$$\vec{L} = I\vec{\omega}$$

$$\tau = I\alpha$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$K_{\text{rolling}} = \frac{1}{2} I_{\text{cm}} \omega^2 + \frac{1}{2} m v_{\text{cm}}^2$$

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$

$$\tau = I\alpha$$

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$K_{\text{rolling}} = \frac{1}{2} I_{\text{cm}} \omega^2 + \frac{1}{2} m v_{\text{cm}}^2$$

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$ **3**

$$\tau = I\alpha$$

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$K_{\mathrm{rolling}} = \frac{1}{2} I_{\mathrm{cm}} \omega^2 + \frac{1}{2} m v_{\mathrm{cm}}^2$$

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$ **3**

$$\tau = I\alpha$$ **5**

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$K_{\mathrm{rolling}} = \frac{1}{2} I_{\mathrm{cm}} \omega^2 + \frac{1}{2} m v_{\mathrm{cm}}^2$$

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$ 3

$$\tau = I\alpha$$ 5

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$ 4

$$K_{\text{rolling}} = \frac{1}{2} I_{\text{cm}} \omega^2 + \frac{1}{2} m v_{\text{cm}}^2$$

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$ **3**

$$\tau = I\alpha$$ **5**

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$ **1**

$$\vec{\tau} = \vec{r} \times \vec{F}$$ **4**

$$K_{\text{rolling}} = \frac{1}{2} I_{\text{cm}} \omega^2 + \frac{1}{2} m v_{\text{cm}}^2$$

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$ **3**

$$\tau = I\alpha$$ **5**

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$ **1**

$$\vec{\tau} = \vec{r} \times \vec{F}$$ **4**

$$K_{\mathrm{rolling}} = \frac{1}{2}I_{\mathrm{cm}}\omega^2 + \frac{1}{2}mv_{\mathrm{cm}}^2$$ **2**

$$\vec{L} = \vec{r} \times \vec{p}$$

ang mom game

$$\vec{L} = I\vec{\omega}$$ 3

$$\tau = I\alpha$$ 5

$$\vec{\tau} = \frac{d\vec{L}}{dt}$$ 1

$$\vec{\tau} = \vec{r} \times \vec{F}$$ 4

$$K_{\mathrm{rolling}} = \frac{1}{2} I_{\mathrm{cm}} \omega^2 + \frac{1}{2} m v_{\mathrm{cm}}^2$$ 2

$$\vec{L} = \vec{r} \times \vec{p}$$ 6

ang mom game

Question #10

Video Demo

A- She will start spinning clockwise
B - She will start spinning counterclockwise
C - She will not spin at all.

Question #11

Video Demo

D- He **can** safely stand at the edge of the plank.
E - He **cannot** safely stand at the edge of the plank

