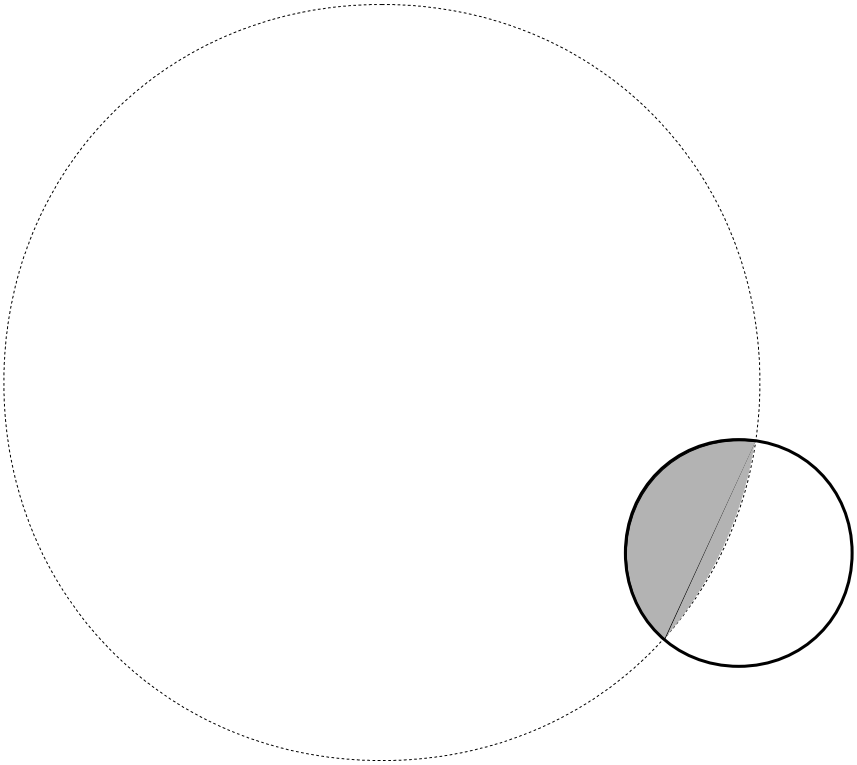
Lunar Eclipse - ANALYSIS 1

You have a series of drawings looking like the heavy circle (Moon) in the diagram below.



The Moon is partly into the Earth's shadow. You can only see a small part of the shadow, but you know that the rest is contained in the dotted line, even though you can't see it. Here is what to do:

- Attach the drawing of the moon to a fairly large sheet of cardboard, using some fixing method that isn't going to damage the picture (spray-on photographic adhesive is a possibility).
- Take a pair of compasses with a long pencil and experiment until you find a radius and a centre that would enable you to draw the edge of the bit of shadow you *can* see.
- Measure and record the radius that your compasses are now set to.
- Repeat this process for each of your drawings.
- Average the radii you have recorded and double the result to obtain the average diameter of the shadow.
- Measure and record the diameter of the Moon.
- Calculate how many times bigger the shadow's diameter is than the Moon's diameter.

HINT 1: If, each time, you join the points where the shadow crosses the edge of the Moon (this will be a chord of the Moon's circle), then it is a fact that the centre of the shadow has to lie somewhere along the perpendicular bisector of this chord. This idea may make it easier to find the centre and compass setting each time.

HINT 2: Here is an alternative procedure, which may be used for each drawing.

- Draw the chord as in Hint 1, and measure its length – call it x.
- Measure the perpendicular (shortest) distance from the centre of the chord to the edge of the shadow – call it y.
- The radius of the shadow will turn out to be approximately $y^2/(8x)$.

It's probably best to carry out the original procedure explained above, and to use Hint 2 as a check. Or you could plot a graph of x-values against the corresponding values of y^2 and use the gradient – or read a point off the graph line and use those data.