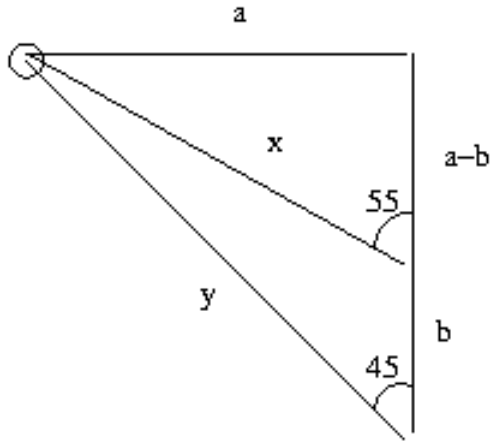
How far away are you ??

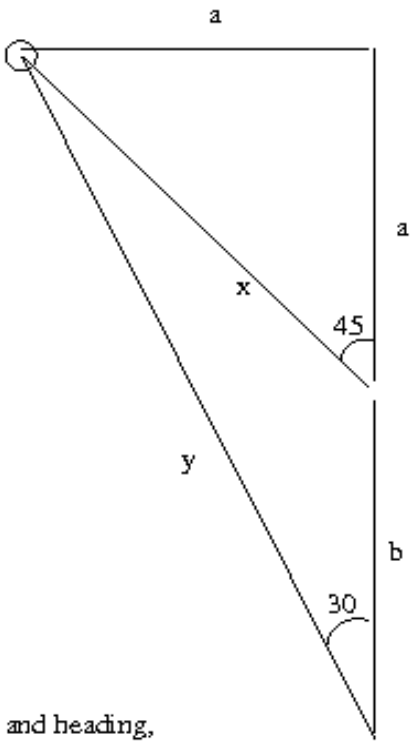
How do you determine the distance to an ADF station or a VOR without a GPS or DME signal?

First get out your stopwatch or modern quartz timing device.

These two methods give us an easy way to do it with a minimal amount of calculation.
The first method is a bit faster than method 2 and will end up using less gas in the long run.
Remember to start timing as soon as you establish the first angle, hold heading, then stop timing when you cross the second angle.
This is easier to do using an ADF instrument than a VOR since there is no twisting or turning of knobs and the instrument directly reads out the angle to the station. With the VOR you have to keep track of headings and when to stop the clock and all the twisting.
Then turn directly to the airport and multiply your time by 4 or 2 depending upon which method you've chosen.



Method 1:
Fly constant speed and heading,
starting at 45 degree angle,
until 55 degree angle to airport.
Time of leg b x 4 equals time of leg x to airport.



Method 2:
Fly constant speed and heading,
starting at 30 degree angle,
until 45 degree angle to airport.
Time of leg b x 2 equals time of leg x to airport.

Keep in mind that distance is related to time by speed. Winds may have a larger effect on method 1 than method 2. Timing errors and misjudging the angles will also get multiplied by twice as much in method 1.

Why is this true?

In the first method, the distance 'a' represents two sides of a right triangle with two 45 degree angles and a hypotenuse of distance 'y'.

After traveling the distance 'b', a second triangle is formed with sides equal 'a', 'a-b' and 'x'. The angle from the original heading and the airport is now 55 degrees.

$$\tan(55)=\frac{a}{(a-b)}=1.428$$

$$a=3.336\times b$$

$$x^2=a^2+(a-b)^2$$

$$x=\sqrt{16.591}\times b=4.073\times b$$

$$x\approx 4\times b$$

x is the time direct to the airport.

In the second method, the distance 'a' again represents two sides of a right triangle with two 45 degree angles but now with a hypotenuse of distance 'x'.

After traveling the distance 'b', the first triangle is formed. Before starting the timing measurement, a second triangle is formed with sides equal to 'a', 'a+b' and 'y'. The angle from this heading and the airport begins at 30 degrees.

$$\tan(30)=\frac{a}{(a+b)}=0.577$$

$$a=1.365\times b$$

$$x^2=a^2+a^2$$

$$x=\sqrt{2}\times 1.365\times b=1.931\times b$$

$$x\approx 2\times b$$

x is the time direct to the airport.

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