BIOMECHANICS

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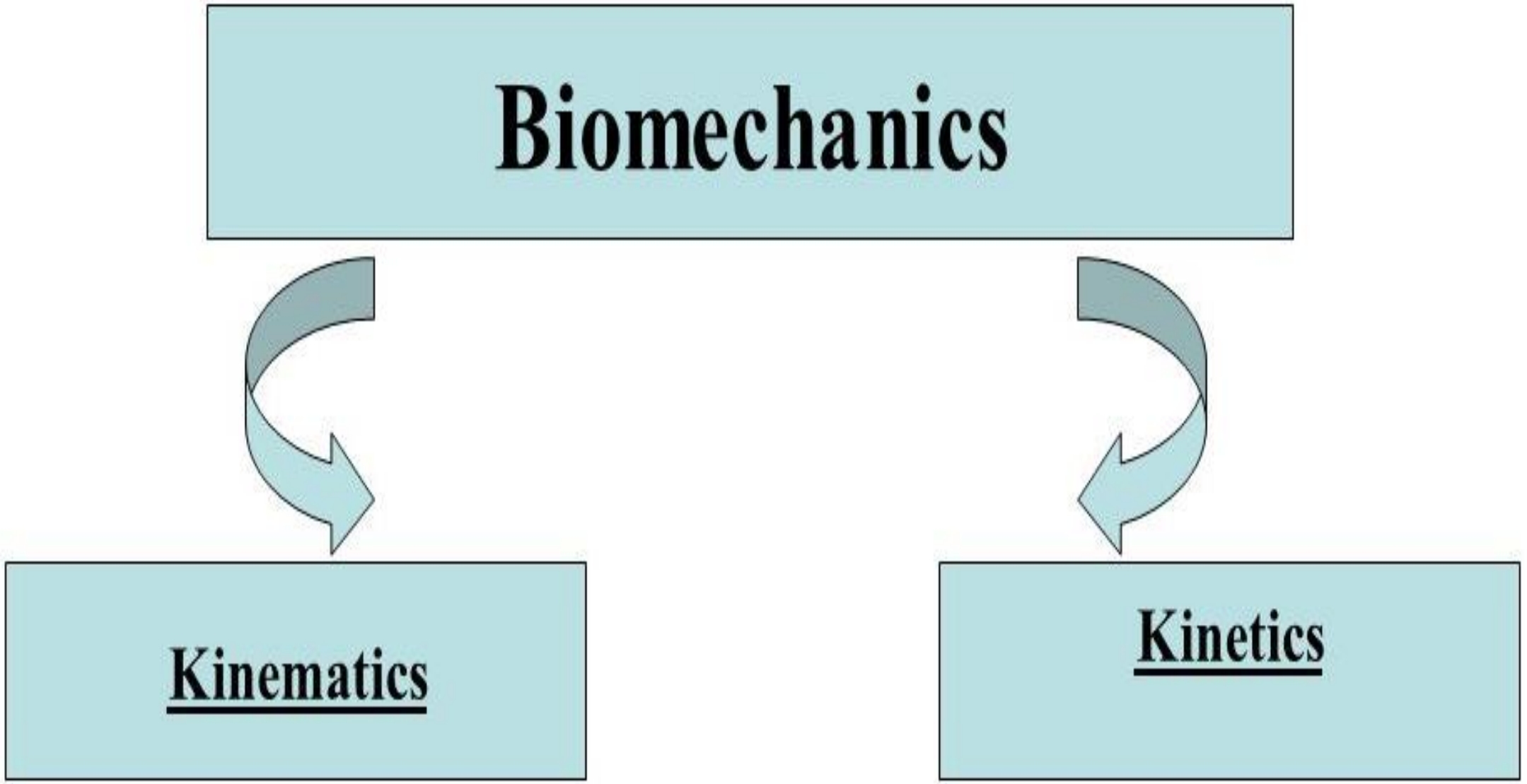
BIOMECHANICS

- Biomechanics is the science that examine the internal and external forces acting on human body and the effect produce by the forces.

SPORTS BIOMECHANICS

- Sports Biomechanics is the application of the principles of biomechanics to the study of human motion in sports and exercise.

