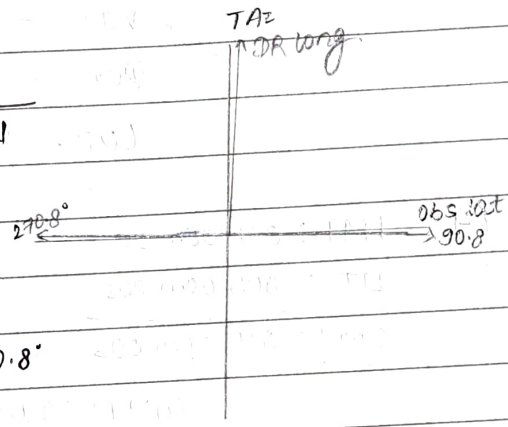
② GMT : 23 05h 21m 08s
LIT(W) : (-)10h 40m 48s
LMT : 22d 18h 40m 20s ✓ question says 22 evening

GMT : Sep. 23d 05h 21m 08s

GHA Y (23d 05h) : 77° 25.2'	Sextant altitude : 36° 18.6'
Increment (2m 08s) : 5° 17.9'	IE (on) : (-) 2.8'
GHA Y : 82° 43.1	Observed altitude : 36° 15.8'
Long (W) : (-) 160° 12.0'	DIP (HE - 10m) : (-) 5.6'
LHA Y : 282° 31.1'	Apparent altitude : 36° 10.2'
	Total corrn : (-) 1.3'
	True altitude : 36° 8.9'

True altitude : 36° 8.9'
a_0 : (+) 1° 18.9'
a_1 : (+) 0° 0.5'
a_2 : (+) 0° 0.9'
Sum : 37° 29.2'
Minus 1° : 1° 00.0'
Obs lat : 36° 29.2' N

True Az - 0.8° (T)
Gyro Az - 002° (G)
Gyro error - 1.2° (H)
LOP :- 90.8° - 270.8°



③ Chron time : 05h 30m 30s
Error : NIL
GMT : 05h 30m 30s
LIT (E) : (+) 10h 00m 00s
LMT : 15h 30m 30s

(OR)

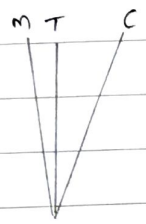
30d 17h 30m 30s
NIL
30d 17h 30m 30s
(+) 10h 00m 00s
01d 03h 30m 30s

GMT : April 30d 17h 30m 30s

GHA Y (30d 17h) : 114° 00.5'	Sextant altitude : 50° 46.8'
Increment (30m 30s) : 7° 38.8'	IE (NIL) : 0.0'
GHA Y : 121° 39.3'	Observed altitude : 50° 46.8'
Long (E) : (+) 150° 00.0'	DIP (HE - 14m) : (-) 6.6'
LHA Y : 271° 39.3'	Apparent altitude : 50° 40.2'
	Total corrn : (-) 0.8'
	True altitude : 50° 39.4'

True altitude : 50° 39.4'
a_0 : (+) 1° 25.2
a_1 : (+) 0° 0.6'
a_2 : (+) 0° 0.3'
Sum : 52° 05.5'
Minus 1° : 1° 00.0'
Obs lat : 51° 05.5'

C D M V T



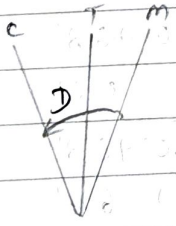
True Az - 0.9°
C Az - 005°
Error - 4.1° W
Var - 1° E
Dev - 5.1° W
LOP :- 90.9° - 270.9°

④ LMT : 02h 00m 00s
LIT : 00h 00m 00s
GMT : 02h 00m 00s

GMT : March 06d 02h 00m 00s

GHAY (06d 02h) : 194° 10.9'
Increment (00m 00s) : 0° 00.0'
GHA Y : 194° 10.9'
Long : 000° 00.0'
LHA Y : 194° 10.9'

C D M V T



True Az - 359.7° (T)
Compass Az - 358.0° (C)
Error - 1.7° E
Var - 1.7° W
Deviation - 3.4' W E

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Exercise 40 - Azimuth Planet No. 61 Date 02/02/2022

(1) LMT : 05d 22h 10m 00s
Dec long is E (-) 05h 00m 00s
GMT : 05d 17h 10m 00s

GMT : March 05d 17h 10m 00s

GHA Mars (05d 17h) : 328° 21·0'	Dec (05d 17h) : N 26° 10·7'
Increment (10m 00s) : 2° 30·0'	d (0·0) : 0·0'
V (1·6) : 0·3'	Dec Mars : N 26° 10·7'
GHA Mars : 330° 51·3'	
Long (E) : (+) 78° 50·0'	Latitude : 36° 08' S
LHA Mars : 49° 41·3'	
P : 49° 41·3'	

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 36° 08'}{\text{Tan } 49° 41.3'}$ $B = \frac{\text{Tan } 26° 10.7'}{\sin 49° 41.3'}$

A = 0.619 N B = 0.645 N

C = A + B

C = 0.619 + 0.645

C = 1.264 N

Tan Az = 1/C x cos lat

Tan Az = 1/1.264 x cos 36° 08'

Az = N 44.4 W

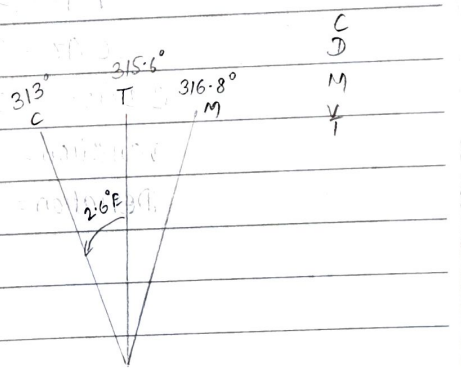
T Az = 315.6°

C Az = 313°

C Error = 2.6° E

variation = 1.2° W

Deviation = 3.8° E



(2) Chron time : 05h 43m 34s
Error (slow) : (+) 04m 06s
GMT : 05h 47m 40s (OR) 17h 47m 40s
LIT (E) : (+) 04h 02m 40s (+) 04h 02m 40s
LMT : 09h 50m 20s 21h 50m 20s ✓ question says PM at ship

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GMT: Apr. 28d 17h 47m 40s

GHA Saturn (28d 17h) : 317° 40·2′	Dec. Saturn (28d 17h) : 12° 33·4′ N
Increment (47m 40s) : 11° 55·0′	d(0·0) : 0·0
v(2·5) : 2·0′	Declination Saturn : 12° 33·4′ N
GHA Saturn : 329° 37·2′	
Long(E) : (+) 60° 40·0′	Latitude : 40° 26′ N
LHA Saturn : 30° 17·2′	
P : 30° 17·2′	

$$A = \frac{\text{Tan lat}}{\text{Tan P}} \qquad B = \frac{\text{Tan dec}}{\text{Sin P}}$$

$$A = \frac{\text{Tan } 40^\circ 26'}{\text{Tan } 30^\circ 17{\cdot}2'} \qquad B = \frac{\text{Tan } 12^\circ 33{\cdot}4'}{\text{Sin } 30^\circ 17{\cdot}2'}$$

A = 1·459S B = 0·442N

C = A − B

= 1·459 − 0·442

= 1·017S

Tan Az = 1/C × cos lat

Tan Az = 1/1·017 × cos 40° 26′

Az = S 52·3 W

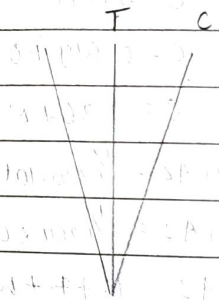
T Az = 232·3° (T)

C Az = 235° (C)

C Error = 2·7° W

variation = 1·0° E

Deviation = 3·7° W



C D M V T

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Exercise 41 - Lat by mer. alt planet No. 63 Date 02/02/2022

① Approx. LMT mer. pass SATURN : 06h 51m 00s
LIT(W) : (+)02h 57m 12s
Approx. GMT mer. pass SATURN : 09h 48m 12s
Dec (29d 09h) : 05° 23·2' N
d(0·0) : 0·0'
Dec saturn : 05° 23·2' N
Sextant altitude : 43° 12·9'
IE (off) : (+) 2·1'
Observed altitude : 43° 15·0'
Dip (HE = 18m) : (-) 7·6'
Apparent altitude : 43° 7·4'
Corrn : (-) 1·0'
True altitude : 43° 6·4' S
MCD : 46° 53·6' N
Dec : 05° 23·2' N
Latitude : 52° 16·8' N
LOP : E-W

Since,
At mer. pass, LHA = 360°
GHA - long (W) = 360°
GHA - 44° 18' = 360°
GHA = 44° 18'
GHA SATURN = 44° 18·0'
GHA (29d 09h) = 31° 18·3'
Increment = 12° 59·7' = 51m 59s
Precise time of mer. pass = NOV. 29d 09h 51m 59s

② Approx. LMT of mer. pass JUPITER : 18h 48m 00s
LIT(E) : (-)06h 40m 40s
Approx. GMT of mer. pass JUPITER : 12h 07m 20s
Dec JUPITER (23d 12h) : 023° 7·9'
d(0·0) : 0·0'
Dec JUPITER : 23° 07·9' S

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Sextant altitude: 21° 32·2'
IE (on): (-) 1·7'
Observed altitude: 21° 30·5'
Dip (HE-13m): (-) 6·4'
Apparent altitude: 21° 24·1'
Corrn: (+) 2·5'
True altitude: 21° 21·6' S
MZD: 68° 38·4' N
Dec: 23° 07·9' S
Latitude: 45° 30·5' N
LOP: E-W

④

Approx LMT of mer. pass JUPITER: 04h 58m 00s
LIT (W): (+) 08h 42m 52s
Approx GMT of mer. pass JUPITER: 13h 40m 52s
Declination JUPITER (30d 13h): 21° 37·8' S
d (0·0): 0·0'
Declination JUPITER: 21° 37·8' S
Sextant altitude: 48° 20·5'
IE (on): (-) 0·7'
Observed altitude: 48° 19·8'
Dip (HE-12m): (-) 6·1'
Apparent altitude: 48° 13·8'
Corrn: (-) 0·9'
True altitude: 48° 12·9' S
MZD: 41° 47·2' N
Dec: 21° 37·8' S
Latitude: 20° 09·4' N
LOP: E-W

⑤

Approx LMT of mer. pass MARS: 19h 06m 00s
LIT (E): (-) 02h 42m 28s
Approx GMT of mer pass MARS: 16h 23m 32s

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Declination Mars (06d 16h): 26° 09.6' N

d(0.0): 0.0'

Declination Mars: 26° 09.6' N

Sextant altitude: 43° 19.6'

IE (On): (-) 1.4'

Observed altitude: 43° 18.2'

Dip (HE-18 m): (-) 7.5'

Apparent altitude: 43° 10.7'

Corrn: (-) 1.0'

True altitude: 43° 09.7' N

MZD: 46° 50.3' S

Dec: 26° 09.6' N

Latitude: 20° 40.7' S

LOP: E-W

Exercise - 42 - Intercept Planet

① GMT : 14h 51m 07s
LIT(W) : (-)09h 20m 48s
LMT : 05h 30m 19s ✓ correct bcz ques says AM at ship

GMT : Mar 02d 14h 51m 07s

GHA Jupiter (02d 14h) : 83° 31·2'	Sextant altitude : 46° 13·8'
Increment (51m 07s) : 12° 46·8'	IE (Off) : (+) 3·2'
v (2·0) 1·7'	Observed altitude : 46° 17·0'
GHA Jupiter : 96° 19·7'	Dip (HE - 20m) : (-) 7·9'
Long (w) : (-) 140° 12·0'	Apparent altitude : 46° 9·1'
LHA Jupiter : 316° 07·7'	Corrⁿ : (-) 0·9'
P : 43° 52·3'	True altitude : 46° 8·2'
Dec (02d 14h) : 22° 25·1's	TZD : 43° 51·8'
d (0·0) : 0·0'	
Dec JUPITER : 22° 25·1's	
Latitude : 09° 42's	

cos CZD = cos P · cos lat · cos dec + sin lat · sin dec

cos CZD = cos 43° 52·3' · cos 09° 42' · cos 22° 25·1' + sin 09° 42' · sin 22° 25·1'

cos CZD = 0·721

CZD = 43° 51·8'

TZD = 43° 51·8'

INTERCEPT = 0·0'

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 09° 42'}{\text{Tan } 43° 52·3'}$ $B = \frac{\text{Tan } 22° 25·1'}{\sin 43° 52·3'}$

A = 0·178 N B = 0·595 S

C = B - A

= 0·595 - 0·178

= 0·417 S

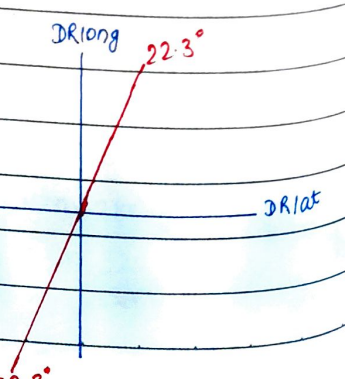
Tan Az = 1/C x cos lat

Tan Az = 1/0·417 x cos 09° 42'

Az = S67·7° E

TAz = 112·3° (T)

LOP : 22·3 - 202·3°



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: 09h 46m 19s
Error (fast) : (-) 01m 40s
GMT : 09h 44m 39s (OR) +12 21h 44m 39s ✓ correct bcz
LIT (W) : (-) 02h 41m 20s (-) 02h 41m 20s question says
LMT : 07h 03m 19s 19h 03m 19s ✓ PM at ship

GMT : Jan 18d 21h 44m 39s

GHA Mars (18d 21h) : 348° 12.7'	Sextant altitude : 39° 06.1'
Increment (44m 39s) : 11° 09.8'	IE (on) : (-) 1.2'
v (3.0) : 2.2'	Observed altitude : 39° 4.9'
GHA Mars : 359° 24.7'	Dip (HE - 21m) : (-) 8.1'
Long (W) : (-) 40° 20.0'	Apparent altitude : 38° 56.8'
LHA Mars : 319° 04.7'	Corrn : (-) 1.2'
P : 40° 55.3'	True altitude : 38° 55.6'
Dec Mars (18d 21h) : 26° 52.9' N	TZD : 51° 04.4'
d (0.0) : 0.0'	
Declination Mars : 26° 52.9' N	Lat : 05° 18' S

$\cos ZD = \cos P \cdot \cos lat \cdot \cos dec - \sin lat \cdot \sin dec$

$\cos ZD = \cos 40°55.3' \cdot \cos 05°18' \cdot \cos 26°52.9' - \sin 05°18' \cdot \sin 26°52.9'$

$\cos ZD = 0.629$

$ZD = 51° 00.0'$

$TZD = 51° 04.4'$

Intercept = 4.4' AWAY

$A = \frac{\tan lat}{\tan P}$ $B = \frac{\tan dec}{\sin P}$

$A = \frac{\tan 05°18'}{\tan 40°55.3'}$ $B = \frac{\tan 26°52.9'}{\sin 40°55.3'}$

