Astronomy 345 Homework #6

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In this problem we solved Kepler's equation:

$$t - \tau = E - \varepsilon \sin(E) \tag{1}$$

where t - τ is the mean anomaly(a parameterization of time) and E is the eccentricity anomaly(a parameterization of polar angle), and ε was given to be 0.2 and a = 1.1 A.U. This equation is a parameterization of r and θ. They are defined as follows:

$$r = a(1 - \varepsilon cos(E))$$

$$\theta = \sqrt{\frac{1+\varepsilon}{1-\varepsilon}} \tan(\frac{E}{2}$$

This transcendental equation (Eq.1) was solved using the Newton-Raphson method for root finding using the equation

$$E_{n+1} = E_n - \frac{f(E_n)}{f'(E_n)} = E_n - \frac{E_n - \varepsilon \sin(E_n) - M(t)}{1 - \varepsilon \cos(E_n)}. \tag{2}$$

Below are the tabulated results of the Python program for the given values of $t - \tau$.

t - τ (yr)	E (degrees)	r (A.U.)	θ (degrees)
0.0	0.0	0.88	0.0
0.2	14.29	0.88	12.67
0.4	28.36	0.91	25.13
0.6	42.05	0.94	37.26
0.8	55.25	0.97	48.96