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Volume - 3

General Awareness & Science

SIERRA INNOVATIONS

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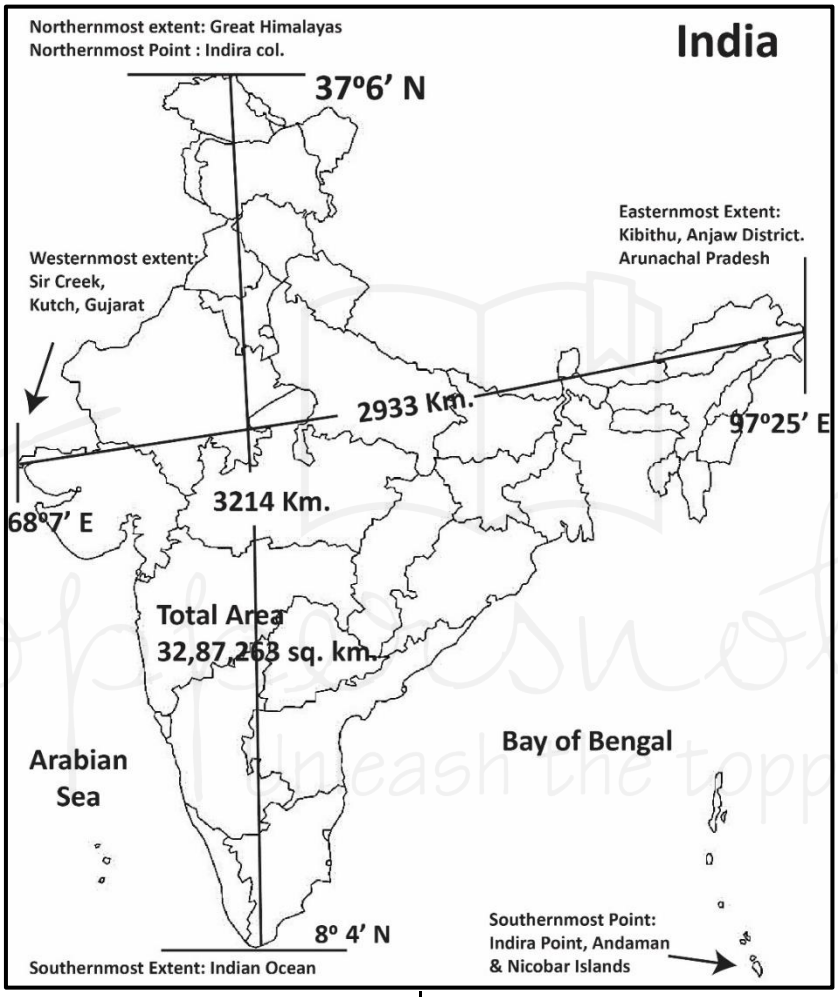
1 CHAPTER

India-Size & Location

- **7th largest country** in the world.
- Situated in the **northern hemisphere** (**8°4'N to 37°6'N and 68°7'E to 97°25'E**)
  - India lies to the north of the equator between **6° 44′ and 37°6'N latitude** and 68° 7′ and 97° 25′ east longitude (including the islands).
- **Area**: 32,87,263 sq. km (**2.42% of the world**)
- 2nd most populated country in the world (**17.5% of the world's population**)
- **Total land boundary** = 15,200 km.
- **Total Sea boundary** = 7516.6 Km
  - Without islands = 6100 Km



Border Countries:

North-west	● Afghanistan and Pakistan ● Indo-Pak border: Radcliffe line ● Pak - Afghanistan border: Durand Line
North	● China, Bhutan and Nepal ● Indo-China border: McMahon line
East	● Myanmar, Bangladesh ● Longest boundary with Bangladesh
South	● Sri Lanka ● Separated by Palk Strait & Gulf of Mannar

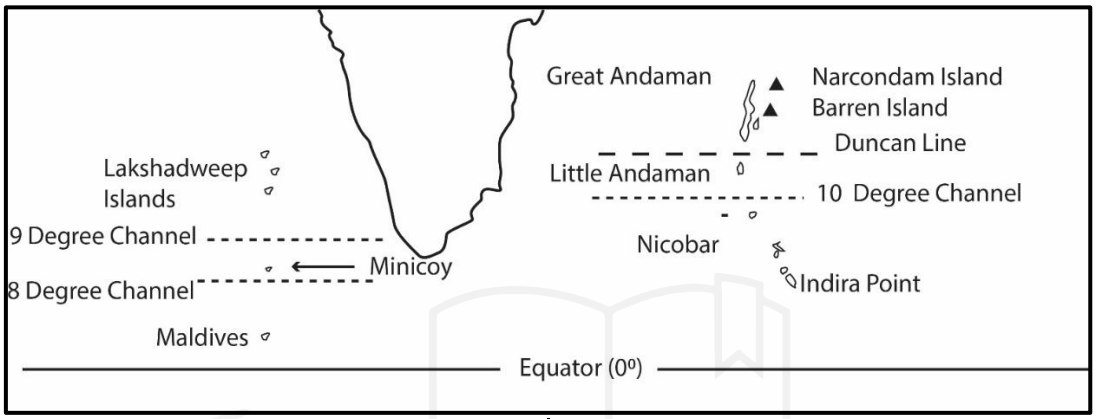
States sharing International borders:

Bangladesh	**5 States:** West Bengal, Mizoram, Meghalaya, Tripura, and Assam (**4096 km)**
China	**4 States and1 UT:** Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh and Ladakh (**3488 km)**
Pakistan	**3 States and 2 UTs:** J&K, Punjab, Gujarat, Rajasthan and Ladakh (**3323 km)**

Nepal	**5 States:** Uttar Pradesh, Bihar, Uttarakhand, Sikkim, West Bengal **(1751km)**
Myanmar	**4 States**: Arunachal Pradesh, Manipur, Mizoram, and Nagaland (**1643 km)**
Bhutan	**4 States**: Arunachal Pradesh, Assam, Sikkim, and West Bengal (**699 km)**
Afghanistan	**1 UT:** Ladakh (**106 km)**

- **Indian Standard Meridian**
  - **82°30'E**, **Mirzapur(UP)** - India's Standard Meridian.
  - **Ahead of meantime** by **5 hours and 30 minutes.**
  - **States through which IST Passes:** Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Odisha and Andhra Pradesh.
- **Tropic of cancer** (23°30'N) - Gujarat, Rajasthan, MP, Chhattisgarh, Jharkhand, West Bengal, Mizoram, and Tripura.
- **Coastal states of India: 9** (West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra, and Gujarat)

Various Channels and their Location



- **Ten Degree Channel**
  - **Separates** the **Andaman Islands** from the **Nicobar Islands** in the Bay of Bengal
  - **150 km wide** from north to south and **10 km long** from east to west with a minimum depth of 7.3m.
- **Nine Degree Channel**
  - **Separates Minicoy** island from the **Lakshadweep archipelago**.
  - **200 km wide** with a **depth** of **2597 metres**.
  - **Strategic importance**: Passage of major merchant shipping between Europe, the Middle East and Western Asia with South-East Asia and the far East.
- **Eight Degree Channel**
  - **Maritime boundary** between the **Maldives** and **India**
  - **Separates** the islands of **Minicoy** and **Maldives**.
  - Traditionally known as **Maliku Kandu** and **Māmalē Kandu Divehi**.