$A = 0.107 N$ $B = 0.774 N$

$C = A + B$

$C = 0.107 + 0.774$

$C = 0.881 N$

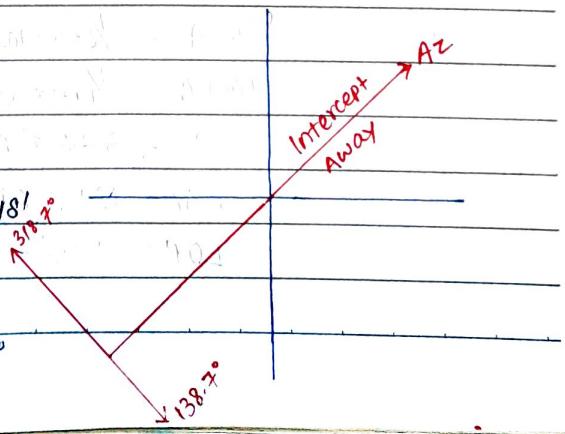
$\tan Az = 1/C \times \cos lat$

$\tan Az = 1/0.881 \times \cos 05°18'$

$Az = N 48.7° E$

$T Az = 48.7° (T)$

$LOP = 138.7° - 318.7°$



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04

GMT : 15d 23h 25m 28s
LIT(E) : (+) 07h 04m 56s
LMT : 16d 06h 30m 24s

GMT: Jan 15d 23h 25m 28s

GHA VENUS (15d 23h) : 200° 30.0'	Sextant altitude : 20° 05.6'
Increment (25m 28s) : 6° 22.0'	IE(off) : (+) 1.3'
v(-0.8) : (-) 0.3'	Observed altitude : 20° 06.9'
GHA VENUS : 206° 51.7'	Dip(HE-14m) : (-) 6.6'
Long(E) : (+) 106° 14.0'	Apparent altitude : 20° 0.3'
LHA VENUS : 313° 05.7'	Corrn : (-) 2.6'
P : 46° 54.3'	True altitude : 19° 57.7'
Dec VENUS (16d 23h) : 21° 41.0' S	TZD : 70° 02.3'
d(0.3) : (+) 0.1'	
Declination VENUS : 21° 41.1' S	Lat : 32° 16' N

$\cos ZD = \cos P \cdot \cos lat \cdot \cos dec - \sin lat \cdot \sin dec$

$\cos ZD = \cos 46°54.3' \cdot \cos 32°16' \cdot \cos 21°41.1' - \sin 32°16' \cdot \sin 21°41.1'$

$\cos ZD = 0.340$

$ZD = 70° 09.0'$

$TZD = 70° 02.3'$

Intercept = 6.7' TOWARDS

$A = \frac{\tan lat}{\tan P}$ $\quad B = \frac{\tan dec}{\sin P}$

$A = \frac{\tan 32°16'}{\tan 46°54.3'}$ $\quad B = \frac{\tan 21°41.1'}{\sin 46°54.3'}$

$A = 0.591$ S $\quad B = 0.545$ S

$C = A + B$

$C = 0.591 + 0.545$

$C = 1.136$ S

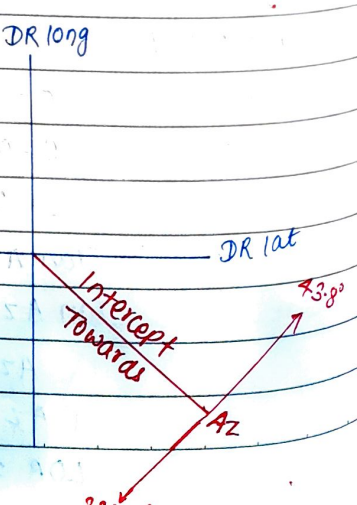
$\tan Az = 1/C \times \cos lat$

$\tan Az = 1/1.136 \times \cos 32°16'$

$Az = S\ 46.2°\ E$

$T\ Az = 133.8°\ (T)$

$LOP = 43.8° - 223.8°$



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GMT : 05d 17h 12m 36s ✓ correct because
LIT(W) : (-) 11h 59m 52s question says
LMT : 05d 05h 12m 44s ✓ AM at ship

GMT: March 05d 17h 12m 36s

GHA JUPITER (05d 17h) : 131° 01.6'	Sextant altitude : 48° 47.9'
Increment (12m 36s) : 3° 09.0'	IE (Off) : (+) 0.2'
V(2.0) : 0.4'	Observed altitude : 48° 48.1'
GHA JUPITER : 134° 11.0'	Dip (HE-17m) : (-) 7.3'
Long (W) : (-) 179° 58.0'	Apparent altitude : 48° 40.8'
LHA JUPITER : 314° 13.0'	Corrn : (-) 0.9'
P : 45° 47.0'	True altitude : 48' 39.9'
Dec JUPITER (05d 17h) : 22° 21.5'S	TZD : 41° 20.1'
d (0.0) : 0.0'	
Dec JUPITER : 22° 21.5'S	Latitude : 30° 22'S

cos CZD = cos P · cos lat · cos dec + sin lat sin dec

cos CZD = cos 45° 47.0' · cos 30° 22' · cos 22° 21.5' + sin 30° 22' · sin 22° 21.5'

cos CZD = 0.749

CZD = 41° 30.9'

TZD = 41° 20.1'

INTERCEPT = 10.8' TOWARDS

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{sin P}}$

$A = \frac{\text{Tan } 30° 22'}{\text{Tan } 45° 47.0'}$ $B = \frac{\text{Tan } 22° 21.5'}{\text{sin } 45° 47.0'}$

A = 0.570N B = 0.574S

C = 0.574 − 0.570

C = 0.004S

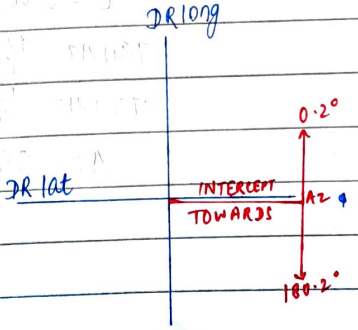
Tan Az = 1/C x cos lat

Tan Az = 1/0.004 x cos 30° 22'

Az = S 89.8° E

TAz = 90.2° (T)

COP = 0.2° − 180.2° (T)



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Exercise 43 - Long by chron planet

No. 70

Date 19

(1)

GMT : 05d 17h 12m 36s

GHA Jupiter (05d 17h)	131° 01·6′	Sextant altitude	48° 47·9′
Increment (12m 36s)	(+) 3° 09·0′	IE (off)	(+) 0·2′
v (2·0)	(+) 0·4′	Observed altitude	48° 48·1′
GHA JUPITER	134° 11·0′	Dip (HE-17m)	(−) 7·3′
Long (W)	179° 58·0′		
LHA	314° 13·0′		
Dec JUPITER (05d 17h)	22° 21·5′ S	Apparent altitude	48° 40·8′
d (0·0)	0·0′	Total corn	(−) 0·9′
Dec JUPITER	22° 21·5′ S	True altitude	48° 39·9′

$$\cos P = \frac{\sin T \cdot alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 48°39·9′ - \sin 30°22′ \cdot \sin 22°21·5′}{\cos 30°22′ \cdot \cos 22°21·5′}$$

$\cos P = 0·699995$

$P = 45°34·4′$

$LHA = 360° - P$

$= 360° - 45°34·4′$

$LHA = 314°25·6′$

$GHA = 134°11·0′$

$Obs\ long = 179°45·4′ W$

LMT mer. pass : 8h 17m
LMT of sight : 05h 12m
Sight is taken before mer. pass
So, LHA = 360° − P

GHA − LHA = Obs. long W
(bada) (chota)

$A = \frac{Tan\ lat}{Tan\ P}$ $\qquad$ $B = \frac{Tan\ dec}{Sin\ P}$

$A = \frac{Tan\ 30°22′}{Tan\ 45°34·4′}$ $\qquad$ $B = \frac{Tan\ 22°21·5′}{Sin\ 45°34·4′}$

$A = 0·574\ N$ $\qquad$ $B = 0·576\ S$

$C = B - A$

$C = 0·576 - 0·574$

$C = 0·002S$

$Tan\ Az = 1/C \times cos\ lat$

$Tan\ Az = 1/0·002 \times \cos 30°22′$

$Az = S89·9E$

Answer not coming

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GMT: Tan 16d 23h 25m 28s

GHA Venus (16d 23h): 200° 30·0′	Sextant altitude: 20° 05·6′
Increment (25m 28s): (+) 6° 22·0′	IE (off): (+) 1·3′
V (−0·8): (−) 0·3′	Observed altitude: 20° 06·9′
GHA Venus: 206° 51·7′	Dip (HE-14m): (−) 6·6′
Long (E): (+) 106° 14·0′	Apparent altitude: 20° 0·3′
LHA Venus: 313° 05·7′	Total corrⁿ: (−) 2·6′
Dec Venus (16d 23h): 21° 41·0′ S	True altitude: 19° 57·7′
d (0·3): 0·1′	
Dec Venus: 21° 41·1′ S	Latitude: 32° 16′ N

$$\cos P = \frac{\sin T\,alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 19°57.7' + \sin 32°16' \cdot \sin 21°41.1'}{\cos 32°16' \cdot \cos 21°41.1'}$$

$\cos P = 0.685546$

$P = 46° 43.3'$

LMT mer. pass = 9h 39m
LMT of sight = 06h 30m
Sight is taken before mer. pass
So, LHA = 360° − P

LHA − GHA = Obs. long E
(bada) (chota)

$LHA = 360° - P$

$= 360° - 46°43.3'$

$LHA = 313° 16.7'$

$GHA = 206° 51.7'$

$Obs\ long = 106° 25.0' E$

$A = \frac{Tan\ lat}{Tan\ P}$

$A = \frac{Tan\ 32°16'}{Tan\ 46°43.3'}$

$A = 0.595$ S

$B = \frac{Tan\ dec}{sin\ P}$

$B = \frac{Tan\ 21°41.1'}{sin\ 46°43.3'}$

$B = 0.546$ S

$C = A + B$

$C = 0.595 + 0.546 = 1.141$ S

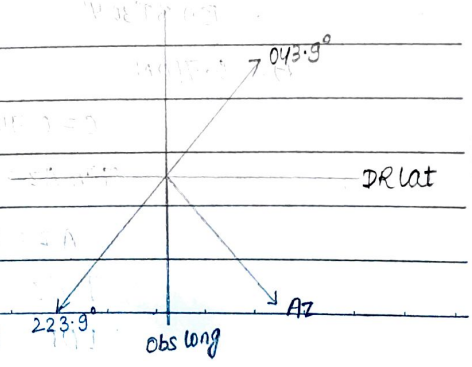
(a) $Tan\ Az = 1/C \times cos\ lat$

$Tan\ Az = 1/1.141 \times \cos 32°16'$

$Az = S46.1°E$

$T\ Az = 133.9°$

$LDP = 043.9° - 223.9°$



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③

Chron time : 09h 33m 21s
Error : (+) 01m 10s
GMT : 09h 34m 31s (+12) 29d 21h 34m 31s
LIT(E) : (+)06h 40m 48' (+) 06h 40m 48s
LMT : 16h 15m 19s 30d 04h 15m 19s ✓ bcz ques say morning of 30th

GMT: Nov 29d 21h 34m 31s

GHA (29d 21h) : 211° 46·2'	Sextant altitude : 38° 08·1'
Increment (34m 31s) : 8° 37·8'	IE(off) : (+) 1·4'
v(2·3) : 1·3'	Observed altitude: 38° 9·5'
GHA Saturn : 220° 25·3'	Dip(HE-22m) : (-) 8·3'
Long (E) : (+)100° 12·0'	Apparent altitude: 38° 1·2'
LHA Saturn : 320° 37·3'	Total corr^n: (-) 1·2'
Dec (29d 21h) : 5° 22·7'N	True altitude: 38° 00·0'
d(0·0) : 0·0'	
Declination SATURN: 5° 22·7'N	Latitude : 30° 20'S

$$\cos P = \frac{\sin T\,alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 38°0.0' + \sin 30°20' \cdot \sin 5°22.7'}{\cos 30°20' \cdot \cos 5°22.7'}$$

$\cos P = 0.771555$

$P = 39° 30.4'$

LMT mer pass = 06h 51m
LMT sight taken: 04h 15m
Sight is taken before mer. pass
So, LHA = 360° - P

$LHA = 360° - P$

$= 360° - 39°30.4'$

$LHA = 320° 29.6'$

$GHA = 220°25.3'$

Obs long : 100° 04·3' E

LHA - GHA = Obs. long E

$A = \frac{Tan\,lat}{Tan\,P}$

$A = \frac{Tan\,30°20'}{Tan\,39°30.4'}$

$A = 0.710N$

$B = \frac{tan\,dec}{sin\,P}$

$B = \frac{Tan\,5°22.7'}{Sin\,39°30.4'}$

$B = 0.148N$

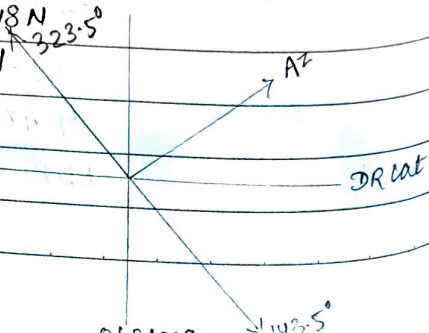
$C = 0.710 + 0.148 = 0.858N$

$Tan\,Az = \frac{1}{0.858 \times \cos 30°20'}$

$Az = N\,53.5°E$

$T\,Az = 53.5°(T)$

$LOP = 143.5° - 323.5°$



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GMT: March 02d 14h 51m 07s

GHA Jupiter (02d 14h): 83° 31.2'	Sextant altitude: 46° 13.8'
Increment (51m 07s): 12° 46.8'	IE (off): (+) 3.2'
V(2.0): 1.7'	Observed altitude: 46° 17.0'
GHA JUPITER: 96° 19.7'	Dip (HE - 20m): (-) 7.9'
Long (W): 140° 12.8'	Apparent altitude: 46° 9.1'
LHA JUPITER: 316° 07.6	Total corr: (-) 0.9'
Dec JUPITER (02d 14h): 22° 25.1'S	True altitude: 46° [redacted] 8.2'
d (0.0): 0.0'	
Dec JUPITER: 22° 25.1'S	Latitude: 09° 42'S

09h 20m 48s

$$\cos P = \frac{\sin T\,alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 46° 8.2' - \sin 09° 42' \cdot \sin 22° 25.1'}{\cos 09° 42' \cdot \cos 22° 25.1'}$$

$\cos P = 0.720734$

$P = 43° 53.1°$

LMT mer pass: 09h 27m
LMT at sight: 05h 30m
Sight is taken before mer. pass
LHA = 360° - P

$LHA = 360° - P$

$= 360° - 43° 53.1°$

$LHA = 316° 06.9'$

$GHA = 096° 19.7'$

$Obs\ long = 140° 12.8' W$

GHA - LHA = Obs long W

$$A = \frac{Tan\ lat}{Tan\ P}$$

$$A = \frac{Tan\ 09° 42'}{Tan\ 43° 53.1'}$$

$A = 0.178N$

$$B = \frac{Tan\ dec}{\sin P}$$

$$B = \frac{Tan\ 22° 25.1'}{\sin 43° 53.1'}$$

$B = 0.595S$

$C = 0.595 - 0.178$

$C = 0.417S$

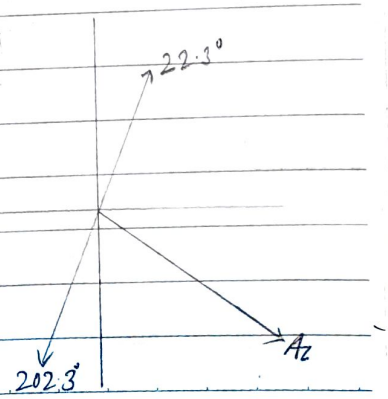
$Tan\ Az = 1/C \times \cos lat$

$Tan\ Az = 1/0.417 \times \cos 09° 42'$

[redacted] $Az = S\ 67.7\ E$

$T\ Az = 112.3°(T)$

$LOP = 22.3° - 202.3°$



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Exercise-44 - Ex meridian planet

①

GMT: Sep 23d 11h 47m 20s

GHA Jupiter (23d 11h): 243° 36·8'	Sextant altitude: 21° 24·9'
Increment (47m 20s): 11° 50·0'	IE (on): (-) 1·7'
v (2·3): 1·8'	Observed altitude: 21° 23·2'
GHA Jupiter: 255° 28·6'	Dip (HE -13m): (-) 6·4'
Long (E) (-) 100° 10·0'	Apparent altitude: 21° 16·8'
LHA JUPITER: 355° 38·6'	Total corrn: (-) 2·5'
P: 4° 21·4'	True altitude: 21° 14·3' S
Dec Jupiter (23d 11h): 23° 07·9' S	TZD: 68° 45·7' N
d (0·0): 0·0'	
Dec JUPITER: 23° 07·9' S	Latitude: 45° 27' N

