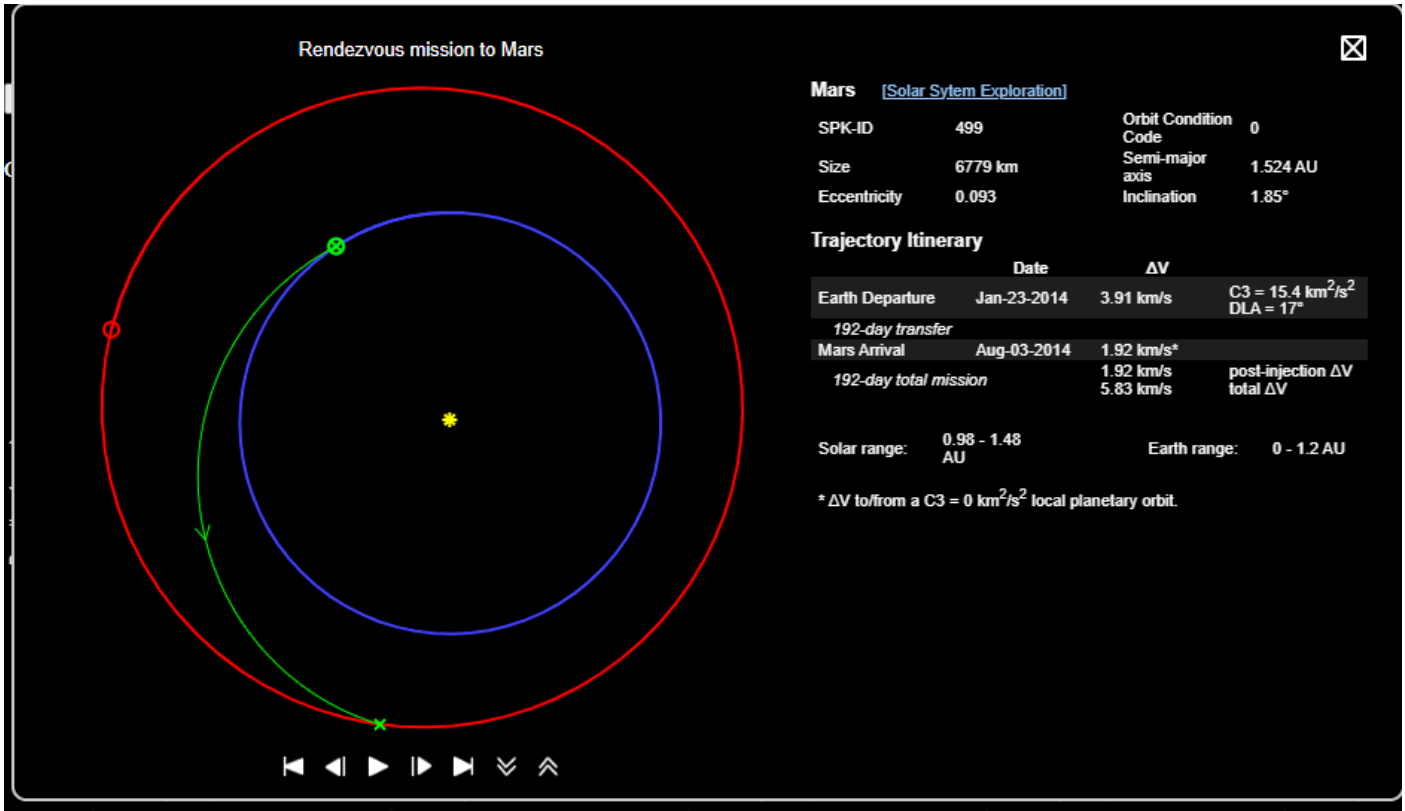
Part 1:



Mars [Solar Sytem Exploration]

SPK-ID	499	Orbit Condition Code	0
Size	6779 km	Semi-major axis	1.524 AU
Eccentricity	0.093	Inclination	1.85°

Trajectory Itinerary

	Date	ΔV	
Earth Departure	Jan-23-2014	3.91 km/s	C3 = 15.4 km^2/s^2 DLA = 17°
192-day transfer			
Mars Arrival	Aug-03-2014	1.92 km/s*	
192-day total mission		1.92 km/s 5.83 km/s	post-injection ΔV total ΔV

Solar range: 0.98 - 1.48 AU Earth range: 0 - 1.2 AU

* ΔV to/from a C3 = 0 km^2/s^2 local planetary orbit.

