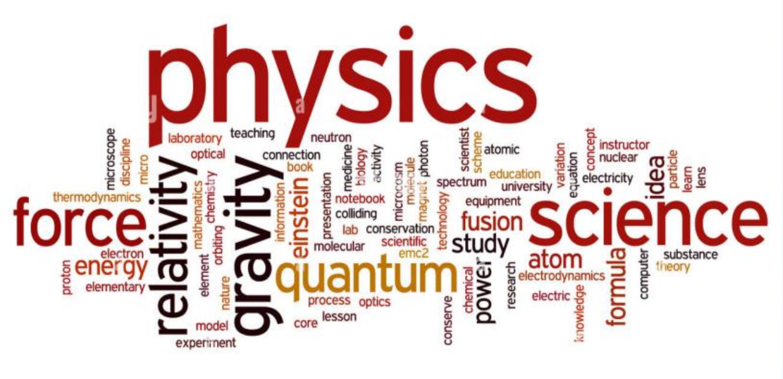


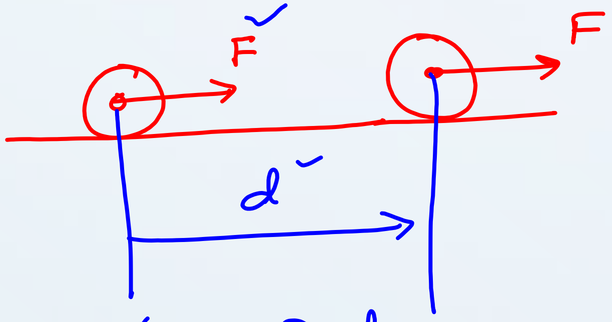
MODULE- 2 CLASS- 4

WORK, POWER, ENERGY, SIMPLE MACHINES.

