10.2 Simple & Compound machines

6 - simple machines Lever, inclined plane, Screw, pulley, wheel + axle, + wedge

Lever
Pulley
Wheel + axle

Inclined Plane
wedge
Screw

Screwdriver: Lever - Length matters
Wedge handle - wide

Bottle opener: Lever

Cutters:

May 8-9:57 AM

Compound Machines

On a multi-gear bicycle, the rider can change the *MA* of the machine by choosing the size of one or both gears.

$MA = \frac{fr}{fe}$

When accelerating or climbing a hill, the rider increases the ideal mechanical advantage to increase the force that the wheel exerts on the road.

$IMA = \frac{de}{dr}$

To increase the *IMA*, the rider needs to make the rear gear radius large compared to the front gear radius.

For the same force exerted by the rider, a larger force is exerted by the wheel on the road. However, the rider must rotate the pedals through more turns for each revolution of the wheel.

May 8-10:00 AM

Compound Machines

On the other hand, less force is needed to ride the bicycle at high spee on a level road.

An automobile transmission works in the same way. To accelerate a car from rest, large forces are needed and the transmission increases the *IMA*.

$$IMA = \frac{dc}{dr}$$

At high speeds, however, the transmission reduces the IMA because smaller forces are needed.

Even though the speedometer shows a high speed, the tachometer indicates the engine's low angular speed.

May 8-10:03 AM

The Human Walking Machine

Movement of the human body is explained by the same principles of force and work that describe all motion.

Simple machines, in the form of levers, give humans the ability to walk and run. The lever systems of the human body are complex.

However each system has the following four basic parts.

1. a rigid bar (bone)
2. source of force (muscle contraction)
3. a fulcrum or pivot (movable joints between bones)
4. a resistance (the weight of the body or an object being lifted or moved).

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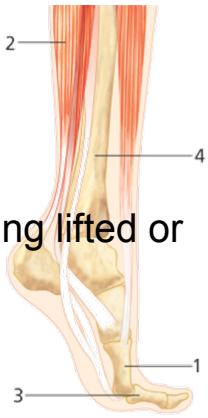

May 8-10:05 AM

The Human Walking Machine

Lever systems of the body are not very efficient, and mechanical advantages are low.

This is why walking and jogging require energy (burn calories) and help people lose weight. Exercise

When a person walks, the hip acts as a fulcrum and moves through the arc of a circle, centered on the foot.

The center of mass of the body moves as a resistance around the fulcrum in the same arc.

The length of the radius of the circle is the length of the lever formed by the bones of the leg.

Athletes in walking races increase their velocity by swinging their hips upward to increase this radius.

May 8-10:09 AM

The Human Walking Machine

A tall person's body has lever systems with less mechanical advantage than a short person's does.

Although tall people usually can walk faster than short people can, a tall person must apply a greater force to move the longer lever formed by the leg bones.

Walking races are usually 20 or 50 km long. Because of the inefficiency of their lever systems and the length of a walking race, very tall people rarely have the stamina to win.

May 8-10:12 AM

Mason + his father exert a total force of 1.24×10^3 N in moving a heavy sofa 18 m to Another room. His father exerts twice as much force as Mason exerts. How much work does each person do?

$F_{Total} = f_{mason} + f_{father}$

$f_{father} = 2f_{mason}$

$f_{total} = f_{mason} + 2f_{mason}$

$f_{Total} = 3f_{mason}$ $f_{mason} = 413.\overline{3}$N

$\frac{1240}{3} = \frac{3f_{mason}}{3}$ $f_{father} = 826.\overline{6}$N

$W_{mason} = f_{mason} \cdot D$

$(413.\overline{3})(18) = 7440$ J

7.4×10^3 J

$W_{father} = f_{father} \cdot d$

$(826.\overline{6})(18) = 14880$ J

1.49×10^4 J

May 8-12:45 PM

Imaan got a job lifting Crates at Walmart. The crates mass is 8.4kg. Carry the crate from the floor 0.6m to 5 3m across the store to place the crate on the shelf 1.8m high. How much work does Imaan Accomplish?

$F_{Imaan} = (m)(g)$

$(8.4)(9.8) = 82.4$ N

$W_1 = (82.4)(0.6m) = 49.44$ J

$W_2 = (82.4)(1.2m) = 98.88$ J

148.32 J

1.48×10^2 J

May 8-12:53 PM

① CR 10 Part 1 Review

② Organize Portfolio

May 8-1:02 PM