

ROAD TRANSPORT

Railway Zones				
S. No.	Name	Date Established	Headquarter	Divisions
1.	Central	1051, November 5	Mumbai	Mumbai, Bhavnagar, Punc, Solapur, Nagpur, Dindarpur, Dharmad, Mughalsarai, Samastipur, Sonpur
2.	East Central	2002, October 1	Jhajpur	Khurda Road, Sambalpur, Jharsuguda, Deogarh, Sealdah, Asansol, Malda, Allahabad, Agra, Jhansi,izzatnagar, Lucknow, Varanasi, Jajpur, Ajmer, Bikaner, Jodhpur, Alipurduar, Kauhar, Rangia, Lumding, Tinsukia
3.	East Coast	2003, April 1	Bhubaneswar	Delhi, Allahabad, Moradabad, Secunderabad, Hyderabad, Guntakal, Vijayawada, Nanded, Bilkaspur, Raipur, Nagpur
4.	Eastern	1052, April	Kolkata	Adra, Chakradharpur, Kharagpur, Ranchi, Hubli, Bangalore, Mysore
5.	North Central	2003, April 1	Allahabad	Chennai, Tiruchirappall, Madurai, Palakkad, Salem, Trivandrum (Thiruvananthapuram), Jabalpur, Bhopal, Kota
6.	North Eastern	1052	Gorakhpur	Mumbai Central, Ratlam, Ahmedabad, Rajkot, Bhavnagar, Vadodara
7.	North Western	2002, October 1	Jalpur	
8.	Northeast Frontier	1058, 15th Jan	Guwahati	
9.	Northern	1052, April 14	Delhi	
10.	South Central	1068, October 2	Bilaspur	
11.	South East Central	2003, April 1	Kolkata	
12.	South Eastern	1955		
13.	South Western	2003, April 1	Hubli	
14.	Southern	1951, April 14	Chennai	
15.	West Central	2003, April 1	Jabalpur	
16.	Western	1951, November 5	Mumbai	

CLASSIFICATION OF ROADS

- The road network in India is one of the largest in the world.
- The total length of roads, at present is 33.4 lakhs.
- The total length of metalled road excluding roads constructed under Jawahar Roongar Yojana is 13,94,081 km and unmetalled roads is 10,71,818 km.
- The Central Government owns the responsibility of 57,737 km long national highways.
- Border Road Organisation was established in 1960.
- Though the national highways do not constitute even 2 per cent of the total road length of the country, they bear about 40 per cent of the traffic.
- Maharashtra has the highest length of roads (3,81,893 km) whereas the lowest length of road has Lakshadweep (1 km).
- National Highways Development Project has been launched to link the four corners of the country by four or six lanes in a network. The four major cities — Kolkata, Delhi, Chennai and Mumbai will be linked by 5,882 km long roads in golden quadrilateral.

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PORTS

- India has 7,516 km long coast line.
- Shipping Corporation of India is the biggest shipping line of the country having the longest number of vessels.
- India has the largest merchant shipping fleet among the developing countries and ranks 17th in the world in shipping tonnage.
- As on 31 July, 2005 the net operative tonnage consisted of 707 ships totalling 82.9 lakh Gross Registered Tonnage (GRT).
- There were 122 shipping companies which were operative in the country till 1st April, 2001.
- The public sector company, The Shipping Corporation of India Limited was established on 2nd October, 1961.
- There are 12 major ports in the country apart from about 187 minor ports. Major ports are under Central Government and others are maintained by State Governments.

SOME IMPORTANT PORTS OF INDIA

CHENNAI

- Artificial harbour.
- Located on the east coast.
- It handles petroleum products, mineral oil and iron ore.
- Oldest port in India.
- Lesser depth of water and tropical cyclones makes it impossible sometimes.

VISAKHAPATNAM

- Eastern coast along Andhra Pradesh.
- Naturally deep water and protected.
- Export of crude oil, petroleum products, iron ore. It is the deepest land locked and protected port.

PARADEEP

- On Orissa coast.
- It has capacity of handling 6.05 million tonnes.

KOLKATA

- Riverine.
- Inland location on Hooghly River.
- Goods from South-East Asia, Australia and New Zealand imported.
- Tidal Port.
- Suffer's problem of silting.

HALDIA

- On Hoogly.
- Crude petroleum for oil refinery.
- For larger ships.
- To release congestion on Kolkata.

KANDLA

- Tidal port.
- Located at the eastern end of Rann of Kutch.
- Export of crude oil, fertiliser, salt, foodgrain, cotton, cement.
- It was created out of compulsion since Karachi port went to Pakistan after partition

MORMUGAO

- Off the coast of Goa natural port.

NEW MANGALORE

- It occupies 5th position in handling the traffic.
- Off the coast of Karnataka.
- Export of iron ore from Kudremukh mines.
- It handles the import of fertiliser, edible oil, petroleum products.

KOCHI

- Natural harbour.
- Backwaters of Kerala Coast.
- Export of tea, coffee, spices, cashew, etc.
- Sheltered backwater bay.
- Import of petroleum for Kochi refinery.

TUTICORIN

- At the coast of Tamil Nadu.
- It handles coal, foodgrain, edible oil, sugar and petro products.
- Only recently developed.

MUMBAI

- Natural harbour.
- Located on the West Coast.
- Import of Mineral Oil from South-West Asia.
- Foreign Trade with Western countries and East African countries.
- Biggest port in India.
- Another port Nhava Sheva is developed to relieve the Mumbai port. It is also called Jawaharlal Nehru Port.

NATIONAL WATERWAYS

- National Waterway 1 : Allahabad — Haldia stretch (1620kms) of the Ganga-Bhagirathi-Hooghly river system in October 1986 as National waterway No. 1 (Nw-1).
- National Waterway 2 : Sadiya — Dhubri stretch (891 kms) of the Brahmaputra river in September 1988 as National waterway No. 2 (Nw-2).

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- **National Waterway 3** : Kolm – Kottapuram stretch (168 kms) of the west coast canal along with Champakara canal (14 kms) and Udyogmandal canal (23 kms) in February 1993 as National waterway No. 3 (NW-3).
- **National Waterway 4** : Kakinada – Puducherry stretch at canals and the Kaluvelly Tank, Bhadrachalam - Rajahmundry stretch of River Godavari and Wazirabad- Vijayawada stretch of River Krishna. Its established in November 2004. (NW-4)
- **National Waterway 5 (623 km)** : Talcher – Dhamra stretch of river Brahmani, Geonkhali - Charbatia stretch of East Costal Canal, Charbatia-Dhamra stretch of Matla river and Mangalgadhi- Paradip stretch of Mahanadi delta rivers. Its established in November 2008.
- **National Waterway 6 (121 km)** : Lakhipur to Bhanga of river Barak. (Proposed)

COMMUNICATION SYSTEM

POSTAL SERVICES

- One Indian Postal network is the largest postal network in the world with approx. 1,54,551 post offices.
- on an average a post-office serves an area of 21.5 sq. km. and a population of 6000.

Fact File

First Postal Service Started	: 1837
First Postal Stamp issued	: 1852 in Karachi (provincial)
First all-India Postal Stamp issued	: 1854
Establishment of Postal Department	: 1854
Money-order Service Started	: 1880
Airmail Service Started	: 1882
Post Office Saving Bank Started	: 1911
Speed-Post Introduced	: August 01, 1986
e-Post Introduced	: August 02, 2001
Gramin Sanchar Sewak Scheme (GSS)	: 24 December, 2002

TELECOMMUNICATION

- Almost all the Indian cities and towns have access to telephone network along with more than 50 per cent villages.
- A Telecommunication research centre was set-up in 1955-56.
- The teledensity in India is 18 per 100 population as on February 2007.
- Luxemburg has highest mobile density in The world and Hong Kong comes next.

Organization	Year of establishment	Headquarter	No. of member states
International Monetary Fund (IMF)	1945	Washington D.C.	186
World Bank	1945	Washington D.C.	186
World Trade Organisation (WTO)	1995	Geneva	153
Asian Development Bank (ADB)	1966	Manila	67
Association of South East Asian Nations (ASEAN)	1967	Jakarta	10
North American Free Trade Agreement (NAFTA)	1992	—	3
Asia-Pacific Economic Cooperation (APEC)	1989	—	21
South Asian Association for Regional Cooperation (SAARC)	1985	Kathmandu	8
South Asian Preferential Trade Agreement (SAFTA)	1995	—	7
Organisation of Petroleum Exporting Countries (OPEC)	1960	Vienna	12
G-8	1975	Australia	8
G-15	1989	Geneva	19
G-77	1964	—	130
Organisation for Economic Co-operation and Development (OECD)	1961	Paris	30
Asian Clearing Union (ACU)	(Renamed) 1975	Tehran (Iran)	8
Asia Europe Meeting (ASEM)	1996	—	45
Food and Agricultural Organisation (FAO)	1945	Quebec (Canada)	175
United Nations Organisation (UNO)	1945	New York	193

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WORLD TRADE ORGANISATION (WTO)

IMPORTANT FACTS

- The Uruguay round of GATT gave birth to WTO.
- WTO was officially constituted on January 1, 1995.
- WTO's ministerial conference is the highest authority of policy making.
- Mr. Renato Ruggaro is the present Director-General of WTO.
- The present strength of WTO membership is 150.
- The ministerial conference has to meet at least every two years.
- So far five ministerial conferences have been held.
- The first ministerial conference was held from 9-13 December 1996 in Singapore.
- The second conference was held from 18-20 May, 1998 at Geneva.
- The third conference was held from November 30 to December 3, 1999 in Seattle (USA).
- The fourth conference was held from 9-14 December, 2001, at Doha (Qatar).
- The fifth ministerial conference was held on 10-14 September, 2003 at Cancun (Mexico).
- The issues relating to Trade and Investment, Trade and Competition, Transparency in Government procurement, and Trade Facilitation, are called as Singapore Issues.
- Amber box constitutes all forms of domestic support deemed to be trade distorting.
- Blue Box subsidies are less trade distorting because they set limits on production through Quotas.
- Green Box subsidies are generally considered to be non-distorting in terms of production and trade.
- The fifth ministerial conference at Cancun remained a failure.
- The sixth ministerial conference is proposed on 13-18 December, 2005 at Hong Kong (China).

WTO Ministerial Conference		
Conference	Year	Place
First	9-13 December, 1996	Singapore
Second	18-20 May, 1998	Geneva
Third	30 November - 3 December, 1999	Seattle (USA)
Fourth	9-14 November, 2001	Doha (Qatar)
Fifth	10-14 September, 2003	Cancun (Mexico)
Sixth	13-18 December, 2005	Hong Kong (China)

Committee/Commission	Area
Lakdawala Committee	Poverty
M.S. Ahluwalia Committee	Employment opportunities
Subimal Dutt Committee (1969)	Licensing System
Hazari Committee (1967)	Disinvestment
R.H. Patil Commission (2001)	Small Scale Industries
S.S. Kohli Committee	Industrial Sickness
Abid Hussain Committee (1984)	Competition Policy
Onkar Goswami Committee (1993)	Tax Reforms
S.S. Raghvan Committee (1999)	Expenditure Reforms
Chelliah Committee (1991)	Banking Sector
Geethi Krishnan Commission (2000)	Corporate Governance
Narsimhan Committee (1991)	Power Sector
Varma Committee	Population
Kumar Mangalam Birla Committee	Stock Exchange
Montek Singh Ahluwalia Committee	Balance of Payment
Swaminathan Committee	Fertilisers
M.J. Ferwani Committee	Sugar Industry
C. Rangrajan Committee	Agriculture Credit
Hanumanta Rao Committee	Banking Reforms
Mahajan Committee	Development of Finance Institutions
R. V. Gupta Committee	Credit and Flow Problems of SSIs
Narsimhan Committee (1998)	Pension scheme for Unorganised sector
Khan Working Group	Auto Fuel Policy
S.L. Kapoor Committee	Restructuring the Commercial Banks
Dave Committee (2000)	Increase in Motor Vehicle Tax
Mashelkar Committee (January 2002)	Development of Domestic Tea Industry
Bhurelal Committee	Long Term Food Policy
Sapta Rishi Committee (July 2002)	Tax Structure Reforms
Abhijit Sen Committee (July 2002)	Consumer Service Importance
Kelkar Committee	Improving Insurance Centre
Goparia Committee	Full convertibility in capital account
Malhotra Committee	Infrastructure
Tarapur Committee	Transfer of Shares
Rakesh Mohan Committee	Company Law Reforms
Chandrashekhar Committee	
J.J. Irani Committee	

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Pay Commissions			
Pay Commission	Chairman	Appointment	Report
First Pay Commission	S. Varadachariar	1946	1947
Second Pay Commission	Jaganath Das	1957	1959
Third Pay Commission	Raghbir Dayal	1970	5.
Fourth Pay Commission	P.N. Singhal	1983	1973
Fifth Pay Commission	S.R. Pandian	1994	1986
Sixth Pay Commission	B.N. Srikrishna	2006	1997
			9.
			10. B.N. Adarkar
			11. S.Jagannathan
			12. K.R. Puri
			13. M. Narasimham
			14. Dr. I.G. Patel
			15. Dr. Manmohan Singh
			16. A. Ghosh
			17. R.N. Malhotra
			18. S. Venkitaraman
			19. C. Rangarajan
			20. Bimal Jalan
			21. Y.V. Reddy
			22. Mr. Duvvuri Subba Rao

Main Share Price Index of the World			
MUMBAI	DOLEX	SENSEX	S & PCNX
New York	NIFTY FIFTY	DOW JONES	
Tokyo	NIKKI	MID DAX	
Frankfurt	HANG SENG		
Hong Kong	SIMEX		
Singapore	STRAITS TIMES		

Establishment Years of Major Financial Institutions in India			
Imperial Bank of India	1921		
Reserve Bank of India	April 1, 1935		
Industrial Finance Corporation of India	1948		
ICICI	January 1955		
State Bank of India	July 1, 1955		
Unit Trust of India	February 1, 1964		
IDBI	July 1964		
NABARD	July 12, 1982		
IRBI	March 20, 1985		
SIDBI	1990		
EXIM Bank	January 1, 1982		
National Housing Bank	-July 1988		
Life Insurance Corporation (LIC)	September 1956		
General Insurance Corporation (GIC)	November 1972		
Regional Rural Banks	October 2, 1975		
Risk Capital and Technology Finance Corporation Ltd.	March 1975		
Technology Development & Information Co. of India Ltd.	1989		
Infrastructure Leasing & Finance Services Ltd.	1988		
Housing Development Finance Corporation Ltd. (HDFC)	1977		

IMPORTANT TERMINOLOGY

- **Ad-Valorem Tax :** A tax based on the value of a transaction. It is normally a given percentage of price at the retail, wholesale or manufacturing stage and is a common form of sales tax.
- **Absolute Poverty :** A situation where a population is able to meet only its bare subsistence essentials of foods, clothing, and shelter.
- **Administered Prices :** Prices which are set by a single decision taking body, e.g. a government agency rather than being determined by the free play of market forces.
- **Asian Development Bank :** It was founded in 1966. It aimed at to further development and investment in Asia, to help prepare and co-ordinate development and provide technical aid. It has twenty regional members and thirteen non-regional members. The bank is having its headquarters in the Philippines.
- **Andean Group :** A common market formed by Bolivia, Colombia, Ecuador, Peru and Venezuela in an effort to promote economic integration, co-ordinate industrial development, regulate foreign investment and maintain a common external tariff among the member countries.

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- **Appreciation** : A rise in the value of an asset or currency. Its opposite is depreciation.
- **Average Cost** : It is the cost per unit of output, where the cost of all inputs is included. If X is output and TC is total cost then average cost may be written as $AC = TC/X$.
- **Black Market** : A situation in which there is illegal selling of goods at prices above a legal maximum set by the government.
- **Budget Deficit** : When the expenditure of the Government exceeds the revenue, the balance between the two is the budget deficit.
- **Buffer Stocks** : Stocks of commodities held to moderate the commodity price fluctuations.
- **Balanced Budget** : A budget in which current income exactly equals current expenditure.
- **Balance of Payments** : The relation between the payments of all kinds made from one country to the rest of the world and its receipts from all other countries.
- **Balance of Trade** : The relationship between the value of a country's imports and its exports.
- **Bandwagon Effect** : The effect whereby as the price of a good falls demand by some sections or individuals in the community expand. Other individuals or sections expand their demand also.
- **Base Period** : A point in time used as a reference point for comparison with some later period.
- **Boom** : The expansionary phase of the trade cycle.
- **Bearer Cheque** : It is a cheque that is payable to a person whoever presents it to the banker.
- **Bill of Exchange** : It means the drawer makes an unconditional undertaking to pay to the drawee a sum of money at a given date. Usually three months ahead.
- **Birth Rate** : The average number of live births occurring in a year for every 1000 populations.
- **Black Economy** : That part of a country's economic activity which is not recorded in the national income accounts, although it does involve in the production of goods and services.
- **Backward Linkage** : The relationship between an industry or firm and the suppliers of its inputs. A change in the output of the industry will get transmitted backwards to the supplier of its inputs by changing its demand for inputs.
- **Backwash Effects** : These are considered to operate where the economic growth in one region of an economy possesses adverse effects on the growth of other regions.
- **Bank Rate** : The Rate of interest payable by commercial banks on the loans or rediscounts from the central bank.

- **Brain Drain** : The migration of educated and skilled labour from poor to richer countries.
- **Bullion** : Precious metal such as gold or silver which are held in bulk in the form of ingots or bars.
- **Bear** : A person who expects prices to fall and sells securities hoping to make a profit by subsequently repurchasing at a lower price.
- **Bid** : The price at which someone is prepared to buy shares.
- **Brokerage** : Changes made by a broker for acting as a agent in the buying and selling of shares.
- **Bull** : -A person who buys securities in the expectation that prices will rise and so give him an opportunity to resell on a profit.
- **Cash Reserve Ratio** : Under this method of credit control, commercial banks have to keep with RBI a percentage of reserves against their deposits.
- **Call Money** : It is a loan that is made for a very short period of a few days only or for duration of a week. It carries a low rate of interest.
- **Capital Account** : Portion of a country's balance of payments table that shows the volume of a private foreign investment and public grants and loans that flow into out of a country over a given period.
- **Capital Accumulation** : It is increase in a country's stock of real capital (i.e. net investment in fixed assets).
- **Capitalism** : Economic system featuring private property in means of production, commodity production and profit as the guiding motivating force of production.
- **Capital Market** : Places where long-term titles to capital assets such as bonds, debentures, shares and mortgages are bought and sold.
- **Capital-output ratio** : A ratio that shows the units of capital required to produce a unit of output over a given period of time.
- **Cartel** : An organisation of producers agreeing to limit the output of their product in an effort to raise prices and profits.
- **Cash Crops** : Crops produced entirely for the market (e.g., coffee, tea, cocoa, cotton, rubber, pyrethrum, jute, wheat).
- **Cheap Money** : Refers to a phase in which loans have been available at low rates of interest or a policy which creates this situation.
- **Commercial Banks** : Financial institutions that create credit; accept deposit and give loans and perform other financial functions. They create credit by creating deposits on the basis of their cash reserves.
- **Capital Budget** : It comprises capital receipt and payments and also incorporates transactions in the Public Account.

- **Capital Expenditure** : It consists of payments for acquisition of assets like land, buildings, machinery, equipments as also investments in shares etc., and loans and advances granted by the Government.
- **Capital Receipt** : These are loans raised by the government from the public, which are called market loans, borrowings by the government from the Reserve Bank of India and other parties.
- **Comparative Cost Method** : Refers to a method of comparing the profitability of alternative projects. The method takes into consideration the initial cost of alternative projects only, it is possible to use this method only where the output and lift of each competing schemes is the same.
- **Consumer Good** : A commodity bought by house-holds for use of consumption.
- **Consumerism** : A widespread movement which is concerned with the quality and safety of consumer goods, with harmful advertising and the conduct of business in a manner harmful to the consumer.
- **Cost Push Inflation** : A situation of general rise in prices in which costs increase faster than productivity or efficiency.
- **Creeping Inflation** : Slow and persistent rise in general level of prices over a long period.
- **Current Account Balance** : The difference between (a) exports of goods and services plus inflows of unrequited official and private transfers, and (b) imports of goods and services plus unrequited transfers to the rest of the world.
- **Cyclical Unemployment** : Unemployment in industrial market economies resulting from down showing of economic activity on account of deficient demand (insufficient to ensure Keynesian full employment).
- **Consolidated Fund** : It is made up of all revenues received by the government loans raised by it, and also receipts from recovery of loans granted by it.
- **Contingency Fund** : This fund is placed at the disposal of the President to meet any unforeseen expenditure where the Parliament's approval cannot be obtained due to time factor. It was created by an Act of Parliament in 1950.
- **Dividend** : Distribution of a part of a company's net profit to share holders as a reward for investing in the company. Usually expressed as a percentage of par value or as per cents per share.
- **Dear Money** : Refers to phases when interest rates have been high compared with their historical average values.
- **Demography** : The study of information in figures about the population of an area or country.

- **Decentralised Planning** : Regionalised or sectoral planning as opposed to planning at the centre.
- **Deflation** : (a) Decline in the general price level of goods and services leading to rise in the value of purchasing power of money. (b) A method of statistical conversion of a series of data to compensate for the general rise in prices.
- **Demand Deposit** : A deposit with bank which can be withdrawn immediately by the depositor also called cheque-book money.
- **Demand Pull Inflation** : A state of rising prices brought about by increase in aggregate demand in the face of short supply.
- **Domestic Income** : Income generated by the factors of production within the country from its own resources is called domestic income.
- **Dependency burden** : That proportion of the total population of a country falling in the ages of 0 to 15 and 64+, which is considered economically unproductive and therefore not counted in the labour force.
- **Depression** : A phase of the business cycle in which economic activity is at a low ebb and there is unemployment/ under employment of resources; prices, profits, consumption/ under capital investment are also at a low level.
- **Devaluation** : Official reduction in the foreign value of domestic currency. For example, if the official rate of exchange between rupee and dollars is rupees 7 = 1\$ and the government reduces the value of rupee by making Rs. 10 = 1\$, this will be devaluation. It is done to encourage the country's exports and discourage imports.
- **Dependency Ratio** : The number of people of non-working age in an economy related to those who are of working age.
- **Direct Tax** : Tax that cannot be shifted, the burden of direct tax is borne by the person on whom it is initially fixed. Examples: personal income tax, social security tax paid by employees, death tax, wealth tax, etc.
- **Disguised Unemployment (under-employment)** : (a) A situation in less developed countries where people are apparently employed but are actually unemployed or under-employed; for example, in agriculture in India. (b) A situation in developed countries in which the employed resources are being employed in uses less efficient than normal; for example, a doctor may be employed as a cab driver or as a compounder.
- **Disinvestment** : Reduction in the total stock of capital goods on account of failure to provide for depreciation.
- **Demands for Grants** : It is a statement of estimates of expenditure from the consolidate fund and is required to be voted by the Lok Sabha.

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- **Expenditure Budget** : It contains expenditure estimates made for a scheme or programme under both the revenue and capital heads.
- **Dumping** : It is a special type of price discrimination in which a monopoly firm charges a higher price at home and a lower price at abroad.
- **Disposable Income** : It means the actual income which can be spent on consumption by individuals and families.
- **Debentures** : Debenture is a written instrument acknowledging a debt.
- **Demand** : The quantity of a commodity which an individual is willing to buy at a given price.
- **Elasticity of Demand** : It express the degree of correlation between demand and price.
- **Engel's Law** : It is a relationship between the family's income and expenditure on different items. According to the Law, when a family's income increases the percentage of its income spent on food decreases.
- **Estate Duty** : A tax payable on a person's property at his death and before it passes into the hands of others.
- **Export Promotion** : Purposeful development efforts to expand the volume of a country's exports through export incentives and other means in order to generate more foreign exchange and improve the current account of its balance of payments.
- **Flat Money** : Money which the State declares to be legal tender, although its content value may be little or nothing. Most of flat money has been notes, although token money may also be included in the term.
- **Fiscal Drag** : The effect of inflation upon effective tax rates or sometimes the effect of growth in nominal gross domestic product on tax revenue. In other words, fiscal drag is directly related to inflation and tax rates.
- **Finance Bill** : This contains the government's proposals for levy of new taxes, modification of the existing tax structure beyond the period approved by parliament.
- **Fiscal Deficit** : It is the difference between the revenue receipts plus certain non-debt capital receipts and total expenditure including loans.
- **Financial Intermediary** : Business institutions that act as middle men between lenders and borrowers. Example : commercial banks, mutual savings banks, saving and loan associations, insurance companies.
- **Fiscal Policy** : Government's expenditure and tax policy, an important means of moderating the upswings and downswings of the business cycle.
- **Fixed Exchange Rate** : The exchange value of a currency is fixed in relation to another (usually the U.S. dollar), not free to fluctuate on the international market.
- **Flexible Exchange Rate** : The exchange value of national currency is free to move up and down in response to shifts in demand and supply arising from international trading.
- **Floating Debt** : Refers to that part of the National Debt which involves short term borrowing, it consists of Ways and Means Advances (q.v) and Treasury Bills.
- **Floating Exchange Rate** : Refers to a market situation in which the exchange rate between currencies has been free to change from day-to-day in response to supply and demand, the opposite to fixed parity.
- **Full Employment** : A situation in which the economy's resources are being used fully; zero deflationary unemployment, i.e. a situation in which all those who want to work at the current rate of wages are, in fact, employed.
- **Gilt-edged** : Refers to a high-grade bond issued by a company over a period and pay its bondholders their interest without interruption.
- **Gini Coefficient** : It measures the income inequality ranging from zero (perfect equality) to one (perfect inequality). It is graphically measured by dividing the area between the perfect equality line and the Lorenz curve by the total area lying to the right of the equality line in a Lorenz diagram. The higher the value of the coefficient, the higher the inequality of income distribution and the lower it is the more equitable the distribution of income.
- **Giffen Paradox** : It holds that for a commodity the demand is strengthened with a rise in price and weakened with a fall in price.
- **Green Money** : Refers to a set of special exchange rates which are used to convert common farm prices into national currencies in the European Economic Community.
- **Green Revolution** : The revolution in grain production associated with the scientific discovery of new hybrid seed varieties of wheat, rice, and corn which have resulted in high farm yields in many LDCs.
- **Gross Domestic Investment** : Consists of the outlays for additions to the fixed assets of both the private and public sector.
- **Gross Domestic Product (G.D.P)** : A measure of the total flow of goods and services produced by the economy over a specified time period, normally a year. It is obtained by valuing outputs of goods and services at market prices and then aggregating.

- ▶ **Gross National Income :** Gross National Product from the income side: consists of national income at factor costs - wages + income interest + profits + indirect taxes and capital consumption.
- ▶ **Gross National Product :** Aggregate value of all final goods and services at market prices produced in an economy during the period of one year.
- ▶ **Goodhart's Law :** This law states that any measure of the money supply which is officially controlled promptly loses its meaning.
- ▶ **Giffen Goods :** Those goods whose demand tends to fall as their price falls.
- ▶ **Hard Currency :** Means a currency which is having a continuing high level of demand relative to supply in the market for foreign exchange.
- ▶ **Hot Money :** Refers to money which gets transferred rapidly from one financial centre to another to take advantage of differences in short term interest rates or to escape the financial penalties of devaluation.
- ▶ **Hyper Inflation :** A situation in which general prices are rising sharply with no or little increase in output, also called runaway or galloping inflation.
- ▶ **Import Duty :** It can be described as a tax on imports and is imposed on an ad-valorem basis.
- ▶ **IDA :** International Development Association is an international body set up in 1960 to assist the World Bank (IBRD) in its efforts to promote economic development of the underdeveloped countries by providing additional capital on a low interest basis especially to the poorest of the poor developing countries.
- ▶ **IFC :** International Finance Corporation is an international financial institution that was set up in 1956 to supplement the efforts of the World Bank in providing development capital to private enterprises for the underdeveloped countries.
- ▶ **ILO :** International Labour Organisation is one of the United Nations functional organisation based in Geneva whose central task is to look into problems of world manpower supply, its training utilisation, domestic and international distribution etc.
- ▶ **IMF :** International Monetary Fund is an autonomous international financial institution that originated from the Bretton Woods Conference of 1944. Its main purpose is to regulate the international monetary exchange system which also originated from that conference but has since been modified.
- ▶ **Import Substitution :** A deliberate effort to replace major domestic industries such as textiles, shoes, household appliances. It requires the imposition of protective tariff and physical quotas to get the new industry started.

