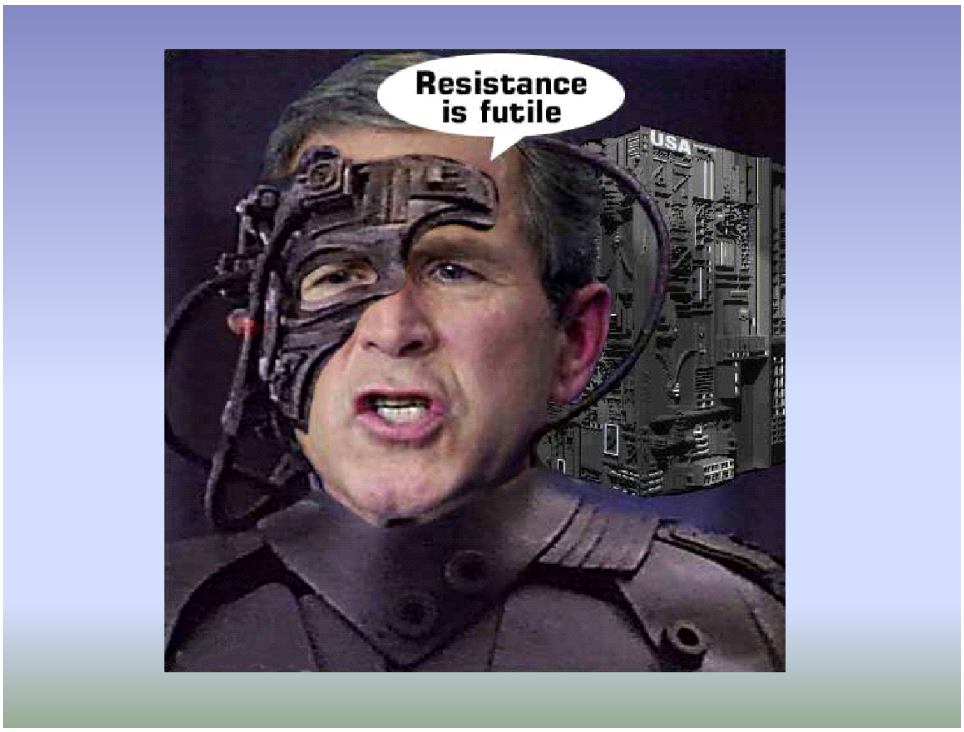
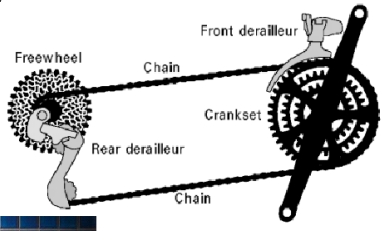
FRICTION

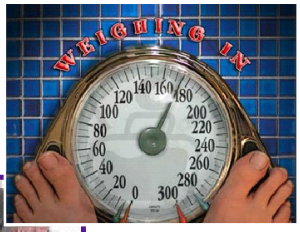
Friction is an opposition to motion and will take many, many forms in your electric go-kart. For each component adjusted and altered to minimize resistance, you free up a little more battery power to the wheels. Little by little, you will gain speed, acceleration and range... that much closer and faster to the finish line. We do not live in a perfect world, therefore...



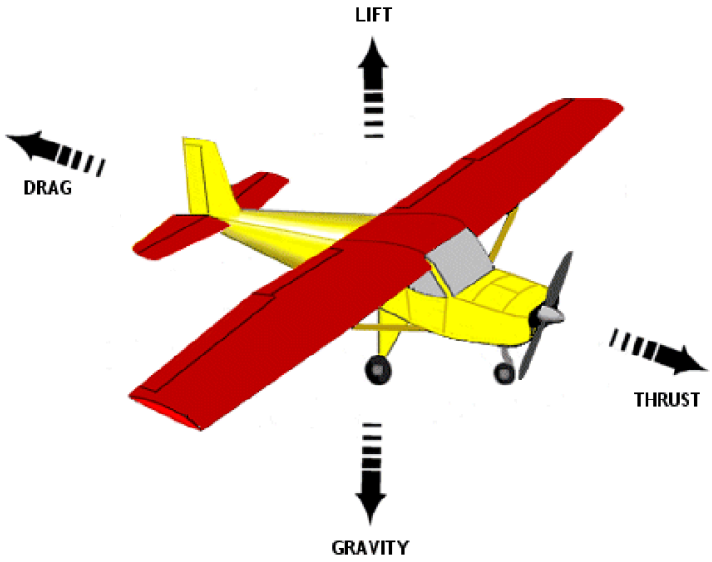
resistance can be minimized but not eliminated.

