Inertia

A body in motion tends to remain in motion;
a body in rest tends to remain at rest.

How to describe motion?

Position: Where you are

Velocity: 2 parts
1) How fast you are going (speed)
2) Which way you are going (direction)

Acceleration: How fast your velocity is changing
speeding up
slowing down
changing direction

Newton's Laws

First Law: An object that is not subject to any outside forces moves at constant velocity, covering equal distances in equal times along a straightline path.

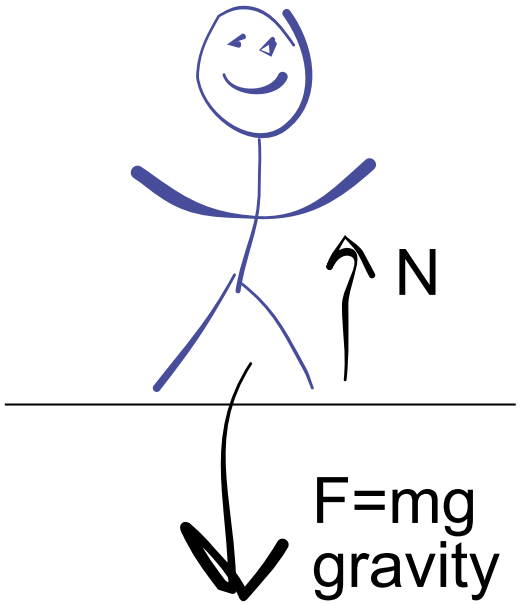
Second Law: The force exerted on an object is equal to the product of the object's mass times its acceleration. The acceleration is in the same direction of the force.

F=ma
Easier to move a light object than a heavy one

Third Law: For every force that one object exerts on a second object, there is an equal but oppositely directed force that the second object exerts on the first object.