Man - 100 kg
Weight - 40 kg
Plank - 15 kg

Question #12

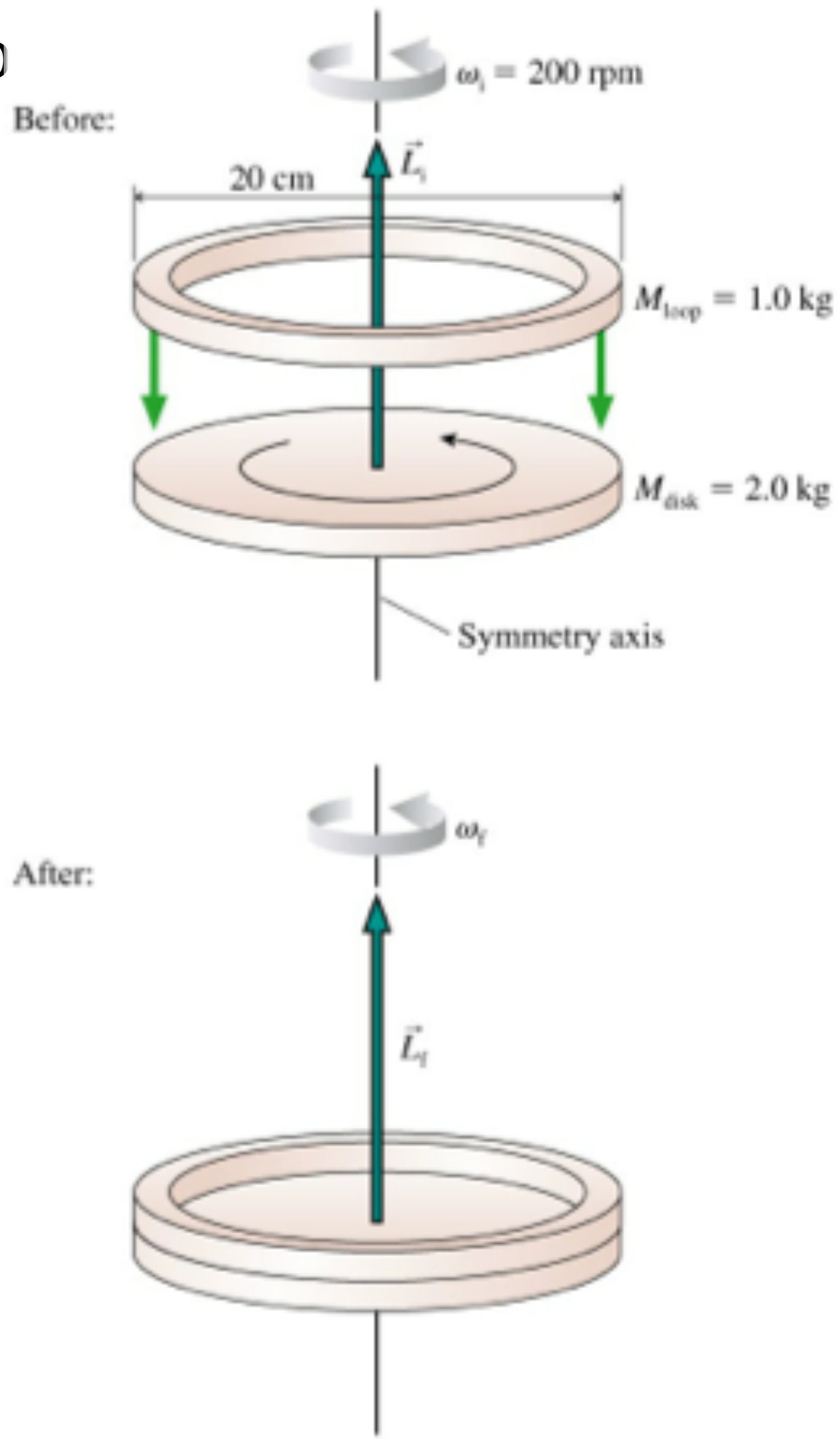
Video Demo

A- 0.6 meters.
B - 0.8 meters.
C - 0.4 meters

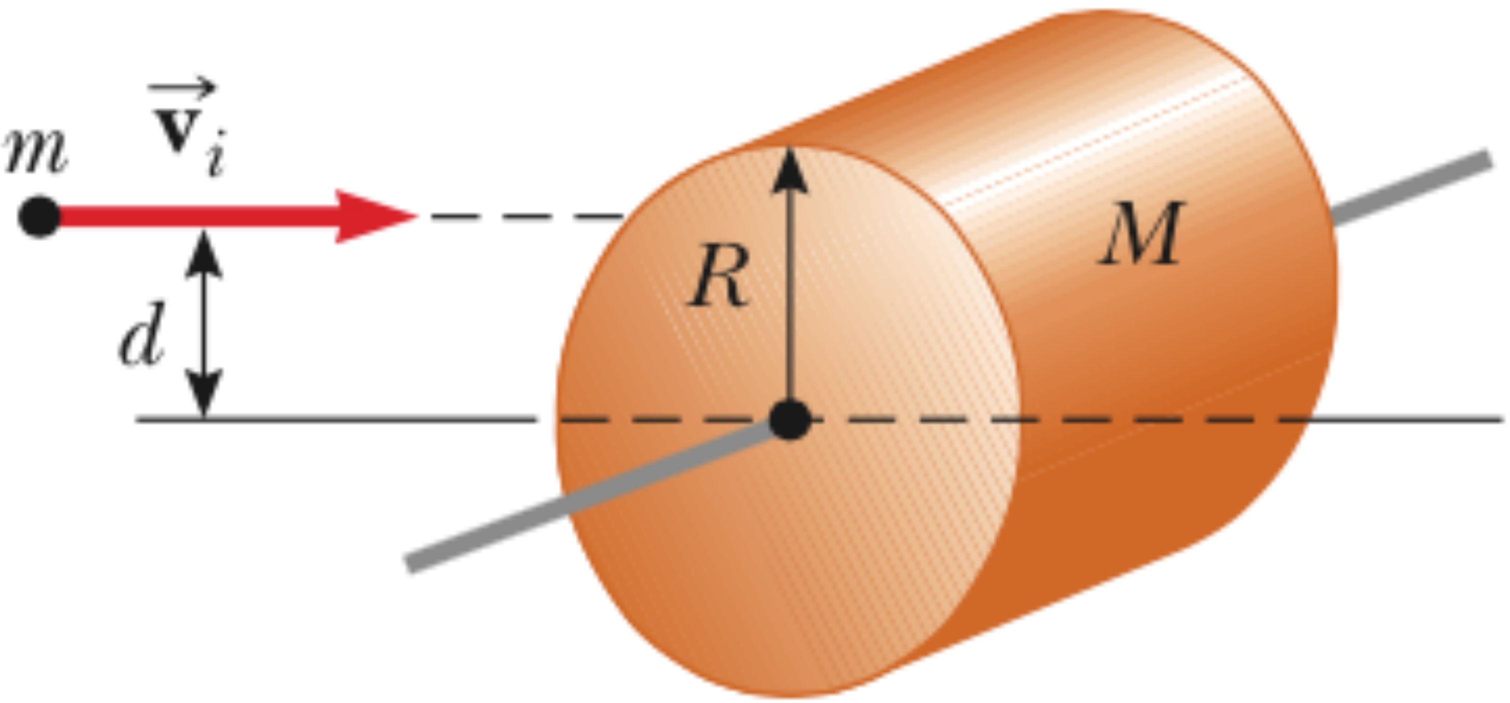
Man - 100 kg
Weight - 40 kg
Plank - 15 kg

Conservation of Angular Momentum Problem

A 20-cm-diameter, 2.0 kg solid disk is rotating at 200 rpm. A 20-cm-diameter, 1.0 kg circular loop is dropped straight down onto the rotating disk. Friction causes the loop to accelerate until it is riding on the disk. What is the final angular velocity of the combined system?