everything counts

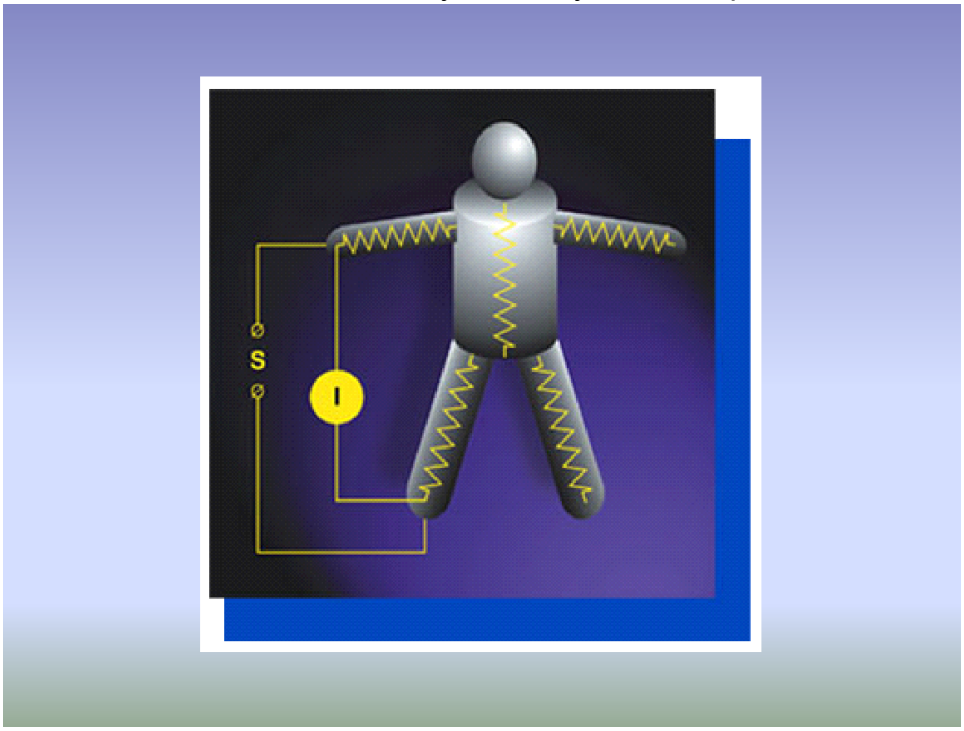




There is friction in bearings, sprockets and chains, electrical connections, vehicle weight, and tires.

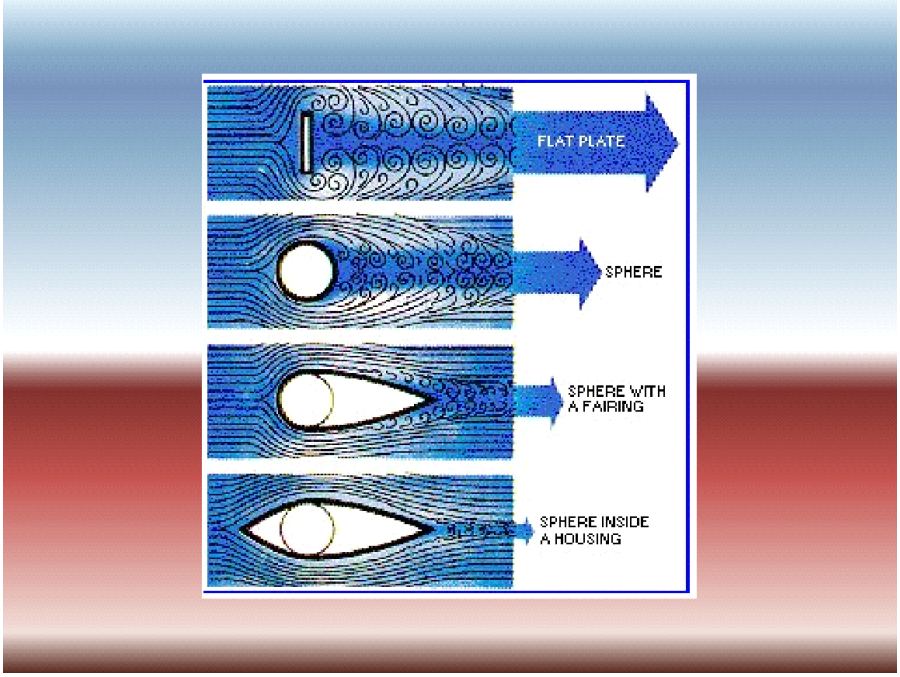


You will encounter friction aerodynamically in four separate directions.



Electrically speaking, there is friction in conductive wire, loads, and switches.

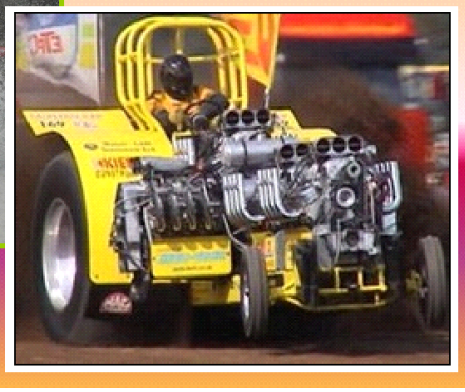
Aerodynamically, friction and or resistance in the form of drag (liquids = air and water).