Duncan Passage

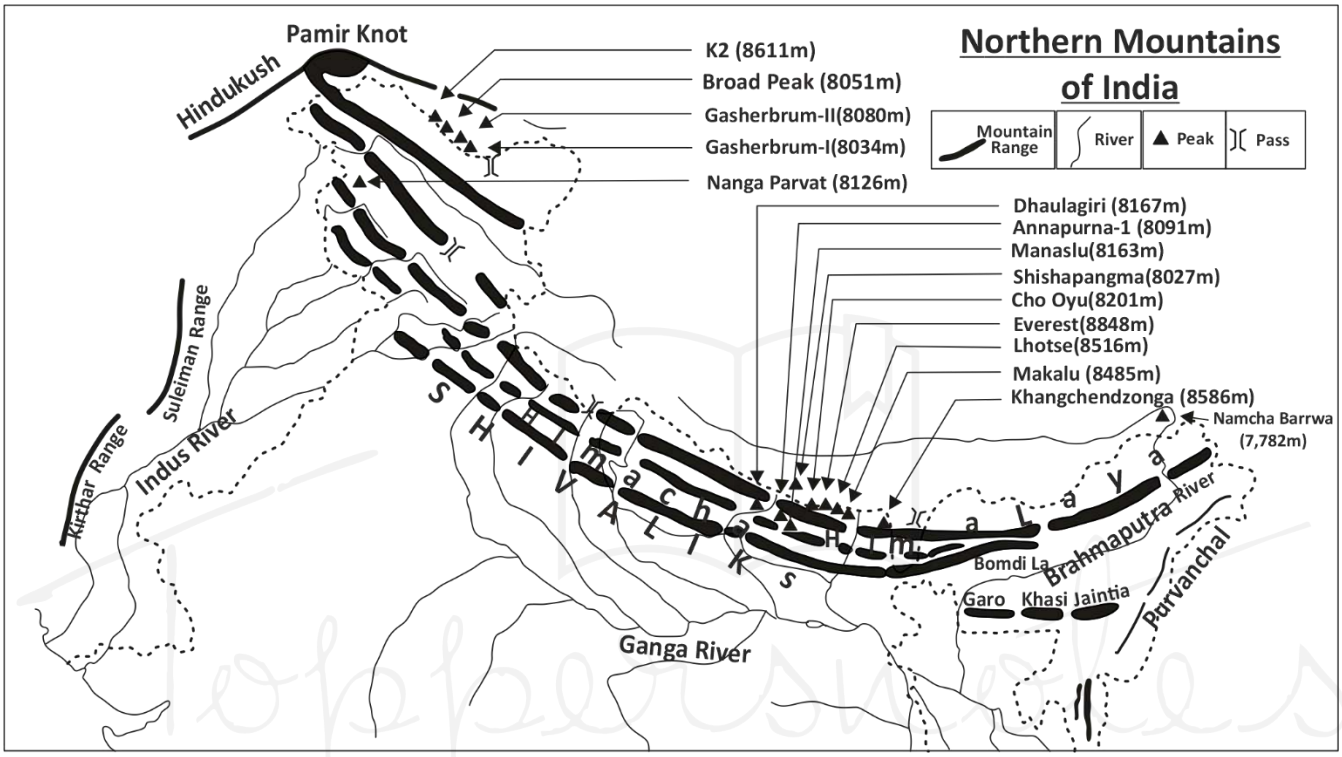
- A strait in the Indian Ocean.
- Located in between South Andaman and Little Andaman.
- Also lies within the EEZ of India, protected by the integrated tri-services Andaman and Nicobar Command of Indian Military.
- **Width**: ~ 48km.

2 CHAPTER Physiographic Divisions of India

Based on physical features, India is divided into six physiographic divisions:

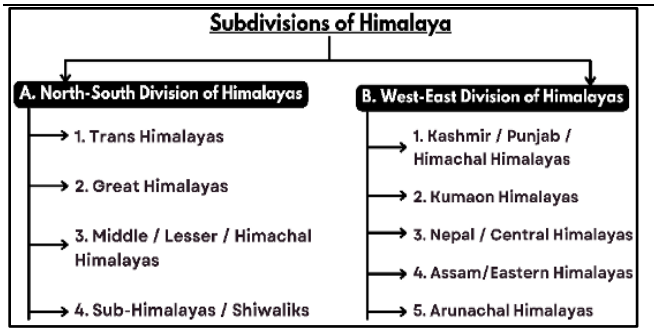
1. Himalayan Mountains
2. Great Plains of India
3. Peninsular Plateau
4. Indian Desert
5. Coastal Plains
6. Islands

1. Himalayan Mountains

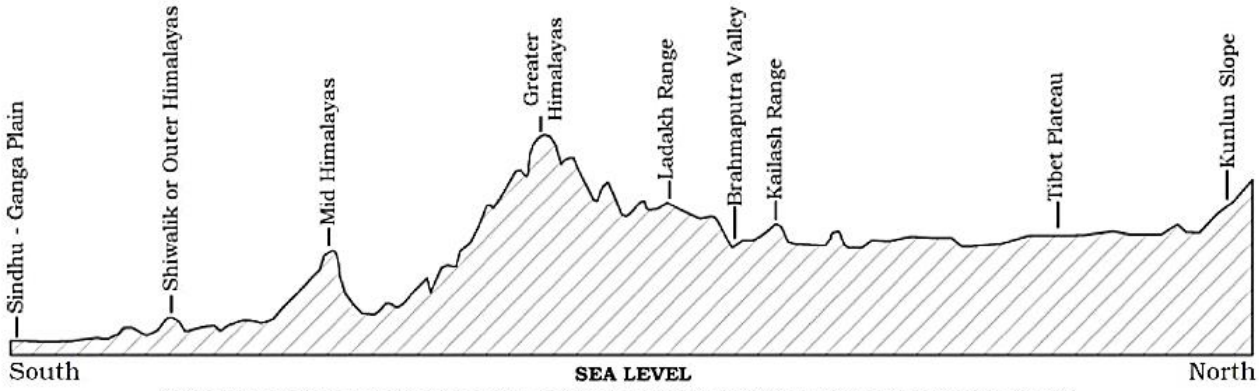


- **Highest and the youngest fold mountain** ranges of the world.
- **One of the highest earthquake-prone regions** of the world.
- **Length:** runs **west-northwest to east-southeast** in an arc **2,500 km long.**
  - **Western anchor**: **Nanga Parbat** (lies just south of the northernmost bend of the Indus River)
  - **Eastern anchor: Namcha Barwa** (lies immediately west of the great bend of the Yarlung Tsangpo River)
- **Width**: 400 km - 150 km (West- East).
- **Soaring heights, steep-sided** jagged peaks, valley and alpine glaciers often of stupendous size
- **Topography** deeply cut by **erosion**, seemingly **unfathomable river gorges**, **complex geologic structure**, and **series of elevational belts** (or zones)
- **Greater part of the Himalayas** lies below the snow line.
- The **mountain-building process** that created the range is still active.
- **Considerable stream erosion** and **gigantic landslides**.