Presented By- Dept. of Physics

TODAY'S LESSON

- Work
- Energy
- Power
- Simple machine
- Collision



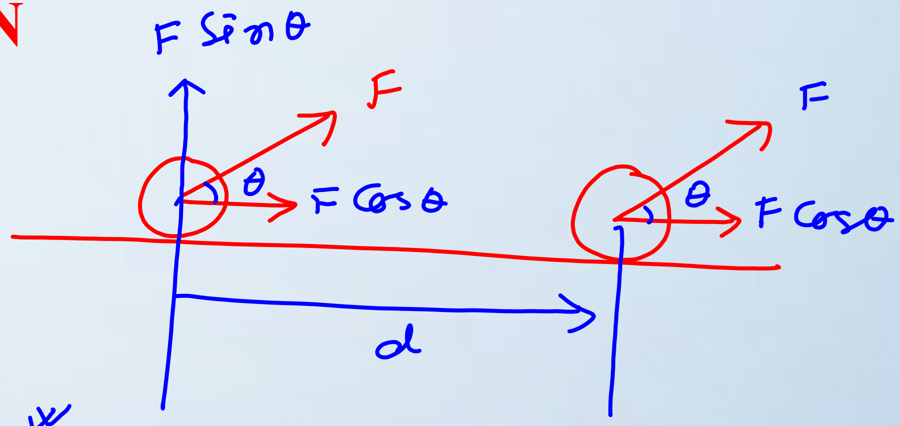
Work (W) = F.d

Unit:- N.m, Joule, dyne.cm, Erg, Poundal.ft,

Dimension :- $[ML^2T^{-2}]$

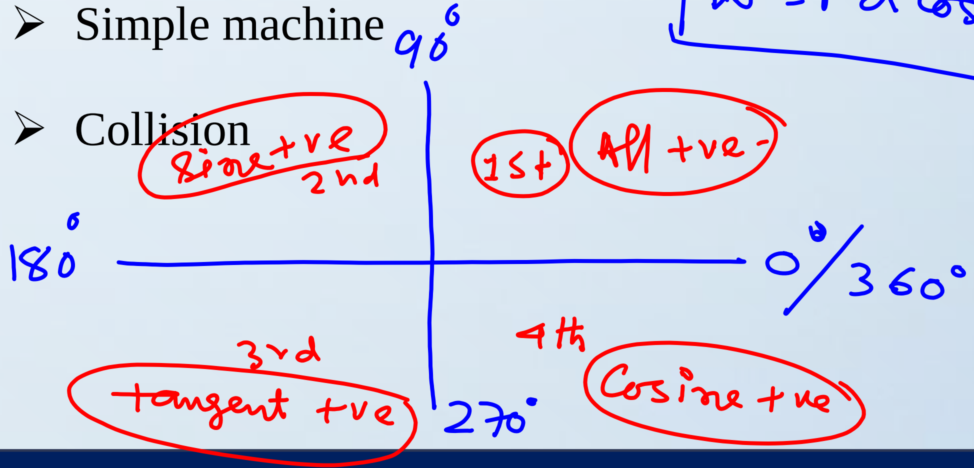
Scaler quantity

$W = \vec{F} \cdot \vec{d}$



$W = F \cos\theta \cdot d$

$\boxed{W = F d \cos\theta}$



work done by the force

WORK

work done against force

$90° > \theta \geq 0°$
$360° \geq \theta > 270°$

$F_{max} = +Fd \; [\theta = 0°]$

- **Positive Work**: cosΘ is positive
- **Negative Work: cosΘ** is negetive $\Rightarrow (270° > \theta > 90°)$ $W = -F.d$ $[\theta = 180°]$
- **Zero Work:** cosΘ is zero or final and initial & final positions are same. $\theta = 90°, 270°$

