Motion and Machine Unit Notes   Name:
DO NOT LOSE!

Energy
- Ability to do _____
- To cause something to change move or _____
- Energy cannot be created or _____, but _____from one form to another.
- Energy quality is _____ due to friction / force/ heat.
   - -From high quality energy to _____ quality energy.

Newton's 1st Law of Motion
- Every object in a state of uniform _____ tends to remain in that state of motion unless an external _____ is applied to it.

- Inertia: The property of matter by which it _____ its state of rest or its velocity along a straight line.
   - -So long as it is not acted upon by an _____ force.

- New mini area of focus: Friction

- Friction - The _____ encountered when one body is moved in contact with another.

The four types of friction
- Static friction- friction between _____ surfaces that are _____ moving past each other.
- Sliding friction- the force that opposes the motion of two surfaces _____ past each other.
- R_____ friction- the friction between a rolling object and the surface it rolls on.
- Fluid friction- when an object is moving in _____ or gas.

Friction
- S_____ an object down until it stops
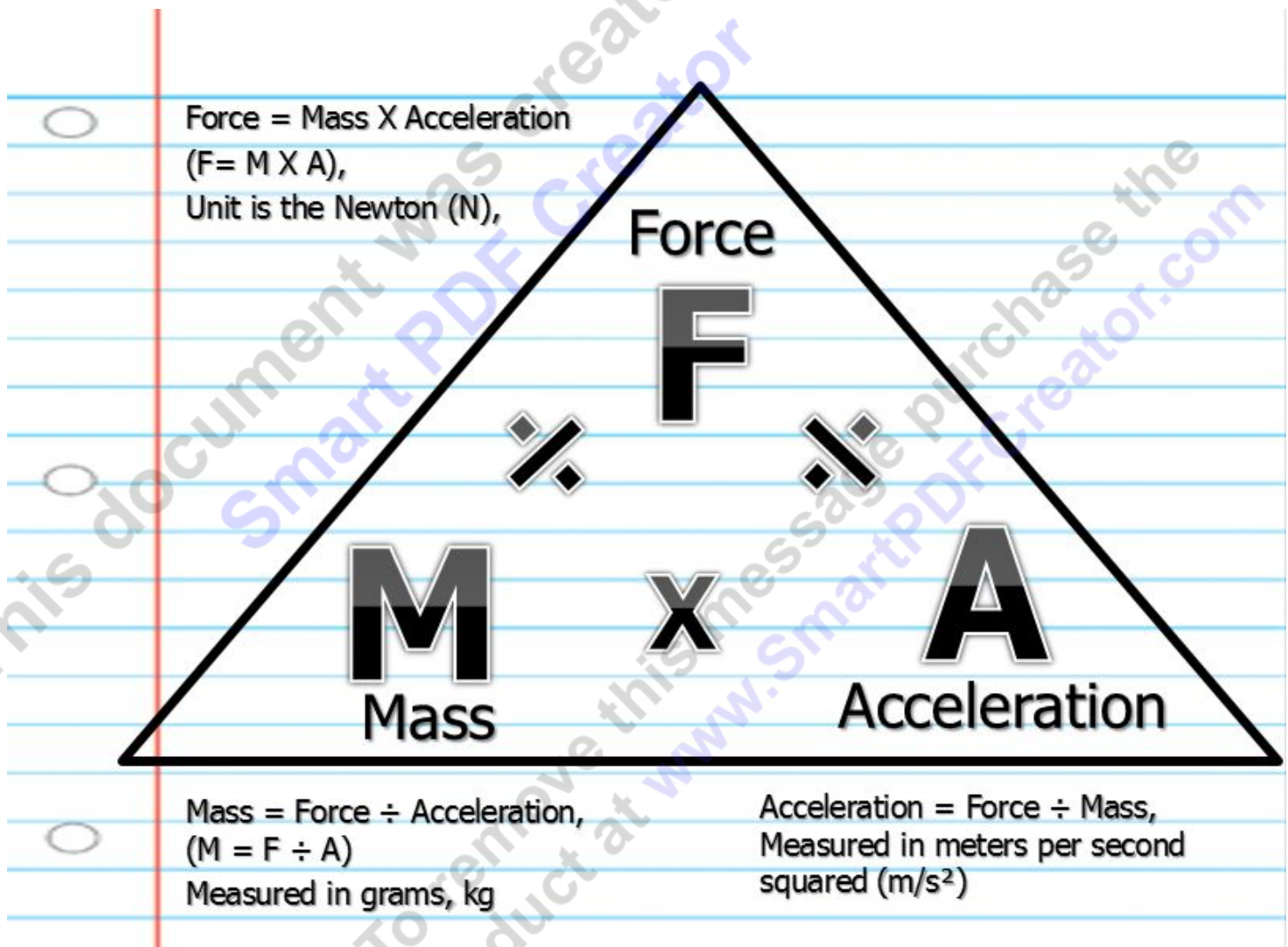- Produces _____
- W_____ object down