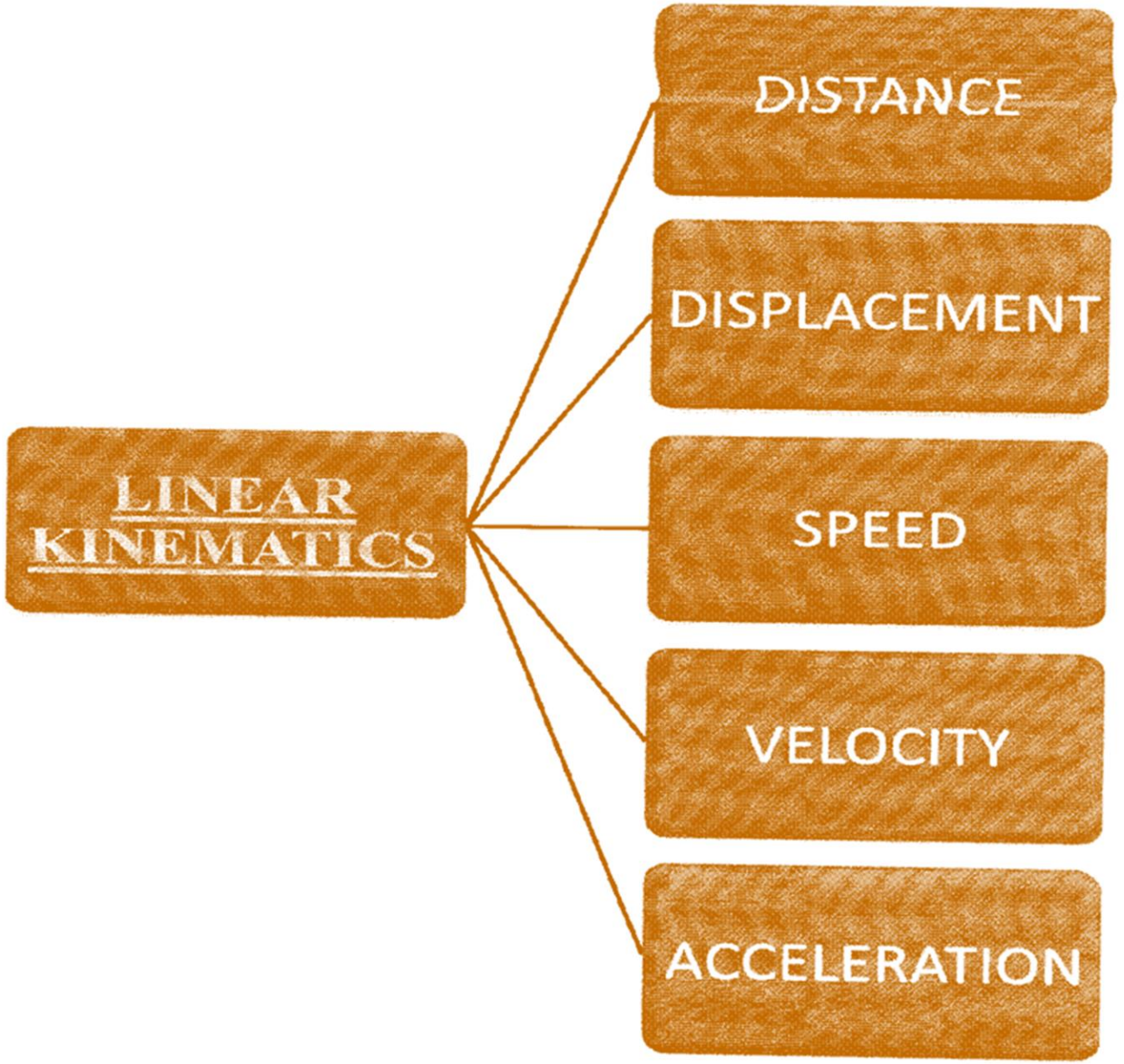

Biomechanics
Kinematics
Kinetics

KINEMATICS

- It is the branch of dynamics that concerned with the description of motion.

- e.g.-

Distance, Displacement, Speed, Velocity etc.


LINEAR KINEMATICS
DISTANCE
DISPLACEMENT
SPEED
VELOCITY
ACCELERATION

DISTANCE

- It’s simply a measure of the length of the path followed by the object who’s motion is being described, from it’s initial position to final position.
- It is scalar quantity.
- Unit of distance is ‘Meter’.