Sub Divisions of the Himalayas



A. North-South Division of Himalayas



Himalayan Mountain Complex : Cross Sectional View from South to North

1. Trans-Himalayan Ranges:

- **Location:** North of the Great Himalayas
- Also known as **Tibetan Himalaya** because most of it lies in Tibet.
- **Lifted much before the Himalayas** between Jurassic and Cretaceous
- **Geologically not a part of the Himalayas**.
- **Start** from **Pamir Knot.**
- **Godwin Austen/ K2/ Qogir** (8,611 m) - **second highest** peak in the **world / highest peak in the Indian Union** found in Karakoram Range
- **Length- 1,000 km** in the **east-west** direction.
- **Average elevation - 5000 m** above mean sea level.
- **Average width** - 40 km- 225 km (extremities -central part).
- **Siachen glacier** - highest battlefield.
- **Glacier Baltaro** - largest Mountain glacier from the Karakoram range.
- **Karakoram Pass** - connects the **Aksai Chin,** an erosional plateau of an average height 5000m.
- **Main ranges**:

Karakoram Range	● **Northernmost range** of the Trans-Himalayan Ranges in India ● Also known as **Krishnagiri range** ● Extends eastwards **from Pamir for about 800 km.** ● **Average elevation** - 5,500 m and above.
Ladakh Range	● **North of the Zaskar** Range ● **Highest point** - Rakaposhi ● Lies **north of Leh.** ● **Merges with the Kailash range** in Tibet. ● **Important passes** - Khardung La, and Digar La.
Zaskar Range	● A mountain range in the **union territory of Ladakh.** ● **Separates Zanskar from Ladakh.**
	● **Average height** - about 6,000 m. ● Acts as a **climatic barrier protecting Ladakh and Zanskar from monsoon** ● **Major passes**- Marbal Pass, Zojila Pass - extreme northwest. ● **Major rivers**- Hanle River, Khurna River, Zanskar River, Suru River (Indus), and Shingo River.
Kailas Range	● **Offshoot** of the **Ladakh Range**. ● **Highest peak -** Mount Kailash (6714 m). ● **River Indus** originates from the **northern slopes of the Kailas range**.

Ladakh Plateau

- **Cold desert**
- Lies to the **northeast of the Karakoram Range**.
- **Dissected into** many plains and mountains - **Soda Plains, Aksai Chin, Lingzi Tang, Depsang Plains and Chang Chenmo**.
- **Northwestern part - Deosai mountains** are the **end of the Trans-Himalayan region**

2. Great Himalayas:

- Also known as **Himadri.**
- **Average height** - 6000 m
- **Average width** - 25 km
- **Extension -** Mt. Namcha Barwa to Nanga Parbat (2400 km)- World's one of the longest-running fold mountain ranges
- **Features:** High relief, deep gorges, vertical slopes, symmetrical convexity, and antecedent drainage.
- **Terminates abruptly** at the **syntaxial bends**.
  - **Nanga Parbat** - north-west
  - **Namcha Barwa** - north-east.
- **Composed** of **metamorphic** and **sedimentary** rocks.

- **Core** - **Batholith** representing the intrusion of Magma (Granitic Magma)
- **Have asymmetrical folds** due to high compression, and they **have fractured rocks** in the **eastern part.**
- **14 of the 28 tallest peaks** in the world (> 8000 m) are situated here.
- **Major passes -** Zojila Pass (connects Srinagar with Leh), Shipki La Pass, Burzil Pass, Nathu La Pass etc.
- **Major glaciers** - Rongbuk glacier (largest in the Himadri), Gangotri, Zemu etc.
- **Separated from lesser Himalayas** by longitudinal **valleys** filled with sediments known as **Doons**.
    - **Eg.** Patli Dun, Chaukamba Dun, Dehradun etc.

3. <u>Middle/ Lesser/ Himachal Himalaya:</u>

- **Most rugged** mountain system.
- Lies **between** the **Shiwaliks** in the south and the **Greater Himalayas** in the north.
- **Composed** of **highly compressed and altered rocks.**
- **Average altitude** - 3,700 - 4,500 metres.
- **Average width** - 50 to 80 Km.
- **Pir Panjal range - longest**
    - **Extends from Jhelum - upper Beas River** for over 300 km.
    - Rises to 5,000 metres and contains **mostly volcanic rocks**.
- **Passes:**
    - **Pir Panjal Pass** (3,480 m), the Bidil (4,270 m), Gulabgarh Pass (3,812 m) and **Banihal Pass** (2,835 m).
    - **Banihal Pass**- Jammu-Srinagar highway and Jammu-Baramulla railway.
- **Rivers**: Kishanganga, the Jhelum and Chenab.
- **Important Valleys**

Valley of Kashmir	● Between the **Pir Panjal** and the **Zaskar Range** (average elevation- 1,585 m) ● **Composed** of alluvial, lacustrine [lake deposits], fluvial [river action] and glacial deposits. ● **Jhelum River meanders** through these deposits and cuts **a deep gorge** in Pir Panjal.
Kangra Valley	● **Extends from** the foot of the **Dhauladhar Range to the south of Beas**.
Kullu Valley	● In the **upper course of the Ravi** ● A **transverse valley.**

- **Most important range** - Dhaula Dhar and Mahabharat ranges.
- **Includes** famous valley of Kashmir, the Kangra and Kullu Valley in Himachal Pradesh.
    - Well **known for its hill stations.**
- **Cut across by the Jhelum and Chenab rivers.**
- **Dhauladhar ranges** – an extension of Pir Panjal into Himachal Pradesh - cut across by the river Ravi.
- **Mussoorie ranges** - divide the waters of Sutlej and Ganga
- Have **steep, bare southern slopes** [prevents soil formation] and gentler**, forest-covered northern slopes.**
- **Uttarakhand**- marked by **Mussoorie and Nag Tibba ranges**.

