

# Problem 1

```
interr = 'latex';
% interr = 'none';
set(groot, 'defaulttextinterpreter', interr);
set(groot, 'defaultAxesTickLabelInterpreter', interr);
set(groot, 'defaultLegendInterpreter', interr);
R_E = 6378.1363;
R_P = 1162;
mu_E = 398600.4415;
mu_P = 981.600887707;
mu_S = 132712440017.99;
a_E = 149597898;
a_P = 5907150229;
```

## Part a)

### Hohmann Transfer

```
rp_H = a_E; ra_H = a_P;
a_H = (rp_H + ra_H)/2
```

```
a_H = 3.0284e+09
```

```
v_s1_n_mag = sqrt(mu_S*(2/rp_H - 1/a_H))
```

```
v_s1_n_mag = 41.5985
```

```
v_s1_n = [v_s1_n_mag 0]'
```

```
v_s1_n = 2×1
    41.5985
         0
```

```
vs2_0_mag = sqrt(mu_S*(2/ra_H - 1/a_H))
```

```
vs2_0_mag = 1.0535
```

```
v_s2_0 = [-vs2_0_mag 0]'
```

```
v_s2_0 = 2×1
    -1.0535
         0
```

### Earth Orbit about Sun

```
v_E_mag = sqrt(mu_S/a_E)
```

```
v_E_mag = 29.7847
```

```
v_E = [v_E_mag, 0]'
```

```
v_E = 2×1
    29.7847
         0
```

### Pluto Orbit about Sun

```
v_P_mag = sqrt(mu_S/a_P)
```

```
v_P_mag = 4.7399
```

```
v_P = [-v_P_mag, 0]'
```

```
v_P = 2×1  
    -4.7399  
         0
```

### Departure Parking Orbit

```
r_e_mag = 250 + R_E
```

```
r_e_mag = 6.6281e+03
```

```
v_e_0_mag = sqrt(mu_E/r_e_mag)
```

```
v_e_0_mag = 7.7548
```

### Departure Hyperbolic Orbit

```
rp_e_n = r_e_mag
```

```
rp_e_n = 6.6281e+03
```

```
v_e_inf = v_sl_n - v_E % v_inf_earth
```

```
v_e_inf = 2×1  
    11.8138  
         0
```

```
v_e_inf_mag = norm(v_e_inf)
```

```
v_e_inf_mag = 11.8138
```

```
v_e_n_mag = sqrt(v_e_inf_mag^2 + 2*mu_E/r_e_mag)
```

```
v_e_n_mag = 16.1196
```

```
dv1_mag = v_e_n_mag - v_e_0_mag
```

```
dv1_mag = 8.3647
```

```
% a_e_n = -mu_E/v_e_inf_mag^2  
% e_e_n = 1-rp_e_n/a_e_n
```

### Arrival Parking orbit

```
r_P_mag = 8.37 * R_P
```

```
r_P_mag = 9.7259e+03
```

```
v_p_n_mag = sqrt(mu_P/r_P_mag)
```

```
v_p_n_mag = 0.3177
```

## Arrival Hyperbolic Orbit

```
v_p_inf = v_s2_0 - v_P
```

```
v_p_inf = 2×1  
3.6864  
0
```

```
v_p_inf_mag = norm(v_p_inf)
```

```
v_p_inf_mag = 3.6864
```

```
v_p_0_mag = sqrt(v_p_inf_mag^2 + 2*mu_P/r_P_mag) % periapsis speed
```

```
v_p_0_mag = 3.7137
```

```
dv2_mag = norm(v_p_n_mag - v_p_0_mag)
```

```
dv2_mag = 3.3960
```

## Total

```
dvtotal_mag = dv1_mag + dv2_mag
```

```
dvtotal_mag = 11.7607
```

## Part b)

### Hohmann Transfer

```
rp_H = a_E, ra_H = a_P
```

```
rp_H = 149597898  
ra_H = 5.9072e+09
```

```
a_H = (rp_H + ra_H)/2
```

```
a_H = 3.0284e+09
```

```
v_s1_n_mag = sqrt(mu_S*(2/rp_H - 1/a_H))
```

```
v_s1_n_mag = 41.5985
```

```
v_s1_n = [v_s1_n_mag 0]'
```

```
v_s1_n = 2×1  
41.5985  
0
```

```
vs2_0_mag = sqrt(mu_S*(2/ra_H - 1/a_H))
```

```
vs2_0_mag = 1.0535
```

```
v_s2_0 = [-vs2_0_mag 0]'
```

```
v_s2_0 = 2×1  
-1.0535  
0
```

## Earth Orbit about Sun

$$v_{E\_mag} = \sqrt{\mu_S/a_E}$$

$$v_{E\_mag} = 29.7847$$

$$v_E = [v_{E\_mag}, 0]'$$

$$v_E = \begin{matrix} 2 \times 1 \\ 29.7847 \\ 0 \end{matrix}$$

## Pluto Orbit about Sun

$$v_{P\_mag} = \sqrt{\mu_S/a_P}$$

$$v_{P\_mag} = 4.7399$$

$$v_P = [-v_{P\_mag}, 0]'$$

$$v_P = \begin{matrix} 2 \times 1 \\ -4.7399 \\ 0 \end{matrix}$$

## Earth Parking Orbit

$$r_{p\_E} = 250 + R_E, \quad r_{a\_E} = 15 \cdot R_E$$

$$\begin{aligned} r_{p\_E} &= 6.6281e+03 \\ r_{a\_E} &= 9.5672e+04 \end{aligned}$$

$$a_E = 1/2 * (r_{p\_E} + r_{a\_E})$$

$$a_E = 5.1150e+04$$

$$v_{a\_E\_0} = \sqrt{\mu_E * (2/r_{a\_E} - 1/a_E)}$$

$$v_{a\_E\_0} = 0.7348$$

## Earth Departure Orbit

$$v_{E\_inf} = v_{s1\_n\_mag} - v_{E\_mag}$$

$$v_{E\_inf} = 11.8138$$

$$v_{p\_E\_n} = \sqrt{v_{E\_inf}^2 + 2 \cdot \mu_E / r_{a\_E}}$$

$$v_{p\_E\_n} = 12.1613$$

$$dv1\_mag = v_{p\_E\_n} - v_{a\_E\_0}$$

$$dv1\_mag = 11.4266$$