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos DR\ lat \cdot \cos dec]$

$\cos MZD = \cos 68°45·7' + [(1-\cos 4°21·4') \cdot \cos 45°27' \cdot \cos 23°07·9']$

$\cos MZD = 0·364112$

MZD = 68° 38·8' N (same as TZD)

Dec = 23° 07·9' S

Obs lat = 45° 30·9' N

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{sin P}}$

$A = \frac{\text{Tan } 45°27'}{\text{Tan } 4°21·4'}$ $B = \frac{\text{Tan } 23°07·9'}{\text{Sin } 4°21·4'}$

A = 13·334 S B = 5·624 S

C = A + B

C = 13·334 + 5·624

C = 18·958 S

Tan Az = 1/C x cos lat

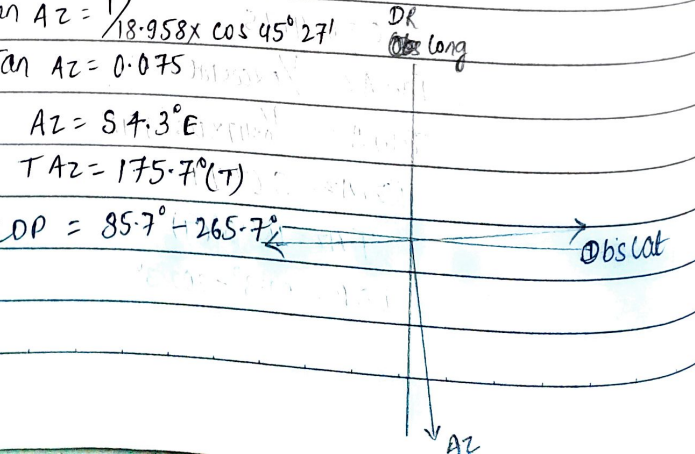
Tan Az = 1/18·958 x cos 45° 27'

Tan Az = 0·075

Az = S 4·3° E

T Az = 175·7° (T)

LOP = 85·7° - 265·7°



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No. 75 Date 19/02/2022

chron time : 09h 31m 30s
Error(fast) (-) 3m 18s
GMT : 09h 28m 12s
LIT(W) : (-)02h 57m 12s
LMT : 06h 31m 00s

GMT : NOV. 29d 09h 28m 12s

GHA SATURN (29d 09h) : 31° 18·3'	Sextant altitude : 42° 57·4'
Increment (28m 12s) : 7° 03·0'	IE(off) : (+) 2·1'
V(2·3) : 1·1'	Observed altitude : 42° 59·5'
GHA SATURN : 38° 22·4'	Dip(HE-18m) : (-) 7·5'
Long(W) : (-)44° 18·0'	Apparent altitude : 42° 52·0'
LHA SATURN : 354° 04·6'	Total corrn : (-) 1·0'
P : 5° 55·6'	Total altitude : 42° 51·0' S
Declination (29 09h) : 5° 23·2' N	TZD : 47° 09·0' N
d(0·0) : 0·0'	
Declination SATURN : 5° 23·2' N	Latitude : 52° 20·0' N

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 47° 09·0' + [(1-\cos 5° 55·6') \cdot \cos 52° 20' \cdot \cos 5° 23·2']$

$\cos MZD = 0·683333$

$MZD = 46° 53·7' N$

$Dec = 5° 23·2' N$

$Obs\ Lat = 52° 16·9' N$

$A = \frac{Tan\ lat}{Tan\ P}$

$A = \frac{Tan\ 52° 20'}{Tan\ 5° 55·6'}$

$A = 12·479S$

$B = \frac{Tan\ dec}{sin\ P}$

$B = \frac{Tan\ 5° 23·2'}{sin\ 5° 55·6'}$

$B = 0·913\ N$

$C = 12·479 - 0·913$

$C = 11·566\ S$

$Tan\ Az = 1/C \times cos\ lat$

$Tan\ Az = 1/11·566 \times cos\ 52° 20'$

$Az = S\ 8·1° E$

$T\ Az = 171·9° (T)$

$LOP = 81·9° - 261·9°$

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(5)

GMT: 30d 20h 02m 45s
LIT(E): (+) 08h 42m 52s

(OR)

29d 20h 02m 45s
(+) 08h 42m 52s
30d 04h 45m 37s

GMT: April 29d 20h 02m 45s

GHA ♃ JUPITER (29d 20h): 224° 08.4'	Sextant altitude: 48° 17.1'
Increment (02m 45s): 0° 41.3'	IE (On): (-) 0.7'
V (2.4): 0.1'	Observed altitude: 48° 16.4'
GHA JUPITER: 224° 49.8'	Dip (HE-12m): 6.1'
Long (E): (+) 130° 43.0'	Apparent altitude: 48° 10.3'
LHA JUPITER: 355° 32.8'	Total corrn: (-) 0.9'
P: 4° 27.2'	True altitude: 48° 9.4' S
Declination (29d 20h): 21° 37.9' S	TZD: 41° 50.6' N
d (0.0): 0.0'	
Declination JUPITER: 21° 37.9' S	Latitude: 20° 06' N

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 41°50.6' + [(1-\cos 4°27.2') \cdot \cos 20°06' \cdot \cos 21°37.9']$

$\cos MZD = 0.747607$

MZD = 41° 37.0' N (same as TZD)

Dec = 21° 37.9' S

Obs lat = 19° 59.1' N

$A = \frac{\tan lat}{\tan P}$ $\quad B = \frac{\tan dec}{\sin P}$

$A = \frac{\tan 20°06'}{\tan 4°27.2'}$ $\quad B = \frac{\tan 21°37.9'}{\sin 4°27.2'}$

A = 4.699S $\quad$ B = 5.107S

C = 4.699 + 5.107

C = 9.806 S

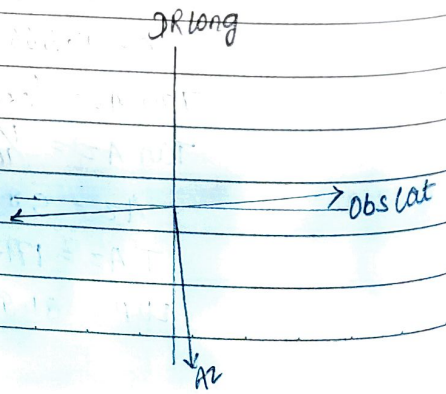
Tan Az = 1/C x cos lat

Tan Az = 1/9.806 x cos 20°06'

Az = S 6.2° E

T Az = 173.8° (T)

LDP = 83.8° − 263.8°



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③

GMT : 17h 30m 00s
LIT(E) : (-) 01h 11m 04s
GMT : 16h . . . .

GMT : Oct 13d 16h 30m 00s

GHA (13d 16h) : 259° 20·7'
Increment (30m 00s) : 7° 09·5'
v (11·9) : 6·0'
GHA moon : 266° 36·2'
long (E) : (+) 17° 46·0'
LHA moon : 284° 22·2'
P : 75° 37·8'

Dec (13d 16h) : 5° 32·5' N
d (15·8) : 8·0'
Declination Moon : 5° 40·5' N

Latitude : 20° 29'S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$

$A = \frac{\text{Tan } 20° 29'}{\text{Tan } 75° 37·8'}$

$A = 0·096\ N$

$B = \frac{\text{Tan dec}}{\sin P}$

$B = \frac{\text{Tan } 5° 40·5'}{\sin 75° 37·8'}$

$B = 0·103\ N$

$C = A + B$

$C = 0·096 + 0·103$

$C = 0·199\ N$

$\text{Tan } Az = 1/C \times \cos \text{lat}$

$\text{Tan } Az = 1/0·199 \times \cos 20° 29'$

$\text{Tan } Az = 5·364$

$Az = N\ 79°\ E$

Answer not coming

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Exercise 46 - RSAz moon No. 79 Date 19/02/2022

Approx LMT moonset : 15h 15m

Previous day LMT moonset : 14h 37m

Daily diff : 38m

Longitude corrⁿ = $\frac{\text{longitude} \times \text{daily diff}}{360^\circ}$

$= \frac{164.7^\circ \times 38}{360}$

$= 17m$

Approx LMT moonset : 02d 15h 15m

Longitude corrⁿ (long W) : (+) 17m

Correct LMT moonset : 02d 15h 32m

LIT (W) : (+) 10h 59m

GMT moonset : 03d 02h 31m

Dec (03d 02h) : 6° 34.2' N

d (16.4) : 8.6'

Dec moon : 6° 42.8' N

$\cos RSAz = \frac{\sin dec}{\cos lat}$

$\cos RSAz = \frac{\sin 6^\circ 42.8'}{\cos 20^\circ 12'}$

$\cos RSAz = 0.125$

S Az = (N) 82.8° (W)

(N) → same as dec

(W) → bcz it is setting moon

T Az = 277.2° (T)

G Az = 277°

Gyro Error = 0.2° L

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(2)

Approx LMT moonset : 08h 23m
Previous day LMT moonset : 07h 38m
Difference : 45m

Longitude corrn = $\frac{\text{Longitude} \times \text{diff}}{360^\circ}$

$= \frac{174.9 \times 45}{360}$

= 22m

Approx LMT moonset : 08h 23m
Long. corrn (long W) : (+) 22m
Correct LMT moonset : 08h 45m
LIT(W) : (+)11h 40m
GMT moonset : 20h 25m
Correct GMT moonset : July 21d 20h 24m

Dec. (21d 20h) : 5° 59.2' S
d(14.7) : (-) 6.0'
Declination Moon: 5° 53.2' S

Cos RSAz = $\frac{\sin dec}{\cos lat}$

COS RSAz = $\frac{\sin 5°53.2'}{\cos 00°01'}$

COS RSAz = 0.103
SAz = S 84.1° W
S Az = 264.1° (T)
C Az = 278.0'
Compass Error = 13.9° W
Variation = 15.5° W
Deviation = 1.6° E

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Approx LMT moonset : 05h 19m

Previous day LMT moonset : 04h 51m

Diff. : 28m

Longitude correction = $\frac{\text{Longitude} \times \text{diff.}}{360}$

$= \frac{74.2 \times 28}{360}$

$= 06m$

Approx LMT moonset : 05h 19m

Long corr. (Long E) : (-) 06m

Correct LMT moonset : 05h 13m

LIT (E) : (+) 04h 57m

Correct GMT moonset : 00h 16m

Correct GMT moonset : Sep 14d 00h 16m

Declination (14d 00h) : 8° 34.9' S

d (14.7') : (-) 4.0'

Declination MOON : 8° 30.9' S

$\cos RSAZ = \frac{\sin dec}{\cos lat}$

$\cos RSAZ = \frac{\sin 8° 30.9'}{\cos 35° 06'}$

(-) $\cos RSAZ = 0.181$

SAz = S 79.6° W

SAz = 259.6° (T)

Gn Az = 259°

Gyro Error = 0.6° L

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Exercise 47 - Lat by mer. alt moon

No. 82 Date 20/02

① always take ← upper (U) Approx. LMT mer pass : 14h 54m
previous day LMT mer. pass : 14h 05m
Difference : 49m

Longitude corrⁿ : $\frac{\text{longitude} \times \text{diff.}}{360^\circ}$

$= \frac{164.8 \times 49}{360}$

$= 22m$

Approx. LMT mer. pass : 14h 54m
long. corrⁿ (long E is '-') : (-) 22m
Correct LMT mer pass : 14h 32m
LIT (E) : (-) 10h 59m
GMT mer pass : 03h 33m

Correct GMT mer. pass : Dec old 03h 33m

Dec (old 03h) : 24° 33.2' S
d (6.1) : (-) 3.4'
Dec Moon : 24° 29.8' S

Sextant altitude : 74° 28.3'
IE (off) : (+) 1.7'
Observed altitude : 74° 30.0'
Dip (HE - 14m) : (-) 6.6'
Apparent altitude : 74° 23.4'
Main corrⁿ : (+) 25.9'
HP (54.1) : (+) 3.5' (UL)
Substract 30' from altitude of UL : (-) 30.0'
True altitude : 74° 22.8' N
MZD : 15° 37.2' S
Dec : 24° 29.8' S
Latitude : 40° 07.0' S
LDP : E-W

② (U) Approx LMT of mer. pass : 28d 06h 02m
previous day LMT of mer. pass : 05h 14m
Difference : 48m

Longitude corrⁿ = $\frac{\text{longitude} \times \text{diff.}}{360^\circ}$

$= \frac{96.6 \times 48}{360} = 13m$

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Approx LMT of mer. pass: 28d 06h 02m
Longitude corrn: (+) 13m (Long 'W'-'+')
Correct LMT of mer. pass: 28d 06h 15m
UT(W): (+) 06h 26m
GMT of mer. pass: 28d 12h 41m
GMT of mer. pass: April 28d 12h 41m
Sextant altitude: 31° 58.8' Dec (28 12h): 19° 49.6'S
IE(off): (+) 0.4' d(10.6): (-) 7.3'
Observed altitude: 31° 59.2' Dec Moon: 19° 42.3'S
Dip(HE-17m): (-) 7.3'
Apparent altitude: 31° 51.9'
Main corrn: (+) 58.1'
HP(55.8): (+) 2.9' (LL)
True altitude: 32° 52.9'S
MZD: 57° 07.1'N
Dec: 19° 42.3'S
Latitude: 37° 24.8'N
LOP: E-W

④ Approx LMT of mer. pass: 23d 04h 57m 17h 26m
Previous day LMT of mer. pass: 04h 02m 16h 29m
Difference: 55m 57m

Longitude correction: $\frac{\text{Longitude} \times \text{Difference}}{360^\circ}$

$= \frac{175.3 \times 5557}{360} = 27m \quad 28m$

Approx LMT of mer. pass: 23d 04h 57m 17h 26m
Longitude correction: (-) 27m (Long 'E'-'-') (-) 28m
Correct LMT of mer. pass: 23d 04h 30m 16h 58m
LIT(E): (-) 11h 41m (-) 11h 41m
GMT of mer. pass: 23d 16h 49m 05h 17m

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⑤ (v) Approx LMT of mer. pass : 22d 05h 54m
Previous day " " " " : 21d 04h 52m
Difference: 01h 02m

Longitude corrn : $\frac{\text{Longitude} \times \text{Diff}}{360^\circ}$

$= \frac{140.2 \times 62}{360} = 24m$

Approx LMT of mer. pass : 22d 05h 54m
Long corrn : (+) 24m (west '+')
Correct LMT of mer. pass : 22d 06h 18m
LIT (W) : (+) 09h 20m 48s
correct GMT of mer. pass : 22d 15h 38m 48s

Dec (22d 15h) : 26° 48.9'N
d (4.0) : (-) 2.6'
Declination moon : 26° 46.3'N

Sextant altitude : 81° 16.3'
IE (on) : (-) 0.6'
Observed altitude : 81° 15.7'
Dip (HE -10m) : (-) 5.6'
Apparent altitude : 81° 10.1'
Main corrn : (+) 19.4' (LL)
HP (59.1) : (+) 5.6' (LL)
True altitude : 81° 35.1'S
MZD : 8° 24.9'N
Dec : 26° 46.3'N
Lat : 35° 11.2'N
LOP : E-W

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Exercise 4.8 - Intercept moon No. 85 Date 28/02/2022

GMT: Oct 13d 17h 29m 05s

GHA (13d 17h)	273° 51.6'	Sextant altitude	23° 20.0'
Increment (29m 05s)	6° 56.1'	IE (off)	(+) 1.3'
v (11.9)	5.9'	Observed altitude	23° 21.3'
GHA moon	280° 53.6'	Dip (HE - 30m)	(-) 9.6'
Long (E)	(+) 017° 46.0'	Apparent altitude	23° 11.7'
LHA moon	298° 39.6'	Main corrn	(+) 1° 1.4'
P	61° 20.4'	HP (58.9')	(+) 6.4' (LL)
Dec (13d 17h)	5° 48.3' N	True altitude	24° 19.5'
d (15.8)	(+) 7.8'	TZD	65° 40.5'
Dec Moon	5° 56.1' N	Lat	20° 29' S