- ▶ **Income Per Capita :** Total GNP of a country divided by the population. Per capita income is often used as an economic indicator of the levels of living and development.
- ▶ **Incremental Capital-Output Ratio (ICOR) :** The amount of capital needed to raise output by one unit.
- ▶ **Indirect Taxes :** Taxes levied on goods purchased by the consumer (and exported by the producer) for which the tax-payer's liability varies in proportion to the quantity of particular goods purchased or sold.
- ▶ **Infant Mortality :** The deaths among children between birth and one year of age. The infant mortality rate measures the number of these deaths per 1,000 live births.
- ▶ **Inflation :** Rise in the general or average price of goods and services; consequently, a decline in the value of money-doubling of the general price level means halving the value of money.
- ▶ **Invisibles :** It represents services in a current account of the foreign trade.
- ▶ **Isoquant :** It is the locus of all technically efficient methods of producing a given level of output.
- ▶ **Investment :** That part of national income of expenditure devoted to the production of capital goods over a given period of time. "Gross" investment refers to the total expenditure on new capital goods, while "net" investment refers to the additional capital goods produced in excess of those that wear out and need to be replaced.
- ▶ **Labour-intensive Technique :** Method of production that uses proportionately more labour relative to other factors of production.
- ▶ **Liquidity :** It refers to the assets which can be converted into cash money easily.
- ▶ **Laffer Curve :** A curve depicting relationship between total tax revenue and corresponding tax rates.
- ▶ **Laissez-faire :** The principle of non-intervention of government in economic affairs.
- ▶ **Life Expectancy at Birth :** Indicates the number of years newborn children would live if subject to the mortality risks prevailing for the cross-section of population at the time of their birth.
- ▶ **Lorenz Curve :** A graph depicting the variance of the size distribution of income from perfect equality.
- ▶ **Micro-economics :** That branch of economics which studies the particular aspects of an economy. It is the study of the particular, of individuals, households, firms, prices, wages or incomes.
- ▶ **Monetised Deficit :** It indicates the level of support extended by the Reserve Bank of India to the governments borrowing programme.

- **Maturity** : Means the date on which a loan or bond or debenture becomes due and is to be paid-off.
- **MNC** : It implies Multi-national Company i.e., a large scale company having its production base in several countries and the bulk of the production is produced in the outside nations.
- **Mixed Economy** : An economy in which both the State and the private sector co-exist; decisions on what, how and for whom are made partially by the market and partially by the State or any other public authority; many consider it essentially a transitory form.
- **Monetary Policy** : Policy through which the Reserve Bank of India expands or contracts the money supply, or makes credit cheap or dear.
- **Money Market** : Money market can be defined as comprising the financial institutions that deal in short-term securities and loans.
- **Money Supply** : Sum of total currency in circulation plus commercial bank demand deposits (M_1) plus sometimes savings bank time deposits (M_2).
- **Mutual Fund** : Type of investment operated by an investment company that raises money from shareholders and invests it in a portfolio of stocks, bonds, or other securities. These funds offer investors the advantages of diversification and professional management.
- **NASDAQ** (National Association of Securities Dealers Automated Quotations) : Owned and operated by the NASD, NASDAQ is the computerised network that provides price quotations for securities traded over the counter as well as many listed securities.
- **New Economics** : Economics thought, founded by John Maynard Keynes (1883-1946) in the thirties; also called Keynesian thought or Keynesianism.
- **Non-Plan Expenditure** : It includes both revenue and capital expenditure on interest payments, the entire defence expenditure, subsidies, postal deficit, police, pensions, economic services, loans to public enterprises and loan as well as grants to State Governments, Union Territory Governments and Foreign Governments.
- **OECD** : Organisation for Economic Co-operation and Development is an organisation of 20 countries from the Western World including all of those in Europe and North America. Its major objectives is to assist the economic growth of its member nations by promoting co-operation and technical analysis of national and international economic trends.
- **OPEC** : Organisation of Petroleum Exporting Countries is an organisation consisting of the 13 major oil exporting countries of the Third World that acts as a "cartel" or oligopoly to promote their joint national interests. Members include Saudi Arabia, N-

geria, Algeria, Venezuela, Libya, Kuwait, United Arab Emirates, Iran, Iraq, Ecuador, Qatar, Gabon and Indonesia.

- **Open Market Operations** : Purchase and sale of Government securities by the Central Bank. Purchases have an expansionary effect, while sales have a contractionist effect.
- **Optional Money** : It is non-legal tender money but, it is generally accepted by the people as a medium of exchange.
- **Oligopoly** : It is a situation, that emerges when a few sellers of a product are found in the market.
- **Opportunity Cost** : It refers to the forgone value of resources in their next best alternative use.
- **Primary Deposits** : People deposit their cash with the banks. Such passively created deposits are known as Primary deposits.
- **Public Finance** : Public finance is the investigation into the nature and principles of public expenditure and public revenue.
- **Primary deficit** : It measures the fiscal deficit after excluding internal payments. It is an indicator of the real state of Government finances.
- **Primary data** : It refers to the data collected for the first time by the investigator. It provides original and first hand information.
- **Proportional Tax** : A proportional tax is one which, whatever the size of the income, the same rate or percentage is charged.
- **Portfolio** : Investors holding of securities of various types.
- **Preference shares** : Rank above ordinary shares for claims on assets, earnings and dividends but rank below creditors and debenture holders. These shares usually have a fixed dividend rate.
- **Premium** : The amount by which a security is quoted or issued above its value. The opposite to 'discount'.
- **Payroll Tax** : A tax levied on employer's wage bills.
- **Positional Goods** : Goods that are necessarily scarce and whose security cannot be reduced by increased productivity; for example, gold.
- **Purchasing Power Parity** : An exchange between two countries such that the same basket of goods and services could be bought in each country if the cost were converted at that exchange rate.
- **Progressive Income Tax** : A tax whose rate increases with increasing personal incomes i.e., where the proportion of personal income paid by a rich person in taxes is higher than that paid by a poorer person. A progressive tax structure therefore tends to improve income distribution.
- **Promissory Note** : A promise to pay by one person to another (I.O.U.) a given sum of money by a given date.
- **Revenue Budget** : It consists of the revenue receipt of the Government and the expenditure met from these revenues. It has two components, revenue receipts and revenue expenditure.

- **Revenue Deficit** : It refers to the excess of revenue expenditure over revenue receipt.
 - **Revenue Expenditure** : It is meant for the normal running of Government Departments and various services, interest charges on debt incurred by the Government and subsidies.
 - **Revenue Receipt** : It includes proceeds of taxes and other duties levied by the Centre, interest and dividend on investments made by the Government and fees and other receipt for services rendered by the Government.
 - **Real Income** : Real income is income expressed in terms of a general level of prices of a particular year taken as base.
 - **Running Inflation** : When price rises rapidly, at a rate of around 10 per cent per annum, it is called running inflation.
 - **Soft Currency** : A currency which is having a falling exchange rate due to continuing balance of payments deficits. Such a currency would not be held by other countries as part of their exchange reserves.
 - **Soft Loan** : A loan bearing either no rate of interest or an interest rate which is below the true cost of the capital lent.
 - **Special Drawing Rights (SDRs)** : An international reserve currency system which was created by the International Monetary Fund in October, 1969. It provides for a new type of money (known as paper gold) to serve the agreement of the free world nations as the first international legal tender.
 - **Strategic Sale** : It refers to the transfer of the management control of a public sector unit to a private party with the sale of a chunk of its equity.
 - **Structural Unemployment** : Unemployment in an economy due to the fundamental change in technology, markets or other development priorities.
 - **Sunrise Industries** : Industries in the forefront of development and which may become large industries in the future e.g. Industries engaged in high technology, biotechnology and solar energy.
 - **SEAO** : Stock Exchange Automated Quotation.
 - **Shadow Price** : It is the opportunity cost to a society of engaging in some economic activity. It is a concept applied to situations where actual prices cannot be charged or where actual prices charged to not reflect the real sacrifice made when some activity is pursued. For example, price of crackers is a shadow price.
 - **Social Capital** : The total stock of society's productive assets is called social capital.
 - **Takeover** : When a company's share of 51 per cent is taken away by another company (or acquired) it is called takeover, whereas merger is the fusion of two or more separate companies into one. Takeover is a forceful process, whereas, merger is a voluntary process.
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- **Total revenue** : It refers to the total money receipts of a firm from the sale of a certain given quantity of output.
 - **Tariff** : It is a duty or tax which is charged by a country on its imports from other countries, a customs duty.
 - **Tariff (*ad valorem*)** : A fixed percentage tax (e.g. 30%) on the value of an imported commodity levied at the point of entry into the importing country.
 - **Tax** : A compulsory payment to Government against which there is no quid pro quo.
 - **Tax Avoidance** : Loopholes in tax laws used by tax payers to avoid taxes. Contrasted with tax evasion.
 - **Tax Break** : A situation which is providing some relief from tax in whole or part.
 - **Tax Incidence** : Ultimate burden of tax.
 - **Tax Shifting** : Refers to the phenomenon whereby those on whom taxes are levied are able to pass the burden either partly or fully on to others.
 - **Time Deposits** : It refers to an interest bearing deposit over a fixed period of time.
 - **Trotting Inflation** : When prices rise moderately and the annual inflation rate is a single digit, it refers to trotting inflation.
 - **Tertiary Sector** : The services and commerce portion of an economy. Examples of services include repair and maintenance or capital goods, haircuts, public administration, medical care, transport and communications, teaching.
 - **Tight Money** : It refers to the tightness of the money market—the comparative scarcity of the loanable funds and a consequently the high rate of interest that tends to prevail.
 - **Trading off** : Something in order to get more of something else—e.g. sacrificing consumption now for consumption later by devoting some present resources to investment.
 - **Transfer earnings** : The price which is necessary to retain a given unit of a factor in a certain industry may be called its transfer earnings.
 - **Transfer Payment** : Payment made by one sector of the economy to another without any returns. Examples: Unemployment and social security payments, relief payments and charity, etc.
 - **Transfer Pricing** : An accounting procedure usually designed to lower total taxes paid by multi-national corporations (MNCs) in which intra-corporate sales and purchases of goods and services are artificially invoiced so that profits accrue to those branch offices located in low tax countries while offices in high tax countries show little or no taxable profits.
 - **Treasury Bills** : Marketable financial bill of the Central Government.

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- **Underlying Inflation** : The rate at which prices are rising in economy, once the impact of erratic effects on price measurement has been removed.
- **UNCTAD** : United Nations Conference on Trade and Development, a body of the United Nations whose primary objective is to promote international trade and commerce with a principle focus on trade and balance of payments problems of developing nations. Its first Secretary General was Raul Prebisch of Latin America.
- **Under-development** : An economic situation in which there are persistent low level of living in conjunction with the following characteristics; absolute poverty, low per capita incomes, low rates of economic growth, low consumption levels, poor health services, high death rates, vulnerability and dependence on foreign economies, and limited freedom to choose between variables that satisfy human wants.
- **Underemployment** : A situation in which persons are working less, either daily, weekly, monthly, or seasonally than they would like to work.
- **Underutilisation of Labour** : Operation of labour force at levels below their capacity or potential output.
- **Union** : Organisation of workers for advancing their social and economic interests.
- **Unit Cost** : The average total cost per unit of output of any economic good or service.
- **Utility** : It is defined as a want satisfying power of a commodity.
- **Variable costs** : Costs incurred on variable factors like raw materials.
- **Value Added Tax (V.A.T)** : A value added tax is a tax levied on the values that is added to goods and services turned out by the producers at each stages of production and distribution.
- **Welfare State** : Refers to a nation that provides minimum standards in respect of education, health, housing, pensions and other social benefits etc. When the individual means of certain sections of the population may be inadequate to provide these standards.
- **Ways and Means Advance** : It refers to the advance of money by the Central Bank to the Government to meet short term expenditure needs.
- **Zero-Based Budgeting** : The practice of justifying the utility in cost benefit terms of each Government expenditure on projects. Otherwise in the next year's budget it would not get the budgetary provision. This form of financial planning is with an object to ensure that every rupee that is spent is result oriented.
- **Zero Growth** : Zero growth in the economy occurs when the economic growth is static and shows no rise at all.

GENERAL SCIENCE

INTRODUCTION

Science is the systematic study of the nature and behaviour of the material. It is through a scientific approach only that we can analyze and understand the world with a rational perspective. The Nature of which we are an important part, is a complex phenomenon. It is only after having the basic knowledge of science subjects like Physics, Chemistry and Biology that we can understand our environment, our surrounding and even our own existence. General science makes us aware of the various laws governing the Nature and help us in understanding the way the entire globe works. However, General science is a very broad term and it includes a variety of scientific disciplines associated with the study of their specific areas.

VARIOUS SCIENTIFIC DISCIPLINES

- **Acarology** : Branch of zoology dealing with ticks and mites.
- **Acoustics** : The study of sound (or the science of sound).
- **Aerodynamics** : The branch of mechanics that deals with the motion of air and other gases; the study of the motion and control of solid bodies like aircraft, missiles in air.
- **Aeronautics** : The science or art of flight.
- **Aerostatics** : The branch of statics that deals with gases in equilibrium and with gases and bodies in them.
- **Actiology** : The science of causation.
- **Agrobiology** : The science of plant life and plant nutrition.
- **Agrology** : Soil science dealing with production of crops.
- **Agronomy** : The science of soil management and production of field crops.
- **Agrostology** : The study of grasses.
- **Alchemy** : Chemistry in ancient times.
- **Anatomy** : The science dealing with the structure of animals, plants or human body.
- **Anaesthesiology** : Branch of medicine dealing with administration of anaesthetics and the patient's condition while under anaesthesia.
- **Anthropology** : The Science that deals with the origin and physical and cultural development of mankind.
- **Arboriculture** : Cultivation of trees and vegetables.
- **Astrochemistry** : The study of antiquities.
- **Astrogeology** : Science relating to composition and reaction of substances found in celestial objects.
- **Astrogeology** : Dealing with structure and formation of rocks and minerals found in other planets.

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- Astrology** : The ancient art of predicting the course of destinies with the help of indications deduced from the position and movement of the heavenly bodies.
- Astronautics** : The science of space travel.
- Astrophysics** : The study of the heavenly bodies.
- Bacteriology** : The study of bacteria.
- Biochemistry** : The branch of astronomy concerned with the chemical nature of heavenly bodies.
- Biometry** : Science dealing with study of living things.
- Bionics** : The study of chemical processes of living things observed in the living world and the application of this knowledge to the world of machines.
- Bionomics** : The study of the relation of an organism to its environment.
- Bionomy** : The science of the laws of life.
- Biophysics** : The physics of vital processes (living things).
- Botany** : The study of plants.
- Cardiology** : A branch of medicine dealing with the heart.
- Carpology** : The study of fruits and seeds.
- Cetology** : Dealing with the study of aquatic mammals.
- Chemistry** : The study of elements and their laws of combination and behaviour.
- Chemothetherapy** : The treatment of disease of using chemical substances.
- Cherology** : Study of geographical areas and distribution of plants/animals.
- Chronobiology** : The study of duration of life.
- Chronology** : The science of arranging time in periods ascertaining the dates and historical order of past
- Conchoiology** : The branch of zoology dealing with the shells of molluscs.
- Cosmogony** : The science of the nature of heavenly bodies.
- Cosmography** : The science that describes and maps the chain features of the universe.
- Cosmology** : The science of the nature, origin and story of the universe.
- Craniology** : The study of skulls.
- Criminology** : The study of crime and criminals.
- Cryptography** : The study of secret writings.
- Crystallography** : The study of structure, forms and properties of crystals.
- Cryogenics** : The science dealing with the production, control and application of very low temperatures.

- Cytochemistry** : The branch of cytology dealing with chemistry of cells.
- Cytogenetics** : The branch of biology dealing with the body of heredity from the point of view of cytology and genetics.
- Cytology** : The study of cells, especially their formation, structure and functions.
- Cytotaxy** : The study of cells, especially their formation, structure and functions.
- Cytopathology** : The study of cells in diseases.
- Dactylography** : The study of fingerprints for the purchase or identification.
- Dactyloscopy** : The study of fingerprints.
- Dandriology** : Science dealing with study of trees.
- Dietetics** : Science dealing with study of diet and nutrition.
- Ecology** : The study of the relation of animals and ants to their surroundings, animate and inanimate.
- Econometrics** : The application of mathematics in testing economic theories.
- Economics** : The science dealing with the production, distribution and consumption of goods and services.
- Embryology** : The study of development of embryos.
- Endocrinology** : The study of endocrine glands and air secretions.
- Entomology** : The study of insects.
- Epidemiology** : The branch of medicine dealing with communicable diseases.
- Epigraphy** : The study of inscriptions.
- Epistemology** : Study of the nature of knowledge.
- Eschatology** : Study of death and destiny.
- Ethnography** : A branch of anthropology dealing with scientific description of individual cultures.
- Ethnology** : A branch of anthropology that deals with origin; distribution and distinguishing characteristics of races of mankind.
- Ethology** : The study of animal behaviour.
- Eugenics** : The study of the production of better offering by the careful selection of parents.
- Exobiology** : Branch of biology relating to the search study of extraterrestrial living organisms.
- Genecology** : The study of genetical composition of plant population in relation to their habitat.
- Genesiology** : The science of generation.
- Genetics** : The branch of biology dealing with the phenomena of heredity and the laws governing it.
- Geobiology** : The biology of terrestrial life.
- Geobotany** : The branch of botany dealing with all aspects of relations between plants and the earth's surface.
- Geochemistry** : The study of the chemical composition of the earth's crust and the changes which take place within it.

- **Geology** : The science that deals with the physical history of the earth.

► **Geomedicine** : The branch of medicine dealing with the influence of climate and environmental conditions on health.

► **Geomorphology** : The study of the characteristics, origin and development of landforms.

► **Geophysics** : The physics of the earth.

► **Geriatrics** : Branch of medicine relating to diagnosis and treatment of diseases afflicting the elderly.

► **Geriodontics** : Dealing with dental problems of the elderly people.

► **Gerontology** : The study of old age, its diseases, etc.

► **Gynaecology** : Dealing with female diseases of the reproductive system.

► **Haematology** : Relating to study of blood and blood disorders.

► **Hepatology** : Branch of medicine relating to study of liver and its diseases.

► **Histology** : The study of tissues.

► **Horticulture** : The cultivation of flowers, fruits, vegetables and ornamental plants.

► **Hydrodynamics** : The mathematical study of the forces, energy and pressure of liquid in motion.

► **Hydrography** : The science of water measurements of the earth with special reference to their use for navigation.

► **Hydrology** : The study of water with reference to its occurrence and properties in the hydrosphere and atmospheres.

► **Hydropathy** : The treatment of disease by the internal and external use of water.

► **Hydroponics** : The cultivation of plants by placing the roots in liquid nutrient solutions rather than in soil.

► **Hydrostatics** : The mathematical study of forces and pressures in liquids.

► **Hygiene** : Science of health and its preservation.

► **Hypnology** : Study of sleep.

► **Ichthyology** : Study of fishes.

► **Immunology** : Branch of medicine relating to the immune system in the body.

► **Lalopathology** : Branch of medicine relating to study of speech disorders.

► **Lithology** : Study of characteristics of rocks.

► **Malacology** : Branch of zoology concerned with study of molluscs of shell-bearing organisms.

► **Metallography** : Study of the crystalline structures of metals and alloys.

► **Meteorology** : Science of the atmosphere and its phenomena.

► **Metrology** : Scientific study of weights and measures, bacteria molds and pathogenic protozoa.

► **Minerology** : Study of distribution, identification and properties of minerals.

PHYSICS

Quantity	Name of Unit	Symbol
Area	square meter	m ²
Volume	cubic meter	m ³
Frequency	hertz	Hz
Mass density (density)	kilogram per cubic meter	kg/m ³
Speed, velocity	meter per second	m/s
Angular velocity	radian per second	rad/s
Acceleration	meter per second per second	m/s ²
Angular acceleration	radian per second per second	rad/s ²
Force	newton	N
Pressure	pascal	Pa
Work, energy, quantity of heat	joule	J
Power	watt	W
Quantity of electric charge	coulomb	C
Potential difference, electromotive force	volt	V
Electric field strength	volt per meter (or newton per coulomb)	N/C
Electric resistance	ohm	Ω
Capacitance	farad	F
Magnetic flux	weber	Wb
Inductance	henry	H
Magnetic flux density	tesla	T
Entropy	ampere per meter	A/m
Specific heat	joule per kilogram kelvin	J/kg
Thermal conductivity	watt per meter kelvin	W/m.K
Radiant intensity	watt per steradian	W/sr
Plane angle	radian	rad
Solid angle	steradian	sr

Physics is the branch of science which is concerned with the study of matter and energy and their inter-relationship. Numerous developments have taken place in the realm of Physics, from the earlier stages of classical physics to the emergence physics based on quantum theory. Classical physics included topics like optics, mechanics, electricity, magnetism, acoustics. In the twentieth century quantum mechanics has made much headway and it includes topics like atomic, nuclear, particle etc.

MECHANICS

MOTION

- Motion is change of position of a body with time.
- Two types of Motion are, Linear Motion and Rotatory Motion.

➤ **Scalar quantities :** Those physical quantities which are completely described by a magnitude (size) alone, are known as scalar quantities, e.g. length or distance, mass, time, area, volume, quantity, power, energy, temperature, speed, pressure, charge and potential.

➤ **Vector quantities :** Those physical which are completely described by their magnitudes as well as directions are known as vector quantities, e.g. displacement, velocity, acceleration, weight, moment, momentum and electric field.

DISTANCE

- The distance traveled by a body is the actual length of the path covered by a moving body irrespective of the direction of the body travels.

DISPLACEMENT

- When a body moves from one position to another, the shortest distance between the initial position and final position of the body alongwith direction is known as its displacement.
- It is a scalar quantity having magnitude only.

SPEED

- Speed is the scalar form of velocity. It is defined as the distance traveled in one second. If the body covers a distance d in time t , then speed $V = d/t$.

VARIABLE SPEED

- If the body covers unequal distance in equal interval of time, then it is said to be moving with a variable speed.

UNIFORM SPEED

- The speed of the body is uniform if it covers equal distances in equal interval of time.
- Acceleration may or may not be there in the motion if the body moving in uniform speed e.g. a body moving in uniform circular motion has uniform speed but variable velocity therefore acceleration is present in the circular motion.

AVERAGE SPEED

- If a body has travelled ' S_1 ' and ' S_2 ' distance with ' V_1 ' and ' V_2 ', then,

$$\text{Average speed} = \frac{S_1 + S_2}{V_1 + V_2}$$

VELOCITY

- The rate of change of displacement is called velocity.

$$V = \frac{s}{t}$$

It is a vector quantity.

UNIFORM VELOCITY

- Velocity may be positive and negative.
- When a body covers equal displacement in equal interval of time the velocity is said to be uniform.

ACCELERATION

- Acceleration is absent if the body moves with uniform velocity.

VARIABLE VELOCITY

- When a body covers unequal displacement in equal intervals of time then it is said to have variable velocity.
- Acceleration is necessarily present in this motion.

- In this case either direction of velocity or magnitude or both change with respect to time e.g. speed is constant in uniform circular motion but velocity is variable.

AVERAGE VELOCITY

1. Average velocity is zero if the body returns to starting point in the given time interval.
2. If the body covers first half distance with velocity v_1 and next half with velocity v_2 then the average velocity = $\frac{2v_1 v_2}{v_1 + v_2}$
3. If a body travels with uniform velocity v_1 for time t_1 and with uniform velocity v_2 for time t_2 , then average velocity is $\frac{v_1 t_1 + v_2 t_2}{t_1 + t_2}$

- A body whose velocity falls with the passage of time is said to be undergoing deceleration or retardation. A retardation may be treated as a negative acceleration.

- The acceleration of a moving body is the rate of change of its velocity, i.e.,

$$a = \frac{(v - u)}{t} ; \text{ where } 'a' \text{ is the acceleration, } 'u' \text{ is the initial velocity which becomes } 'v' \text{ in } 't' \text{ second.}$$

ACCELERATION

- Time rate of change in velocity is known as acceleration.
- It is a vector quantity.
- Negative acceleration is known as retardation. It indicates that the velocity of the object is decreasing with respect to time.

VARIABLE ACCELERATION

- If the velocity of the body changes in different amounts in the same time intervals, then the acceleration of the body is variable acceleration.
- Acceleration is variable if either its direction or magnitude changes with respect to time, e.g. acceleration in uniform circular motion.

UNIFORM ACCELERATION

- If the velocity of the body changes by same amounts in equal intervals of time, then the acceleration of the body is known as uniform acceleration, e.g. acceleration due to gravity.

EQUATIONS OF MOTION

$$(i) v = u + at, \quad (ii) s = ut + \frac{1}{2}at^2, \quad (iii) v^2 = u^2 + 2as;$$

Where initial velocity = u

Final velocity = v

Elapsed time = t

Acceleration = a

Distance covered = s

- The acceleration caused by the earth's attraction is known as acceleration due to gravity and it is identified by the symbol as 'g'. Mean value of 'g' is 9.8 m/s^2 .
- If the body travels downwards, then 'g' is positive. However, if the body is projected vertically upwards, then 'g' is negative.

LAWS OF MOTION

- Newton's First Law of Motion :** Every body continues to be in state of rest or of uniform motion, unless compelled by an external force to change that state. The first law can be called law of Inertia.
- Newton's Second Law of Motion :** The rate of change of momentum is directly proportional to the applied force and takes place in the direction in which the force acts. The second law can be termed as the law of acceleration.
- Newton's Third Law of Motion :** For every action, there is an equal and opposite reaction.

FORCE AND INERTIA

- A force is that pull or push which changes or tends to change the state of motion of a body.
- The tendency of a body to remain in the state it is, either stationary or moving, is called its inertia.
- The more the mass of the objects, the greater is their inertia.
- The force (F) which causes an acceleration (a) in a moving object of mass (m) is given by $F = ma$
- The SI unit of force is Newton.
- To every action there is always an equal and opposite reaction and action-reaction forces act on different bodies.

GRAVITY

- Gravity is the force which pulls all bodies towards the centre of the earth, keeps the planet revolving round the sun in definite paths and is responsible for the weight of all objects.
- A falling body accelerates under the influence of gravity.
- Different masses, fall to the ground together, because acceleration due to gravity is same for all objects.
- Every particle in the universe attracts every other particle with a force F which depends on the masses ' m_1 ' and ' m_2 ', of the interacting particles and on their separation ' r '. Greater the masses and smaller the separation, greater is the force of attraction. It is called Gravitational Force.
- Gravity is a special form of Gravitational Force, in which the interacting bodies are the earth and any other object.
- The value of acceleration due to gravity, i.e., 'g' decreases with height and depth.
- The radius of the earth is slightly more at the equator than at the poles. So, 'g' is less at the equator than at the poles. So artificial satellites are launched from the places near or on the equator.

MASS AND WEIGHT

- Mass is measure of the atoms contained in an object, and the number of atoms in the object remains constant. So, mass is an intrinsic, unchanging property of matter.
- The force with which a body is attracted towards earth is called weight.
- $W = mg$, where 'W' is the weight and 'm' is the mass.
- Mass is measured with the help of physical balance, while a spring balance measures the weight of an object.

