

**PRELAB FOR LAB A16**  
**PH355**  
**10/29/03**

Reading: Walker Chapter 12 Sections 1-3

Consider a satellite of mass  $m$  orbiting a planet of mass  $M$  under the influence of the planet's gravitational attraction. The planet is so massive that its motion is unaffected by the satellite's gravity – we will assume that the planet is stationary. We will also assume that the satellite's orbit is a perfect circle of radius  $R$ .

You may use the following physics laws in completing the prelab: 1) Newton's Second Law; 2) Newton's Law of Universal Gravitation; 3) the definition of speed ( $v = \text{distance}/\text{elapsed time}$ ); and 4) the formula for the centripetal acceleration of an object in circular motion ( $v^2/R$ ).

Your job is to derive expressions for the satellite's period  $P$ , speed  $v$  and acceleration  $a$ . Your final expressions must depend only on the variables  $M$  and  $R$  (and possibly some constants) – find a way to eliminate all other variables ! Start each derivation with one of the 4 physics laws mentioned above. There may be more than one method to derive each of the expressions, but all methods should lead to the same final expressions. Simplify your final expressions as much as possible.

1. Derivation of expression for  $P$ :

2. Derivation of expression for  $v$ :

3. Derivation of expression for  $a$ :