Practice Problems
For Chapter 20

The problems and solutions that follow were designed by students. Although I have checked them, there are very possibly a few errors here and there. If you notice a mistake and turn in a typed correction, you will receive two extra homework points. You may also write new homework problems to add to any chapter and receive between 2 and 5 homework points per problem (see syllabus for details.) Please note: since these problems were written by students, the teacher takes no responsibility for errors – in other words, if there is a mistake and you make the same mistake on a test, you will not get credit for that mistake.

In the problems below, I have highlighted what I feel are the best problems to study prior to tests. The other problems are all ok, but they tend to be very easy problems or repeats of homework problems with slight variations. You may want to start with a few of the regular problems as warm up and then move on to the highlighted problems.

Chapter 20 – Practice Problems

1.) If the gravitational field strength at the peak of Mt. Tonks is 9.773 m/s^2, the gravitational field strength at sea level is 9.803 m/s^2, and the mass of the earth is 5.98×10^{24}, what is the height of Mt. Tonks?

John Wheeler (class of 2008)

2.) What is the strength of the gravitational field on the moon? (radius = 1.74×10^{6}, mass = 7.36×10^{22})

John Wheeler (class of 2008)

3.) On the newly discovered asteroid of Furgaberg, the dominant life form is a goat. If Furgaberg only has a mass of 3.20×10^{11} and radius of 743m, what is the force of attraction between a 50 kg goat and Furgaberg?

John Wheeler (class of 2008)

4.) What is the force of attraction between the moon and the sun? (mass of sun = 1.99×10^{30} kg, avg. distance between sun and moon = 1.5×10^{11}, mass of moon = 7.36×10^{22})

John Wheeler (class of 2008)

5.) What is the strength of the gravitational field on the planet of xenon? (radius = 3.71×10^{8} and mass = 1.32×10^{28})

John Wheeler (class of 2008)

6.) Uncle Sam builds two towers 22,000 km apart. If Uncle Sam wants to create a gravity of .22N between the two towers, how much money must Uncle Sam use in order to build these two towers? (The towers are the same mass, a single stone has a mass of 2 kg, ten stones cost 5 dollars, and a work crew can lay 1,000 stones an hour (for 50 dollars))

John Wheeler (class of 2008)

7.) Using a jet pack, Marvin manages to launch away from the moon. If he keeps going until his weight is a quarter of what it was on the surface, how far did he go?

John Wheeler (class of 2008)

8.) Since Mercury is such an awesome planet, it inherits a unicorn, a really, really big unicorn (8.7×10^{13} kg). Unfortunately, due to the terms of the inheritance, the unicorn has to stay far enough away for the gravitational field to have a strength of 3.2N. If the unicorn orbits Mercury at this distance, how long will it take it to complete one full revolution if it trots at a speed of 24,422 m/sec? (Mass of Mercury = 3.302×10^{23} kg)

John Wheeler (class of 2008)

Chapter 20 – Answers

1.)

$$r^2 = Gm/g$$

At Sea Level $r^2 = (6.67x10^{-11}\ Nm^2/kg^2)(5.98\ x\ 10^{24})/(9.803)$

$$r = 6{,}378{,}726m$$

At the Peak $r^2 = (6.67x10^{-11}\ Nm^2/kg^2)($ is $5.98\ x\ 10^{24})/(9.773)$

$$r = 6{,}398{,}308m$$

$$6{,}398{,}308m - 6{,}378{,}726m = 19{,}581m$$

2.)

$$r^2 = Gm/g$$

$$(1.74\ x\ 10^6)^2 = (6.67x10^{-11}\ Nm^2/kg^2)(7.36\ x10^{22})\ /\ g$$

$$g = .932\ m/s^2$$

3.)

$$F = G(m1)(m2)/r^2$$

$$F = (6.67x10^{-11}\ Nm^2/kg^2)(50)(3.20\ x\ 10^{11})/(743)(743)$$

F = .0019 N (not very strong)

4.)

$$F = G(m1)(m2)/r^2$$

$$F = (6.67x10^{-11}\ Nm^2/kg^2)(\ 1.99x10^{30})(\ 7.36\ x\ 10^{22})/(\ 1.5\ x\ 10^{11})(\ 1.5\ x\ 10^{11})$$

$$F = 4.34\ x\ 10^{20}\ N$$

5.)

$$r^2 = Gm/g$$

$$(3.71\ x\ 10^8)^2 = (6.67x10^{-11}\ Nm^2/kg^2)(1.32\ x10^{28})\ /\ g$$

$$g = 6.40\ m/s^2$$

6.)

$$F = G(m)(m)/r^2$$

$$.22N = (6.67x10^{-11}\ Nm^2/kg^2)(m^2)/(22{,}000{,}000m)^2$$

$$m = 8.427\ x\ 10^{12}$$

$8.427\ x\ 10^{12}$ stones needed

Each stone costs 5/10 + 50/1000 = .55 dollars
It will cost 4,635,105,544,000 dollars (don't try this at home)

7.)

$g_{\text{Pluto surface}} = Gm_p/r_p^2$

$g_{\text{Pluto surface}} = (6.67\text{x}10^{-11}\ Nm^2/kg^2)(1.3 \times 10^{22})/(1{,}180{,}000)^2$

$g_{\text{Pluto surface}} = .623\ m/s^2$

We want to get one fourth of this .623/4 = .156 m/s^2

$g_{\text{Pluto to Marvin}} = Gm_p/r_{\text{center of Pluto to Marvin}}^2$

$.156\ m/s^2 = (6.67\text{x}10^{-11}\ Nm^2/kg^2)(1.3 \times 10^{22})/\ r_{\text{center of Pluto to Marvin}}^2$

r = 2,357,611.79m

2,357,611.79m - 1,180,000m = 1,177,711.79 meters

8.)

Not cool distance

$F = G(m1)(m2)/r^2$

$F = (6.67\text{x}10^{-11}\ Nm^2/kg^2)(1.99\text{x}10^{30})(6.4 \times 10^{23})/(227{,}000{,}000{,}000m^2)$

$F = 1.65 \times 10^{21}$

Cooler distance

$F = G(m1)(m2)/r^2$

$F = (6.67\text{x}10^{-11}\ Nm^2/kg^2)(1.99\text{x}10^{30})(6.4 \times 10^{23})/(122{,}000{,}000{,}000m^2)$

$F = 5.71 \times 10^{21}$

5.71/1.65 = x/3

Mars will now get slightly more than ten invites this orbit!!!