The World is flat

Well at least it was a couple of hundred years ago according to the Old Worlds best scholars. It took a ship full of sailors and a couple of cask of rum to prove those scholars wrong. The shortest distance between two places is a straight line, right? Wrong! If you have a flat piece of paper and draw a line connecting two dots on opposite ends you would be right. But when you connect the dots between two places on the globe the shortest distance is a Great Circle route. Not a straight line.

Last week while reading Miss Marian's editorial, I came across a simple question." ***How many miles is it from Hawaii to Cape Town.?*** " It appeared to be easy enough. But let's look at this a little closer. Hawaii is in the Northern Hemisphere in the Pacific Ocean and Cape Towne is in South Africa on the Southeastern Atlantic Ocean. A whole lot of miles between the two of them. Now to send Chris Measures van, it has to go by sea. So that means a container ship traveling at about 25 knots. That means a straight line goes over land. As far as I know, no containerships have conquered this task yet. So you have to travel around the land which brings you to the next question. Do you go East or West? Which is the shortest route? Which is the safest? Which route has the most favorable currents and weather for that time of the year? Ok maybe we will just stick to the miles part of the equation. Since we can't go over land we will have to start with first what is called a Rhumb line. A Rhumb line is a line on the surface of the earth making the same oblique angle with all meridians. In other words a straight line. Simple enough but remember the Earth is not a flat piece of paper so a Rhumb line is not the shortest route. The Earth is not perfectly round either, it is an Oblate Spheroid. So we need to use Spherical Geometry. Not Plane Geometry. So the Great Circle is the way to determine distances. A Great Circle is defined as the intersection of a sphere and a plane through its center according to Nathaniel Bowditch.

Working our Problem

Now we need a few things. Departure Latitude and Longitude and Arrival Latitude and Longitude. Seems easy enough so far. So we pull Latitude and Longitude off of a nautical chart. Latitude are the degrees, minutes and seconds from the right hand side of the chart and Longitude is from the top. One pointer is you use the sides of the charts for distances, never the top and you try to measure off the distances at the mid latitude position. We will calculate going east. It may not be the shortest but it has the least amount of waypoints or turning points along the way.

Honolulu	Cape Horn	Cape Town	Equator
21°18.3 North	56°46.9 South	34°22.00 South	00.00°
157°52.15 West	067°24.3 West	018° 23.0 East	145°West

Now we need to have a language so things are a little abbreviated. The following will be used in out math calculations and worksheets.

L1 Departure Latitude
L2 Arrival Latitude
DLO Difference in Longitude

First we need to take the degrees, minutes and seconds of Latitude and the DLO of Longitude and convert them to whole numbers and decimals. Not as difficult as it sounds. Let's take Honolulu for example. 21°18.3 North. 21 is already a whole number so place it next to L1.

Now take 18.3 and divide it by 60 that will give you a decimal. (Note: 6o miles in a degree of Latitude or 60 minutes in a degree, it is in multiples of 60 so we can divide by 60 here)

So L1 is 21.305 (round off to the thousands place)

Now we need to find difference in Longitude. We will need Honolulu to Cape Horn and Cape Horn to Cape Towne.

Now do the rest of them.

You should have come up with the following.

Honolulu to Equator at 145 West longitude is 12.866
Equator to Cape Horn
Cape Horn to Cape Towne 85.788

Now you are ready for spherical trigonometry

Here is your formula:

Distance=$\cos^{1}$((sin L1x Sin L2)+(cosL1x cosL2 x cos DLO)) x 60 = miles to run

Honolulu to Equator
D=$\cos^{1}$((sin21.305 x Sin 00.00) + (cos 21.305 x cos 00.00 + cos 12.866)) x 60 = 1483.96 miles

Equator to Cape Horn or (Cabo de Hornos)
D=$\cos^{1}$((sin00.00 x sin 56.781) + (cos 00.00 x cos 56.781 x cos 77.591)) x 60 = 4994.35 miles

Cabo de Hornos to Cape Towne South Africa
D=$\cos^{1}$((sin 56.781 x sin 34.366) + (cos 56.781 x cos 34.366 x cos 85.788)) x 60 = 3578.34 miles

So, 1483.96 plus 4994.35 plus 3578.34 equals ***10056*** miles from Honolulu to Cape Towne South Africa.

So that's no so hard, is it. Now if you just wanted to know how many miles it was that would be the way to go about working the problem however as a mariner there are many other factors to factor in.

What is the Initial Course angles and what are the Latitudes and Longitudes along the way. It's not so hard just a little time consuming.

We will need to abbreviate a few more words, you remember the ones from before here are the new ones.

C	Course angle
Lv	Latitude of the Vertex
Dvx	Distance Latitude or Longitude of Point away from the departure point. If it is 900 miles you divide by 60 so 900 miles would be "15" in the equation.
Lx	Longitude of Point away from Departure point

Initial Course formula is as follows:

$C = \tan^{1}((\sin Dlo)/((\cos L1 \times \tan L2) - (\sin L1 \times \cos Dlo))$

Now that you have the initial course and miles you need to know the points or waypoints along the way. Yes, different formulas.

Latitude at a certain point along the track line.

$Lv = \sin^{1} (\sin L1 \times \cos Dvx)$

Longitude at a certain point along the track line

$DloVx = \sin^{1} (\sin Dvx / \cos Lx)$

It would be wise to do the calculations every 150 miles along the track line to get optimal savings along the Great Circle route. So don't feel bad if this was a little confusing. I have been sailing for over 20 years and it still takes a little refresher to remember all the steps. So if this question ever falls upon your doorstep again, please allow me to offer some advice. Go to Wall Mart and by a GPS (Global Positioning System) for about a hundred dollars. Or you can even go online, they have distance calculators for you to use.

Here's a question to ponder as I sign off, The date is the same all over the World at what time? A.0000GMT B.0600 GMT C.1200 GMT D.1800 GMT

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