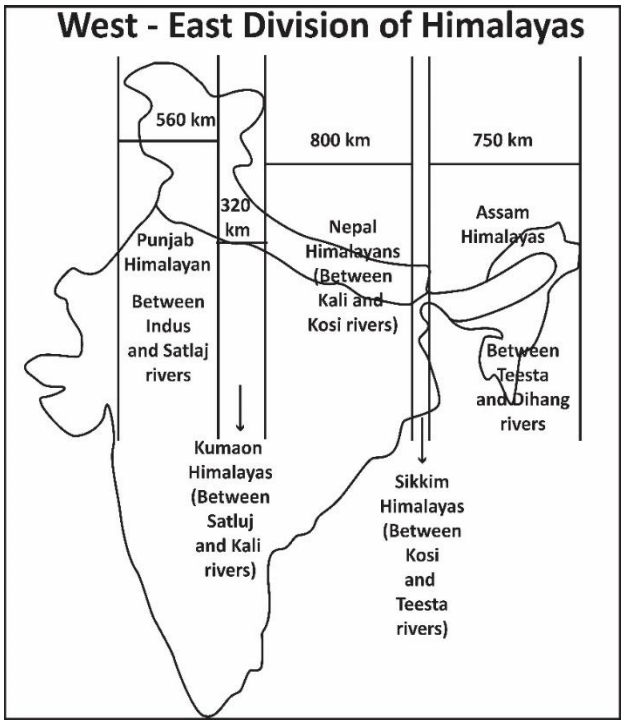
Important ranges of Lesser Himalayas	Region
Pir Panjal Range	Jammu and Kashmir (south of Kashmir Valley)
Dhauladhar Range	Himachal Pradesh
Mussoorie Range and Nag Tibba Range	Uttarakhand
Mahabharat Range	Nepal

4. <u>Sub-Himalayas/ Shiwaliks:</u>

- Also known as **Outer Himalayas.**
- **Between Great Plains and Lesser Himalayas**.
- **Altitude**- 600-1500 metres.
- **Length**- 2,400 km - **Potwar Plateau to Brahmaputra valley.**
- **Southern slopes** - steep
- **Northern slopes** - gentle.
- **Width** - 50 km - 15 km (Himachal Pradesh -Arunachal Pradesh).
- **Almost unbroken except** for 80-90 km – **Tista and Raidak River valley**.
- Covered with **thick forests from North-East India up to Nepal**.
- **Southern slopes** in **Punjab** and **Himachal Pradesh**- almost **NO forest cover.**
- **Highly dissected** by **seasonal streams** - **Chos**.
- **Valleys** - part of **synclines** and **hills** - part of **anticlines**
- **Different names:**

Region	Name of Shiwaliks
Jammu Region	Jammu Hills
Dafla, Miri, Abor and Mishmi Hills	Arunachal Pradesh
The Dhang Range, Dundwa Range	Uttarakhand
Churia Ghat Hills	Nepal

B. West-East Division of Himalayas



1. Kashmir /Punjab/ Himachal Himalayas

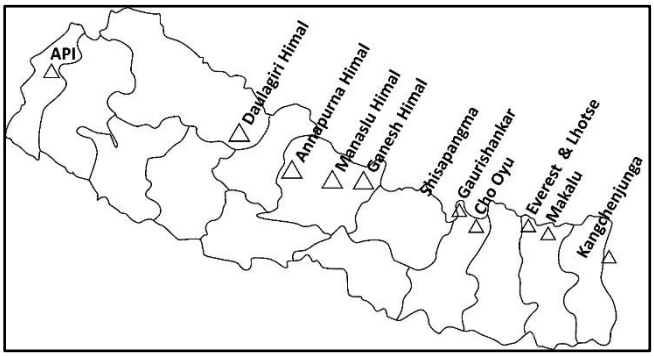
- Located **between Indus and Satluj gorge**
- **Length**- 560 kms
- **Width** - 320 kms
- **Zaskar range -** northern boundary and **Shiwaliks -** Southern boundary
- **Characterized by** ridge and valley topography (Kashmir Valley is the syncline basin) formed by the Lacustrine deposits (**Karewas**- helpful in **growing saffron**- from Pulwama to Pampore) of Jhelum.
- **Major ox-bow lakes** - Wular lake, Dal Lake, etc.
- Also known as "**Vail of Kashmir**"
- **Rainfall** upto 100cm in **summers** and **snow** during **winters**
- **Only gateway to Kashmir - Banihal pass** - Jawahar tunnel (Second Largest in India)
- **Major passes**- Burzil pass, Zozila pass.

2. Kumaon Himalayas

- Located between **Satluj and Kali gorges**
- **Length**- 320 kms
- **Major mountain ranges -** Nag Tibba, Dhaula Dhar, Mussoorie, and the Greater Himalayas.
- **Major peaks -** Nandadevi, Kamet, Badrinath, Kedarnath, etc.
- **Major rivers –** Gangotri, Yamunotri, Pindari, etc.
- **Characteristics:**
  - **Snowfall** in winters
  - **Coniferous** forests above **3200m** and **Deodar** Forest between **1600-3200m**.
  - Has **tectonic valleys**- Kullu, Manali, and Kangra.
  - **Rainfall** of about 200cm in summers
  - **More prone to Seismicity** and landslides.

3. Nepal/ Central Himalaya

- **Length- 800 km**
- **Between Kali** in the west and **Tista** in the east.
- **Great Himalayas attain a maximum height** in this portion.
- **Major peaks**- Mt. Everest, Kanchenjunga, Makalu, Annapurna, Gosainthan and Dhaulagiri.
- **Lesser Himalaya** is known as **Mahabharat Lekh** here.
- **Major rivers**- Ghaghara, Gandak, Kosi, etc.
- **Major valleys**- Kathmandu and Pokhra lacustrine valleys (previously lakes).



4. Assam/ Eastern Himalayas

- **Length-** 750km
- Located between **Tista** in the **west** and **Brahmaputra** (Dihang gorges) in the **east**.
- Occupy **mainly Arunachal Pradesh** and **Bhutan**.
- Narrow longitudinal valleys
- **Rainfall > 200cms.**
- Show a **marked dominance of fluvial erosion** due to heavy rainfall.
- **Landslides** and **earthquakes** are very **common** as rocks are fractured
- **Inhabited by tribes**
- **Important peaks** - Namcha Barwa (7756 m), Kula Kangri (7554 m), ChomoLhari (7327 m).
- **Major hills** - Also known as hills, Dafla hills, Miri hills, Abor hills, Mishmi hills, Namcha Barwa, Patkai bum, Manipur hills, Blue Mountain, Tripura range, and Braille range.
- **Major passes-** Bomdi La, Yong Yap, Diphu, Pangsau, Tse La, Dihang, Debang, Tunga, and Bom La.

5. Arunachal Himalayas

- **Form the eastern frontier** of the **Eastern Himalayas.**
- **Namcha Barwa** - **extreme east** of Arunachal Pradesh.
- **Earlier known as Assam Himalayas.**
- **Himalayan range** enters Arunachal Pradesh **from Bhutan** in the West Kameng district.
- **Characteristics**
  - **High ridges** and **low valleys**
  - **Altitude** - 800 m to 7,000 m above sea level.
  - **Extend** from the east of the Bhutan Himalayas - Diphu pass in the east.
  - **Dissected by the Brahmaputra,** which flows through a deep gorge after crossing Namcha Barwa.
- **Major tribes**- Monpa, Abor, Mishmi, Nyishi and the Nagas- practice Jhumming.

