

# GET YOUR ACCURATE QIBLA DIRECTION (WITHOUT A COMPASS)

## The Most Accurate Method

It is not advisable to determine the **Qibla** specially for a Masjid using an ordinary compass. The following method which uses the sun is more reliable and accurate. It has been observed for centuries and reported in many books by Muslims around the world that two times a year the sun comes overhead above Ka'bah. This is observational fact for centuries, and is used to set the correct Qibla direction in places far from Makkah by Muslims for last so many centuries. Those two dates and times are:

**May 28 at 12:18pm Local Civil Time at Makkah**

**July 16 at 12:27pm Local Civil Time at Makkah**

When you observe the sun at these times (after converting it to your local time, see Table below), you will be facing the Ka'bah giving you Qibla direction, because if there were a very high minaret over Ka'bah reaching up to the sky, then you will see it just like you are seeing the sun. Now, let us take a few examples.

If you are in Islamabad, Pakistan (+2 hours time difference from Makkah time), the local time to observe the sun would be 2:18pm on **May 28**, and 2:27pm on **July 16**.

Similarly, if you are in Nova Scotia, Canada (-6 hours time difference from Makkah time), the local time to observe the sun would be 6:18am on **May 28**, and 6:27am on **July 16**.

The following table provides the local time for several countries when one can face toward the sun to determine the Qibla on those two dates. Consideration has been given for Daylight Saving Time in countries that observe it during summer (marked \*).

Countries with several time zones have been listed with major cities in different time zones. In North America (cities shown in color) the sun can only be seen in Northeast corridor from Providence, RI to Montreal, Quebec.

For other cities in North America, the sun is not visible at noon time of Makkah, however, in those cities the sun rises a few hours later. By looking at the rising sun, one can estimate where the sun was a few hours earlier to give an approximate Qibla direction.

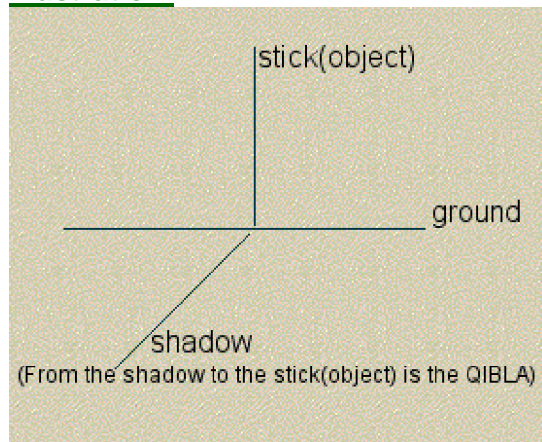
Local Time facing sun gives Qibla		
PLACE	May 28	July 16
Afghanistan	13:48	13:57
Bangladesh	15:18	15:27
Bosnia	11:18*	11:27*
Burma	15:18	15:27
Canada, Montreal	15:18*	5:27*
Egypt	11:18	11:27

France	11:18*	11:27*
Germany	11:18*	11:27*
India	14:48	14:57
Indonesia, Jakarta	16:18	16:27
Iran	13:48*	13:57*
Malaysia	17:18	17:27
Pakistan	14:18	14:27
Palestine	12:18*	12:27*
South Africa	11:18	11:27
United Kingdom	10:18*	10:27*

\* means that these times are local Daylight Saving Times as observed in those countries.

FOR EXAMPLE: In South Africa on **July 16 at 11:27 am** or on **May 28 at 11:18 am**, the 'SHADOW' the sun casts on an object ('stick') will be in the direction of the Qibla.

**Illustration:**



*Khalid Shaukat is a consultant to ISNA, Fiqh Council Of North America, and Shura Council of North America for the matters of Qibla Direction, Prayer Times, and Moonsighting. He has specialized in physics, mathematics, computer programming, and computational astronomy; he is actively doing research work for over 2 decades on Moonsighting, Islamic Calendar, Prayer Schedule, and Qibla Direction serving Muslim Ummah all across the world. He has provided Salaat Schedules, Qibla Directions, and Moonsighting information to over 178 countries (over 2500 cities) in the world including polar regions (Norway, Sweden, Finland, and Alaska), where sun does not rise or set for several months. Several masjids in USA, Puerto Rico, and Canada have been built with his help, setting masjid orientations in the proper Qibla direction.*



# DIRECTION FOR KABAHA (Mathematical) - FROM ANYWHERE

Bismillah hir-Rahman nir-Rahim

(I begin with the Name of ALLAH, The Most Beneficent, The Most Merciful)

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*****  
* THE MUSLIM STUDENTS' ASSOCIATION OF COLUMBIA UNIVERSITY *  
* 102 Earl Hall, Columbia University, NEW YORK, NY 10027 *  
*****  
1 Muharram 1415  
11 June 1994
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*****  
* DIRECTION FOR KABAHA (Mathematical) - FROM ANYWHERE *  
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The calculation for the Mathematical Direction for Kabah from any point on the surface of the world is a comparatively simple calculation.

(NOTE: I am NOT presenting a Proof by Fiqh. I am only presenting the information, based on Spherical Trigonometry.)

The calculations are based on SPHERICAL TRIGONOMETRY.

(The actual shape of the earth can be better approximated as an oblate ellipsoid of revolution, or spheroid. For the present, only a spherical shape has been considered. The variation is not much, for the purposes of determining the direction for the Kabah. In future, the other shapes will be included, inshallah.)

