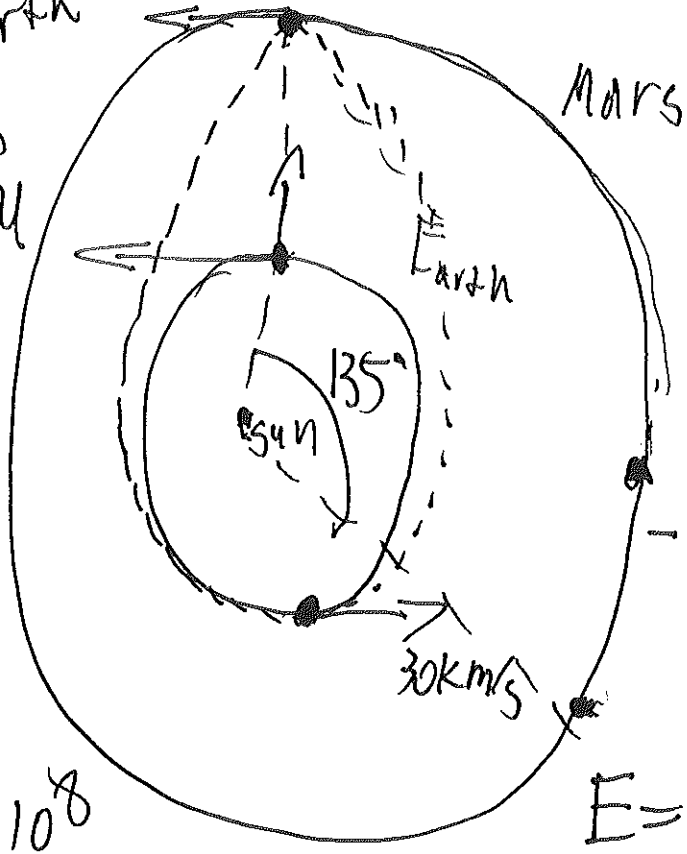
perihelion @ Earth

aphelion @ Mars

$a = 190 \cdot 10^9 m = 1.26 AU$

$T_{sat} = 1.4$ years



$\frac{.7 \text{ years}}{1.89 \text{ years}} = \frac{\theta}{360^\circ}$

$\theta = 135^\circ$

$E_{sat} = -m3.5 \cdot 10^8$

Can we fire straight?

- Satellite moves too fast
- Earth's rotation
- Earth's gravity
- ☆ Sun's gravity

$\frac{a^3}{T^2} = \text{const}$

$-\frac{GMm}{r^2} = \frac{mv^2}{r}$

$E = -\frac{GMm}{2a}$

$R_E = 150 \cdot 10^9 m = 1 AU$

$R_M = 230 \cdot 10^9 m = 1.53 AU$

$T_E = 1$ year

$T_M = 1.89$ year

$V_E = 30 km/s$

$V_M = 24 km/s$

$M_E = 6 \cdot 10^{24} kg$

$M_M = 6.5 \cdot 10^{23} kg$

$M_{Sun} = 2 \cdot 10^{30} kg$

$E_E = 2.7 \cdot 10^{33} J$

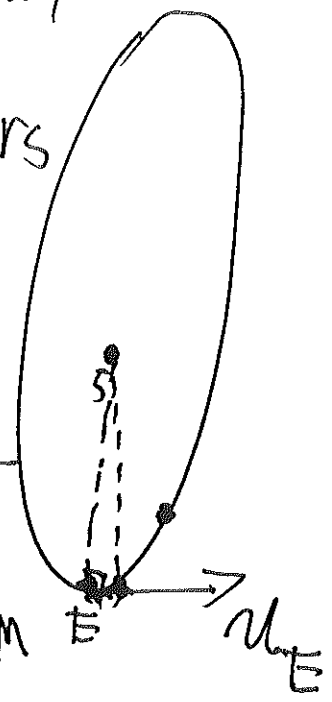
$E_M = 1.7 \cdot 10^{32} J$

$G = 6.67 \cdot 10^{-11} \frac{N m^2}{kg^2}$

v_E: velocity of satellite at Earth

v_M: at Mars

$T = 1$ sec



$A_E = \frac{v_E \cdot T \cdot R_E}{2}$

$A_M = \frac{v_M \cdot T \cdot R_M}{2}$

$A_E = A_M$

$v_E R_E = v_M R_M$ (1)

$v_M = v_E \cdot \frac{R_E}{R_M}$

$\frac{1}{2} m v_E^2 - \frac{GMm}{R_E} = \frac{1}{2} m v_M^2 - \frac{GMm}{R_M}$ (2)

$v_E = 33$ km/s

$v_M = 21.5$ km/s