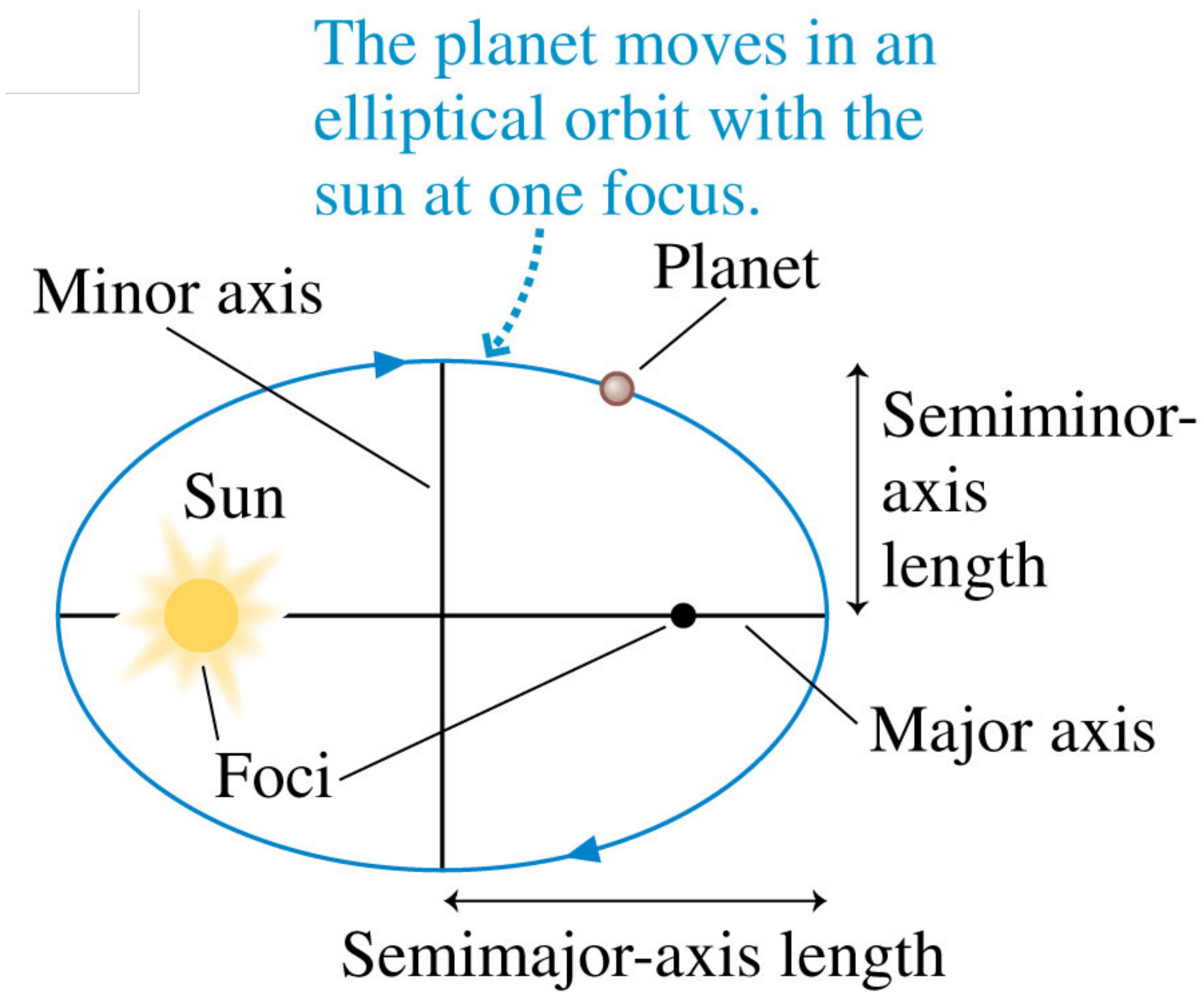


What is the angular speed of the combination after the ***<u>collision</u>***?



