Physics 151-01 Accelerated Physics I
Test 2
Monday, October 25, 2010

Name: _____

All problems must begin with either a fundamental principle or with an equation from the equation sheet. If any question is unclear, please ask immediately. Be sure to show your work **clearly**. Partial credit may be given for work *if* it can be understood.

Problem 1: (20 pts.) Astronauts are exploring a distant planet. The planet has a radius of 4.00×10^6 m, and the astronauts are flying in a circular orbit of radius 5.00×10^6 m with a period of 7020 s. A 90 kg astronaut lands on the surface of the planet. What is the weight of the astronaut on the surface? (You may ignore any rotation of the planet.)

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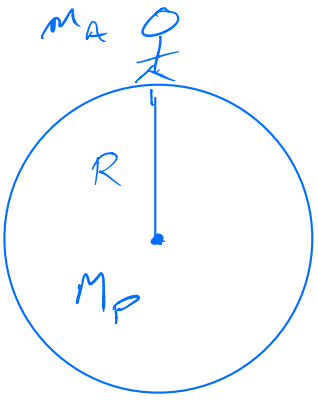
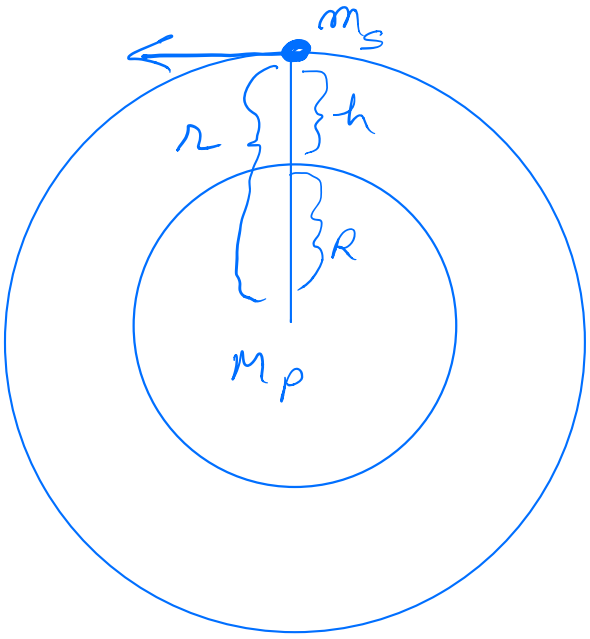


$$w_A = \frac{G m_A M_p}{R^2}$$

Need GM_p.



$$\Sigma F = m_s a$$

$$\frac{G m_s M_p}{r^2} = \frac{m_s v^2}{r}$$

need GM_p.

$$GM_p = v^2 r = \left(\frac{2\pi r}{T}\right)^2 r$$

$$GM_p = \frac{4\pi^2 (5.00 \times 10^6 m)^3}{(7020 s)^2} = 1.00 \times 10^{14} \frac{m^3}{s^2}$$

Then $w_A = \frac{G M_p m_A}{R^2}$

$$w_A = \frac{(1.00 \times 10^{14}\ m^3/s^2)(90\ kg)}{(4.00 \times 10^6\ m)^2}$$

$$\boxed{w_A = 563\ N}$$

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Name: SOLUTIONS

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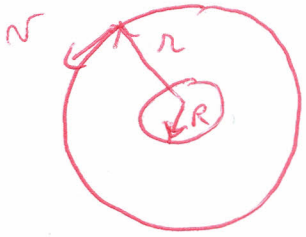

In orbit: $GMT^2 = 4\pi^2 r^3 \Rightarrow GM = \frac{4\pi^2 r^3}{T^2}$

On surface: $F = \frac{GMm}{R^2}$

$$F = \left(\frac{4\pi^2 r^3}{T^2}\right)\frac{m}{R^2} = \boxed{563\ \text{N}}$$