There are some references given at the end of this document.

The information is presented in the following sections:

- A. Overview.
- B. True Directions (and Magnetic) for the Kabah from various cities around the world.
- C. Spherical Trigonometry (Fundamentals).
- D. Examples: 1. Points around the North Pole (NP), all on the same Latitude, NEAR THE NP.  
2. Points around the North Pole, on constant Latitudes, upto Equator.

3. Points on the same Latitude as Kabah.
4. Points all around Kabah (0 Deg to 360 Deg).
5. Points on the same Longitude as Kabah.
6. Points at approximately the center of U.S.A., France, Australia, Japan.

E. References.

A. OVERVIEW  
\*\*\*\*\*

SPHERICAL TRIGONOMETRY IS USED. This is because the Latitudes, Longitudes, and the Cardinal Directions (North, N; South, S; East, E; and West, W) are all defined on an equivalent sphere representing the Earth. The Equivalent Earth radius is 6,378.14 Kilometers.

THE SHORTEST DISTANCE BETWEEN ANY TWO POINTS IS ALONG A GREAT CIRCLE.  
\*\*\*\*\*

Consider two places "A" and "B".  
If "B" is North-East (N-E) of "A", then IT IS POSSIBLE that "A" is North-West (N-W) of "B" (Note: NOT South-West, S-W) !!!

This is because of the definitions of N, S, E, and W directions and the changing North direction (when viewed globally) from point to point. Please see the examples presented in Section D.

IN NORTH AMERICA, THE QIBLA IS MOSTLY NORTH-OF-EAST.  
\*\*\*\*\*  
Please see Section B for actual values of the directions for the Qibla at places all around the globe.

COUNTRY	Latitude	Longitude	QIBLA DIRECTION (From TRUE NORTH)
=====			
Australia:	30 Deg S	130 Deg E	289 Deg E-of-N (19 Deg N of W)
France:	43 Deg N	3 Deg E	113 Deg E-of-N (23 Deg S of E)
Japan:	35 Deg N	140 Deg E	293 Deg E-of-N (23 Deg N of W; NOT S of W !!)
U.S.A.:	40 Deg N	100 Deg W	39 Deg E-of-N (51 Deg N of E; NOT S of E !!)

The difference between the TRUE NORTH direction and the MAGNETIC NORTH direction varies from place to place and also varies slightly every year. The "Variation" between the True and Magnetic North, at places around the world, can vary upto nearly 25 Degrees East and 25 Degrees West, for the list of places mentioned in Section B, and the actual value of the variation can be easily obtained from Reference 2.

"AND ALLAH (swt) KNOWS BEST, AND HE IS MOST WISE"  
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B. KIBLA DIRECTION  
\*\*\*\*\*

QIBLA DIRECTIONS FROM AROUND THE WORLD

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Dr.Mohibullah N.Durrani  
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11 June 1994

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D I R E C T I O N   O F   Q-I-B-L-A,   EAST-of-NORTH (AZ)							
CITY - Country	Lat	Long	From	From	1992	Annual	1995
	(N +)	(E +)	TRUE	MAGNT	Var	Drift	Total
	(S -)	(W -)	NORTH	NORTH	Deg	Min	Var-Min
MAKKAH-S.Arab	21.4	39.8	-	-	-	-	-
DAR SALAM-Tnz	-6.8	39.2	1.2	3.1	2.0W	1.2E	1.9W
MOSCOW - USSR	55.8	37.6	176.4	168.0	8.3E	1.3E	8.4E
ISTANBUL-Turk	41.0	28.9	151.5	148.1	3.4E	0.8E	3.4E
CAIRO - Egypt	30.1	31.3	136.7	34.3	2.3E	1.2E	2.4E
KHARTOUM-Sudn	15.5	32.6	48.1	46.7	1.3E	1.7E	1.4E
CAPETOWN-S.Af	-33.8	18.6	23.2	46.2	22.8W	3.0W	23.0W
LAGOS-Nigeria	6.5	3.4	63.3	68.2	5.2W	6.8E	4.9W
ALGIERS-Algra	36.8	3.0	105.5	107.1	1.9W	6.2E	1.6W
GREENWICH-Engl	51.5	0.0	119.2	123.7	4.8W	6.8E	4.5W
DAKAR-Senegal	14.7	-17.5	74.0	84.7	11.0W	7.1E	10.7W
RIO DeJENEIRO	-22.9	-43.2	67.6	88.3	20.4W	6.2W	20.7W
PARAMARIBO-Suri	5.9	-55.2	68.2	83.9	15.4W	6.3W	15.7W
BUNOS ARESarg	-34.7	-58.4	76.3	81.6	4.9W	7.8W	5.3W
LIMA-Peru S.A	-12.4	-77.0	72.2	70.7	2.0E	10.6W	1.5E
HALIFAX -CNDA	44.6	-63.6	65.6	85.9	20.4W	1.3E	20.3W
NEW YORK -USA	40.8	-74.0	58.5	73.3	14.6W	3.7W	14.8W
WASH DC -USA	38.9	-77.0	56.6	66.9	10.0W	5.2W	10.3W
MIAMI - USA	25.8	-80.2	56.6	60.7	3.7W	8.2W	4.1W
CHICAGO - USA	41.2	-87.6	48.8	50.7	1.6W	5.4W	1.9W
DALLAS - USA	32.8	-96.8	43.5	37.9	5.8E	4.0W	5.6E
DENVER - USA	39.7	-105.0	35.0	23.9	11.3E	3.3W	11.1E
SAN DIEGO-USA	32.7	-117.1	25.4	12.2	13.3E	1.7W	13.2E
SAN FRANCISCO	37.7	-122.4	18.9	3.3	15.8E	3.3W	15.6E
VANCOUVER-CND	49.3	-123.1	16.7	356.2	20.8E	6.7W	20.5E
ANCHORAGE-Als	61.1	-150.0	350.8	326.9	24.2E	5.5W	23.9E
HONOLULU -Hwi	21.3	-157.5	337.3	326.6	10.8E	2.8W	10.7E
SYDNEY-Austra	-33.9	151.2	277.5	265.1	12.4E	0.9E	12.5E
TOKYO - Japan	35.7	139.7	293.0	299.8	6.7W	1.2W	6.8W
BEIJING-China	39.9	116.4	278.9	284.8	5.9W	0.2W	5.9W
JAKARTA-Indon	-6.3	106.9	295.1	295.1	0.0W	0.7W	0.0W
DHAKA -B.Desh	23.8	90.3	277.5	278.2	0.7W	1.0E	0.7W
AGRA - India	27.2	77.9	269.0	268.9	0.0E	1.1E	0.1E
PESHAWAR -Pak	33.6	71.4	254.5	252.5	2.0E	0.7E	2.0E
BUKHARA -Uzbk	39.6	64.6	236.6	232.6	4.0E	0.3E	4.0E
TEHRAN - Iran	35.7	51.4	218.4	214.8	3.6E	0.0E	3.6E