Kepler's First Law of Planetary Motion

1. Planets move in elliptical orbits, with the sun at one focus of the ellipse.



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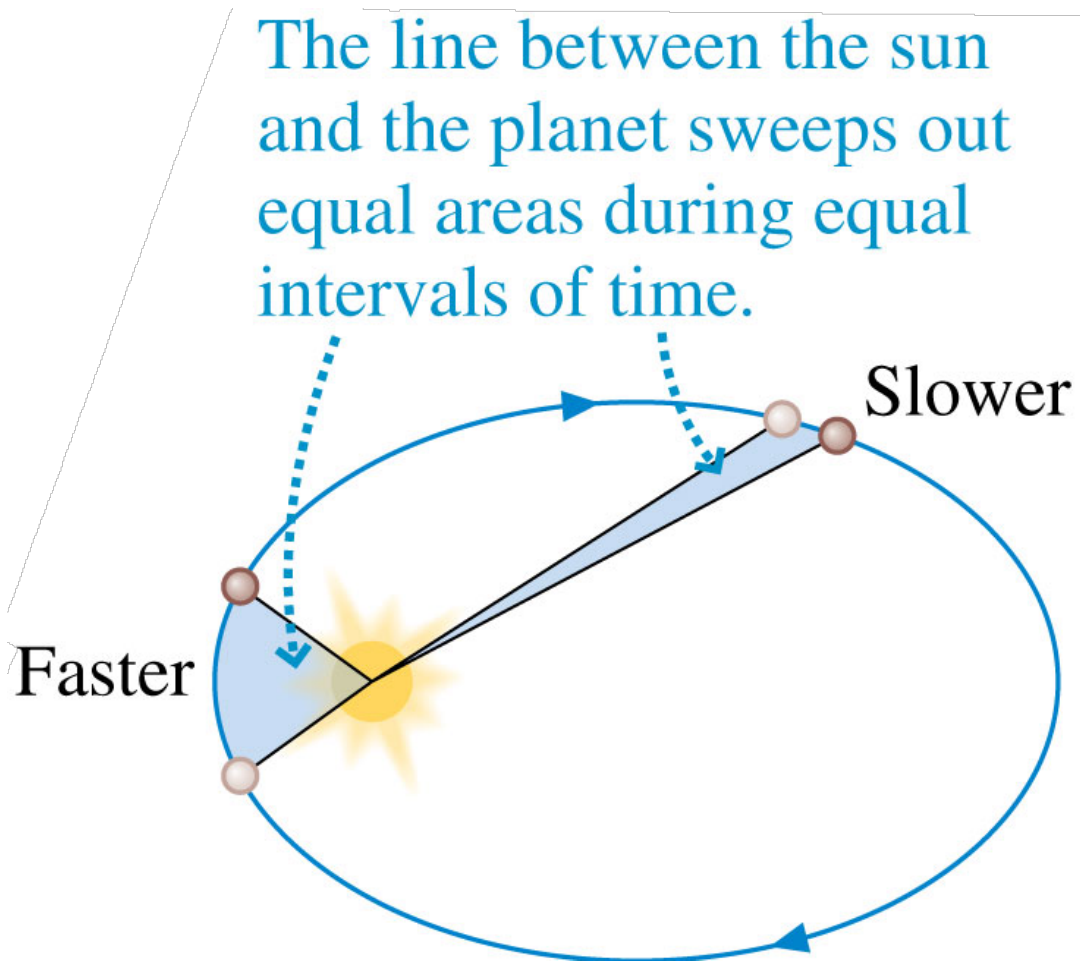
Kepler's Second Law of Planetary Motion

