FRS 157: PROBLEM SET 3

DUE WEDNESDAY, OCTOBER 12TH

Reading: Archimedes, The Sand Reckoner and Hanson, The Mathematical Power of Epicyclical Astronomy

Problem 1: A simple model for the motion of a celestial object is the following: Suppose that the object is moving uniformly at a rate r_1 in a great circle that intersects the ecliptic at points A and B at an angle θ. Additionally, suppose that the points A and B move along the ecliptic at a uniform rate r_2.

(a) If the object starts at time 0 at the point $A = (0, 0)$ in longitude and latitude coordinates, what is the object's location at time t? **Hint:** First find where the object will be on a fixed great circle, then find where A and B will be after time t.

(b) If the sun moves along the ecliptic at a uniform rate r_3, find the times that the celestial object will coincide with the sun and the times when the object will be opposite the sun (these would correspond to solar and lunar eclipses respectively).

Problem 2: Finish the computations done in class to prove that

$$\cos(x + y) = \cos x \cos y - \sin x \sin y$$

and

$$\sin(x + y) = \sin x \cos y + \cos x \sin y.$$

Hint: Use the property of exponentials, $e^{i(x+y)} = e^{ix}e^{iy}$.

Problem 3: Whittlesey, Section 21, Exercises 6 and 7.