



IB

Security Assistant/Executive

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Volume - 1

General Awareness & Science



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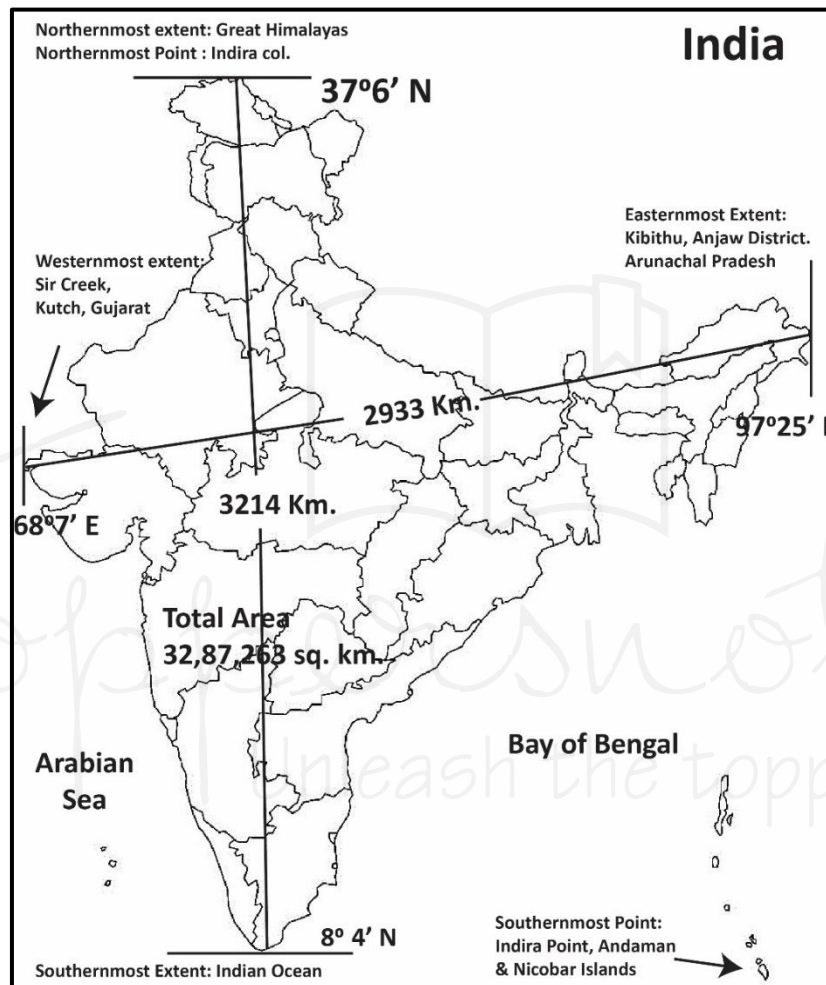
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CHAPTER

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 and 1 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)

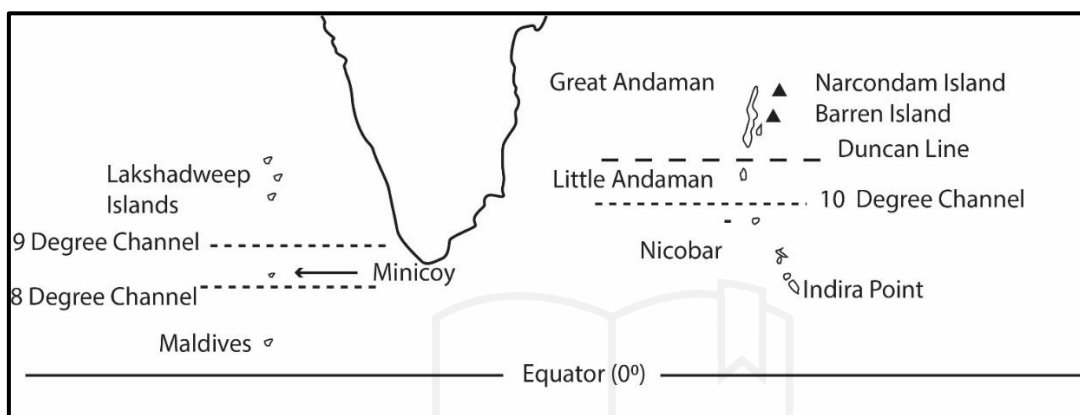
Nepal	5 States: Uttar Pradesh, Bihar, Uttarakhand, Sikkim, West Bengal (1751km)
Myanmar	4 States: Arunachal Pradesh, Manipur, Mizoram, and Nagaland (1643 km)
Bhutan	4 States: Arunachal Pradesh, Assam, Sikkim, and West Bengal (699 km)
Afghanistan	1 UT: Ladakh (106 km)

- **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.

