LATITUDE PAR LA MERIDIENNE

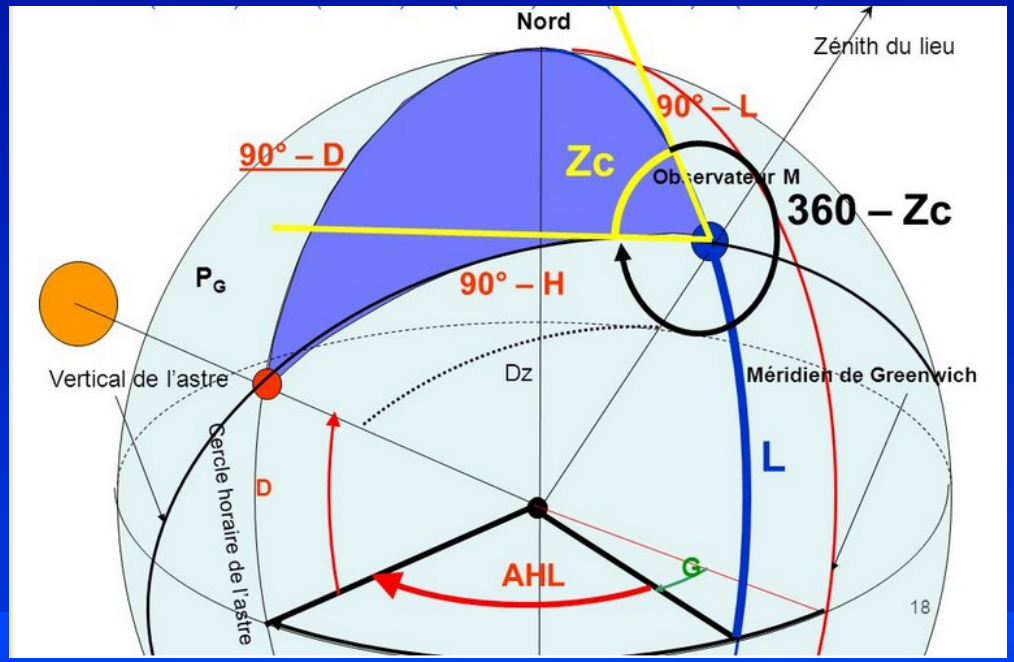
cc BY NC ND

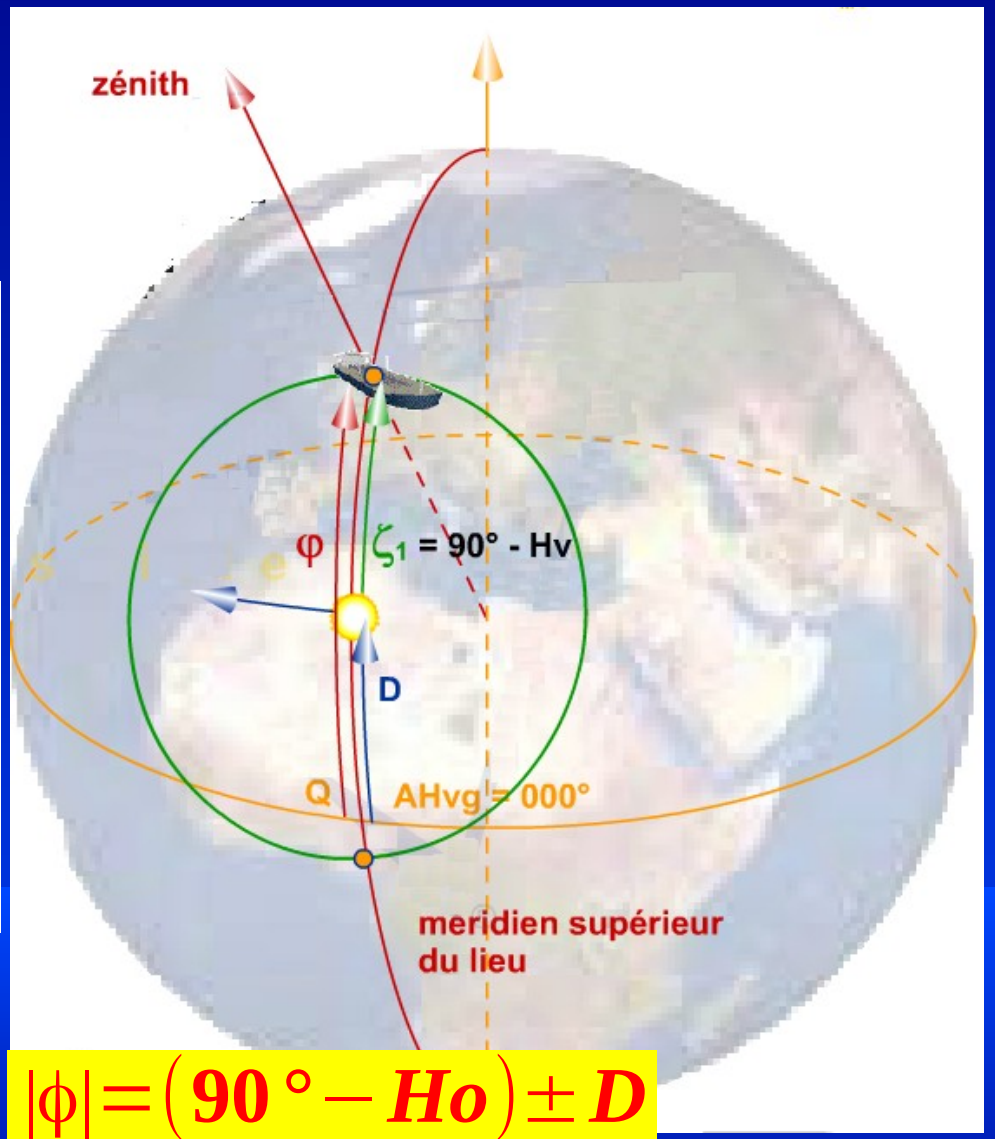
- 1 -
PRINCIPE DE LA MÉRIDIENNE

1- Principe de la méridienne

Le principe

Soleil au méridien du lieu