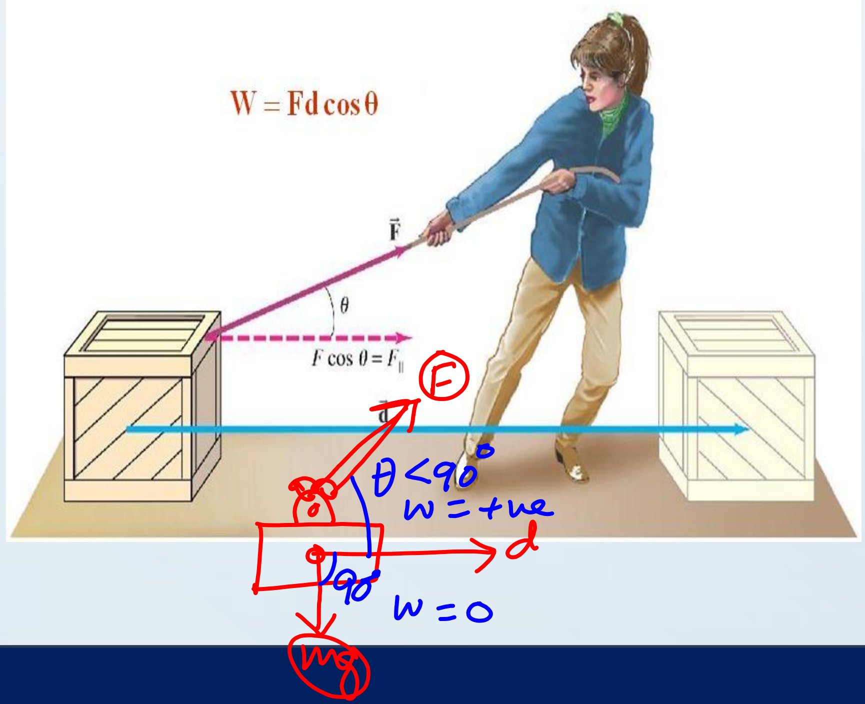
$d = 0$

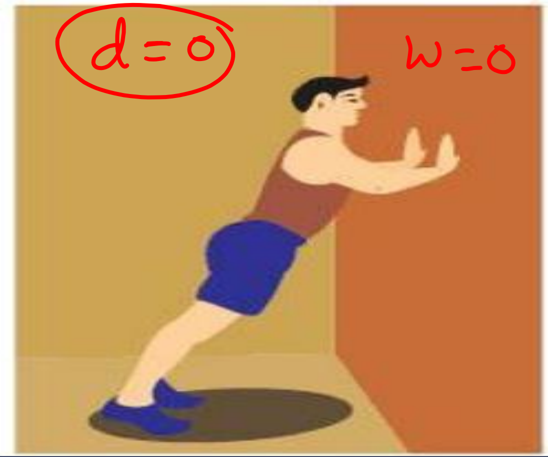
$W = 0$

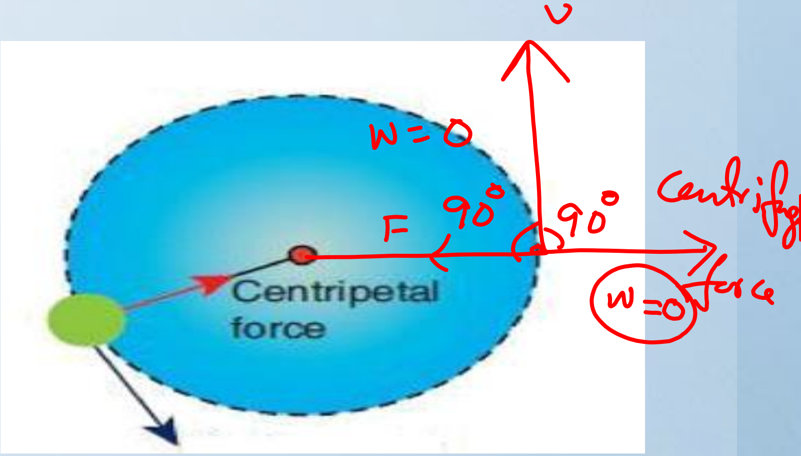
Zero Work ⇒ 'F' is called No work force

•Cos Θ is zero or Displacement is zero.

The work done by a constant force is defined as the distance moved multiplied by the component of the force in the direction of displacement:







Capacity for doing work

$E = \frac{1}{2} m v^2$

Momentum

$p = mv$

$E = \frac{1}{2} \frac{m^2 v^2}{m} = \frac{p^2}{2m}$

KINETIC ENERGY

i) $E = \frac{p^2}{2m} \Rightarrow E \propto \frac{1}{m}$ (when P is constant)

ii) $p = \sqrt{2mE} \Rightarrow p \propto \sqrt{m}$ (when E is constant)

$P_1 = \frac{120}{100} P = 1.2P$

$E_1 = \frac{P_1^2}{2m} = \frac{(1.2P)^2}{2m}$

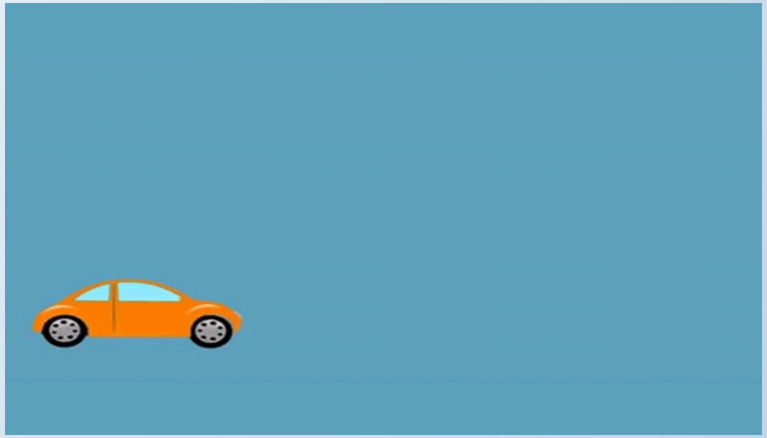
$= 1.44 E$

$\frac{E_1 - E}{E} \times 100\% = 44\%$ increase

- The **energy** that it possesses due to its motion.