- Aerodynamic: D_____ or arranged to offer the least _____ to fluid flow.
- Hydrodynamic: A shape designed to move efficiently through the _____.
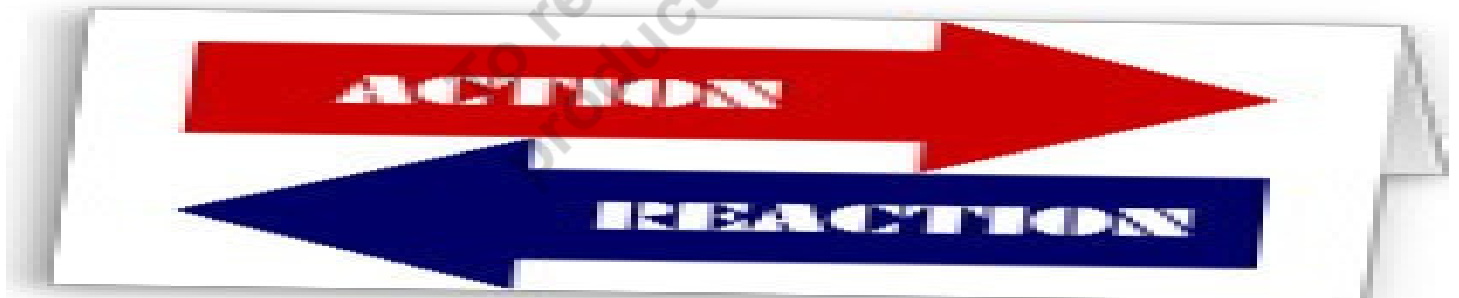
Newton's 2nd Law

● The relationship between an object's _____ m,
its _____ a, and the applied _____ F
is $F = ma$.

The net force on an object is equal to the _____ of
the object multiplied by its _____.

Force = Mass X Acceleration
(F= M X A),
Unit is the Newton (N),

Force

F

÷   ÷

M   x   A

Mass   Acceleration

Mass = Force ÷ Acceleration,
(M = F ÷ A)
Measured in grams, kg

Acceleration = Force ÷ Mass,
Measured in meters per second
squared (m/s²)

3rd Law of Motion

● For every _____ there is an equal and
_____ reaction.

Energy can either kinetic or potential.

Potential Energy: (PE) The energy stored by an object as a result of its _____.

- Potential Energy is the energy of _____. Objects that are elevated have a _____ potential energy.
- Kinetic Energy is the energy of _____.

PE = mgh
- PE = Energy (in J_____)
- m = mass (in kilo_____)
- g = gravitational acceleration of the earth (9.8 m/s²)
- h = height above earth's surface (in m_____)

- Gravity: The force of _____ between all masses in the universe.
  - The more _____ an object has, the greater the force of attraction.
  - Law of Gravity F = G M m / r^2
  - Gravity is an attractive force between _____ bodies, which depends only on the mass of the two bodies (M and m) and _____ on the square of the separation between the two bodies.

- Ex. (If you double the mass of the earth, its gravitational force will become _____ as big; if you get 3 times further away from the earth, its gravitational force will be ___ times weaker.)

Kinetic Energy
- The energy that matter has because of its _____ and mass.
- where m = _____ of object
- v = _____ of object
- KE = Energy in J_____

$$KE = \frac{1}{2} * m * v^2$$

- Don't forget your order of operations.
- PEMDAS
- For KE, you must do exponents (E) before multiplying (M). So square the velocity first, and multiply by half of the mass.

Kinetic energy
- Translational Energy: M_____ from one location to another.
- V_____energy (sound)
- Electrical energy: Flow of _____.
- Rotational energy.

