DISTANCE MODULUS LAB

AST 102LB Stars, Galaxies, Universe Laboratory
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PURPOSE: To offer some quantitative familiarity with parallax and the distance modulus equations.

NOTE: Round off all answers to 3 significant figures. e.g., if your answer is 2.3948 pc, round off to 2.39. Or if your answer is 694.385974 pc, round off to 694.

The Distance Modulus Equation:

$$(m - M) = 5 \log d - 5$$

or

$$d = 10^{\frac{m - M + 5}{5}} \qquad d \text{ is in parsecs}$$

Sample problem, try this first:

Let m = 4.5 magnitude and M = 7.8 mag. Find the distance in parsecs (pc) and light years (ly).

1) Plug in the magnitude values to get $d = 10^{0.34}$

2) Enter 0.34 into your calculator.

3) Hit the 10^x key. (Most calculators will display 10^x above the log x key. If that is the case with your calculator, then before hitting log x , you must first it the inverse, shift, or 2nd function key, depending on the model of you calculator.)

   The answer is 2.1877616. This is in pc, and you must round it off to 2.19 pc. Since the pc unit is larger than (3.26x) the ly, then you multiply 2.187… by 3.26 to get 7.13 ly. So, you see that it would take light 7.13 years to travel that distance, about a light year short of the distance to Sirius.

First, let's review the simple inverse relation between distance and parallax.

1. Find the distances (in pc and ly) of objects with the following parallaxes (π or p):
   0.5, 0.1, 0.05, 0.01 0.005, 0.001 arc sec.

Now let's practice the distance modulus equation, in the form that solves for distance.

2. Suppose some star has an absolute magnitude (M) of +8.0. Calculate how far in pc and ly this star would be if viewed it from different distances as a star with the following magnitudes (m):
   4.0, 6.0, 8.0, 10.0, 12.0, 14.0, mag

Now some specific cases…

3. Tau Ceti is a G- type star and the most likely nearby star for hosting life forms on of its planets (none yet detected). Given its $m = 3.50$ and an $M = 5.72$, how far (in pc) from us is this star? How long would it take for a radio message to travel the distance?

4. Beta Pictoris, a nearby A- type star was photographed in infrared by University of Arizona astronomers and found to have an intriguing dusty disk surrounding it. Given its $m = 3.85$ and $M = 1.5$, how far (pc) is this star from us? How long would it take for a radio message to travel the distance?

5. How far out into space, in pc and ly, could humans on a starship leaving our solar system still see our sun with their unaided eyes? (Use $m = 6.0$ and $M = 4.84$.)