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General Physics I, Quiz 3
PHYS10400, Class year 99
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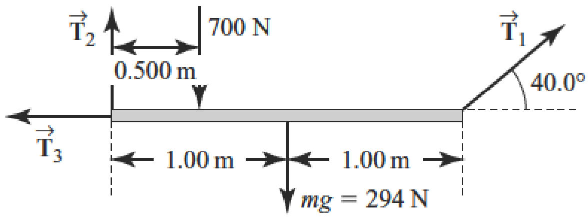
SN:_______________, Name:________________

Chapter 12-13, Serway; ABSOLUTELY NO CHEATING!
Please write the answers on the blank space or on the back of this paper to save resources.

1.

Consider the torques about an axis perpendicular to the page and through the left end of the plank.

$\Sigma\tau = 0$ gives



ANS FIG. P12.25

$$-(700\ \text{N})(0.500\ \text{m}) - (294\ \text{N})(1.00\ \text{m}) + (T_1 \sin 40.0°)(2.00\ \text{m}) = 0$$

or $T_1 = \boxed{501\ \text{N}}$

Then, $\Sigma F_x = 0$ gives $-T_3 + T_1 \cos 40.0° = 0$, or

$$T_3 = (501\ \text{N})\cos 40.0° = \boxed{384\ \text{N}}$$

From $\Sigma F_y = 0$, $T_2 - 994\ \text{N} + T_1 \sin 40.0° = 0$,

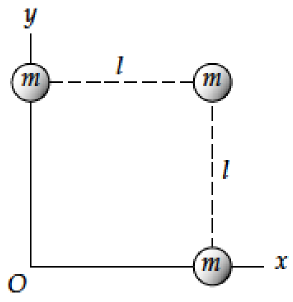
or $T_2 = 994\ \text{N} - (501\ \text{N})\sin 40.0° = \boxed{672\ \text{N}}$

2.

$$\vec{g} = \frac{Gm}{l^2}\hat{i} + \frac{Gm}{l^2}\hat{j} + \frac{Gm}{2l^2}\left(\cos 45.0°\hat{i} + \sin 45.0\hat{j}\right)$$

so $$\vec{g} = \frac{Gm}{l^2}\left(1 + \frac{1}{2\sqrt{2}}\right)\left(\hat{i} + \hat{j}\right) \text{ or}$$

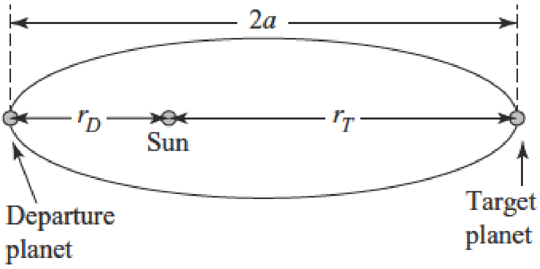
$$\boxed{\vec{g} = \frac{Gm}{l^2}\left(\sqrt{2} + \frac{1}{2}\right) \text{toward the opposite corner.}}$$



ANS FIG. P13.25

3.

The desired path is an elliptical trajectory with the Sun at one of the foci, the departure planet at the perihelion, and the target planet at the aphelion. The perihelion distance r_D is the radius of the departure planet's orbit, while the aphelion distance r_T is the radius of the target planet's orbit. The semi-major axis of the desired trajectory is then $a = (r_D + r_T)/2$.



ANS FIG. P13.15

If Earth is the departure planet, $r_D = 1.496 \times 10^{11}\ \text{m} = 1.00\ \text{AU}$

With Mars as the target planet,

$$r_T = 2.28 \times 10^{11}\ \text{m}\left(\frac{1\ \text{AU}}{1.496 \times 10^{11}\ \text{m}}\right) = 1.52\ \text{AU}$$

Thus, the semi-major axis of the minimum energy trajectory is

$$a = \frac{r_D + r_T}{2} = \frac{1.00\ \text{AU} + 1.52\ \text{AU}}{2} = 1.26\ \text{AU}$$

Kepler's third law, $T^2 = a^3$, then gives the time for a full trip around this path as

$$T = \sqrt{a^3} = \sqrt{(1.26\ \text{AU})^3} = 1.41\ \text{yr}$$

so the time for a one-way trip from Earth to Mars is

$$\Delta t = \frac{1}{2}T = \frac{1.41\ \text{yr}}{2} = \boxed{0.71\ \text{yr}}$$