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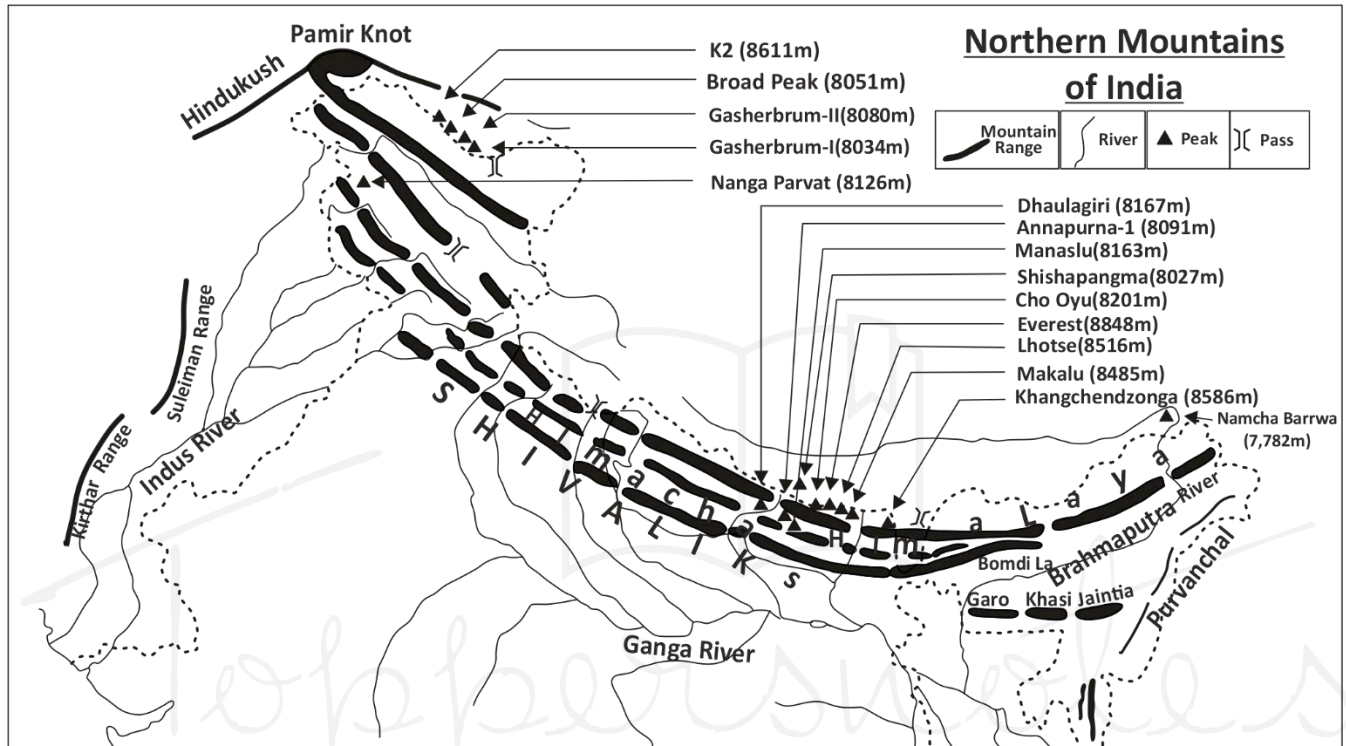
CHAPTER

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

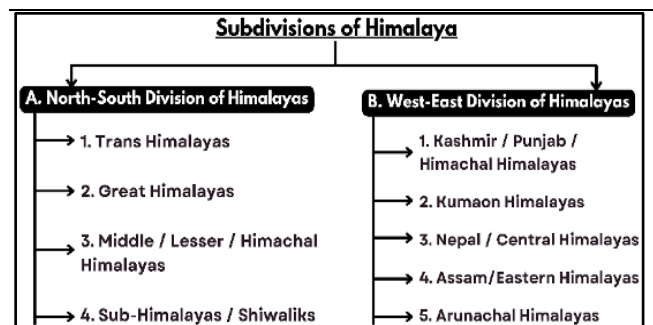
1. Himalayan Mountains



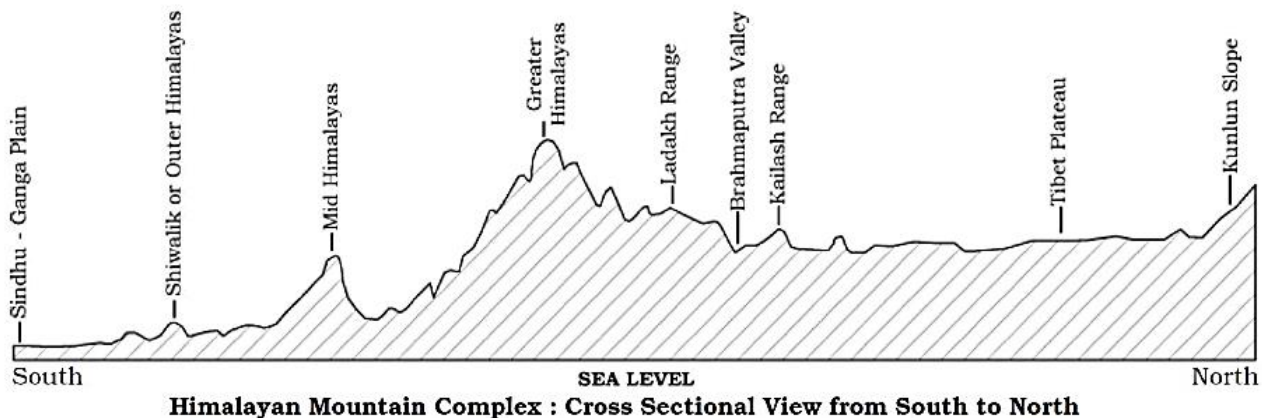
- **Highest and the youngest fold mountain ranges** of the world.
- **One of the highest earthquake-prone regions** of the world.
- **Length:** runs **west-northwest to east-southeast** in an arc **2,500 km long**.
 - **Western anchor:** **Nanga Parbat** (lies just south of the northernmost bend of the 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



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 Zaskar from Ladakh.