$$KE = \frac{1}{2} \times mass \times speed^2$$

$$KE = \boxed{\frac{1}{2} mv^2}$$



POTENTIAL ENERGY

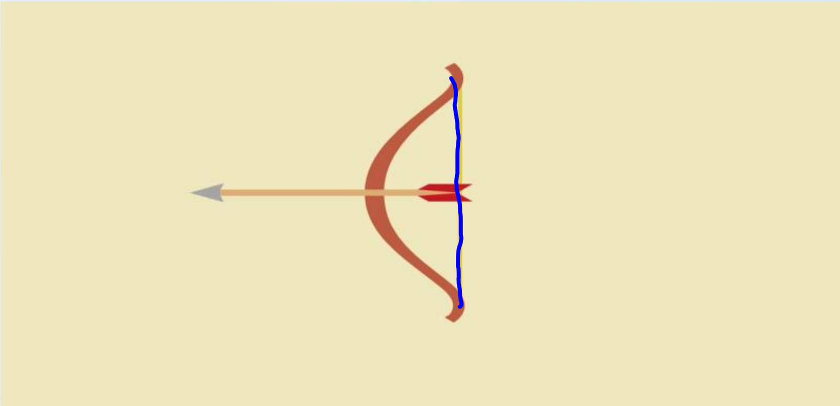
Elastic Potential Energy Per unit volume

$E_p = \frac{1}{2} \times stress \times strain$

- **Energy** is the stored energy by virtue of the position or configuration of a body.

- Gravitational potential energy P.E. = mgh

m, g and h are respectively mass, gravitational acceleration and height from ground level.