[=====]

C. SPHERICAL TRIGONOMETRY  
\*\*\*\*\*

I will present, inshallah, some basics of Spherical Astronomy and then obtain the direction for Kabah from some points on the globe.

The EARTH can be considered as an APPROXIMATE SPHERE. The variation between the actual shape of the earth (oblate ellipsoid, or spheroid) and the approximating sphere is not more than a few degrees in azimuth and is not very significant for the purpose of determination of the direction of the Kabah.

The earth can be sliced "vertically" by LONGITUDES, from 0 Deg Longitude, through Greenwich, England, to 180 Deg East (E) Longitude, and from 0 Deg Longitude to 180 Deg West (W) Longitude.

The earth can also be sliced "horizontally" by LATITUDES, from 0 Deg Latitude (the Equator) to 90 Deg North (N) Latitude (the North Pole), and from 0 Deg Latitude (Equator) to 90 Deg South (S) Latitude (the South Pole). The Latitude is the angle at the center of the earth, from the Equator to the point on the surface of the earth, on the same Longitude.

The intersection of the surface of a sphere with a plane through the center of the sphere is a circle called the GREAT CIRCLE. Longitudes are all Great Circles. The Equator is also a Great Circle. When two Great Circles intersect, the angle between the tangents of the two Great Circles, at the point of intersection, is the SPHERICAL ANGLE.

\*\*\*\*\*  
\* THE SHORTEST DISTANCE BETWEEN ANY TWO POINTS ON THE SURFACE OF A SPHERE \*  
\* IS ALONG A GREAT CIRCLE \*  
\* BASED ON THE PRINCIPLES OF SHPERICAL TRIGONOMETRY \*  
\*\*\*\*\*

>From any point on the earth, the North (N) direction is defined as the direction pointing to the North Pole. The AZIMUTH ( [AZ], angular direction, in degrees, of any one point from any other point) is the angular rotation FROM TRUE NORTH (not magnetic North) in a ClockWise (CW) direction.

North (N) is	0 Deg	CW from N	[AZ = 0]
East (E) is	90 Deg	CW from N	[AZ = 90]
South (S) is	180 Deg	CW from N	[AZ = 180]
West (W) is	270 Deg	CW from N	[AZ = 270]

North-East (N-E) is	45 Deg	CW from N	[AZ = 45]
South-East (S-E) is	135 Deg	CW from N	[AZ = 135]
South-West (S-W) is	225 Deg	CW from N	[AZ = 225]
North-West (N-W) is	315 Deg	CW from N	[AZ = 315]

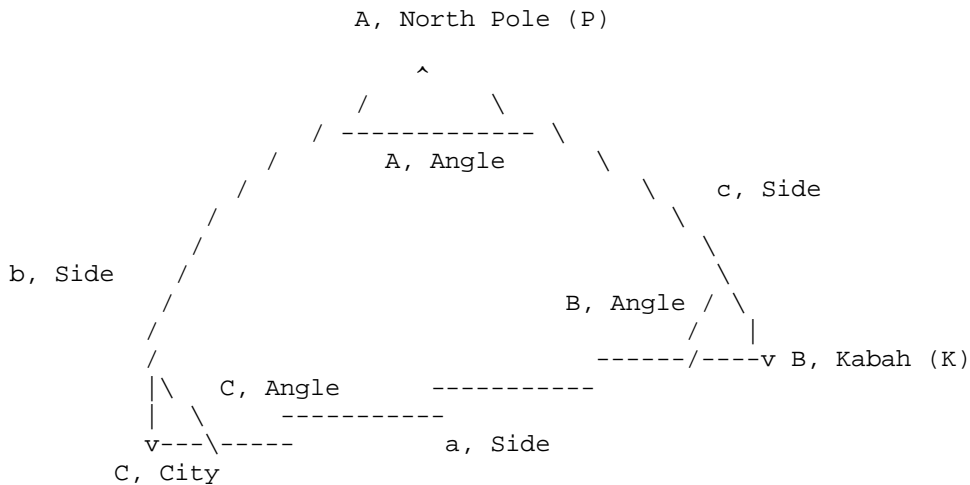
(S is also	180 Deg	CCW from N)	[AZ = 180]
(W is also	90 Deg	CCW from N)	[AZ = 270]
(CCW = CounterClockWise)			