Gravity

On ground



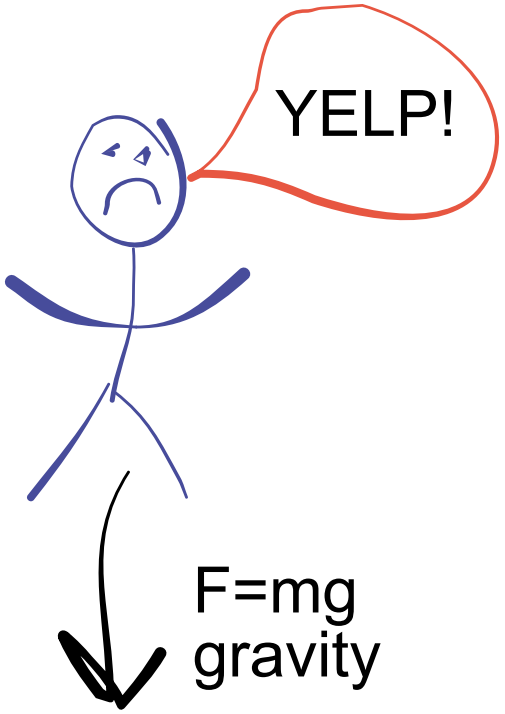
g acceleration due to gravity

Need to consider all the forces acting on the body

Normal force from ground pushes up on stick man

$F_{Total} = N - F = 0$

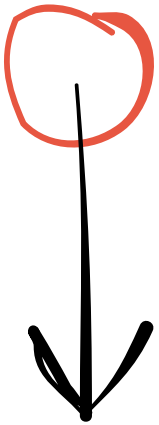
No ground

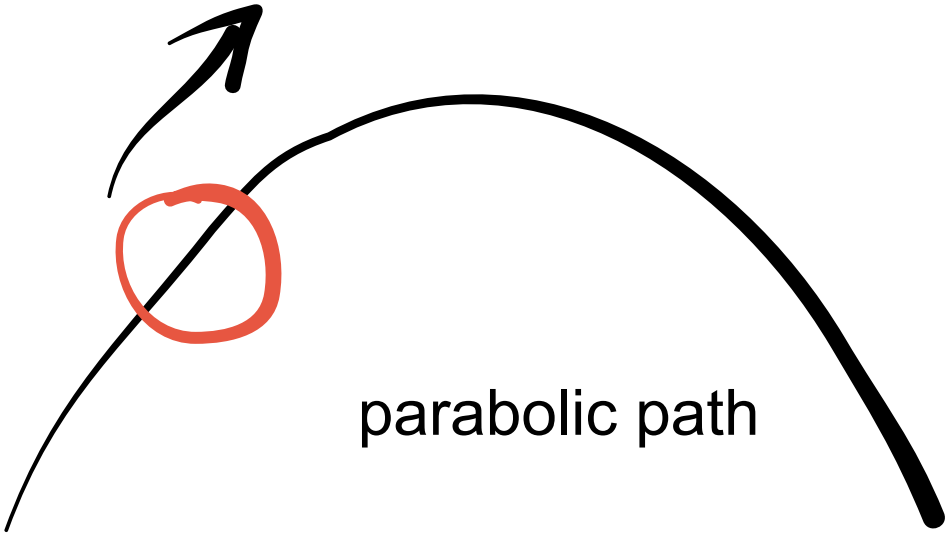


$F_{Total} = - F$

accelerate down

Falling ball





F = mg = ma
g = a
acceleration independent of mass

feather falls as fast as
a lead brick

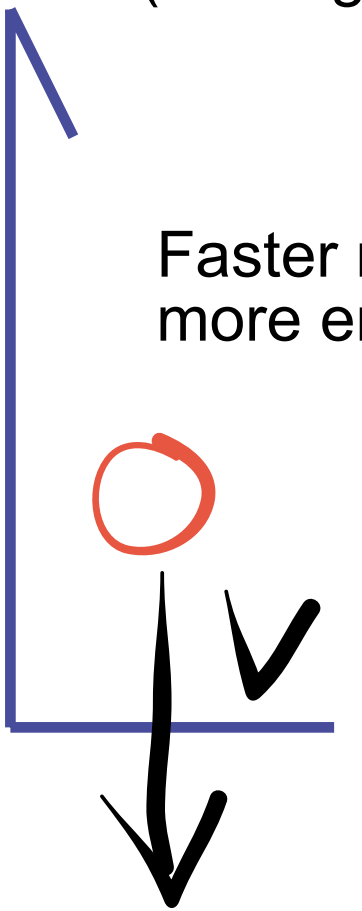
Energy

Potential
(Stored)

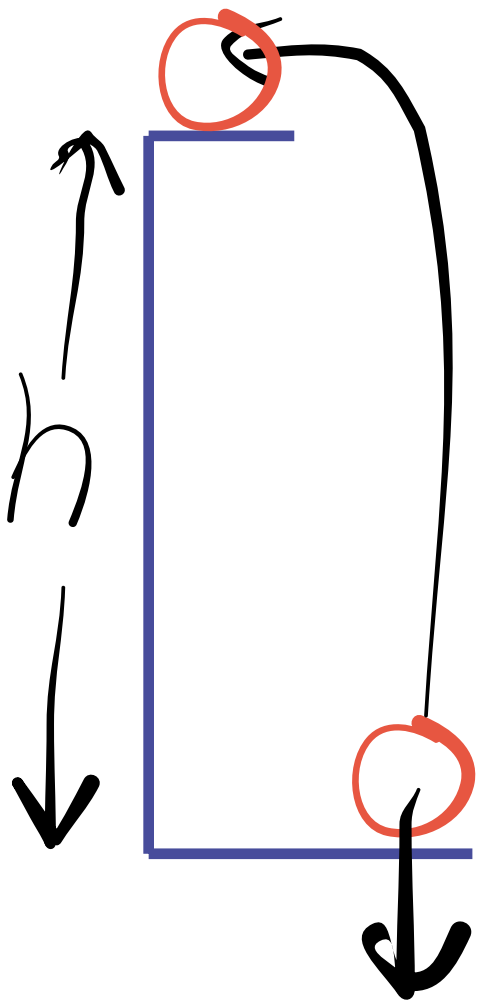
Higher has
more energy

Kinetic
(Moving)

Faster moving has
more energy



Work



$F_{gravity} = mg$

work = force x distance

work = mgh

If you are not pushing or it is not moving, then you are not working.