FRICITION

- Friction is a kind of force that opposes relative motion.
- It comes into existence at the common boundary of two bodies in contact with one another, when one of them either moves or tends to move relative to the other.

- Force of friction does not depend on the area of contact.
- Frictional force increases with weight.
- On rough surfaces, frictional force is more than that on the smooth surfaces.
- Less force is needed to maintain motion than to initiate it i.e., Kinetic friction < Static friction.
- Kinetic friction does not depend on the speed, when the speed is not large.
- The vehicles are provided with wheels and their axles are supported with ball bearings, because the rolling friction is much less than the sliding friction.
- Friction is necessary for the operation of belts, pulleys, clutches and brakes. Nails and screws remain firmly fixed in which they are driven because of friction.
- For motion in a fluid, the frictional forces that oppose the motion are called **drag forces**.
- The drag forces depend on area, shape and the velocity of the moving body. For faster motion, the drag force may be assumed to be proportional to the square of the velocity.

TYPES OF FRICTION

- **Static Friction** : Frictional force arises on account of the contact of two surfaces. If the surfaces remain at rest, there is static friction.
- Static friction acts as a resistance to the commencement of relative motion between the two surfaces.
- **Dynamic Friction** : Friction that exists during the relative slipping of one surface over another is called dynamic or kinetic friction.
- Dynamic friction is less than the Static Friction.
- **Rolling Friction** : When a body rolls over a surface the frictional force that develops is known as rolling friction.

WORK, POWER AND ENERGY

- Work is said to be done only, when a force or its component causes displacement in its own direction.
- In SI system, unit of work is called Joule.
- $W = F \times d$; where 'W' is the work done, 'F' is the force and 'd' is the displacement.
- Rate of doing work is called **power**. Power (P) can be defined as the product of force (f) and velocity (v).
- $P = fv$
- In SI system, absolute unit of power is called **Joules/second** or **Watt**.
- The capacity of a body to do work is called **energy**.
- Energy is the total amount of work done by a body, therefore, its unit is the same as that of work.

- Conveniently, energy is divided into (i) potential energy and (ii) kinetic energy.
- When a body does work by virtue of its motion, it is said to have kinetic energy. If 'm' is the mass of the body, moving with an initial velocity v , then its Kinetic Energy (KE) is given by

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

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- A fast moving electron, running water, blowing wind; a speeding car; a shooting arrow etc., have kinetic energy.
- Electric energy, radiant heat, light energy, mechanical energy can be regarded as kinetic energy.
- If a body does work by virtue of its position or configuration, it is said to have potential energy.
- If a body of mass 'm' be raised vertically through a height 'h' against the acceleration due to gravity 'g', then its Potential Energy (PE) is $PE = mgh$.
- When a body is on the surface of earth, then the potential energy between the system of body, and the earth is zero.
- When the body moves vertically upward, the height of the body from ground increases, and hence potential energy between the system of the earth and the body increases.
- When a body falls towards the earth, the height of the body from ground decreases. Thus the potential energy between the system of the earth and the body decreases.
- When, the spring of watch is wounded, its configuration changes. Thus, it possess potential energy. On unwinding, the potential energy moves hands of watch, by being converted into kinetic energy.
- Similarly, a stretched bow and arrow system, a cocked-up spring of an air gun, a stretched catapult, water stored high up in the dams, a stone lying on the top of the roof etc., posses potential energy.
- Magnetic energy, chemical energy, nuclear energy, energy of static electricity are the forms of potential energy.
- **Law of conservation of energy** states that the energy can neither be created, nor can be destroyed, It may be transformed from one form to another form, but total energy of the system remains constant.
- The phenomenon of transformation of energy from useful form to useless forms, is known as **dissipation of energy**.

INTERCONVERSION OF ENERGY

- When hands are rubbed, the mechanical energy due to friction changes to heat energy.
- When two stones are struck, the mechanical energy changes to heat and light energy.
- When a knife is rubbed against grinding stone the mechanical energy changes to heat, light and sound energy.

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- When brakes are applied, the mechanical energy changes to kinetic energy at the point where brakes rub against moving wheel.
- When an arrow is stretched in a bow, the mechanical energy changes to potential energy. On releasing string, the potential energy changes to kinetic energy of arrow.
- The water stored in dams has potential energy. When this water is released, it changes to kinetic energy of flowing water. When this water turns blades of turbine and changes mechanical energy. The mechanical energy of turbine changes to nano and changes to electric energy.
- When a torch is switched on, the chemical energy drives electric energy. The electric energy on flowing through filament of bulb changes to heat and light energy.
- The electric energy in an electromagnet changes to magnetic energy.
- The electric energy flowing through an electric motor or fan changes to mechanical energy. It partly changes to heat energy.
- The sound energy in a microphone changes to electric energy.
- The electric energy changes to sound energy while flowing through speaker.
- In an electric heater, electric oven, electric geyser etc., the electric energy changes into heat energy.
- In steam engine, the heat energy of steam changes to mechanical energy.
- In an electric generator, the mechanical energy changes to electric energy.
- In photo voltaic cell, the light energy changes to electric energy.
- In Television, the electric energy changes to sound and light energy.
- When fuels are burnt the chemical energy of fuels changes to heat energy.
- In matches, due to friction, the chemical energy changes to heat and light energy.
- When a cracker is exploded, the chemical energy changes to heat and sound energy.
- During photosynthesis, the light energy changes to chemical energy.
- During charging of battery, the electric energy changes to chemical energy.
- During respiration, the chemical energy of food changes to heat energy. It is the heat energy which keeps our bodies warm. It is the heat energy which changes to mechanical energy when we do perform locomotion.
- During nuclear fusion or fission, it is the nuclear energy, which ultimately changes to heat and light energy.
- During the pumping up of water into an overhead tank by an electric motor pump, the electric energy changes to kinetic energy of water. The kinetic energy of water, then changes to potential energy of the stored water.

FLUID PRESSURE

- **Pressure** is defined as the thrust acting per unit area of the surface of contact i.e., $P = F/A$ where 'P' is the pressure, 'F' is the thrust and 'A' is the area over which the thrust is acting.
- The SI unit of pressure is known as **pascal**.

FACTS TO REMEMBER

- On the surface of moon there is no atmospheric pressure and hence lemonade cannot be pushed up the straw.
- **Barometer** is used for the measurement of pressure.
- Why mercury is used in barometers ?
 - (i) With mercury, practically no vapours are produced.
 - (ii) Mercury does not wet or stick with glass.
 - (iii) It is shining and opaque, so readings can be easily taken.
- A **gradual fall** in the atmospheric pressure indicates a steady increase in the atmospheric water vapour, and rain may occur.
- A **steady rise** in the atmospheric pressure shows a gradual fall in the atmospheric water vapour and indicates a fair weather.
- A sudden fall in atmospheric pressure predicts a storm.
- The boiling point of a liquid increases with the increase in pressure on its surface.
- On higher altitudes, the pressure of atmosphere is less. Thus, water starts boiling below 100°C. As the cooking temperature of rice, pulses, meat etc, is slightly above 100°C, therefore, they do not cook well on hills.
- Density of brine is more than that of fresh water. Thus, upthrust experienced by the floating ice in brine is more than upthrust due compared to that in fresh water.
- Ships are hollow from within, thus have fairly large volume. Thus, they are able to displace more weight of water than their own weight and hence float on the surface of water.
- The weight of hydrogen filled balloon as well as its fabric is less than the weight of air displaced by it. Thus, a net upthrust acts on the balloon and hence it rises upward.
- Floating and swimming in sea water is easier than in fresh water, because density of sea water is more than fresh water. Thus, for the same volume, the sea water provides greater upthrust as compared to the fresh water.
- The density of human body is slightly less than the density of water and it should have floated on water, but the density of human head is very large and hence, on the whole, density of human body becomes more than that of water. Thus, if we jump in deep water, we are liable to be drowned.
- Human corpse always float on the surface of water, but the head stays within water. The reason being when the dead body decays,

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MAGNETISM

- Its volume increases. Thus, it becomes lighter than water. However, head being heavy cannot displace water.
 - Hydrometer** is used for measuring the densities of liquids immersed with water.
 - Lactometer** is used to measure the purity of milk, if it is completely or partially, it suffers an upthrust.
 - The upthrust is equal to the weight of liquid displaced by the immersed part of it.
 - The result of the upthrust is an apparent loss of weight of body in the liquid.
- HEAT AND THERMODYNAMICS**
- Heat is a form of energy that flows from one body to another due to temperature difference between them. It is the combined energy of all molecules moving inside a body.
 - Temperature is only a measure of how fast these molecules are moving. The faster the molecules in a body vibrate, the hotter it is.
 - The flow of heat from one body to another continues until both the sides are at the same temperature. The two bodies are said in 'Thermal Equilibrium'.
 - In general, matter (whether solid, liquid or gas) expands when heated and contracts when cooled.
 - Black or dark bodies absorb heat while white or bright, shiny surfaces reflect away the heat.
 - Kelvin is the SI unit of temperature. In it, temperature is expressed in kelvin and not in degree kelvin. If T is the temperature on the kelvin scale and 0°C is the temperature on the celsius scale, then $T = 273.15 + 0$
 - If the temperature of a hot body on the celsius scale and farenheit scale are 0°C and 0°F respectively, then the relation between them is
$$\text{two is } \frac{0}{100} = \frac{0^\circ\text{F} - 32}{180}.$$
- TRANSMISSION OF HEAT**
- The process of net energy transfer through a substance without movement of the substance itself is called conduction.
 - The process of transfer of heat energy within the heated medium by the movement of the substance itself is known as convection.
 - The process of transfer of heat from one body to another without requiring any medium is called radiation.
 - Heat energy from the sun is transmitted to earth by radiation.
 - Very poor conductors, such as glass, are called insulators.
- Magnetism is the branch of physics concerned with magnetic phenomena.
 - Magnetism is caused by the way atoms are arranged in materials.
 - Materials can be divided broadly into three categories.
 - (i) Diamagnetic Substances
 - (ii) Paramagnetic Substances
 - (iii) Ferromagnetic Substances
 - Diamagnetic substances are those substances which are repelled by a magnet, e.g., copper, lead, gold, zinc, tin, water, air, antimony.
 - Paramagnetic substances are attracted by a magnet very feebly.
 - Ferromagnetic substances behave just like paramagnetic materials but the effect is much more intense.
- ELECTROMAGNETIC INDUCTION**
- It is a process in which an electromotive force (EMF) is set up in an electrical circuit by changing magnetic flux linked with the circuit. If the circuit is closed, an electric current will flow.
 - The magnitude of the EMF is proportional to the rate of change of flux. The direction of induced EMF is such that it opposes the change of flux which produces it.
 - The law of induction was given by Faraday and the direction of induced EMF is given by Lenz's law.
- SOME IMPORTANT FACTS ABOUT MAGNETISM**
- The regions of strongest magnetisation near the ends of a magnet are called **poles** of the magnet.
 - The distance between the two poles of a magnet is known as the **Effective Length** of the magnet.
 - An imaginary line bisecting the effective length of the magnet, at right angles to it, is called the **magnetic equator** of the magnet.
 - Iron can be easily magnetised even by weak magnetic fields whereas steel needs strong magnetic fields.
 - The induced magnetism acquired by iron is temporary, whereas the induced magnetism acquired by steel is more or less permanent i.e., steel has greater retentivity and it has higher coercivity.
 - Magnetic materials which retain magnetism for considerable time are known as **hard materials** and those which lose magnetism easily are called **soft materials**.
 - Iron is an example of a soft material while steel is a hard material.
 - A vertical plane passing through the magnetic axis of a freely suspended magnet at rest is called the **magnetic meridian** of that place.

- A vertical plane passing through the north-south place is known as the **geographical meridian** of that place.
- The angle between the magnetic meridian and the geographical meridian is known as the **Angle of declination**.
- The angle of dip at places lying on the so-called magnetic equator is zero.
- The magnetism of the Earth is caused by the link between magnetism and electricity. The rapid spinning of the Earth creates electric currents in the molten core, which are responsible for the magnetic field around the earth.
- Repulsion, and not attraction, is the sure test for polarity of a magnet.
- Certain types of iron, which once magnetised retain their magnetism, are called **permanent magnets**.
- An insulated copper wire wounded on some cylindrical card board or plastic tube, such that its length is greater than its diameter and it behaves like a magnet when current is made to flow through it is called **solenoid**.
- A solenoid which has an iron core is called an **electromagnet**.
- Electromagnet is a temporary magnet.
- Electromagnets are used :
 - (i) in electrical appliances, such as electric bell, electric fan, electric relay, electric motor, electric generator etc, and
 - (ii) for magnetic separation and for lifting heavy ferromagnetic loads.
- Rough handling, heating and hammering, demagnetising with other magnet and by using alternating current are some of the methods of **demagnetisation** of permanent magnet.
- Galvanometer is an instrument used for :
 - (i) detecting the flow of current in an electric circuit,
 - (ii) finding the direction of flow of current,
 - (iii) measuring the strength of current,
 - (iv) making measuring devices, such as voltmeter and ammeter.

BASIC ELECTRONICS

- The electrons, revolving in the outermost orbit of metals, which are weakly held by nucleus are called **free electrons**.
- The electrons emitted from the surface of metal, when heat energy is supplied to metal are called **Thermions**.
- Emission of electron from any metallic surface caused by heating is known as **Thermoionic Emission**.
- The minimum heat energy required to make a metal emit an electron (thermion) from its surface is called **threshold energy** or **work function**.

- Rate of emission of light electrons is directly proportional to intensity of falling radiation. The minimum frequency of radiation required for emission of electrons is known as '**Threshold frequency**'.
- A good thermion emitter must have low work function and high melting point, e.g., tungsten, alkali metal oxides.
- A thermion emitter, which gets heated on the passage of electric current, and when its temperature become more than threshold temperature, it starts emitting electrons, is called **directly heated thermion emitter**, e.g., tungsten.
- A material, which itself does not get heated up on the passage of electric current, but when heated by some other source emits thermions is called **indirectly heated thermion emitter**, e.g., alkali metal oxides.
- An electronic device, which allows the electron to flow only in one particular direction is called **diode valve**.
- Diodes are used as half and full wave rectifiers.
- In 1904, Sir J.A. Fleming, an English physicist, invented first vacuum diode, called the Fleming's valve.
- This electronic device allows the electron to flow only in one direction.
- It is used as a rectifier i.e., it can convert AC into DC.
- Instead of obeying Ohm's law it works on Child-Langmuir law.
- Substance having number of valance or free electrons between conductor and insulator is called **semiconductor**. It is in-between conductor and insulators, e.g., Ge, Si, C, etc.

FACTS TO REMEMBER

- Germanium (Ge), and Silicon (Si) are pure (intrinsic) semiconductors.
- Integrated Circuit (IC) chips are made of Silicon.
- Einstein has described **photo electric effect**. Einstein photo electric equation :

$$\frac{1}{2}mv^2 = h(V - V_0)$$
- Good absorbers are good emitters.

ATOMIC AND NUCLEAR PHYSICS

- Rutherford first invented the nucleus.
- X rays are produced when high speed electrons are falling on tungsten.
- Radioactivity was discovered by 'Henry Becquerel.'
- α particles are doubly ionized helium atoms or helium nuclei.
- γ rays are electromagnetic radiation of very high energy thus its frequency is very low.
- γ rays are emitted with both α and β particles.

► An element becomes radioactive when

- (i) its atomic number exceeds 82, and
- (ii) there is an imbalance of protons and neutrons as compared to normal stable atoms.

► The process by which a heavy radioactive nuclei is broken light nuclei by the bombardment of slow neutron, so as to liberate energy and more neutrons than used for bombardment is called **nuclear fission**.

► **Chain reaction** is the phenomenon in which neutrons during fission process lead to further fission of atoms, thereby a large amount of energy.

► If the fission process is carried out under controlled conditions i.e., the neutron formed during fission are absorbed by the control rods made up of graphite and boron, then the energy released can be utilised in producing steam which can be further used in running electric turbines.

► The process of combining lighter nuclei (atomic weight less than 20) into heavier nuclei is called **nuclear fusion**.

► To fuse hydrogen atoms, the minimum temperature required is 1000,000°C. It is for this particular high temperature, the fusion reaction are sometimes called **thermo-nuclear reaction**.

► The principle of nuclear fusion is used in Hydrogen bomb.

► Geiger counter is used for measuring radioactivity.

► The radiation which is omnipresent every where on the earth is cause of radioactive substances and cosmic ray particles are called **background radiation**.

► Radioactive property of carbon is used in carbon-14 dating to determine the age of fossils.

► **Half life** : It is the time after which the amount of radioactive element becomes half of the initial.

ELECTRICITY

► Electricity is the phenomenon associated with stationary or moving electrons, ions or other charged particles.

► The electricity produced by friction is called frictional electricity.

► If the charges in a body do not move, then the frictional electricity is known as static electricity.

► The electricity that travels along wires is called current electricity.

► An electric current is defined as an electric charge in motion. Unit of current is **ampere** and it is measured with the help of instrument known as **ammeter**.

► The opposition or obstruction offered by a conductor to the flow of drifting electrons is called **electric resistance**. Its unit is **ohm**.

► Resistance of conductor is directly proportional to its length across-section.

FACTS TO REMEMBER

► Fuse is a safety device in an electrical circuit.

► It is the weakest point in an electrical circuit, which melts and breaks the electric circuit, when the circuit gets :

(i) overloaded due to large withdraw of current,

(ii) due to short-circuiting in the electric circuit,

(iii) due to fluctuations of current in power supply system.

► Fuse wire has a low melting point, and high resistance.

► Earthing protects the user and the appliance from electric shock and burn out respectively.

► Household distribution of electricity is done in parallel, so that :

(i) if there is short-circuit or overloading in one particular circuit, then only the fuse of that circuit will melt; but the power supply to other circuits is not affected.

(ii) As the resistance due to appliances goes on increasing, the overall resistance of circuit decreases. Thus, more current flows in the various circuits depending upon the resistance of appliances. Hence, each appliance receives optimum amount of current, while potential difference at the ends of each appliance remains the same.

► Switches are always placed in live wire, so that an appliance is completely cut off from live wire in off position. Thus, a user will not receive any accidental shock.

► According to new international convention for colour coding of electric wires, **brown is for live wire, light blue for neutral wire and green or yellow for earth wire**.

► Nichrome and Manganin are the common alloys used for making heating elements of electric appliances, because they have good resistivity, high melting point, low thermal expansion and do not get oxidised till 1000°C.

- In most of the cases, nichrome is used as heating element in electric iron, electric heater, geyser etc.
- The heating element of heater becomes red hot, but not the connecting wires, because the resistance of connecting wires is extremely small as compared to the element. So, the heat produced in connecting coils is much less compared to that produced by element.
- The filament of electric bulb is made up of tungsten.
- The bulb is filled with a mixture of nitrogen and argon gases at very low pressure.

FARADAY'S LAW OF ELECTROLYSIS

- During electrolysis, amount of the mass deposited on the electrode is directly proportional to the amount of electricity passed through it.
- $M \propto Q$

where, M = amount of mass deposited

Q = charge

I = current

T = time

Z = electrochemical equivalent of element (ECE)

- During electrolysis, the amount of different elements deposited from the same current is proportional to their electrochemical equivalent.

DIRECT CURRENT AND ALTERNATIVE CURRENT

- Direct Current or DC is that whose magnitude remains constant as a function of time. An Alternative Current or AC is that which varies in magnitude continuously and whose direction varies periodically.

ELECTRIC MOTOR

- When a current carrying rectangular conductor is placed in a magnetic field at right angles to it, the forces acting on the two parallel lengths will be equal and opposite thus constituting a couple. The conductor therefore rotates. This is the principle of electric motor. (The EM doesn't work on the principle of electro-magnetic induction).

DYNAMO

- It works on the reverse principle of the motor, i.e. Electro-magnetic induction.

TRANSFORMER

- Transformer is an electric device, by which the e.m.f. of an alternating current can be increased or decreased as per need of a particular situation. The relation between the o/p voltage and input voltage is

$$\frac{\text{Voltage in secondary}}{\text{Voltage in primary}} = \frac{\text{number of turns in secondary}}{\text{number of turns in primary}}$$

Voltage in primary is in the inverse proportion in the case of step-down transformer

$$\frac{\text{Current in secondary}}{\text{Current in primary}} = \frac{\text{number of turns in primary}}{\text{number of turns in secondary}}$$

COLUMB'S LAW

- Force of attraction or repulsion between two point charges is directly proportional to the product of their magnitude of charges and inversely proportional to the square of the distance between them and acting in the direction of the line joining the points. In SI system

$$F = 9 \times 10^9 \frac{q_1 \times q_2}{r^2}$$

INTENSITY OF ELECTRIC FIELD

- The force experienced by a point charge of 1 coulomb in any electric field is called the intensity of the electric field at the point. It is a vector quantity and its unit is Unit - N/C (NC^{-1})

$$F = 9 \times 10^9 \frac{q_1 \times q_2}{r^2} \text{ N/C}$$

ELECTRIC POTENTIAL (V)

- It is defined as the amount of work done (W) in bringing a charge (q_0) from infinity to any electric field.

$$V = \frac{W}{q_0} \text{ volt}$$

POTENTIAL DIFFERENCE

- The amount of work required in moving a charge of 1 Coulomb from a point to the another is called the potential difference between those points.

EFFECT OF TEMPERATURE UPON RESISTANCE

- In case of pure metal the resistance increases with increase in temperature and vice-versa. It is given by the relation $R_t = R_0 (1 + \alpha t)$ (α = coefficient of thermal resistance)

ELECTRIC POWER

- The rate of loss of electric power in any electric circuit is called the power (W)
- Power = current \times voltage
- $W = V \times A$
- Watt = volt \times ampere

OHM'S LAW

- The amount of electric current passes through any conductor directly proportional to the potential difference between its ends i.e. $V = IR$, (Unit = Ohm)

➤ Ice has the highest specific latent heat. So, compared to other matter, it requires higher amount of energy for melting. That's why,

- (i) Water bodies in cold countries do not freeze suddenly, to which, there are no flash floods, and the rivers contain water for whole year,
- (ii) Soft drinks are cooled by ice rather than iced cold water.

- Boiling point of a liquid rises with presence of dissolved impurities.
- The phenomenon due to which, a liquid changes into its vapour state at any temperature without the aid of any external source of heat is called evaporation. Evaporation is basically the internal property of liquid.

OPTICS

- Light is the physical cause which produces sensation of sight and makes the surrounding objects visible to us.
- Bodies which themselves emit light are called luminous objects. The luminous objects are usually hot. However, cold luminous objects also exist. The sun and the stars are examples of hot luminous objects, whereas, the light emitting diodes used in digital instruments are examples of cold luminous objects.
- Objects which do not emit light themselves are called non-luminous objects. They become visible to us only when the light reflected (or scattered) by them is able to enter our eyes.
- In a pin-hole camera, the image is always at focus, real, inverted and usually smaller than the object.
- If the size of the pin-hole is increased, the image becomes blurred.
- When the object is moved towards the pin-hole camera, the size of the image and its luminosity increases.
- Reflection is the phenomenon whereby light, on striking a surface is thrown back into the same medium.
- An opaque body absorbs some of the light that falls on it and reflects the remaining light.
- A transparent body like glass or water transmits almost all the light through it and does not reflect any light.
- A smooth shining surface like a mirror reflects away almost all the light that falls on it.
- When rays shooting from a point object, after reflection or refraction, appear to converge at a second point, the second point is known as the real image of the first. A real image can be received on a screen as it is actually formed by the intersection of rays.

- MIRRORS**
- The image formed by a plane mirror is erect, laterally inverted and virtual. Also, it has the same size as the object and is as far behind the mirror as the object is in front of it.
 - A polished surface is visible only from that direction in which it reflects the light.
 - In reflection from irregular surfaces, the object can be seen from all directions.
 - A man can see the whole of his body in a mirror, the size of which is half of his own height.
 - The minimum size of a plane mirror required to be fixed on the wall of a room so that an observer at the centre of the room can see the full image of the wall behind him is one-third the height of the wall behind the observer.
 - A set of two parallel mirrors, therefore, produces theoretically an infinite number of images. However, in practice only a limited number of images are observed, since each successive image is fainter than the preceding one.
 - The total number of images formed by two plane mirrors inclined at right angles is 3.
 - The portion of the mirror from where reflection actually takes place is known as Aperture.
 - In a concave mirror, the image is always real except when the object is within the focal length. In the latter case, the image is virtual.
 - In a convex mirror, irrespective of the position of the object, the image distance from the mirror is always less than the object's distance.
 - The image formed by a concave mirror might be an enlarged or diminished one depending upon the position of the object. But in a convex mirror, the image is always a diminished one.
 - A concave mirror is used as shaving mirror, Doctor's reflector, reflectors of search light, telescope etc.
 - A convex mirror or a diverging mirror is used as driving mirror and street lamp reflector.

FACTS TO REMEMBER

- The phenomenon, due to which a ray of light deviates from its original path, while traveling from one optical medium to another optical medium is called Refraction.
- When a ray of light travels from optically rarer medium to optically denser medium, it always bends towards normal, drawn at the point of incidence.

- When a ray of light travels from optically denser medium (air or water) to optically rarer medium (air or vacuum), it always bends away from the normal, drawn at the point of incidence.
- When an incident ray strikes at right angles at the point of incidence, it suffers no refraction.
- The perpendicular shift in the path of incident ray, while emerging out from an optical slab is called lateral displacement.
- Because of **refraction** :
 - (i) A stick appears bent and short when immersed in water. It also appears magnified because image is formed close to the eye.
 - (ii) The bottom of a beaker filled with water appears raised. Swimming pool appears shallow when filled with water.
 - (iii) Stars twinkle and appear higher in horizon than their actual position.
 - (iv) The Sun appears bigger during sunset or sunrise. Also, refraction is responsible for twilight and helps in increasing the length of the day.
- The phenomenon due to which a ray of light, while traveling from optically denser medium to optically rarer medium, gets reflected into the same medium at the surface of separation, is called total internal reflection.
- For total internal reflection :
 - (i) rays of light must travel from optically denser medium to optically rarer medium,
 - (ii) the angle of incidence in optically denser medium, must be greater than critical angle.
 - (iii) Angle of incidence in a denser medium for which angle of refraction in rarer medium is 90° is called Critical Angle.
 - (iv) Sparkling of diamonds and formation of mirage take place due to total internal reflection.

LENSSES

- A convex lens always forms real and inverted images, except if forms a virtual and erect image, when object is between optical centre and principal focus.
- A convex lens can be used as :
 - (i) burning glass,
 - (ii) objective lens for telescopes,
 - (iii) erecting lens,
 - (iv) objective lens for photographic camera,
 - (v) objective lens for cinema projector,
 - (vi) objective lens for search light,
 - (vii) as a simple microscope and,
 - (viii) for correcting long sightedness.
 - A concave lens always forms virtual, erect and diminished image.

FUNCTIONING OF THE CAMERA

- A photographic camera has different f-numbers marked on a ring.
- The f-number is adjusted according to intensity of light.
- In dim light f-number is kept higher and in bright light f-number is decreased so that film may not get over-exposed. The diaphragm helps in controlling the amount of light entering in camera.
- A shutter of variable speed is fixed behind the diaphragm of the photographic camera to control the exposure time of film.
- The time of exposure is directly proportional to the square of f-number.
- The shutter is so constructed that automatically closes after a certain required time-interval.

HUMAN EYE

- In human eye, cornea, acts as window to the world, i.e., allows the light to enter the eye.
- In human eye, choroids darkens the eye from inside and hence prevents any internal reflection.
- The function of retina is to receive the optical image of an object and then convert it into optical pulses which are finally sent to brain through optic nerve.
- Yellow spot in the eye is responsible for forming an extremely clear image. When we want to examine an object very minutely, the image of object is brought to focus at this point.
- Ciliary muscles alter the focal length of crystalline lens, so that images of objects at various distances are clearly focused on retina.
- Iris of the eye controls the amount of light entering into the eye.
- Eye-lids of human eye act as the shutter in front of camera to restrict light.