\*\*\*\*\*

\* THE NORTH DIRECTIONS FROM POINTS ON THE SAME LATITUDE \*  
 \* ARE NOT PARALLEL TO ONE ANOTHER. \*  
 \* (Only exception are points on 0 Deg latitude, the Equator.) \*  
 \*\*\*\*\*

In a Spherical Triangle, three points on the surface of a sphere are joined by three lines on the surface of the sphere. Each of the lines (shortest distance) joining any two of the three points are on a Great Circle.

The vertex A can represent the North Pole, P,  
 the vertex B can represent the location of Kabah, K, and  
 the vertex C can represent any City,  
 from where the direction of Kabah needs to be located.



The SIDES are curves on the spherical surface of the sphere,  
 ON GREAT CIRCLES (it is difficult to represent curves in ASCII file,  
 as shown above, but please use your imagination, hopefully just a little !!!)

The length of SIDES are represented by "degrees" at the center of the sphere.  
 The three Spherical SIDES are denoted by LOWER CASE LETTERS, ex. a,b,c.  
 The three Spherical ANGLES are denoted by UPPER CASE LETTERS, ex. A,B,C.  
 The Angles are at the intersection points (vertices) of the sides, and  
 the Sides are the ones opposite to the intersection points (angles).

Spherical Trigonometric formulae exist which relate the sides and angles  
 of Spherical Triangles. We shall use one such formula.

THE FOUR PART FORMULA  
 =====

$$\cos B \cos A = \sin b \cot c - \sin A \cot C$$

rearranging the terms, we obtain

$$C = \text{TAN}^{-1} \left[ \frac{\sin A}{\sin b \cot c - \cos b \cos A} \right]$$

Note: UPPER CASE Letters are ANGLES,  
 Lower Case Letters are Sides.

Computed answers could be supplements, compliments, etc. of actual values depending on your computing machine's evaluation of trigonometric functions.

Let us now consider a numerical example, "near" the North Pole. The formula is valid for any choice of points B and C. (For directions for the Qibla, please see later section of this document.)

Consider two points "B" and "C" on the SAME Latitude of 80 Degrees North. Let the Longitude of "B" be 0 Degrees and that of "C" be 90 Degrees East.

Then, the spherical triangle would have:  
 Angle "A" = 90 Degrees (the difference in the Longitudes of "B" and "C")  
 Side "b" = 10 Degrees (90 - Latitude of Point "C" = 90 - 80 = 10 Deg)  
 Side "c" = 10 Degrees (90 - Latitude of Point "B" = 90 - 80 = 10 Deg)

$$C = \text{TAN}^{-1} \left[ \frac{\text{SIN } A}{\sin b \cot c - \cos b \text{ COS } A} \right]$$

$$C = \text{TAN}^{-1} \left[ \frac{\text{SIN } 90}{\sin 10 \cot 10 - \cos 10 \text{ COS } 90} \right]$$

$$C = \text{TAN}^{-1} \left[ \frac{1.000}{\sin 10 \cot 10 - \cos 10 \text{ COS } 90} \right]$$

C = 45.44 Degrees

Note: Even though B and C are on the SAME LATITUDE, B is approximately North-East (45 Deg E of N) of C !!!

D. EXAMPLES  
 \*\*\*\*\*

All the examples in this section do NOT include the variation of the Magnetic North Pole from the (True) North Pole. The values given in Section B includes, in addition, the Qibla direction as read from a magnetic compass, and hence from the Magnetic North Pole.

- Examples: 1. Points around the North Pole (NP), all on the same Latitude, NEAR THE NP.
- 2. Points around the North Pole, on constant Latitudes, upto Equator.
- 3. Points on the same Latitude as Kabah.
- 4. Points all around Kabah (0 Deg to 360 Deg).
- 5. Points on the same Longitude as Kabah.
- 6. Points at approximately the center of U.S.A., France, Australia, Japan.

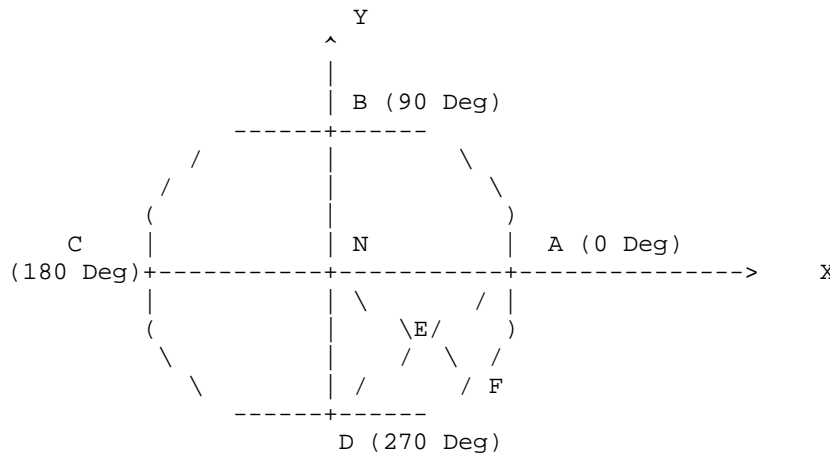
EXAMPLE D-1: Points around the North Pole (NP), all on the same Latitude,  
 =====  
 NEAR THE NP.  
 =====