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec \pm \sin lat \cdot \sin dec$

$\cos CZD = \cos 61°20.4' \cdot \cos 20°29' \cos 5°56.1' - \sin 20°29' \sin 5°56.1'$

$\cos CZD = 0.411$

$CZD = 65°43.9'$

$TZD = 65°40.5'$

Intercept: 3.4' TOWARDS

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 20°29'}{\text{Tan } 61°20.4'}$ $B = \frac{\text{Tan } 5°56.1}{\sin 61°20.4'}$

$A = 0.204\ N$ $B = 0.118\ N$

$C = A + B$

$C = 0.204 + 0.118$

$C = 0.322\ N$

$\text{Tan } Az = 1/C \times \cos lat$

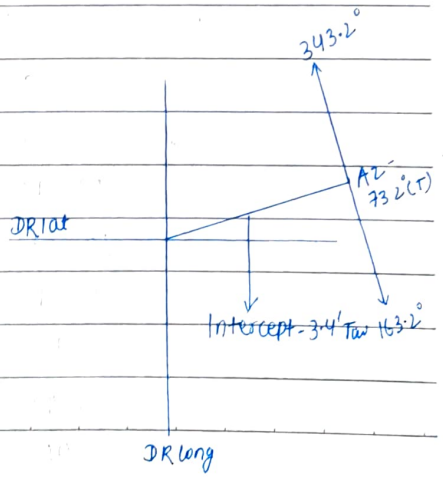
$\text{Tan } Az = 1/0.322 \times \cos 20°29'$

$\text{Tan } Az = 3.315$

$Az = N\ 73.2°E$

$T\ Az = 73.2°(T)$

$LOP = 163.2° - 343.2°(T)$



② Chron time : 06h 08m 05s
Error (slow) : (+) 00m 46s
GMT : 20d 06h 08m 51s
LT (W) : (-) 11h 41m 20s
LMT : 19d 18h 27m 31s

GMT : Jan 20d 06h 08m 51s

GHA (20d 06h) : 120° 25.4'	Sextant altitude : 31° 24.3'
Increment (08m 51s) : 2° 6.7' (V (2.5) : 0.4)	IE (on) : (-) 2.2'
GHA moon : 122° 32.5	Observed altitude : 31° 22.1'
Long (W) : (-) 175° 20.0'	Dip (HE-22m) : (-) 8.3'
LHA : 307° 12.5'	Apparent altitude : 31° 13.8'
P : 52° 47.5'	Main corrn : (+) 58.4'
Dec (20d 06h) : 27° 54.7' N	HP (59.8) : (+) 7.3'
d (1.4) : (-) 0.2'	True altitude : 32° 19.5'
Declination Moon : 27° 54.5' N	ZD : 57° 40.5'

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec \pm \sin lat \cdot \sin dec$

$\cos CZD = \cos 52° 47.5' \cdot \cos 00° 10' \cdot \cos 27° 54.5' + \sin 00° 10' \cdot \sin 27° 54.5'$

$\cos CZD = 0.536$

CZD = 57° 36.3'
TZD = 57° 40.5'
Intercept = 4.2' AWAY

$A = \frac{\tan lat}{\tan P}$ $B = \frac{\tan dec}{\sin P}$

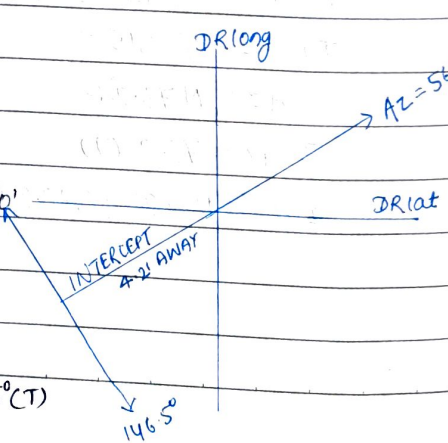
$A = \frac{\tan 00° 10'}{\tan 52° 47.5'}$ $B = \frac{\tan 27° 54.5'}{\sin 52° 47.5'}$

A = 0.002S B = 0.665N

C = B - A

C = 0.665 - 0.002
C = 0.663N

Tan Az = 1/C x cos lat
Tan Az = 1/0.663 x cos 00° 10'
Tan Az = 1.508
Az = N 56.5° E
T Az = 56.5° (T)
LOP = 146.5° - 326.5° (T)



GMT : 21d 23h 18m 02s

LIT(E) : (+) 09h 47m 20s

LMT : 22d 09h 05m 22s — bcz question say 22d AM at ship

GMT : Sep 21d 23h 18m 02s

GHA moon (21d 23h) : 260° 42.4'	Sextant altitude : 44° 49.1'
Increment (18m 02s) : 4° 18.2'	IE (Off) : (+) 0.9'
v (3.5) : 1.1'	Observed altitude : 44° 50.0'
GHA moon : 265° 1.8'	Dip (HE - 18m) : (-) 7.5'
LONG (E) : (+) 146° 50.0' ✓	Apparent altitude : 44° 42.5'
LHA moon : 51° 51.7'	Main corrn : (+) 50.7'
P : 51° 51.7'	HP (59.3) : (+) 6.6' (LL)
Dec (21d 23h) : 27° 26.5' N	True altitude : 45° 39.8'
d (0.9) : (-) 0.3'	TZD : 44° 20.2'
Declination Moon : 27° 26.2' N	Latitude : 36° 03' N

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec \pm \sin lat \cdot \sin dec$

$\cos CZD = \cos 51°51.7' \cdot \cos 36°03' \cdot \cos 27°26.2' + \sin 36°03' \cdot \sin 27°26.2'$

$\cos CZD = 0.7143$

$CZD = 44° 24.9'$

$TZD = 44° 20.2'$

Intercept = 4.7' TOWARDS

$A = \frac{\tan lat}{\tan P}$

$A = \frac{\tan 36°03'}{\tan 51°51.7'}$

$A = 0.572S$

$B = \frac{\tan dec}{\sin P}$

$B = \frac{\tan 27°26.2'}{\sin 51°51.7'}$

$B = 0.66007N$

$C = B - A$

$C = 0.66007 - 0.572$

$C = 0.088 N$

$\tan Az = 1/C \times \cos lat$

$\tan Az = 1/0.088 \times \cos 36°03'$

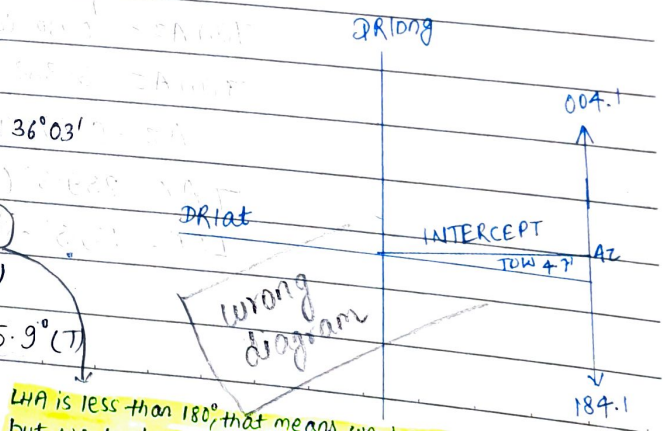
$\tan Az = 14.055$

$Az = N85.9E$

$T\,Az = 85.9°(T)$

$LOP = 175.9° - 355.9°(T)$

not sure



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⑤

GMT : Aug 23d 02h 05m 12s

GHA moon (23d 02h)	317° 27.2'	Sextant altitude	38° 45.8'
Increment (05m 12s)	1° 14.4'	IE (off) : (+)	2.8'
v (7.1)	0.7'	Observed altitude	38° 48.6'
GHA moon	318° 42.3'	Dip (HE-10m) : (-)	5.6'
Long (E)	(+)096° 40.0'	Apparent altitude	38° 43.0'
LHA moon	55° 22.3'	Main corrn : (+)	54.5'
P	55° 22.3'	HP (59.0) : (+)	4.3' (UL)
Declination (23d 02h)	22° 20.4' N	True altitude	39° 41.8'
d (10.0) :	(+) 0.9	Substract 30' from alt of UL :	(-) 30.0'
Declination Moon	22° 21.3' N	True altitude	39° 11.8'
Latitude	48° 29' N	ZD	50° 48.2'

$\cos CZD = \cos P \cdot \cos lat \cdot \cos dec \pm \sin lat \cdot \sin dec$

$\cos CZD = \cos 55°22.3' \cdot \cos 48°29' \cos 22°21.3' + \sin 48°29' \sin 22°21.3'$

$\cos CZD = 0.633138$

$CZD = 50°43.0'$

$TZD = 50°48.2'$

Intercept = 5.1' AWAY

$A = \frac{Tan\ lat}{Tan\ P}$

$A = \frac{Tan\ 48°29'}{Tan\ 55°22.3'}$

$A = 0.780\ S$

$B = \frac{Tan\ dec}{sin\ P}$

$B = \frac{Tan\ 22°21.3'}{sin\ 55°22.3'}$

$B = 0.500\ N$

$C = A - B$

$C = 0.780 - 0.500$

$C = 0.280\ S$

$Tan\ Az = 1/C \times cos\ lat$

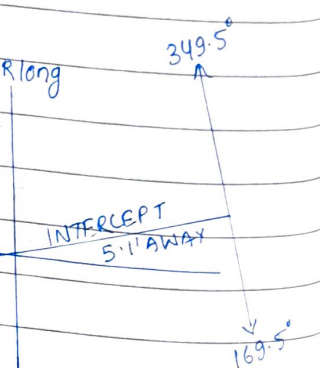
$Tan\ Az = 1/0.280 \times \cos 48°29'$

$Tan\ Az = 5.388$

$Az = S\ 79.5°\ W$

$TAz = 259.5°\ (T)$

$LDP = 169.5° - 349.5°\ (T)$



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Ex 49 - Long by chron moon

No. 89 Date 04.03.2022

GMT : 22d 23h 18m 02s
LIT(E) : (+) 09h 47m 20s
LMT : 23d 09h 05m 22s

21d 23h 18m 02s
(+) 09h 47m 20s
22d 09h 05m 22s ✓ bcz question says AM on ship

GMT: Sep 21d 23h 18m 02s

GHA (21d 23h)	260° 42.4'
Increment (18m 02s)	4° 18.2'
v (3.5)	1.1'
GHA moon	265° 1.7'
Long (E)	(+) 146° 50.0'
LHA	51° 51.7'
Dec (21d 23h)	27° 26.5' N
d (0.9)	(-) 0.3'
Declination Moon	27° 26.2' N

Sextant altitude	44° 49.1'
IE (off)	(+) 0.9'
Observed altitude	44° 50.0'
Dip (HE - 18m)	(-) 7.5'
Apparent altitude	44° 42.5'
Main corrn	(+) 50.7'
HP (59.3)	(+) 6.6' (LL)
True altitude	45° 39.8'
Latitude	36° 03' N

$$\cos P = \frac{\sin T.alt \mp \sin lat . \sin dec}{\cos lat . \cos dec}$$

$$\cos P = \frac{\sin 45°39.8' - \sin 36°03' . \sin 27°26.2'}{\cos 36°03' . \cos 27°26.2'}$$

$\cos P = 0.618882782$
$P = 51° 45.9'$
$LHA = 51° 45.9'$
$GHA = 265° 1.7'$
Obs long = 146° 44.2' E

LMT mer. pass : 05h 54m
LMT of sight : 09h 05m
Sight is taken after mer. pass
so, LHA = P

LHA - GHA = Obs. long E
↓ bada ↓ more than 180° (chota)

$A = \frac{Tan\ lat}{Tan\ P}$

$A \Rightarrow \frac{Tan\ 36°03'}{Tan\ 51°45.9'} = 0.574S$

$B = \frac{Tan\ dec}{Sin\ P}$ but LHA more than 180° (bada)

$B \Rightarrow \frac{Tan\ 27°26.2'}{sin\ 51°45.9'} = 0.661N$

$C = B - A$

$C \Rightarrow 0.661 - 0.574 = 0.087\ N$

$Tan\ Az = 1/C \times cos\ lat$

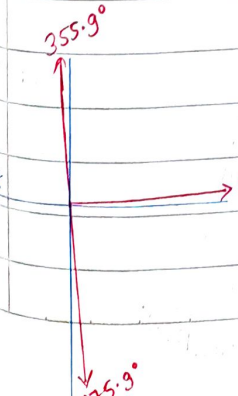
$Tan\ Az = 1/0.087 \times cos\ 36°03'$

$Tan\ Az = 14.217$

$Az = N85.9°(E)$ — LHA is less than 180° but we take east because we had substracted from 360

$TAz = 85.9°(T)$

$LDP = 175.9 - 355.9°$ not sure



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②

GMT: Oct 13d 17h 29m 05s

GHA (13d 17h)	273° 51·6'	Sextant attitude	23° 20·0'
Increment (29m 05s)	6° 56·4'	IE (off)	(+) 1·3'
v (11·9)	5·9'	Observed attitude	23° 21·3'
GHA MOON	280° 53·9'	Dip (HE - 30m)	(-) 9·6'
Long (E)	(+) 017° 46·0'	Apparent attitude	23° 11·7'
LHA	298° 39·9'	Main corrn	(+) 1° 1·4'
Dec (13d 17h)	5° 48·3' N	HP (58·9)	(+) 6·4' (LL)
d (15·8)	(+) 7·8'	True attitude	24° 19·5'
Declination moon	5° 56·1' N	Latitude	20° 29' S

$$\cos P = \frac{\sin T\,alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 24°19·5' + \sin 20°29' \cdot \sin 5°56·1'}{\cos 20°29' \cdot \cos 5°56·1'}$$

$\cos P = 0·4809165$

$P = 61°15·3'$

Sight is taken before mer. pass

so, LHA = 360° - P

$LHA = 298°44·7'$

$GHA = 280°53·9'$

LHA - GHA = Obs. long E

$Obs\ long = 17°50·8'\ E$

$A = \frac{Tan\ lat}{Tan\ P}$

$A = \frac{Tan\ 20°29'}{Tan\ 61°15·3'}$

$A = 0·205\ N$

$B = \frac{Tan\ dec}{\sin P}$

$B = \frac{Tan\ 5°56·1'}{\sin 61°15·3'}$

$B = 0·119\ N$

$C = A - B$

$C = 0·205 + 0·119$

$C = 0·324\ N$

$Tan\ Az = \frac{1}{C} \times \cos lat$

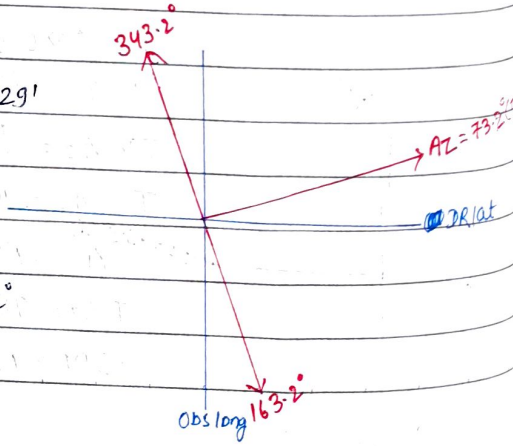
$Tan\ Az = \frac{1}{0·324} \times \cos 20°29'$

$Tan\ Az = 3·295$

$Az = N\ 73·2°\ E$

$T\ Az = 73·2°\ (T)$

$LOP = 163·2 - 343·2°$



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No. 91 Date 04/03/2022

chron time : 06h 08m 05s
Error (slow) : (+) 00m 46s
GMT : 06h 08m 51s
Long (W) : (-) 11h 41m 20s
LMT : 19d 18h 27m 31s