- **Average height** - about 6,000 m.
- Acts as a **climatic barrier** protecting **Ladakh and Zaskar from monsoon**
- **Major passes-** Marbal Pass, Zojila Pass - extreme northwest.
- **Major rivers-** Hanle River, Khurna River, Zaskar 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, Dopsang 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. Middle/ Lesser/ Himachal Himalaya:

- **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** - Dhauladhar 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**.

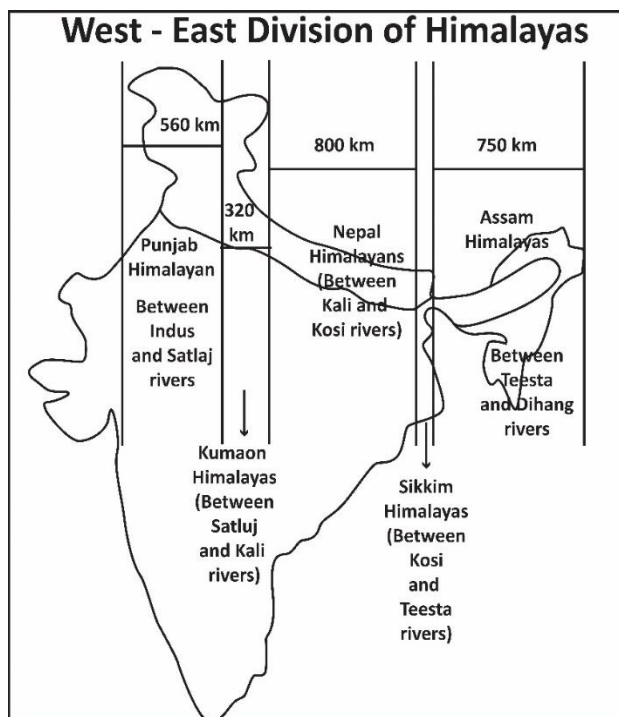
Important ranges of Lesser Himalayas	Region
Pir Panjal Range	Jammu and Kashmir (south of Kashmir Valley)
Dhauladhar Range	Himachal Pradesh
Mussoorie Range and Nag Tibba Range	Uttarakhand
Mahabharat Range	Nepal

4. Sub-Himalayas/ Shiwaliks:

- 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

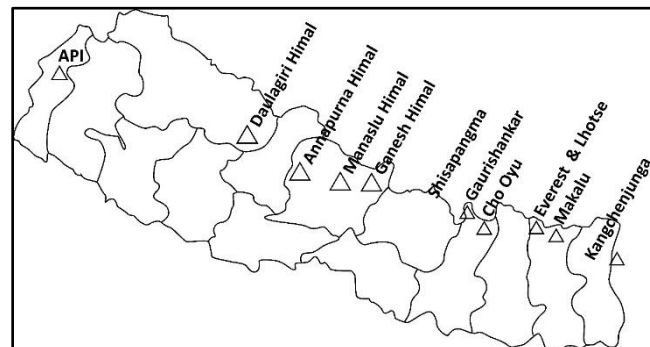
- Located **between Indus and Satluj gorge**
- **Length**- 560 kms
- **Width** - 320 kms
- **Zaskar range** - northern boundary and **Shiwaliks** - Southern boundary
- **Characterized by** ridge and valley topography (Kashmir Valley is the syncline basin) formed by the Lacustrine deposits (**Karewas**- 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:**

Dafila 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 Lakh 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 Lakh	- 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.
Trail'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

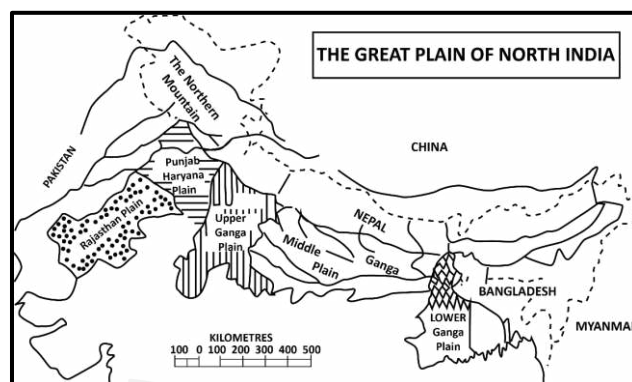
Bomdi-La	- Connects Arunachal Pradesh- Lhasa, the capital city of Tibet. - Located in the east of Bhutan.
Dihang pass	- Located in the Northeastern states of Arunachal Pradesh. - Connects Arunachal Pradesh with Myanmar (Mandalay)
Diphu pass	- An alternate route to Myanmar. Remains open throughout the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

Yonggyap Pass	Connects Arunachal Pradesh with Tibet
Kumjawng Pass	Connects Arunachal Pradesh with Myanmar
Hpungan Pass	Connects Arunachal Pradesh with Myanmar
Chankan Pass	Connects Arunachal Pradesh with Myanmar
Tuju Pass: • Manipur. • Connects Imphal to Myanmar.	

