AOE 4134 Homework 10

Due: Wednesday November 8, 2000 at beginning of class

**Reminder: There will be a 2nd exam in class on Monday November 13. This exam will be open notes but closed book.**

1. Using $e = 0.3$, and $a = 15,000$ km, and $\mu = 3.98601 \times 10^5$ km$^3$/s$^2$, and $t - T = \mathsf{TP}/3$, solve Kepler's equation and determine the true anomaly. Do this two ways:

   (a) Using 5 iterations of Newton's method, using $M$ as the initial guess for $E$.

   (b) Using 5 iterations of the bisection method, using $\pi/2$ and $\pi$ as the initial bracketing interval.

   Show the results of your iterations in a table with 6 significant digits of accuracy, with the resulting position error at each step.

   Example format for table:

| | Newton | | Bisection | |
|---|---|---|---|---|
| Iteration | $E_n$ (rad) | error (km) | $E_n$ (rad) | error (km) |
| 1 | 2.31512 | 123.456 | 2.30234 | 234.567 |
| 2 | 2.31423 | 45.6378 | 2.32434 | 123.763 |
| 3 | ... | | | |

2. A satellite is in Earth orbit with periapsis altitude 400 km and apoapsis altitude 800 km. The RAAN is 90°, the inclination is 51°, and the argument of periapsis is 270°. At epoch $t_0 = 0$, the satellite is at the ascending node. Find the position and velocity of the satellite at epoch and at a time 30 minutes later.

3. A satellite is in Earth "orbit" with periapsis altitude 400 km. The RAAN is 90°, the inclination is 51°, and the argument of periapsis is 270°. At epoch $t_0 = 0$, the satellite is at the ascending node, and is traveling at escape velocity. Find the position and velocity of the satellite at epoch and at a time 30 minutes later.

4. A satellite is in Earth "orbit" with periapsis altitude 400 km. The RAAN is 90°, the inclination is 51°, and the argument of periapsis is 270°. At epoch $t_0 = 0$, the satellite is at the ascending node, and is traveling at twice escape velocity. Find the position and velocity of the satellite at epoch and at a time 30 minutes later.