Tabulated Results Export to CSV

▶ **Column heading descriptions**

	SPK ID	Name	Abs Mag	Size	Orbit condition code	Earth Departure	Destination Arrival	Duration	Injection C3 (km^2/s^2)	Abs DLA	Injection ΔV (km/s)	Post-Injection ΔV (km/s)	Total ΔV (km/s)	Route
View	499	Mars		6779 km	0	Jan-23-2014	Aug-03-2014	192 days	15.4	17°	3.91	1.92	5.83	EM

Part 1:

C3 at departure: $(V_{inf-1})^2 \Rightarrow (4.0184)^2 = 16.1476$

C3 at arrival: $(V_{inf-2})^2 \Rightarrow (4.7639)^2 = 22.69$

Calculating delta_v at earth:

$V_p = \sqrt{(V_{\infty\,departure})^2 + \frac{2 \cdot N_{earth}}{r_p}}$

$V_{\infty\,departure} = 4.0184$ km/s

$N_{earth} = 398,600$ km^3/s^2

$r_p = 6779$ km

$V_p = 11.5649$

$V_c = \sqrt{\frac{N_{earth}}{r_p}}$ $\quad V_c = 7.66807$

$\Delta V_{departure} = V_p - V_c = 3.8968$

Calculating delta_v at mars:

$a = 227.9 \cdot 10^6$ km

$r_p = 5.771 \cdot 10^5$ km

r_{SOI} of mars: $227.9 \cdot 10^6 \left(\frac{6.419 \cdot 10^{23}}{1.989 \cdot 10^{30}}\right)^{2/5} = 5.771 \cdot 10^5$ km

$\varepsilon = \frac{v^2}{2} - \frac{N}{r_p} = \frac{-N}{2a}$

$N = 42,830$ km^3/s^2

$V = 4.7639$ km/s

$-\frac{1}{r} = \left(\frac{-N}{2a} - \frac{v^2}{2}\right) \cdot \frac{1}{N}$ $\quad r = r_p = 3774$ km at arrival of hyperbola

$e_{ellipse} = 1 - \frac{r_p}{a_{ellipse}} \Rightarrow 1 - \frac{5.771 \cdot 10^5}{227.9 \cdot 10^6} = 0.99746$ under mars sphere of influence

$V_{\infty\,arrival} = 4.7639$ km/s

$V_{p\,arrival} = \sqrt{(V_{\infty\,arrival})^2 + \frac{2 \cdot N_{mars}}{r}}$

$= 6.737$ km/s

$V_{p\,ellipse} = \sqrt{\frac{N_{mars}}{r}(1 + e_{ellipse})}$ $= 4.76$ km/s

$\Delta V_{arrival} = V_{p\,arrival} - V_{p\,ellipse} = 1.976$ km/s

total ΔV: $\Delta V_{departure} + \Delta V_{arrival} = 5.873$ km/s

```
Example 8.8

Departure:

  Planet: 3
  Year  : 2014
  Month : 1
  Day   : 3
  Hour  : 0
  Minute: 0
  Second: 0

  Julian day: 2456680.500

  Planet position vector (km)     = [-7.95404e+07  1.23908e+08  -3259.1]
  Magnitude                       = 1.47241e+08

  Planet velocity (km/s)          = [-25.5531  -16.204  0.000658356]
  Magnitude                       = 30.2578

  Spacecraft velocity (km/s)      = [-29.2794  -14.8606  -0.675751]
  Magnitude                       = 32.8417

  v-infinity at departure (km/s) = [-3.72631  1.34348  -0.67641]
  Magnitude                       = 4.01843

  vp)departure                        = 11.5649

  vc)departure (circular parking orbit)                     = 7.66807

  delta-vl                   = 3.89681


Time of flight = 192 days
```

```
Arrival:

  Planet: 4
  Year  : 2014
  Month : 8
  Day   : 3
  Hour  : 0
  Minute: 0
  Second: 0

  Julian day: 2456872.500

  Planet position vector (km)   = [-5.04776e+07  -2.16231e+08  -3.29122e+06]
  Magnitude                     = 1.47241e+08

  Planet velocity (km/s)        = [24.5112  -3.42719  -0.674036]
  Magnitude                     = 24.7588

  Spacecraft Velocity (km/s)    = [20.7883  -6.23805  0.292504]
  Magnitude                     = 21.7061

  v-infinity at arrival (km/s)  = [-3.72285  -2.81086  0.96654]
  Magnitude                     = 4.7639
  vp arrival                     = 6.73719
  vp ellipse                     = 4.76091
  delta-v2                    = 1.97628
 total delta-v                = 5.87309
 eccentricity of ellipse      = 0.997468
 radius of periapsis at Mars  = 3774.41
 semimajor axis at mars SOI = 2.279e+08
 radius of periapsis at Mars SOI = 577100


 Orbital elements of flight trajectory:

  Angular momentum (km^2/s)                    = 4.81099e+09
  Eccentricity                                 = 0.220102
  Right ascension of the ascending node (deg) = 302.636
  Inclination to the ecliptic (deg)            = 1.18491
  Argument of perihelion (deg)                 = 147.01
  True anomaly at departure (deg)              = 33.051
  True anomaly at arrival (deg)                = 167.207

  Semimajor axis (km)                          = 1.83284e+08
  Characteristic energy at departure                        = 16.1478
  Period (days)                                = 495.331
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