This is an INTERESTING EXAMPLE. It seems contrary to "intuition". Many CONCEPTS OF SPHERICAL TRIGONOMETRY can be understood by this



"extreme" case of pints on a constant Latitude circle around and NEAR THE NORTH POLE.

Consider a Circle around the North Pole with a small radius of only ten (10) feet. Choose "N" as the center of the circle. We choose four points around the circumference, "A" at 0 Deg, "B" at 90 Deg, "C" at 180 Deg, and "D" at 270 Deg. Choose the positive direction of the "X" axis from the center of the circle, "N", through the Point "A" on the circumference. Choose the positive direction of the "Y" axis from the center, "N", through the Point "B" on the circumference. On this small scale for our circle, ALL POINTS "A", "B", "C", "D", and "N" ARE DIRECTLY VISIBLE FROM EACH OF THE OTHER POINTS. Join DA and drop a perpendicular from N to DA to intersect DA at "E". Extrapolate NE to meet the circumference of the circle at "F".



Since the center of this circle is the North Pole, "N", each INWARD-DRAWN RADIUS, from any point on the circumference would be the NORTH DIRECTION for that particular point on the circumference. Similarly, EN is the North direction for point E. These North directions are NOT parallel to each other. The North directions converge to the center of the circle, which we had chosen as the North Pole.

The North (N) direction is defined as the direction pointing to the North Pole. The AZIMUTH (angular direction, in degrees, of any one point from any other point) is the angular rotation FROM NORTH, in a Clockwise direction.

The following can be obtained, by direct inspection (no need to calculate):

>From "A" the North direction is AN (0 Deg Azimuth).  
 The direction of "B" from "A" is "North-East" (N-E), ( 45 Deg Azimuth).  
 The direction of "C" from "A" is "North" (N), ( 0 Deg Azimuth).  
 The direction of "D" from "A" is "North-West" (N-W), (315 Deg Azimuth).

>From "B" the North direction is BN (0 Deg Azimuth).  
 The direction of "C" from "B" is "North-East" (N-E), ( 45 Deg Azimuth).  
 The direction of "D" from "B" is "North" (N), ( 0 Deg Azimuth).  
 The direction of "A" from "B" is "North-West" (N-W), (315 Deg Azimuth).

>From "C" the North direction is CN (0 Deg Azimuth).  
 The direction of "D" from "C" is "North-East" (N-E), ( 45 Deg Azimuth).  
 The direction of "A" from "C" is "North" (N), ( 0 Deg Azimuth).  
 The direction of "B" from "C" is "North-West" (N-W), (315 Deg Azimuth).

>From "D" the North direction is DN (0 Deg Azimuth).  
The direction of "A" from "D" is "North-East" (N-E), ( 45 Deg Azimuth).  
The direction of "B" from "D" is "North" (N), ( 0 Deg Azimuth).  
The direction of "C" from "D" is "North-West" (N-W), (315 Deg Azimuth).

Since the circle has the North Pole as its center, the points on the circle can be considered as a having the same latitude, the latitude being very close to 90 Deg (but smaller than 90 Deg, since the Latitude of the North Pole is exactly 90 Deg, by definition).

We note some VERY INTERESTING facts:  
\*\*\*\*\*

All points on the circle have the SAME LATITUDE.  
Even though "B", "C", and "D" are on the same latitude as "A", "B" is North-East (N-E) of "A", C is N of A, and D is N-W of A. Similarly, C, D, and A are on the same latitude as B, C is N-E of B, D is N of B, and A is N-W of B; and similarly, D is N-E of C, A is N of C, and B is N-W of C; A is N-E of D, B is N of D, and C is N-W of D.

\*\*\*\*\*  
\* When "B" is North-East (N-E) of "A", for this small circle, \*  
\* "A" is North-West (N-W) of "B" !!! (NOT S-W !!!) \*  
\*\*\*\*\*

The direction from "A" to other points on the same Latitude circle is along points that are on the LINE-of-the-SHORTEST-DISTANCE joining that particular point and the point "A". The Line of the Shortest Distance is along the GREAT CIRCLE. The direct direction is NOT along points on the same Latitude. (Only exception is for points on the equator). The SHORTEST (Direct) DISTANCE between any two points on the surface of the earth is along the Great Circle.

We also note that at the point "A", due "East" is 90 Degrees Clockwise (CW) from the North direction (N is along the radius AN), hence is perpendicular to the radius AN, and hence tangential to the circumference of the circle. If a person travels due East from point "A", and that person travels in a "straight line" (along the Great Circle) and does not change direction, then he would be traveling along the tangent (at "A") to the circle, and hence moving "away" from the circle. This would cause the latitude of the person to change while traveling in the "straight line" !! As the person travels in the "straight line" the direction of East would no longer be "straight ahead" since the North direction would change and hence the East direction would also change !