GMT : 20d 06h 08m 51s

GHA (20d 06h) : 120° 25.4'	Sextant altitude : 31° 24.3'
Increment (08m 51s) : 2° 06.7'	IE (on) : (-) 2.2'
v (2.5) : 0.4'	Observed altitude : 31° 22.1'
GHA moon : 122° 32.5'	Dip (HE - 22m) : (-) 8.3'
Long (W) : (-) 175° 20.0'	Apparent altitude : 31° 13.8'
LHA : 307° 12.5'	Main corrn : 58.4'
Declination (20d 06h) : 27° 54.7' N	HP (59.8') : 7.3' (LL)
d (1.4) : (-) 0.2'	True altitude : 32° 19.5'
Declination Moon : 27° 54.5' N	Latitude : 00° 10' N

$$\cos P = \frac{\sin T\,alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 32°19.5' - \sin 00°10' \cdot \sin 27°54.5'}{\cos 00°10' \cdot \cos 27°54.5'}$$

$\cos P = 0.603556994$

$P = 52° 52.5'$

LHA = 307° 07.5'

Sight is taken before mer. pass
∴ LHA = 360° − P

GHA = 122° 32.5'

Obs. long = 175° 25.0' W

$$A = \frac{\text{Tan lat}}{\text{Tan P}} \qquad B = \frac{\text{Tan dec}}{\sin P}$$

$$A = \frac{\text{Tan } 00°10'}{\text{Tan } 52°52.5'} = 0.002S \qquad B = \frac{\text{Tan } 27°54.5'}{\sin 52°52.5'} = 0.664\,N$$

C = B − A

C = 0.664 − 0.002 ⇒ 0.662 N

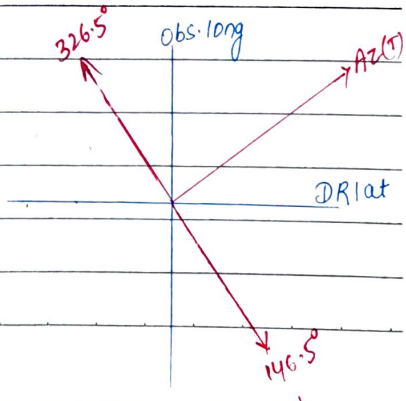
Tan Az = 1/C × cos lat

Tan Az = 1/0.662 × cos 00°10'

Az = N 56.5° E

TAz = 56.5° (T)

LOP = 146.5° − 326.5° (T)



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Chron time : 03h 44m 53s
Error (fast) : (-) 03m 19s
GMT : 03h 41m 34s
LIT (E) : (+) 07h 02m 48s
LIT : 10h 44m 22s ✓

GMT : April 30d 03h 41m 34s

GHA (30d 03h) : 293° 07.5'	Sextant altitude : 40° 28.2'
Increment (41m 34s) : 9° 55.1'	IE (on) : (-) 2.6'
v (13.1) : 9.1'	Observed altitude : 40° 25.6'
GHA moon : 303° 11.7'	Dip (HE - 11m) : (-) 5.8'
Long (E) : (+) 105° 42.0'	Apparent altitude : 40° 19.8'
LHA : 48° 53.7'	Main corrn : 53.5'
Declination (30d 03h) : 11° 46.2' S	HP (57.1) : 4.4' (LL
d (14.1) : (-) 9.8'	True attitude : 41° 17.7'
Declination moon : 11° 36.4' S	Latitude : 05° 50' N

$$\cos P = \frac{\sin T\,alt \mp \sin lat \cdot \sin dec}{\cos lat \cdot \cos dec}$$

$$\cos P = \frac{\sin 41° 17.7' + \sin 05° 50' \cdot \sin 11° 36.4'}{\cos 05° 50' \cdot \cos 11° 36.4'}$$

$$\cos P = 0.6982$$

$$P = 45° 43'$$

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Exercise 50 - Ex meridian moon No. 93 Date 04/03/2022

GMT: Dec 01d 03h 52m 48s

GHA moon (01d 03h)	187° 21.6'	Sextant altitude	63° 29.1'
Increment (52m 48s)	12° 35.9'	IE (on)	(-) 1.7'
v (11.7)	10.2'	Observed altitude	63° 27.4'
GHA moon	200° 07.6'	Dip (HE - 13m)	(-) 6.3'
Long (E)	(+) 164° 48.0'	Apparent altitude	63° 21.1'
LHA moon	4° 55.7'	Main corrn	(+) 36.1'
Declination (01d 03h)	24° 33.2' S	HP (54.1)	(+) 2.3' (LL)
d (6.1)	(-) 5.3'	True altitude	63° 59.5' N
Declination Moon	24° 27.9' S	TZD	26° 0.5' S

P 4° 55.7'

COS MZD = COS TZD + [(1 - COS P) . COS DR lat . COS dec]

COS MZD = COS 26° 0.5' + [(1 - COS 4° 55.7') . COS 50° 12' . COS 24° 27.9']

COS MZD = 0.900884325

MZD = 25° 43.5' S

Dec = 24° 27.9' S

Obs Lat = 50° 11.4' S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\text{Sin P}}$

$A = \frac{\text{Tan } 50° 12'}{\text{Tan } 4° 55.7'}$ $B = \frac{\text{Tan } 24° 27.9'}{\sin 4° 55.7'}$

A = 13.919 N B = 5.296 S

C = A - B

C = 13.919 - 5.296

C = 8.623 N

Tan Az = 1/C x cos lat

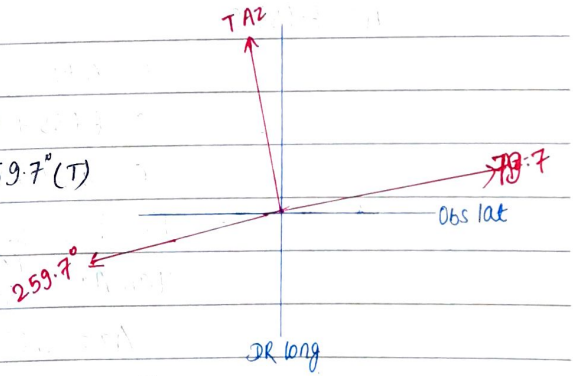
Tan Az = 1/8.623 x cos 50° 12'

Tan Az = 0.18117

Az = N10.3° W

T Az = 349.7° (T)

LOP = 79.7° - 259.7° (T)



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② chron time : 01h 14m 42s

Error(fast) : (-) 3m 18s

GMT : 01h 11m 24s (+12) 13h 11m 24s ✓

LAT(W) : (-)06h 26m 24s (-)06h 26m 24s

LMT : 18h 45m 00s 06h 45m 00s bcz question says am at ship

GMT: April 28d 13h 11m 24s

GHA moon(28d 13h) : 101° 01.8'	Sextant altitude : 32° 11.8'
Increment (11m 24s) : 2° 43.2'	IE(off) : (+) 2.1'
V(12.2) : 2.3'	Observed altitude : 32° 13.9'
GHA moon : 103° 47.3'	Dip(HE-18m) : (-) 7.5'
Long(W) : (-) 96° 36' W	Apparent altitude : 32° 6.4'
LHA moon : 7° 11.3'	Main corrn : (+) 57.9'
Declination(28d 13h) : 19° 39.0' S	HP(55.8) : (+) 2.9' (UL)
d(10.8) : (-) 2.1'	Substract 30' from the UL : (-) 30.0'
Declination Moon : 19° 36.9' S	True altitude : 32° 37.2' S
Latitude : 37° 22' N	TZD : 57° 22.8' N

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 57° 22.8' + [(1-\cos 7° 11.3') \cdot \cos 37° 22' \cdot \cos 19° 36.9']$

$\cos MZD = 0.544949$

$MZD = 56° 58.7' N$

$Dec = 19° 36.9' S$

$Obs\ lat = 37° 21.8' N$

$A = \frac{Tan\ lat}{Tan\ P}$ $\quad$ $B = \frac{Tan\ dec}{sin\ P}$

$A = \frac{Tan\ 37° 22'}{Tan\ 7° 11.3'}$ $\quad$ $B = \frac{Tan\ 19° 36.9'}{sin\ 7° 11.3'}$

$A = 6.055\ S$ $\quad$ $B = 2.848\ S$

$C = A + B$

$C = 6.055 + 2.848$

$C = 8.903\ S$

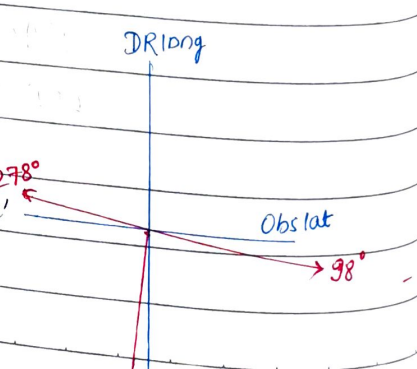
$Tan\ Az = Y/C \times \cos lat$

$Tan\ Az = 1/8.903 \times \cos 37° 22'$

$Az = S\ 8°\ W$

$T\ Az = 188°(T)$

$LOP = 098° - 278°(T)$



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No. 95 Date 04/02/2022

05h 23m 53s
Error (fast) : (-) 2m 16s
GMT : 05h 26m 09s
LIT (E) : (+) 11h 41m 04s
LMT : 17h 07m 13s

22d 17h 21m 37s
(+) 11h 41m 04s
23d 05h 07m 13s

GMT : Aug 22d 17h 21m 37s

GHA moon (22d 17h) :	187° 28.4'
Increment (21m 37s) :	5° 09.5'
v (7.9) :	2.8'
GHA moon :	192° 40.7'
Long (E) :	(+) 175° 16.0'
LHA moon :	7° 56.7'
P :	7° 56.7'
Declination (22d 17h) :	20° 44.8' N
d (11.1) :	(+) 4.0
Declination moon :	20° 48.8' N
Latitude :	50° 02' N

Sextant altitude :	59° 50.8'
IE (Off) :	(+) 2.6'
Observed altitude :	59° 53.4'
Dip (HE - 15m) :	(-) 6.8'
Apparent altitude :	59° 46.6'
Main corrn :	(+) 39.1
HP (58.9') :	(+) 3.9'
Substract 30' from altitude of UL :	(-) 30.0'
True altitude :	59° 59.6' S
TZD :	30° 0.4' N

$\cos MZD = \cos TZD + [(1 - \cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 30° 0.4' + [(1 - \cos 7° 56.7' \cdot \cos 50° 02' \cos 20° 48.8']$

$\cos MZD = 0.87173$

MZD = 29° 20.4' N

Dec = 20° 48.8' N

Obs lat : 50° 09.2' N

$A = \frac{\text{Tan lat}}{\text{Tan P}}$

$A = \frac{\text{Tan } 50° 02'}{\text{Tan } 7° 56.7'}$

A = 8.549S

$B = \frac{\text{Tan dec}}{\text{Sin P}}$

$B = \frac{\text{Tan } 20° 48.8'}{\text{Sin } 7° 56.7'}$

B = 2.750 N

C = A - B

C = 8.549 - 2.750

C = 5.799S

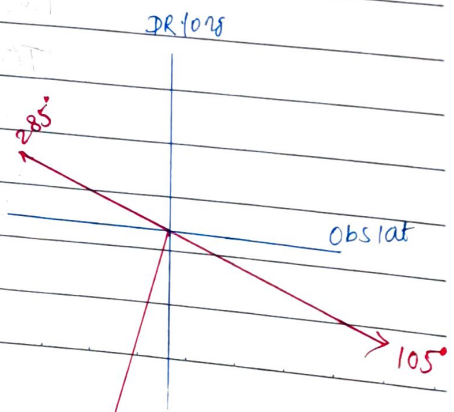
Tan Az = 1/C x cos lat

Tan Az = 1/5.799 x cos 50° 02'

Az = S15°W

T Az = 195° (T)

LOP = 105° - 285° (T)



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⑤

GMT: 22d 16h 10m 24s

GHA moon (22d 16h): 145° 10·9'	Sextant attitude: 27° 15·1'
Increment (10m 24s): 2° 28·9'	IE(on): (-) 0·7'
V(4.3): 0·8'	Observed attitude: 27° 14·4'
GHA moon: 147° 40·6'	Dip(HE-12m): (-) 6·1'
Long(W): (-)140° 12·0'	Apparent attitude: 27° 8·3'
LHA moon: 7° 28·6'	Main corrn (-)31' 0·1'
P: 7° 28·6'	HP(59.1)(+) 4·5'
Declination(22d 16h): 26° 44·9'N	Substract 30' from Attitude of UL: (-) 30·0'
d(4.0): (-) 0·7'	True attitude: 27° 42·9' N
Declination moon: 26° 44·2'N	TZD: 62° 17·1' S
Latitude: 35° 05'S	

$\cos MZD = \cos TZD + [(1-\cos P) \cdot \cos lat \cdot \cos dec]$

$\cos MZD = \cos 62°17.1' + [(1-\cos 7°28.6') \cdot \cos 35°05' \cdot \cos 26°44.2']$

$\cos MZD = 0.471287351$

MZD = 61° 52·9' S

Declination = 26° 44·2' N

Obs lat = 35° 08·7' S

$A = \frac{\text{Tan lat}}{\text{Tan P}}$ $B = \frac{\text{Tan dec}}{\sin P}$

$A = \frac{\text{Tan } 35°05'}{\text{Tan } 7°28.6'}$ $B = \frac{\text{Tan } 26°44.2'}{\sin 7°28.6'}$

A = 5·352 N B = 3·871 N

C = A + B

C = 5·352 + 3·871

C = 9·223 N

Tan Az = 1/C x cos lat

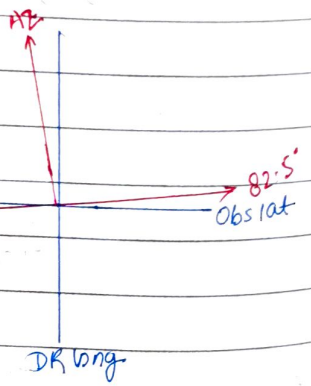
Tan Az = 1/9·223 x cos 35°05'

Tan Az = 0·132497

Az = N 7·5° W

T Az = 352·5° (T)

LOP = 82·5° - 262·5° (T)



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Combination of Sights

No. 109 Date 11·03·2022

Worked Example :- ① TWO LOPs BY CHRON

Step ① : CLOP 1 : Az ± 90° = 046° ± 90° = 136° - 316° (T)

CLOP 2 : Az ± 90° = 130° ± 90° = 040° - 220° (T)

Step ② : Find d'long

Obs long 1 : 146° 13·4'W

Obs long 2 : 146° 19·3'W

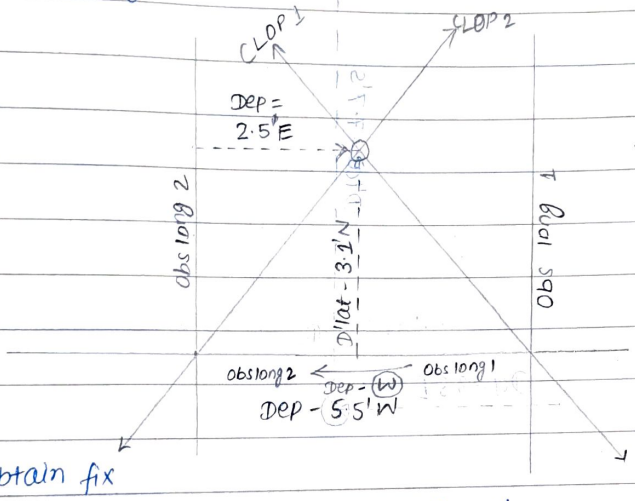
D'long : 5·9'W

step ③ :- From Norie's table,

Using lat - 20·6° & d'long - 5·9'W

Dep - 5·5'W

Step ④ : DRAW diagram



Scale used:
1cm = 1 min

Step ⑤ Obtain fix

DR Lat : 20° 36'N DR lat : 20° 36·0'N

d'lat : 3·1'N Fix lat : 20° 39·1'N

Fix lat : 20° 39·1'N m'lat : 20° 37·5'N

Using m'lat - 20° 37·5'N , dep : 2·5'E

d'long = 2·7'E

Obs long2 : 146° 19·3'W

d'long : 2·7'E

Fix long : 146° 16·6'W

** (since I have taken dep from obs long 2, so finding fix I will use obs long 2)

(I can measure dep. from obs long 1 also, so for finding fix I will use obs long 1)