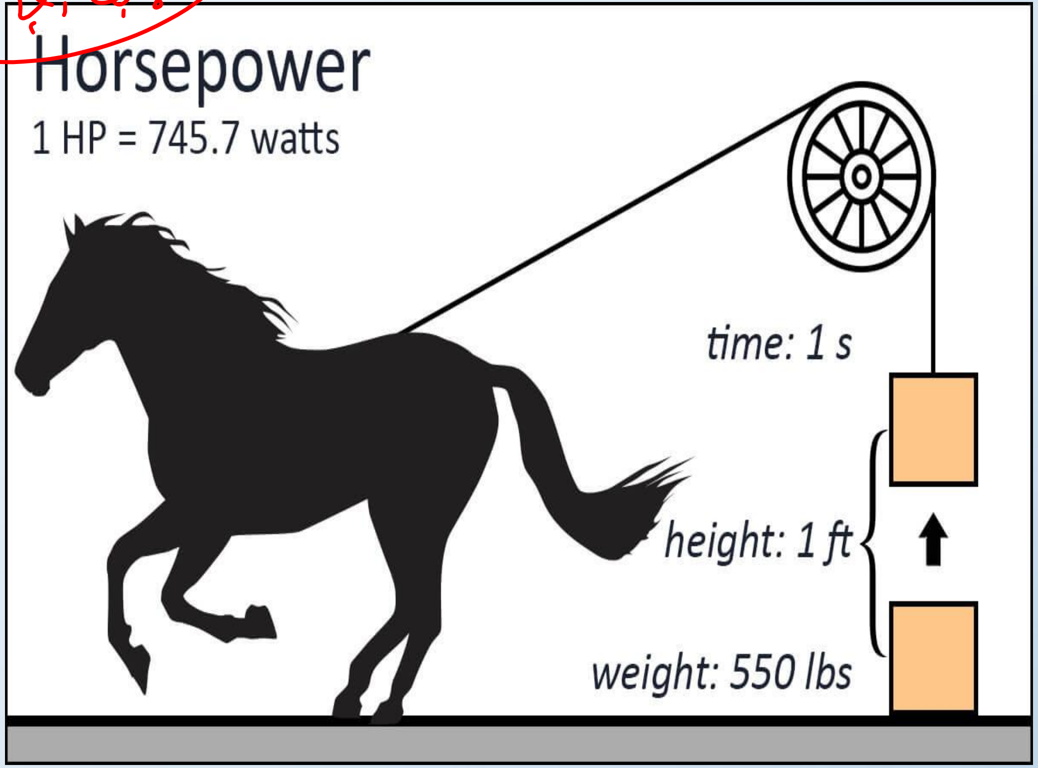
POWER

- $P=W/t = \frac{W}{t} = \frac{F \cdot d \cos\theta}{t} = F \cdot v \cos\theta$
- $P=FV \cos\Theta$
- 1hp= 746 watt

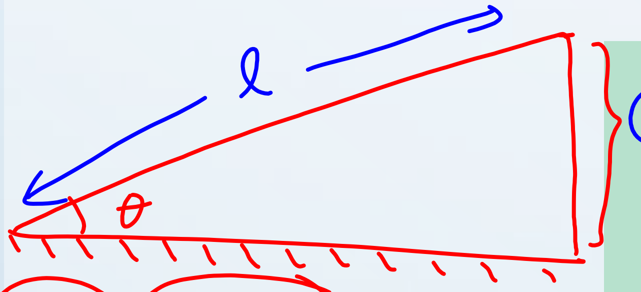
Unit :- J/sec, watt, Erg/sec

Dimension → (ML^2T^{-3})