Kinetic energy is a **s**_____ quantity; as it does not have a direction.

■ Velocity, acceleration, force, and momentum, are **v**_____. A quantity having direction as well as magnitude

● <u>Mechanical Energy</u> (ME) – Energy due to _____ and _____; sum of potential and kinetic energies. Includes heat and friction.
  ● Just add Potential Energy + Kinetic Energy.

● Centrifugal Force: (Does not exist) The _____ that makes feel that a force is acting outward on a body moving around a center, arising from the body's inertia.

● Centripetal Force: A force that makes a body follow a _____ path.

■ Hydropower – Potential to Kinetic energy

● Speed: A measure of _____, = distance divided by time. D/T

●
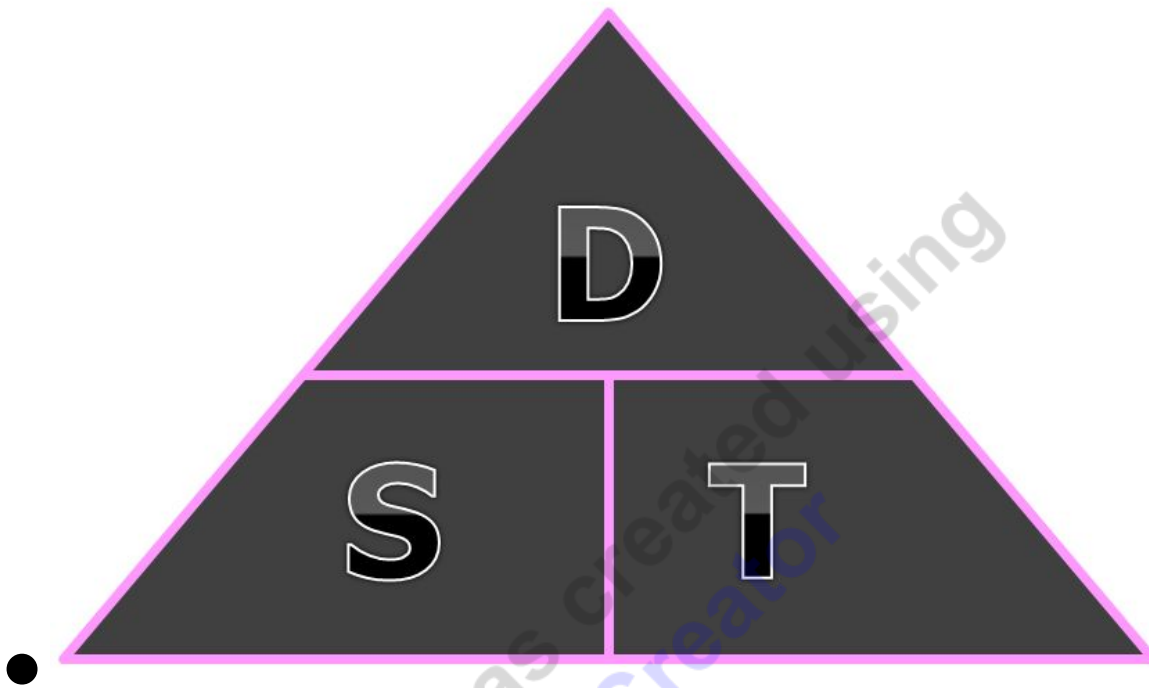
Distance = Speed * time (Multiply)
Speed = Distance _____ by time
Time = Distance divided by Speed

■ Velocity = Speed (distance / time) and
  d_____.
■   velocity = Distance Divided by Time

■ Acceleration = The rate of _____ in
    velocity. (m/s²)
        The final velocity – the starting velocity, divided
by time.
        also... a = $(v_2 - v_1)/(t_2 - t_1)$

■ Deceleration – To _____ velocity.

The same formula but value will be
_____.

- Momentum: A measure of the _____ of a body equal to the product of its _____ and velocity.
    - Momentum = Mass times _____
    - Law C_____ of Momentum: The momentum of an object is the product of its mass and its velocity.
    - Angular momentum: Rotating objects tend to remain _____ at the same speed / direction unless acted upon.
    - When you draw the weights inward, your moment of inertia decreases, and your velocity _____ (spin faster).

- Amount of Work (w) done depends on two things: The amount of F_____ (F) exerted.