=> culmination (ho max)





$$|\phi| = (90° - Ho) \pm D$$

1- Principe de la méridienne

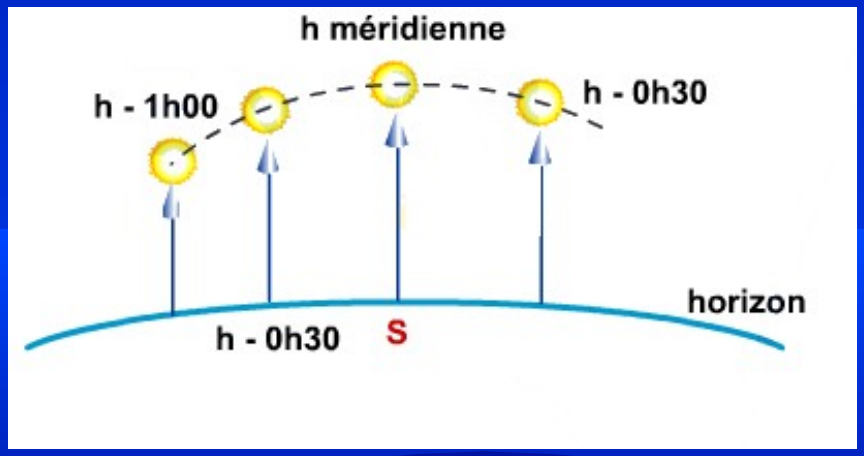
Les différentes méthodes

Soleil au méridien du lieu
=> culmination (ho max)