Scaler quantity

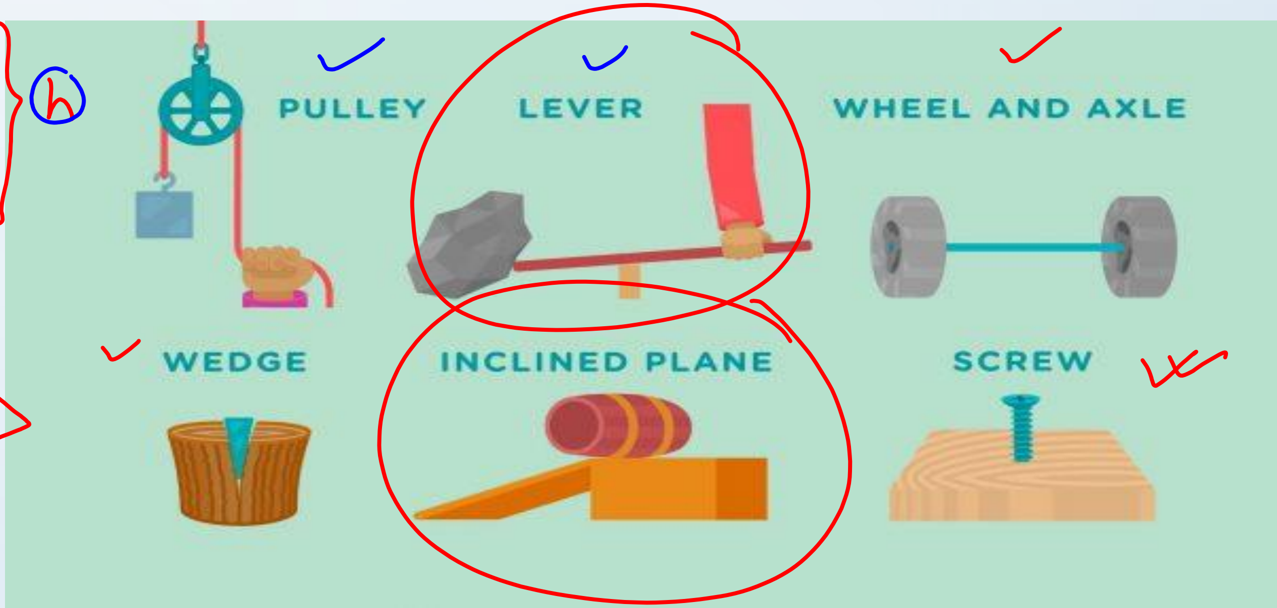


TYPE OF SIMPLE MACHINES



$\theta \downarrow \Rightarrow M.A \uparrow$

$M.A = \dfrac{l}{h} > 1$ Always



Principle of Moment

Force x Force arm = Resistance x Resistance arm

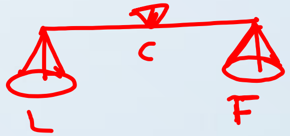
LEVER

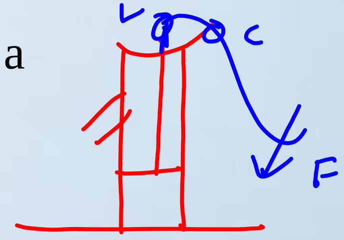
C = Fulcrum/Pivot Point

F = Force/Effort

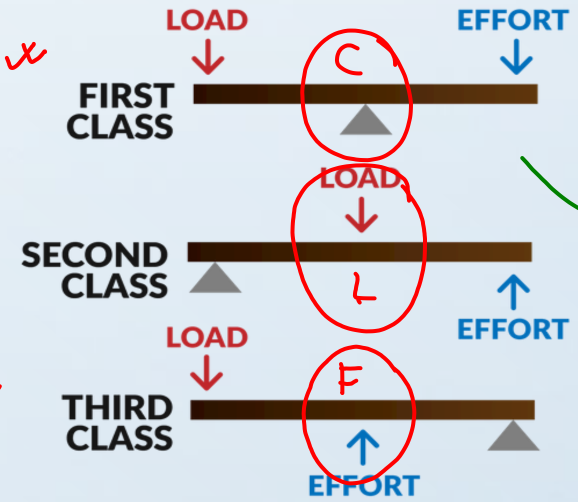
L = Resistance/Load

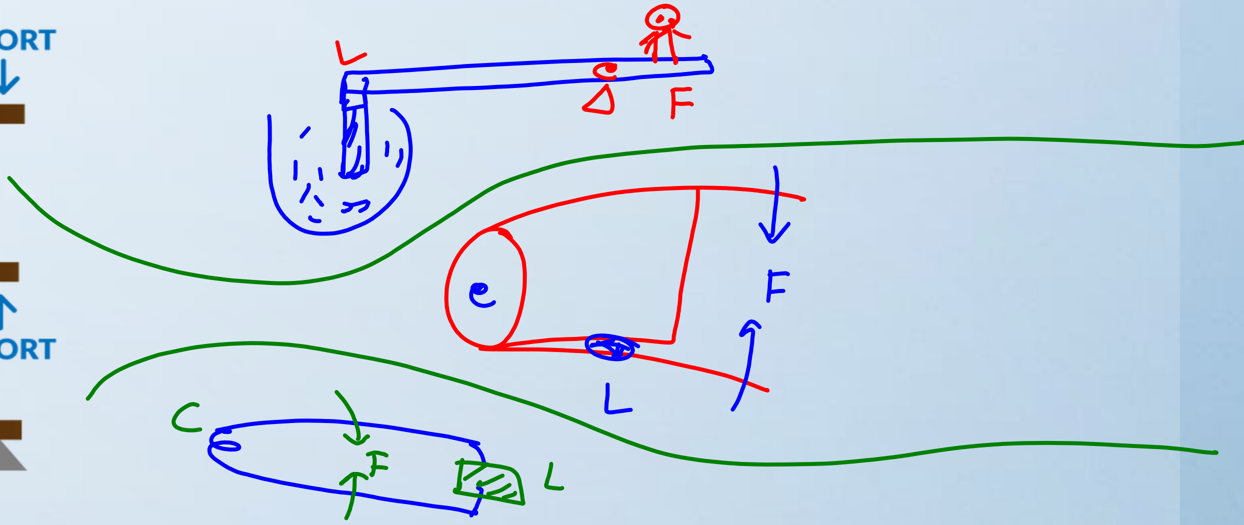
- A rigid bar or beam that pivots about one point and that is used to move an object at a second point by a force applied at a third.
- Components: fulcrum or pivot, load and effort.