- The electromagnetic radiations which can excite our retina and hence are let towards red.
 - Colour is a sensation produced in the brain due to the excitation of retina, by an electromagnetic wave length.
 - A light, which is a mixture of several colours called polychromatic light. White light is a phenomenon due to which a polychromatic light component colours, when passed through a prism, is called dispersion.
 - The angle through which light of a particular wave length splits up in glass is less than violet colour.
 - The refrangibility for red light is least, whereas that of the violet light is maximum.
 - As the velocity of light is least in case of the violet in glass, therefore, refractive index of red colour absorbs, reflects or transmits when white light is incident on all the colours, it appears black.
 - The colour of the transparent object in white light depends upon
 - (i) colours of white light being absorbed, and
 - (ii) colours of white light being transmitted.
 - A green glass will absorb all the colours of white light but transmits only green.
 - The colour of an opaque object in coloured light depends upon pigment present in the object. It is the pigment, which selects up absorbs or reflects coloured light falling on it.
 - When a green light is incident on red opaque object, the red pigment will absorb green light and reflects none. Thus, the object appears dark.
 - When blue light is incident on blue opaque object, the blue pigment will reflect the blue light and hence object appears blue.
 - When yellow light is incident on white opaque object, the yellow light is reflected, because there is no pigment in white object. Thus object appears yellow.
 - The colour of a transparent object in coloured light depends upon the pigment present in transparent object and the light absorbed or transmitted by it.
 - A red object will appear black through blue glass, because red light coming from it is absorbed by blue glass.
 - A yellow flower will appear yellow through yellow glass because yellow light coming from object is transmitted by yellow glass.
- Red, blue and green form primary colours.
 - Cyan, yellow and magenta form primary pigments.
 - The regions of spectrum which do not excite retina and hence are not visible are parts of it.
 - Ultra-violet magnetic radiations beyond red end of visible spectrum are called infra-red radiations.
 - The wave length of infra-red spectrum extends from 8000×10^{-10} m to $4,00,000 \times 10^{-10}$ m.
 - White hot sources of light, such as sun, arc lamp, burning gases or any other material are best-suited for producing infra-red radiations of higher intensity. However, all living beings, animals, plants or humans are infra-red emitters.
 - Infra-red rays produce heating effect, therefore, they are used by doctors for therapeutic purposes.
 - Infra-red radiations have a very long wave length, so they do not easily get scattered in fog or smoke. Thus, they can be used for taking infra-red photographs with suitable photographic plates and filters in foggy weather.
 - Since all objects are the emitters of infra-red radiations, therefore, specially prepared devices, i.e., night-vision devices can see the objects in darkness by receiving the infra-red radiations.
 - Infra-red radiations are used in surface-to-air missiles for tracking and destroying enemy planes. The on-board sensor of infra-red radiations in the nose of missile detects the heat trail left by enemy plane to locate its position.
 - By measuring infra-red or heat radiations from crops via satellite we can find any change in the heat radiation pattern. This change generally indicates some disease.
 - Laws of reflection and refraction are valid for invisible spectrum too.
 - The region of spectrum which extends beyond violet colour of visible spectrum is called ultra-violet spectrum.
 - Any source of light at temperature of more than 2500°C is a good source of ultra-violet radiation. Electric sparks, electric arc lamp, mercury vapour lamps, and sun-light are good sources of UV-radiations.
 - The range of UV-radiations is between 4000\AA to 100\AA .
 - UV-radiations produce fluorescence in substances like zinc sulphide, barium sulphide, barium platinocyanide and quinine sulphate solution.
 - UV-radiations produce chemical effect in silver salts.
 - UV-radiations are absorbed by atmosphere and convert oxygen to ozone.
 - Fluorescence is the phenomenon, where a substance absorbs an incident light of smaller wave length and then reflects a light of longer wave length.

► UV-radiations when absorbed by skin, stimulate the body and teeth.

ACOUSTICS

- The scientific study of sound and sound waves is termed as Acoustics.
- The unit of measurement of the intensity of sound is decibel (dB).
- The average range of audible frequencies to which the human ear responds is usually between 20 Hz to 20,000 Hz.
- Vibrations at frequencies beyond 20,000 Hz are too fast for human ear to respond. These vibrations are called ultrasonic vibrations. Infants, dogs and certain fishes are able to respond to these vibrations.
- Vibrations at frequencies below 20 Hz are too slow for the human ear to respond and they are called infrasonic vibrations. Such vibrations are produced during earthquakes.

SOUND AND WAVE MOTION

- Sound is a wave-and requires a material medium for transmission.
- A transverse wave is one in which the motion of the individual particles of the medium takes place at right angles to the direction of propagation of the wave.
- Transverse waves can be generated in solids and liquids but not in gases.
- A longitudinal wave is the one in which the motion of individual particles of the medium takes place in the direction of propagation of the wave, resulting in the formation of alternate compressions and rarefactions.
- Longitudinal waves can be produced in solids, liquids and gases. Light waves are transverse in nature, while sound waves are longitudinal waves.
- The speed of sound is independent of loudness, provided the amplitude is not very large.
- The velocity of sound is independent of pressure.
- Sound travels faster in warm air. As the velocity of sound in air is 332 m/s at 0°C, its velocity at 0°C is given by $C = 332 + 0.6t$.
- The presence of water vapour lowers the density of air, consequently the velocity of sound in humid air increases.
- The velocity of sound increases if the wind is blowing in the direction of sound wave propagation and vice-versa.
- Sounds of all frequencies travel with the same speed.
- Speed of sound is more in water than in air and still more in solids.
- The phenomenon due to which repetition of sound is heard, after reflection from distant object (such as high building or hillock) after the original sound from a given source dies off is called Echo.

► Resonance is defined as a phenomenon when the frequency of applied external force is equal to the natural frequency of the body on which begins to vibrate with an increased amplitude.

- Tuning forks enclosed in the sound box is so adjusted that its amount of air enclosed matches with the frequency of the tuning fork, natural frequency is produced due to resonance.
- Soldiers are often asked to break their steps while crossing a bridge. This precaution is taken to prevent any sudden collapse of the bridge, due to matching of the natural frequency of the bridge with that of the impressed force due to the marching of soldiers.

► Pitch is the characteristic of musical sound, which enables us to differentiate between two sounds of equal loudness, coming from different frequencies.

► The higher the frequency of a note, the higher is its pitch or the shriller is its note.

► The rate of flow of sound energy per unit is called intensity of sound. The rate of flow of sound energy per unit area and its effect on the ear collectively is called loudness of sound.

► The property by which two notes of the same frequency and same loudness can be distinguished from each other, because of the difference in wave forms is called quality of timbre.

► A wave form which travels at a constant speed of 3×10^8 m/s and is unaffected by electric or magnetic fields, such that it needs no material for its propagation is called electromagnetic wave.

► Light waves, television waves, radio waves, infra-red rays, visible light, ultra-violet rays, x-rays and gamma rays are major parts of electromagnetic spectrum in the order of decreasing wavelength or increasing frequency.

► Radio waves, TV-waves and micro-waves are produced by oscillating circuits in special vacuum tubes.

► Infra-red rays, visible radiation and ultra-violet rays are produced by the excitation of outer electronic shell in increasing order.

► X-rays are produced by the excitation of inner electrons of an atom and sudden destruction of high energy free electrons.

► Gamma radiation are produced by the nucleus of an atom, by the sudden destructions of high energy particles. They find use in the cure of cancer.

SOME CONVERSION FACTORS

Mass and Density

$$1 \text{ kg} = 1000 \text{ g} = 6.02 \times 10^{26} \text{ u}$$

$$1 \text{ slug} = 14.6 \text{ kg}$$

$$1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$$

► Length and Volume

1 m = 100 cm = 39.4 inch = 3.28 ft.
1 mile = 1.61 km = 5280 ft.

1 inch = 2.54 cm
1 nm = 10^{-9} m = 10A

1 pm = 10^{-12} m = 1000 fm
1 light year = 9.46×10^{12} m
1 m³ = 1000 L = 35.3 ft³ = 264 gal

► Time

1 d = 86400 s

$$1 Y = 365 \frac{1}{4} d = 3.16 \times 10^7 \text{ s}$$

► Angular Measure

$$1 \text{ rad} = 57.3^\circ = 0.159 \text{ rev}$$

$$\pi \text{ rad} = 180^\circ = \frac{1}{2} \text{ rev}$$

► Speed

$$1 \text{ m/s} = 3.28 \text{ ft/s} = 2.24 \text{ mi/h}$$

$$1 \text{ km/h} = 0.621 \text{ mi/h} = 0.278 \text{ m/s}$$

► Force and Pressure

$$1 \text{ N} = 10^5 \text{ dyne} = 0.225 \text{ lb}$$

$$1 \text{ ton} = 2000 \text{ lb}$$

$$1 \text{ Pa} = 1 \text{ N/m}^2 = 10 \text{ dyne/cm}^2$$

$$= 1.45 \times 10^{-4} \text{ lb/inch}^2$$

$$1 \text{ atm} = 1.01 \times 105 \text{ Pa} = 14.7 \text{ lb/inch}^2$$

$$= 76 \text{ cm-Hg}$$

► Energy and Power

$$1 \text{ J} = 10^7 \text{ erg} = 0.239 \text{ cal} = 0.738 \text{ ft. lb}$$

$$1 \text{ kW.h} = 3.6 \times 10^6 \text{ J}$$

$$1 \text{ cal} = 4.19 \text{ J}$$

$$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$$

$$1 \text{ Horsepower} = 746 \text{ W} = 550 \text{ ft. lb/s}$$

► Magnetism

$$1 \text{ T} = 1 \text{ Wb/m}^2 = 10^4 \text{ gauss}$$

FACTS TO REMEMBER

- Speed of light is maximum in vacuum.
- Longitudinal waves can't be polarized.
- Rainbow are always formed in direction opposite to the sun.
- The frequency of visible light varies between 400 nm to 700 nm.
- Colour blindness was first discovered by Horner (1976).

- Focal distance of lens is maximum for red-light and minimum for violet light
- If a transparent material is invisible in any liquid, then both of its image is known as hologram.
- 3-D image
- If two mirrors are at an angle of 75° then the number of images is 5.
- If two mirrors are at an angle of 15° then the number of images is 3.
- Human eyes have convex lens.
- Raman effect is related to scattering.
- Optical fibers works on the principle of total internal reflection.
- Hypo or radium thiosulphate is used for fusing in photography.
- Power of sunglasses is zero.
- Heat energy are transmitted as infra-red rays.
- The first use of telescope for research was by Galileo Galilei of Italy in 1609.
- Power measures the degree of divergence or convergence and is measured in dioptres.
- Negative sign denotes divergence or a convex lens.
- Positive sign is for convergence or a concave lens.
- Air bubble in water behaves as concave lens.
- As temperature of medium increases, its refractive index increase.
- Refractive index of a material is independent of angle of incidence.
- The angle of deviation in refractions is given by $d = (i - r)$, i = angle of incidence and r = angle of refraction.
- $100^\circ\text{C} = 212^\circ\text{F} = 373 \text{ K} = 80 \text{ R}$.
- Bolometer is used for detection of infra-red rays.
- Specific heat of water is 1.0 calorie/gm-°C.
- Two thinner blankets are more warmer than a single blanket equal to their width.
- Colour cloths are good absorber of heat.
- Ammonia is used as a coolant in regrigerator.
- If there is a relative motion between the source and the observer, then the frequency of sound heard by the observer might be different from the frequency of the source. (Doppler's effect).
- Echo forms due to reflection of sound.
- When two sound sources of nearly same frequency are played together, then beats occur.
- Number of beats per sound equal to difference between the frequencies of sources.
- The frequency of sound produced by supersonic engines are above audible range.
- The same note from 'Sitar' and 'Veena' have different quality.
- There is a coating of iron oxide on tape used in tape-recorder.
- The pitch of sound depends upon the frequency. If n is the frequency of open organ pipe and we close an end of the organ pipe, then the frequency will be $n/2$.

- At room temperature velocity of sound is 330 ms^{-1} .
 - There is no change in velocity, wavelength and frequency of refractive wave.
 - Audible frequency ranges from 20 Hz to $20,000 \text{ Hz}$.
 - There is no change in frequency of sound when it changes medium but its velocity, direction and intensity will be changed.
 - The direction of wave is independent of velocity, wavelength and frequency.
 - The velocity of sound is increased with increasing density of medium.
 - Sensation of sound is for $1/10$ second.
 - Receiver of telephone converts electrical energy into sound which the wave is formed.
 - Wave is formed by repeated vibrations of particles of medium.
 - Pulse is a wave set up by single disturbance of short duration.
 - The change in frequency due to Doppler's effect is dependent on the velocities of observer and source.
 - A stationary wave is characterised by the appearance of nodes and antinodes.
 - There is a decrease of 2 in atomic number and decrease of mass number after emission of an α particle.
 - There is an increase of 1 in atomic number after emission of a β particle.
 - There is no effect of γ radiation upon atomic as well as mass number.
 - Neutron was discovered by Chadwick.
 - Carbon dating is used in determining age of fossils.
 - Atomic mass unit (amu) is equal to $\frac{1}{12}$ of the mass of ${}^6\text{C}^{12}$.
 - 1 amu = $1.6 \times 10^{-27} \text{ kg}$
 - 1 amu = 931 MeV
 - Binding energy is the amount of energy required to separate each nucleons from the nucleus.
 - In nuclear fission, a greater nuclei is broken into smaller nuclei and there is a huge amount of energy released. Atom Bomb works on nuclear fission.
 - When two or more smaller nuclei are joined together to form a large nuclei, the process is called nuclear fusion. A great amount of energy is released. Hydrogen bomb works on principle of nuclear fusion. Nuclear fusion is the source of the Sun's energy.
 - Cadmium is a good absorber of neutrons, used as controller in atomic reaction.
 - Nuclear reactor is used for controlled chain reaction.
 - Heavy water, Graphite or Boron oxide are used as moderator in nuclear reactor. (D_2O : heavy water).
- Polonium is first human made element.
 - Mass of neutron is slightly greater than that of proton.
 - Elements having atomic number greater than 83 must be radioactive.
 - Cobalt-60 is normally used in radiation therapy.
 - Before X-ray, Barium is given to the patient because Barium is good absorber of X-ray radiation.
 - X-rays is used for determining structure of crystals.
 - The unit of Plank's is J/S.
 - Proton is ionized hydrogen atom.
 - Cryogenic engine is used in space shuttle.
 - Titanium is known as metal of future.
 - Uranium oxide is known as yellow cake.
 - Tritium is radioactive isotopes of Hydrogen.
 - Tuning of radio is an example of resonance.
 - Cobalt-60 is used in Leukemia treatment.
 - Cybernetics is study of communication between human and machine.
 - The filament of Halogen lamp is made of tungsten-iodine mixture.
 - Ceramic is used in Super-conductivity.
 - A transformer which increases the applied e.m.f. of an alternating current is called **Step-up transformer**.
 - A transformer, which decreases applied e.m.f. of alternating current is called **Step-down transformer**.
 - A device which convert mechanical energy into electric energy is called **dynamo**. However, if it produces a fairly large amount of power, it is called **Generator**.
 - Generator is based on the principle of electromagnetic induction.
 - In generator, armature consists of laminated soft iron core, from the centre of which passes a steel axle.
 - **Slip rings** of generator are made of gun metal.
 - Brushes of generator are made out of carbon or gun metal.
 - Coulomb is the unit of electric charge (coulomb = ampere/second).
 - 1 coulomb = 6.25×10^{18} electron.
 - Magnetic effect of electric current was discovered by Weston.
 - Ammeter is used in DC as well as in AC.
 - Resistance of Ammeter is very low.
 - Resistance of Voltmeter is very high.
 - Voltmeter measures potential difference between two points.
 - A parallel combination of a galvanometer and a small resistance is equivalent to an ammeter.
 - A series combination of a galvanometer and a high resistance is equivalent to a voltmeter.
 - Ammeter is always connected in series while voltmeter is always connected in parallel.

Electron volt is the unit of energy.

► Watt

Watt is the unit of electric power. watt = volt × ampere = $\frac{\text{volt}}{\text{ohm}}$

$1 \text{ KWH} = 3.6 \times 10^6 \text{ J}$

- The resistance of low power (watt) bulb is high.
- Wire of electric heater is made of tungsten.
- Fuse wire is made up of nichrome.
- Transformers work on the principle of electromagnetic induction.
- A step-up transformer can convert low voltage, high frequency AC, to low voltage, high frequency AC.
- Transformer works on AC only.
- Transformation ratio of step-up transformer is always greater than 1.
- Ohm-meter is the unit of specific resistance.
- Lead is used in storage battery.
- Silver is the best conductor of electricity.
- Heating effect of current doesn't depend upon the direction of current.
- AC can't be used in electroplating.
- Soft iron is used in electric magnet.
- For preventing formation of eddy currents, laminated cores are used in transformer.
- Electric current is a continuous flow of electron.
- Capacity of battery is shown in 'Ampere-hour'.
- Chemical energy is stored in battery.
- Specific resistance of any conductor depends upon material of conductor and temperature.
- Dilute HCl is used in car battery.
- AC is not suitable for charging of storage battery.
- With increase in temperature, there is decrease in resistance of Carbon, Silicon and Platinum.
- Muscovite is a common separator in electrical industries.
- Dry cell is primary cell.
- Cadmium cell is called standard cell.
- The frequency of AC mains in India is 50Hz.
- The voltage difference of AC mains is 230V.
- The resistance of Mercury is zero at 4K.
- Copper is the most suitable for electric wire, because it has maximum number of free electrons.

Kiran's One Liner Approach General Knowledge

► Candescent of tube-light is always greater than that of electric power

► Candescent bulb of the same power

1 KW = 1.34 HP

1 KW = 1.34 HP

► bulb of the same power

CHEMISTRY

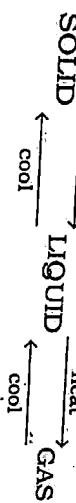
INTRODUCTION

Chemistry is the branch of scienceistry, in our day to day lives, is associated with the properties, characteristics and reactions concerned with the substances, chemistry is playing an important role. Industry and production also chemistry is concerned with the compounds found in living organisms. **Electrochemistry** deals with the chemical changes. **Geochemistry** deals with the relation between the chemical composition of rocks and minerals.

Inorganic Chemistry is associated with the elements found in living organisms. **Organic Chemistry** deals with the compounds of Carbon.

Block diagram: Chemistry is divided into three main branches:

- Anything that occupies space and has mass or weight is called Matter.
- Matter undergoes changes which may be either chemical changes or physical changes.
- All matters exist in one of the three forms or states: solid, liquid and gas.
- The three states of matter are interconvertible.



KINETIC THEORY OF MATTER

- All matters are composed of small particles (molecules, atoms, ions).
- The particles are in continuous, never-ending motion. The higher the temperature, the faster is the motion, as thermal energy is converted into kinetic energy.
- The particles attract one another with a force which decreases with the increasing distance between them.

CHARACTERISTICS OF MATTER

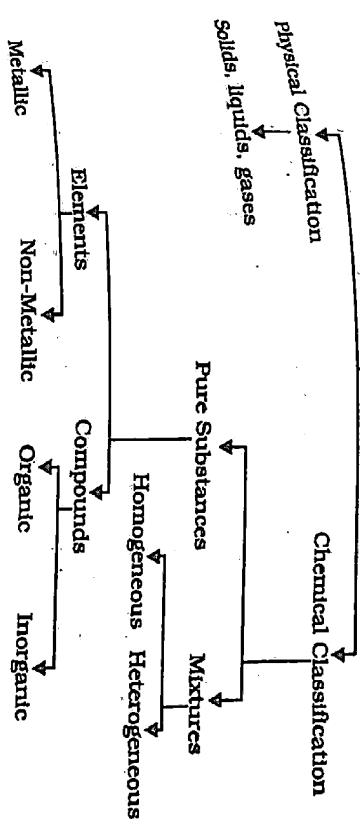
- In a solid, the particles are packed closely together, so inter-particle attractive force is very high.
- Inter-particle force is weak in liquids, so they are able to flow.
- This force is negligible in gases, so they are able to wander about.

CHANGES IN STATES OF MATTER

- Heating increases the kinetic energy and consequently motion of the particles and the rigid structure of the solid is lost.
- Further heating leads to escaping of the particles from the surface.

- When heat is removed from a gas (vapour) the kinetic energy of the particles is reduced and they become slower and thus come nearer. This leads to increase in inter-particle attractive forces and thus condensation occurs, where the attractive forces between the particles are low.

CLASSIFICATION OF MATTER



ELEMENTS

- An element is a pure substance that is composed of only one kind of atoms.
- An element cannot be composed from or decomposed into simpler substance by a physical or chemical change.
- Examples : Aluminium (Al), Hydrogen (H), Iron (Fe) etc.
- Metals are characterised by :
- Metallic Lusture
- Good thermal and electrical conductivity
- Ductility (can be drawn into wires)
- Malleability (can be beaten into sheets) e.g.-Iron, Aluminium Iodine, Chlorine etc.
- Non-metals are characterised by absence of above properties. e.g. Iodine, Chlorine etc.
- Metalloids are elements which exhibit properties midway between those of metals and non-metals, e.g., Arsenic, Antimony.
- Except Mercury, all metals are solid at ordinary temperatures.
- Non-metals are gases or solids under ordinary conditions.

COMPOUNDS

- Compound is a pure substance that is composed of two or more elements chemically combined in definite and constant proportions, e.g. water (H_2O), Sodium Chloride (NaCl) etc.
- The separation of a compound into its elements by chemical means is called Analysis.

The formation of a compound by the union of elements is called

MIXTURES

- A mixture is matter composed by two or more substances (i.e. elements, compounds or both) in variable proportions which properties.
- Mixtures can be heterogeneous i.e. non uniform, or homogeneous, i.e. the same throughout.
- Homogeneous mixtures have the same composition throughout the sample e.g. salt solution.
- Heterogeneous mixture consists of two or more parts which have different compositions.

PROPERTIES OF GASES AND GAS LAWS

- **Kinetic-Molecular theory of Gases**
- Gases consist of molecules widely separated in space. The total volume of the molecules is negligible compared to the volume of the gas as a whole.
- Each molecule in a gas is in a continuous, very rapid, straight-line motion. The moving gas molecules frequently collide elastically with one another and with the walls of the container.
- The total kinetic energy of the gas remains unchanged during collisions.
- Inter-molecular attractive force is negligible in the gases.
- The average kinetic energy of the gas molecules is proportional to the absolute temperature.
- At a given temperature, all gases have the same kinetic energy.

Boyle's Law

- The volume (V) of a given mass of a dry gas is inversely proportional to the pressure (P), if the temperature remains

$$\text{constant i.e., } P \propto \frac{1}{V}$$

Charle's Law

- At constant pressure, the volume (V) of given mass of gas is directly proportional to the absolute (Kelvin) temperature (T). i.e. $V \propto T$.
- Kelvin temperature = Celsius temperature + 273 e.g., $27^\circ\text{C} = (273+27) \text{ K} = 300 \text{ K}$
- **STP:** By convention standard temperature and pressure condition (STP) for volumes of gases have been accepted as 0°C (or 273°K) and 1 atmosphere pressure (760mm Hg).

Ideal Gas Equation :

$$PV = \text{Constant, or } \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$\frac{PV}{T} = \text{Constant}$, or $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$ where, P_1, V_1, T_1 and P_2, V_2, T_2 are changed ones. It is used for calculating pressure change.

ATOMIC STRUCTURE

- An atom consists of a small positively charged heavy nucleus with negatively charged light electrons revolving round the nucleus in circular orbits.
- The nucleus contains protons and neutrons.
- Proton is a positively charged particle having an absolute charge of 1.6×10^{-19} coulombs.
- Electron is a negatively charged particle having an absolute charge of 1.6×10^{-19} coulombs.
- Neutron is an uncharged or neutral particle.

Symbols of some Important Particles

Particle	Symbol	Atomic No.	Mass No.
Alpha (α) particle	${}^4_2\text{He}$	2	4
Beta (β) particle	${}^0_{-1}\text{e}$	-1	0
Proton	${}^1_1\text{H}$	1	1
Neutron	${}^1_0\text{n}$	0	1
Gamma ray (γ)	${}^0_0\gamma$	0	0
Deutron	${}^2_1\text{H}$	1	2
Positron	${}^0_1\text{e}$	1	0
Neutrino	${}^0_0\nu$	0	0

FACTS TO REMEMBER

- Nucleus, consisting of protons and neutrons accounts for the whole mass of the atom.
- Extra-nuclear part is occupied by electrons orbiting in fixed energy levels.
- Having equal number of protons and electrons, atom as a whole is neutral.
- Mass number (A) is the number of protons plus the number of neutrons in the nucleus, also called atomic mass.

- Atomic number (Z) is a number equal to the number in the nucleus.
- Element (Y) is represented as : ${}_{Z}^{A}Y$ e.g., ${}_{1}^{1}H^2$ represents hydrogen (H) with atomic mass = 2 and atomic number = 1
- Electronic configuration is the manner in which electrons arrange themselves in the various orbits.

SOME PRINCIPLES

- Heisenberg's uncertainty principle : It is not possible to determine simultaneously the position and the momentum of a body to arbitrary accuracy.
- Pauli's exclusion principle : No two electrons in an atom can have the same set of 4 quantum numbers.
- Hund's rule : Pairing of electrons in degenerate orbitals belonging to a particular sub-shell does not take place till each orbital is occupied by a single electron with parallel spin.
- Aufbau's principle : In the ground state of an atom and electron enters the orbital of lowest energy first any subsequent electrons are filled in order of increasing energies.

ISOTOPES

- Isotopes are atoms of the same element having the same atomic number, but different atomic weights or mass numbers. e.g., Protium (${}_{1}^{1}H^1$), Deuterium (${}_{1}^{2}H^2$), Tritium (${}_{1}^{3}H^3$) are isotopes of hydrogen. ${}_{6}^{12}C^{12}$ and ${}_{6}^{13}C^{13}$ are isotopes of carbon.

ISOBARS

- Isobars are atoms of two elements having the same mass number, though different atomic number, e.g., both Argon (Ar) and Calcium (Ca) have mass number = 40; C-14 and Nitrogen have mass number = 14

ISOTONES

- Isotones are atoms with different atomic number and mass number, but having same number of neutrons.

PERIODIC TABLE OF ELEMENTS

- Periodic table is the arrangement of elements according to some recurring property.
- Total number of known elements is 109, of which 92 are naturally occurring elements and others are artificially prepared in laboratories.
- Mendeleev's periodic table, based upon Atomic Weights was the first really successful arrangements of elements.
- Modern periodic table or the extended form or long form of periodic table is based upon Atomic Number.

Groups

➤ Vertical columns of the table are called groups.

➤ Group-number is assigned to an element depending upon the number of valence electrons present in the atom of the element.

➤ There are 8 main groups and 18 vertical columns representing the various sub-groups, out of these,

➤ 14 columns represent 14 sub-groups of the first seven groups,

➤ 3 columns for the elements of group VIII,

➤ 1 column for the zero group elements,

➤ There are 8 main groups and 18 vertical columns representing the various sub-groups, out of these,

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➤ 14 columns represent 14 sub-groups of the first seven groups,

➤ 3 columns for the elements of group VIII,

➤ 1 column for the zero group elements,

➤ All Group B-elements, Transition metals, because their chemical properties are between those of elements in Group II and Group III.

Periods

➤ Horizontal rows are called periods.

➤ There are 7 periods in the table, each beginning with an alkali metal on the left and ending with a noble gas on the right [exception 1st and 7th period].

