

Physics 111-01  
**Test 2**  
October 23, 2000

**Name:** \_\_\_\_\_

Be sure to show your work **clearly** and **draw a box around your answer**. If any question is unclear, please ask immediately. All answers must have the correct units.

1. (20 pts.) In 1978, a moon (now named Charon) was discovered orbiting the distant planet Pluto. For the sake of this problem, assume that the moon orbits around Pluto in a circular orbit of radius  $1.93 \times 10^7$  m with a period of 552,000 s.

a. (5 pts.) What is the acceleration of Charon?

b. (15 pts.) What is the mass of Pluto?

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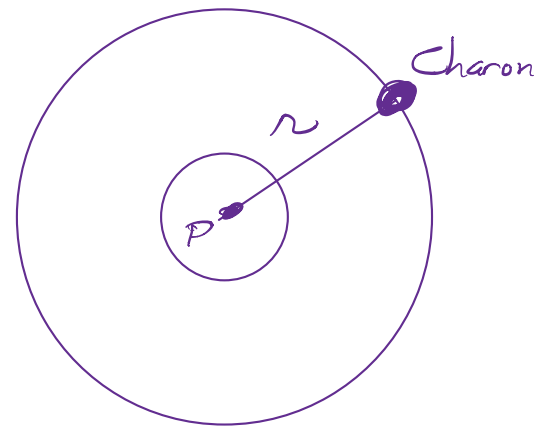
1. (20 pts.) In 1978, a moon (now named Charon) was discovered orbiting the distant planet Pluto. For the sake of this problem, assume that the moon orbits around Pluto in a circular orbit of radius  $1.93 \times 10^7$  m with a period of 552,000 s.

a. (5 pts.) What is the acceleration of Charon?

$$r = 1.93 \times 10^7 \text{ m}$$

$$T = 552,000 \text{ s}$$

$$a = ?$$



$$\Sigma F = m_c a$$

$$\frac{GM_p m_c}{r^2} = m_c a$$

But - don't know  $M_p$  or  $a$ . Look at part (b). That gives  $M_p$ . Here we need  $a$ .

$$a = \frac{v^2}{r} = \frac{(2\pi r/T)^2}{r} = \frac{4\pi^2 r}{T^2} = 2.50 \times 10^{-3} \text{ m/s}^2$$

b. (15 pts.) What is the mass of Pluto?

$$\Sigma F = m a$$

$$\frac{GM_p m_c}{r^2} = m_c a \Rightarrow M_p = \frac{a r^2}{G}$$

$M_p \approx 1.40 \times 10^{22} \text{ kg}$

(actual value  $\sim 1.31 \times 10^{22} \text{ kg}$ )