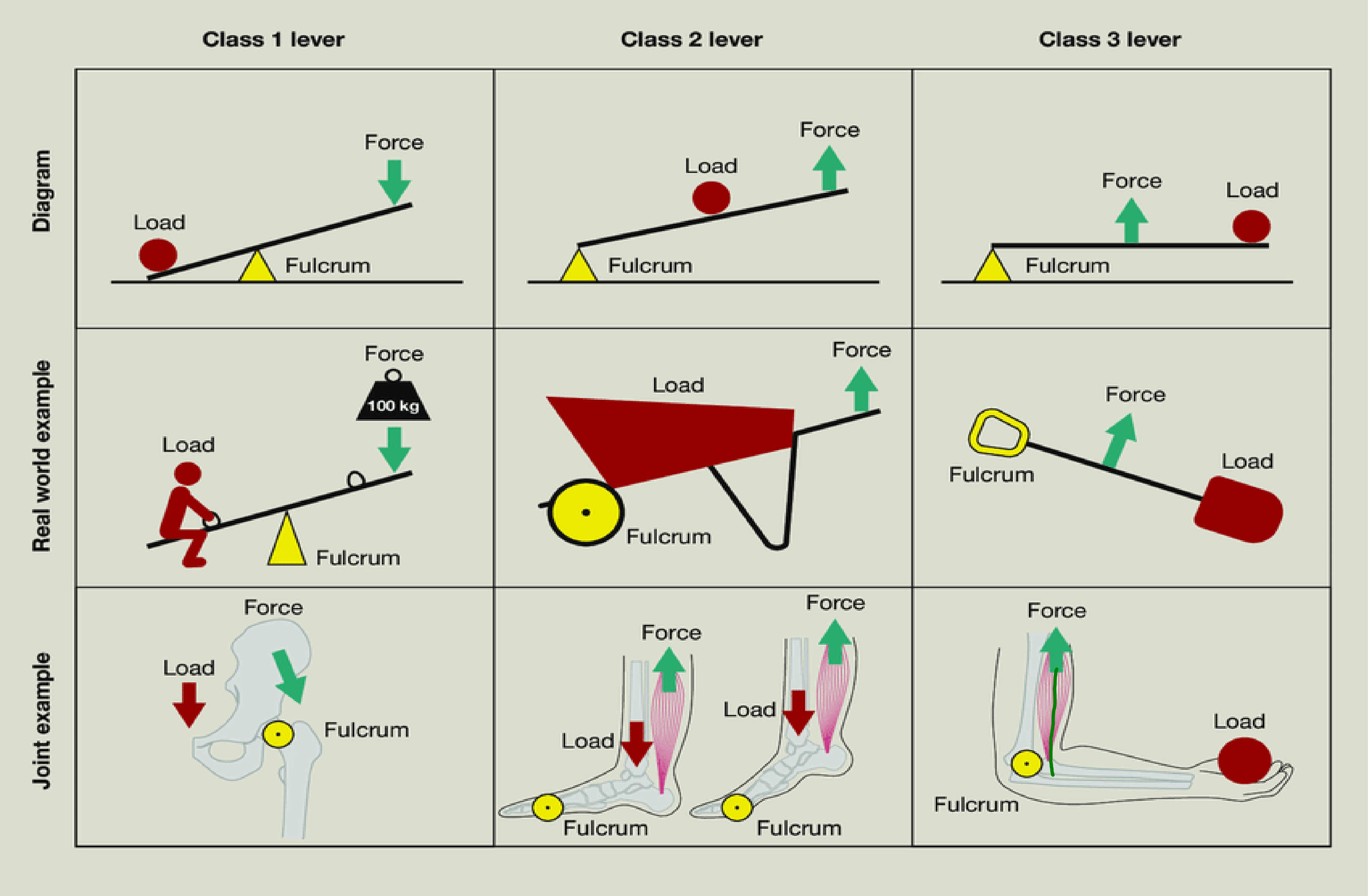




➢ Types:-






Class 1 lever
Class 2 lever
Class 3 lever
Diagram
Real world example
Joint example
Force
Load
Fulcrum
Force
Load
Fulcrum
Force
Load
Fulcrum
Force
100 kg
Load
Fulcrum
Load
Force
Fulcrum
Force
Fulcrum
Load
Force
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Fulcrum
Force
Load
Fulcrum

