Homework #1

Note: Some of these problems are taken from Orbital Mechanics for Engineering Students by Howard Curtis

1. If $\boldsymbol{R}$, in meters, is given by $\boldsymbol{R} = 3t^4\hat{\boldsymbol{I}} + 2t^3\hat{\boldsymbol{J}} + 9t^2\hat{\boldsymbol{K}}$, where t is time in seconds, calculate $\dot{R}$ at t=2sec.
2. A satellite is in a circular, 350 km orbit (i.e., it is 350 km above the earth's surface). Calculate
   (a) the speed in km/s;
   (b) the period.

3. An unmanned satellite orbits the earth with a perigee radius of 7000 km and an apogee radius of 70 000 km. Calculate
   (a) the eccentricity of the orbit;
   (b) the semimajor axis of the orbit (km);
   (c) the period of the orbit (hours);
   (d) the specific energy (E) of the orbit (km^2/s^2);
   (e) the true anomaly at which the altitude is 1000 km (degrees);
   (f) the speed at perigee and apogee (km/s).

4. A satellite is launched into earth orbit at an altitude of 640 km with a speed of 9.2 km/s and a flight path angle of 10°. Calculate the true anomaly of the launch point and the period of the orbit.

5. A satellite is in a circular orbit at an altitude of 320 km above the earth's surface. If an onboard rocket provides a delta-v (velocity increase) of 500 m/s in the direction of the satellite's motion, calculate the altitude of the new orbit's apogee.