DISPLACEMENT

- Displacement is the straight line distance in a specific direction from it's initial position to find position.
- It is a vector quantity which include both magnitude and direction.
- Unit of Displacement is 'Meter'.

SPEED

- Speed is the rate at which the distance is covered by the body.
- Speed is the rate of change of motion/ distance
- Speed = distance/time
- UNIT= meter/sec

VELOCITY

- The average velocity of a body is defined as the rate at which displacement has occurred.
- Average Velocity = Displacement/time
- Unit = meter/sec.

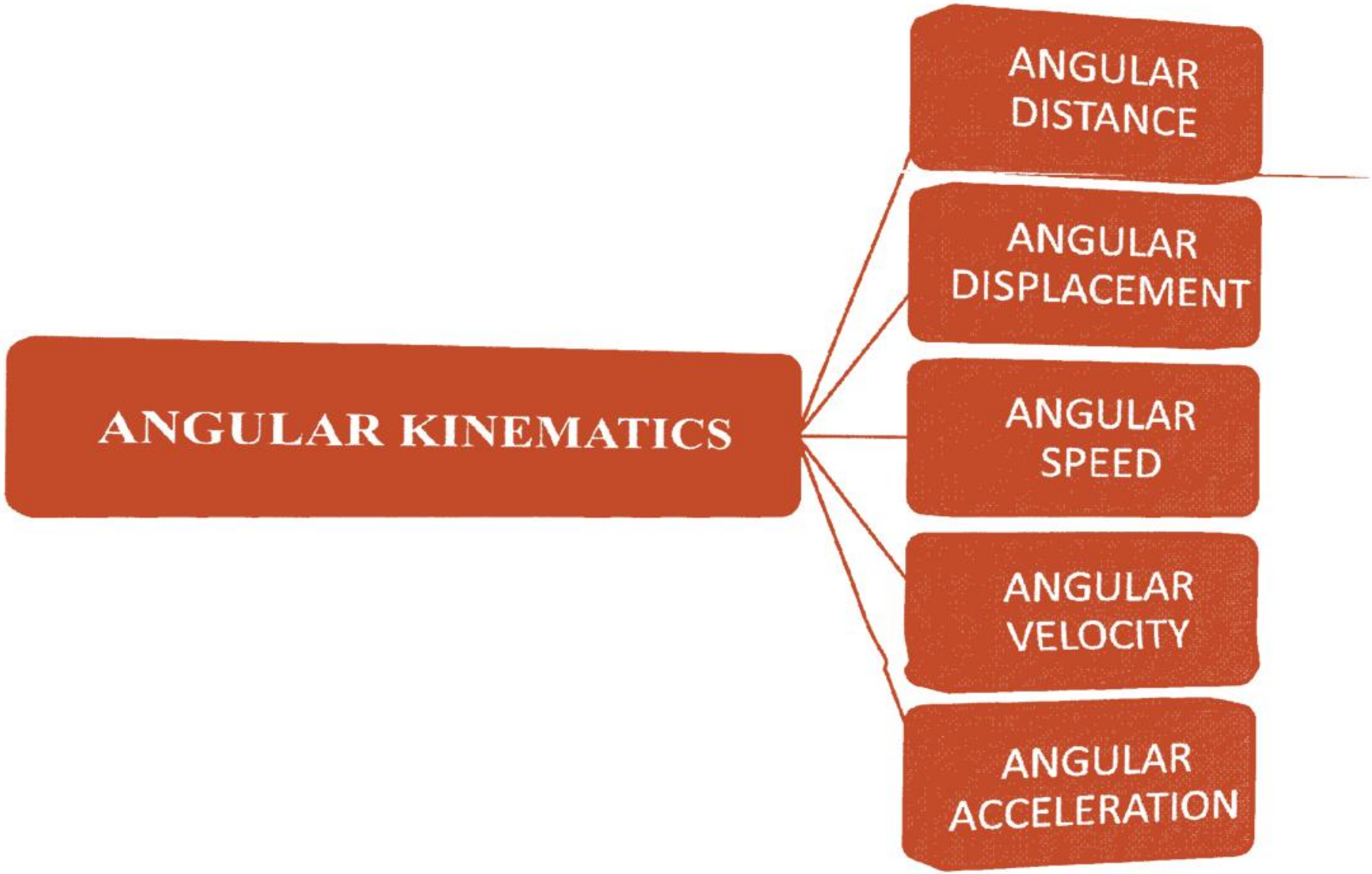
ACCELERATION

- The rate of change of velocity is called average acceleration.
- Average Acceleration = $\frac{\text{change in velocity}}{\text{Change in time}}$
- Acceleration is a vector quantity.
- Unit = meter/sec^2

