Chapter 4, 5 & 6
Work, Energy and Power
Lecture Notes

A. **Section 4-1: What is Work?**

Work is force exerted on an object that causes the object to move some distance

Force without moving a distance yields NO WORK!!

If you push on a wall until your arms are soooooooo tired you can't push anymore and the wall doesn't move….. then you have done no work.

If you blow on a piece of paper and it moves….. you have done more work that the example above.

In order for work to be done on an object, the force you apply must be in the same direction as the movement of the object.

The formula for Work:

Work = Force x Distance

SI Unit for work is the **Joule**

1 Joule = 1Newton x 1 Meter

Problems: Work = Force x Distance

How much work performed:

85N x 3Meters = 255 J

37N x 4.3 Meters = 159.1 J

How much force required:

75 Joules in 3 Meters= 75J = N x 3M N=25Newtons

124 Joules in 12 Meters = 124 J = N x 12M N=10.3

What distance is covered:

12 newtons of force performs 24 Joules of Work 24=12 x D D=2Meters

18 newtons of force performs 46.8 Joules of Work 46.8=18 x D

D=2.6Meters

B. **Section 4-2 Mechanical Advantage and Efficiency**

What is a **Machine**?

A device that makes work easier or more effective

A machine makes work easier by changing the amount of force, the distance covered or by changing the direction of the force

Input Force (AKA the effort force) = the force you exert on the machine

Output Force (AKA resistance force)= the force exerted by the machine

Ideal Situation: the input work into a machine will be exactly the same as the out put work of that machine; however, friction causes this not to happen.

Mechanical Advantage

A machine's **mechanical advantage** is the number of times a force exerted on a machine is multiplied.

MA = output force / input force

Efficiency of a machine

Some input work is used to overcome friction, i.e. rusty old scissors are harder to use than new sharp scissors.

Calculate the efficiency of a machine by:

efficiency = output work / input work x 100%

Section 4-3 Simple Machines

Six basic simple machines

Inclined Plane: a flat slanted surface

Wedge: a device thick on one end and thin on the other (an inclined plane tipped on its side)

Screw: an inclined plane wrapped around a cylinder
Lever: a rigid bar that is free to pivot about a fixed point (the fulcrum)
Wheel & Axle: two circular objects attached together about a common axis
Pulley: a grooved wheel w/ a rope or chain wrapped around it.

Inclined Plane

Ideal MA of an incline plane

IMA = length of incline / height of incline

Examples – handicap ramp, stairs

Input force is the force you use to push or pull the object up the ramp

Output force is the force required to lift the object straight up (its weight)

Wedge

The wedge moves along or thru the object where as the object moves along an incline plane

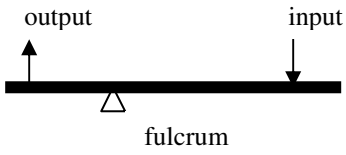
Examples – ax, wood splitter, zipper

Screw

Examples – screw, bolt, jar lid

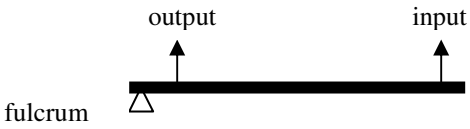
Levers –

IMA = Distance from input force to fulcrum / distance from output force to fulcrum

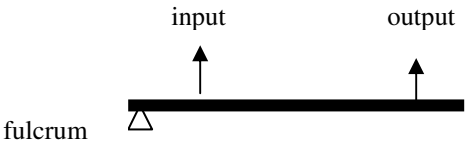
1st Class – 

amples: nail remover, paint can opener scissors, seesaw

2nd Class - example: wheel barrow, door, nutcracker



iv. **3rd Class** example: rake, shovel, baseball bat



Wheel and Axle

Wheel is the large cylinder

Axle is the small cylinder

IMA = Radius of the wheel / radius of the axle

C. **Pulley**

1. IMA of a pulley system = the number of ropes that support the weight of the object

D. **Compound Machines –** a machine that utilizes two or more simple machines