Physics 200 (Stapleton) Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Test Study Guide – Gravity and Circular Motion

**Provided Equations:**

acentripetal = v2/r Fcentripetal = mv2/r G = 6.67x10-11Nm2/kg2

Circumference = 2πr

**Concepts:**

1. Kepler’s Laws
   1. State the first Law
   2. 2nd Law
      1. State and explain
      2. Identify intervals on a planet’s orbit for which Δt would be equal.
      3. Rank positions along an orbit in terms of satellite speed
      4. On an orbit diagram, draw velocity and gravity vectors.
         1. Vector directions must be correct
         2. Vector lengths must be proportional to magnitude
   3. 3rd Law – formula provided, but it will not labeled as *Kepler’s 3rd Law.* You will need to be able to recognize it. You should also be able to put the formula into words that explain the meaning of the law.
2. Given the provided equations, above, be able to list all of the factors that determine:
   1. Gravitational force between two objects
   2. Gravitational acceleration (g) of an object on a planet
   3. Speed of an object in a stable circular orbit around a planet
   4. Centripetal acceleration
   5. Centripetal force
3. Know the difference between orbital radius and altitude.
4. Know that the reading on a scale equals the normal force that the scale is exerting on the object that it is touching.
5. Know acceptable units for all of the variables in the provided equations, above.

**Types of Problems:**

**Circles and Circular motion**

1. When one of the following variables is provided, calculate either of the other two -- circumference, radius, diameter.
2. When two of the following 3 variables are provided, find the third variable -- Orbital period (e.g. rpm), orbital radius, orbital speed

**Gravitation Formula**

1. Solve for any missing variable in the Universal Gravitation formula.

**Continued↓**

**Centripetal Force**

1. For an object traveling in horizontal circle (or following the curve of part of a circle) at a constant speed…
   1. Find centripetal force
   2. Find net force
   3. In the case of an orbiting object that is attached to a string, find tension
   4. In the case of an object traveling on a surface, find Ffriction or µ.
   5. Use any of the values above (along with other necessary information) to find the circling object’s mass or velocity, or the radius of the circle.
2. Objects traveling in vertical circle (or following the curve of part of a circle) at a constant speed…
   1. Object is held in place by surfaces (bathroom scales)
      1. Find the normal force, including both magnitude and direction, at either the top or the bottom of the circle [given radius, speed, and mass or weight].
      2. Find the rotational speed, radius, mass, or weight of the circling object, given the normal force.
   2. Object is held in place by a string
      1. Find the tension in the string, including both magnitude and direction, at either the top or the bottom of the circle [given radius, speed, and mass or weight].
      2. Find the rotational speed, radius, mass, or weight of the circling object, given the string tension.

**Kepler’s 3rd Law**

1. When three of the variables are provided (or common knowledge), solve for the remaining (4th) variable.
2. Given that one of two satellites is geosynchronous, and given only two of the following three values, find the remaining value: 1) orbital radius of the geosynchronous satellite, 2) orbital radius of the other satellite, 3) period of the other satellite.

**Gravitation Formula + centripetal force formula = formula for speed of a circling object**

1. Calculate orbital speed of a circling object in a circular orbit, given the object’s period and orbital radius.
2. Calculate orbital speed of a circling object in a circular orbit, given the mass of the object being orbited and the orbital radius.

**Gravitation Formula + weight formula = formula for “g”**

1. Find the value of “g” on the surface of a planet (or at some other distance from the planet’s center).