Consider again the "small" circle around the North Pole.  
For a person to "FACE" Point "A" from Point "D", that person would have to face in the North-East (N-E) direction at "D". When that person travels in a "STRAIGHT LINE" along DA, the person is INITIALLY ORIENTED towards the NORTH-EAST direction (defined at Point D) while AT POINT D. Continuing to travel from D, WITHOUT CHANGING THE DIRECTION OF TRAVEL IN THE "STRAIGHT LINE" to an intermediate point E (note that NE is perpendicular to DEA), the INTERMEDIATE ORIENTATION is DUE EAST AT POINT E, to continue from E towards A. Further continuing to travel from E, WITHOUT CHANGING THE DIRECTION OF TRAVEL IN THE "STRAIGHT LINE" to a final point A, the FINAL ORIENTATION is SOUTH-EAST at POINT A.

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*   TRAVEL EVEN IN A "STRAIGHT LINE" CAUSES   *
*   THE ORIENTATION TO CHANGE WHILE TRAVELLING *
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STRAIGHT LINE TRAVEL FROM POINT "D", THROUGH POINT "E", TO POINT "A":

```

LOCATION POINT:  Point D      Point E      Point A
ORIENTATION:   North-East   East       South-East
NORTH DIRECTION:  DN          EN          AN

```

If the person traveled a little distance due East from Point D, since direction East is no longer in the person's line of travel (the North direction changes from point to point) the person re-oriens towards due East and again travels a short distance, and again re-oriens towards the new East direction and travels a short distance, then that person WOULD BE TRAVELLING IN A CIRCLE (from Point D, to Point F, to Point A) and would NOT be traveling in a "straight line" from Point D, to Point E, to Point A.

EXAMPLE D-2: Points around the North Pole (NP), on constant Latitudes,  
=====
upto the EQUATOR
=====

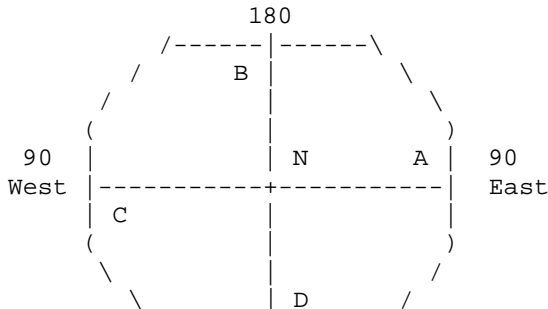
This is the general case of Example D-1 and D-3. We will consider only four (4) points on each Latitude, at Longitudes 0, 90E, 180, 90W Degrees. Since both the points are on the same latitude, the equation for the Azimuth (given in Section C) is reduced to:

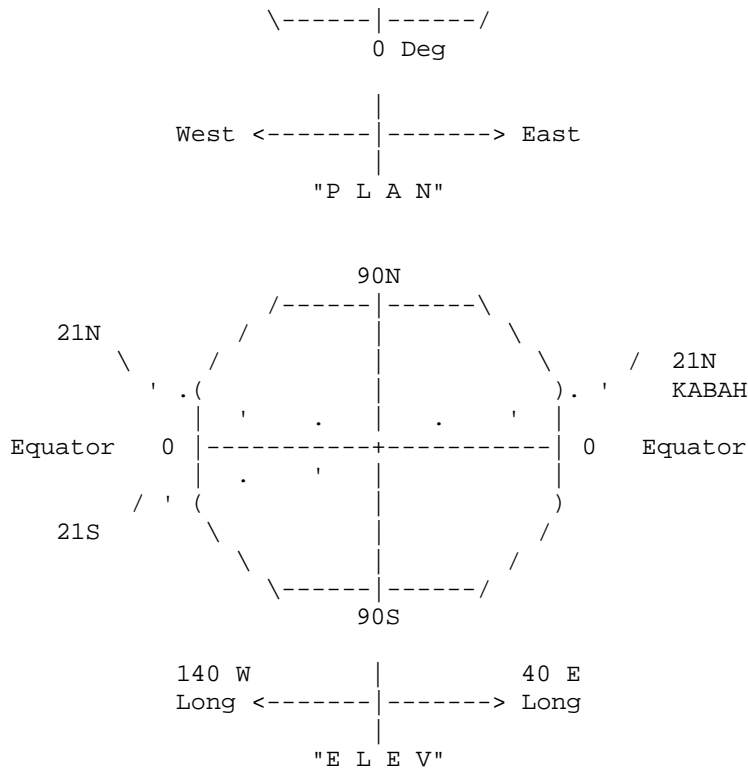
$$C = \text{TAN}^{-1} \left[ \frac{1.000}{\sin(\text{PHI})} \right]$$

where ANGLE PHI = Latitude

	Near NP											Near Equator		
N Latitude:	89.99	89.9	89	85	80	70	60	50	40	30	21	20	10	00
Direction														
"A from D":	45.00	45.0	45	45	45	47	49	53	57	63	70	71	80	90
"B from D":	00.00	00.0	00	00	00	00	00	00	00	00	00	00	00	00
"C from D":	315.00	315.0	315	315	315	313	311	307	303	297	290	289	280	270

(All Directions are Azimuthal, ie E of N.)





Places on any particular Longitude are the same distance apart if they have the same difference in Latitude.  
 A 10 Deg difference in Latitude has the same distance at any Longitude, and the distance is approximately 692 miles.