    The D_____ (d) over which the Force is applied.

- Equation for Work - w = F x ____

- Joule: Unit of energy, work, or amount of _____.

- Equal to the energy expended in applying a force of one _____ through a distance of one meter.

- **Catapults** - By the law of conservation of energy, the stored _____ energy (U) is transferred into rotational _____ energy (K), with some loss due to friction. U = K

- **Trajectory** – The path of flying object: the path that a projectile makes through space under the action of given forces such as _____, wind, and _____.

- Force: Is a PUSH or a PULL, that causes a change in the _____ or shape of an object
  - Gravity, Electricity, Magnetism, and Friction
- F = w x d.
- W = F x d

Machines…
  - Tr_____ force from one place to another.
  - C_____ direction of a force.
  - Increase the _____ of a force.
  - Increase the _____ or speed of a force.

- Machine: Anything that helps you do _____.
  - Work = Force x Distance

Efficiency: A measure of how much more work must be put _____ a machine than you get out of the machine.
  - The efficiency of a machine will always be _____ than 100%.
  - If there was no friction, the best you could hope for is an efficiency of 100% meaning work in = _____.

- Law Conservation of energy: energy cannot be _____ or destroyed.
  - -Simple machines generally require more _____ / energy to complete a task.

- Force is a quantity which is measured using the standard metric unit known as the _____

- One newton is the amount of _____ required to give a 1-kg mass an acceleration of 1 m/s/s.

$$1 \text{ Newton} = 1 \text{ kg} * \frac{m}{s^2}$$

Quick Cheat Sheet

- Potential Energy (PE) = mass kg * gravity (9.8 m/s²) * height (Answer is in Joules)

- Kinetic Energy (KE) = ½ mass kg * Velocity squared (velocity * Velocity) (Answer is in Joules)
  - Square velocity first because it an exponent (PEMDAS)

- Mechanical Energy (ME) = Kinetic Energy + Potential Energy (Answer is in Joules)

- Speed – A Measure of motion, = Distance divided by time (Answer in meters per second m/s)

- Velocity – Rate of which an object changes its position. = Distance divided by time and direction. (Answer in meters per second and direction such North, East, South, West, or Northwest etc.) (m/s)

- Acceleration – Change in velocity over time. Final Velocity minus the starting velocity divided by time. (Answer is in meters / sec²/ and direction North, etc. (m/s² North)

- Deceleration – Same as acceleration but the number will be negative. (m/s²)

- Mass – Amount of matter in an object. On earth, weight and mass are the same. (Metric unit is the gram)

- Force = (F=MA) F = Mass (Weight on earth) * Acceleration (Answer is in newtons (m/s)

- Work – Force * Distance the force was applied (Answer is in newtons)

New Area of Focus: Simple machines

- **Law Conservation of energy: energy cannot be created or destroyed.**

Simple machines generally require more work / energy to complete a task.

But they….
- *Transfer force from one place to another.*
- *Change direction of a force.*
- *Increase the magnitude of a force.*
- *Increase the distance or speed of a force.*
  - *This makes work seem easier.*

To find Mechanical Advantage
- **D_____ resistance force (usually weight in g) by the _____ force (Newton)**

- Types of machines that do work with one movement.

Pulley
- Uses grooved _____ and a rope to raise, lower or move a load.
  Three types of pulleys
- A pulley makes work seem _____
  - Changes the _____ of motion to work with gravity. Instead of lifting up, you can pull down.
  - Uses your body _____ against the resistance.