Mechanical Advantage of Lever (M.A)

- It is the ratio of output force to input force.
- M.A of class 1 lever is equal to 1 or less than 1 or greater than 1.
- M.A of class 2 lever is always greater than 1.
- M.A of class 3 lever is always less than 1.

COLLISION

- Collision or Impact Collision is an isolated event in which a strong force acts for a short interval. The motion of colliding particles changes (at least one of them must change) abruptly. During collision, particles may or may not come in physical contact.

  For example, in collision between two balls, the balls are in physical contact but in collision of A-particles by a nucleus there is no physical contact.

- In collisions, we consider the situation before and after collision. The term before collision and after collision refers to the conditions when the interaction force between the particles become effectively zero. The duration of collision is negligibly small as compared to the time for which event is observed. During collision internal forces act between the colliding particles.

- If the motion of the colliding particles before and after impact remains in the same line, the collision is said to be ‘direct’ or ‘head on’ or ‘one dimensional’.

- If the two particles after collision do not maintain the same line of motion, the collision is called oblique.

PYQ

Q1. The principle of lever is based on—

a) work   b) power   ***c) principle of moments***   d) energy

Q2. When a body is lifted by hand, what type of work is performed by hand? [WBCS Prelims]

a) First type of lever   b) Second type of lever   ***c) Third type lever***   d) Simple machine

Q3. In simple harmonic motion the kinetic energy— [WBCS Preli]

a) is never zero   ***b) becomes zero twice in every period***

c) is zero in the mean position   d) is always constant

Q4. What kind of energy works when a watch spring is wound up? [WBCS Preli]

a) Kinetic energy ***b) Potential energy*** c) Electrical energy d) Magnetic energy

Q5. For the same Kinetic energy, the momentum shall be maximum for— [WBCS Preli]

a) Electron b) Proton c) Deuteron ***d) Alpha particle***

RICE ADAMAS GROUP

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① Elastic Collision ⇒ $e = 1$, $u = v$,

K.E & linear momentum Conserve

② Inelastic Collision

$e < 1$, $\boxed{u > v}$

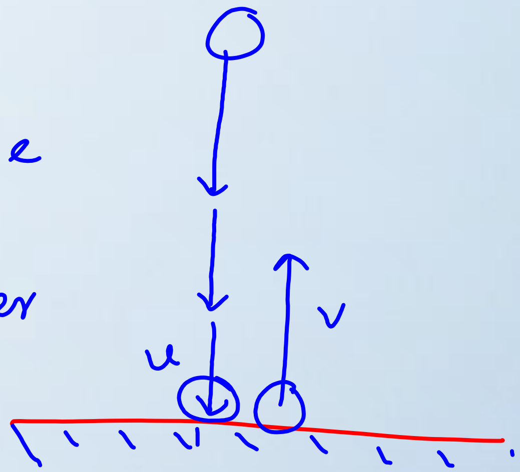
K.E Not conserve, only linear momentum conserve

LIBRARY REFERENCE BOOK

- CHAYA PHYSICS (11+12)
- GENERAL SCIENCE ENCYCLOPEDIA (ARIHANT)

u = velocity before Collision

v = velocity after Collision.



③ perfectly inelastic collision

$e = 0$, $\left.\begin{matrix} v = 0 \\ u \neq 0 \end{matrix}\right\}$

two object stick together

Co-efficient of restitution.

$e = \frac{v}{u}$

Unitless & dimensionless.

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