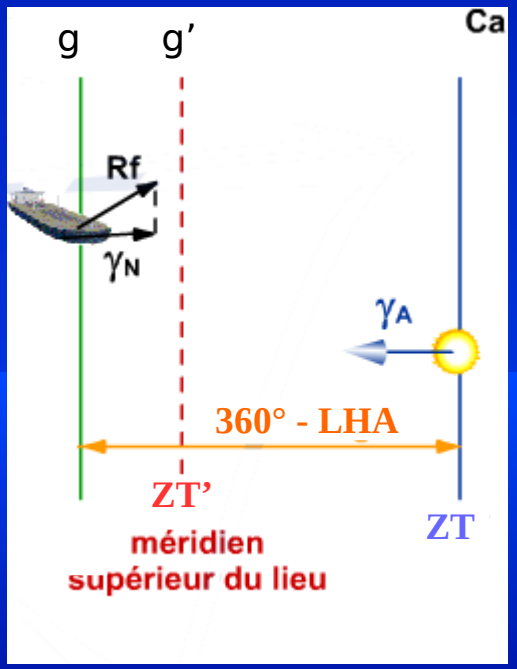
$$|\phi| = (90° - Ho) \pm D$$

Déterminer Ho_{max}
en observant la culmination

Par des mesures fréquentes



Par le calcul de l'heure de passage

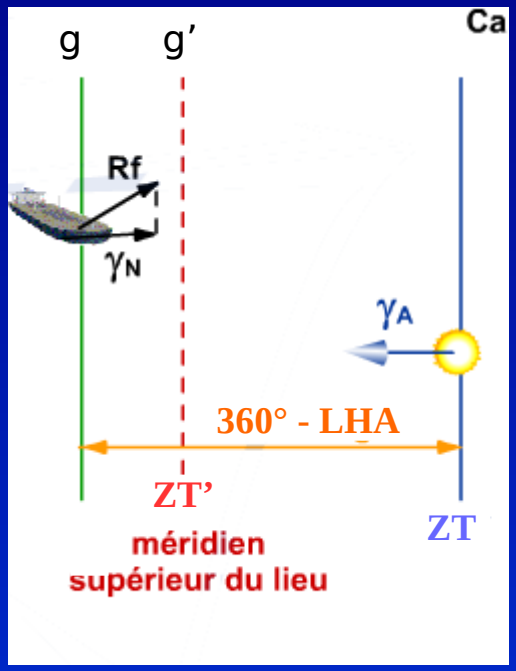


1- Principe de la méridienne

Les formules pour déterminer l'heure de la méridienne

γ_n : vitesse en longitude du navire

$$\gamma_N = \frac{-V_f \cdot \sin(Rf)}{60 \cdot \cos(\phi_e)} \quad (en\ °/h)$$



γ_A : vitesse en longitude de l ' astre

$$\gamma_a = 15\ °/h$$

γ : vitesse relative astre / navire

$$\gamma = \gamma_a - \gamma_N$$

$$\Rightarrow \gamma = 15\ ° + \frac{V_f \cdot \sin(R_f)}{60 \cdot \cos(\phi_e)}$$

Intervalle de temps avant rencontre astre / navire

$$\Delta t = \frac{d}{v} = \frac{360\ ° - LHA_{sun}}{\gamma}$$

$$\Delta t = ZT' - ZT = UT' - UT$$

ZT' : heure fuseau du passage au méridien
UT' : heure universelle du passage au méridien

1- Principe de la méridienne

Méthodoogie

Pour déterminer la latitude par la méridienne, il faut d'abord déterminer l'heure de passage au méridien.

1. **Déterminer l'heure UT_1 à laquelle on a défini la position**

   $UT_1 = ZT_1 + DZ$

2. **Calculer LHA_A à UT_1 et en déduire P**

   $LHA_A = GHA_A - G$

   $P = LHA_A \; si \; LHA_A < 180°$

   $P = 360° - LHA_A \; si \; LHA_A > 180°$

3. **Calculer γ_N et en déduire γ**

   $$\gamma_N = \frac{-V_f \cdot \sin R_f}{60 \cdot \cos \varphi_e} \qquad \gamma = \gamma_A - \gamma_N$$

   $$\gamma_A = 15°/h(soleil)$$

4. **Calculer UT_{pass}/ZT_{pass}**

   $$UT_{pass} = UT_1 + \frac{P}{\gamma}$$

5. **Mesurer la hauteur Ho à UT_{pass}**

6. **Calculer la latitude**

   $$|\varphi| = (90 - h_o) \pm D$$

- 2 -
Exercice - exemple
LATITUDE PAR LA MERIDIENNE

2- Exercice – Latitude par la méridienne

Exemple 1

On 15 november your 0913 zone time fix gives you a position of 22° 30,0'N /068°28,0'W
Your vessel is on course 164°T, and your speed is 13,5 knots.
At local apparent noon, you observed the maximum altitude for the sun Ho = 49°46'

What is the calculated latitude at LAN ?

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1. Déterminer l'heure UT à laquelle on a défini la position

UT = ?