2. A line drawn between the sun and a planet sweeps out equal areas during equal intervals of time.



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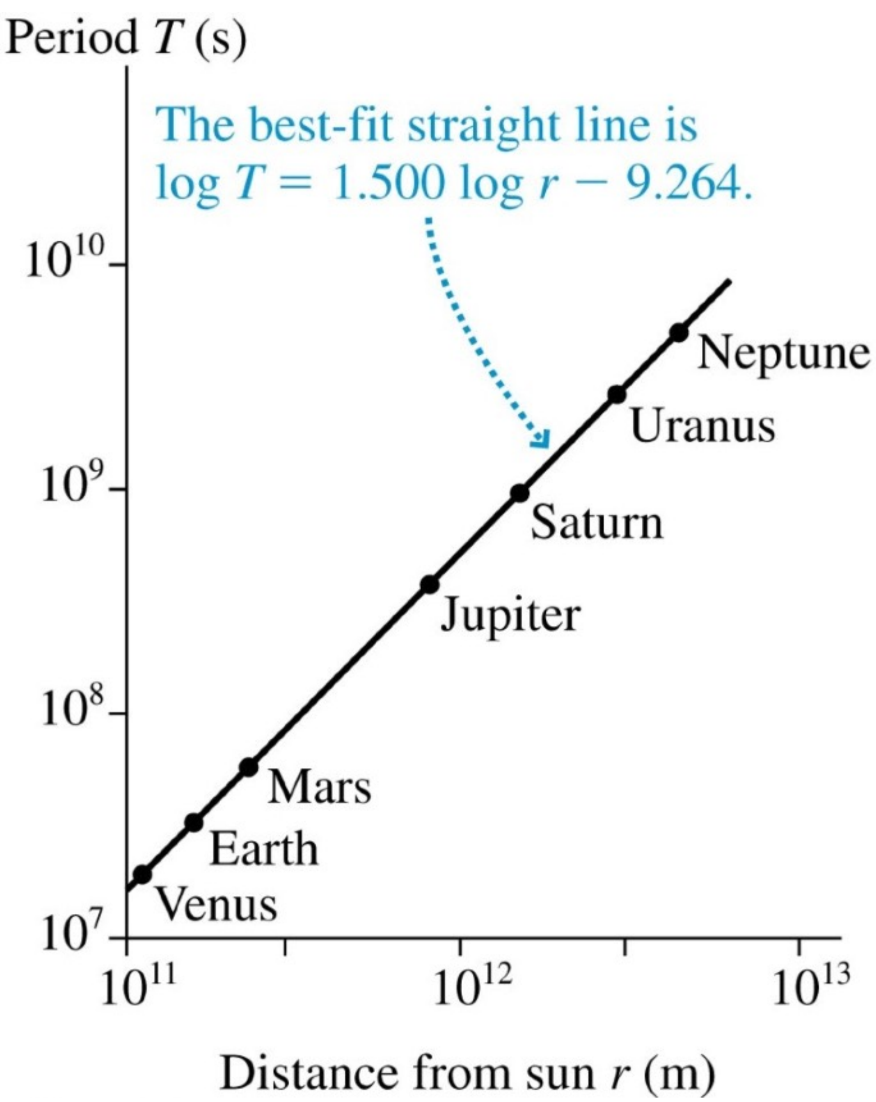
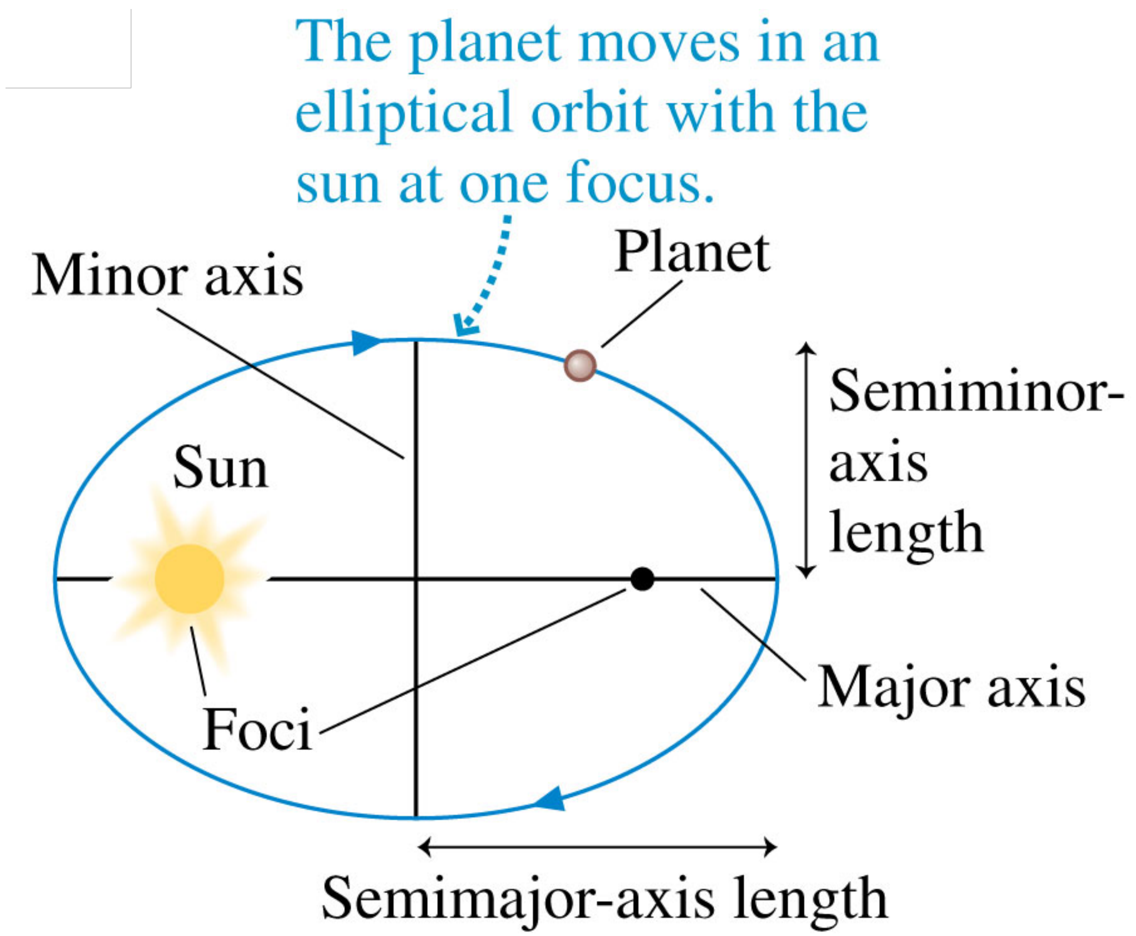
Kepler's Third Law of Planetary Motion

3. The square of a planet's orbital period is proportional to the cube of the semimajor-axis length.





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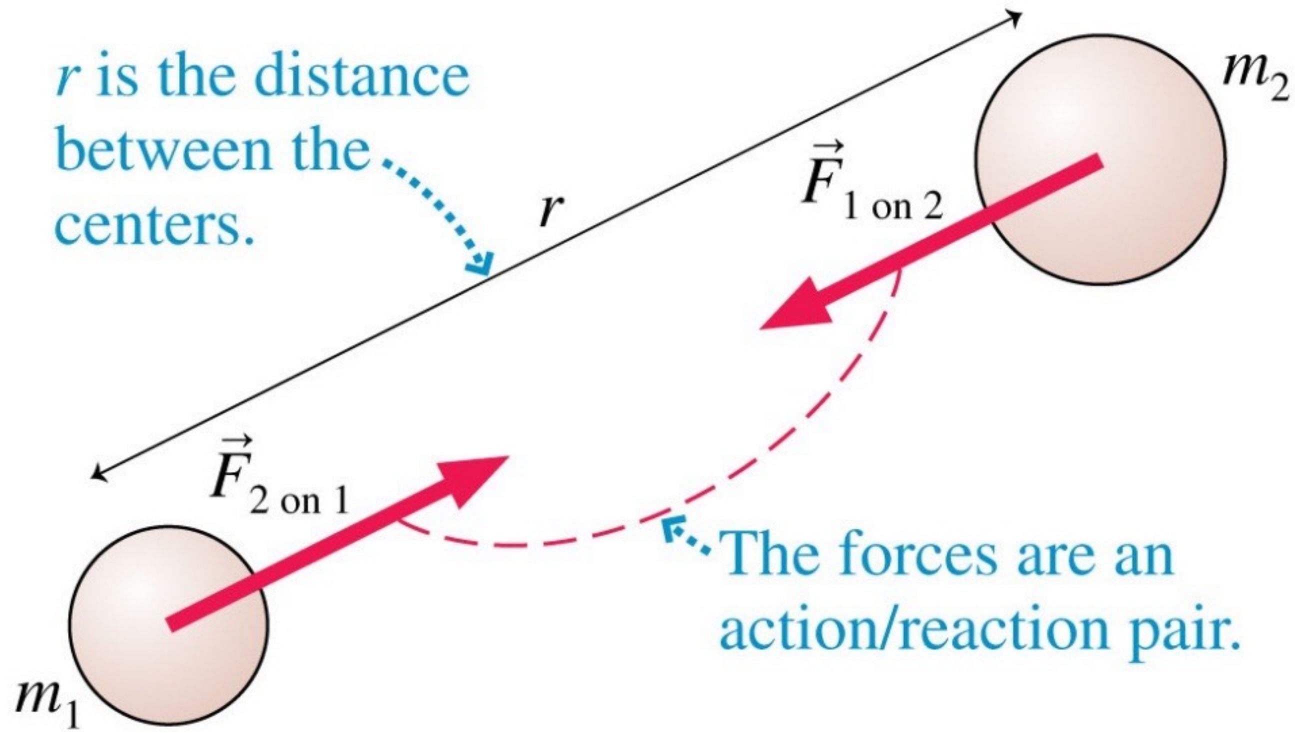
Newton's Law of Gravity