Places on any particular Latitude are the same distance apart if they have the same difference in Longitude.  
 A 10 Deg difference in Longitude has a greater distance at Latitudes closer to the Equator than at latitudes closer to the Poles.

At the Equator (00 Deg Lat) a 1 Deg Long difference is 69 miles,  
 further north (40 Deg Lat) a 1 Deg Long difference is 53 miles, and  
 further north (60 Deg Lat) a 1 Deg Long difference is 35 miles.

EXAMPLE D-3: Points on the same Latitude as Kabah  
 =====

All points have the same Latitude as that of Kabah (21 Deg N).  
 The Longitudes are taken in steps of 30 Degrees (Kabah: Long 40 Deg E).

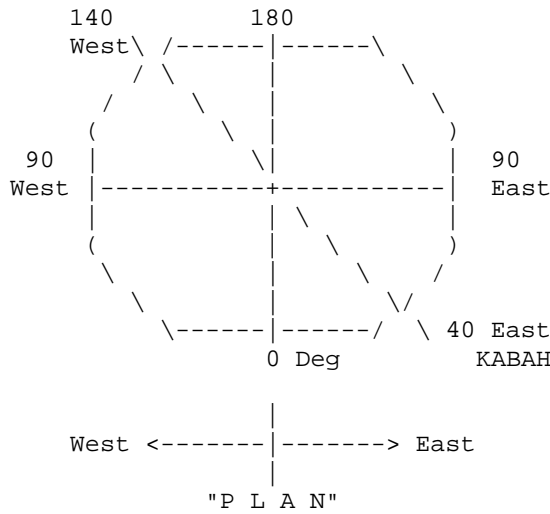
For ease of presenting the directions, the Lat and Long of Kabah have been approximated to:  
 Latitude 21 Deg North (21 Degrees 26 Minutes)  
 Longitude 40 Deg East (39 Degrees 49 Minutes)

Latitude	21N	21N	21N	21N	21N	21N	21N	21N	21N	21N	21N
Longitude	10E	20W	50W	80W	110W	140W	170W	160E	130E	100E	70E
Direction *	85	78	70	58	37	0	323	302	290	282	275

\* All Directions are Azimuthal, ie E of N.

Note that the Azimuths to Kabah CHANGES even though all the points are on the same Latitude of Kabah (21 Deg N). In fact, the Azimuth is 0 Deg,

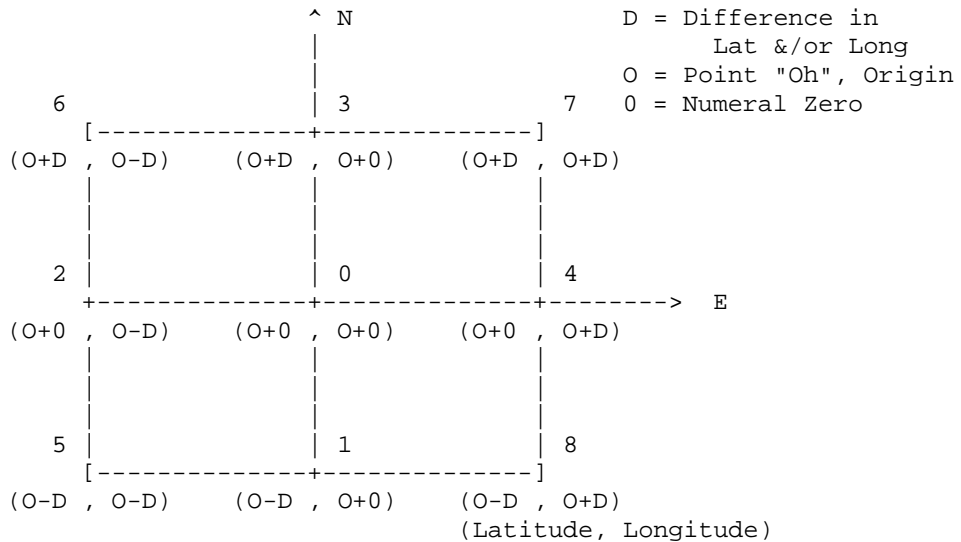
ie due North, when the Long of a point is 140 Deg West, this direction is 90 Deg CCW from East !!



EXAMPLE D-4: Points around Kabah (0 Deg to 360 Deg).  
 =====

We will consider eight (8) points around the Kabah, with each point at a constant difference (DIFF) in Latitude (Lat) and/or Longitude (Long) from Kabah. The direction for the Qibla would be the direction for the "Shortest Distance" to Kabah.

