

# Problem 1

Given:

```
Re = 6378.1; % Earth radius, km  
mu = 398600.4415; % Earth mu, km^3/s^2
```

```
a = 8 * Re
```

```
a = 5.1025e+04
```

```
Om_deg = 45; Om = deg2rad(Om_deg);  
e = 0.4;  
w_deg = +60; w = deg2rad(w_deg);  
i_deg = 30; i = deg2rad(i);  
th_deg = 120; th = deg2rad(th_deg);
```

```
p = a*(1-e^2)
```

```
p = 4.2861e+04
```

```
r_mag = p/(1+e*cos(th))
```

```
r_mag = 5.3576e+04
```

```
v_mag = sqrt(mu*(2/r_mag - 1/a))
```

```
v_mag = 2.6586
```

```
th_dot = sqrt(mu*p)/r_mag^2
```

```
th_dot = 4.5536e-05
```

```
gamma = acos(r_mag*th_dot/v_mag), gamma_deg = rad2deg(gamma)
```

```
gamma = 0.4086  
gamma_deg = 23.4132
```

```
r_rth = r_mag * [1 0]';  
v_rth = v_mag * [sin(gamma), cos(gamma)]'
```

```
v_rth = 2×1  
1.0564  
2.4397
```

```
eCr = [cos(th), -sin(th); sin(th), cos(th)]
```

```
eCr = 2×2  
-0.5000 -0.8660  
0.8660 -0.5000
```

```
r = eCr * r_rth
```

```
r = 2×1  
104 ×  
-2.6788  
4.6398
```

```
v = eCr * v_rth
```

```
v = 2×1  
    -2.6410  
    -0.3050
```

```
E = 2*atan(sqrt((1-e)/(1+e))*tan(th/2))
```

```
E = 1.6961
```

```
E_deg = rad2deg(E)
```

```
E_deg = 97.1808
```

```
dt = sqrt(a^3/mu)*(E-e*sin(E))
```

```
dt = 2.3719e+04
```

```
dt_hr = dt/3600
```

```
dt_hr = 6.5887
```

```
rv2mu = r_mag*v_mag^2/mu
```

```
rv2mu = 0.9500
```

```
h = cross([r;0],[v;0])
```

```
h = 3×1  
105 ×  
      0  
      0  
    1.3071
```