- **POSITIVE ACCELERATION** indicates the increase in velocity.
- **NEGATIVE ACCELERATION** indicates the decrease in velocity.
- **ZERO ACCELERATION** indicates the maintenance of velocity.

INSTANTANEOUS ACCELERATION

- It is the average acceleration over a short interval of time in such a way that the acceleration has no time to change its value.
- $a = d^2s/ dt^2$


ANGULAR KINEMATICS
ANGULAR DISTANCE
ANGULAR DISPLACEMENT
ANGULAR SPEED
ANGULAR VELOCITY
ANGULAR ACCELERATION

ANGULAR DISTANCE

- The angle traveled by a rotating body is called angular distance.
- It is the angle between the initial and final position measured following the path of rotation.
- It is represented by the symbol ‘ϕ’.

ANGULAR DISPLACEMENT

- The minimum angular distance between the initial position and the final position of a body in rotation.
- It is the smaller of the two angles between the initial and the final position.
- It is represented by the symbol ‘Θ’.

ANGULAR SPEED

- Average angular speed of a rotating body is defined as the rate at which angular distance is covered.

- Avg. Angular speed = $\frac{\text{Total Angular Distance}}{\text{Total Time}}$

AVERAGE ANGULAR VELOCITY

- The average angular velocity of a rotating body is defined as the rate at which angular displacement has occurred.

- Angular Velocity = $\frac{\text{Total Angular Displacement}}{\text{Total Time}}$

AVERAGE ANGULAR ACCELERATION

- The rate of change of angular velocity is called average angular acceleration.