- The more pulleys that are used, the more the MA (Mechanical Advantage).
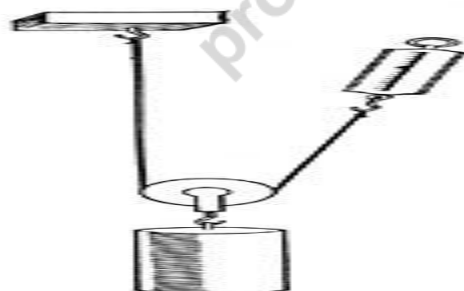- MA = The number of _____ that support the pulley. The end of the rope doesn't count.
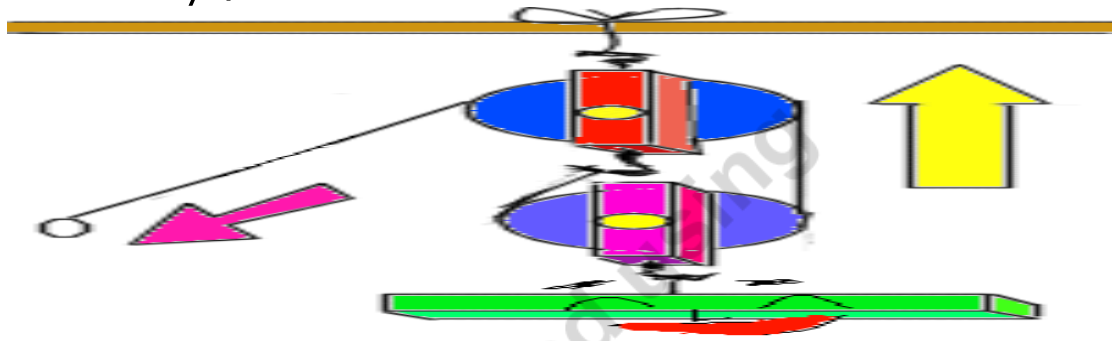