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The observed altitude (Ho) for this sight is 49° 46'.
What is the calculated latitude at LAN ?

2. Déterminer LHAo / P

À 14h 00min	GHA_{sun} =	
Pour 13 min	$+\Delta GHA_{sun}$ =	
À 14h 13min	= GHA_{sun} =	
	-Ge=	
À 14h 13min	LHA_{sun} =	

NOVEMBER 15, 16, 17 (SUN., M

G.M.T.	SUN G.H.A.	SUN Dec.	MOON G.H.A.	MOON v	MOON Dec.	MOON d	MOON H.P.	Lat.	Twilight Naut.	Twilight Civil
	° ′	° ′	° ′	′	° ′	′	′	°	h m	h m
								N 72	07 03	08 39
15 00	183 51.9	S18 24.3	317 46.4	3.8	N21 41.4	1.5	60.4	N 70	06 52	08 15
01	198 51.8	25.0	332 09.2	3.9	21 42.9	1.2	60.4	68	06 43	07 57
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03	228 51.6	26.3	0 55.0	3.9	21 45.3	0.9	60.3	64	06 30	07 30
04	243 51.5	26.9	15 17.9	4.0	21 46.2	0.8	60.3	62	06 24	07 20
05	258 51.4	27.5	29 40.9	4.0	21 47.0	0.7	60.3	60	06 19	07 11
06	273 51.3	S18 28.2	44 03.9	4.1	N21 47.7	0.4	60.2	N 58	06 14	07 03
07	288 51.1	28.8	58 27.0	4.1	21 48.1	0.4	60.2	56	06 10	06 56
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D 12	3 50.6	S18 32.0	130 23.0	4.3	N21 48.2	0.4	60.0	N 40	05 44	06 17
A 13	18 50.5	32.6	144 46.3	4.4	21 47.8	0.6	60.0	35	05 38	06 08
Y 14	33 50.4	33.3	159 09.7	4.4	21 47.2	0.7	60.0	30	05 31	06 00
15	48 50.3	33.9	173 33.1	4.5	21 46.5	0.9	59.9	20	05 19	05 46
16	63 50.2	34.5	187 56.6	4.6	21 45.6	1.1	59.9	N 10	05 07	05 33
17	78 50.1	35.2	202 20.2	4.6	21 44.5	1.2	59.9	0	04 54	05 19
18	93 50.0	S18 35.8	216 43.8	4.6	N21 43.3	1.3	59.8	S 10	04 39	05 05
19	108 49.9	36.4	231 07.4	4.7	21 42.0	1.5	59.8	20	04 21	04 49
20	123 49.8	37.1	245 31.1	4.8	21 40.5	1.6	59.8	30	03 58	04 29
21	138 49.6	37.7	259 54.9	4.9	21 38.9	1.8	59.7	35	03 43	04 17
22	153 49.5	38.3	274 18.8	4.9	21 37.1	2.0	59.7	40	03 26	04 03
23	168 49.4	38.9	288 42.7	5.0	21 35.1	2.0	59.6	45	03 03	03 46
16 00	183 49.3	S18 39.6	303 06.7	5.0	N21 33.1	2.3	59.6	S 50	02 32	03 24
01	198 49.2	40.2	317 30.7	5.2	21 30.8	2.3	59.6	52	02 16	03 14

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At local apparent noon, you observed the maximum altitude for the sun Ho = 49°46'

What is the calculated latitude at LAN ?

1. Déterminer l'heure UT à laquelle on a défini la position

UT = ZT + DZ avec DZ= arrondi (Ge/15) = arrondi (68° 28'/15°) = 5
= 9h13+5h
= 14h 13min

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What is the calculated latitude at LAN ?