The shape of an object greatly influences aerodynamic drag/friction/resistance.

mechanical resistance

(friction…wet or dry)



Friction can be found between two different surfaces. The idea, again, is to minimize friction. This can be done with careful planning, design, and execution. The maintenance of your vehicle plays a role: What tire pressure are you going to use? Chain tension? Alignment? Brake drag? Aerodynamics? Electrical connections? Sprocket condition? Chain alignment? Driving ability? Driving strategy? Battery condition? Loose body panels? Gear ratio? Wheel covers? Mirror treatments? Do others draft you? Do you draft others? Bearing condition? Etcetera, etcetera, etc.

There are three basic types of friction regarding wheels, bearings, brakes or anything that uses one surface in contact with another.

static friction

the friction that must be overcome to initiate movement

kinetic friction

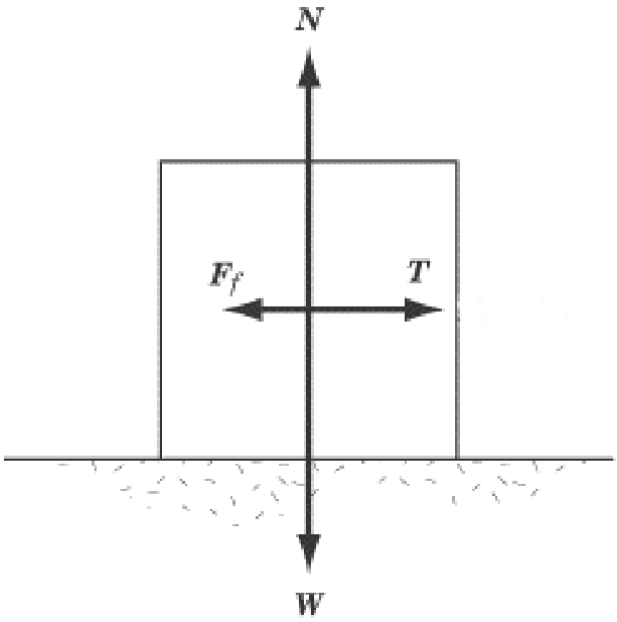
friction after movement begins

rdling friction

thefriction developed whilerdling

friction depends

Friction depends upon the surface materials and the weight.



force of friction
=
coefficient of friction
x
normal force

$f = \mu \times N$

coefficient of friction values

material	μ_s	μ_k	μ_r
wood on wood	0.7	0.4	?
steel on steel	0.15	0.09	0.05
metal on rubber	0.65	0.55	0.35
wood on leather	0.5	0.4	?
rubber on dry concrete	0.9	0.7	0.3
rubber on wet concrete	0.7	0.57	0.19

Railway engines get about 100 miles per gallon!!! Take a look at the rolling resistance figure for steel on steel versus rubber on dry concrete... amazing!

ASSIGNMENT: Calculate the forces required to move the gas-powered go-kart in the following scenarios. Use the "f = μ x N" formula.

1. Determine the force required to overcome the static friction of a 360 pound go-kart.

[rubber tires on dry concrete]

2. Determine the force to keep a 360 pound go-kart sliding across the ground (wheels are locked up).

[rubber tires on dry concrete]

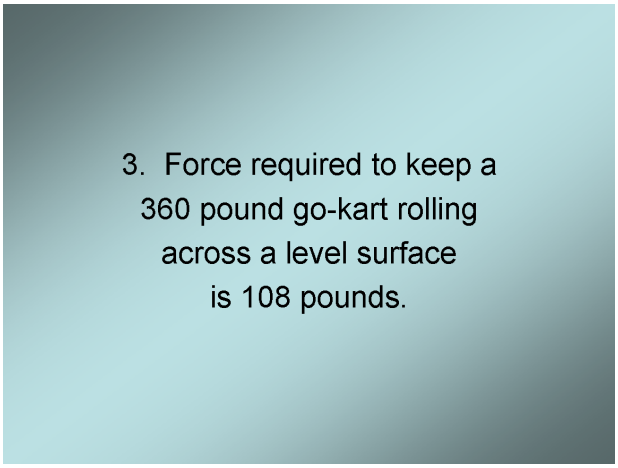
3. Determine the force required to keep a 360 pound go-kart moving (wheels are not locked).

[rubber tires on dry concrete]

ANSWERS

1. Force to overcome static friction is 324 pounds.

2. Force to continue sliding go-kart across the ground is 252 pounds.



QUESTION: Do you suppose tire tread or tread hardness makes a difference in rolling resistance? In other words, are there different energy requirements for mud tires versus passenger car tires and sticky racing tires versus skateboard wheels?