- Avg. Angular Velocity = $\frac{\text{Angular Velocity}}{\text{Total Time}}$

Instantaneous angular acceleration

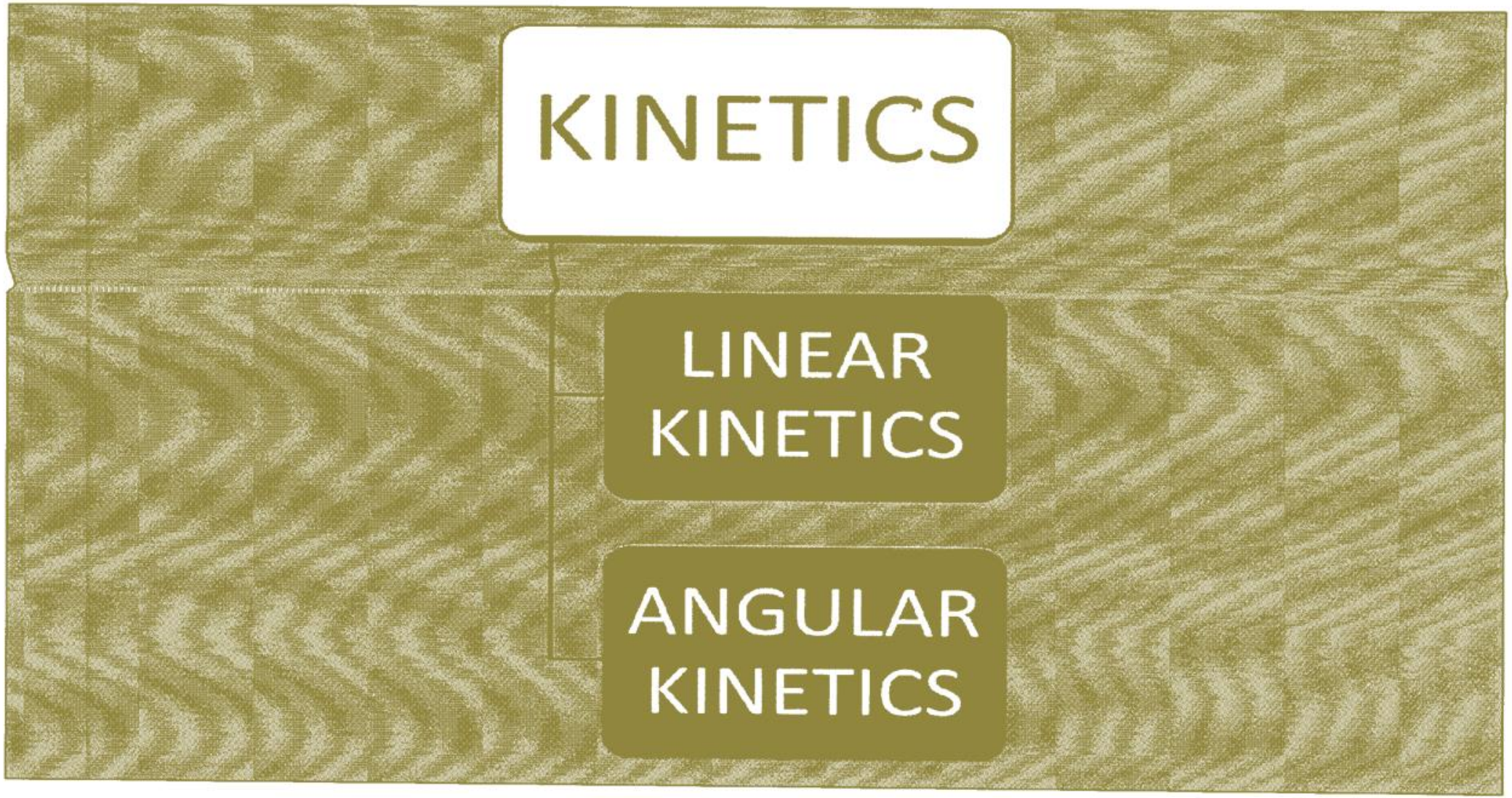
- It is the average angular acceleration over a short interval of time in such a way that the angular acceleration has no time to change its value.
- It is simply referred to as angular acceleration.