Answer :- Lat : 20° 39·1'N 146° 16·6'W

Worked example ② :- three intercepts

Step ① :- CLOP 1 : Az ± 90° = 042 ± 90° = 132° - 312°

CLOP 2 : Az ± 90° = 100° ± 90° = 010° - 190°

CLOP 3 : Az ± 90° = 170° ± 90° = 080° - 260°

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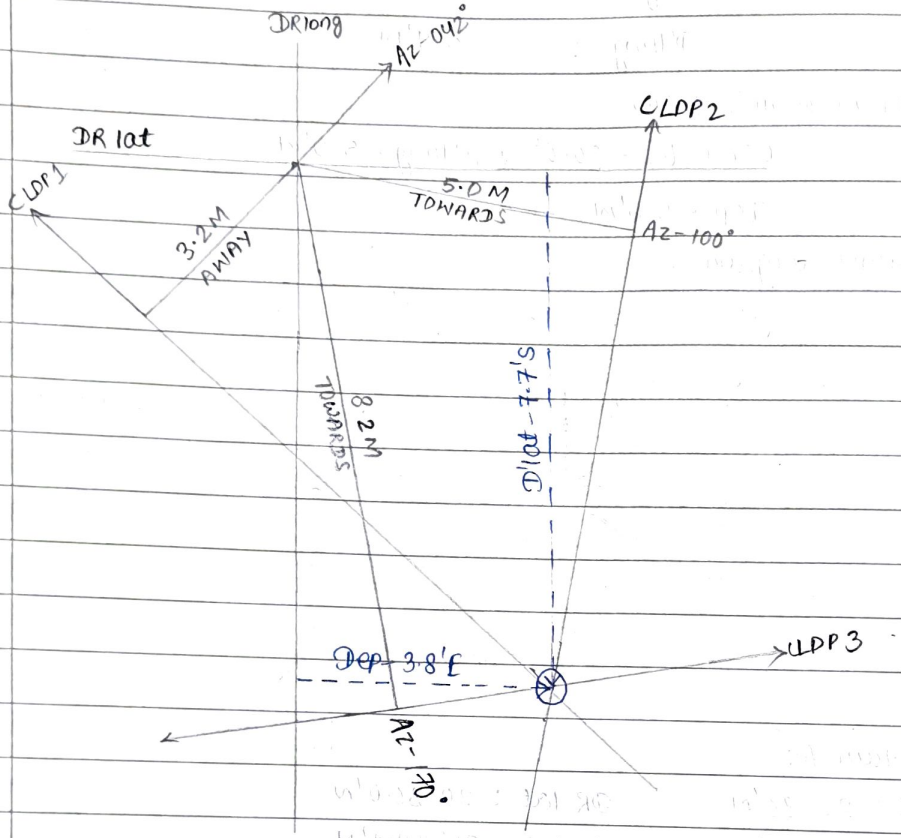
No. 11D Date 11-03-2024

:- Intercept 1 : 3.2M away
Intercept 2 : 5.0M towards
Intercept 3 : 8.2M towards

Step ③ : Take any point suitable as a DR position



DR lat : 20° 11'S
d'lat : 7.7'S
fix lat : 20° 18.7'S

DR lat : 20° 11'S
fix lat : 20° 18.7'S
m'lat : 20° 14.9'S

Using m'lat : 20° 14.9'S & dep : 3.8'E
d'long : 4.0'E

DR long : 140° 36'E
d'long : 4.0'E
Fix long : 140° 40.0'E

Answer :- Lat : 20° 18.7'S Long : 140° 40.0'E

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One intercept & one long by chron. No. 111 Date 11.03.2022

Step 1 : CLOP 1 : Az ± 90° = 335° ± 90° = 065° - 245°

CLOP 2 : Az ± 90° = 030° ± 90° = 120° - 300°

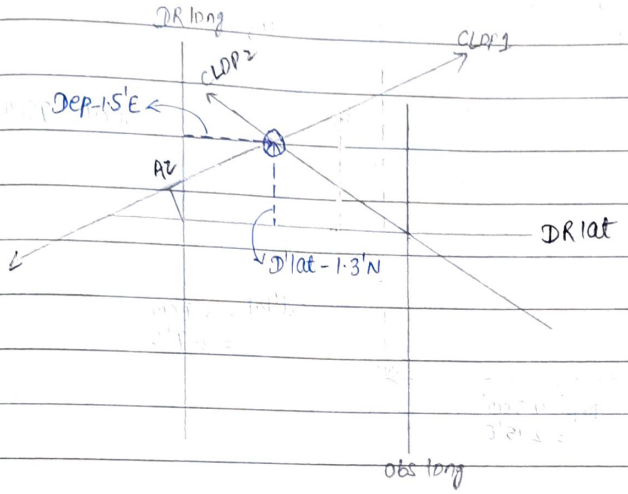
Intercept 1 :- 0.5' Towards

DR long : 179° 59'E

Obs long 1 : 179° 55.4'W

d'long : 0° 5.6'E

Using d'long - 5.6', lat - 48.4'N, dep = 3.7M



DR lat : 48° 24'N

d'lat : 1.3'N

Fix lat : 48° 25.3'N

DR lat : 48° 24'N

Fix lat : 48° 25.3'N

m'lat : 48° 24.6'N

Using m'lat : 48.4°N Dep - 1.5'E

d'long - 0° 2.3'E

DR long : 179° 59.0'E

d'long : 0° 2.3'E

Fix long : 179° 58.7'W

Answer : Lat : 48° 25.3'N Long : 179° 58.7'W

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Exercise - 51

Graphical combination - simultaneous observation

No. 112

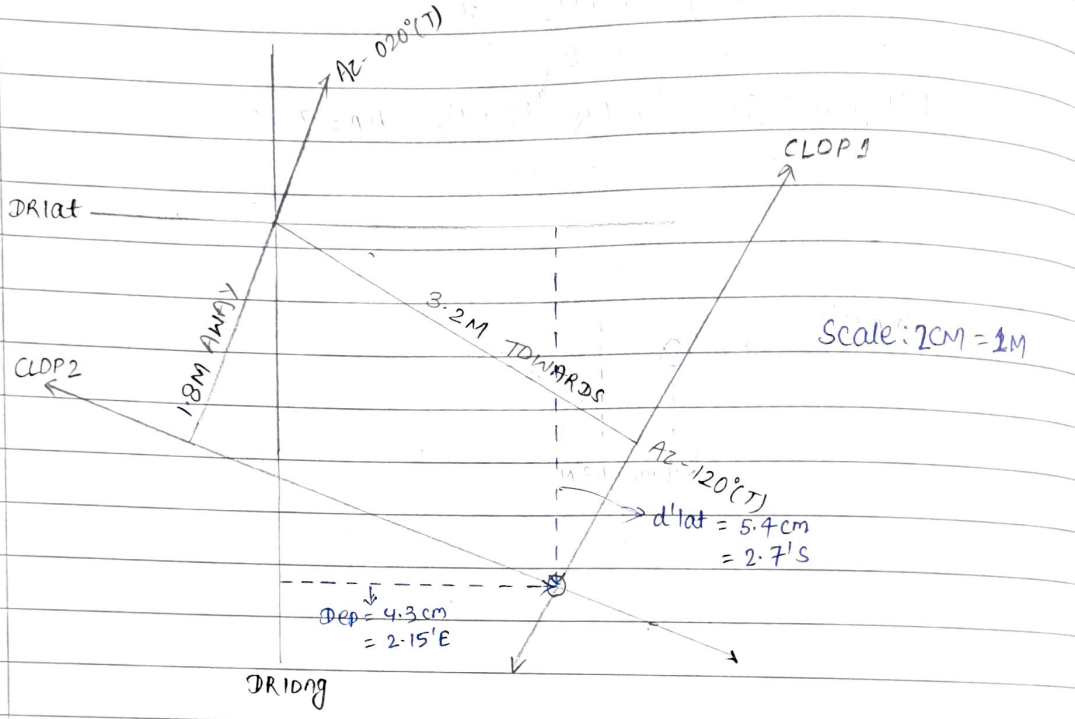
Date 11.03.2022

① CLOP 1 : Az ± 90° = 120° ± 90° = 030° - 210°

CLOP 2 : Az ± 90° = 020° ± 90° = 110° - 290°

Intercept 1 : 3.2 M Towards

Intercept 2 : 1.8 M Away



DR lat : 36° 18'S

d'lat : 2.7'S

Fix lat : 36° 20.7'S

DR lat : 36° 18'S

Fix lat : 36° 20.7'S

m'lat : 36° 19.4'S

Using m'lat - 36.3'S & dep - 2.15'E

d'long - 0° 2.7'E

DR long : 93° 27'E

d'long : 0° 2.7'E

fix long : 93° 29.7'E

1.6	2	
2.15		2.0 + 0.7 = 2.7
2.4	3	
0.8	1	
1	$\frac{1}{0.8} \times 0.55 = 0.7$	

Answer: Lat : 36° 20.7' long : 93° 29.7'E

② DR long : 147° 44'E

Obs long : 147° 50.2'E

d'long : 6.2'E

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No. 113 Date 11.03.2022

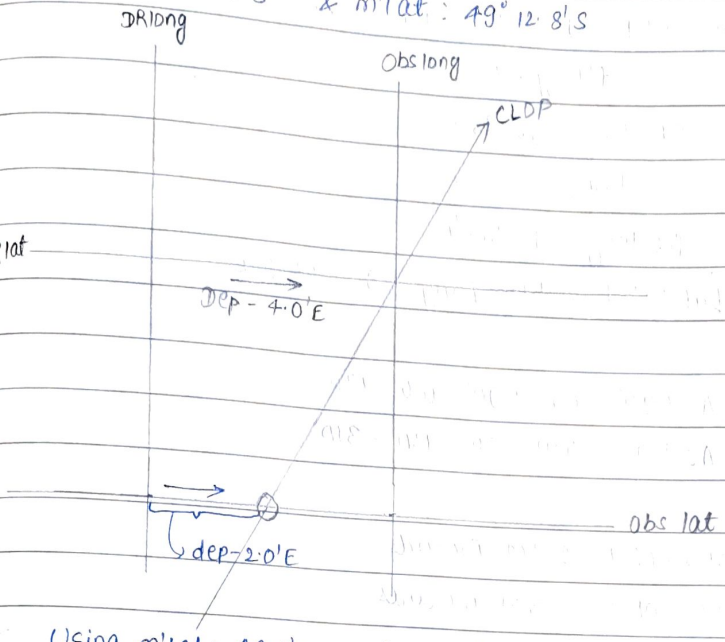
Using d'long: 6.2'E lat - 49.2'S
dep - 4.0'E

CLOP: Az ± 90° = 300° ± 90° = 030° - 210°

DR lat: 49° 11'S

Obs lat: 49° 14.5'S

d'lat: 3.5'S & m'lat: 49° 12.8'S



Using m'lat: 49.2'S. dep - 2.0'E

d'long: 3.0'E

DR long: 147° 44'E

d'long: 3.0'E

fix long: 147° 47.0'E

Answer:-

Ship's position: 49° 14.5'S 147° 47.0'E

③ DR lat: 60° 00'N

Obs lat: 59° 58.4'N → 002° ± 90° = 92° - 272°

d'lat: 1.6'S

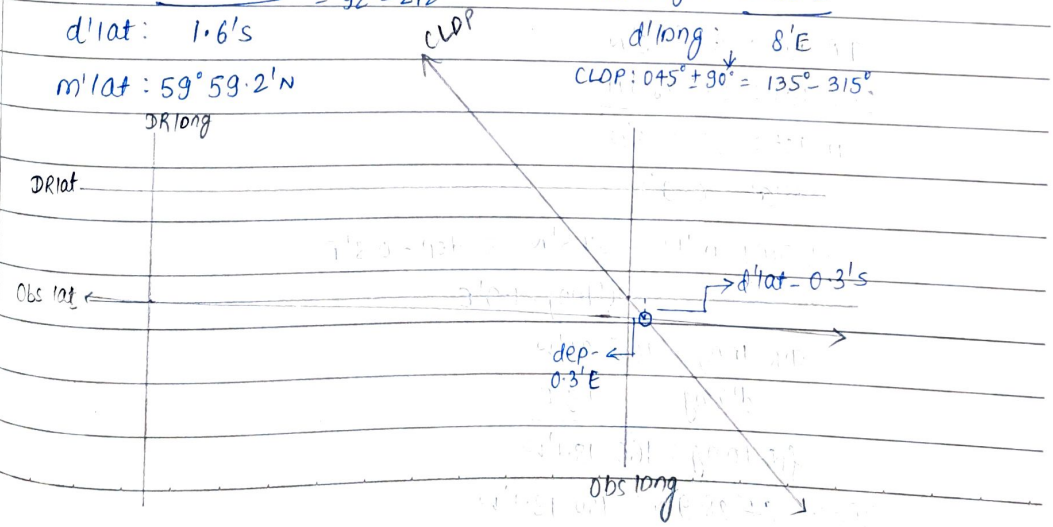
m'lat: 59° 59.2'N

DR long: 90° 30'E

Obs long: 90° 38'E

d'long: 8'E

CLOP: 045° ± 90° = 135° - 315°



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Obs lat : 59° 58·4'N
d'lat : 0·3'S
fix lat : 59° 58·1'N

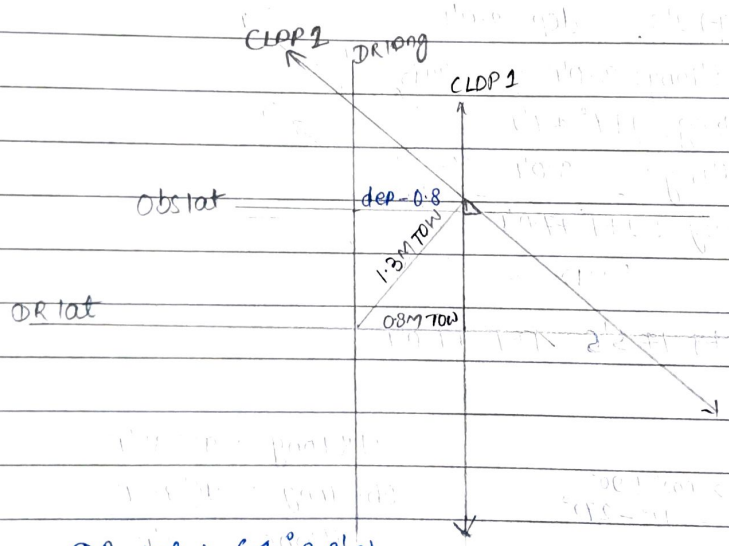
Obs lat : 59° 58·4'N
fix lat : 59° 58·1'N
m'lat : 59° 58·3'N

Using m'lat - 59° 58·3'N dep - 0·3'E
d'long - 0·6'E
Obs long : 90° 38'E
d'long : 0·6'E
fix long : 90° 38·6'E

Answer: Lat : 59° 58·1'N Long : 90° 38·6'E

④ CLOP 1 : Az ± 90° = 090° ± 90° = 000° - 180°
CLOP 2 : Az ± 90° = 040° ± 90° = 130° - 310°

Intercept 1 : 0·8M Towards
Intercept 2 : 1·3M Towards



Scale used - 2CM = 1M

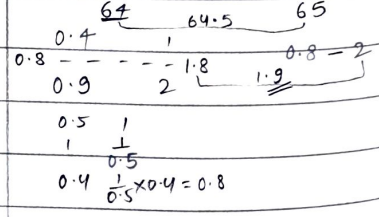
Note :- LOP in lat. by merid alt is E-W i.e 090° - 270°