The three types of Pulleys
  F_____ pulley
  No Mechanical Advantage

LOAD

FULCRUM

EFFORT

100 LBS.
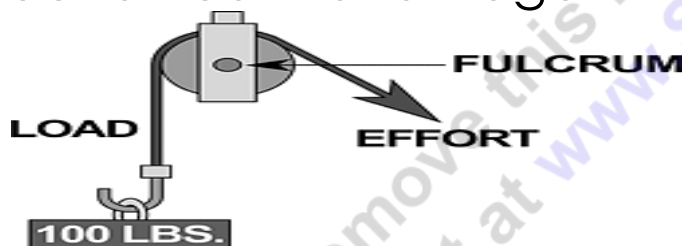
Movable Pulley

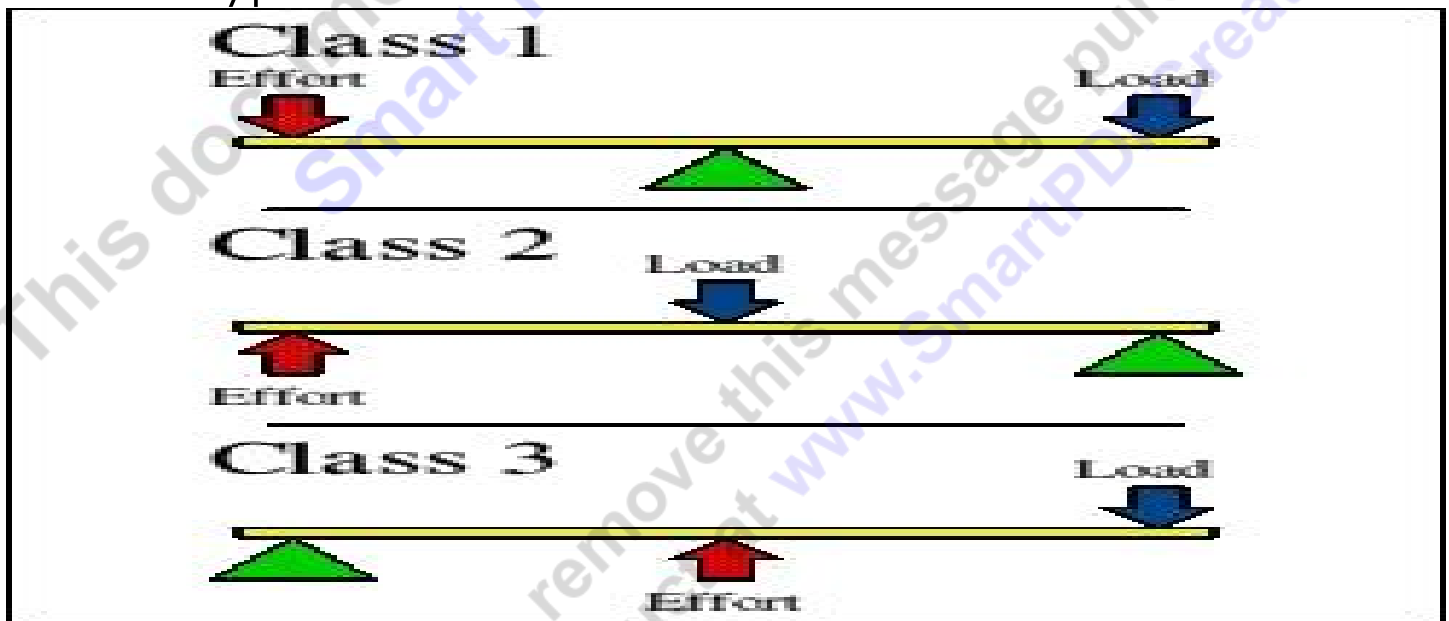# Combined Pulley / Block and tackle

Lever

- A stiff bar that rests on a support called a
  _____ which lifts or moves loads
- MA = length of effort arm _____ length of
 resistance arm.

The 3 types of levers

Third Class Lever.

- Has Mechanical D_____
- Requires more force to lift the load.

- Wedge: An object with at least one _____ side ending in a sharp edge, which cuts material apart.
    - The mechanical advantage of a wedge can be found by dividing the _____ of the slope (S) by the thickness (T) of the big end.

- Wheel and Axle: A wheel with a rod, called an _____, through its center lifts or moves a load.
    - The mechanical advantage of a wheel and axle is the _____ of the radius of the wheel divided by the radius of the axle.
   - Radius: A straight line from a circles _____ to its perimeter.
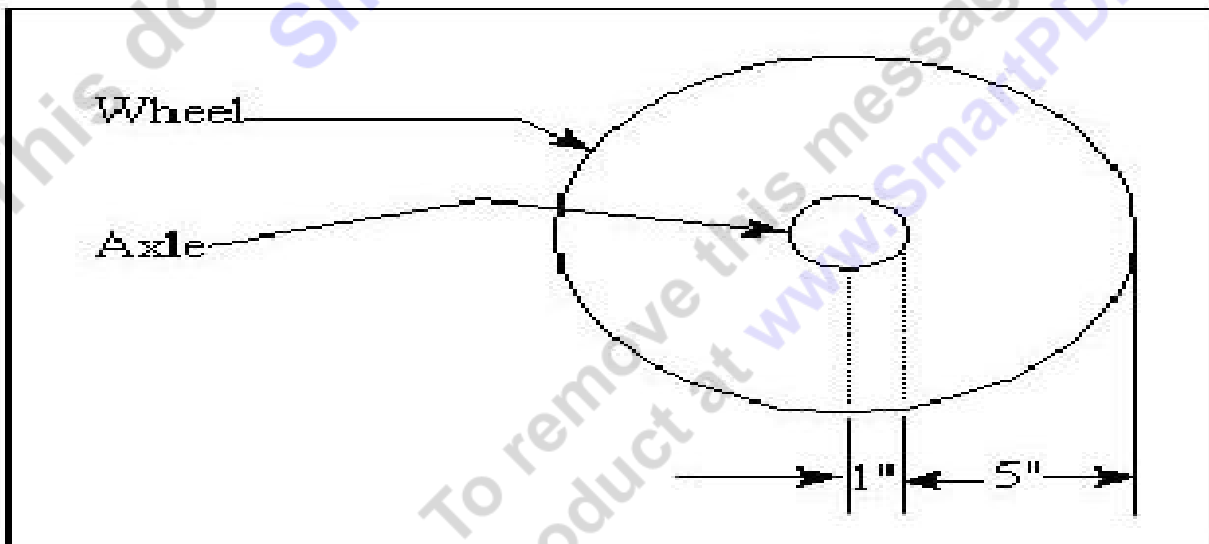
Divide 5 by 1

- An Inclined plane: A _____ surface connecting a lower level to a higher level
  - MA for an inclined plane is the length of the slope _____ by the height (Rise).

