

Name: Key

Math 1310-004

Quiz 7

October 24, 2014

1. (10 points) Newton's Law of Gravitation says that the magnitude F of the force exerted by a body of mass m on a body of mass M is:

$$F = \frac{GmM}{r^2}$$

where G is the gravitational constant and r is the distance between the two bodies.

(a) Find $F'(r)$ and explain its meaning.

(b) Suppose the Earth attracts an object with a force that decreases at a rate of 4 N/km when $r = 10,000$ km. How would the force of attraction to the same object be changing with r when $r = 20,000$ km? (Note: the numbers are not the same as in the homework problem!)

$$(a) F'(r) = -2 \frac{GmM}{r^3}$$

Inversely Proportional to r^3 , decreasing with r .

$$(b) -4 \text{ N/km} = -2 \frac{GmM}{(10,000)^3} \Rightarrow GmM = 2 \times (10,000)^3$$

$$F'(20,000) = \frac{-2 (2 \times 10,000^3)}{(20,000)^3} = \frac{-2 \cdot 2}{8} = -\frac{1}{2} \text{ N/km}$$