

Practice Quiz Key

Saturn has 62 moons, which has data given below.

Moon	Distance from planet	Radius of planet	mass	Orbital period
Atlas	137,640,000	37,000	6.6×10^{15}	0.602
Dione	377,400,000	112,000	1.095×10^{21}	2.737
Epimetheus	151,422,000	138,000	5.266×10^{17}	0.694
Saturn	n/a	602,680,000	568×10^{24}	n/a

1. What is the force of gravity between Saturn and Dione? Saturn and Epimetheus?

$$F_g = \frac{Gm_1m_2}{r^2} = \frac{(6.67 \times 10^{-11})(568 \times 10^{24})(1.095 \times 10^{21})}{(377,400,000)^2}$$

$$F_g = \frac{Gm_1m_2}{r^2} = \frac{(6.67 \times 10^{-11})(568 \times 10^{17})(5.266 \times 10^{17})}{(151,422,000)^2}$$

$2.91 \times 10^{20} \text{ N}$ $8.70 \times 10^{17} \text{ N}$

2. Calculate the acceleration due to gravity on Atlas? Explain.

$$g = \frac{Gm}{r^2} = \frac{(6.67 \times 10^{-11})(6.6 \times 10^{15})}{(37,000)^2}$$

$3.2 \times 10^{-4} \text{ m/s}^2$

3. If Atlas was flung twice as far, what would the new gravitational force be between Atlas and Saturn?

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

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

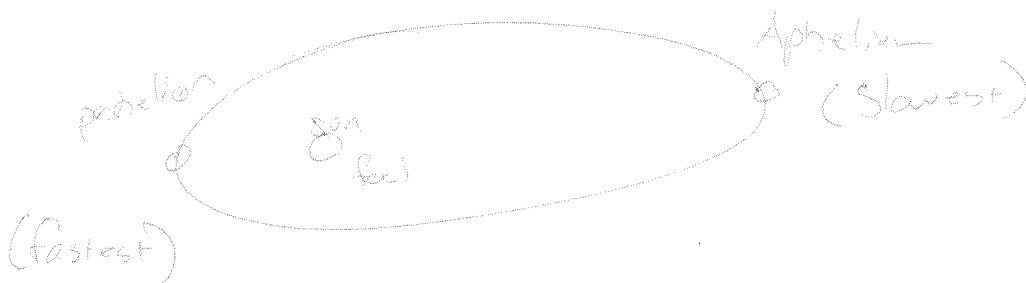
$$\frac{F_g}{4} = \frac{Gm_1m_2}{4r^2}$$

$1/4$ as much or $\frac{1.31 \times 10^{16}}{4} = 3.2 \times 10^{15} \text{ N}$

4. If Saturn turned into a blackhole but did not change mass or radius, what would happen to the moons?

continue to orbit as usual
(F_g did not change)

5. Draw an orbit and label the parts.

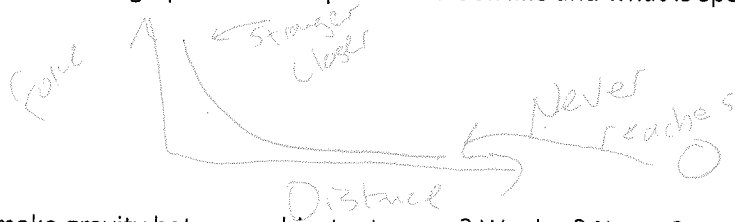


6. If Atlas is 0.74 Au away from Saturn, how far is Epimetheus from Saturn?

$$\frac{0.602^2}{0.74^3} = \frac{0.694^2}{R_B^3}$$

$$R = 0.81 \text{ AU}$$

7. Draw a F_g and Distance graph. What shape does it look like and what is special about it?



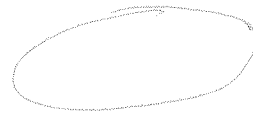
8. How do you make gravity between objects stronger? Weaker? Name 2 ways of each.

Stronger
 gain mass
 closer distance

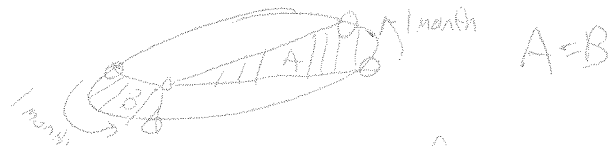
weaker
 loss mass
 get further

9. What are Kepler's 3 laws in simplified terms?

1. Orbit in ovals



2. faster closer \Rightarrow Equal times = Equal Areas



3. $\frac{T^2}{R^3} \rightarrow$ If an orbit is further it must take longer.