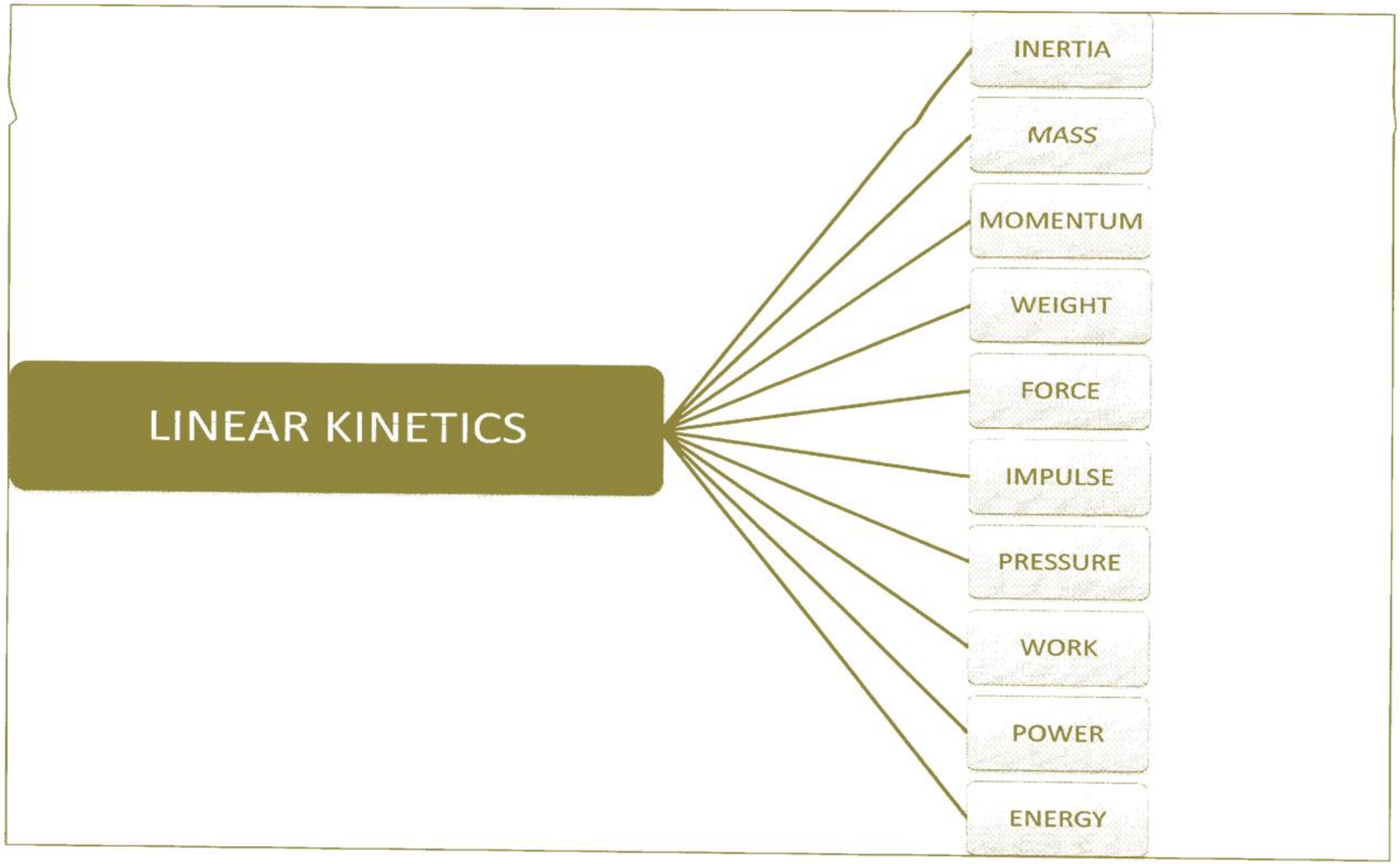
KINETICS

KINETICS

- KINETICS is the study of motion of object *(particles/ rigid bodies etc) and the forces that* causes those motion.

- The study of force that cause motion.


KINETICS
LINEAR KINETICS
ANGULAR KINETICS


LINEAR KINETICS
INERTIA
MASS
MOMENTUM
WEIGHT
FORCE
IMPULSE
PRESSURE
WORK
POWER
ENERGY

INERTIA

- It is the characteristics of a body to resist change in its state of motion.
- If a body is lying at rest, it has a tendency to remain at rest.
- If a body moving, it tends to remain in motion.
- It depends upon the mass of the body.

MASS

- The quantity of matter possessed by a body is called its mass.
- It is measured in kilograms (kg).

MOMENTUM

- It is the quantity of motion of body in liner motion.
- It is equal to the product of body's mass and velocity.
- Momentum= mass* velocity (M=m*v).

WEIGHT

- The weight of a body is the measure of gravitational force that the earth exerts on the mass of a body.
- It depends upon the mass of the body and the acceleration exerted on the body due to gravity.
- Weight=Mass* Acceleration due to gravity.

  (W=m*g).

FORCE

- Force is the effect which one body has on another to change the state of the second body.
- The pushing or pulling action that this other body has and that causes the change, is termed a force.
- Force = Mass* Acceleration ($F=m\ \alpha$).

IMPULSE

- Impulse of a force is the product of the force and the time for which the force acts.

- Impulse = Force* Time (F=t).

PRESSURE

- Force acting per unit area on an object or body.
- The amount of force exerted in a particular area.
- Pressure = Force/Area (P=F/A).

WORK

- Work is defined as the product of the force and distance in which the force acts.
- Whenever a force acts on the body, the work done by the force is equal to the product of the magnitude of the force and the distance to which the body moves in the direction of the applied force.
- Work = Force* Distance (W=F*s).