Periodic Properties

➤ Atomic radii is the distance between the nucleus and the valency shell of the atom.

➤ Ionisation (energy) potential is the amount of energy required to remove one or more electrons from the valency shell of an isolated gaseous atom.

➤ Electron Affinity is the amount of energy released on adding one or more electrons to the valence shell of an isolated gaseous atom.

➤ Electronegativity is the tendency of an atom to attract electrons to itself when combined in a compound.

➤ An element is considered as a metal, if it loses electrons when supplied with energy. When an element gains electrons, it is considered as non-metal.

CHEMICAL BONDING

➤ Chemical bonds are formed as a result of loss, gain or sharing of electrons between the atom of reacting elements.

➤ Atoms tend to combine together to change from an unstable form with an incomplete outer shell to a more stable form having

➤ 2 electrons in the first and outer-most shell, e.g., Helium

➤ Or, 8 electrons in the outer-most shell, e.g., inert gases other than helium.

- The linkage which actually holds the atoms together within the molecule is called a chemical bond.
- Cation is the positively charged particle formed by loss of an electron, e.g. Na^+ .
- Anion is the negatively charged particle formed by gain of an electron, e.g. Cl^- .
- Valence e.g. electron is the number of electrons present in the outer-most shell of an atom.
- Valency of an element is the number of electrons lost, gained or shared by one atom of the element during the course of chemical reaction.
- Electropositive nature is the tendency of an atom to lose electrons and form cations. e.g. Metals like sodium, potassium etc.
- Electro negative nature is the tendency of an atom to gain electrons and become anion e.g. Non-metals like hydrogen, carbon, chlorine etc.,
- Electrovalent or ionic bond is the bond formed by transfer of one or more electrons, from the atom of an electropositive element to the atom of an electronegative element, e.g., NaCl , MgCl_2 , CaO .
- Covalent bond is the chemical bond formed between two combining atoms by mutual sharing of one or more electron of atoms of non-metallic element, e.g. H_2O , NH_3 , HCl etc.
- A bond is polar, if the charge is unevenly spread over the bond and Non-Polar, if charge is even spread.
- Coordinate bond is a type of covalent bond in which only one of the atoms contributes both the electrons of the shared electron pair, e.g. $\text{H}_2\text{SO}_4 \cdot \text{NH}_3$.
- Hydrogen bond is an electrostatic force between covalently bonded hydrogen atom of one molecule and an electronegative atom (such as, Fluorine (F), Oxygen (O), Nitrogen (N) of another molecule)
- Hydrogen bond is responsible for exceptionally high melting and boiling points of water (H_2O), Ammonia (NH_3) and Hydrogen fluoride (HF).
- Van der Waal's bond is the force of attraction between neighbouring atom because of their different dipoles induced by instantaneous unsymmetrical distribution of electrons in the atom. It is responsible for condensation of inert elements, and gases, like H_2 , N_2 , O_2 , Methane etc.
- Metallic bond is the attractive force between mobile electrons and the metallic kernels, e.g. Gold, Silver, Copper etc.

CHEMICAL REACTION AND CHEMICAL EQUATIONS

- A chemical change is also termed as a chemical reaction.
- In combination reaction, a single new substance is formed by the union of two or more substances.

- In decomposition reaction, a substance breaks up into smaller, simpler substances.
- In displacement reaction, one element displaces another element from a compound and takes its place.
- A reaction, in which the constituents of two compounds mutually exchange their radicals to form two different compounds, is called a Double Displacement reaction. Its subtypes are:

 1. **Precipitation reaction** in which two compounds in their aqueous state react to form an insoluble residue, called precipitate.
 2. **Neutralisation reaction**, in which acids and bases mix and exchange their radicals to form salt and water.

- In redox reactions oxidation and reduction take place simultaneously.
- Oxidation is the process in which a substance loses electrons.
- Reduction is the process involving gain of electrons.
- Reduction is also identified with removal of oxygen, or addition of hydrogen.
- Oxidising agent is a substance that brings about oxidation, e.g.; Oxygen, Chlorine, Concentrated sulphuric acid, Concentrated and dilute Nitric acid,
- Reducing agent is a substance that brings about reduction e.g.; Hydrogen, Carbon monoxide, Carbon, Ammonia, Coke, Charcoal, Hydrogen sulphide and sulphur oxides.
- Oxidation number is a charge assigned to an atom of a compound or of an ion according to some arbitrary rules.
- Energy is needed to break chemical bonds and energy is released when bonds are formed.
- Study of these energy changes is called Thermodynamics.
- Exothermic reaction: Heat is evolved
- Endothermic reaction: Heat is absorbed
- Photochemical reaction: Light is required
- Chemiluminescent reaction: Electricity is required
- Electrochemical reaction: Electricity is produced
- Nickel and chromium plating is done to prevent steel articles from rusting.
- Gold and silver plating is done on iron or brass objects to improve their appearance.
- Electro-refining of metals is a process by which impurities from metals, extracted by chemical processes, are removed electrolytically to obtain a highly pure metal.

► Metals generally refined by this process are:

1. Zinc
2. Silver
3. Nickel
4. Lead
5. Copper
5. Aluminium

► Electrometallurgy is the extraction of metals from its ores by electrolysis.

ACIDS, BASES AND SALTS

- Acids are substances, which produce hydronium ion (H_3O^+) in their aqueous solution.
- Oxy-acids essentially contain oxygen along with hydrogen and other elements, e.g. H_2SO_4 , HNO_3 , H_2CO_3
- Bases are substances producing hydroxyl ions in their aqueous solution.
- Oxides and hydroxides of metals (or metal like radicals) are called bases.
- Alkali is a water-soluble base, e.g. sodium hydroxide.
- A weak acid remains weak even if it is concentrated because it produces a low concentration of hydrogen ions.
- A strong acid remains a strong acid even if it is diluted, because it produces a high concentration of hydrogen ions.
- Acids generally have a sour taste, while bases have a bitter taste.
- Strong acids are corrosive and can burn through the skin.
- Bases are soapy to touch.

SOME IMPORTANT USES OF ACIDS BASES AND SALTS

Acids

- Sulphuric acid: Manufacture of fertilizers, chemicals, explosives, paints, dyes and drugs.
- Nitric acid: Also used in manufacture of fertilizers, chemicals, explosives, paints, dyes and drugs.
- Hydrochloric acid: Tanning and printing industry.
- Citric acid: In medicine (source of vitamin C), flavouring drinks.
- Boric acid: As an eye-wash, preservation of grains.
- Acetic acid: Flavouring food, food preservation.
- Benzotic acid: Food preservation.
- Carbonic acid: It lends 'fizz' to aerated drinks.
- Oxalic acid: In ink-stain removers.
- Tartaric acid: Constituent of baking powder (reacts with the sodium bicarbonate to release carbon dioxide which makes the dough light and spongy).

Bases

- Sodium hydroxide: Manufacture of soap.
- Calcium hydroxide: Manufacture of bleaching powder, mortar,
- (i) Manufacture of hard water,
- (ii) Softening acid in the soil and in water supplies.

- Potassium hydroxide: Alkaline batteries.
- Magnesium hydroxide: As an antacid to neutralise acidity caused by the hydrochloric acid in the stomach.
- Aluminium hydroxide: Foaming agent in fire extinguishers.
- Ammonium hydroxide: Used to remove grease stains from clothes.

Salts

- Salts are ionic compounds containing a positive ion (cation) and a negative ion (anion).
- Sodium chloride ($NaCl$) is a normal salt.
- Mohr's salt [$FeSO_4(NH_4)_2 \cdot SO_4 \cdot 6H_2O$] and Alum [$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$] are double salt.
- Hydrolysis is a reaction in which a salt reacts with water to form a solution which is either acidic or alkaline.
- Efflorescence is the property of salts to lose their water of crystallisation and are transformed into a powder at ordinary temperatures. Examples:
 1. Washing soda ($Na_2CO_3 \cdot 10H_2O$): sodium carbonate decahydrate.
 2. Glauber's salt ($Na_2SO_4 \cdot 10H_2O$): sodium sulphate decahydrate.
 3. Blue vitriol ($CuSO_4 \cdot 5H_2O$): copper sulphate pentahydrate
 4. Epsom salt ($MgSO_4 \cdot 7H_2O$): magnesium sulphate septahydrate
- Deliquescence is the property of salts to absorb moisture at ordinary temperatures to lose their crystalline form and form a saturated solution.
- Hygroscopy is the property of salts to absorb atmospheric moisture at ordinary temperature without dissolving in it.

ELECTROLYSIS

- Electrolysis is a chemical process by which a chemical substance, in its fused state or in aqueous solutions, is decomposed by the passage of an electric current, leading to the discharge of ions of the electrolyte at the two electrodes.
- Electrolyte is a compound which, in the fused state or in aqueous solution, allows the passage of an electric current and is composed by it.
- Example of strong electrolytes :
 1. Strong acids : Hydrochloric acid, nitric acid, sulphuric acid.

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- 2. Strong bases : Sodium hydroxide, potassium hydroxide.
 - 3. Salts : Lead bromide, sodium chloride, silver nitrate.
 - Examples of weak electrolytes :
 1. Weak Acids : Acetic acid, carbonic acid, formic acid.
 2. Weak bases : Ammonium hydroxide, magnesium hydroxide, copper hydroxide.
 3. Salts : Lead acetate, sodium carbonate.
 - Compounds, which in the fused state or in the aqueous solution do not dissociate into ions are called non-electrolytes.
 - Examples : Distilled water, Acetone, Sugar solution, Petrol, Alcohol, Benzene, Glycerol,
 - Electrodes are the two conducting poles of a metal or graphite through which electric current, i.e., electrons enter or leave the electrolyte in fused or aqueous solution state.
 1. Anode is the electrode connected to the positive terminal of the battery. The current enters the electrolyte through the anode. At the anode the anion loses electrons to form neutral atoms.
 2. Cathode is the electrode connected to the negative terminal of the battery. The current leaves the electrolyte through the cathode. At the cathode, the cation gains electrons to form neutral atoms.
 - Electrolytic cell or voltameter is the complete set-up or vessel consisting of electrodes and electrolytes, in which electrolysis takes place.
 - Theory of Electrolytic Dissociation was first explained by Arrhenius.
 - Non-attackable electrodes are inert and do not enter into a chemical reaction with the electrolyte.
 - Their inertness is because of their higher reduction potential than the ions present in the electrolyte, e.g. graphite, platinum.
- ### SOLUTIONS, SOLUTE AND SOLVENT
- A solution is a homogenous mixture of two or more substances.
 - The substance which is dissolved to make a solution is called solute and the liquid in which solute is dissolved is known as solvent.
 - The true solutions are always homogenous and the size of solute particles is 10^{-8} cm.
 - In a true solution, the solute particles cannot be distinguished from the solvent molecules even by using a microscope.
 - A colloid is a kind of solution in which the size of solute particles is bigger than that of a true solution but smaller than that of a suspension.
- Milk, Blood, Ink, Soap solution, Gum, Jelly are example of colloidal solutions.
 - The size of the solute particles in a colloidal solution is between 10^{-7} cm and 10^{-5} cm.
 - The scattering of light by colloidal particles is called Tyndall effect.

METALS AND NON-METALS

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- The metal oxides are reduced to metal by carbon, aluminium, electrolytic reduction.
- The refining of metals can be done by electrolysis, leaching, distillation or oxidation methods.
- Flotation process is used for the concentration of sulphur ores.

COMPOUNDS OF SODIUM

The important compounds of sodium metal are Common Salt, Washing Soda and Baking Soda.

(1) Common Salt (NaCl)

- Common salt is sodium chloride, NaCl.
- It is a colourless crystalline substance which is highly soluble in water.
- It is hygroscopic due to the presence of small amount of magnesium chloride.

(2) Washing Soda (Sodium Carbonate)

- Chemically, washing soda is a carbonate of sodium metal.
- It is actually sodium carbonate dehydrate, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$.
- It is prepared from sodium chloride by the Solvay process.
- The raw-material used in the manufacture includes, Sodium Chloride (NaCl), Ammonia (NH_3) and Limestone.

(3) Baking soda (NaHCO_3)

- Its chemical name is sodium bicarbonate or sodium hydrogencarbonate.
- It is manufactured from sodium chloride by the Solvay process.
- Sodium bicarbonate is the primary product of the Solvay process.

COMPOUNDS OF CALCIUM

(1) Lime (Calcium Oxide, CaO)

- Chemically Lime is calcium oxide and its formula is CaO.
- It is also called as Quick Lime.
- It is prepared by heating limestone to a temperature of 800°C to 1000°C in a lime kiln.
- Its melting point is very high being 2600°C .

Use of Lime

- (1) Calcium oxide (lime) is used in the manufacture of cement and glass.
- (2) Calcium oxide (lime) is used for drying gases and alcohol.
- (3) Calcium oxide (lime) is used as a basic lining in furnaces.
- (4) Calcium oxide (lime) is used in the preparation of calcium carbide, basic calcium nitrate, and calcium bisulphite.

Uses of Calcium Hydroxide (Slaked Lime)

- (1) A solution of calcium hydroxide (slaked lime) in water called lime-water is used for testing carbon dioxide gas in chemistry laboratories.

(2) Suspension of slaked lime in water is used in white-washing buildings. The calcium hydroxide solution applied to the walls reacts slowly with the carbon dioxide of air to form calcium carbonate which gives a bright appearance to the walls.

(3) Slaked lime is used by brick-layers (masons) to make mortar. Lime mortar is prepared by mixing slaked lime with sand and water.

(4) Slaked lime is used in the preparation of bleaching powder, caustic soda and ammonia.

(5) Slaked lime is used by the farmers to reduce the acidity of sand.

(6) Slaked lime is used for softening temporary impurities of hard water.

(7) Slaked lime is used to remove hair from hides before they are tanned or converted into leather.

(2) Bleaching Powder

- Chemically, bleaching powder is calcium oxychloride.
- Its formula is CaOCl_2 .
- It is produced by passing chlorine gas over dry slaked lime.
- It is soluble in cold water.
- It is a yellowish white powder which gives a strong smell of chlorine.

Uses of Bleaching Powder

- (1) Bleaching powder is commonly used for bleaching washed clothes in laundry (laundry is a place where clothes are washed and pressed).
- (2) Bleaching powder is used for bleaching cotton and linen in textile industry and for bleaching wood pulp in paper industry.
- (3) Bleaching powder is used for disinfecting drinking water supply, i.e. for making drinking water free from germs.
- (4) Bleaching powder is used for the manufacture of chloroform (CHCl_3).
- (5) Bleaching powder is used for making wool unshrinkable.
- (6) Bleaching powder is used as an oxidising agent in many chemical industries.

(3) Plaster of Paris

- Chemically it is calcium sulphate hemihydrate.
- Its formula is $(CaSO_4)_2 \cdot H_2O$.
- It is prepared from Gypsum.
- Gypsum is calcium sulphate dihydrate, $CaSO_4 \cdot 2H_2O$.
- When Gypsum is heated to a temperature of $120^{\circ}C$, it loses three-fourths of its water of crystallisation and forms Plaster of Paris.
- It sets into a hard mass on wetting with water.

Uses of Plaster of Paris

- (1) Plaster of Paris is used in hospitals for setting fractured bones in the right position to ensure correct healing. It keeps the fractured bone straight. This use is based on the fact that when Plaster of Paris is mixed with water and applied around the fractured limbs, it sets into a hard mass. In this way, it keeps the bone joints in a fixed position.
- (2) Plaster of Paris is used in chemistry laboratories for sealing the air-gaps in apparatus where air-tight arrangement is required.
- (3) Plaster of Paris is used in making castings for statues, cheap ornaments, toys and decorative materials.
- (4) Plaster of Paris is used as a fire-proofing material.
- (5) Plaster of Paris is used in making black-board chalk.

Difference Between Metals and Non-metals

Metals	Non-metals
<ol style="list-style-type: none"> 1. Metals have 1 to 3 electrons in the outer-most shell of their atoms. 2. Metals are malleable and ductile, i.e., metals can be hammered into thin sheets and drawn into thin wires. 3. Metals are good conductors of heat and electricity. 	<ol style="list-style-type: none"> 1. Non-metals have 4 to 8 electrons in the outer-most shell of their atoms (except hydrogen which has 1 and helium which has 2 outer-most electrons). 2. Non-metals are brittle. They are neither malleable nor ductile. 3. Non-metals are bad conductors of heat and electricity (except graphite which is a good conductor of electricity).

ELEMENTS AND THEIR OCCURRENCE IN EARTH

- Earth is a rich source of elements, found either in native state or in compound form.
- The solid phase of the earth is called the lithosphere.
- Percentage distribution of elements in earth's crust is as shown below :

Element	Weight (%)	Element	Weight (%)
Oxygen	46.6	Silicon	27.7
Aluminium	8.3	Iron	5.1
Calcium	3.6	Sodium	2.8
Potassium	2.6	Magnesium	2.1
Titanium	0.4	Manganese	0.1
Other metals	>0.1	Hydrogen	0.1
Phosphorous	0.1	Other non-metals	<0.1

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- Ocean and seas, which form major component of hydro-sphere again vast reservoirs of elements.
- The major elements are Chlorine, Sodium, Magnesium, Sulphur, Calcium, Potassium and Carbon in that order.
- The minor elements are Bromine, Boron, Strontium, Silicon, Aluminium and Rubidium.
- Four elements, Chlorine, Bromine, Sodium and Magnesium recovered commercially from sea water.
- The Manganese nodules found in the sea bed may form a potential source of some of the less common metals.
- The atmosphere mainly consists of nitrogen (78.09%), oxygen (20.95%), Argon (0.93%) and other gases (<1%).
- Carbon dioxide forms about 0.03% of the atmosphere.
- Ozone exists mostly at the outer atmospheric level, where it helps in the absorption of solar ultraviolet radiation.
- Examples of elements accumulated in living organisms are:
 1. Iodine in sea weeds
 2. Vanadium in sea cucumbers
 3. Potassium in plant life
- Examples of elements concentrated in different parts of living beings are:
 1. Iron in blood
 2. Zinc in the eyes of certain animals
 3. Magnesium in chloroplast
- The materials which are burnt to produce heat energy are known as fuels.
- On the basis of their physical state fuels can be classified into solid fuels, liquid fuels and gaseous fuels.
 - (i) **Solid fuels** : Coal, coke, wood, charcoal.
 - (ii) **Liquid fuels** : Petrol, diesel, kerosene, alcohol.
 - (iii) **Gaseous fuels** : Natural gas, coal gas, LPG, water gas, gobat gas, producer gas.
- The waste material of living objects like cattle dung and the dead parts of living objects like plants, trees, is called Bio-mass.
- Bio-mass contains carbon compounds and is the oldest source of heat energy for domestic purposes.
- Examples of Bio-mass being used as a fuel are, wood, cattle dung and agricultural wastes like bagasse.
- The destructive distillation of wood yields woodgas, Charcoal, methyl alcohol, acetic acid.
- Bio-gas is a mixture of methane, carbon-dioxide, hydrogen and hydrogen sulphide.
- The major constituent of bio-gas is methane.

- Bio-gas is obtained by the anaerobic fermentation of animal wastes in the presence of water.
- Bio-gas plants.
- Khadi and Village Industries Commission (KVIC) is the major organisation engaged in the promotion and construction of bio-gas plants.
- Coal is a complex mixture of compounds of carbon, hydrogen and oxygen.
- Coal was formed by the decomposition of large plants and trees buried under the earth millions of years ago.

Type of Coal	Carbon Content
Peat	60%
Lignite	70%
Bituminous	80%
Anthracite	90%

- Bituminous coal is used as fuel in our households, and in industry.
- The destructive distillation of coal yields coal gas, ammoniacal liquor, coal tar and coke.
- Coal gas is a mixture of hydrogen, methane, and carbon monoxide.
- Water gas is a mixture of carbon monoxide and hydrogen.
- Producer gas is a mixture of carbon monoxide and nitrogen.
- Petroleum oil was formed by the decomposition of the remains of extremely small plants and animals, buried under the sea millions of years ago.
- The refining of petroleum is done by the process of fractional distillation.

Fractions of Petroleum

Fraction	Molecular composition (Alkanes present)	Boiling range	Uses
1. Gas	C ₁ to C ₄	Below 40°C	Gas is used as a fuel; in the production of carbon black and hydrogen; in the production of liquefied petroleum gas (LPG) and in the manufacture of gasoline (petrol) by polymerisation

2. 'Gasoline or Petrol	C ₅ to C ₁₂	40°C to 170°C	Gasoline is used as motor fuel; as a solvent; for dry cleaning and for making petrol gas.
3. Kerosene	C ₁₂ to C ₁₆	175° to 275°C	Kerosene is used as a household fuel; as an illuminant (for lighting) and for making oil gas.
4. Gas oil and Diesel Oil	C ₁₅ to C ₁₈	250° to 400°C	Used as furnace fuel; fuel for diesel engines, and for making petrol by cracking Lubricating oil is used for lubrication. Vaseline is used for making toilet goods and grease. Paraffin wax is used for making candles.
5. Lubricating oil, Vaseline, and Paraffin wax	C ₁₆ to C ₅₀	Above 350°C	The organic compounds prepared from the hydrocarbons obtained from petroleum and natural gases are called petrochemicals.

- D.T., B.H.C., Ethyl Alcohol, Benzene are important petrochemicals.
- Petroleum gas is a mixture of butane, propane and ethane.
- Petroleum gas liquefied under pressure is called Liquefied Petroleum Gas (LPG).
- LPG consists mainly of butane and small amount of propane and ethane.
- Ethyl mercaptan is added to LPG to help in the detection of gas leakage.
- Natural gas mainly consists of methane (CH₄) and small quantities of ethane and propane.
- The process of breaking bigger hydrocarbon molecules into smaller hydrocarbon molecules by heating in the presence of a catalyst is called cracking.
- The amount of heat produced by burning a unit mass of the fuel completely is known as its calorific value.
- The calorific value is expressed in Kilojoules per gram, KJ/g.

Fuel	Calorific Value
Wood	17 KJ/g
Coal	30 KJ/g
Kerosene oil	48 KJ/g
Petrol	50 KJ/g
Bio-gas	40 KJ/g
Natural gas	50 KJ/g
LPG	55 KJ/g
Methane	

NOBLE GASES

- These are : Helium, Neon, Argon, Krypton, Xenon and Radon.
- Also called 'rare gases', as they are present in very small quantities in the air.
- Radon is not present in air.
- Also called 'inert gases', as they do not enter into chemical reactions.
- Helium is used for filling meteorological balloons and also by sea divers.
- Neon is used in making advertising signs.
- Argon is used to create an inert atmosphere in chemical reactions and in electric bulbs.
- Krypton and Xenon are used in electrical valves and TV tubes and also in lighthouses and miner's lamp.

Common Organic Compounds	
Common name	Chemical name
Marsh gas	Methane
Chloroform	Trichloromethane
Methanol	Methyl Alcohol
Ethanol	Ethyl Alcohol
Vinegar	Acetic acid

SOME USES OF ELEMENTS AND COMPOUNDS

Ozone (O₃)

1. For disinfecting water for drinking purpose
2. For bleaching delicate fabrics, oils starch etc.
3. For purifying air in crowded places
4. For the ozonolysis of organic compounds

Hydrogen peroxide (H₂O₂)

1. As an anticolour in bleaching
2. For restoring the colour of lead painting
3. For preserving milk, wine and other liquids

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Under

Ammonia (NH_3)

- In the manufacture of nitric acid and sodium carbonate
- As a refrigerant
- In the manufacture of rayon
- As an important reagent

Nitric Acid (HNO_3)

- In the manufacture of ammonium nitrate
- In the manufacture of sulphuric acid
- In the manufacture of dyes, perfumes and synthetic silk
- In purification of gold and silver
- In laboratory for borax lead test
- In the manufacture of enamels and glazes for earthen pots
- In preparation of medicinal soaps
- Used for softening water

Boric acid (H_3BO_3)

- In manufacture of enamels and pottery glazes
- For preservation of food in industry
- In the manufacture of pigments and borax
- Used for softening water

Silica (SiO_2)

- As sand which is a building material
- In manufacture of glasses
- $\text{SiO}_2 \cdot \text{NH}_2\text{O}$ is used in chromatography and also for absorbing moisture

Sulphur (S)

- In manufacture of sulphur dioxide and sulphuric acid
- In manufacture of matches, gun powder, fireworks etc.
- In making sulpha drugs
- For disinfecting rooms
- In vulcanisation of rubber

Sulphuric acid (H_2SO_4)

- In fertiliser industry
- In petroleum refining
- In chemical industry
- In metallurgy
- In manufacture of explosives such as T.N.T.

manufacture of paints, plastics, pigments

6. In drying and dehydrating agent

7. As a preservative for fruit products

8. For clearing the surface of metals before electroplating

Sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$)

- In photography as a fizzing agent
- As a preservative for fruit products
- As an antichlor in bleaching
- As a volumetric agent for the estimation of iodine
- Used in medicines

Fluorine (F_2)

- As an oxidizing agent
- Fluorine and its compound (NF_3, OF_2) are used as rocket fuel
- In manufacture of plastic known as teflon
- In manufacture of fluorocarbons from $(\text{CF}_2\text{Cl})_n$
- Preparation of uranium hexafluoride

Iodine (I_2)

- In preparation of ethylene bromide which is mixed with tetraethyl lead and added to the petrol as an anti-knock
- In manufacture of AgBr used in photography
- In manufacture of dyes, drugs, etc.
- In manufacture of benzyl bromide-a tear gas

Helium (He)

- In filling discharge tube
- In gas chromatography
- AgI is used in photographic emulsion

Steel

To protect metal surfaces from oxidation during the welding of

Krypton and Xenon (Kr and Xe)

- For filling incandescent metal filament of bulbs
- Kr-Xe mixture is used in some flash bulbs
- Xe is used in research laboratories for detecting mesons

Radon (Rn)

- In treatment of cancer
- In radioactive researches

Sodium

- Sodium amalgam is used for preparation of organic compounds
- Liquid Na is used as a coolant in nuclear reactors
- In sodium vapour lamps
- As reagent to detect presence of Na, S and Halogens

Potassium (K)

1. as a fertiliser in agriculture

Sodium Chloride (NaCl)

1. As a table salt
2. In manufacture of Na_2CO_3 , NaOH, Cl etc.
3. For salting out soaps
4. In freezing mixtures
5. In tanning and textile industry

Sodium Carbonate (Na_2CO_3)

1. For softening hard water
2. For washing purposes in industries
3. Na_2CO_3 - K_2CO_3 is used as a fusion mixture
4. In petroleum industries
5. In manufacturing of soaps, glasses, paper, borax etc.
6. As a reagent in laboratories

Sodium hydroxide (NaOH)

1. In manufacture of soaps, paper, artificial silk etc.
2. In petroleum industry
3. In purification of bauxite
4. In textile industry for mercerizing cotton fabrics.
5. As a chemical reagent for machines and metal sheets

Postassium Chloride (KCl)

1. As a fertilizer
2. In preparation of potassium compounds

Potassium hydroxide (KOH)

1. In manufacture of soft soaps
2. Absorbing carbondioxide and sulphur dioxide
3. In some organic reactions

Magnesium (Mg)

1. As a reducing agent
2. Alloy with Al used in aircraft industries
3. Mg-powder in flash light
4. $\text{Mg}(\text{OH})_2$ is used as antacid

Calcium (Ca)

1. Removes traces of air from vacuums tube
2. It is a powerful reducing agent
3. To remove moisture from alcohol

Calcium oxide (CaO)

1. As a building material
2. In manufacture of caustic soda
3. As a flux in metallurgy

4. In manufacture of dying stuffs and alcohol
5. In drying gases and alcohol

Calcium Hydroxide ($\text{Ca}(\text{OH})_2$)

