EX 1

Sin (hc) = [Cos(D-L) - Cos(D+L)] /2 + [Cos(S) + Cos(S-2D) + Cos(S-2L) + Cos(S-2t)] /4 . (S def. as D+L+ t)

1.

D :	10°	in arc min D :	600
		2D :	1200
L :	20°	in arc min L :	1200
		2L :	2400
t :	30°	in arc min t :	1800
		2t :	3600

1. t : -180° to +180°
2. Transform angles to arc min .
3. Negative angles may not necessarily be wrong!
4. Value, sign of cos()? See Adjustment below.
5: Use the algebraic sign rules !!

2.

D	600	D	600	(D+L)	1800
-L	− 1200	+L	+ 1200	+t	1800
A = (D-L)	− 600	A = (D+L)	1800	S: A=(D+L+t)	3600
Rule :	#1,2	Rule :	#2	Rule :	#2
Sign of cos :	⊕	Sign of cos :	⊕	Sign of cos :	⊕
B = (D-L)	600	B = (D+L)	1800	B = (D+L+t)	3600
cos(D-L) :	⊕9848	cos(D+L) :	⊕ 8060	cos(S) :	⊕ 5000

S	3600	S	3600	S	3600
-2D	−1200	-2L	− 2400	-2t	−3600
A = (S-2D)	2400	A = (S-2L)	1200	A = (S-2t)	0
Rule :	#2	Rule :	#2	Rule :	#
Sign of cos :	⊕	Sign of cos :	⊕	Sign of cos :	O
B = (S-2D)	2400	B = (S-2L)	1200	B = (S-2t)	
cos(S-2D) :	⊕7660	cos(S-2L) :	⊕ 9396	cos(S-2t) :	⊕ 10,000

32057 : 4

= 8014

3.

Put pos values under "if pos".
Put neg values under "if neg".
Total both.
Put the neg. total under the pos. total.
Subtract.

	if pos	if neg
cos(S)	5000	
cos(S-2D)	7660	
cos(S-2L)	9396	
cos(S-2t)	10000	
+/−	32,057	
−		
=	32,057	
* ¼: Q =	8014	

COS(D-L)	9848
COS(D+L)	8060
−	1188
* ½: P =	594

Q	8014
P	594
Q+P :	8636

	5400'
−	1836'
	3564'

hc = 3564/60 = 59° 24'

hc in amin :

Final calculation to find hc :

Ex: Assume Q+P contains 2345 .
a. find 2345 in cos( ) - column.
b. in cell left of 2345 find 4586'.
c. enter 4586' into field under 5400'.
d. subtraction yields hc in amin.

7/25/2013

For correct cos() value adjust sign and angle:

Rule # 1 :	Rule # 2 :	Rule # 3 :	Rule # 4 :	Rule # 5 :	Rule # 6 :
A < 0 ⟵ 0	0 ⟷ 5,400'	5,400' ⟷ 10,800'	10,800' ⟷ 16,200'	16,200' ⟷ 21,600'	21,600' ⟶ A > 21,600'
A = − A repeat	B = A cos : +	B = 10,800' − A cos : −	B = A − 10,800' cos : −	B = 21,600' − A cos : +	B = B − 21,600' repeat
Example: A = − 12,345' Result: A = + 12,345' repeat	A = 2345' B = 2345' cos : + 8066	A = 8455' B = 10,800' − 8455' B = 2345' cos : − 8066	A = 13,145' B = 13,145' − 10,800' = 2345' cos : − 8066	A = 19,255' B = 21,600' − 19,455' = 2345' cos : + 8066	A = 34,567' A = 34,567' − 21,600' = 2967' repeat

LHA = 313° ~ t = -470

EX2, G, LA Pool

Sin (hc) = [Cos(D-L) - Cos(D+L)] /2 + [Cos(S) + Cos(S-2D) + Cos(S-2L) + Cos(S-2t)] /4 . (S def. as D+L+ t)

1.

D :	-14°48'	in arc min D :	-888
		2D :	-1776
L :	26°	in arc min L :	1560
		2L :	3120
t :	-47°	in arc min t :	-2820
		2t:	-5640

1. t : -180° to +180°.
2. Transform angles to arc min !
3. Negative angles may not necessarily be wrong!
4. Value, sign of cos()? See Adjustment below.
5. Use the algebraic sign rules !!

2.

D	-888	D	-888	(D+L)	672
-L	-1560	+L	+1560	+t	-2820
A = (D-L)	-2,448	A = (D+L)	+672	S: A=(D+L+t)	-2148
Rule :	#1,2	Rule :	#2	Rule :	#1,2
Sign of cos :	⊕	Sign of cos :	⊕	Sign of cos :	⊕
B = (D-L)	2448	B = (D+L)	672	B = (D+L+t)	2148
cos(D-L) :	⊕ 7569	cos(D+L) :	⊕ 9809	cos(S) :	⊕ 8810

S	-2148	S	-2148	S	-2148
-2D	+1776	-2L	-3120	-2t	+5640
A = (S-2D)	-372	A = (S-2L)	-5268	A = (S-2t)	+3492
Rule :	#1,2	Rule :	#1,2	Rule :	#2
Sign of cos :	⊕	Sign of cos :	⊕	Sign of cos :	⊕
B = (S-2D)	372	B = (S-2L)	5268	B = (S-2t)	3492
cos(S-2D) :	⊕ 9941	cos(S-2L) :	⊕ 383	cos(S-2t) :	⊕ 5269

3.

Put pos values under 'if pos'
Put neg values under 'if neg'.
Total both.
Put the neg. total under the pos. total.
Subtract.

cos(S)	if pos 8110	if neg
cos(S-2D)	if pos 9941	if neg
cos(S-2L)	if pos 383	if neg
cos(S-2t)	if pos 5269	if neg
+	23703	
−		
=	23703	
* ¼: Q =	5926	

COS(D-L)	7569
COS(D+L)	9807
−	-2240
* ½: P =	-1120

Q	5926
P	-1120
Q+P :	4806

	5400'
−	3676'
	1724

hc in amin :

Final calculation to find hc :

Ex: Assume Q+P contains 2345.
a. find 2345 in cos( ) - column.
b. in cell left of 2345 find 4586'.
c. enter 4586' into field under 5400'.
d. subtraction yields hc in amin.

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23705 : 4
37
10
25

5926

a = 60 : 28° 44'

MATLAB:
hc
28.7285°
= 28° 43.4'

For correct cos() value adjust sign and angle:

Rule # 1 :	Rule # 2 :	Rule # 3 :	Rule # 4 :	Rule # 5 :	Rule # 6 :
A < 0 ⟵ 0	0 ⟷ 5,400'	5,400' ⟷ 10,800'	10,800' ⟷ 16,200'	16,200' ⟷ 21,600'	21,600' ⟶ A > 21,600'
A = − A repeat	B = A cos : +	B = 10,800' − A cos : −	B = A − 10,800' cos : −	B = 21,600' − A cos : +	B = B − 21,600' repeat
Example: A = − 12,345' :	A = 2345' :	A = 8455' :	A = 13,145' :	A = 19,255' :	A = 34,567' :
Result: A = + 12,345' repeat	B = 2345' cos : + 8066	B = 10,800' − 8455' B = 2345' cos : − 8066	B = 13,145' − 10,800' = 2345' cos : − 8066	B = 21,600' − 19,455' = 2345' cos : + 8066	A = 34,567' − 21,600' = 2967' repeat