Newton's law of gravity: If two objects with masses m_1 and m_2 are a distance r apart, the objects exert attractive forces on each other of magnitude

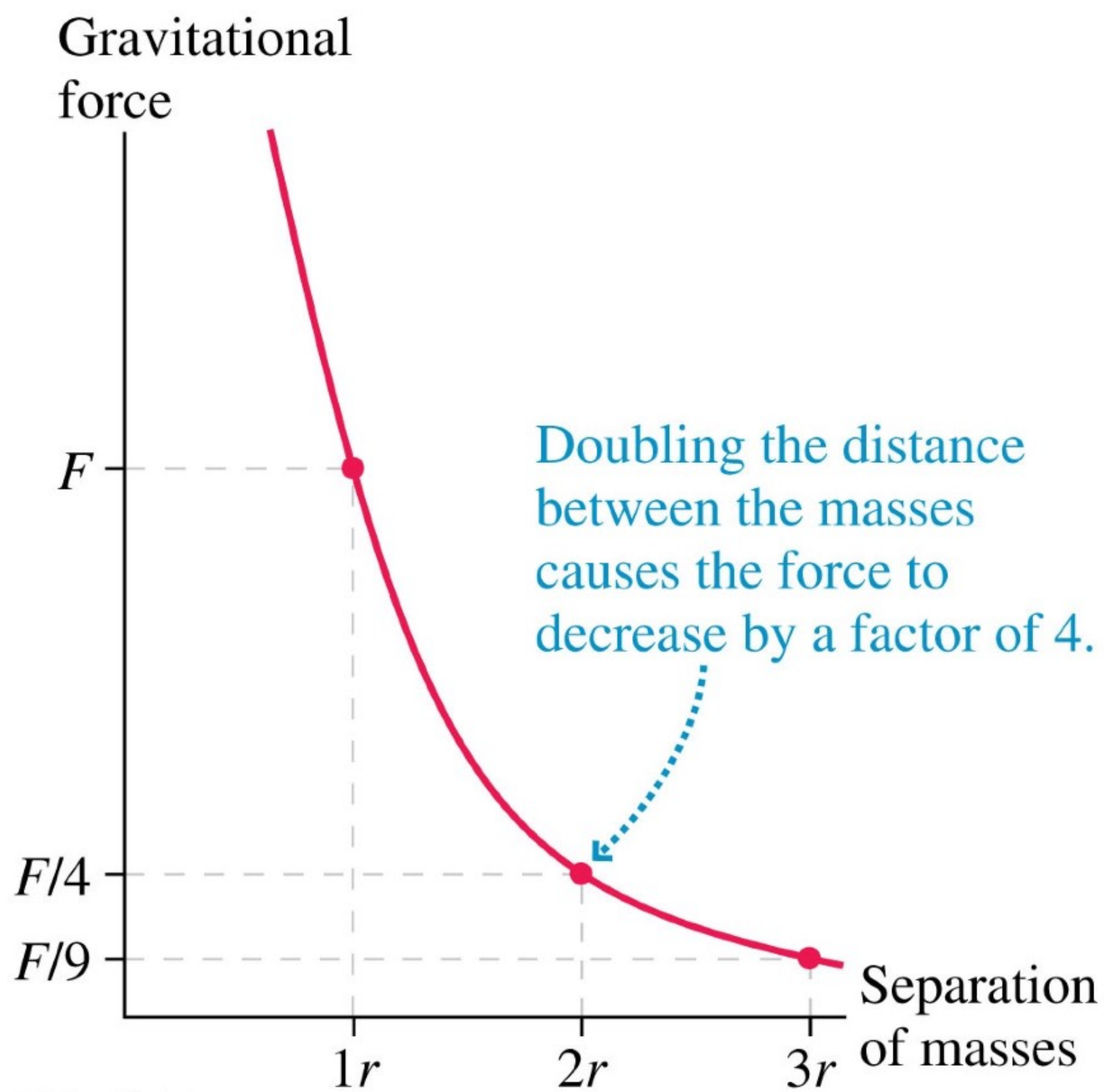
$$F_g = \frac{Gm_1m_2}{r^2}$$

The forces are directed along the straight line joining the two objects



Newton’s Law of Gravity

The gravitational force is an inverse-square force.