2. Déterminer LHAo / P

À 14h 00min	GHA_{sun} =	33 °50,4'
Pour 13 min	$+\Delta GHA_{sun}$ =	3° 15'
À 14h 13min	= GHA_{sun} =	37° 05,4'
	-Ge=	-68°28'
À 14h 13min	LHA_{sun} =	- 31° 22,6'
	=	328° 37,4'

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2. Déterminer γ

$$\gamma_N = \frac{-V_f \cdot \sin(Rf)}{60 \cdot \cos(\phi_e)}$$

$$\gamma_A = 15°$$

$$d'ou\ \gamma = \gamma_A - \gamma_N$$

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2. Déterminer γ

$$\gamma_N = \frac{-V_f \cdot \sin(Rf)}{60 \cdot \cos(\phi_e)} = \frac{-13{,}5 \cdot \sin(164)}{60 \cdot \cos(22°30')} = -0{,}067°/h$$

$$\text{¿}\ \gamma_A = 15°$$

$$d'ou\ \gamma = \gamma_A - \gamma_N = 15{,}067°/h$$

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3. Déterminer $UT_{pass\ mer}$

$$UT_{pass} = UT + \frac{360 - LHA_{sun}}{\gamma}$$

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3. Déterminer $UT_{pass\ mer}$

$$UT_{pass} = UT + \frac{360° - LHA_{sun}}{\gamma} = 14\,h\,19 + \frac{31°\,22{,}6°}{15{,}067°} = 14\,h\,19 + 2\,h\,04\,min\,56\,s = 16\,h\,17\,min\,56\,s \simeq 1$$

Ce qui fait ZT_{pass} =11h 18 min , c'est cohérent

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3. Déterminer Ho

Ho donné directement ici
ho= 49°46'i

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NOVEMBER 15, 16, 17 (SUN., M

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		G.H.A.		Dec.	G.H.A.	v	Dec.	d	H.P.		Naut.		Civil	
d	h	° ′		° ′	° ′	′	° ′	′	′	°	h	m	h	m
15	00	183 51.9	S18	24.3	317 46.4	3.8	N21 41.4	1.5	60.4	N 72	07	03	08	39
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	04	243 51.5		26.9	15 17.9	4.0	21 46.2	0.8	60.3	64	06	30	07	30
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										52	02	16	03	14

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The observed altitude (Ho) for this sight is 49° 46'.
What is the calculated latitude at LAN ?

2. Déterminer la latitude

	D_{sun} =	
	$+\Delta D_{sun}$ =	_____
	= D_{sun} =	

90°	90 °
- ho	_____
ZD =	
+/-D	_____
φ=	

NOVEMBER 15, 16, 17 (SUN., M

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U	10	333 50.8	30.7	101 36.4	4.3	21 48.7	0.2	60.1	50	05 59	06 38
N	11	348 50.7	31.4	115 59.7	4.3	21 48.5	0.3	60.1	45	05 51	06 27
D	12	3 50.6	S18 32.0	130 23.0	4.3	N21 48.2	0.4	60.0	N 40	05 44	06 17
A	13	18 50.5	32.6	144 46.3	4.4	21 47.8	0.6	60.0	35	05 38	06 08
Y	14	33 50.4	33.3	159 09.7	4.4	21 47.2	0.7	60.0	30	05 31	06 00
	15	48 50.3	33.9	173 33.1	4.5	21 46.5	0.9	59.9	20	05 19	05 46
	16	63 50.2	34.5	187 56.6	4.6	21 45.6	1.1	59.9	N 10	05 07	05 33
	17	78 50.1	35.2	202 20.2	4.6	21 44.5	1.2	59.9	0	04 54	05 19
	18	93 50.0	S18 35.8	216 43.8	4.6	N21 43.3	1.3	59.8	S 10	04 39	05 05
	19	108 49.9	36.4	231 07.4	4.7	21 42.0	1.5	59.8	20	04 21	04 49
	20	123 49.8	37.1	245 31.1	4.8	21 40.5	1.6	59.8	30	03 58	04 29
	21	138 49.6	37.7	259 54.9	4.9	21 38.9	1.8	59.7	35	03 43	04 17
	22	153 49.5	38.3	274 18.8	4.9	21 37.1	2.0	59.7	40	03 26	04 03
	23	168 49.4	38.9	288 42.7	5.0	21 35.1	2.0	59.6	45	03 03	03 46
16	00	183 49.3	S18 39.6	303 06.7	5.0	N21 33.1	2.3	59.6	S 50	02 32	03 24
	01	198 49.2	40.2	317 30.7	5.2	21 30.8	2.3	59.6	52	02 16	03 14

2- Exercice – Latitude par la méridienne

Exemple 1

On 15 november your 0913 zone time fix gives you a position of 22° 30,0'N /068°28,0'W
Your vessel is on course 164°T, and your speed is 13,5 knots.
Local apparent noon (LAN) occurs at 11:18 ZT at which tim meridian latitude of the Sun's Lower limb is observed.
The observed altitude (Ho) for this sight is 49° 46'.
What is the calculated latitude at LAN ?