Purvanchal Himalayas

- Geologically considered **part of the Himalayas**
- Has **structural differences**, thus, **separated from the main Himalayan ranges**.
- Lies **south of the Brahmaputra valley.**
- Belong to **Arakan Yoma orogenesis.**
- Have **loose, fragmented sedimentary rocks** like shale, mudstone, sandstone, quartzite
- **Most fractured parts** of the Himalayas.
- **Naga fault line**- earthquakes and landslides
- **Rainfall** - 150-200 cm
- **Densely forested**
- **Elevation** decreases from **north to south.**
- **Convex to the west.**
- **Low hills** where Jhum cultivation is prevalent.
- **Major Hills**:

Dafla Hills	● **Location**: north of Tezpur and north Lakhimpur ● Bounded on **west** by the **Aka Hills** and on the **east** by the **Abor Range.**
Abor Hills	● **Location:** region of Arunachal Pradesh in NE of India, near China border ● Bordered by **Mishmi Hills** and **Miri Hills.** ● **Drained by the Dibang River**, a tributary of the Brahmaputra.
Mishmi Hills	● **Location:** southward extension of the Great Himalayan ranges. ● **Northern and eastern parts touch China.**
Patkai Bum Hills	● **Location:** India's NE border between Arunachal Pradesh and Myanmar. ● **"Patkai" - "to cut chicken"** in Tai-Ahom language. ● **Originated by the same tectonic processes** that resulted in the **formation of the Himalayas** in the Mesozoic. ● Have **conical peaks, steep slopes** and **deep valleys** ● **Not** as **rough** as the **Himalayas**. ● Whole region is **surrounded by forests** composed of sandstones.
Naga Hills	● **Location:** extending into Myanmar forms a divide between India and Myanmar. ● **Highest peak** - Saramati. ● Receive a **heavy monsoon rainfall** and densely forested.
Manipur Hills	● **Location:** north of Nagaland, Mizoram in the south, upper Myanmar in east and Assam in the west bound Manipur Hills. ● **Border** between **Manipur and Myanmar.** ● **Loktak Lake** - only floating national park of the world. ● **Keibul-Lamjao national park** situated here.
Mizo Hills	● **Location-** south-eastern Mizoram state. ● **Formerly** known as **Lushai Hills.** ● **Highest part**- Blue Mountain. ● Part of the **North Arakan Yoma system.** ● Also known as **'Molasses basin'** - made up of **soft unconsolidated deposits.** ● **Shifting agriculture** and some **terrace cultivation** practised.
Tripura Hills	● series of **parallel north-south folds**, **decreasing** in **elevation** to **south**. ● Merge into **greater Ganges-Brahmaputra lowlands** (aka Eastern Plains).
Mikir Hills	● **Location-** south of the Kaziranga National Park, Assam. ● Part of the **Karbi Anglong Plateau.** ● **Mikir Hills** - oldest landform in Assam. ● **Radial drainage pattern** ● **Major rivers**- Dhansiri and Jamuna. ● **Highest peak –** Dambuchko.
Garo Hills	● **Location:** Meghalaya state. ● **Highest peak**: Nokrek Peak.
Khasi Hills	● Part of **Garo-Khasi Range** in Meghalaya. ● **Cherrapunji** - East Khasi Hills. ● **Highest peak**: Lum Shyllong.
Jaintia Hills	● **Location:** further to the east of the Khasi Hills.
Barail Hill	● **Location:** North Cachar Hill District. ● **Southwestern extension** of the **Patkai Range.** ● Runs in a **south-westerly direction from southern Nagaland** and parts of **northern Manipur** up to the Jaintia Hills of Meghalaya.

Himalayan Passes

1. Passes of Jammu and Kashmir and Ladakh

Banihal Pass (Jawahar Tunnel)	● A famous pass in Jammu and Kashmir. ● Situated in **Pir- Panjal Range**. ● Connects **Banihal with Qazigund**.
Zoji La	● Connects **Srinagar with Kargil and Leh.** ● **Border Road Organization**- clears and **maintains** the road, especially during winter.
Burzil Pass	● **Srinagar- Kishan Ganga Valley** ● Joins the Valley of **Kashmir with** the **Deosai Plains of Ladakh**.
Pir-Panjal Pass	● A traditional pass **from Jammu to Srinagar**. ● **Closed after the partition**. ● **Shortest roadway access to Kashmir** valley from Jammu.
Qara Tagh Pass	● Located in the **Karakoram Mountains**. ● A **subsidiary of the ancient silk route.**
Khardung La	● **Highest motorable pass** in the country (5602 m). ● **Connects Leh and Siachen** glaciers. ● **Closed** during the **winter**.
Thang La	● Located in **Ladakh**. ● **Second highest motorable** mountain **pass** in **India**.
Aghil Pass	● **North of Mount Godwin-Austen** in Karakoram. ● Connects **Ladakh with Xinjiang province** of China.
Chang-La	● Connects **Ladakh with Tibet.**
Lanak La	● **Aksai Chin** in Ladakh region. ● Connects **Ladakh and Lhasa**. ● **Chinese** authorities have built a **road to join Xinjiang with Tibet**.
Khunjerab Pass	● **Kashmir** and **China** ● On the **Indo-China border**
Mintaka Pass	● **Kashmir and China** ● **Tri Junction** of **India-China** and **Afghanistan border**

2. Passes of Himachal Pradesh

Shipki La Pass	● Passes **through Sutlej Gorge.** ● **Connects Himachal Pradesh with Tibet.** ● **India's 3rd border post** for **trade with China** (Lipu Lekh and Nathula Pass)
Bara-Lacha Pass	● **Himachal Pradesh- Leh-Ladakh** ● Situated **on the National Highway** in Jammu and Kashmir. ● Connects **Manali and Leh**.
Debsa Pass	● Joins **Spiti and Parvati Valley.** ● **Between the Kullu and Spiti** of Himachal Pradesh. ● **Bypass** route of **Pin-Parvati Pass.**
Rohtang Pass	● **High road transportation**- high jams ● Connects **Kullu, Spiti, and Lahaul.**

3. Passes of Uttarakhand

Lipu Lekh	● Connects **Uttarakhand with Tibet.** ● **Important border post** for trade with China. ● The **pilgrims for Kailash-Manasarovar travel** through this pass.
Mana Pass	● Located in the **Greater Himalayas**. ● Connects **Tibet with Uttarakhand.** ● **Remains under snow for six months** during winter.
Mangsha Dhura Pass	● Connects **Uttarakhand-Tibet**. ● **Known for landslides**. ● **Pilgrims for Manasarovar** cross this route.
Muling La	● **Seasonal pass** ● Connects **Uttarakhand with Tibet** ● Snow covered during the winter season
Niti Pass	● **Joins Uttarakhand with Tibet.** ● Remains **snow-covered during the winter** season.
Traill's Pass	● Situated at the **end of the Pindari glacier**. ● Connects the **Pindari valley to Milam valley**. ● **Steep** and rugged.