Question #13

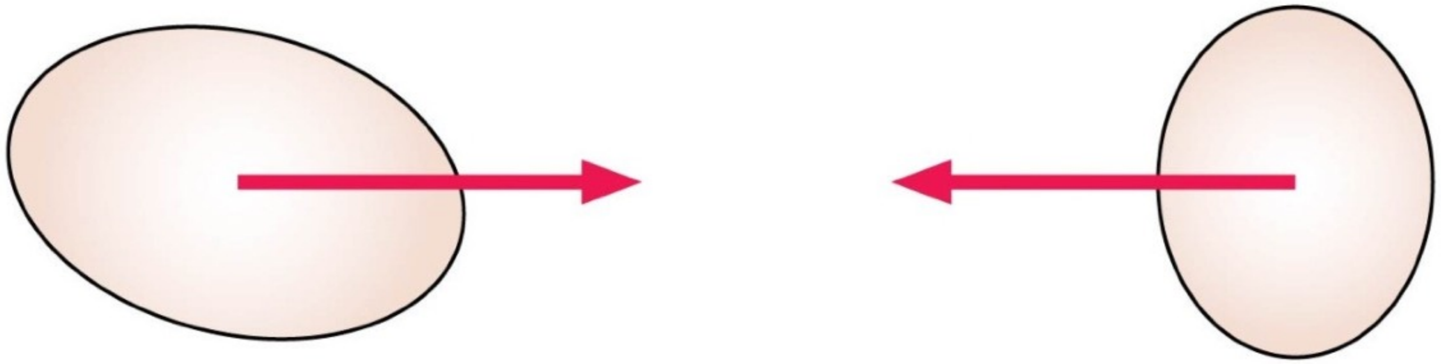
The force of Planet Y on Planet X is ___ the magnitude of $\vec{F}_{\text{X on Y}}$.

a. One quarter.
b. Four times.
c. One half.
d. Twice.
e. The same as.

Question #14

The gravitational force between two asteroids is 1,000,000 N. What will the force be if the distance between the asteroids is doubled?

a. 4,000,000 N.
b. 250,000 N.
c. 1,000,000 N.
d. 500,000 N.
e. 2,000,000 N.



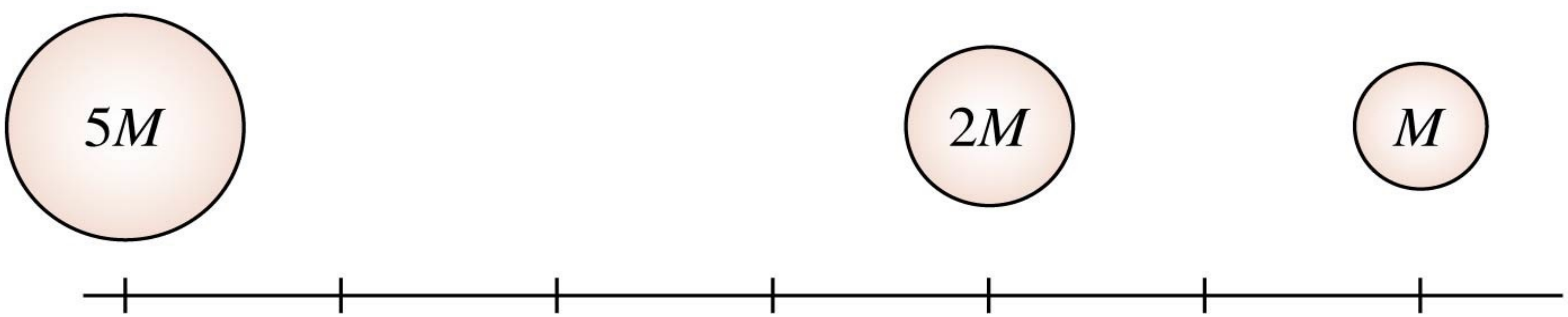
Question #15

Three stars are aligned in a row. The net force on the star of mass $2M$ is

C - To the right.