1. As a building material
2. As a white wash material
3. For softening hard water
3. For detection of CO_2
4. For carbonate (CaCO_3)

Calcium carbonate (CaCO_3)

1. As a building material

Calcium Sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)

1. For manufacture of Plaster of Paris and ammonium sulphate
2. In manufacture of cement and mortar
3. In preparation of black board chalks
4. As a drying agent

Aluminum Chloride (AlCl_3)

1. As a catalyst in Friedal Crafts reaction
2. As a catalyst in cracking of petroleum
3. As a mordant in dying

Potash alum ($\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$)

1. In purification of water
2. As a mordant of dying and calico-printing
3. In tanning leather
4. To stop bleeding from a fresh cut

Ferric Oxide (Fe_2O_3)

1. As a red pigment
2. For metal polishing
3. As a catalyst

Ferric Chloride (FeCl_3)

1. In medicines as astringent and antiseptic
2. As a mordant in dying
3. As a reagent in Fridei Crafts reaction
4. In block making

Ferrous sulphate ($\text{Fe SO}_4 \cdot 7\text{H}_2\text{O}$)

1. As a mordant in dyeing and tanning industries
2. In manufacture of blue-black ink
3. In manufacture of Mohr's salt, ferric oxide, ferric alum etc.
4. As an insecticide in agriculture

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Kiran's One Liner Approach General Knowledge

1. In making utensils
2. In manufacturing electrical wire
3. In manufacturing electric goods
4. For preparing alloys
5. In electroplating and electrotyping
6. For preparing copper salts
7. As a coinage metal
8. In jewellery

Silver (Ag)

1. In ornaments
2. In silvering of mirrors and in photography.
3. In silver plating
4. In some medicines
5. In making useful alloys

Gold (Au)

1. In Jewellery and is an article of wealth
2. As a coinage metal
3. In covering temple domes
4. In dental filling
5. For gold plating other metals

Copper Sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$)

1. Anhydrous salt is used to test the presence of moisture
2. As a mordant in dyeing and calico printing
3. In electroplating and electrofixing of metals
4. Used as a fungicide

Mercury (Hg)

1. Used in various instruments
2. In mercury vapour lamps
3. In medicines
4. In preparing amalgams
5. As an electrode in various electrolytic process

IMPORTANT PROCESSES

Bosch process	:	Hydrogen
Castner Process	:	Sodium
Down process	:	Sodium
Nelson cell	:	NaOH
Caster Kellner cell	:	NaOH
Lowing process	:	NaOH
Solvay process of Ammonia soda process	:	Na_2CO_3 and NaHCO_3
Leblanc process	:	K_2CO_3
Pecht process	:	K_2CO_3

1. In tinning of copper and brass utensils
2. In tin plating
3. For making a number of alloys
4. For making

Lead (Pb)

1. For making water pipes
2. In lead storage batteries
3. In manufacturing bullets, shots etc.
4. For making $(\text{C}_2\text{H}_5)_4\text{ Pb}$ which is an anti knocking agent for petrol
5. For making pigments
6. For making a number of alloys
7. For making

Carbon Dioxides (CO_2)

1. In preparation of aerated water
2. As a fire extinguisher
3. In manufacture of washing soda
4. As a refrigerant
5. For artificial respiration (85% of O_2 + 5% of CO_2 - carbogen)
6. In purification of cane sugar juice

Carbon Halides (CX_4 , X is F, Cl, I, Br)

1. CCl_4 is used as a solvent
2. CCl_4 is used as fire extinguisher called pyrene
3. CF_2Cl_2 is used as a refrigerant
4. CCl_4 is also used as medicine

Carbides

1. SiC -Carborundum is second hardest substance
2. Tungsten carbide is used for making tools
3. Calcium carbide is used for preparing acetylene
4. Be_4C is also very hard and is used as a shield against radioactive radiations

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Mac Arthur Forrest process : Ag
(Cyanide process)

Parke's process

Pattinson's process

Cupellation process

Mond process

Baeyer's process

Serpeck's process

Hoop's process

Hall-Heroult process

Goldschmidt process

Carter process

Haber's process

Birkeland-Eyde process

Ostwald process

Deacon's process

Lead chamber process

Contact process

Kaldo and L.D. process

Corey-House

Oxo process

Dow's sea water process

Plagion process

Cyanamide process

Bessember-Thomas process

Siemens process

Frasch process

IMI process

Kiran's One Liner Approach General Knowledge

$\text{Ca}_3(\text{PO}_4)_2$

CaO

$\text{Ca}(\text{OH})_2$

NaOH

$3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaCl}_2$

$3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$

K_2CO_3

KCl

$\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

KAlSi_3O_3

KNO_3

$\text{K}_2\text{SO}_4 \cdot \text{MgSO}_4 \cdot 6\text{H}_2\text{O}$

NaNO_3

$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$

$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$

$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$

NaHCO_3

Cu, Ag and Au

H_2SO_5

$\text{H}_2\text{S}_2\text{O}_8$

$\text{B}_3\text{N}_3\text{H}_6$

phosphorite

Quick lime

Slaked lime

Soda lime

Chlorapatite

Apatite (Fluorapatite)

Pearl ash, Potash

Sylvine

Carnallite

Relspar

Saltpetre (Indian saltpetre)

Kainite

Schonite

Calgon (Graham's salt)

Chile saltpetre

Salt cake

Glauber's salt

Nitre salt

Borax

Soda ash

Washing soda

Crystal carbonate

Baking soda

Coinage metals

Caro's acid

Marshall's acid

Borazine (inorganic

Benzene)

Boron nitride

(inorganic graphite)

Copper pyrites

Cuprite (Ruby copper)

Copper glance

Malachite

Azurite

Blue vitriol

Argentite (Silver glance)

Horn silver (Chlorargyrite)

Ruby silver (Pyrrhotite)

Argentiferrous galena

Lunar caustic

Zinc blende

Calamine

Zincite (Red ZnO)

Willemite

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Kiran's One Liner Approach General Knowledge

Bauxite	$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
Diaspore	$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$
Cryolite	Na_3AlF_6
Kaolinite	$\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$
Mica	$\text{K}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2 \cdot 2\text{H}_2\text{O}$
Alum shale	$\text{Al}_2\text{O}_3 \times \text{SiO}_2 + \text{FeS}_2$
Alum stone (Alunite)	$\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 4\text{Al}(\text{OH})_3$
Cassiterite (Tin stone)	SnO_2
Galena	PbS
Anglesite	PbSO_4
Masscote (Litharge)	PbO
Haematite	Fe_2O_3
(Red haematite)	$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$
Limonite	(Brown haematite)
Magnetite	Fe_3O_4
Siderite (Spathic iron ore)	FeCO_3
Iron pyrites	FeS_2
Mohr's salt	$\text{FeSO}_4 \cdot (\text{NH}_4)_2 \cdot \text{SO}_4 \cdot 6\text{H}_2\text{O}$
Green vitriol	$\text{CaMg}_3(\text{SiO}_3)^4$
Asbestos	Conc. HNO_3 + Conc. HCl (1:3 part)
Aqua-regia	$\text{Mg}(\text{ClO}_4)_2$
Anhydrene	BaSO_4
Barytes	$\text{Ba}(\text{OH})_2$ solution
Bleaching powder	CaOCl_2
Boranes	Hydride of boron
Brine	NaCl solution
Carborundum	SiC
Cementite	FeC
Chinese white	ZnO
Caliche	$\text{NaNO}_3 + \text{NaO}_3$
Caustic potash	KOH
Calomel	Hg_2Cl_2
Corrosive sublimate	solid CO_2
Dry ice	CF_2Cl_2
Freon	CaH_2
Hydrolith	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
Hypo	Graphite
Lead pencil	N_2O
Laughing gas	PbO
Litharge (Masscote)	Salked lime + sand (1:3 in water)
Mortar	

Kiran's One Liner Approach General Knowledge

$\text{Cu}_2\text{S} + \text{FeS}$
Pb_3O_4
$\text{NaNH}_3 \cdot \text{HPO}_4$
Paste of $\text{Mg}(\text{OH})_2$ in water (Antacid)
CH_4
$[\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{CO}_3]$
CaCN_2 (a fertilizer) + C
$\text{Ca}(\text{H}_2\text{PO}_4)_2 + 2\text{Ca}(\text{NO}_3)_2$
$\text{NaHCO}_3 + \text{Ca}(\text{H}_2\text{PO}_4)_2 + \text{starch}$
Conc. H_2SO_4
$\text{H}_2\text{S}_2\text{O}_7$
COCl_2
Impure form of iron
A mixture of $\text{CO} + \text{N}_2 + \text{H}_2$
SiO_2
Hg
$\text{CO}_2, \text{NH}_3, \text{CF}_2\text{Cl}_2$, etc
Pb_3O_4
Sodium-potassium tartrate
$\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$
Trinitro toluene (an explosive)
Trinitro benzene (an explosive)
$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$
Na_2SiO_3
$\text{CO} + \text{H}_2$
Pure form of iron
Mustard gas
ZnO

IMPORTANT REAGENTS

Fehling solution	Copper sulphate + potassium tartrate (Rochelle salt) + NaOH
Tollen's reagent	AgNO_3 solution + NaOH solution + NH_4OH
Benedict solution	Alkaline solution of cupric ion complexed with citrate ions
Schiff's reagent	Dilute solution of rosaniline hydrochloride in water, colour has been discharged by passing SO_2
Soda bleach	A mixture of Na_2O_2 and dilute HCl
Soda lime	A mixture of $\text{Ca}(\text{OH})_2$ + NaOH
Fusion mixture	A mixture of $\text{Na}_2\text{O}_3 + \text{K}_2\text{CO}_3$
Lithopone	A mixture of $\text{ZnS} + \text{BaSO}_4$
Nessler's reagent	K_2HgI_4
	Calcium cyanamide + graphite

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Superphosphate	Calcium dihydrogen phosphate + $\text{Ca}_3(\text{PO}_4)_2$
Baeyer's reagent	Cold alkaline KMnO_4 solution + $\text{C}_6\text{H}_5\text{CO}_2\text{Na}$
Lindlar catalyst	Palladised charcoal deactivate with CuCl_2
Milk of magnesia	Suspension of $\text{Mg}(\text{OH})_2$ in water
Lucas reagent	A mixture of conc. HCl and anhy. ZnCl_2
Fenton's reagent	$\text{H}_2\text{O}_2 \cdot \text{FeCl}_3$

IMPORTANT ALLOYS

Aluminium bronze	$\text{Cu} + \text{Al}$
Bronze	$\text{Cu} + \text{Zn}$
Bell metal	$\text{Cu} + \text{Sn}$
Coin alloys (Red)	$\text{Cu} + \text{Sn}$
Duralumin	$\text{Cu} + \text{Zn} + \text{Sn}$
Electron	$\text{Cu} + \text{Ag} + \text{Zn} + \text{Ni}$
German Silver (nickel silver)	$\text{Al} + \text{Cu} + \text{Mg} + \text{Mn}$
Fun Metal	$\text{Mg} + \text{Zn}$
Magnalium	$\text{Cu} + \text{Zn} + \text{Ni}$
Pewter	$\text{Al} + \text{Mg}$
Solder	$\text{Pb} + \text{Sn}$
Type metal	$\text{Pb} + \text{Sb} + \text{Sn}$
Wood metal	$\text{Bi} + \text{Pb} + \text{Sn} + \text{Cd}$
Y-alloy	$\text{Cu} + \text{Al}$
Devarda's alloy	$\text{Cu} + \text{Al} + \text{Zn}$
Ferrosilicon	$\text{Fe} + \text{V}$
Ferovanadium	$\text{Ni} + \text{Cu} + (\text{Fe} + \text{Mn} \text{ is traces})$
Monel metal	$\text{Ni} + \text{Cr} + \text{Co} + \text{Al} + \text{Tl}$
Nimonic series	$\text{Ni} + \text{Cr}$
Hastelloy C, Nochrome	

SCIENTISTS AND THEIR CONTRIBUTIONS

Scientist	Contribution
Neils Bohr	Atomic model, Long form of periodic table
Burzelius	Catalysis
H. Becquerel	Radioactivity
Bronsted-Lowry	Acid-Base concept
J. Chadwick	Discovery of neutron
Debye-Huckel	Theory of strong electrolytes
de Broglie	Wave nature of electron
Faraday	Laws of electrolysis
Fajari	Polarisation of anion
Goldstein	Discovery of proton
Helmholtz	First law of thermodynamics

Hund-Mulliken	Electronegativity scale; Molecular orbital theory
Heitler-London	Valence bond theory
Madam Curie and F. Joliot	Artificial radioactivity
Libby	Radioactive dating
Maxwell	Cyclotron
Mendeleef	Kinetic theory of gases
Mulliken	Periodic table
Mosley	Charge on electron
Ostwald	Modern periodic law
Pauling-Slater	Dilution law for weak electrolytes
Planck	Valence bond theory
Rutherford	Wave nature of light
Roentzen	Discovery of nucleus, nuclear reactions
Rayleigh-Ramsay	Discovery of X-rays
Ramsay-Travers	Discovery of Ar, Kr, Xe
Soddy-Fajan	Group displacement law
Sorenson	pH
Schulze-Hardly	Coagulatin by electrolyte
Thomson	Discovery of mesons
Tyndall	Discovery of solute particles
Yukawa	Light scattering by solute particles

NATURAL OCCURRENCE OF SOME ACIDS

- ▼ Citric acid - Citrus fruits (lemon, orange)
- ▼ Lactic acid - Sour milk
- ▼ Uric acid - Urine
- ▼ Formic acid - Sting of bees and ants
- ▼ Butyric acid - Rancid butter
- ▼ Tartaric acid - Tamarind, grapes, apples
- ▼ Malic acid - Apples
- ▼ Stearic acid - Fats
- ▼ Hydrochloric acid - Gastric juice
- ▼ Acetic acid - Vinegar

pH SCALE

- pH scale is used to measure the strength of an acid.
- If $\text{pH} = 7$ solution is neutral
- $\text{pH} > 7$ solution is alkaline
- $\text{pH} < 7$ solution is acidic
- Water is neutral, having $\text{pH} = 7$.
- Body enzymes act only at specific pH values.
- Crops need specific pH for enhanced growth.

Name	% composition	Alloy of Copper	uses
Brass	Cu: 60% to 80% Rest Zn	utensils	► Bifocal lens : Benjamin Franklin (USA); 1780
Bronze	Cu: 75% to 90% Rest Sn	utensils and bullet	► Blood transfusion : Karl Land Steiner and James Harrison
Phosphorus bronze	Cu: 84-75% to 97.5%	galvanometer	► Blood : Louis Braille (France); 1829
German silver	Sn: 15% P: 0.25-2.5%	utensils	► Braille : Louis Braille (France); 1829
Al Bronze	Cu: 50% to Zn: 25%, Ni: 25%	utensils	► Braule : Robert Wilhelm von Bunsen (Germany); 1855
Monel metal	Cu: 80-90% to Al: 7-12% Sn: 0.5%	jewellary, golden	► Braule : Robert Wilhelm von Bunsen (Germany); 1855
Gun metal	Cu: 30%, Ni: 65%, Re + Mn: 30%	paints coins	► Bunsen burner : Edwin T. Holmes (USA); 1851
Bell metal	Cu: 87%, Sn: 10%, Zn: 3%	acid pump	► Burglar alarm : Pascal (France); 1642
	Cu: 80%, Sn: 20%	in gun industries	► Burglar machine : Pascal (France); 1642
		in bells	► Calculating machine : Pascal (France); 1642

INVENTIONS, DISCOVERIES AND THEORIES

- **Aeroplane** : Orville Wright and Wilbur Wright-the Wright Brothers (USA); 1903
- **Aerosol** : Lyle Goodhue (USA); 1941
- **Airship** : Non-rigid; Henry Giffard (France) in 1952; Rigid : Graf Ferdinand von Zeppelin (Germany) in 1900.
- **Alcohol thermometer** : Fahrenheit (Germany); 1709
- **Anti-polio vaccine** : Jonas E. Salk; 1955
- **Antiseptic surgery** : Joseph Lister; 1867
- **Artificial radioactivity** : Madame Joliot and Irene Curie; 1934
- **Atom bomb (uranium fission)** : Otto Hahn; 1941
- **Atomic numbers** : Mosley; 1913
- **Atomic structure** : Bohr and Rutherford; 1913
- **Atomic theory** : Dalton; 1803
- **Automobile Stream** : Nicolas Cugnot (France) in 1769; First petrol-engined car : Educard Delamare-Deboutteville (France) in 1883; First successful petrol-engined car; Karl Benz (Germany) in 1885
- **Bacteria** : Anton van Leeuwenhoek (Holland); mid 1670s
- **Ball bearings** : (wooden) Benvenuto Cellini of Italy in 1543; (modern) Philip Vaughan of Wales in 1794.
- **Balloon** : Jacques and Joseph Montgolfier (France); 1783
- **Ballpoint pen** : John J. Loud (USA); 1888. (First practical model-Ladisloa and George Biro of Hungary in 1938).
- **Barbed wire** : Joseph F. Glidden (USA); 1873
- **Barometer** : Evangelista Torricelli (Italy); 1644
- **Battery** : Alessandro Volta (Italy); 1800
- **Bicycle** : Kirkpatrick Macmillan (Scotland); 1839
- **Bicycle tyres** : John Boyd Dunlop (Scotland); 1888

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- Electromagnet : William Sturgeon (England); 1824
 - Electron theory : Bohr; 1913
 - Electronic computer : J.G. Brainerd, J.P. Eckert and J.W. Mauchly (USA); 1942
 - Engine (railway) : Stephenson; 1814
 - Escalator : Jesso Reno (USA) and Charles Wheeler (USA) independently; 1892
 - Evolution (theory) : Charles Darwin (England); 1858
 - Film : Musical : Lee de Forest (USA) in 1923; Talking : Warner Bros (USA) in 1926
 - Fire extinguisher (modern type) : George Manby; 1816
 - Fluorescent Light : (Principle) Antoine-Henri Becquerel (France); 1855
 - Flying shuttle : John Kay (England); 1733
 - Fountain pen : Lewis E. Waterman (USA); 1884
 - Gas fire : Philippe Lebon (France); 1799
 - Gas lighting : James Sharp (England)
 - Gas stove : William Murdoch (Scotland); 1792
 - Generator : Picottti (Italy); 1860
 - Gramophone : Thomas Alva Edison (USA)
 - Hearing-aid (electronic) : Miller Reese Hutchinson (USA); 1901
 - Helicopter : Launoy and Bienvenu (France) in 1784-built the first model helicopter in Europe that could fly. E.R. Mumford (1805)-designed the first helicopter capable of carrying a person. Louis Breguet (France) built a four-rotor craft that undertook the first manned flight in 1907.
 - Helium : Pierre J. Janseen (France); 1868
 - Laws of Heredity : Gregor Johann Mendel (Australia); mid-1800s
 - Homoeopathy : Hahnemann
 - Hydrogen : Henry Cavendish (England); 1766
 - Incandescent bulb : Thomas Alva Edison (USA); 1879
 - Induction of electric current : Michael Faraday; 1841
 - Insulin : Frederic Grant Banting (Canada) and Charles Best; 1921
 - Intelligence tests : Alfred Binet and Theodore Simon (France); 1905
 - Jet engine : First turbo-jet engine for flight in 1939 designed by Hans von Ohain (Germany). Practical and successful turbojet by Frank Whittle (Britain)-first flight in 1941
 - Juno (asteroid) : Heinrich Olbers (Germany); 1804
 - Laser : Charles H. Townes (USA) and A.L. Schawlow; 1958-60
 - Laughing gas (nitrous oxide) : Joseph Priestley (Britain); 1772
 - Lightning conductor : Benjamin Franklin (USA); 1752
 - Locomotive : Richard Trevithick (England); 1804
 - Logarithms : First book of tables by John Napier (Scotland); 1614
 - Loudspeaker : Rice-Kellogg (USA); 1924
 - Machine gun : Richard Gatling (USA); 1861
- Man-made fibre : Joseph Swan; 1885
 - Match (safety) : John Lundstrom (Sweden); 1855
 - Microphone : Alexander Graham Bell (USA); 1876
 - Microscope : Zacharias Jansen (Netherlands); about 1590. Electron microscope-Vladimir Kosme Swoykin (Russia and then, USA)
 - Nylon : Wallace H. Carothers (USA); 1938
 - Oxygen : Joseph Priestley (England) and Carl Scheele (Sweden) independently; 1770s
 - Parachute : First design by Leonardo da Vinci (1485). First demonstration L.S. Lenormand (France); 1783
 - Paraffin : Auguste Laurent (France); 1830
 - Parking meter : Carl Magee (USA); first used in 1935
 - Penicillin : Alexander Fleming (England); 1928
 - Periodic Law (of chemistry) : Mendeleyev (Russia)
 - Petrol engine : First internal combustion engine-Etienne Lenoir (1860); the four-stroke engine-Nikolaus Otto (Germany); petrol engine for the modern vehicle-Gottlieb Daimler and Karl Benz independently.
 - Phonograph : Thomas Alva Edison (USA); 1877
 - Photography : (on metal); J. Nicéphore Niépce (France) in 1826; (on paper); W.H. Fox Talbot (England) in 1835; (on film) : John Carbutt (USA) in 1888
 - Planetary motion : Johann Kepler (Germany); 1600
 - Plastic : First plastic material, Parkesine by Alexander Parkes (1850)
 - Powerloom : Edmund Cartwright (England); 1785
 - Psycho-analysis : Sigmund Freud (Austria)
 - Pressure Cooker : Denis Papin (England); 1679
 - Printing press : Johan zu Guttenberg (Germany); 1455
 - Propeller (rotary) : Richard Hoe (USA); 1846
 - Radar : Experiment by Americans Gregory Breit and Merle A. Tuve (1925) often considered the first practical use of radar.
 - Radioactivity (uranium) : Antoine Henri Becquerel (France) discovered natural radioactivity (1896)
 - Radium : Marie Curie (France); 1898

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- **Radio telegraphy** : (Over one km)-Ernest Lord Rutherford New Zealand in 1895; (trans-Atlantic)-Guglielmo Marconi of Italy in 1901
- **Radio transmitter** : Alexanerson; 1914
- **Railway (underground)** : Suggested by Charles Pearson (England) in 1846. Electric-opened in 1890
- **Rayon** : Count Hilaire de Chardonnet (France); 1892
- **Razor** : (Safety) King Camp Gillette (USA)-1895; (Electric) Jacob Schick (USA)-1931
- **Record (long playing)** : Petter Goldmark (USA); 1948
- **Refrigerator** : First compression machine-Jacob Perkins (USA) in 1834. Use of ammonia-James Harrison (Scotland) in 1837
- **(Concept of) Relativity** : Albert Einstein (Germany-born Amer. can)
- **Revolver** : Samuel Colt (USA); 1835
- **Rubber** : Latex foam-1928; tyres-R.W. Thompson (England) in 1845; vulcanized-Charles Goodyear (USA) in 1841; waterproof Charles Macintosh (Scotland) in 1819
- **Safety lamp** : Humphrey Davy (England); 1816
- **Safety pin** : William Hunt (USA); 1849
- **Seed drill** : Jethro Tull; 1701
- **Seismograph** : Robert Mallet
- **Sewing machine** : Barthélémy Thimonnier (France); 1830. The double-pointed needle-Charles Weisenthal (England) in 1755
- **Ship** : Steam-J.C. Perier (France) in 1775; Turbine-Charles Parsons (England) in 1894
- **Short-hand (modern)** : Issac Pitman (Britain); 1837
- **Silicone** : F.S. Kipping (England); 1904
- **Skyscraper** : William Le Baron Jenny (USA); 1882
- **Spinning jenny** : James Hargreaves (England) in 1784
- **Spinning mule** : Samuel Crompton (England); 1779
- **Steamboat** : John Fitch (USA); 1787
- **Steam engine** : Thomas Savery (England) in 1639; (Piston) Thomas Newcomen of England in 1712. (Condenser) James Watt of Scotland in 1765
- **Steam turbine** : Charles Persons (after 1884)
- **Steel production** : Henry Bessemer (England); 1855
- **Steel (stainless)** : Harry Brearley (England); 1913
- **Stethoscope** : Rene T.H. Laennec (France); 1816
- **Streetcar** : Railed 1550; electric-E. Warner von Siemens (Germany) in 1879
- **Submarine** : Cornelius Drebbel (Dutchman living in England); demonstrated in 1624
- **(Phenomenon of) Superconductivity** : (Holland); 1911
- **Synthetic dyes** : William Henry Perkin (England); 1856
- **Tank (military)** : Ernest Swinton (England); 1914
- **Telegraph code** : Samuel F.B. Morse (USA); 1837

- **Telephone** : Alexander Graham Bell (USA); 1876
- **Telex** : Emile Bando, John George Halsey
- **Telescop** : Hans Lippershey (Netherlands); 1608
- **Television** : First proper TV picture transmitted by John Logie Baird (Scotland); 1926
- **Thermometer** : Galileo Galilei (Italy), 1593. Mercury thermometer in 1720
- **Transformer** : Michael Faraday (England); 1831
- **Transistor** : First demonstrated by John Bardeen, William Shockley, Walter Brattain (USA); 1948
- **Typewriter** : Basic-idea-Henry Mill (England); 1714. The first one designed by Christopher Latham Sholes (USA) with Carlos Glidden and Samuel W. Soule (1867)
- **Ultraviolet rays (curative effect)** : Niels Ryberg Finsen (Denmark)
- **Uranium fission** : Otto Hahn (Germany); Bohr (Danish); Fermi (Italy)
- **Vaccination (small-pox)** : Edward Jenner; 1796
- **Vacuum cleaner** : Herbert Booth in early 20th century
- **Vacuum flask** : James Dewar; 1892
- **Velocity of light** : Fizeau; 1902
- **Video recorder** : (Using gramophone discs) J.L. Baird in 1928; (using tape) Alexander Poniatoff in 1956
- **Watch (self-winding)** : Abraham-Louis Breguet (France); 1791
- **Welder (Electric)** : Elisha Thomson (USA); 1877
- **Wireless telegraphy** : G. Marconi (Italy); 1896
- **X-ray** : Wilhelm von Roentgen (Germany); 1895

FACTS TO REMEMBER

- Most reactive solid element : Li
- Most reactive liquid element : Cs
- Highest electronegativity : F
- Highest ionization potential : H
- Lowest electron affinity : Noble gases (zero)
- Liquid element of radioactive nature : Francium (Fr)
- Total number of radioactive elements in periodic table : 25
- Volatile d-block elements : Zn, Cd, Hg
- Element containing no neutron : $^{1}H^1$
- Most abundant element of earth : Oxygen (O)
- Rarest element of earth : Astatine (At)
- Most abundant metal of earth : Al

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BIOLOGY

Element having maximum tendency for catenation	: Carbon
Lightest element	: H
Heaviest naturally occurring element	: U ₂₃₈
Poorest conductor of current	: Pb (metal), S (non-metal)
Amphoteric non-metal	: Si.
Elements showing diagonal relationship	: Li-Mg, Be-Al; B-Si
Metalloids elements	: Ge, As, Sb, Te
Non-metals having metallic luster	: Graphite, Iodine
Element sublime on heating	: I
Noble metals	: Au, Pt
Amphoteric metals	: Zn, Al, Sn, Pb
Non-metal having highest m.pt, b. pt	: Diamond
Metals showing highest ox. no.	: Pu, Os
Element having highest tensile strength	: Boron
Coolant in nuclear reactors	: D ₂ O
Latest discovered element	: Hahnium (Hg, atomic no. 105) Eka (Eka mercury atomic no. 112)
Element kept in water	: P (yellow)
Elements kept in kerosene oil	: Na, K, I ₂ , Cs
Dry ice or Cardice	: CO ₂
Artificial explosive	: Dynamite
First noble prize of chemistry was given to	: Vant Hoff
Tincture iodine (antiseptic)	: I ₂ in alcohol
Some commonly used oxidants	: H ₂ O ₂ , SO ₂ , Cl ₂ , H ₂ SO ₄ , HNO ₃ , SO ₂ , H ₂ S, Cl ₂
Some commonly used reductants	: Bleaching power CO, N ₂ O, NO, H ₂ O
Neutral oxides of non-metals	: O ₃ , NCl ₃
Dry bleacher	: ZnO, PbO, Al ₂ O ₃
Natural explosive	: SnO, BeO
Amphoteric oxides	: O ₂ , S, P
Some polymorphic elements	: FeSO ₄ ·7H ₂ O, MgSO ₄ ·7H ₂ O, ZnSO ₄ ·7H ₂ O, Na ₂ S ₂ O ₃ ·5H ₂ O, FeSO ₄ ·7H ₂ O
Some isomorphous substances	

INTRODUCTION

Biology (Bios = life, logos = study) is defined as the study of Plants and Animals. Biology as a subject encompasses in itself various functions of life, movement, breathing, interaction with the environment, feeding, reproduction etc. Biology also includes a variety of other crucial topics like structure, behaviour etc. Thus to provide a wider perspective to development, behaviour etc. Thus to provide a wider perspective to 'Life Sciences' has been introduced to include all the above mentioned studies. Broadly there are two main divisions of Biology, a new term 'Life Sciences' has been introduced to include all the above mentioned studies. Broadly there are two main divisions of Biology — Botany and Zoology. But both Botany and Zoology have various branches and each forms a new discipline in Biology.