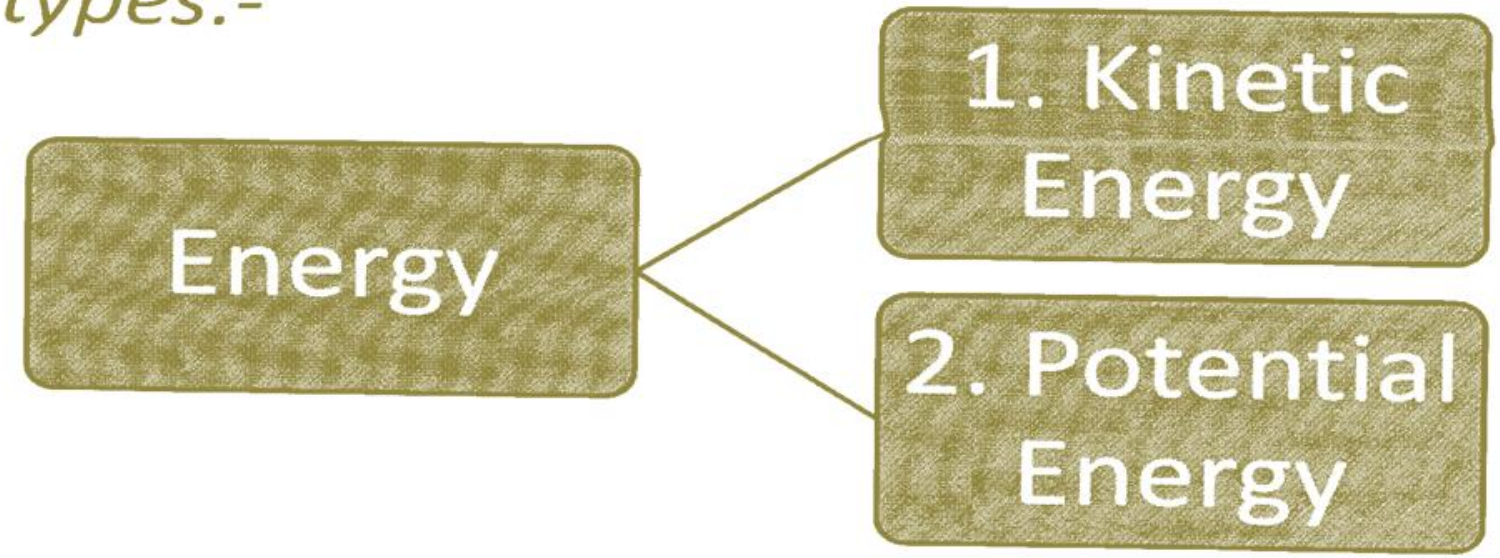
POWER

- The rate at which work is performed is called power.

- Power = Work/ Time.
  (p= w/t).

Energy

- *Energy is expressed as the capacity to do work.*
- *From the Mechanical point of view energy is of two types:-*



KINETIC ENERGY

- It is energy possessed by a body by virtue of its motion.
- Kinetic Energy = $\frac{\text{Mass* (velocity)}^2}{2}$

  (K.E. = $mv^2/2$)
- Unit = Kg. m/sec^2.

