PHYSICS

UNIT 6

WORK , POWER, AND

UNIVERSAL GRAVITATION

Pgs 240

Johannes Kepler (1571- 1630)

-Tycho Brahes assistant ( article)

- German astronomer and mathematician

- formulated three laws of planetary motion

**First Law:**

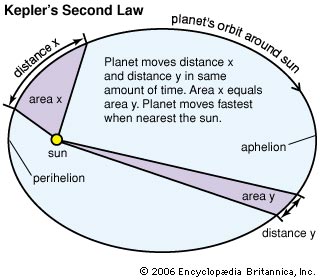
Each planet travels in an elliptical orbit around the sun and

the sun is at one of the focal points.

**Second Law:**

An imaginary line drawn from the sun to any planet sweeps

out equal areas in equal time intervals



**Third law**:

The square of a planet’s orbital period (T2) is proportional to the cube of the distance between the planet and the sun or

T2 = k

R3

SIR ISAAC NEWTON: (1642 -1727)(English physicist/ mathematician)

* Asked if the force causing an apple to fall to the ground was peculiar to the earth or did all bodies cause an attractive force on one another?
* Newton utilized Kepler’s 1st and 3rd laws to formulate his law of universal gravitation.

1. The elliptical orbits are almost circular so the force acting on the planets must be the same.

Fc = m4∏2r

T2

1. Newton used Kepler’s 3rd law

k=r3  so T2 = r3

T2  k

He then substituted r3

T2

Fc = m4∏2r Fc= m4∏2k

T2 r2

Because 4∏2k is a constant K= 4∏2k

So Fc= mK

R2

Newton realized from this that the **force** between any planet and the sun varies **inversely** w/ the square of its **distance** from the sun. Also that the force between them varies **directly** w/ the **masses** of the sun and the planet.

With distance and masses in mind Newton wrote the Law of Universal Gravitation.

STATES:

Every object in the universe attracts every other object

with a force that varies 1. Directly with the product of the

masses (m1m2) 2. Inversely with the square of the

distance between the center of the masses (1/r2)

The Equation reads:

F= G m1m2

r2

m1 & m2 are the masses

r2 = radius

G = Universal Constant = 6.67 X10-11 Nm2 /Kg2

Ex. Two people standing 10m apart weigh 590N and 900N.

What is the gravitational force between them?

Old book page 149 pr 1- 7 pg 154 Qu 1-5

**CALCULATING THE WEIGHT OF AN OBJECT ON ANY PLANET**

The gravitational attraction between an object and a planet is known as its weight.

W= Gmome

r2

CALCULATING GRAVITATIONAL ACCELERATION ON ANY PLANET.

g= G mp

r2

g= gravitational acceleration

mp= mass of planet

r= radius of planet in (m)

EXAMPLE:

What is the weight of an object that has a mass of 50kg and

is found on a planet which has a mass of 6.0 X 1024Kg and a

radius of 6.4 X 103km?

EXAMPLE 2

What is the gravitational acceleration of a planet w/ a

radius of 100,000 m and a mas of 1.0 X 1020kg?

GRAVITATIONAL FIELD CONCEPT:

Physicists have proposed the field concept to better

understand stellar and astronomical motion.

Gravitational field:

In the case of gravity, the field concept suggests that a

mass (such as from a planet) distorts the space around

it setting up a gravitational field .

* This concept considers gravity as a peculiarity of space rather than some mysterious force between two objects.
* Einstein first proposed that space is curved or distorted due to the mass of an object in the early 1900’s .

ASSIGNMENT: pg 242 Practice C 1-3

PERIOD AND SPEED OF AN OBJECT IN CIRCULAR ORBIT

T = 2π√r3/Gm

vt = √Gm/r

Magellan, the first planetary spacecraft to be launched from a space shuttle. During the spacecraft’s fifth orbit around Venus, ( venus has a radius= 6.05 X 106m ) Magellan traveled at a mean altitude of 361km. If the orbit had been circular, what would Magellan’s a. period and b. speed have been?

ASSignment : Pg 251 practice D

WORK AND POWER:

WORK:

Is the product of the force applied and the distance

through which the force acts.

(work is done when an objects displacement changes due to the applied force)

The unit for work is the Joule and is equal to 1 newton meter.

WORK AND THE DIRECTION OF FORCE:

If a force is applied to an object at an angle with the direction of motion the net force is the component of the force that acts in the direction of motion . 600N

Net force

To find the net force in this case use Cos θ = adjacent

Hypotenuse

POWER: WHAT IS POWER?

The rate at which work is done. P = work

Time

The unit for power is the watt. Watt = Joule/sec

Ex. A machine produces a force of 50N through a distance of

10m in 2 minutes. Calculate the work done by the

machine a and the power of the machine.

ASSIGNMENT : 1

Old book Pg 154 Questions 1-5

Pg 155 pr 1-4

Pg 158 pr 1-12

ASSIGNMENT : 2

Pg 160 pr 13- 17

Pg 162 pr 18-23

Pg 164 q 1-6 pr 1-8

CONFUSION OF KILOWATTS WITH KILOWATT HOURS

Watts are a unit of power = joules/s = joules/s

Joule = Nm = kgm/s2 x m

Kilowatt hour is a unit of energy

A joule is a unit of work, heat, and energy

So power X time = energy Joules/s x time = energy