4. Passes of Sikkim

Nathu La Pass	● Located on the **India- China border.** ● Forms a part of an **offshoot of the ancient silk route.** ● One of the **trading borders posts between India and China.**
Jelep La Pass	● Passes **through the Chumbi valley.** ● Connects **Sikkim with Lhasa**, the capital of Tibet.

5. Passes of Arunachal Pradesh

Bomdi-La	● Connects **Arunachal Pradesh-Lhasa**, the capital city of Tibet. ● Located in the **east of Bhutan.**
Dihang pass	● **Located** in the **Northeastern states of Arunachal Pradesh.** ● **Connects Arunachal Pradesh with Myanmar** (Mandalay)
Diphu pass	● An alternate route to **Myanmar.** ● **Remains open throughout the year** for transportation and trade.
Lekhapani	● **Remains open throughout** a year for transport and trade. ● Connects **Arunachal Pradesh with Myanmar**.
Pangsan Pass	Connects **Arunachal Pradesh and Myanmar**.

50 CHAPTER

Basics of Everyday Physics

Measurement

Scalar Quantities:

- **Definition:** Quantities that have only magnitude and no direction.
- **Examples:** Mass, temperature, speed, distance, energy.
- **Characteristics:** Described by a single value; can be added or subtracted using simple arithmetic.

Vector Quantities:

- **Definition:** Quantities that have both magnitude and direction.
- **Examples:** Velocity, force, displacement, acceleration.
- **Characteristics:** Represented by arrows; require vector addition for combining; direction is crucial in describing them.

Every measurement has two parts:

- The **first** is a **number** (n) and the **next** is **a unit** (u).
- **Q = nu.**
- **For Example**, the **length** of an **object** = **40 cm.**
- The **number expressing** the **magnitude** of a **physical quantity** is **inversely proportional** to the **unit selected.**
- **If n1** and **n2** are the **numerical values** of a **physical quantity** corresponding to the **units u1** and **u2,** then **n1u1 = n2u2.**
- **For Example,**
  - ✓ 2.8 m = 280 cm
  - ✓ 6.2 kg = 6200 g.

Fundamental Quantities

The **quantities** that are **independent of other quantities** are **called fundamental quantities.**

- The **units** that are **used** to **measure** these **fundamental quantities** are **called fundamental units.**
- There are **four systems** of **units namely**
  - ✓ C.G.S,
  - ✓ M.K.S,
  - ✓ F.P.S,
  - ✓ SI.
- The **quantities** that are **derived using** the **fundamental quantities** are **called derived quantities.**
- The **units** that are **used** to **measure** these **derived quantities** are **called derived units.**

Fundamental and Supplementary Physical Quantities in SI system

Fundamental Quantity	System of units		
	C.G.S.	M.K.S.	F.P.S.
Length	centimeter	Meter	foot
Mass	gram	Kilogram	pound
Time	second	Second	second

Physical quantity	Unit	Symbol
Length	Meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Intensity of light	candela	cd
Quantity of substance	mole	mol

SI Units

- **Most SI units** are **used** in **scientific research**.
- **SI** is a coherent **system of units.**

Cohenrent System Of Units

- A coherent system of units is **one in which** the **units of derived quantities** are **obtained** as **multiples or submultiples** of certain basic units.
- **SI system** is a **comprehensive**, **coherent** and **rationalized** M.K.S. Ampere system (RMKSA system) and was devised **by Prof. Giorgi.**
- **Meter:** A meter is **equal** to **1650763.73 times** the **wavelength** of the **light emitted** in **vacuum due to electronic transition** from 2p10 state to 5d5 **state in Krypton-86**.
  - ✓ But **in 1983, 17th General Assembly** of **weights and measures adopted** a **new definition** for the **meter** in **terms of velocity of light**.
  - ✓ According to this definition, a **meter** is **defined as** the **distance traveled** by **light in vacuum during** a **time interval** of 1/299, 792, 458 of a second.
- **Kilogram:** The **mass** of a cylinder of **platinum-iridium alloy** kept **in** the **International Bureau** of **weights** and **measures preserved** at Serves **near Paris** is **called one kilogram.**
- **Second:** The **duration** of **9192631770 periods** of the **radiation corresponding** to the **transition between** the **two hyperfine levels** of the **ground state** of **cesium-133 atoms** is **called one second.**
- **Ampere:** The **current** which **when flowing** in **each** of **two parallel conductors** of **infinite length** and **negligible cross-section** and placed **one meter apart** in vacuum, **causes** each **conductor** to **experience** a **force** of **2 × 10-7 newtons per meter** of length **is known** as **one ampere.**
- **Kelvin:** The **fraction** of **1/273.16** of the **thermodynamic temperature** of the **triple point** of **water** is **called Kelvin.**
- **Candela:** The **luminous intensity** in the **perpendicular direction** of a **surface** of a **black body** of area **1/600000 m2** at the **temperature** of **solidifying platinum** under a **pressure of 101325 Nm-2** is known as **one candela.**

- **Mole:** *The* ***amount*** *of a* ***substance*** *of a* ***system*** *which* ***contains*** *as* ***many elementary entities*** *as there are* ***atoms*** *in* ***12 × 10-3 kg*** *of* ***carbon-12*** *is known as* ***one mole.***

- **Radian:** *The* ***angle made*** *by an* ***arc*** *of the* ***circle equivalent*** *to its* ***radius*** *at the* ***center*** *is known as* ***radian.***
  - ✓ ***1 radian = 57 °17 ' 45 ".***
- ***Derived SI units with Special Names:***

Physical quantity	***SI unit***	***Symbol***
Frequency	*hertz*	*Hz*
Energy	*joule*	*J*
Force	*newton*	*N*
Power	*watt*	*W*
Pressure	*pascal*	*Pa*
Electric charge or quantity of electricity	*coulomb*	*C*
Electric potential difference and emf	*volt*	*V*
Electric resistance	*ohm*	*Ω*
Electric conductance	*siemen*	*S*
Electric capacitance	*farad*	*F*
Magnetic flux	*weber*	*Wb*
Inductance	*henry*	*H*
Magnetic flux density	*tesla*	*T*
Illumination	*lux*	*Lx*
Luminous flux	*lumen*	*Lm*

Important Measuring Instruments

Instrument	***Function***
Micrometer	*Measures small dimensions with high precision (typically in the range of microns).*
Vernier Caliper	*Measures internal and external dimensions, as well as depth and step measurements.*
Anemometer	*Measures the speed and velocity of wind or airflow.*
Balance (Analytical)	*Measures the mass of objects with high precision.*
Voltmeter	*Measures the potential difference (voltage) between two points in a circuit.*
Ammeter	*Measures electric current in a circuit.*

Manometer	Measures the pressure of gases or liquids.
Seismometer	Detects and measures seismic waves caused by earthquakes or other ground motion.
Hygrometer	Measures the humidity level in the air.
Sphygmomanometer	Measures blood pressure.
Spectrophotometer	Measures the intensity of light absorbed by a sample at various wavelengths.
Tachometer	Measures the speed of rotation of an object (e.g., engine RPM).
Lux Meter	Measures light intensity in an area.
Altimeter	Measures altitude, typically in aviation and mountainous regions.
Pulse Oximeter	Measures oxygen saturation in blood.