2. Great Plains of India

- Lie to the **south of Shiwalik** separated by the Himalayan Front Fault (HFF).
- A **transitional zone between the Himalayas and Peninsular India.**
- **Aggradation plain** formed by **alluvial deposits of the Indus, Ganga, Brahmaputra** and their tributaries.
- Stretches for about **2400 km from west to east.**

- **Width-** 90-100 in Assam, 160 km near Rajmahal (Jharkhand), 200 km in Bihar, 280 km near Allahabad and 500 km in Punjab. (Increases from east to west.)
- **Consists largely of alluvial deposits** brought down by rivers of the Himalayan and the Peninsular region.
 - **Maximum depth > 8000 metres** - Ambala, Yamunanagar and Jagadhri (Haryana).
- Merges into the **Thar Desert** in the **southwest.**
- A **low watershed of the Delhi ridge (278 m) + Yamuna River separates the Satluj plains** (a part of the Indus plain) from the **Ganga plains.**



Divisions of the Great Plains

A. North-South Division of Great Plains of India

1. Bhabar	• Along the foot of Siwaliks with remarkable continuity from Indus to Tista. • 8-16 km wide belt consisting of gravel and unsorted sediments • Deposited by Himalayan rivers in the foreland zone due to sudden slope break. • Himalayan rivers deposit their loads along the foothills in the form of alluvial fans. ◦ Coarser sediments merged to build up piedmont plain/ Bhabar. • Most unique feature - porosity. ◦ Porous due to the deposition of a huge number of pebbles and rock debris across the alluvial fans. ◦ Not suitable for agriculture • Comparatively narrow in the east
2. Tarai	• 10-20 km wide marshy region in the south of Bhabar and runs parallel to it. • Wider in eastern parts of the Great Plains - Brahmaputra valley due to heavy rainfall. • Re-emergence of underground streams of the Bhabar belt • Most of Terai land (especially in Punjab, Uttar Pradesh and Uttarakhand) has been reclaimed and turned into agricultural land over some time. • Receives high rainfall and has excessive humidity. • Has underground streams → ground marshy. • Suitable for wheat, maize, rice, rice, sugarcane, etc.
3. Khadar	• Younger alluvium of flood plains of numerous rivers • Also known as Bet/betlands (in Punjab). • Contains new alluvial deposits along the course of the river. • Alluvium – light-coloured and poor calcareous matter consisting of sand, silt, mud and clay deposits. • Suitable for extensive cultivation. • Rivers in the Punjab-Haryana plains have broad floodplains of Khadar flanked by bluffs known as Dhayas.
4. Bangar or Bhangar Plains	• Uplands (alluvial terrace) formed by deposition of older alluvium. • Lies above the flood limit of the plains. • Main constituent: clay. • Rich in humus - high yield.

	● Contains Calcium Carbonate nodules known as 'Kankars' - impure and found in doabs ● Regional variations: ○ Barind plains- the deltaic region of Bengal ○ Bhur formations - middle Ganga and Yamuna doab. ○ 'Reh', 'Kollar' or 'Bhur' - Drier areas- exhibit small tracts of saline and alkaline efflorescence.
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B. Regional Classification of Great Plains

1. Sindh Plain

- Lies in **Pakistan**
- Mainly **formed of** the **Bhangar Plains**.
- **Dhors**: **Long narrow depressions** - remnants of the course of **former rivers**.
- **Dhand**: **Alkaline lakes** on some **Dhors**.

2. Rajasthan Plains

- **Occupied by Thar Desert**.
- An **undulating plain** (average elevation - 325 m above mean sea level).
- **Desert region known as Marusthali** forms a greater **part of the Marwar plain**.
- Has a few outcrops of **gneisses, schists** and **granites**
 - Proof that it is **geologically a part of the Peninsular Plateau**.
- **Eastern part is rocky**, while the **western part** has **shifting sand dunes**.
- **Eastern part of Thar Desert till Aravalli Range - Rajasthan Bangar**- semi-arid plain.
- **Drained by several short seasonal streams** from the Aravali and **supports agriculture** in some patches of fertile tracts.
- **Luni** – a significant **seasonal stream** which **flows into Rann of Kutch**.
- **Tract north of Luni** - **thali** or sandy plain.

3. Punjab Plain

- Form the **western part of northern plain**.
- Majorly in **Pakistan**.
- **Divided into many Doabs**. Formed by **5 important rivers** of the Indus system.
- **Literally means** "(The Land of Five Waters" referring to: **Jhelum, Chenab, Ravi, Sutlej, and Beas**.

Sindh Sagar Doab	between the Indus and Jhelum rivers.
Jech Doabs/ Chaj Doab	between the Jhelum and Chenab rivers.
Rechna Doab	between the Chenab and Ravi rivers.

Bari Doabs	between the Ravi and Beas rivers.
Bist Doab	between the Beas and Sutlej rivers.

- **Total area** - 1.75 lakh sq km.
- **Average elevation** - 250 m above mean sea level.
- **Eastern boundary** - Delhi-Aravali ridge.
- **Northern part** [Shivalik hills] is **intensively eroded** by numerous **streams** called **Chaos**.
 - Resulted in **enormous gullying**.
- **South of Satluj river** - **Malwa plain** of Punjab.
- **Area between the Ghaggar and Yamuna rivers** - '**Haryana Tract**'.
 - **Water divide** b/w **Yamuna and Satluj** rivers.

Other Doabs of India:

- **Malwa Doab**: Covers **Madhya Pradesh** and parts of north-eastern **Rajasthan**.
- **Raichur Doab**: A triangular region of **Andhra Pradesh** and **Karnataka** lying between **Krishna** and its tributary **Tungabhadra River**.