DR lat : 64° 28'N
Obs lat : 64° 28·9'N
m'lat : 64° 28·5'N
d'lat : 0·9'N

Using m'lat - 64·5'N & dep - 0·8'E
d'long - 1·9'E
DR long : 160° 20'W
d'long : 1·9'E
fix long : 160° 18·1'W

Ans :- 64° 28·9'N, 160° 18·1'W

Rough



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No. 115 Date 11·03·2022

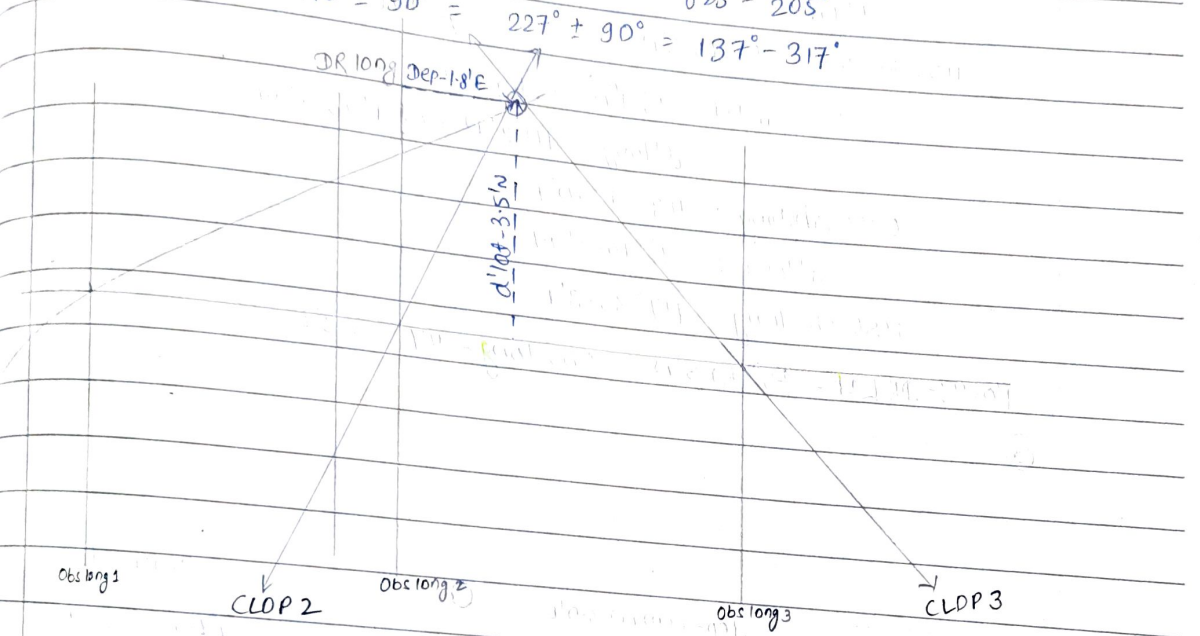
g : 75° 39'W
: 75° 42·7'W
d'long : 3·7'W
dep : 3·6'W

DR long : 75° 39' W
Obs long 2 : 75° 38·1'W
d'long = 0·9'E
dep = 0·9'E

DR long : 75° 39'W
Obs long 3 : 75° 32·8'W
d'long : 6·2'E & dep = 6·0'E

By using lat - 15° 02'N & respective d'long

CLOP 1 : Az ± 90° = 331 ± 90° = 061° - 241°
CLOP 2 : Az ± 90° = 115° ± 90° = 025° - 205°
CLOP 3 : Az ± 90° = 227° ± 90° = 137° - 317°



DR lat : 15° 02'N
d'lat : 3·5'N
fix lat : 15° 5·5'N

DR lat : 15° 02'N
fix lat : 15° 5·5'N
m'lat : 15° 3·8'N

Using m'lat - 15° 3·8'N dep : 1·8'E
d'long : 1·8'E
Obs long 2 : 075° 38·1'W
d'long : 1·8'E
fix long : 075° 36·3'W

Answer: Lat : 15° 5·5'N Long : 075° 36·3'W

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No. 116 Date 12·03·22

Fix By staggered CLOP's

Example ①:-

① 0800 HRS DR lat - 46° 20'N Obs long - 118° 46'E

CLOP 1 : 150° ± 90° = 060° - 240°

② 1150 hrs :

Ship's CO:- 238° - S 58° W Distance steamed : 15 knots x 3h 50m = 57.5 M

Using Nories Table,

Dep - 48.8'W D'lat - 30.5's

0800 dr lat : 46° 20'N

d'lat : 30.5's

1150 DR lat : 45° 49.5'N

0800 DR lat : 46° 20'N

1150 DR lat : 45° 49.5'N

m'lat : 46° 04.8'N

Using m'lat - 46.1°N dep - 48.8'W

d'long - 70.2'W i.e. 1° 10.2' W

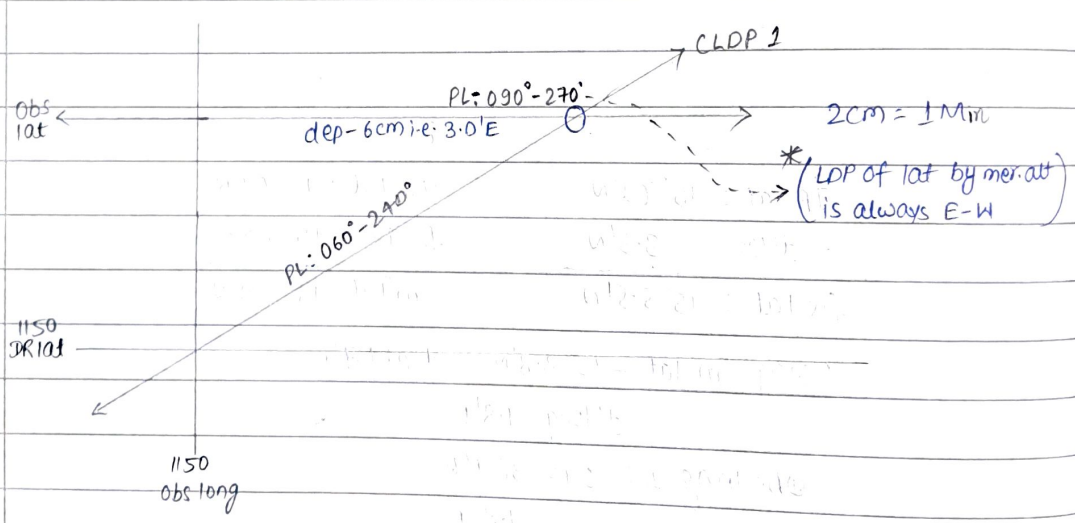
0800 Obs long : 118° 46.0'E

d'long : 1° 10.2' W

1150 obs long : 117° 35.8'E

Posn :- DR Lat - 45° 49.5'N Obs long - 117° 35.8'E

③ Plot 1150 DR lat & Obs long



1150 DR lat : 45° 49.5'N

1150 fix lat : 45° 51.2'N (given in question)

d'lat : 1.7'N & m'lat : 45° 50.4'N

Using m'lat - 45.8'N & dep : 3.0'E

d'long = 4.3'E

1150 Obs long : 117° 35.8'E

d'long : 4.3'E

1150 fix long : 117° 40.1'E

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Answer:

No. 117 Date 12.03.2022

1150 fix - 45° 51.2'N 117° 40.1'E

Now find position at 1200 hrs

Course - S58°W Distance steamed - 15 knots x 10 min = 2.5M

d'lat - 1.3's dep - 2.1'W

1150 fix lat : 45° 51.2'N

d'lat : 1.3'S

1200 Lat : 45° 49.9'N

1150 fix lat : 45° 51.2'N

1200 lat : 45° 49.9'N

m'lat : 45° 50.6'N

Using m'lat - 45.8'N & dep - 2.1'W

d'long - 3.0'W

1150 fix long : 117° 40.1'E

d'long : 3.0'W

1200 long : 117° 37.1'E

Answer: 1200 posn: Lat : 45° 49.9'N Long : 117° 37.1'E

Example ②:- @ At 0500 HRS,

DR lat: 18° 41's DR long: 179° 56'E , Az - 083°(T)

CLDP 1: Az ± 90° = 083 ± 90° = 173° - 353°(T)

ⓑ At 1210 hrs,

Course	Distance	dep E	dep W	d'lat N	d'lat S
083° = N83°E	8.4'	8.3'		1.0	
121° = S59°E	70	60.0			36.1
224° = S44°W	10		6.9		7.2

Dep: 61.4'E d'lat: 42.3's

0500 DR lat: 18° 41's

d'lat : 42.3's

1210 EP lat: 19° 23.3's

0500 DR lat: 18° 41's

1210 EP lat: 19° 23.3's

m'lat: 19° 2.1's

Using m'lat - 19° 2.1's dep - 61.4'E

d'long - 64.9'E i.e - 1° 4.9'E

0500 DR long : 179° 56.0'E

d'long : 1° 4.9'E

1210 EP long : 178° 59.1'W

Position :- 1210 EP -

Lat 19° 23.3's Long 178° 59.1'W

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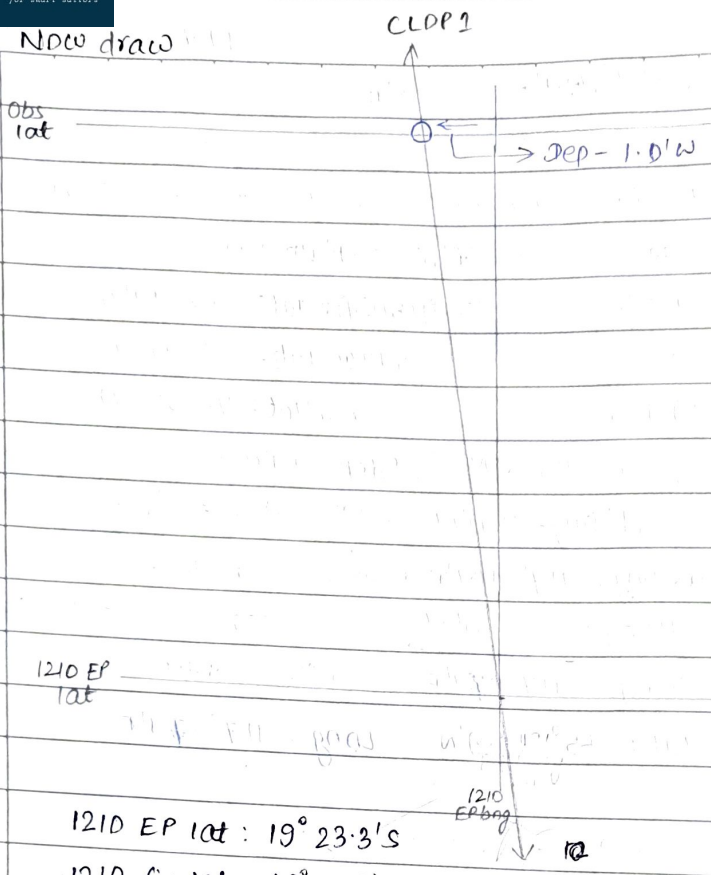
Now draw



1210 EP lat : 19° 23·3'S

1210 fix lat : 19° 14·9'S

d'lat : 8·4' N & m'lat : 19° 19·1'S

Using m'lat - 19·3°S & dep - 1.0'W

d'long = 1·1'W

1210 EP long : 178° 59·1 W

d'long : 1·1'W

1210 fix long : 179° 00·2' W

1200 fix position :-

Lat 19° 14·9'S Long 179° 00·2' W

Now have to find 1200 hrs posn:
we have to go 10 mins back, so ship is S 59°E
Reverse the course N 59°W
Distance steamed in 10 min - 1·6M

Using co - 59° & dist. - 1·6m, d'lat = 0·8'N dep = 1·4'W

1210 fix - 19° 14·9'S

d'lat - 0·8'N

1200 lat :

different from book
d'lat & dep is opposite

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Exercise - 52

No. 119 Date 24/04/2022

① 0600 HRS : DR lat : 01° 20'N Obs long : 179° 54'E

CLOP 1 : 062° ± 90° = 152° - 332°

1600 HRS : Vessel CO : 131° (T) = 549°E

Distance steamed = 14 knots × 10 hrs = 140 miles

using CO & dist, we can find dep & d'lat

$\sin CO = \frac{dep}{dist}$

$\sin 49° = \frac{dep}{140}$

dep = 105.7 ⇒

$\tan CO = \frac{dep}{d'lat}$

$\tan 49° = \frac{105.7}{d'lat}$

d'lat ⇒ 91.9 = 1° 31.9'S

0600 DR lat : 01° 20'N

d'lat : 1° 31.9'S

1600 DR lat 00° 11.8'S

0600 DR lat : 01° 20'N

1600 DR lat : 00° 11.8'S

m'lat : 0° 34.1'

$\cos m'lat = \frac{dep}{d'long}$

$\cos 0° 34.1' = \frac{105.7}{d'long}$

d'long ⇒ 105.7 = 1° 45.7'E

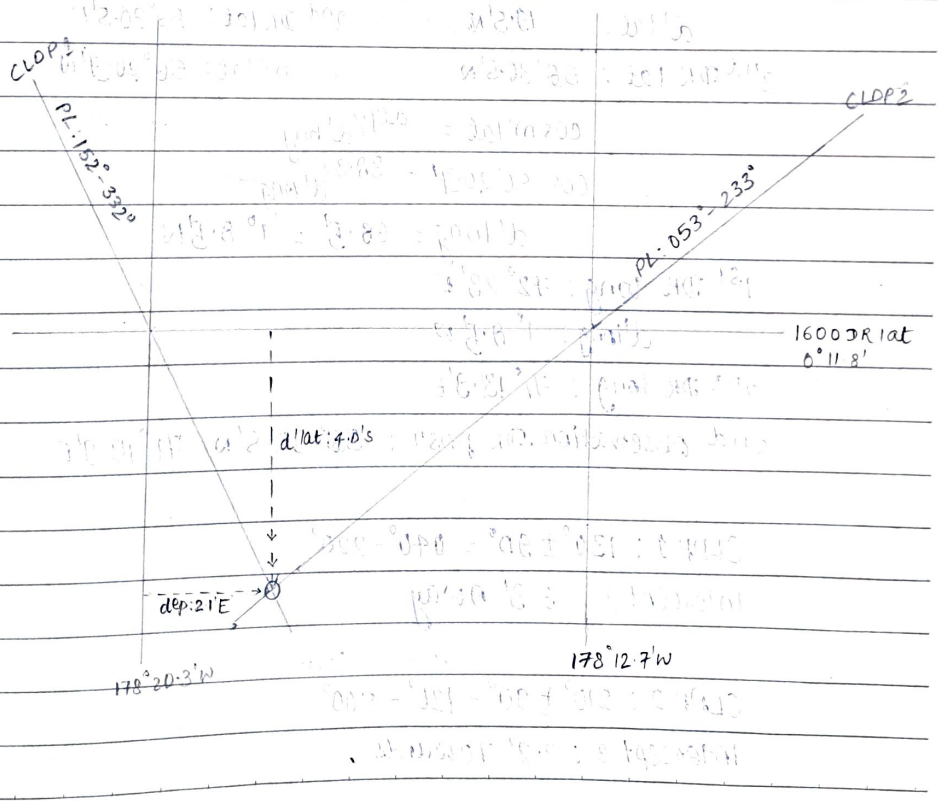
0600 Obs long : 179° 54'E

d'long : 1° 45.7'E

1600 Obs long 178° 20.3'W

CLO2 : 323 ± 90° = 053° - 233°

1 min = 1 cm



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1600 DR lat : 00° 11 8'S
d'lat : 4.0'S
1600 fix lat : 00° 15.8'S

