DATE: __/__/____
PAGE _____

# PHYSICS

## Unit - 1

## NEWTON'S LAWS

**1st Law :-** It states that "A body at rest or in motion remains at rest or in motion until and unless an external force is applied."

(Law of Inertia)

**Standard International Unit :** → MKS
- metre
- kg
- sec

# mass remains same. It does not change with gravity.
# weight changes with gravity

Speed = $\frac{\text{Distance}}{\text{Time}}$
- → scaler quantity
- → Unit : m/s
- Eg : 10 m/s

Velocity = $\frac{\text{Displacement}}{\text{Time}}$
- → vector quantity
- → Unit : m/s
- Eg : 10 m/s towards east

→ Mass m
→ velocity v
→ Momentum 'P' = mv

$v = \frac{s}{t} = \frac{ds}{dt}$

$a = \frac{dv}{dt}$ (acceleration)

$a = -\frac{dv}{dt}$ (retardation)

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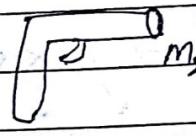
**II^nd Law :-** It states that the rate of change of momentum is directly proportional to the external force applied.

$$\frac{dp}{dt} \propto F \quad , \quad \frac{dp}{dt} = (1)F$$

**Recoiling of Gun**




$m_1 = 250\ g$

Find $v_1$ ?

$$m_1 v_1 = m_2 v_2$$

$$250 \times v_1 = 5 \times 200$$

$$v_1 = \frac{5 \times 200}{250} = 4\ m/s$$

Conservation of Momentum

Let 'p' be the momentum, 'm' be the mass, 'v' be the velocity & 't' be the time.

$$F = \frac{dp}{dt}$$

$$F = \frac{d(mv)}{dt}$$

$$F = m\left(\frac{dv}{dt}\right)$$

$$\boxed{F = ma}$$

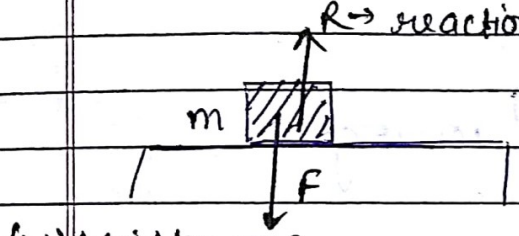
DATE: __/__/____
PAGE _____

III^rd Law :- It states that every action has an equal and opposite reaction.

$$F_1 = -F_2$$

## FRICTION

Inertia → the inability of an object to change its position.




$F \propto R$

$F = \mu R$

↳ coefficient of friction

### Types of Friction

1. Static Friction :- Friction when the body is at rest.
2. Dynamic Friction :- Friction when the body is in motion.
3. Limiting Friction - Friction when the object / body just starts sliding / moving from the state of rest.

### Laws of Friction

1. $F \propto R$
2. Frictional force is independent of area of contact.
3. Frictional force depends on nature of ~~contact~~ surface in contact and their state of polish.

* Coefficient of Friction ($\mu$) depends on the material.

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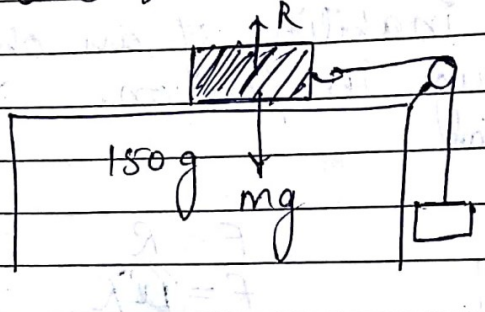
## Laws of friction

1. First Law :- It states that friction ~~if force~~ is directly proportional to the normal reaction (R). If the mass increases, then weight of the body increases, hence force increases and then reaction will also increase.




2. Second Law :- Frictional force is independent of the area of contact. Since, $F \propto R$. So reaction is directly proportional to the mass of the body and not depends on the area because mass is uniformly distributed.

Third Law :- $F \propto R$

$F = \mu R$

$\mu$ differs with different contact surfaces.
For eg :- In case of honey & water, $\mu$ of honey is more than that of water. Hence, frictional force of object on honey is greater than that of on water.

Coefficient of friction ($\mu$) → It is defined as the ratio of friction to the normal reaction (R).

$$\mu = \frac{F}{R}$$

GOOD WRITE

DATE :__/__/____
PAGE _____

**Paper Code : BCA 109** | **L** 3 | **T** 1 | **C** 4
**Paper ID: 20109**
**Paper : Physics**
**Aim: To know the fundamentals of Physics**
**Objectives**

- To get the knowledge about the basic laws of nature such as motion, work, power and energy
- To study the electrostatics, semiconductors and devices.

**INSTRUCTIONS TO PAPER SETTERS:** **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and over the entire syllabus. It should be of 25 marks and it may contain objective or short type question.
2. Rest of the paper shall contain two questions from each unit. However students will attempt only one question from each unit. Each question should be 12.5 marks.