4. Ganga Plain

- **Extend from Yamuna River** in west to **western borders of Bangladesh** (~ 1,400 km).
- **Average width** - 300 km.
- **Maximum height** - **Saharanpur** (276m) - decreases towards **Sagar Islands** (3 m).
- **Largest unit of Great Plain** of India - from **Delhi to Kolkata** (about 3.75 lakh sq km).
- **Major Himalayan river**- **Ganga**.
- **Peninsular rivers** - **Chambal, Betwa, Ken, Son**, etc. (join **Ganga river system** - contribute to formation of this plain).
- **Slope** - east and south east.
- **Rivers flow sluggishly in lower sections of Ganges** resulting in **levees, bluffs, oxbow lakes, marshes, ravines**, etc.
- **Rivers keep shifting their courses** making this area **prone to frequent floods**.
 - **Kosi river**- '**Sorrow of Bihar**'.

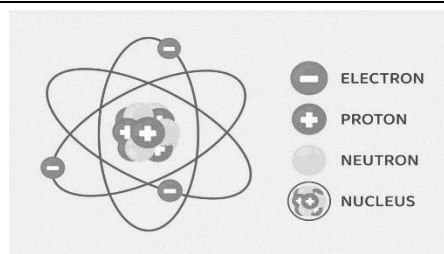
47 CHAPTER

Chemistry

Atomic Structure

Fundamental Constituents of an Atom

- An atom contains **three basic particles** namely protons, neutrons and electrons.
- The **nucleus** of the atom contains **protons** and **neutrons**.
 - Protons** are **positively charged**.
 - Neutrons** are **neutral**.
- The **electrons** are located at the **outermost regions** called the **electron shell**.

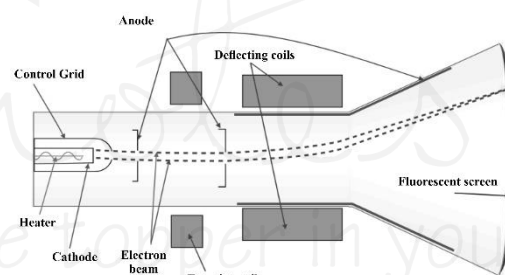


Electron

- J. J. Thomson**, in **1897**, discovered **negatively charged particles** emitted by the **cathode** towards the anode in a cathode ray experiment.
- These **negatively charged** particles are **Electrons**.

Cathode ray experiment

- J. J. Thomson** discovered the **existence of electrons**.
- He did this using a cathode ray tube, which is a **vacuum-sealed tube** with a **cathode** and **anode** on one end that created a **beam** of electrons travelling towards the other end of the tube.
- The air inside the **chamber** is subjected to **high voltage** and **electricity** flows through the air from the **negative electrode** to the **positive electrode**.
- The **characteristics** of cathode rays (electrons) **do not depend** upon the **material of electrodes** and the **nature** of the **gas** present in the cathode ray tube.
- The experiment showed that the **atom** was **not a simple, indivisible particle** and contained **at least one subatomic particle** – the electron.



Protons

- Ernest Goldstein**, in 1886, discovered that with a different condition in the same chamber, **anode** emitted **positively charged particles** known as **Canal rays** or later named as **Protons**.

Neutrons

- J. Chadwick** discovered a subatomic particle with **no charge** and a **mass** equivalent to **protons** in the nucleus of all atoms.
- These **neutrally charged** particles are **Neutrons**.

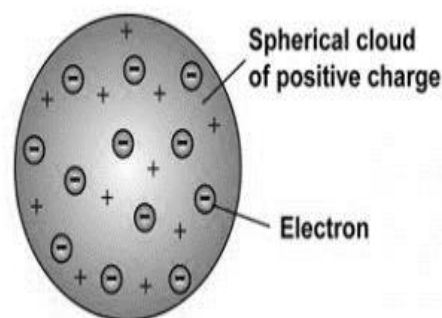
Properties of electrons, protons, and neutrons

Property	Electrons	Protons	Neutrons
Charge	Negatively Charged	Positively Charged	No Charge
Affinity	Attracts to positively charged	Attracts to negatively charged	Get attracted neither to positive nor negative
Weight	Mass is negligible	1 a.m.u	1 a.m.u
Location	Outside the nucleus	Within the nucleus	Inside the nucleus

Different Models on Structure of an Atom

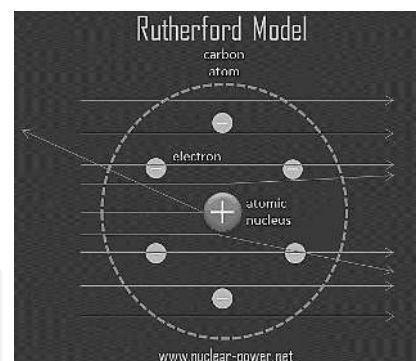
Thomson's Model of an Atom

- **J. J. Thomson** proposed that the structure of an atom is similar to that of a **Christmas pudding** where electrons are embedded like currants in the sphere.
- He **proposed** that:
 - The **structure** of an **atom** is a **positively charged sphere** that embeds electrons in it
 - An atom is **electrically neutral** as the **protons** and **electrons** are **equal** in magnitude
- **Drawbacks** of Thomson's Model:
 - Thomson's structure of an atom **failed** to **explain** the **arrangement** of **protons** and **electrons** in its structure.