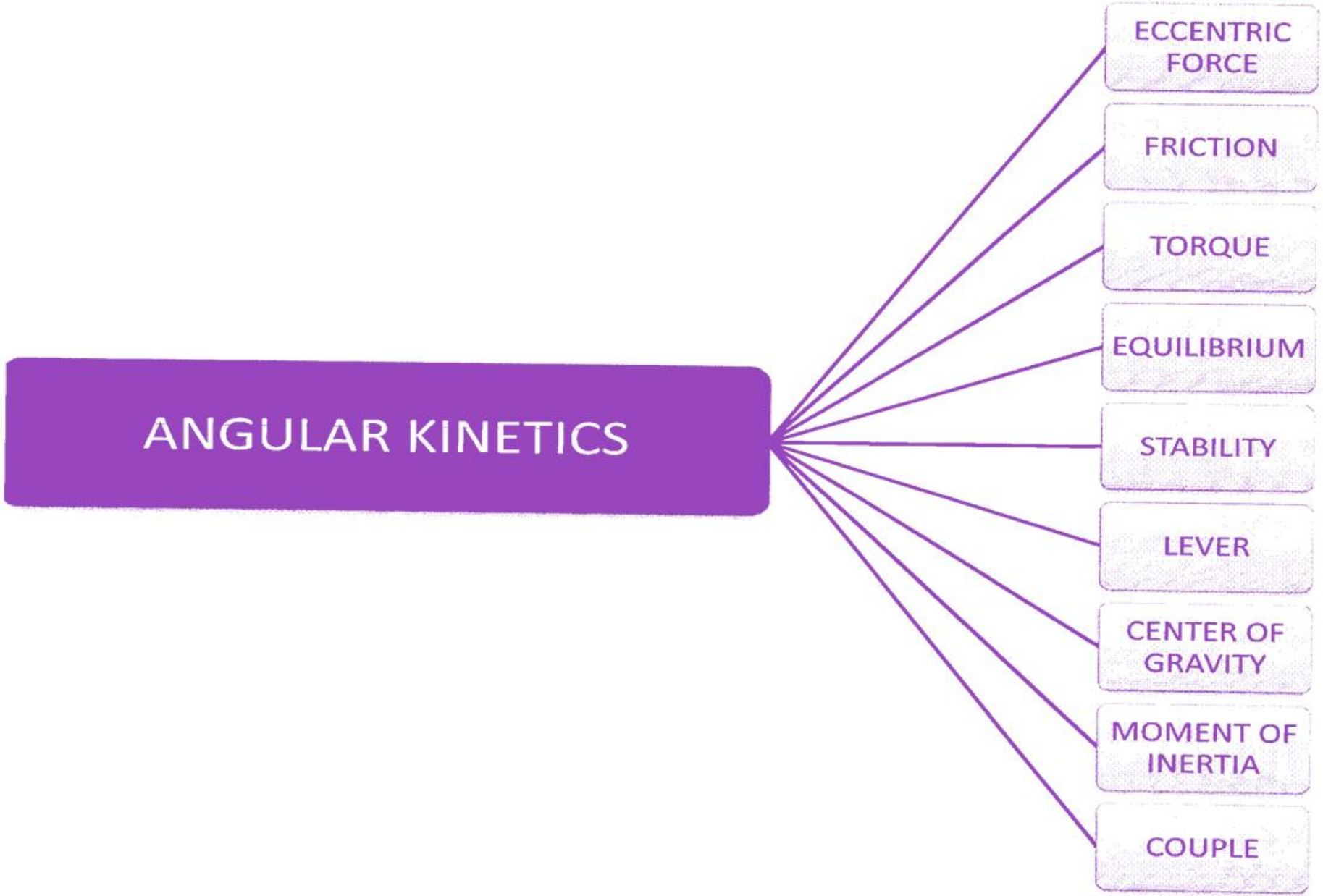
POTENTIAL ENERGY

- Energy possessed by a body by virtue of its position is called positional energy.

- It depends on the weight of the body and its height above the ground (position).

- Potential Energy = Weight* Height
- P.E. = W*h

  P.E. = m.g.h.


ANGULAR KINETICS
ECCENTRIC FORCE
FRICTION
TORQUE
EQUILIBRIUM
STABILITY
LEVER
CENTER OF GRAVITY
MOMENT OF INERTIA
COUPLE

ECCENTRIC FORCE

- A force whose line of action does not pass through the center of gravity of a body on which it acts is called an eccentric force.
- It results in a simultaneous linear motion and angular motion in the body on which it is exerted.
- The direction of rotation depends on which side of the center of the body the force is applied.

FRICTION

- When a body moves or tends to move over the surface of another body, the force that apposes motion is called friction.
- Friction is a resistance to motion created by the contact between the surfaces of the two bodies in question.

TORQUE

- The turning effect of a couple is called torque or the moment of couple.
- It depends upon the magnitude of the forces and the perpendicular distance between the line of action of the force.
- Torque = force * moment arm ($M = F * r$).

EQUILIBRIUM

- When a body is neither having linear motion nor rotation and is at rest, it is said to be in a state of equilibrium.

- It is state of balance between two opposing forces of effected.

STABILITY

- It is the measure in equilibrium, which determines how quickly an object or a body can come out of the resting position or will remain in its original position when imbalancing forces are impressed upon the body.

LEVER

- A lever is rigid bar, which can rotate about a fixed point when a face is applied to it to overcome a resistance.
- It is a simple machine consisting of a rigid bar like body that may be made to rotate about on axis.

MOMENT OF INERTIA

- It is the property of body by virtue of which it tends to remain in its state of angular motion.
- It depends upon the mass of the body and the distance from the axis of rotation.

COUPLE

- The combination of two equal force opposite and parallel forces exerted on a body is called a couple.

- EXAMPLES: Winding a clock; pole vaulter's rotation over the cross bar; rotation of steering wheel; etc.

thank you