Length

Rise

Run
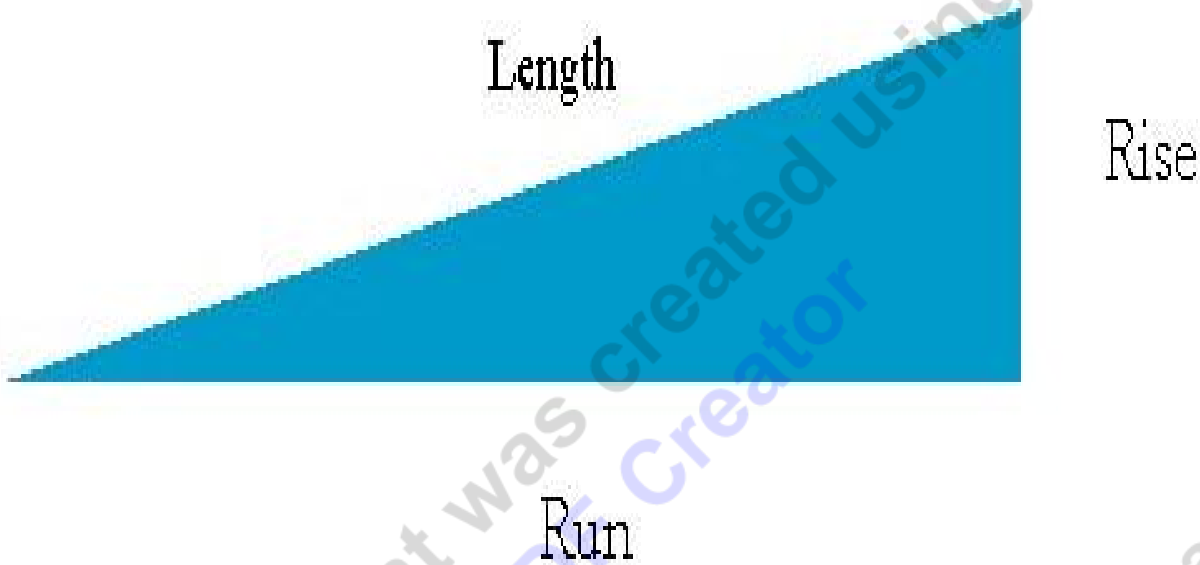
- Screw: An inclined plane _____ around a pole which holds things together or lifts materials.
  - The mechanical advantage of a screw can be found by dividing the _____ of the screw by the _____ of the screw.
  - The circumference of a circle is the distance around the _____. It is the circle's perimeter. The formula for circumference is:
    - Circumference = π times Diameter
    - C = πd
    - Where π = 3.14
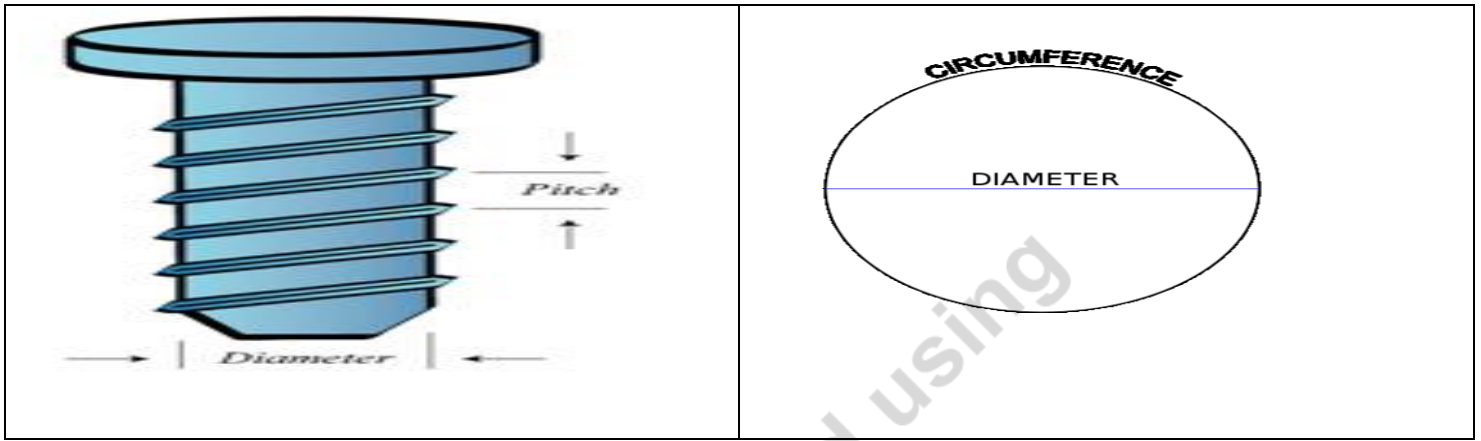
■ Compound machines: _____ or more simple machines working together.

DO NOT LOSE THESE NOTES! PLEASE PUT THEM IN YOUR SCIENCE FOLDER!

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