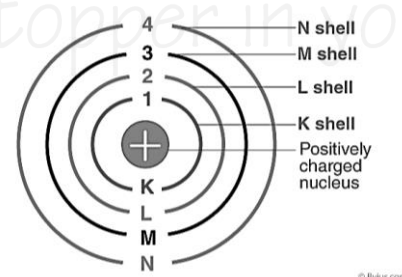
Rutherford's Model of an Atom

- **Rutherford** conducted an experiment **bombarding** the **alpha (α)-particles** on a **gold foil**.
- He observed the **trajectory** of the **alpha (α)-particles** after passing through an atom and **drafted** some **postulates** of the experiment, which are:
 - **Most** of the **space** in an **atom** is **empty** as the **particles** **passed** through the **gold foil** without any **hindrance**
 - The **positively charged centre** is called the **Nucleus**, and all the **mass** of an atom **resides** in the **centre**.
 - The particles **deflected 180°** after **bombarding** the **nucleus**
 - The **electrons orbit** the centre in a **defined path**
 - The **size** of the **nucleus** is **small** compared to the total size of the atom
- **Drawbacks** of the Model:
 - Although **Rutherford** presented an **entirely new model** regarding the structure of the atom, there were a lot of drawbacks which he failed to explain, are-
 - The **electrons revolve** in an **unstable path**, and they undergo **acceleration radiating energy**.
 - When the **electrons revolve**, they **lose energy**.
 - Soon electrons would **collapse** into the **nucleus**.
 - This tendency would make an **atom highly unstable** while the **atom** is **highly stable**
 - Rutherford's structure of an atom **failed** to **explain** the **atomic number** concept as it explained only the presence of protons in the nucleus



Bohr's Model of an Atom

- Bohr devised a model in order to **overcome** the **objections** that **Rutherford's model** raised.
- So, he stated the following **postulates**:
 - An atom **permits** only a **discrete** amount of **orbitals** for the **electrons** to **orbit** and make the outer structure of an atom
 - While revolving, the **negatively charged particles** do **not lose energy** in these **orbitals** or **energy levels**
 - When the **electron jumps** from **one energy shell** to **another**, a change in magnitude takes place
- Bohr's model gives an **elaborative explanation** on the structure of an atom and **overcomes** the **objections** faced by all the other models on the structure of an atom.



Distribution of Electrons in Distinct Shells

- Bohr-Bury Scheme **suggested** the **arrangement** of **particles** in **different orbits**.
- The following are the rules to write the number of particles in different orbitals:
 - The formula $2n^2$ gives the accommodation of the **maximum number of electrons** in each shell, $n=1, 2, 3, 4$ for $K=2, L=8, M=18, N=32$.
 - The **outermost orbit** can hold a **maximum of 8 electrons**.
 - The electrons fill the inner levels first as they **follow** the **stepwise filling of orbitals**
- **Number of electrons in K-shell:** $n = 1$
 - $2n^2 = 2 \times 1^2 = 2$
 - Maximum number of electrons in K-shell, first shell = 2

- **Number of electrons in L-shell, $n = 2$,**
 - $2n^2 = 2 \times 2^2 = 8$
 - Maximum number of electrons in L-shell, Second shell = 8
- Using the **formula $2n^2$** number of **electrons** in any shell can be **calculated**.

Valency

- **Valence Electrons** - The negatively charged particles present in the outermost shell.
 - These valence electrons are **responsible** for the **valency** of an atom.
- **Valency** - tendency of an atom to react with the other atoms of the same or various elements.
 - The atoms that fill the **outermost paths** show **chemical activity** towards other valence electrons.
 - This reactivity is **responsible** for the **formation** of **molecules** between two or more atoms.
- The valency **becomes zero** for an **atom** when the **outer bounds** have **eight electrons** or **no electrons** to lose.
- The particle with **eight electrons** in the **outermost shell** is an octet, and these molecules are **mostly inert** in nature.
- **Eg:**
 - **Magnesium** (Mg) has a configuration (2, 8, and 2), so the valency is two.
 - **Oxygen** (O) (2, 8, and 6) has the valency two as the number electrons it can gain is two to achieve a packed outer energy level.
 - **Helium** (He) has 2 electrons in its outer shell, Neon (Ne) (2, 8, and 8) has eight electrons in its outer shell.
 - Hence, they do not show any chemical activity.

Atomic Number (Z)

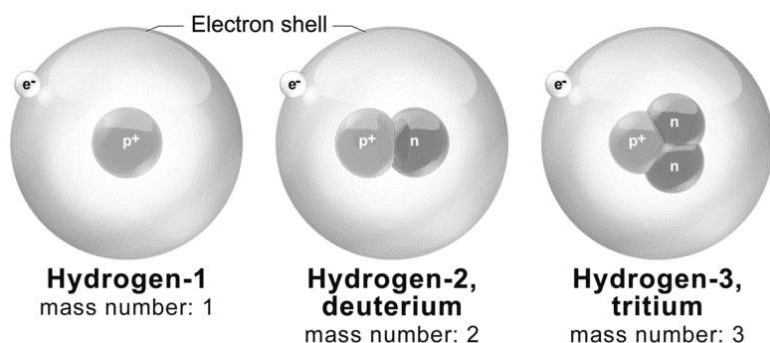
- Atomic number = **number of protons** present in one atom of an element.
- As the atom is **electrically neutral**, the number of **protons** and **electrons** are the same.
- The notation **Z** denotes an **Atomic number**.
- The atomic number of Hydrogen is one as it has **only one proton**.
 - **Number of Protons** present in an atom = Atomic number (Z)
 - **Number of Electrons** present in an atom = Atomic number (Z)
 - **Number of Neutrons** = Mass number (A) - Atomic number (Z)

Mass Number (A)

- Measure of the **total** number of **protons** and **neutrons** in the nucleus of an atom.
- The notation **A** indicates the Mass number.
- **N** = total number of **neutrons**.
- Mass Number = **Atomic Number + Number of Neutrons** in the Nucleus
 - $A = Z + n^0$
- aka **Nucleon** number.

