

Just a Little Math on a \$12 Calculator

To enter 30° degrees, 30' minutes and 30" seconds of Arc into the calculator, first convert the seconds to a decimal of the minutes $30' \frac{30''}{60} = 30.5'$. Then convert the minutes to a decimal $\frac{30.5'}{60} = .5083$. Now add the degree 30.5083° into the calculator memory(s). Try to enter the latitude first, declination second and local hour angle 3rd, as this sequence is common to all the formulas.

Break the formula into two parts when the division is required and save each part in stored memory, then divide as indicated. Use the inverse key as indicated, (\sin^{-1} or \cos^{-1}) for the answer. Convert the decimal by multiplying $60 \times .5 = 30'$ etc.

To Get Longitude:

West LHA under 180° subtract LHA from GHA

East LHA over 180° add (LHA – 360) to GHA

ZN = 360° - Z = Azimuth when LHA is 0° to 180°

ZN = Z = Azimuth when LHA is 180° to 360°

Just a Little More Math

decimal

(L) Latitude = $30^\circ \frac{20.0'}{60} = 30.3333^\circ$ H_c Height calculated = 48.2673°

(d) declination = $21^\circ \frac{25.0'}{60} = 21.4166^\circ$ H_o Height observed = 48.2673°

(t) Local Hour Angle (LHA) = $45^\circ \frac{38.0'}{60} = 45.6333^\circ$ **GHA 135° 38' SUN**

Ship's Longitude = 90° West

$$H_c = \sin^{-1} \left(\frac{30.3333^\circ}{L\cos} \times \frac{21.4166^\circ}{d\cos} \times \frac{45.6333^\circ}{t\cos} \right) + \left(\frac{30.3333^\circ}{L\sin} \times \frac{21.4166^\circ}{d\sin} \right) = 48.2673^\circ = 48^\circ 16'$$

.561850983 **.184408055**

$$Z = \cos^{-1} \left[\left(\frac{21.4166^\circ}{d\sin} - \frac{30.3333^\circ}{L\sin} \times \frac{48.2673^\circ}{h\cos} \right) \div \left(\frac{30.3333^\circ}{L\cos} \times \frac{48.2673^\circ}{h\cos} \right) \right] = \frac{359^\circ 60'}{268^\circ 50'} = 269^\circ = ZN$$

(-.011735867) **÷** **(.574529461)** **=** **269° = ZN**

$$LHA = +/- \cos^{-1} \left[\left(\frac{48.2673^\circ}{H\sin} - \frac{30.3333^\circ}{L\sin} \times \frac{21.4166^\circ}{d\sin} \right) \div \left(\frac{30.3333^\circ}{L\cos} \times \frac{21.4166^\circ}{d\cos} \right) \right] = 45^\circ 38'$$

(.561848693) **÷** **(.803505025)** **=** **45.6333**

GHA	=	135° 38'
LHA	=	45° 38'
Ship's Longitude	=	90° 0.0'

90 JUST 89
A LITTLE
REAL
MATH

$H_s = 9^\circ 57'$
 $H_o = 10^\circ 07' = 10.1166$

$L = 29^\circ 47.8'$
 29.7966

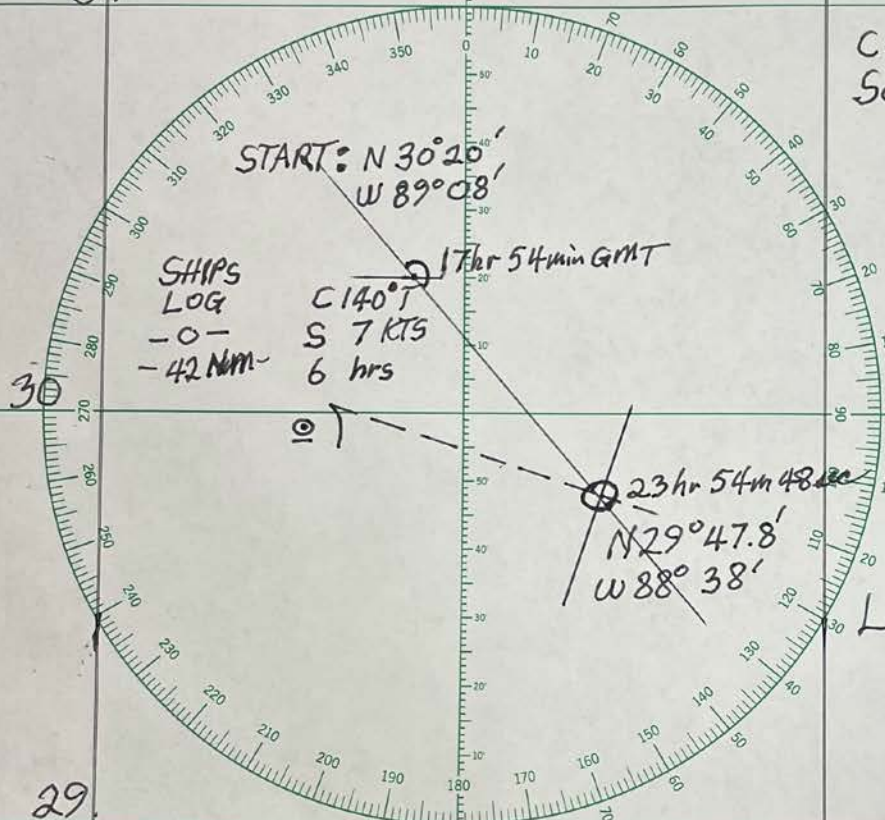
$d = 21^\circ \frac{32.7'}{60} = 21.545$

$ZN = 289^\circ T$

88 May 28 2023
LMT 17 hr 53 min 48 sec SHOT
+ 6 hr
GMT 23 hr 53 min 48 sec

Sun \odot $165^\circ 40'$ $d + 0.4$
 $13^\circ 27'$ $N 21^\circ 32.3'$

GHA $\frac{179^\circ 07'}{40.4}$ $N 21^\circ 32.7'$



31
COSINE 140° = $-.7660 \times 42$ NM
South Latitude $-32.2'$

N 30° 20'
- 32.2'

N 29° 47.8'

SHIPS DR Latitude
GMT 23 hr 53 min 48 sec

30
GHA \odot 179° 07'
WEST LHA $-90^\circ 29'$

LONGITUDE W $88^\circ 38'$
at GMT 23 hr 53 min 48 sec

29
 $\cos^2 \left[\frac{\sin H_o - \sin L \cdot \sin d}{\cos L \cdot \cos d} \right]$
 $.006833809 \quad .807161617$

$INV = -.008466469 \text{ COSINE}^{-1}$
 $LHA = 90.48509873^\circ = 90^\circ 29'$