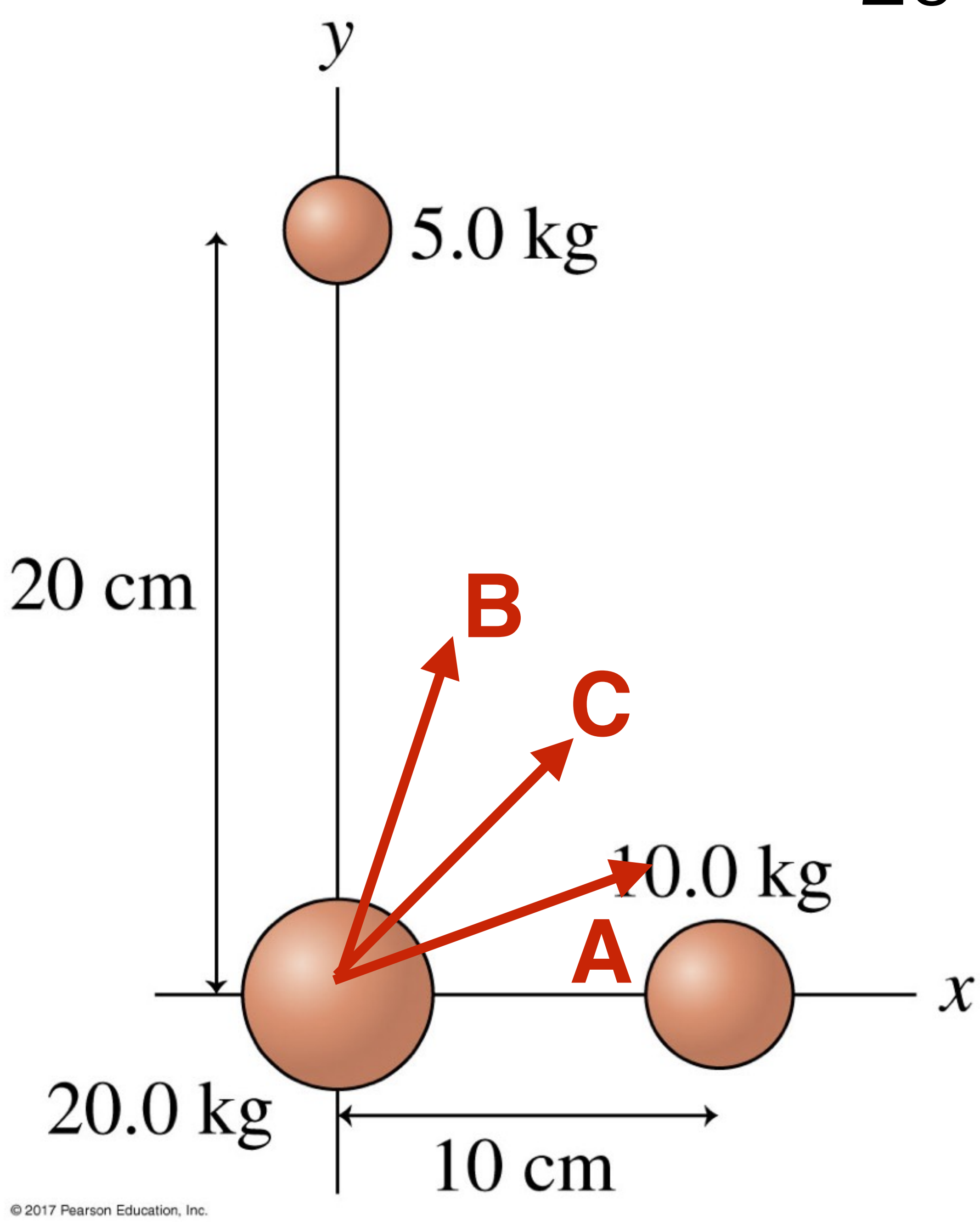
D - Zero.

E - To the left.



Question #16

Which vector best represents the net force on the 20 kg mass?



Little g and big G

According to observer on earth

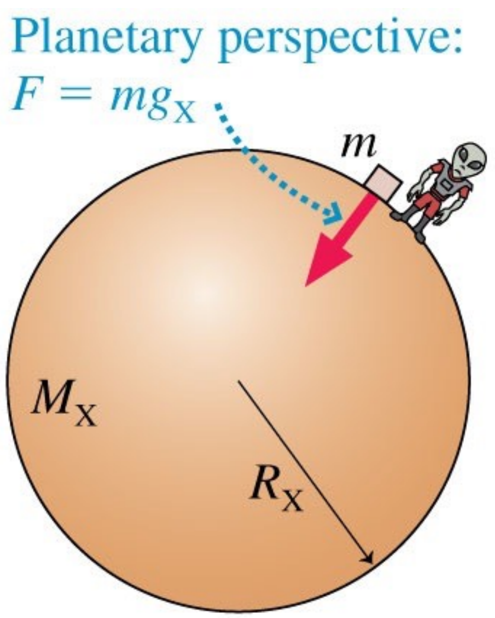
$$F_G = mg_{\text{surface}}$$

According to Newton's Law of gravity

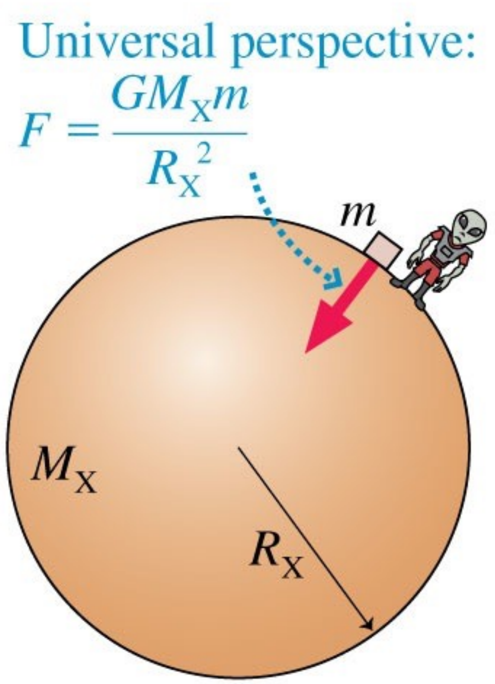
$$F_G = \frac{GMm}{r^2}$$

These are equal if:

$$g_{\text{surface}} = \frac{GM}{R^2_{\text{earth}}}$$



Planet X



Planet X