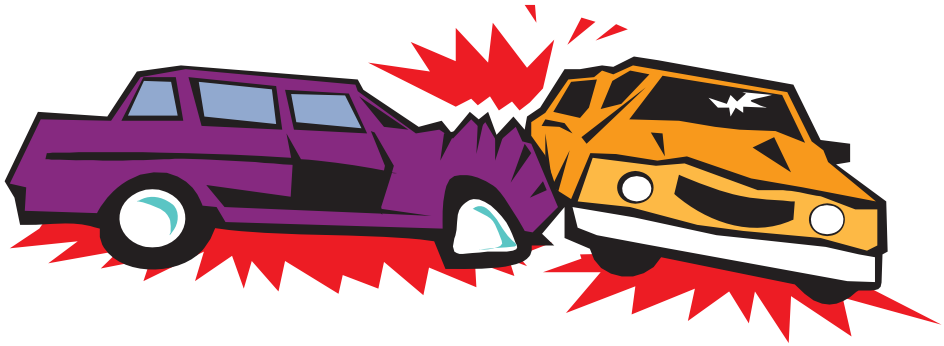
Momentum

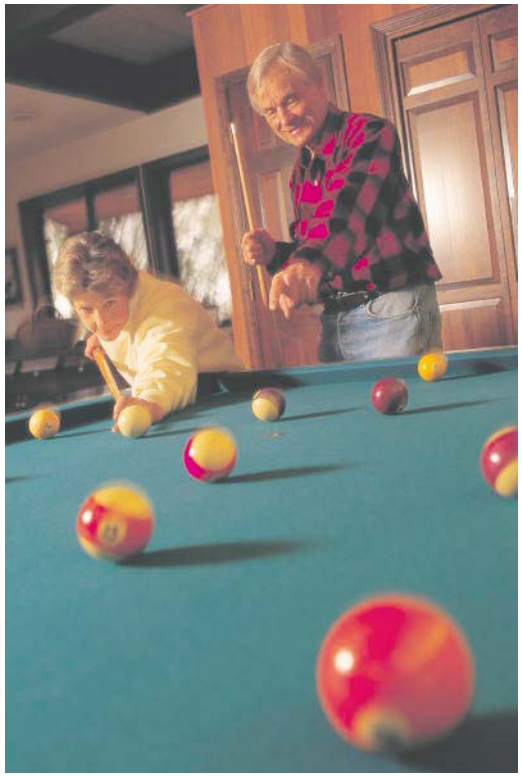
tendency to continue moving in a certain direction

more momentum: tend to win in collisions

Momentum = Mass x Velocity

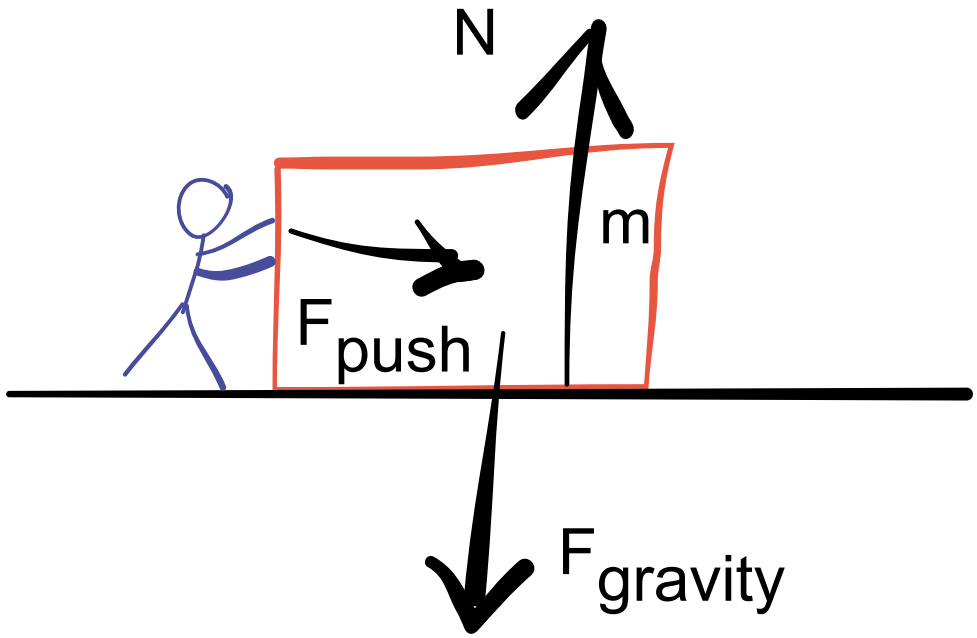
more mass = more momentum
more velocity = more momentum