2. Déterminer la latitude

À 16h 00min	D_{sun} =	
Pour 18 min et d=0,6'	$+\Delta D_{sun}$ =	
À 16h 38min	= D_{sun} =	

	90°
-ho	
ZD =	
+/-D	
φ=	

NOVEMBER 15, 16, 17 (SUN., M

G.M.T.	SUN G.H.A.	SUN Dec.	MOON G.H.A.	MOON v	MOON Dec.	MOON d	MOON H.P.	Lat.	Twilight Naut.	Twilight Civil
d h	° ′	° ′	° ′	′	° ′	′	′	°	h m	h m
								N 72	07 03	08 39
15 00	183 51.9	S18 24.3	317 46.4	3.8	N21 41.4	1.5	60.4	N 70	06 52	08 15
01	198 51.8	25.0	332 09.2	3.9	21 42.9	1.2	60.4	68	06 43	07 57
02	213 51.7	25.6	346 32.1	3.9	21 44.1	1.2	60.3	66	06 36	07 42
03	228 51.6	26.3	0 55.0	3.9	21 45.3	0.9	60.3	64	06 30	07 30
04	243 51.5	26.9	15 17.9	4.0	21 46.2	0.8	60.3	62	06 24	07 20
05	258 51.4	27.5	29 40.9	4.0	21 47.0	0.7	60.3	60	06 19	07 11
06	273 51.3	S18 28.2	44 03.9	4.1	N21 47.7	0.4	60.2	N 58	06 14	07 03
07	288 51.1	28.8	58 27.0	4.1	21 48.1	0.4	60.2	56	06 10	06 56
08	303 51.0	29.4	72 50.1	4.2	21 48.5	0.1	60.2	54	06 06	06 50
S 09	318 50.9	30.1	87 13.3	4.1	21 48.6	0.1	60.1	52	06 02	06 44
U 10	333 50.8	30.7	101 36.4	4.3	21 48.7	0.2	60.1	50	05 59	06 38
N 11	348 50.7	31.4	115 59.7	4.3	21 48.5	0.3	60.1	45	05 51	06 27
D 12	3 50.6	S18 32.0	130 23.0	4.3	N21 48.2	0.4	60.0	N 40	05 44	06 17
A 13	18 50.5	32.6	144 46.3	4.4	21 47.8	0.6	60.0	35	05 38	06 08
Y 14	33 50.4	33.3	159 09.7	4.4	21 47.2	0.7	60.0	30	05 31	06 00
15	48 50.3	33.9	173 33.1	4.5	21 46.5	0.9	59.9	20	05 19	05 46
16	63 50.2	34.5	187 56.6	4.6	21 45.6	1.1	59.9	N 10	05 07	05 33
17	78 50.1	35.2	202 20.2	4.6	21 44.5	1.2	59.9	0	04 54	05 19
18	93 50.0	S18 35.8	216 43.8	4.6	N21 43.3	1.3	59.8	S 10	04 39	05 05
19	108 49.9	36.4	231 07.4	4.7	21 42.0	1.5	59.8	20	04 21	04 49
20	123 49.8	37.1	245 31.1	4.8	21 40.5	1.6	59.8	30	03 58	04 29
21	138 49.6	37.7	259 54.9	4.9	21 38.9	1.8	59.7	35	03 43	04 17
22	153 49.5	38.3	274 18.8	4.9	21 37.1	2.0	59.7	40	03 26	04 03
23	168 49.4	38.9	288 42.7	5.0	21 35.1	2.0	59.6	45	03 03	03 46
16 00	183 49.3	S18 39.6	303 06.7	5.0	N21 33.1	2.3	59.6	S 50	02 32	03 24
01	198 49.2	40.2	317 30.7	5.2	21 30.8	2.3	59.6	52	02 16	03 14

2- Exercice – Latitude par la méridienne

Exemple 1

On 15 november your 0913 zone time fix gives you a position of 22° 30,0'N /068°28,0'W
Your vessel is on course 164°T, and your speed is 13,5 knots.
Local apparent noon (LAN) occurs at 11:18 ZT at which tim meridian latitude of the Sun's Lower limb is observed.
The observed altitude (Ho) for this sight is 49° 46'.
What is the calculated latitude at LAN ?