**UNIT – I**

Law of Motion: Force and Inertia, Law of inertia or Newton's first law of motion, Newton's Second law of motion, Newton's third law of motion and it's applications, Basic forces in nature, Weight of body in lift, Equilibrium of concurrent forces, Lemi's Theorem
Friction: Cause of friction, Types of friction, Laws of friction, Angle of friction and repose, Centripetal and centrifugal force, velocity of vehicle on curved leveled and banked road.
**[T1] [T2]** **[No. of Hrs: 11]**

**UNIT – II**

Work, Energy & Power: Work, Conservative force, Power, Kinetic Energy, Work energy theorem, Potential Energy, Conservation of gravitational P.E. into K.E., P.E. of spring.
Collisions: Types of collision, elastic collision in 1D & 2D, Inelastic collision in 1D, Perfectly inelastic collision in 1D. **[T1] [T2]** **[No. of Hrs: 11]**

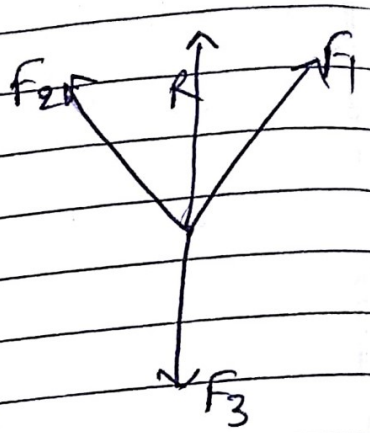
**UNIT – III**

Electricity & electromagnetism: Electric charge, Electron theory of electrification, Frictional electricity, Properties of electric charge, Coulomb's Law, Superposition Principle, Electric field intensity, Electric Lines of forces.
Electrostatics: Line integral of electric field, Electrostatic potential, State & Proof of Gauss's theorem.
Capacitance: Principal of Capacitor, Parallel and spherical capacitors, Grouping of capacitors and their capacitance, Effect of dielectric in capacitors.
Current Electricity: Current, Ohm's Law, Resistance, Grouping of resistance, Krichoff's rule, Wheatstone bridge, Slide Wire Bridge. **[T3] [T4] [No. of Hrs: 11]**

**UNIT – IV:**

Structure of Atom: Thomson's atomic model, Rutherford's alpha scattering experiment and atomic model, Postulates of Bohr's Model.
Semiconductors: Energy bands in solids, Difference between metals, insulators and semi conductors, Current carriers in semiconductors, Intrinsic semiconductor, Doping, Extrinsic semiconductors, Formation of p-n junction, Biasing of p-n junction, Light emitting diode.
Transistors: Action of n-p-n & p-n-p transistors, Advantages of transistors, Integrated Circuit.**[T3] [T4]** **[No. of Hrs: 11]**

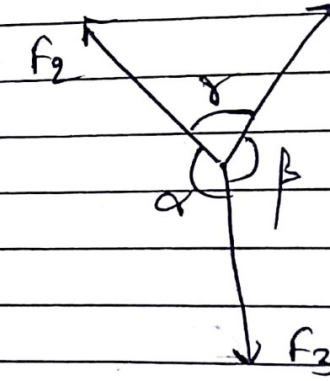
## Concurrent Forces (3M)




Let $F_1$ be the force applied in one direction and $F_2$ be the force applied in another direction. Their net force is represented by the resultant R in which the body will move. A force $F_3$ is applied in opposite direction to the resultant force. Now the body won't move. These forces together acting on the body are called concurrent forces.

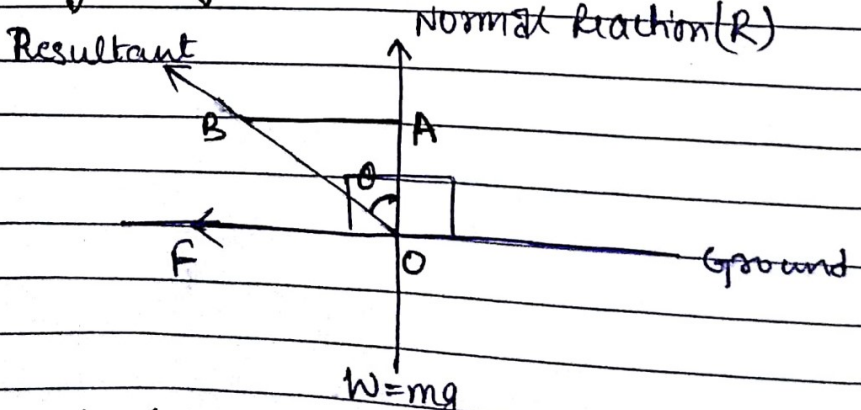
$$F_1 + F_2 + F_3 = 0$$

## Lami's Theorem




$$\frac{F_1}{\sin\alpha} = \frac{F_2}{\sin\beta} = \frac{F_3}{\sin\gamma}$$

## Angle of Friction ($\theta$)




# Weight always acts towards the centre of earth.

GOOD WRITE

DATE: __/__/____
PAGE _____

$$\tan\theta = \frac{F}{R} \quad \text{— (1)}$$

Earlier → $F \propto R$

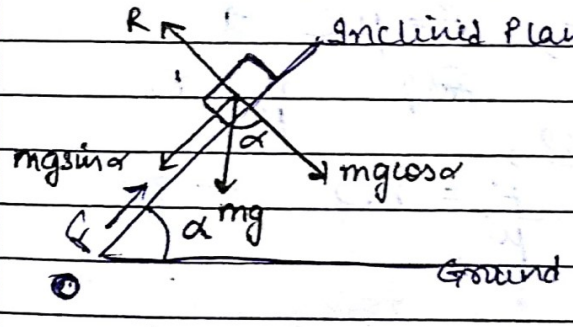
$F = \mu R$

$\mu = \frac{F}{R}$ — (2)