Microsoft Office Clipart

Pushing a block

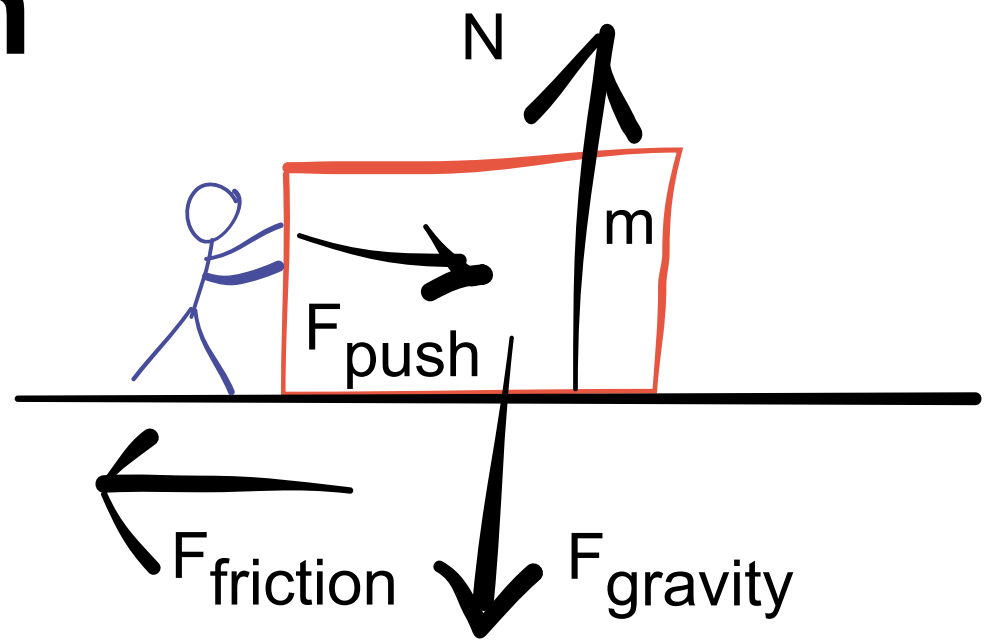


$F_{gravity}$ = N (block not falling)

F_{push} = ma (the block accelerates)

Friction

Friction slows the motion



$F_{gravity}$ = N (block not falling)

$F_{push} - F_{friction}$ = ma (the block accelerates)

F_{push} needs to be greater than $F_{friction}$ for motion to occur

Does friction push the block left? NO
Friction only resists the motion.

Friction

Two kinds of friction:

1) Static Friction — not moving
keeps the object in place
(desk on the floor)