1600 DR lat : 00° 11.8'S
1600 fix lat 00° 15.8' S
m'lat : 00° 13.8'S

cos m'lat = dep/d'long
cos 00° 13.8' = 2.1'/d'long
d'long = 0° 2.1' E

1600 obs long : 178° 20.3'W
d'long : 0° 2.1'E
1600 fix long : 178° 18.2'W

So, position of vessel at 1600 : 00° 15 8'S 178° 18.2'W

② 1st posn :- DR lat : 56° 11'N DR long : 72° 23'E
Ship's co : 243°(T) = S63°W
Distance steamed = 43 miles
Using co & dist, we can get dep & d'lat
Sin co = dep/dist
sin 63° = dep/43
dep = 38.3'W

Tan co = dep/d'lat
Tan 63° = 38.3/d'lat
D'lat = 19.5'S

1st DR lat : 56° 11'N
d'lat : 19.5'S
2nd DR lat : 55° 51.5'N

1st DR lat : 56° 11'N
2nd DR lat : 55° 51.5'N
m'lat : 56° 1.3'N

cos m'lat = dep/d'long
cos 56° 1.3' = 38.3/d'long
d'long = 68.5' = 1° 8.5'W

1st DR long : 72° 23'E
d'long : 1° 8.5'W
2nd DR long : 71° 14.5'E

2nd observation, DR posn : 55° 51.5'N 71° 14.5'E

CLDP 1 : 130° ± 90° = 040° - 220°
Intercept 1 : 6.3' Away

CLDP 2 : 210° ± 90° = 120° - 300°
Intercept 2 : 2.2' Towards

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CLDP1

7)

⟷ :- PL

⟷ :- Transferred PL

71°14.5'E

No. 121

Date 24/04/2022

2nd DR lat : 55°51.5'N

d'lat : 1.9'N

2nd fix lat : 55°52.9'N

2nd DR lat : 55°51.5'N

2nd fix lat : 55°52.9'N

m'lat : 55°52.2'N

cos m'lat = dep/d'long

cos 55°52.2' = 6.9/d'long

d'long = 12.3'

= 0°12.3'W

2nd DR long : 71°14.5'E

d'long : 0°12.3'W

2nd fix long : 71°2.2'E

Hence, position of ship at 2nd observation are:-

55°52.9'N 071°2.2'E

③ At 1st observation: DR lat: 33°18'S DR long: 000°12.6'W

CLDP 1 : 241° ± 90° = 151° - 331°

Intercept : 4.2' Towards

PTO

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- CO:- 241° = S61°W Distance : 4.2

  sin CO = dep/dist Tan CO = dep/d'lat

  sin 61° = dep/4.2 Tan 61° = 3.7/d'lat

  dep = 3.7W d'lat = 2.1'S

- CO:- 090° = E Distance : 122

  Sin 90° = dep/122 Tan 90° = 122/d'lat

  dep = 122'E d'lat = 0

Final d'lat : 2.1'S Final dep : 118.3'E

1st DR lat : 33° 18'S 1st EP lat : 33° 18'S

d'lat : 2.1'S 2nd EP lat : 33° 20.1'S

2nd EP lat : 33° 20.1'S m'lat : 33° 19.1'S

cos m'lat = dep/d'long

cos 33° 19.1' = 118.3/d'long

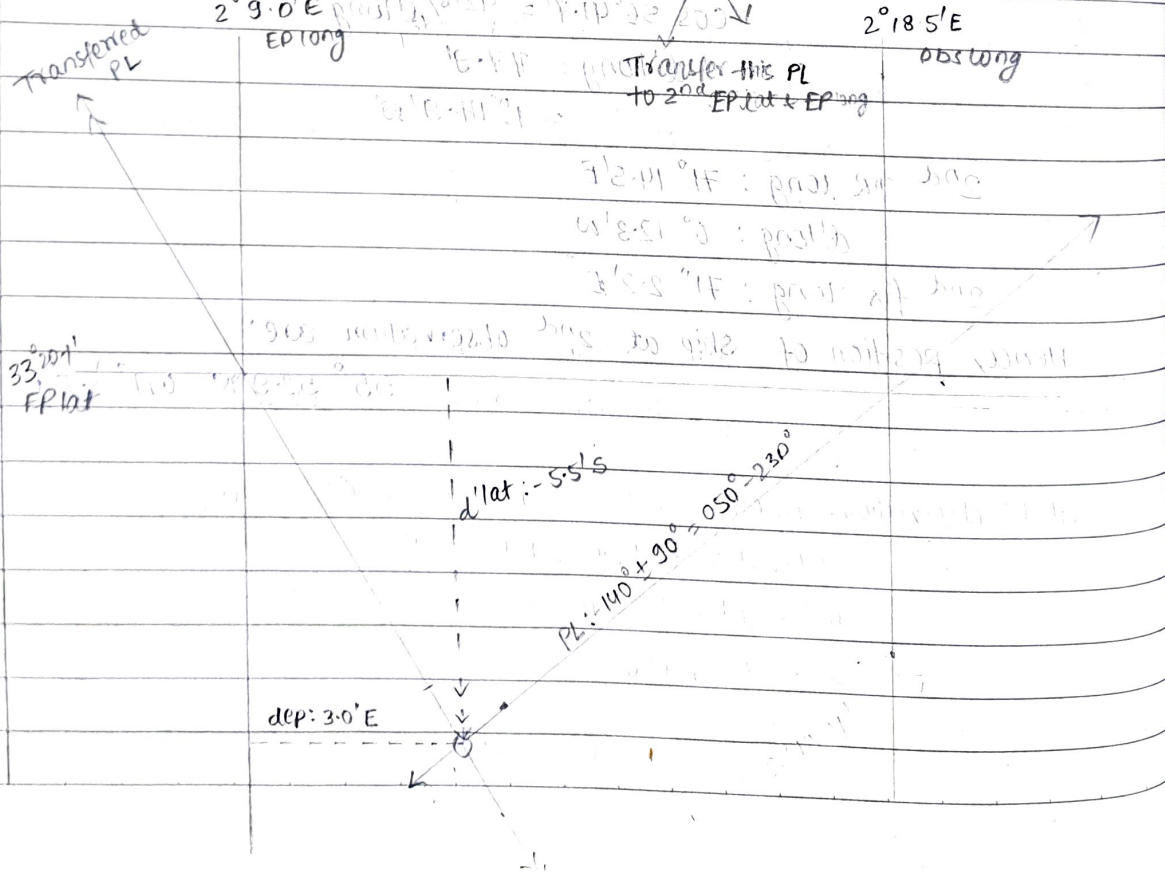
d'long = 141.6'

= 2° 21.6' E

1st DR long : 000° 12.6' W

d'long : 2° 21.6' E

2nd EP long : 2° 9.0' E



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No. Date

2nd EP lat : 33° 20.1'S
d'lat : 5.5'S
2nd fix lat : 33° 25.6'S

2nd EP lat : 33° 20.1'S
2nd fix lat : 33° 25.6'S
m'lat : 33° 22.9'S

cos m'lat = dep/d'long
cos 33° 22.9' = 3/d'long
d'long = 3.6'E

2nd DR long : 2° 09.0'E
d'long : 3.6'E
2nd fix long : 2° 12.6'E

So, position of the ship at second observation is

33° 25.6'S 002° 12.6'E

* Answer is not matching but calculation is correct. Just error in plotting. If we do on graph paper it will be exact

④ - At 1st observation, DR lat : 68° 12.5'N Obs long : 44° 10.6'W

CLOP 1 : 281 ± 90° = 011° - 191°

Ship's course : 327°(T) = N33°W

Distance steamed = 112M

Sin co = dep/dist
sin 33° = dep/112
dep = 61'W

Tan co = dep/d'lat
Tan 33° = 61/d'lat
d'lat = 94' = 1° 34'N

1st DR lat : 68° 12.5'N
d'lat : 1° 34.0'N
2nd DR lat : 69° 46.5'N

1st DR lat : 68° 12.5'N
2nd DR lat : 69° 46.5'N
m'lat : 68° 59.5'N

cos m'lat = dep/d'long
cos 68° 59.5' = 61/d'long
d'long = 170 2' = 2° 50.2'W

1st Obs long : 44° 10.6'W
d'long : 2° 50.2 W
2nd Obs long : 47° 0.8' W

DR lat : 69° 46.5'N Obs long : 047° 0.8'W

CLOP 2 : 358° ± 90° = 088° - 268°

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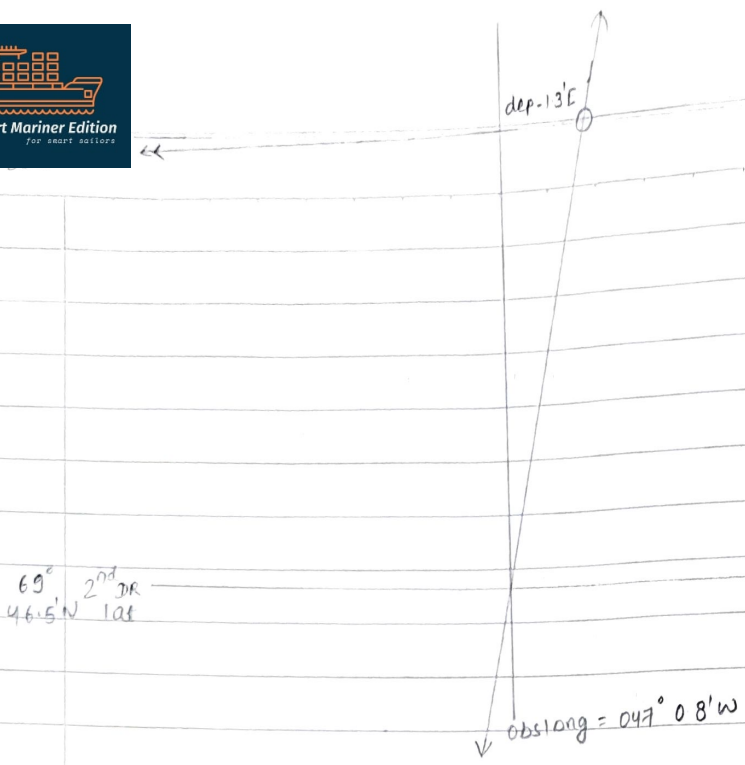

Obs lat : 69° 53.3' N

d'lat : 0.0

2nd fix lat : 69° 53.3' N

cos m'lat = dep/d'long

cos 69° 53.3' = 1.3/d'long

d'long = 3.8' E

2nd obs long : 047° 0.8' W

d'long : 3.8' E

2nd fix long : 047° 57.0' W

So, position of the ship at second observation is

69° 53.3' N 047° 57.0' W

(5) 1st observation:-

Obs lat : 37° 00's DR long : 110° 37' E

CLOP 1 : 090° - 270° (mer. pass.)

- Vessel co : 000° (T) = N

Distance steamed : 87 M

sin co = dep/dist

sin 0° = dep/87

dep = 0

Tan co = dep/d'lat

Tan 0° = 0/d'lat

d'lat = 87' N = 1° 27' N

- Vessel co : 270° (T)

Distance steamed : 101 M

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CO = dep/dist.

sin 90°or 270° = dep/101

dep = 101'W

Final d'lat : 1°27'N

1st obs lat: 37°00's

d'lat : 1°27'N

2nd obs lat : 35°33'S

d'lat = 0.0'

Final dep: 101'W

1st obs lat : 37°00'S

2nd obs lat : 35°33'S

m'lat : 36°16.5'S

cos m'lat = dep/d'long

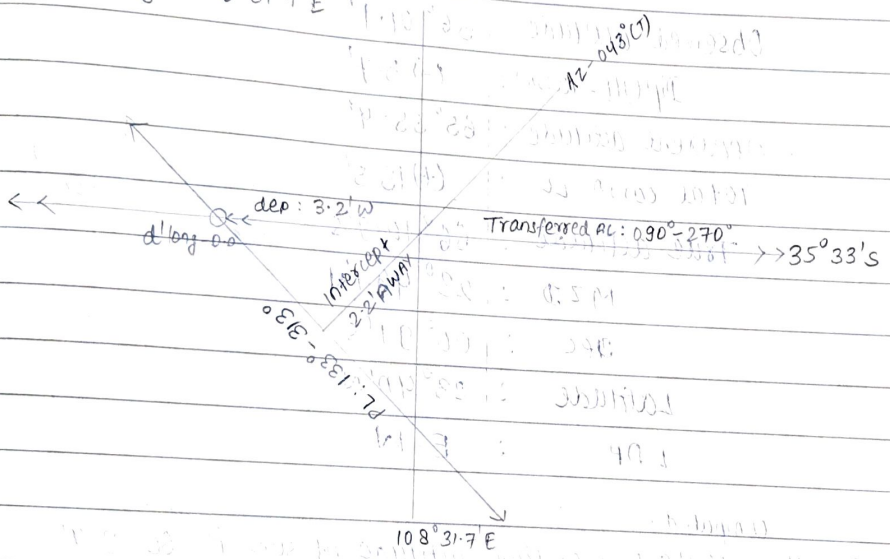
cos 36°16.5' = 101/d'long

d'long ⇒ 125.3' = 2°5.3'W

1st DR long : 110°37'E

d'long : 2°5.3'W

2nd DR long : 108°31.7'E



2nd obs lat : 35°33's

d'lat : 0.0'

2nd fix lat : 35°33's

cos m'lat = dep/d'long

cos 35°33' = 3.2/d'long

d'long = 3.9'W

2nd DR long : 108°31.7'E

d'long : 3.9'W

2nd fix long : 108°27.8'E

Position of ship at time of second observation:

35°33's 108°27.8'E

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UTATION OF ALTITUDES

Worked example 1 - mer alt sun

Soln :- same as Lat by mer. alt sun (just reverse it)

LMT mer. pass: 23d 11h 52m
LIT(E) : (-) 10h 48m
GMT mer. pass : 23d 01h 04m

Declination (23d 01h) : 00° 9.0's
d(1.0) : (+) 0.1
Declination sun : 00° 9.1's

First write the format & start entering values from down

Sextant altitude :	66° 3.4'
IE (On) :	(-) 2.3'
Observed altitude :	66° 01.1'
Dip (HE - 10.5m) :	(-) 5.7'
Apparent altitude :	65° 55.4'
Total corrn LL :	(+) 15.5'
True altitude :	66° 10.9's
MZD :	23° 49.1'N
Dec :	00° 9.1's
Latitude :	23° 40.0'N
LOP :	E - W

23°N (lat)
0°9.1'S (dec)
(opp to T. alt)
diff name subtract

computed.
So, the sextant meridian altitude of sun is 66° 3.4'

Worked example 2 : mer. alt moon.

(U) Approx LMT mer. pass : Aug 24d 05h 56m
Previous day LMT mer. pass : Aug 23d 04h 57m
Difference : 59m

Longitude correction : $\frac{\text{longitude} \times \text{diff.}}{360°}$

$= \frac{103.3 \times 59}{360}$

$= 16.9$

$= 17m$

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Approx LMT mer. pass: Aug 24d 05h 56m
Longitude correction (long E is (-)): 17m
Correct LMT mer. pass: Aug 24d 05h 39m
LIT (E): (-) 06h 53m
GMT mer. pass: Aug 23d 22h 46m

Dec (23d 22h): 25° 13·0'N
d (7·0): (+) 5·4'
Declination Moon: 25° 18·4'N

Sextant altitude:	74° 31·1'	
IE (ON):	(-) 1·6'	
Observed altitude:	74° 29·5'	
Dip (HE-12m):	(-) 6·1'	
Apparent altitude:	74° 23·4'	
Main corrn:	(+) 25·4'	
HP (59·2):	(+) 5·8'	If UL then (-)30'
True altitude:	74° 54·6'N	
MZD:	15° 5·4'S	15° 5·4'~~N~~S
Dec:	25° 18·4'N	
Lat:	10° 13' N	
LOP:	E-W	

lorked example 3: POLARIS