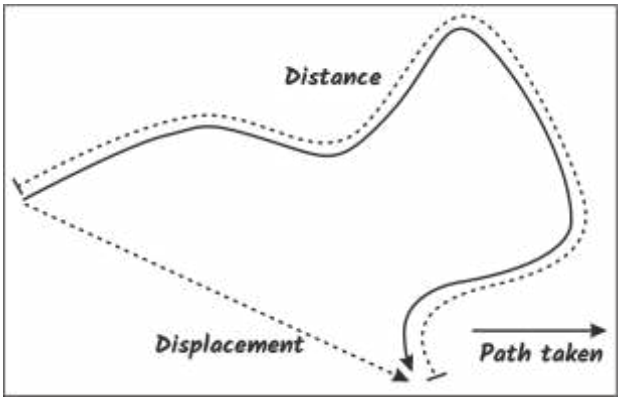
Everyday Equipments and Physics behind them

Equipment	Physical Phenomenon
Stethoscope	Reflection of sound
Remote Control	Infrared Radiation
Microwave oven	Electromagnetic Waves
Refrigerator	Thermodynamics
Washing Machine	Centrifugal Force
Electric Fan	Electromagnetic induction
Light Bulb	Incandescence
Smartphone	Radio Waves, Touch sensitivity
Television	Electromagnetic Waves
Air Conditioner	Refrigeration Cycle
Electric Kettle	Electrical Resistance Heating
Camera	Optics (Lens Focusing)
Speaker	Electromagnetic Induction
Hair Dryer	Convection Heating
Computer	Semiconductor Electronics
Photovoltaic cell	Solar energy (Photoelectric Effect)

Motion

- **An object** is said to be **in motion if** it **changes** its **position with time**.
- A **body which does not move** is said to be at **rest**, **motionless**, or **stationary**.
- An **object's state of motion** or rest cannot **change unless** it is **acted upon** by a **force**.
- **Described in** terms of **displacement**, **velocity**, and **displacement**.

Displacement



- ***Shortest distance from** the **initial to** the **final position** of the object.*
- ***Represents** the **length** and **direction of** the **straight path**.*
- ***Vector quantity** as it has **both magnitude** and **direction***

Distance

- ***Scalar quantity** measuring only the length of path.*

Velocity

- ***Speed in a given direction.***
- ***Describes** only **how fast** an **object** is **moving** and **direction** of object's **motion***
- *A **vector quantity**.*
- ***Unit** - meter per second (m/s).*

Acceleration

- ***Rate of change of velocity with time.***
- ***Rate** at which an **object speeds up** or **slows down**.*
- ***Positive Acceleration:** If the object speeds up.*
- ***Negative Acceleration:** If the object slows down.*
- *A **vector quantity**.*
- ***SI unit:** meter per second squares (m/s2).*

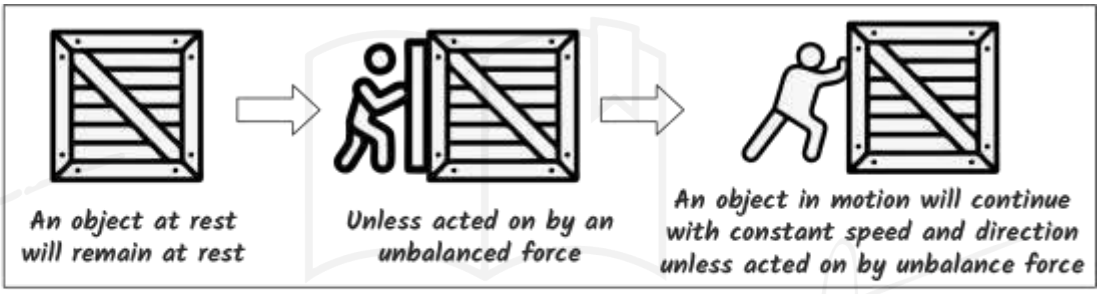
Types of Motion

Oscillating Motion	➢ ***Back** and **forth oscillation** causes this motion* ➢ *If a **thing repeats** the **motion cycle** after a certain period is considered to be oscillating.* ➢ ***Example:** sprinkler system, the pendulum of a clock ,sound waves.*
Linear Motion (Uniform + Non Uniform)	➢ ***Straight Line Path**: The motion occurs along a straight line (either uniform or non-uniform).* ➢ ***Velocity**: In uniform linear motion, velocity remains constant, while in non-uniform motion, velocity changes.* ➢ ***Acceleration**: In uniform motion, acceleration is zero, while in non-uniform motion, acceleration may be constant or variable.*
Uniform motion:	➢ ***Constant Speed**: The object moves at a constant speed along a straight path.* ➢ ***Equal Distance in Equal Time**: The object covers equal distances in equal intervals of time.* ➢ ***No Acceleration**: There is no change in the velocity or direction of motion.*

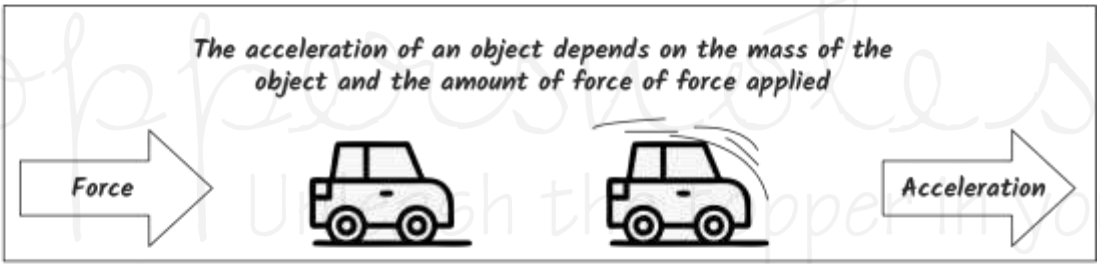
Non-uniform motion:	➢ **Varying Speed**: The speed of the object changes continuously over time. ➢ **Unequal Distance in Equal Time**: The object covers unequal distances in equal intervals of time. ➢ **Acceleration/Deceleration**: The object may speed up (acceleration) or slow down (deceleration) during its motion.
Circular Motion	➢ **Motion along a Circular Path:** The object moves along a circle, maintaining a constant distance from a fixed point (center). ➢ **Centripetal Force:** A force acts towards the center of the circle to keep the object in its circular path. ➢ Constant Speed, Changing Velocity: The object may move at a constant speed, but its direction constantly changes, so velocity is not constant.