BRANCHES OF BIOLOGY

- Morphology** – It deals with the study of external features of an organism. For example a plant is made up of roots, stem, leaf, flower, fruit etc.; man has eyes, ears, nose, arms, legs etc.
- Anatomy** – The study of gross internal structures of plants and animals is known as internal morphology or anatomy. For example, man has heart, liver, lungs, kidney, pancreas, stomach etc.
- Histology** – The branch of biology which deals with the cellular structures of plants and animals is known as histology.
- Cell Biology** – It deals with the structure, function, reproduction and all other activities of a cell itself.
- Physiology** – It is the study of various processes and functions (like digestion, respiration, excretion, etc.) of the life that make an organism.
- Embryology** – The branch of biology that deals with the study of various events and changes that occur in the formation of zygote and then to transform it into an individual till the birth is known as embryology.
- Ecology** – The branch of biology which deals with the study of organisms with respect to their environment is termed as ecology.
- Taxonomy** – The branch of biology that deals with identifying, naming (nomenclature) and classifying organisms into various groups is known as taxonomy.
- Genetics** – The characters are always transmitted from parents to their children or from one generation to the next generation. For this the nucleus of the cell has chromosomes which bear genes on them. Genes are chemically made-up of DNA (deoxy ribonucleic acid). This DNA acts as a hereditary material. **Heredity** is the science dealing with the study of resemblances and differences between the parents and their off-springs. While, Genetics is a larger science governing heredity.

- 10. Organic Evolution** – It deals with the study of how simple primitive forms have changed to, gradually over a period of time, more complex and present day forms of life. The vast variety of plants and animals have come up due to organic evolution.
- 11. Palaeobiology** – It deals with the study of origin, structure, growth of various forms of life that have existed in the past, and only the fossils are available now. **Palaeobotany** deals with the study of fossil plants; and **Palaeozoology** deals with the study of fossil animals. The study of fossils, as such, is known as **Palaeontology**.
- 12. Molecular Biology** – It deals with the study of various complex organic molecules of which the organism is made. For example, the structures of various enzymes or proteins, carbohydrates, nucleic acids, hormones etc. It also includes the ways they are metabolised in our body.
- 13. Space Biology** – It deals with the effects of space conditions on an organism. It is also called as **Exobiology**.
- 14. Radiation Biology** – It is the study of harmful and useful effects of various radiations (α , β , γ rays, etc.) on the organisms.
- 15. Anthropology** – It is the study of physical and mental constitution of man, his cultural development, social conditions in the past and present. In other words, it is the study of evolution of man through culture.
- 16. Agriculture** – It is the science of producing plants and animals useful to man. It includes the cultivation of land, breeding and management of crops and animals.
- 17. Agronomy** – It is a branch of agricultural science and deals with the study of crops and soils in which they grow.
- 18. Soil Science** – It is the study of structures, types, and dynamics of the soil.
- 19. Horticulture** – It is a branch of agriculture that deals with the study of growing vegetables, fruits and ornamental plants.
- 20. Pathology** – It is a science that deals with the study of nature of diseases, their causes, symptoms and effects.
- 21. Entomology** – It is a branch of science dealing with the study (habits, classification, functions, structures etc.) of insects.
- 22. Protozoology** – It is the study of unicellular organisms.
- 23. Bacteriology** – It is the study of bacteria.
- 24. Ichthyology** – It is a branch of science that deals with the study of fishes.
- 25. Ornithology** – It is a branch of science that deals with the study of birds.
- 26. Herpetology** – It is the study of amphibians and reptiles.
- 27. Veterinary Science** – It is the study of diseases of domesticated animals and their health care.
- 28. Poultry Science** – It deals with the study of domestic fowls such as chickens, ducks and geese.

BIOLOGICAL CLASSIFICATION

- There are seven main categories used in any plan of classification —
- 1. SPECIES
 - A species is a population of plants or animals which are genetically distinct, reproductively isolated and similar in morphological characteristics. The members of a species can freely interbreed among each other. For example, a population of lions represents the species *Panthera leo*; and a population of tigers comprises the species *Panthera tigris*.
- 2. GENUS
 - It is a category consisting of two or more species. In general, species in a genus usually have many features in common. Such groups of common features are known as correlated characters. Each species of a genus is given a scientific name based on binomial nomenclature. For example; the genus *Solanum* includes the

29. Sericulture – It deals with the management and breeding of silk worms to produce silk.

30. Silviculture – It is the science of studying the establishment, development, care and reproduction of valuable timber trees.

31. Forestry – It is the science of developing, cultivating and conserving forests to have the maximum utility.

32. Apiculture – It is the science of keeping and breeding of honey bees to obtain honey and bee's wax.

33. Dairy Technology – It is the application of science for the manufacture of milk products.

34. Microbiology – It is a science dealing with the structure, function, uses etc. of microscopic organisms.

35. Pharmacology – It is a science dealing with the knowledge of drugs and the preparation of medicines.

36. Psychology – It is a science dealing with the qualities and behaviour of human mind.

37. Pharmacy – It is a science of preparing and compounding medicines and dispensing them according to the medical prescriptions.

38. Physiotherapy – It is the science of treatment of diseases, body weakness or defects by physical methods like massage and exercise.

39. Nutrition – It is the study of nourishment of human beings or other organisms.

40. Genetic Engineering – It involves the manipulations at gene level so as to produce an organism with new and desired characters.

41. Biomedical Engineering – It is the science of producing spare parts of man, implants artificial limbs, heart lung machines etc.

42. Food Technology – It is the application of science for the processing and preservation of foods.

species *Solanum melongena* (makoi), *Solanum tuberosum* (brinjal), *Solanum xanthocarpum* (Kantali).

3. FAMILY

- This category comprises one or more genera having some common features but differing from the genera of other families in having certain characteristic differences. For instance, the family Papilionaceae represents all the genera of the pulses; and the family Gramineae contains all the genera of cereals and millets.

4. ORDER

- It consists of one or more families having certain common characters which differ from families of other orders in some diagnostic characters. For example, the order Carnivora includes the families felidae (which includes lions, leopards and tigers) and Canidae (which represents dogs and foxes).

5. CLASS

- It consists of one or more orders having certain characters in common but differ from orders of other classes in some other characters.

6. PHYLUM

- It comprises one or more classes having certain common diagnostic characters but differ from classes of other phyla in some other diagnostic characters.

7. KINGDOM

- It is the highest category in the plan of classification. Each kingdom has several independent phylum which in turn, represent specific classes, orders, families and genera.

KINGDOM OF LIVING BEINGS

Kingdoms	Characters	Members
1. Monera	Unicellular, prokaryotic, Autotrophic mode of nutrition, Asexual reproduction, Multiplication by amitosis	Archabacteria (ancient bacteria), Eubacteria (true bacteria), cyanobacteria and Blue green algae
2. Protista	Unicellular, Eukaryotic, Aquatic, Autotrophic and Heterotrophic mode of nutrition, asexual reproduction by division into two, sexual reproduction by fusion.	Protozoans, slime moulds and water moulds
3. Fungi	Multicellular, Eukaryotic, no true tissues, cell wall made up of chitin. Heterotrophic, saprobiotic, parasitic mode of nutrition (absorptive), asexual and sexual reproduction by spores and gametes respectively.	Bread mould, yeast, mushrooms.

A Comparison of Prokaryotes and Eukaryotes

Eukaryote :- Within the cell, in most of plants and animals, there are various **membrane bound** structures called as organelles like mitochondria, chloroplast, nucleus, etc. Such a cell is known as an **eukaryote**. There are non-membrane bound organelles also present in eukaryotic cells. They are mainly the ribosomes and centriole. Each cell organelle performs a specific function of the cell in a well organised manner.

Prokaryote :- In bacteria and blue green algae cells, there are no definite cell organelles and the nucleoplasm and cytoplasm is not separated. Such a cell is known as a **prokaryote**. Prokaryotic cells can also carry out all biological functions similar to those of eukaryotic cells. However, the absence of membrane bound structures within the cell simply shows that they are primitive cells.

Difference between Plant cell and Animal cell

Plant Cell	Animal Cell
1. Cells are covered by a cell wall made up of cellulose.	A Cell wall is absent.
2. Centrioles with centrosome are absent (except a few lower plants).	Centrioles with centrosome are present near the nucleus.
3. Plastids containing pigments are present.	Plastids are absent.
4. Golgi bodies are in the form of a number of unconnected units called dictyosomes.	Golgi bodies are localized and consists of connected complexes.
5. Vacuoles are large in size and more in number.	Vacuoles are either absent or a few only.

Structure and Function of Cell Organelles	
Organelle	Structure
1. Cell Wall	Found in plant cells only; mainly made up of cellulose and hemicellulose, chitin (fungus), protein (bacteria).
2. Nucleus	Contains DNA and protein; limited by a nuclear membrane in eukaryotic cells, nuclear membrane not formed in prokaryotic cells, contains nucleoplasm; nucleoplasm contains chromatin material.
3. Mitochondria	Two membranes — larger membrane folded inside the smaller membrane forming cristae; the inner surface of the inner membrane has a number of F_1 or elementary particles.
4. Plastids	Double membranous structure, inner membrane in the form of thylakoids forming stroma and grana, They are of three types: (i) Chloroplasts contain chlorophyll (ii) Chromoplasts contain pigments other than chlorophyll (iii) Leucoplasts do not contain any pigment.
5. Endoplasmic Reticulum	Membrane folds forming cisternae, vesicles and tubules; of two types SER (without ribosomes) and RER (with ribosomes); Stacks of membranes in the form of cisternae, vacuoles and vesicles; in plant cells known as dictyosomes .
6. Golgi Complex	Stacks of membranes in the form of cisternae, vacuoles and vesicles; in plant cells known as primary lysosomes, secondary
7. Lysosomes	Small membrane sacs containing hydrolytic enzymes; classified as primary lysosomes, secondary

Organelle	Structure
lysosomes, autophagic vacuoles and residual bodies depending upon the physiological state of their action.	
8. Peroxisomes	Small-sized organelles containing enzymes like catalyses and oxidases.
9. Ribosomes	Small spherical bodies having high deposits of fats and lipids; enzymes like acid phosphates are found. Small bodies found in the seeds of groundnut and castor (that contain fatty acids).
10. Centriole	Two dot-like bodies present near the nucleus; shows 9+0 pattern of arrangement of microtubules.
11. Cilia and Flagella.	Surrounded by a membranous covering; shows 9+2 pattern of arrangement of microtubules.
12. Microtubules and Micro-filaments	Long, unbranched cylindrical tubes made up of proteins like tubulin and actin; forms network in the cytoplasm of the cell.
13. Vacuoles	Membraneous bags filled with cell-fluids; membrane is known as tonoplast.

Function
(i) It provides strength and rigidity to the cells.
(ii) Inheritance characters.
(iii) Controls various metabolic activities of the cell.
(iv) Helps in cell expansion.
(i) Division of the cell.
(ii) Inheritance characters.
(iii) Controls various metabolic activities of the cell.
(iv) Helps in cell division.
(i) Site of cellular respiration (Krebs cycle and electron transport chain); associated with the release of energy by the oxidation of food (oxidative phosphorylation).
(ii) Site of photosynthesis in green plants.
(iii) Release of energy in the process of photophosphorylation (photosynthesis).
(iv) Provide different colours to flowers and fruits.
(v) Store the food of the plant body.
(vi) Provides surface for various chemical reactions and the transport of substances within the cell.
(vii) Involved in the secretion, absorption and transport of various substances within the cell.
(i) Forms spindle-fibres at the time of cell division.
(ii) Involved in the formation of cilia and flagella of the cell.
(iii) Helps in the formation of sperms from spermatids.
(i) Locomotion in unicellular organisms
(ii) Transport of substances in higher organisms.
(i) Maintenance of cell and chromosome movements.
(ii) Contraction and relaxation of muscles.
(i) contain various materials
(ii) Osmo-regulatory in function.

Kiran's One Liner Approach General Knowledge

Cycads : They grow in the warmer regions of the plains and have high ornamental value. e.g. Cycas Circinalis.

Conifers :- They are the most predominant gymnosperms.

They are a good source of timber, resin and turpentine oil.

e.g. Pines, Fir, Cedar.

Angiosperms :- They are vascular seed plants characterised by their flowers are further divided into two groups :

(a) **Monocotyledons** :- They are characterised by a single cotyledon in the seed e.g. wheat (*Triticum Vulgare*), rice (*Oryza Sativa*), Maize (*Zea Mays*).

(b) **Dicotyledons** :- They are characterised by having two cotyledons in the seed e.g. Rose (*Rose Indica*), apple (*Malus Silvestris*), Pea (*Pisum Sativum*).

Difference between DNA and RNA	
RNA	DNA
(i) The sugar is ribose.	The sugar is deoxyribose
(ii) It is a single-stranded structure	It is a double-stranded structure
(iii) Adenine, guanine, uracil and cytosine are the four bases.	Adenine, guanine, cytosine and thymine constitute the four bases.
(iv) It is found both in the nucleus and in the cytoplasm.	It is found only in the nucleus.

BOTANY

- Botany is the scientific study of plants.

Classification of Plants

- A. Cryptogamiae** :- These plants do not bear flowers or seeds and reproduce by spores. They have three divisions.
- Thallophyta** :- They are most primitive plants devoid of any body differentiation. They are divided into three classes :
 - Algae** :- They are simple plants, largely found in marine & freshwater habitats. Some algae are terrestrial also. e.g. Blue green algae (*Nostoc*), green algae (*Ulothrix*), red algae (*Grateloupia*) etc.
 - Fungi** :- These simple plants lack chlorophyll and are generally saprophytic or parasitic. e.g. *Agaricus*, *Aspergillus*, *Rhizopus*.
 - Lichens** :- Lichens grow on rocks, tree-trunks and are symbiotic associations between algae and fungi, e.g. *Usnea*, *Parmelia*.
 - Bryophyta** : These are simple, terrestrial plants commonly found in moist habitats. e.g. *Funaria*, *Riccia*. They are divided into two classes-
 - Hepaticae (Liverworts)** :- A class of bryophytes containing prostrate thallose dichotomously branching plants bearing unicellular rhizoids e.g. *Pellia*, *Marchantia*.
 - Musci (Mosses)** :- This class includes erect leafy plants with multicellular rhizoids. e.g. *Funaria*, *Mnium*.
 - Pteridophyta** : These are vascular non-seed bearing plants. They are found mainly in shady or damp places. e.g. *Azolla*, *Pteris*, *Marsilea*, *Pteridium*.
 - Phanerogamae** : These are higher plants bearing flowers and seeds. Their body is differentiated into root, stem and leaves and vascular system are well-developed. These are divided into Gymnosperms and Angiosperms.

- Gymnosperms** :- These are the naked seeded vascular plants. They includes cycads and conifers.

PLANT STRUCTURE AND FUNCTIONS

The Root

- The Plant structure that grows into the soil and anchors the plant to the ground.
- Roots develop from the radicle of the embryo.
- Roots differ from shoots in lacking chlorophyll and in the arrangement of Xylem and Phloem.

Kinds of Root Systems

- Tap Root System** :- Root develops from the radicle and continues growing actively producing later branches. Tap roots are characteristic of most of the dicot plants. They are mostly present in some annual plants.
- Adventitious Root System** :- Root develops from any part of the plant other than the radicle. They occur in grasses and may be regarded as characteristic of monocot plants.

Modifications of Roots

- Fusiform** :- Swollen root with tapering at both ends. e.g. radish.
- Napiform** :- Root is globular and tapers abruptly e.g. beet root.
- Tuberous** :- Root with no definite shape e.g. 4' O clock plant.
- Fasciculated** :- When storage roots occur in cluster e.g. Dahlia.
- Beaded** :- When roots are swollen at frequent intervals e.g. bitter gourd.
- Assimilatory** :- Which develop chlorophyll and photosynthesis e.g. *Tinospora* and *Trapa*.
- Haustoria** :- They are the roots of the parasitic plants which penetrate the host tissue e.g. in *cuscuta*.

Functions of Root

- The roots absorb water and minerals from the soil.
- The roots fix the plant to the soil firmly.

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- (3) The roots absorbed water and minerals are translocated to the stem through the xylem of the root.
- (4) Some roots help in vegetative propagation of species.
- (5) Some roots store food and become swollen.
- (6) Some roots manufacture food through photosynthesis.
- (7) In parasitic plants roots penetrate the host stem to obtain food and water.

The Stem

- Stem is a longitudinal axis upon which are borne the leaves, buds and reproductive organs of the plants.
- The stem along with its leafy branches constitutes the shoot system of the plant.

Categories of Stem

- (1) **Tree** :- A tree possesses a main stout stem called the trunk and bears branches.

- (2) **Shrub** :- The stem is 3 to 10 ft long and bears branches near the base of the plant. e.g. Rose, Jasmine etc.

- (3) **Herb** :- Soft and pliable stem. e.g. Tomato, Tulsi.

Forms of the Stem

- (1) **Erect Stems** :- These are stout stems and can stand erect without any external support. e.g. Neem, Mango, bamboo.
- (2) **Weak Stems** :- These stems are thin, delicate, weak and are unable to stand erect e.g. Portulaca, Cuscuta, Grass.

Modifications of Stems

- (1) **Underground Modifications** :- They are of four types.

- (i) **Rhizome** :- horizontally grousing, fleshy, underground stem e.g. Ginger, Turmeric etc.

- (ii) **Bulb** :- The stem is reduced to a disc like structure, bearing concentric layers of fleshy leafy bases that comprises the food store e.g. Onion, garlic.

- (iii) **Tuber** :- A swollen underground stem that contains stored food, and acts as an organ of perennation and vegetative propagation. e.g. Potato.

- (iv) **Corm** :- Short erect fleshy swollen underground stem. e.g. Alocasia, Colocasia.

- (2) **Subaerial Modifications** :- These are of four types.

- (i) **Runner** :- e.g. Grass, Oxalis.

- (ii) **Stolon** :- e.g. Jasmine, Strawberry.

- (iii) **Offset** :- e.g. Water hyacinth.

- (iv) **Sucker** :- e.g. Rose, Chrysanthemum.

- (3) **Special Modifications** :

- (i) **Stem tendril** : e.g. Grapes,

- Thorns** : e.g. Citrus, Bougainvillea.
(ii) Phylloclade : e.g. Cactus.
(iii) Bulbils : e.g. Aloë.
(iv)

The Leaf is a flattened appendage of the stem that arises as a superficial outgrowth from the apical meristem.

- Leaves are the chief photosynthetic organs of the plant.
- Collectively leaves constitute the foliage of the plant.
- Leaves initiate from the shoot meristem as Primordia and gradually emerge as they grow older.
- Compound leaves may be of two types (a) Pinnate and (b) Palmate.

Types of Leaves
 Depending upon the incision of lamina, they are of two kinds —
 (i) Simple leaves (ii) Compound leaves.

- Simple Leaves** :- A leaf is said to be simple when its lamina is entire or is incised but the incision do not touch the midrib.
- Compound Leaves** :- A leaf is said to be compound when its lamina is completely divided into distinct segments or leaflets.

- (1) Leaf Tendrils :- e.g. Sweep pea, Wild pea.

- (2) Leaf Hooks :- e.g. In Bignonia unguis - cati

- (3) Leaf Spines :- e.g. In Berberis, Opuntia.

- (4) Leaf Scales :- e.g. In Asparagus, Ruscus

- (5) Phyllodes :- e.g. In Acacia moniliformis, Parkinsonia aculeata.

Functions of Leaves

- (1) The most important function is the manufacture of organic food through photosynthesis.
- (2) Gaseous exchange, necessary for photosynthesis and respiration takes place through leaves.
- (3) Stomata borne on the leaves helps in the process of transpiration.
- (4) In insectivorous plants, leaves are modified into insect-traps.
- (5) In some plants, leaves store water to resist drought.

The Flower

- Flower is the characteristic reproductive structure of an angiosperm.
- Morphologically, the flower is considered as a shoot bearing nodes and modified floral leaves.
- Flowers exhibits wide variation in size, shape, colour and arrangement of floral parts.

compiled by Sujoy

Basic Plan of Flowers

- The stalk of the Flower is called Pedicel.
- Sepals are green, leaf-like structure that arise at the base of flower and forms the outermost circle of appendage.
- Collectively the Sepals are referred to as Calyx.
- Petals are brightly coloured and are collectively called petals.
- The third group of appendages consists of Stamens, collectively called the Androecium.
- Each Stamen consists of a slender stalk, the Filament and the Anther.
- The Stamens are the male reproductive organs of the flower.
- The centre of the flower contains the female reproductive whorl called the Gynoecium or Pistil.
- Pistil is composed of one or more carpels.
- Each Carpel consists of three parts — Stigma, Style and Ovary.
- Inside the ovary the ovules develop from the Placenta.

Pollination

- The term pollination refers to the transfer and deposition of pollen on the stigmatic surface of the flower.

Types of Pollination	
Technical Term	Agencies of Pollination
Anemophily	Wind
Hydrophily	Water
Entomophily	Insects
Ornithophily	Birds
Chiropterophily	Bats

IMPORTANT INFORMATION

- (i) **Hypogynous Flowers** :- When the ovary is situated on the torus above all other floral parts. e.g. Mustard, Tomato.
- (ii) **Perigynous Flowers** :- The thalamus forms a cup shaped structure around the ovary and bears sepals, petals and stamens. e.g. Rose.
- (iii) **Epigynous Flowers** :- The thalamus is cup shaped and is fused with the ovary such that the other floral parts arise on the top of the ovary. e.g. Cucumber, Apple.
- (iv) **Hermaphrodite** :- Flowers that bear organs of only one sex.
- (v) **Unisexual** :- Flowers that bear flowers of both sexes. e.g. Maize.
- (vi) **Monocious** :- Plants that bear flowers in which male and female flowers are borne on separate individuals.
- (vii) **Dioecious** :- Denoting a plant species in which male and female flowers are borne on separate individuals.

Plant Hormones and their functions	
Hormone	Functions
Auxins	Prevent premature fall of leaves, fruits etc., promotes enlargement, stimulates respiration.
Gibberellins	Promote germination, promote flowering, break dormancy of buds.
Ethylene	Triggers fruit ripening, accelerates abscission of leaves, flowers and fruits.
Cytokinin	Break dormancy in seeds, delay the ageing process in plants.
Abscisic Acid	It is a growth regulator, involves in the dormancy of seeds, acts as a stress hormone.

FRUITS

- A Fruit is a ripened ovary.
- fruit is formed through the processes of pollination and fertilization which stimulates the ovary to grow and as a response ovary grows into a fruit.
- The fruit consists of a fruit wall, the Pericarp.

Zones of Fruit Wall (Pericarp)

1. Epicarp :- Outer Skin.
2. Mesocarp :- Sweet, edible flesh.
3. Endocarp :- innermost hard zone that enclosed the seed.

Types of Fruits

1. **True Fruits** :- Fruit which is derived only from the single ovary of a single flower and in the development of which no other part outside the ovary has taken part is called the true fruit e.g. Mango, Orange.
2. **False Fruit** :- When apart from the ovary other floral parts also take part in the formation of fruit, it is called as false fruit. e.g. Apple, Banana.
3. **Simple Fruits** :- A simple fruit is one in which ovary takes part in development e.g. Bean, Mustard, Citrus.
4. **Aggregate Fruit** :- In an aggregate fruit each free carpel develops independently to form a bunch of fruits e.g. Strawberry, Custard apple.
5. **Composite Fruit** :- A composite or multiple fruit develops from an inflorescence by the fusion of flowers and their parts e.g. Pineapple.

NUTRITION IN PLANTS

- Autotrophic Nutrition and Heterotrophic Nutrition are two modes of Plant Nutrition.
- Sixteen essential elements are required for the normal growth of plants.

- Sixteen essential elements includes ten Macroelements and six micro-elements.
 - Macronutrients :- Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, Potassium, Magnesium, Sulphur, Calcium, Iron, Chlorine.
 - Micronutrients :- Boron, Copper, Manganese, Zinc, Molybdenum, Chlorine.
- ### Nitrogen Nutrition in Plants
- Atmosphere is the ultimate source of nitrogen.
 - Nitrogen cannot be used directly but has to be fixed to form compounds.
 - Higher plants utilise nitrogen in the oxidised forms such as nitrate (NO_3^-) and nitrite (NO_2^-) or in the reduced form (NH_4^+).
 - The best known nitrogen fixing symbiotic bacterium is Rhizobium.
 - Free living micro-organisms such as the cyanobacteria and photosynthetic bacteria can also fix nitrogen.
 - In nitrogen fixation the diatomic nitrogen of the atmosphere is reduced to ammonia with the help of enzyme nitrogenase.
 - Soil bacteria like Nitrosomonas and Nitrospoccus are capable of converting ammonia to nitrite (NO_2^-) ions.
 - Then, these (NO_2^-) ions are converted into Nitrate (NO_3^-) by Nitrobacters.
 - These nitrates are absorbed by the plants through their roots.