Isotopes

- The atoms of the **same elements** with the **same atomic number** and **different mass numbers**.
- **Hydrogen** has **three isotopes**: *Protium, Deuterium, Tritium*.



Isobars

- The atoms of **different molecules** with the **same mass number**.
- **Eg**, in **Calcium**, atomic number 20, and **argon**, atomic number 18, the mass number of both these elements is 40.
 - This shows that the total number of **nucleons** is the **same** in the atoms.

Metals, Non- metals and Metalloids

Metalloids

- Elements which have the properties of both metals and non-metals are known as metalloids.
 - For example, Boron, Arsenic, etc.

METALS

Physical Properties

- Solid.
- Lustrous.
- Malleable and ductile.
- Hard and have high density.
- Good conductors of heat and electricity.
- High melting and boiling points.

Chemical Properties

- React with dilute acids to liberate hydrogen gas
- React with oxygen to form basic oxides.
- Do not combine with hydrogen.
- React with water to form metal oxides or metal hydroxides.
- Electropositive i.e. form positive ions by losing electrons.
- Reducing agents.

Corrosion

The eating up of metals by the action of air and moisture or a chemical on their surface.

Alloys

It is a homogeneous mixture of two or more metals (or a metal and a non-metal). For e.g. Brass is an alloy of 2 metals-copper and zinc.

Ionic Compounds

- Usually crystalline solids.
- Have high melting point and boiling point.
- Conduct electricity when dissolved in water or melted.
- Usually soluble in water and insoluble in organic solvent.

NON-METALS

Physical Properties

- Solids, liquids and gases.
- Non-lustrous.
- Non-malleable and non-ductile.
- Varying hardness and have low density.
- Poor conductors of heat and electricity.
- Low melting and boiling points.

Chemical Properties

- Do not displace hydrogen on reaction with dilute acids.
- React with oxygen to form acidic or neutral oxides
- Combine with hydrogen to form stable hydrides.
- Do not react with water.
- Electronegative i.e. form negative ions by gaining electrons.
- Oxidising agents.

Rusting

The corrosion of iron is known as rusting. Rust is hydrated iron (III) oxide, $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$.

Presence of air and water are the two conditions necessary for rust. It can be prevented by painting, applying grease, by galvanization and by alloying.

Covalent Compounds

- Usually liquids / gases, few are solids.
- Have low melting and boiling point.
- Do not conduct electricity.
- Usually insoluble in water and soluble in organic solvents.

METALS AND NON-METALS

Table 5.6 Modern Periodic Table

Metals																		Non-metals										metals from the 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The zigzag line separates the metals from the non-metals.

Properties of Metalloids

- They have a metallic luster but behave like non-metals.
- They are brittle, shiny substances
- They are solid at ambient temperatures and have relatively high melting points.

Melting Temperatures of Metalloids

Element	Melting Temperature (°C)
Boron	2079
Silicon	1410

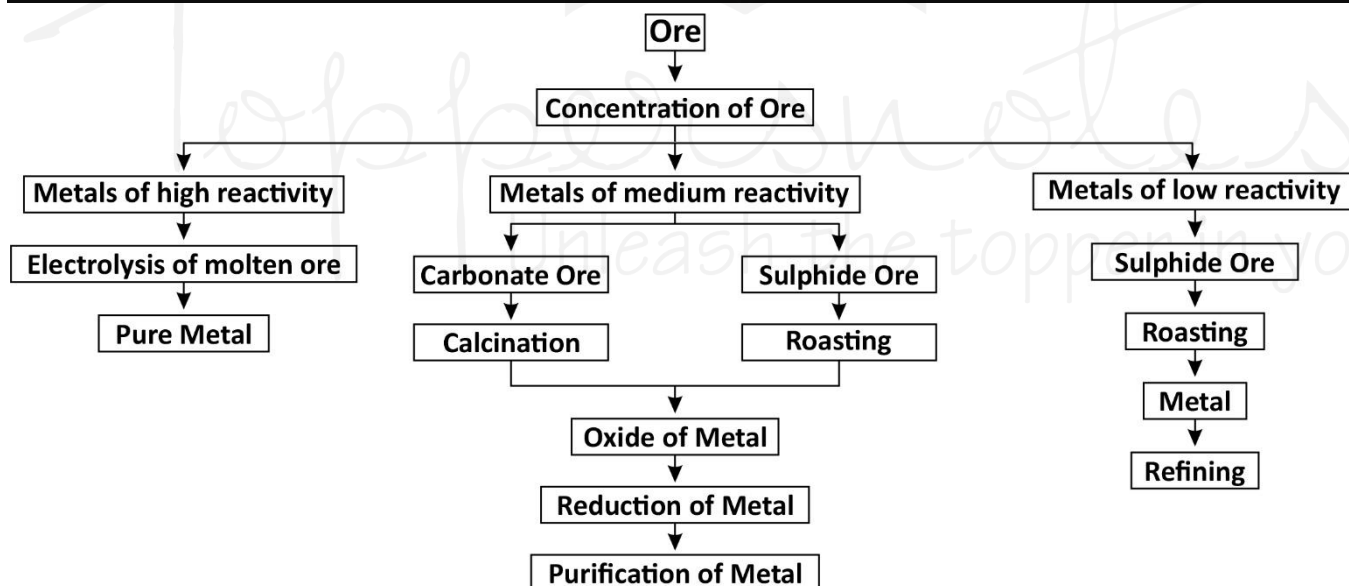
Germanium	938.3
Arsenic	817
Tellurium	449.5
Antimony	631

- They are good electric conductors but poorer than metals.
- They have intermediate energies of ionisation and values of electronegativity
- Like non-metals, they form anions, have multiple oxidation states, and form covalent bonds
- They form metallic alloys.