For ease of presenting the directions, the Lat and Long of Kabah have been approximated to:  
 Latitude 21 Deg North (21 Degrees 26 Minutes)  
 Longitude 40 Deg East (39 Degrees 49 Minutes)



DIRECTIONS TO KABA FOR POINTS AROUND KABA

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=====
*****
* Pt|Guess| Difference in Latitude and/or Longitude of points from Kabah *
*-----*
* No|Angle| 0.01 0.10 0.5 1 2 5 10 20 40 60 *
*****
*
* 1 | 0 | 0.00 0.00 0.0 0.0 0.0 0.0 0.0 0 0 0 *
* 2 | 90 | 89.99 89.98 89.9 89.8 89.6 89.1 88.2 86 83 78 *
* 3 | 180 | 180.00 180.00 180.0 180.0 180.0 180.0 180.0 180 180 180 *
* 4 | 270 | 270.00 270.02 270.1 270.2 270.4 270.9 271.8 274 277 282 *
*
* 5 | 45 | 43.03 43.02 42.99 42.95 42.88 42.7 42.6 43 46 55 *
* 6 | 135 | 136.97 136.96 136.93 136.88 136.79 136.5 135.7 134 127 117 *
* 7 | 225 | 223.03 223.04 223.08 223.12 223.22 223.5 224.3 226 233 243 *
* 8 | 315 | 316.97 316.98 317.01 317.05 317.12 317.3 317.4 317 314 305 *
*
*****

```

Note that our "Guess" at Point No.2, for the direction of the Kabah is 90 Deg (ie Due East). As the difference in Longitude from Kabah increases (but at the same Latitude), the directions to the Kabah changes upto 78 Deg E of N (NOT CONSTANT AT 90 Deg) for a Longitude difference of 60 Deg. from Kabah. Similar variations are evident for many of the other points. Also note that the actual distance for 10 Deg North/South is greater than the distance for 10 Deg East/West because Kabah is not at the Equator but is at 21 Deg North.

EXAMPLE D-5: Points on the same Longitude as Kabah  
=====

All points have the same Longitude as that of Kabah (40 Deg E). The Latitudes are taken in steps of 30 Degrees, (21N, 51N, 81N, 69N, 39N, 09N, 21S, 51S, 81S, 69S, 39S, and 09S) with intermediate latitudes at locations of interest.

For ease of presenting the directions, the Lat and Long of Kabah have been approximated to: Latitude 21 Deg North (21 Degrees 26 Minutes)  
Longitude 40 Deg East (39 Degrees 49 Minutes)

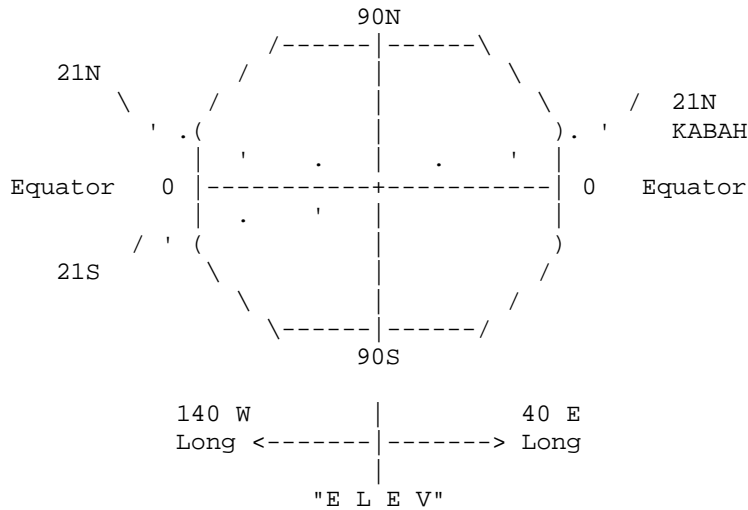
Latitude	20N	21N	22N	51N	81N	89N	90N	89N				
Longitude	40E	40E	40E	40E	40E	40E	40E	140W				
Direction *	0	-	180	180	180	180	180	0				
	N	-	S	S	S	S	S	N				
Latitude	90N	90N	89N	69N	39N	22N	21N	20N	09N	20S	21S	22S
Longitude	40E	140W	140W	140W	140W	140W	140W	140W	140W	140W	140W	140W
Direction *	180	0	0	0	0	0	0	0	0	0	+	180
	S	N	N	N	N	N	N	N	N	N	+	S
Latitude	20S	21S	22S	51S	81S	89S	90S	90S				
Longitude	140W	140W	140W	140W	140W	140W	140W	40E				
Direction *	0	+	180	180	180	180	180	0				
	N	+	S	S	S	S	S	N				
Latitude	90S	90S	89S	69S	39S	09S	20N	21N	22N			
Longitude	140W	40E	40E	40E	40E	40E	40E	40E	40E			
Direction *	180	0	0	0	0	0	0	-	180			

S        N        N        N        N        N        N        -        S

\* All Directions are Azimuthal, ie E of N.  
 Direction of 0 Deg is due North = N  
 Direction of 180 Deg is due South = S

+ The Qibla direction can be in ANY DIRECTION since  
 this point (21S 140W) is directly opposite to the Kabah  
 on the spherical globe.

Note that even though at the Latitude of 69N (this Latitude is N of Kabah),  
 and at Longitude of 140W, the direction for the Qibla is NORTH !!  
 Similarly even though at the Latitude is 51S (this Latitude is S of Kabah),  
 and at Longitude of 140W, the direction for the Qibla is SOUTH !!



EXAMPLE D-6: Points at approximately the center of various countries  
 =====

	Latitude	Longitude	Qibla Direction from TRUE North
Australia:	30 Deg S	130 Deg E	289 Deg E-of-N (19 Deg N of W)
France:	43 Deg N	3 Deg E	113 Deg E-of-N (23 Deg S of E)
Japan:	35 Deg N	140 Deg E	293 Deg E-of-N (23 Deg N of W; NOT S of W)
U.S.A.:	40 Deg N	100 Deg W	39 Deg E-of-N (51 Deg N of E; NOT S of E)

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