2. Déterminer la latitude

À 16h 00min	D_{sun} =	18 °34,5' S
Pour 18 min et d=0,6'	$+\Delta D_{sun}$ =	00° 00,2'
À 16h 38min	= D_{sun} =	18° 34,7' S

	90°
-ho	- 49° 46,0'
ZD =	40° 14,0'
+/-D	- 18° 34,7'
φ=	21°39,3 **N**

NOVEMBER 15, 16, 17 (SUN., M

G.M.T.		SUN G.H.A.	SUN Dec.	MOON G.H.A.	MOON v	MOON Dec.	MOON d	MOON H.P.	Lat.	Twilight Naut.	Twilight Civil
		° ′	° ′	° ′	′	° ′	′	′		h m	h m
									N 72	07 03	08 39
15	00	183 51.9	S18 24.3	317 46.4	3.8	N21 41.4	1.5	60.4	N 70	06 52	08 15
	01	198 51.8	25.0	332 09.2	3.9	21 42.9	1.2	60.4	68	06 43	07 57
	02	213 51.7	25.6	346 32.1	3.9	21 44.1	1.2	60.3	66	06 36	07 42
	03	228 51.6	26.3	0 55.0	3.9	21 45.3	0.9	60.3	64	06 30	07 30
	04	243 51.5	26.9	15 17.9	4.0	21 46.2	0.8	60.3	62	06 24	07 20
	05	258 51.4	27.5	29 40.9	4.0	21 47.0	0.7	60.3	60	06 19	07 11
	06	273 51.3	S18 28.2	44 03.9	4.1	N21 47.7	0.4	60.2	N 58	06 14	07 03
	07	288 51.1	28.8	58 27.0	4.1	21 48.1	0.4	60.2	56	06 10	06 56
	08	303 51.0	29.4	72 50.1	4.2	21 48.5	0.1	60.2	54	06 06	06 50
S	09	318 50.9	30.1	87 13.3	4.1	21 48.6	0.1	60.1	52	06 02	06 44
U	10	333 50.8	30.7	101 36.4	4.3	21 48.7	0.2	60.1	50	05 59	06 38
N	11	348 50.7	31.4	115 59.7	4.3	21 48.5	0.3	60.1	45	05 51	06 27
D	12	3 50.6	S18 32.0	130 23.0	4.3	N21 48.2	0.4	60.0	N 40	05 44	06 17
A	13	18 50.5	32.6	144 46.3	4.4	21 47.8	0.6	60.0	35	05 38	06 08
Y	14	33 50.4	33.3	159 09.7	4.4	21 47.2	0.7	60.0	30	05 31	06 00
	15	48 50.3	33.9	173 33.1	4.5	21 46.5	0.9	59.9	20	05 19	05 46
	16	63 50.2	34.5	187 56.6	4.6	21 45.6	1.1	59.9	N 10	05 07	05 33
	17	78 50.1	35.2	202 20.2	4.6	21 44.5	1.2	59.9	0	04 54	05 19
	18	93 50.0	S18 35.8	216 43.8	4.6	N21 43.3	1.3	59.8	S 10	04 39	05 05
	19	108 49.9	36.4	231 07.4	4.7	21 42.0	1.5	59.8	20	04 21	04 49
	20	123 49.8	37.1	245 31.1	4.8	21 40.5	1.6	59.8	30	03 58	04 29
	21	138 49.6	37.7	259 54.9	4.9	21 38.9	1.8	59.7	35	03 43	04 17
	22	153 49.5	38.3	274 18.8	4.9	21 37.1	2.0	59.7	40	03 26	04 03
	23	168 49.4	38.9	288 42.7	5.0	21 35.1	2.0	59.6	45	03 03	03 46
16	00	183 49.3	S18 39.6	303 06.7	5.0	N21 33.1	2.3	59.6	S 50	02 32	03 24
	01	198 49.2	40.2	317 30.7	5.2	21 30.8	2.3	59.6	52	02 16	03 14