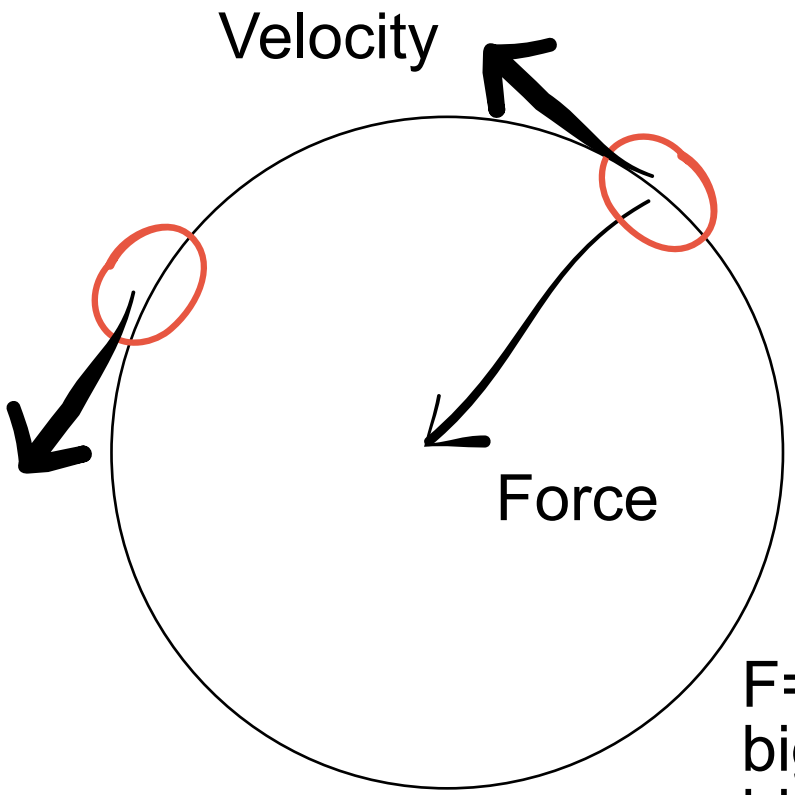
2) Kinetic friction — while moving

generally static friction is bigger than kinetic
hard to get the motion started

Friction force does work **HEAT**

Circular Motion

Requires an inward force



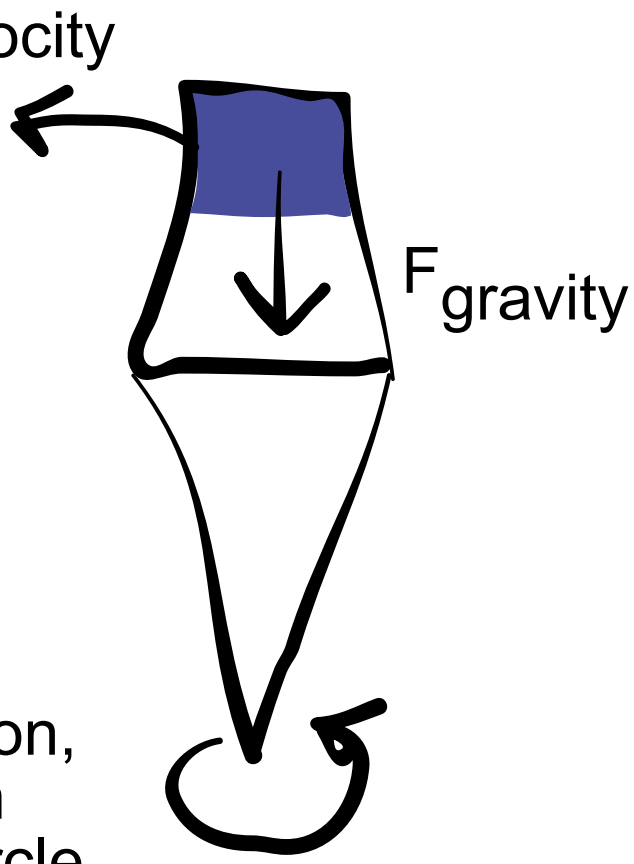
direction of velocity changes

$F=mv^2/R$

bigger Radius, smaller force

bigger velocity, larger force

Water in a bucket



If gravitational force greater than that required for circular motion, the water will fall.

If the gravitational force is smaller than that required for circular motion, the bucket will exert more force on the water to keep it moving in a circle.

Dishes

Table cloth moves.
friction force pulls cup along slowly

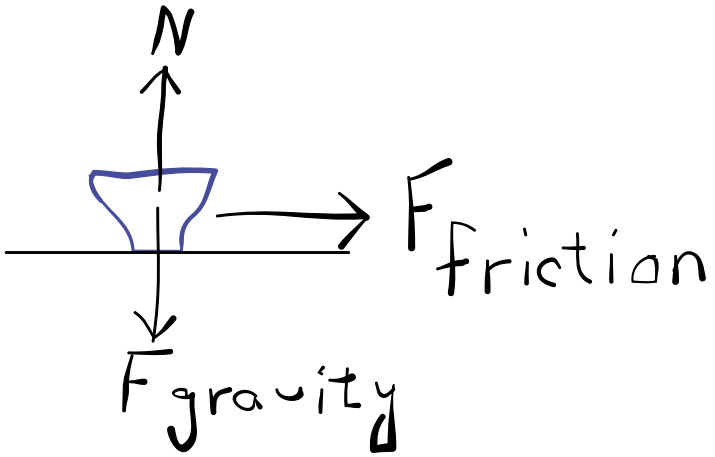
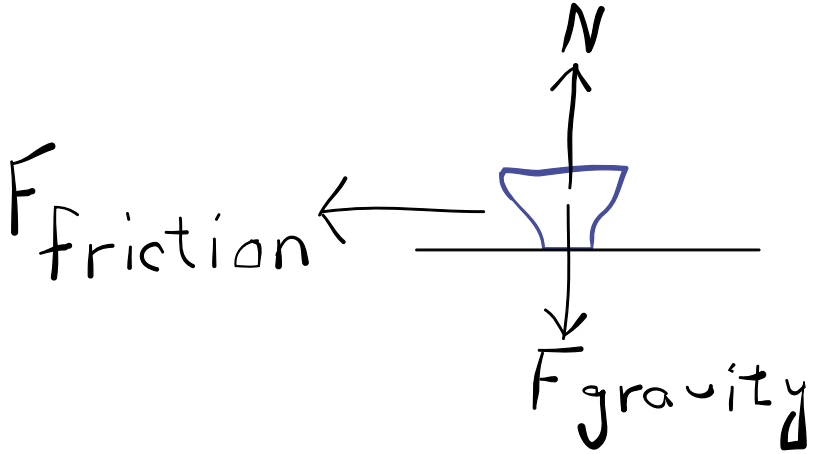


Table cloth leaves.
friction force slows it down to a rest and stops it



$F_{gravity}$ = N (block not falling)

$F_{friction}$ = kinetic friction (small)

get very little acceleration

$F_{friction} = ma$