From (1) & (2)

$$\boxed{\mu = \tan\theta = \frac{F}{R}}$$

## Angle of Repose or Slide




$F = mg\sin\alpha$ — (1)

$R = mg\cos\alpha$ — (2)

(1)/(2) $\frac{F}{R} = \frac{mg\sin\alpha}{mg\cos\alpha} = \tan\alpha = \tan\theta = \mu$

↳ Show that angle of repose = angle of friction.

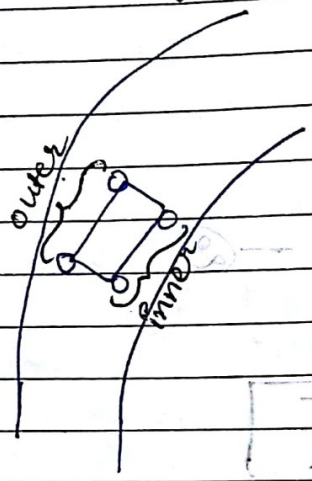
## INERTIA

1. Inertia of rest
2. Inertia of motion
3. Inertia of direction

GOOD WRITE

DATE: __/__/____
PAGE _____

# Bending of Road




Let us consider a curved road and a car is moving on it.

Let 'm' the mass of the car, $R_1$ be the reaction from inner wheels and $R_2$ be the reaction from outer wheels, r be the radius of curvature of the road, v be the velocity of the vehicle and 'g' be the acceleration due to gravity.

So we can apply,

$$\underbrace{R_1 + R_2}_{R} = mg$$

Let 'R' be the net reaction. Hence, $R = mg$ — (1)

We know that, $F = \mu R$ — (2)

$$\frac{F}{\mu} = R$$

From (1) and (2),

$$\frac{F}{\mu} = mg \quad \text{— (3)}$$

While moving on the curved road, the car will experience some centripital force which is given by :-

$$F = \frac{mv^2}{r} \quad \text{— (4)}$$

Substituting the value of eq (4) in eq (3),

$$\frac{mv^2}{\mu r} = mg$$

$$v^2 = \mu r g$$

Max. velocity of car on curved road → $\boxed{v = \sqrt{\mu r g}}$

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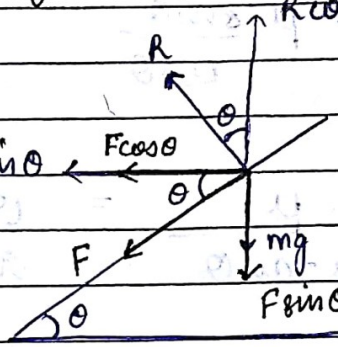
From this eq, we conclude that the max. velocity of the car depends upon the — 1. radius and 2. coefficient of friction.

**Banking Of Roads** → The phenomenon of raising outer edge of the curved road to provide necessary centripetal force to the vehicles for safe turn.




Here F = frictional force

$R\cos\theta = mg + F\sin\theta$ — ①

$R\sin\theta + F\cos\theta = \frac{mv^2}{r}$ — ②

Rearranging eq ① → $R\cos\theta - F\sin\theta = mg$ — ③

We know that, $F = \mu R$ — ④

Substituting value of F from eq ④ in ② & ③

Eq 2 → $R\sin\theta + \mu R\cos\theta = \frac{mv^2}{r}$

Eq 3 → $R\cos\theta - \mu R\sin\theta = mg$

② / ③ → $\frac{R\sin\theta + \mu R\cos\theta}{R\cos\theta - \mu R\sin\theta} = \frac{mv^2}{rmg}$

$= \frac{R(\sin\theta + \mu\cos\theta)}{R(\cos\theta - \mu\sin\theta)} = \frac{v^2}{rg}$

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→ Dividing numerator and denominator by $\cos\theta$

$$\Rightarrow \frac{\frac{\sin\theta}{\cos\theta} + \frac{\mu\cos\theta}{\cos\theta}}{\frac{\cos\theta}{\cos\theta} - \mu\frac{\sin\theta}{\cos\theta}} = \frac{v^2}{rg}\,\frac{\cos\theta}{\cos\theta}$$

$$\Rightarrow \frac{\tan\theta + \mu}{1 - \mu\tan\theta} = \frac{v^2}{rg}$$

$$\Rightarrow \boxed{v^2 = \left[\frac{\tan\theta + \mu}{1 - \mu\tan\theta}\right] rg}$$

→ By raising the road, coefficient of friction increases and hence, velocity of the car on a banked road also increases.