Laws of Motion

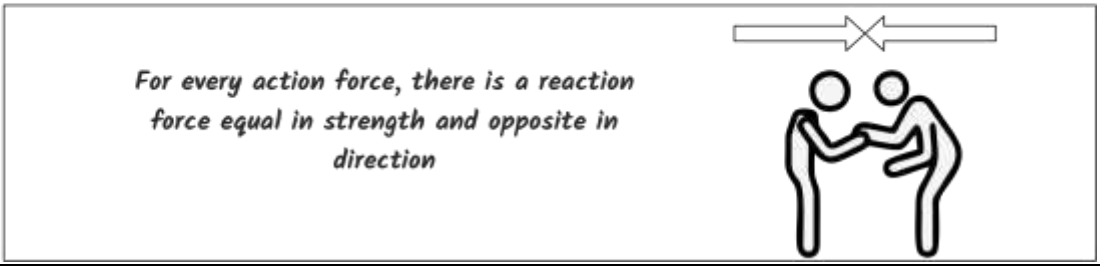
Newton's First Law of Motion



Newton's Second law of Motion



Newton's Third law of Motion



Inertia:

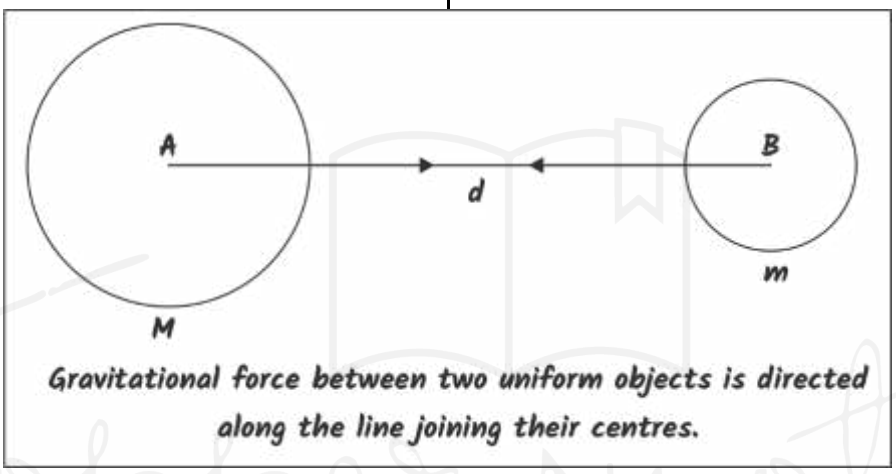
- **Resistance** of any physical object **to any change in its velocity.**
- **Includes changes** to the **object's speed**, or **direction** of **motion**.
- **Tendency of objects** to **keep moving** in a **straight line** at a **constant speed** or to **remain** in state of **rest** when **no forces act** upon them, according to the first law of motion.

Gravity

- **Force** that **attracts** a **body towards centre** of earth, or **towards any other physical body** having mass.
- **Every object** that has **mass exerts** a **gravitational pull** or force on every other mass.
- **Strength** of this pull **depends on** the **masses** of **objects**
- **Gets weaker** with **distance**.
- **Keeps planets in orbit** around sun and moon around the Earth
- **First discovered** in 1687 by Sir Isaac **Newton**.

Universal law of gravitation:

- **Every object** in the universe **attracts** every **other object with a force** which is **proportional to** the **product** of their **masses** and **inversely proportional** to the **square** of the **distance** between them.
- The **force** is **along** the **line joining** the **centres** of **two objects**.



Gravitational force between two uniform objects is directed along the line joining their centres.

Formula:

$$F = \frac{G \times M \times m}{d^2}$$

- Here M and m = masses of the objects interacting
- d- distance between the center of the masses
- G -gravitational constant (6.674×10^−11 m3·kg−1·s−2)

Free Fall due to Gravity

Free fall: Motion of an object under the influence of gravity alone, with no air resistance.

Acceleration due to gravity (g): Constant at 9.8 m/s29.8 \, \text{m/s}^29.8m/s2 near Earth's surface, independent of mass.

Mass: The acceleration in free fall does not depend on the mass of the object.

Dropped object: Initial velocity (uuu) is zero when dropped from a height.

Thrown upwards: Final velocity (vvv) becomes zero at the highest point of the upward motion.

Same acceleration: All objects near Earth's surface experience the same acceleration due to gravity.

Energy

- **Capacity** of a body **to do work.**
- **SI unit:** Joule (J).

Forms of Energy

Kinetic Energy: Energy possessed by an object due to its motion.

Potential Energy: Energy stored in an object due to its position or state.

Thermal Energy: Energy related to the temperature of an object, due to the motion of its particles.

Chemical Energy: Energy stored in chemical bonds, released during chemical reactions.

Electrical Energy: Energy from the movement of electrons through a conductor.

Nuclear Energy: Energy stored in the nucleus of atoms, released during nuclear reactions.

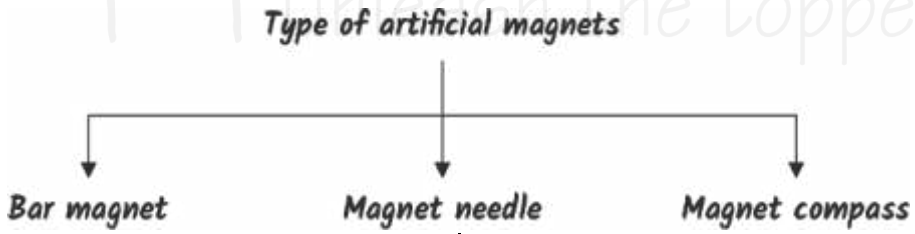
Radiant (Light) Energy: Energy carried by electromagnetic waves, including light.

Conversion from one form to another

Energy Conversion	Instrument	Energy Form Converted
Kinetic → Potential	Elevators, Waterfalls	Kinetic to Potential Energy
Potential → Kinetic	Falling Object, Pendulum	Potential to Kinetic Energy
Chemical → Thermal	Stove, Combustion Engine	Chemical to Thermal Energy
Electrical → Thermal	Electric Heater, Toaster	Electrical to Thermal Energy
Electrical → Mechanical	Electric Motor, Fan	Electrical to Mechanical Energy
Mechanical → Electrical	Generator, Dynamo	Mechanical to Electrical Energy
Radiant → Chemical	Photosynthesis (in plants)	Radiant to Chemical Energy
Mechanical → Sound	Loudspeaker, Bell	Mechanical to Sound Energy

Magnetism

Magnet:



- An **object that attracts objects** made **of iron**, **cobalt** and **nickel**.
- **Use**:
  - ✓ in refrigerators.
  - ✓ in radio and stereo speakers.
  - ✓ in audio and video cassette players.
  - ✓ in children's toys and;
  - ✓ on hard discs and floppies of computers.
- **Properties**:
  - ✓ A **freely suspended magnet** always **points** towards **north** and **south** direction.
  - ✓ **Pole** which points **toward north** direction **–north pole**.
  - ✓ **Pole** which points **toward south** direction – **south pole**.
  - ✓ **Like poles repel** each other while **unlike poles attract** each other.