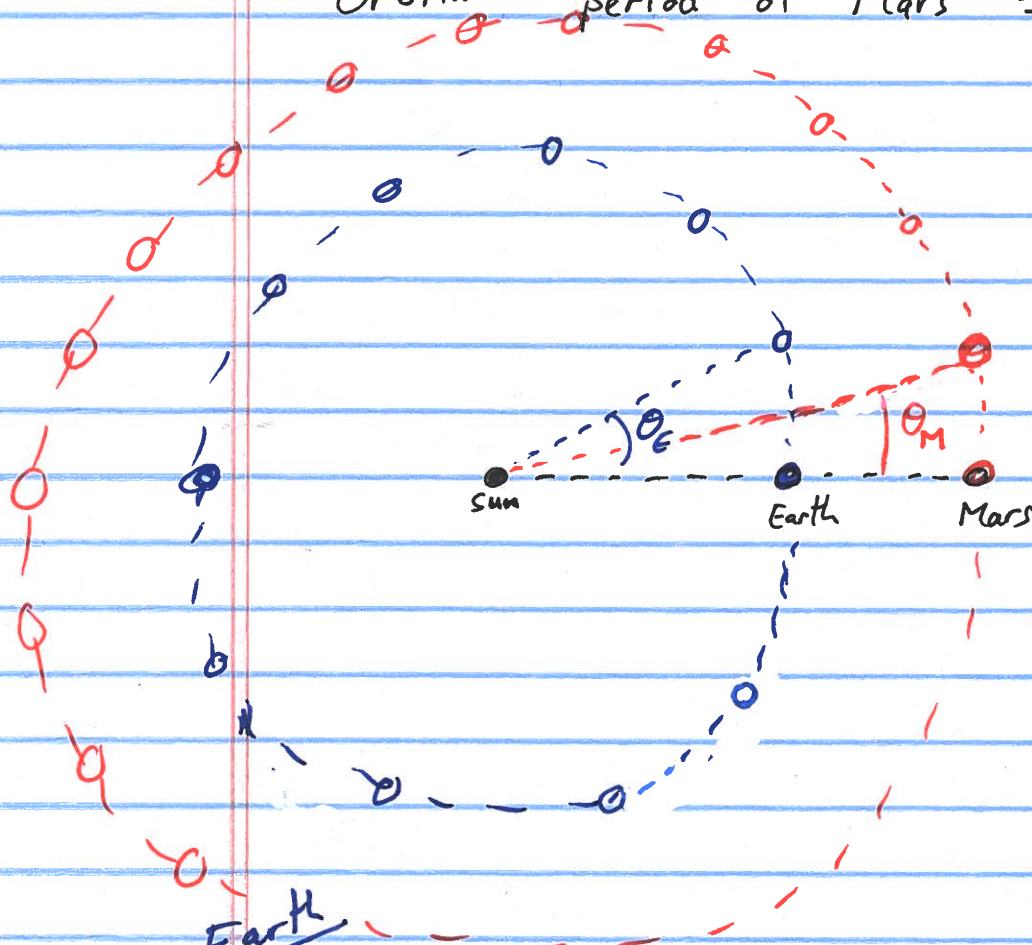


Monday, August 24, 2020

How long does it take for Earth to pass Mars?

Orbital period of Earth = 1.00 years

Orbital period of Mars = 1.88 years



Earth

Angular velocity of Earth = $\alpha_E = 360^\circ/\text{year}$

↳ Angular location of Earth: $\theta_E = \alpha_E t$ \leftarrow in years

Mars

Angular velocity of Mars = $\alpha_M = 360^\circ/1.88 \text{ years}$

$= 191.5^\circ/\text{year}$

→ Angular location of Mars: $\theta_M = \alpha_M t$
 t in years
 (Earth years)

Earth passes Mars when they line up again (with sun)
 \Leftrightarrow when $\theta_E = \theta_M$

or when $\theta_E = \theta_M + 360^\circ$
 \nearrow or $+ 720^\circ$
 or $+ 1080^\circ$

Degrees traveled = $\alpha_E t = \alpha_M t + 360^\circ$

$$\Leftrightarrow \alpha_E t - \alpha_M t = 360^\circ$$

$$\Leftrightarrow (\alpha_E - \alpha_M) t = 360^\circ$$

$$\Leftrightarrow t = \frac{360^\circ}{\alpha_E - \alpha_M} = \frac{360^\circ}{360^\circ/\text{yr} - 191.5^\circ/\text{year}}$$

$$\Leftrightarrow t = \frac{360^\circ}{168.5^\circ/\text{year}} = 2.136 \text{ years}$$

Earth will pass Mars in $t = 2.14 \text{ years}$