Metalloids and their applications

Element	Description	Application
Boron	An allotropic semimetal that is extremely hard and heat resistant. Has an atomic number of 5.	Used with silicon to make thermal shock-resistant glass.
Silicon	A grey and shiny semiconductive metal. It has high melting (1,410 °C) and boiling points (3,265 °C). Has an atomic number of 14.	Commonly used for semiconductors.
Germanium	Is hard and brittle in its elemental form. Has an atomic number of 32.	Less commonly used for semiconductors.
Arsenic	A steel-grey semimetal known for being poisonous. It has an atomic number of 33.	Often used as an insecticide.
Tellurium	Brittle in its elemental form. It is a chalcogen, along with selenium and sulfur. It has an atomic number of 52.	Used as a steel additive to improve machinability.
Antimony	A hard and brittle semimetal with an atomic number of 51.	Used to colour paints; often alloyed with lead.

Metallurgical Principles and methods



- **Metallurgy** - a process that is used for the extraction of metals in their pure form.
- **Minerals** - The compounds of metals mixed with soil, limestone, sand, and rocks.
- Metals are **commercially extracted** from **minerals** at **low cost** and minimum effort.
 - These minerals are known as **ores**.
- A **substance** which is added to the **charge** in the **furnace** to remove the **gangue** (impurities) is known as **flux**.
- Metallurgy **deals** with the **process** of **purification** of **metals** and the **formation** of **alloys**.

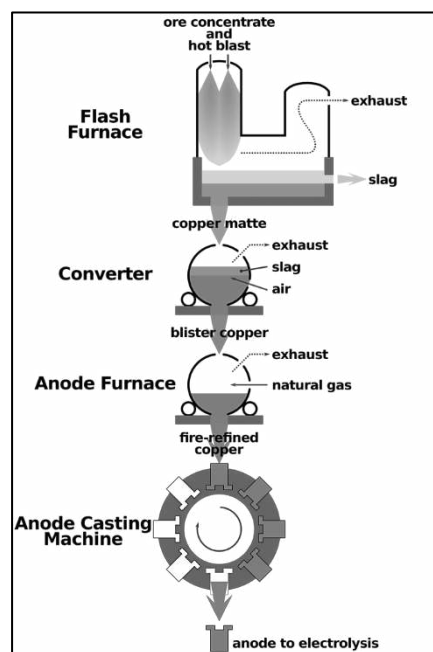
Steps in Metallurgical Process

- The following are the various **steps** in the metal extraction or metallurgical process:
 - **Crushing and grinding** the ore.
 - The **concentration of ore**, is also known as ore enrichment.
 - **Metal extraction** from concentrated ore.
 - Impure metals are **refined or purified**.

Fig. Copper Flash Smelting Process

Principles of Metallurgy

- The metallurgical process can be **classified** as the following:
 - Crushing and grinding
 - The **first process in metallurgy**.
 - Crushing of ores into a **fine powder** in a **crusher or ball mill**.
- This process is known as **pulverization**.
 - Concentration of ores
 - aka **ore dressing**.
 - It is the process of **removing impurities** from ore.
 - In metallurgy, we concentrate the ores mainly by the following **methods**.
 - Hydrolytic method
 - The **ore** is **poured** over a sloping, **vibrating corrugated table** with grooves.
 - A **jet of water** is allowed to **flow** over the **surface**.
 - The denser ore particles **settle** in the **grooves**, and the **impurities** are **washed away** by water.
 - Magnetic separation
 - The **crushed ore** is placed on a **conveyor belt**.
 - This belt **rotates** around **two wheels** in which one of the **wheels** is **magnetic**, and therefore the **magnetic particles** get **attracted** to the **magnetic wheel** and fall apart from the **non-magnetic particles**.
 - Froth floatation
 - The **crushed ore** is taken in a **large tank** which contains **oil and water**.
 - A **current of compressed air** is **passed** through it.
 - The ore gets **wet** by **oil** and is **separated** from the **impurities** in the form of **froth**.
 - **Ore** is **lighter**, and so it **comes** on the **surface** and impurities are left behind.
 - Roasting and calcination
 - **Roasting** - The process of heating a concentrated ore in the **presence of oxygen**.
- This process is applied in the case of **sulfide ores**.
 - **Calcination** - For ores containing **carbonate** or **hydrated oxides**, heating is done in the **absence** of air to melt the ores.



Important ores and alloys

Ores

- A mineral from which a metal can be extracted economically is called an ore.
- In it, a metal is present in appreciable quantities and from which the metal can be extracted economically.
- The main active substances present in nature, especially in the atmosphere are oxygen and carbon dioxide.
- In the earth's crust, sulphur and silicon are found in large quantities.
- Sea-water contains large quantities of chloride ions (obtained from dissolved sodium chloride).
- Most active metals are highly electropositive and therefore exist as ions.
- It is for this reason that most of the important ores of these metals occur as
 - Oxides
 - Sulphides
 - carbonates
 - halides
 - silicates
- Some sulphide ores undergo oxidation by air to form sulphates.
 - This explains the occurrence of sulphate ores.
- Ores are invariably found in nature in contact with rocky materials.
 - These rocky or earthy impurities accompanying the ores are termed as gangue or matrix.