Mineral Elements in Plants and Their Deficiency Symptoms

Elements	Deficiency symptoms
Nitrogen	Stunted growth, chlorosis, Chlorosis, Yellowing of leaves.
Magnesium	Poor growth, leaves dull green
Calcium	Yellow edges to leaves, premature death.
Phosphorus	Chlorosis, leaf curl, woody stems.
Potassium	Chlorosis, reduced growth.
Sulphur	Chlorosis, grey spots on leaves.
Iron	Brown heart disease.
Manganese	Dieback of shoots.
Boron	Retardation of growth.
Copper	Malformed leaves, reduced flowering and fruiting.
Molybdenum	
Zinc	

Element	Obtained as	Role of mineral required	Functions
Sulphur	SO_4^{2-}	Leaves and seeds	Stem and root tips; young leaves; remobilised during senescence
Iron	Fe^{3+}	Everywhere; collects along leaf veins	Constituent of ferredoxin and cytochrome; activates catalase; required for synthesis of chlorophyll
Manganese	Mn^{2+}	Leaves and seeds	Activates certain enzymes (carboxylases)
Molybdenum	Mo^{3+} or Mo^{4+}	Leaves and seeds	Activates certain enzymes in nitrogen metabolism
Boron	$\text{B}_4\text{O}_5^{2-}$ or BO_3^{2-}	Everywhere	Required for uptake and utilisation of Ca^{2+} ; pollen germination and cell differentiation.
Copper	Zn^{2+}	Everywhere	Activates certain enzymes
Zinc	Cu^{2+}	Everywhere	Activates various enzymes especially carboxylases, part of carbonic anhydrase and various dehydrogenases; needed for auxin synthesis.
Chlorine	Cl^-	Everywhere	With Na^+ and K^+ helps determine solute concentration and anion-cation balance in cells; essential for oxygen evolution in photosynthesis.
Nitrogen	NO_3^- or NO_2^- or NH_4^+	Everywhere; particularly in meristematic tissues	Constituent of proteins, nucleic acids, vitamins, hormones, coenzymes, ATP, chlorophyll
Phosphorus	H_2PO_4^-	Younger tissues; withdrawn from old; meristemically less active cells	Constituent of Cell membrane, certain proteins; all nucleic acids and nucleotides; required for all phosphorylation reactions.
Potassium	K^+	Meristematic tissues; buds, leaves, root tips	Helps determine anioncation balance in cells; involved in protein synthesis; involved in formation of cell membrane and in opening and closing of stomata; increases hardness; activates enzymes and helps in maintenance of turgidity of cells.
Calcium	Ca^{2+}	Meristematic and differentiating tissues; accumulates in older leaves	Involved in selective permeability of cell membranes; activates certain enzymes; required for development of stem and root apex, and as calcium-uptake in the middle lamella of the cell wall.
Magnesium	Mg^{2+}	Leaves; withdrawn from ageing leaves and exported to developing seeds	Activates enzymes in phosphate metabolism; constituent of chlorophyll; maintains ribosome structure

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Photosynthethals

- Photosynthesis is the process by which green plants energy and convert it into chemical energy of carbohydrates trap
- Photosynthesis is the only source of energy for all organisms.



- This reaction occurs in the grana of cell's chloroplast.
- The dark reaction occurs in the stroma of chloroplast and absorbed from the atmosphere is reduced to make Carbohydrates.
- Only 0.2% of the light energy incident on earth is utilised by photosynthesis organisms.
- Leaf is the major organ of photosynthesis in plants.
- All green parts of the plants have chloroplasts.
- Chloroplasts are enveloped by double-membrane enclosing stroma in which grana are present. The grana contains pigments such as Chlorophyll.
- Photosynthesis involves two distinct phases :- Photocatalyzed phase (light reactions) and biosynthetic phase (dark reactions).
- The light reaction occurs in the grana of cell's chloroplast.
- The dark reaction occurs in the stroma of Chloroplast and absorbed from the atmosphere is reduced to make carbohydrate.

Respiration

- Respiration is the chemical breakdown of food to release the energy.
- Respiration is of two types -

1. **Anaerobic respiration** :- Respiration which takes place in the absence of oxygen. The process can be represented through the following equation



2. **Aerobic Respiration** :- Respiration which uses oxygen is called aerobic respiration. The process can be represented through the following equation

**FACTS TO REMEMBER**

- Phyllotaxy is the way in which leaves are arranged on stem.
- P-Proteins are proteinaceous structures present in sieve tubes.
- Para rubber and Indian rubber are obtained from the latex of Hevea Brasiliensis and Ficus elastica, respectively.
- Latex of poppy (*Papaver somniferum*) yields opium which contains the alkaloid morphine.
- Latex of banana contains tannins.

- Scrubby climbers which climb with the help of hooks are called stragglers e.g., Artabotrys.
- Suckers developing in Musa are called sword suckers.

- Strugglers developing in Musa are called sword suckers.
- Suckers developing in vascular cambium during secondary growth.
- Wood is secondary wood because it lacks vessels.
- Softwood is generally produced by Gymnosperms e.g., coniferous woods.
- Lightest wood is found in Ochroma pyramidalis (= Ochroma Lagopus). Wood occurs in Guaiacum officinale. In India, it occurs in Acacia sandra.
- Heaviest wood is obtained from the plants of Cedrus deodara.
- Most durable wood is obtained from Tectona grandis (Teak).
- There is no distinction between heart wood and sap wood in Salix, Populus, etc.
- In Morus, Taxus, the heart wood is most abundant and the sap wood zone is quite thin.
- Heart wood is dark coloured due to deposition of extractives and is considered durable.
- Number of annual rings decrease as we proceed from base to the top of tree.
- The bark of Cinnamomum zeylanicum (Dalchini) is used as a flavouring material.
- Psychrometer is an instrument measuring both relative humidity and transpiration.
- Trace element is an element which is needed in very small amounts in plants.
- Tracer elements are the atoms of chemical elements called isotopes. They differ in atomic weight but not in chemical properties. Examples ^{14}C , ^{18}O and ^{32}P .
- Molybdenum is the micro-nutrient required by the plants in least quantity.
- Potassium is required for the activity of about 40 enzymes.
- Manganese is essential for photolysis of water.
- Prokaryotes absorb the element nitrogen in gaseous form.
- Characteristic pungent smell of onion and garlic is due to sulphur compounds.
- Gold has been reported to occur in the stems of Equisetum.
- Photometer is an apparatus used for measuring the rate of transpiration.
- Porometer is an apparatus used for measuring the rate of transpiration.
- Tensiometer is an instrument used for measuring soil water tension.

ZOOLOGY

- Zoology is the scientific study of animals.
- Easis of Classification**
 - The animal kingdom is divided into two main sub-kingdoms - Protozoa and Metazoa.
 - Protozoa are unicellular or acellular organisms. Metazoa are multicellular organisms.
 - The two major groups of Metazoans are the non-chordates and chordates.
 - They derive the names from the absence or presence of NotoCHORD.
 - A notochord is present at same time in the life of Chordates.
 - Non-Chordates don't possess a notochord at any stage of their life.
- Non-Chordates :-** This group consists of the following phyla :
 - (1) **Protozoa**
 - They are the most primitive, microscopic, unicellular organisms.
 - Many protozoa lives as parasites in the body cavities, tissues and cells of animals and plants.
 - They reproduce by fission, budding, by spores or sexually.
 - Examples includes, Amoeba, Paramecium, Vorticella, Euglena, Trypanosoma.
 - (2) **Porifera**
 - Sponges are the most primitive group of animal. Most of them are marine and sessile.
 - Body consists of layer of cells lining of non-living matrix.
 - The matrix consists of calcareous and siliceous spicules embedded in the gelatinous material.
 - Flagellated collar cells line canals, while flattened cells line the outer & inner surfaces.
 - Amoeboid cells wander through the matrix carrying food between cells.
 - Water and food is drawn through collar cells & expelled through Osculum.
 - Sponge reproduce asexually by fragmentation. During sexual reproduction some cell become egg or sperm cells.
 - (3) **Platyhelminthes (Flatworms)**
 - Mostly parasite. The liver and blood fluke (fasciola & schistosomal) are prevalent in places with poor sanitation and unprotected water supply.

Kiran's One Liner Approach General Knowledge

- Flatworm help biologist to understand animal evolution.
- They are acelomates with blind sac body plan, exhibit bilateral symmetry and internal surface of branched digestive cavity to require a flat body because each cell has to be near external body surface and nutrient & removal of waste product.

- They obtain oxygen and regenerate and reproduce asexually. They are flatworm can regenerates and HERMORRHOIDE or Bisexual, e.g. Fluke, Marine flatworm, Planaria, Tapeworm.

(4) **Nematheleminthes (Roundworms)**

- Round worms have tube within tube body plan with mouth, pharynx, intestine & anus.
- The muscular pharynx allows the parasitic nematode to suck blood from the host.
- They are pseudocoelom. Sexes are usually separated, often with small male and large female individuals.
- Several nematodes infect plant roots and other lives as parasite in animals e.g. Hookworm, Filaria worm, Guinea worm, Pinworms etc.

(5) **Cnidaria (Coelenterata)**

- Mainly Marine.
- Hydra is fresh water form, Corals & sea anemones found in shallow warm sea & Jelly fish found in cooler water.
- Cnidarians exhibit a blind sac body plan and are radially symmetric, advance than sponges in having true tissue, acelomate, body wall consist of only two layer (ectoderm & endoderm) i.e. DIPLOBLASTIC.
- Most ectoderm cell are contractile and posses muscular fiber, some transmit stimuli & form primitive nervous system.
- Muscles and nerve cells allowed body to co-ordinate in to movements.
- Stinging cells (unique to cnidarians) mainly in ectoderm of the tentacles discharge-stinging organ called NEMATOSYST.
- Undigested matter is egested from mouth.
- Cnidarians exhibit two basic body forms, the Polyp & Medusae.
- In many Cnidarians, polyp gives rise to medusa by budding & medusae form polyp by sexual reproduction.
- Hydra doesn't have medusae stage. They reproduce sexually at polyp stage & do exhibit locomotion.
- (6) **Annelida (Segmented Worms)**
 - Segmented with bilateral symmetry, soft and have true body cavity.

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- Body is covered with true chitinous cuticle.
- Bristles on the lower side help to grip the ground during locomotion in earthworm.

A close circulatory system of blood vessel, a heart to move blood is found for the first time in annelids in evolution of animals.

- Mostly Hermaphrodite but sexes are separate in polychaetes grow asexually by regeneration e.g. Nereis, Earthworm, Blood Sucking leech.

(7) Mollusca

- It is second largest animal phylum after arthropoda.
- They breathe through gills. Land snails and slugs (a shell less hinge shell) form the second largest class e.g. oyster, clam and mussels.
- Bivalves have no sensory tentacles & their foot is reduced to tongue shaped structure, which help them burrow over sea floor cavity modified in to where water can be expelled with force, which help animal to move fast.
- Their foot and head region is modified into structure bearing eyes and tentacles.

(8) Arthropoda

- Arthropoda consist largest group of animals. It includes four major classes – Arachnida, Crustacea, Myriapods, & Insecta.
- Success of arthropoda is to a large extent due to their unique cuticle, it's lightweight, and tough and hard chitin composed of protein and polysaccharides.
- Body is bilaterally symmetrical, segmented and divided in head, thorax, and abdomen.
- A characteristic feature is jointed legs, which may be variously modified for walking, swimming and flying.
- Arthropod eyes may be simple or compound.
- Compound eye is made of many identical units, each with own lens. So, several separate images are formed. This enables the detection of slightest movement.
- Sensory structures in arthropods are antennae.
- Arthropods, particularly insects also communicate by chemicals called PHEROMONES.
- Sexes are separate. In few aquatic arthropods fertilization is external, but in others fertilization is internal.
- Eggs are laid by most arthropods, i.e., VIVIPAROUS

In some (e.g. scorpion), the eggs hatch within the female body i.e. IN VITRO PAROUS.

VIVIPAROUS development is direct. The young hatched from in some arthropods resemble the adult. They grow by Moulting.

In some arthropods the exoskeleton is periodically shed by a process called moult. To enable growth the exoskeleton is periodically shed by a process called moult. This is called Moulting.

In others, developments occur through series of transformations called METAMORPHOSIS.

Arachnids

- Six pair of appendages. Posterior four pairs are legs, anterior two are for feeding.
- Head and thorax are fused.
- Wings and antennae are absent. e.g. spider, scorpion, tick and mites.

Crustaceans

- Distinctive with two pair of antennae.
- Head and thorax are fused.
- Appendages are present in all segment, mostly aquatic e.g. Crabs, crayfish, prawns, water flea, lobster, and shrimps.

Myriapods

- Body has numerous segments. Each segment bear one or two pair of legs.
- One pair antennae e.g. centipedes, millipedes.

Insects

- Body is divided in thorax, abdomen and head, distinctly.
- Thorax bears three pair of legs. The second and third segment may have wings.
- Insects could be graded into four groups, based on absence or presence of wings and type of deployments :
 1. Wingless form e.g. silverfish.
 2. Wings not foldable: dragon and damselflies.
 3. Wings foldable, grass hopper, locust, cricket, cockroach, termites, & some aphids.
 4. Wings insects can both, fold their wings and exhibit complete metamorphosis: this group include most successful and diverse insects.

compiled by Sujoy

► Their most distinctive feature is WATER VASCULAR system

consists of radiating canals and tube feet. Their main function is locomotion and capture of food.

► Echinoderms have proper circulatory system.

10. Chordates

- The name chordate refers to the notochord which these animals possess, either throughout or during early embryonic life.
- Chordate are divided into two sub-phyla, Invertebrates and vertebrates.

- (A) **Invertebrate Chordates**
- These are also known as Protochordates.
- These forms are without a backbone but they do possess a notochord.
- Invertebrate chordates are further sub-divided into three sub-class, Cephalochordata, Hemichordata, Urochordata.
- Respiration occurs typically by gills.
- They are cold blooded.
- They are divided into Placodermic, Chondrichtyes, Osteichthyes

- (B) **Vertebrate**
- Vertebrates represent the largest group of the chordates.
- In Vertebrate the notochord is present only during embryonic development.
- The gill slits remain functional only in gill-breathing fishes.
- This subphylum is further divided into two super class - Agnatha and Gnathostomata.

- (i) **Agnatha**
- They are fish-like forms with no jaws and no scales.
- The skeleton is cartilaginous.
- All are parasites on other fishes.
- Examples are sea lamprey, hag fish.
- (ii) **Gnathostomata**
- These are the Vertebrates with jawed mouth.
- This superclass is further subdivided into five classes.

- (1) **Pisces**
- It includes true fishes.
- All are aquatic.
- The body bears fins.
- (2) **Amphibians**
- Toad, frog, newt, salamander.

Kiran's One Liner Approach General Knowledge

live only in fresh water, have moist, smooth, non-sclaly skin." and toads, the four limbs have fore toes while hind limb have five... are used for perceiving odour and in respiration.

► Amphibian heart is three chambered. Gas exchange takes place in lungs, moist skin and moist cavity.

(3) **Reptiles**
Cold blooded, body protected with waterproof scaly exoskeleton.

- They respire through lung, eardrum is depressed.
- Reptiles are oviparous.
- Respirations in reptiles improve due to development of ribs, which help expand and contract the body cavity.
- Heart is three chambered. In crocodile heart is four chambered.
- Reptiles truly land animals :
- Two feature make reptiles truly land animals :
 1. Development of internal fertilization.
 2. The presence of special third membrane in yolk filled egg called "AMNION". The amnion encloses embryo and provide watery environment during development.

- (4) **Aves**
Characteristic features are presence of feather and power of flight.

- Birds have a reptilian ancestry. Feathers are highly modified reptilian scales.
- Their egg resembles reptilian egg but have calcareous shell.
- Body is streamlined, fore limb converted to wings. Long feather are essential for flight. Weight reduced due to hollow bones. Heart and Lung improve in order to transport oxygen. Heart is four chambered.
- Warm blooded.
- Few birds have wholly or partly lost the ability to fly. e.g.; emu, ostrich, and cassowary.

- In absence of teeth birds swallow food. The digestive tracts have additional chambers; the CROP and GIZARD.
- The crop store and soften food, whereas muscular gizzard help in crushing and churning it. Some birds store small stone in their gizzard for effective churning.

- (5) **Mammals**
- The most unique characteristic is milk producing mammary gland.
- Mammals are viviparous, with exception of two; egg laying animal, the platypus and echidna.
- Other features are presence of hair on body and sweat glands in skin. External ear is present in most of mammals. Heart is four chambered.

► Other than eggs lying there are two major groups :

1. MARSUPIALS
2. PLACENTAL

► Marsupials are common in Australia. Young one is nourished in a special pouch e.g. kangaroo, koala, Tasmanian wolf.

► Placental can arranged in four evolutionary series :

1. The insectivorous : The most primitive series : EDENTATES or tooth less mammals are related to the insectivorous e.g. anteater or pangolin, armadillo. PRIMATES also evolve from shrew like animals.
2. Whales, dolphins and porpoises.
3. Rodents : rat, mice, squirrel, and beavers. Two pair of chisel like incisor characterizes them. Rabbits and hares are also closely related.
4. Carnivorous and Ungulates (hoofed mammals) and elephant, house cat. Other major group is dog like — wolves, foxes, jackals, & dogs. Seal, walrus and sea lion are aquatic carnivores.

► Ungulates are divided into two groups— even hooved ungulate (cows, buffaloes, sheep, goats, camel, pig, giraffes, hippopotamus) and odd toed ungulates (horse, donkey, zebra, rhino). There is no cud-chewing animal in this group.

Organs of Excretion — Invertebrates

Excretory System	Invertebrates
1. Canal System	Sponges
2. Hypostomal Opening	Hydra
3. Flame Cells	Tapeworm like fluke and Planaria
4. Nephridia	Annelids like Earthworm, leech
5. Green Glands	Prawn
6. Malpighian Tubules	Insects

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Cells of multi-cellular organisms undergo differentiation and each cell is specialised for a limited number of specific functions.

► Cells of cell is specialised for a limited number of specific functions.

► One or more types of specialised cells are set in specific extra-cellular materials to constitute a tissue.

► An organ is made up of different types of tissue. Each organ performs specific functions, which depend on the collective and integrated activities of its tissues.

► Several organs constitute an organ system. Organs of a system function in a coordinated manner to carry out a major life process.

Human Body

► Human Body can be divided into nine systems :

1. The Digestive System
2. The Respiratory System
3. The Circulatory System
4. The Excretory System
5. The Endocrine System
6. The Reproductive System
7. The Skeletal System
8. The Muscular System
9. The Nervous System

The Digestive System

► Digestion is the process of biochemical transformation of complex and large food particles into simpler form, making it suitable for absorption and assimilation. The process of the breakdown of large food molecules into simpler compounds is catalysed by special enzymes.

Organs involved and their functions

► **The Mouth** : Ingestion and chewing takes place in the mouth with the help of teeth. A starch hydrolysing enzyme, Ptyalin is present in the Saliva.

► **The Oesophagus** : The mouth leads to a funnel-shaped pharynx which communicates with a long muscular tube-like oesophagus. The oesophagus opens into the stomach.

► **The Stomach** : The stomach is a large muscular sac. The stomach has many glands on its wall. The cells of these glands secrete HCl, protein-digesting enzymes and mucus in the lumen of the stomach. The mixture of their secretions in the gastric lumen is called Gastric Juice. It digests proteins in the stomach.

► **The Small Intestine** : The small intestine is distinguished into three parts, viz., Duodenum, Jejunum and Ileum. The common bile duct opens into Duodenum and drains juices from Pancreas and liver. The Jejunum follows duodenum and is longer and more coiled. The last part or ileum is also highly-coiled and opens into the large intestine. Nearly all absorption of digested material takes place through the wall of the ileum through the villi.

The Large Intestine : The large intestine has three parts. So it is not lost from the body. The semi-solid remains are called faeces. They are stored in large intestine until passed out at intervals through the anus.

STAGES IN DIGESTION

Part of the Alimentary Canal	Gland and its secretion	Enzyme secreted	Substrate	Product of Digestion
Mouth	Salivary gland : Saliva	Salivary amylase (Ptyalin)	Starch	Maltose
Oesophagus	None	None	None	None
Stomach	Glands lining the stomach : Gastric juice and hydrochloric acid.	Pepsin in adults and Renin in children	Proteins	Peptides and Caspein
Duodenum	1. Liver : bile	None	Fats	1. Emulsified fat 2. Provides alkaline medium for the action of intestinal juices 3. Proteases, peptidases, peptides, amino acids, fatty acids and glycerol
Jejunum	2. Pancreas : Pancreatic Juice	1. Amylopsin 2. Trypsin 3. Steapsin (lipase)	Starch Proteins Fats	1. Maltose 2. Glucose 3. Fructose 4. Sucrose
Ileum	Glands lining the Ileum : Intestinal juice.	Erepsin (Peptidase) Maltase Sucrase (Invertase) Lactase	Proteins and peptides Maltose Sucrose Lactose	Amino acids Glucose Fructose Glucose and Fructose Glucose and Fructose Glucose and Fructose Absorbs water and mineral salts
Colon	None	None	None	Temporary stores undigested food
Rectum	None	None	None	

The Respiratory System

- The Respiratory System takes in oxygen from the air and expels carbon dioxide and water vapour.
- The mammalian respiratory system consists of nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles and lungs.

The Circulatory System

- The Circulatory System is constituted of following important parts:
- **Arteries :** A large thick walled blood vessels that carries blood from the heart to the limbs and organs. All arteries except the pulmonary artery carry oxygenated blood.
 - **Veins :** A blood vessel that conveys blood from the capillary network in the tissues to the heart. All veins except the pulmonary vein carry deoxygenated blood.
 - **Heart :** The human heart is situated in the thorax between the lungs with its apex resting on the diaphragm. It consists of four chamber viz two Atria (Auricles) and two Ventricles. The Auricles receive blood from the veins. The ventricles pump blood into the arteries. Human heart beats at the rate of about 72/min in the resting condition.

The Excretory System

- Metabolism of different chemical substances produces different waste products in the body. The process of elimination of waste products from the body is called excretion. Important constituents of the Excretory system are :

1. **Skin**
 - Human skin possess glands for secreting two fluids on its surface viz. sweat from sweat glands and sebum from sebaceous gland.
 - Sweat is an aqueous fluid containing mainly sodium chloride, lactic acid, urea, amino acids and glucose.
 - Sebum is wax-like secretion which eliminates some lipids, hydrocarbons and fatty acids.
2. **Kidney**
 - Kidneys are the urine forming organs. Nephrons are functional units of kidney. They form urine and drain it ultimately into the pelvis of kidney, from where the ureter arises. Ureters from both the kidneys finally open into urinary bladder which stores it temporarily. Urethra arises from the neck of the bladder and conducts urine to the exterior. The act of voiding the urine is called Micturition.
3. **Lungs**
 - Lungs regularly participate in the excretion of some volatile materials by respiration. The entire volume of carbon dioxide produced in the body, and some moisture are regularly excreted in the expired air.

4. Liver :-

- Liver is principal organ for the excretion of cholesterol hormones, some vitamins and many drugs.
- The Nervous System
- The Nervous System receives information about external changes, conducts such information about external and internal changes, coordinates the activities of different organs and tissues in the light of those changes.

The Central Nervous System

- The Central Nervous System consists of the Central Nervous System, Peripheral Nervous System and Autonomic Nervous System.
- The Central Nervous System consists of brain and spinal cord.
- The forebrain consists of cerebrum, the largest part of human brain.
- Brain and spinal cord are covered by three connective tissue membranes—pia matter, arachnoid matter and dura mater.
- An extra-cellular fluid called CEREBROSPINAL FLUID occurs between pia and arachnoid matter. It affords some protection to CNS against mechanical injury and shock. It exchange materials.
- Hypothalamus contain higher nerve centres for temperature regulation, hunger, thirst and emotional functions. It secretes neuro-hormones which control secretions of anterior pituitary hormones. It synthesises the posterior pituitary hormones.
- Cerebellum is second largest portion of brain located at base, under the cerebrum.
- Cerebral hemisphere divided into frontal, parietal, temporal and occipital.
- The spinal cord is a series of 31 sections called segments. Each segment giving rise to pair of spinal nerve.

Peripheral Nervous System (PNS)

- PNS is composed of spinal nerves and cranial nerves.
- Neurons and nerve fibres conduct nerve impulses from the CNS to peripheral organ are called EFFERENT NEURONS and NERVE FIBRES.
- Neurons and nerve fibres conduct nerve impulses from periphery to CNS are called EFFERENT NEURONS & NERVE FIBRE.
- Neurons and nerve fibres which cause movement of the muscles are called MOTOR NEURONS and NERVE FIBRE.
- Autonomic Nervous System (ANS)**
- Nerves conveying impulses to glands involuntary muscles and heart muscles constitute ANS.
- ANS is divided into two Sympathetic and Parasympathetic nervous system.

sympathetic nerves enhance the force and rate of heart beat, constrict blood vessel, raise arterial blood pressure, dilate pupils, relax urinary bladder.

Parasympathetic nerves, decrease both rate and force of heart beat, relax sympathetic nerves, lower the blood pressure, constrict the pupil, contract the urinary bladder.

The Skeletal System

Axial Skeleton (80 bones)

Skull	8
Cranium	14
Race	6
Ear ossicles	1
Hyoid bone	26
Vertibral column vertebrae (cervical 7, thoracic 12, lumbar 5, sacrum 1, coccyx 1)	1
Morax : Sternum	24
Ribs	

Appendicular Skeleton (126 bones)

Upper Regions	
Pectoral girdle : Clavicle	2
Scapula	2
Arm : Humerus (upper arm)	2
Radius	2
Ulna	2
Carpals (wrist)	16
Metacarpals (palm)	10
Phalanges (fingers)	28
Lower extremities : Pelvic (hip) Girdles	
Femur (thigh)	2
Tibia	2
Fibula	2
Patela (knee cap)	2
Tarsals	2
Metatarsals	14
Phalanges	10
	28

The Endocrine System

- Endocrine glands secrete hormones into the blood. Hormones are informational molecules. They regulate functions of other organs and tissues. Their actions are more widespread and slower than nerve impulses. They coordinate the activities of different organs and tissues.

Gland/ Location	Secretion	Function	Hyposecretion	Hypertrophy	Hypofunction	
1. Pituitary gland/ Attached to the hypothalamus of the brain. a. Anterior lobe	1. Adrenocorti- cotrophic hormone, follicle stimulating hormone, thyroid stimulating hormone. 2. Human growth hormones (Hgh) 3. Prolactin	Control the activities of the thyroid, adrenal gland and the gonads.	Dwarfism	Gigantism (during grow- ing age). Acromegaly (in adults). Dwarfism (in children).	Regulates calcium me- tabolism.	
b. Intermediate pi- tuitary	Melanocyte stimulat- ing hormone	Stimulate general body growth. Stimulate the mammary glands to produce milk.	1. Glucagon	Raises blood sugar lev- el.	Tetany	
c. Posterior lobe	1. Vasopressin 2. Oxytocin	Regulates amount of pig- ment in skins of certain animals. Stimulates kidneys to re- tain water, causes blood vessels to constrict. Stimulates the muscles of the uterus to contract during labour. Increases rate of metab- olism and maintains en- ergy balance. Regulates calcium and phosphate levels in the blood.	2. Insulin 3. GH/H (Somatotro- phin)	Lowers blood sugar lev- el. Inhibits secretion of glu- cagon and insulin.	Diabetes mellit- us	
2. Thyroid/On either side of the trachea, in front of the larynx.	Thyroxine	Cretinism, Myxedema Simple goitre Tetany	4. Parathyroid/ Embedded in the posterior surface of the thyroid gland. Pancreas/ Slightly below the stomach.	Development of primary and secondary sex char- acteristics in males. Influences sex instincts, and reflexes. Development of the pri- mary and secondary sex characteristics in fe- males.	Insulin shock.	
3. Adrenal gland/ Kidney.	1. Glucocorticoid (especially cortisol) 2. Mineralocorticoid (especially aldoster- one) 3. Gonadocorticoid (especially andro- gens)	Regulate metabolism. Help body adjust to stress. Stimulate kidney to retain sodium and excrete po- tassium. Stimulate development of secondary sexual char- acteristics especially in female secondary char- acteristics in second- ary sex char- acteristics & sex characteristics vice versa.	5. gonads a. Testes (male)/ in the scrotum in males b. Ovaries (fe- male)/in the pel- vic cavity.	1. Oestrogen 2. Progesterone 3. Relaxin	Prepares the uterus for the implantation, retention and growth of the foetus. Helps to dilate the cervix towards the end of preg- nancy to enable child birth. Initiates production of lymphocytes, antibodies.	Tetany
BLOOD						
		Blood Cells	Blood Platelets	Plasma		
		Erythrocytes	Leukocyte			
		Granulocytes				
		Neutrophils				
		Bosinophils				
		Basophils				
		Monocytes				
		Agranulocytes				
		lymphocytes				

compiled by Sujoy

- Blood is a fluid connective tissue.
- Erythrocytes (RBC) are most numerous of the formed element of blood.
- Their most characteristic feature is presence of haemoglobin, as total count of RBC. It averages 5m and 4.5m million in adult man and adult women respectively.
- The total count would be low in anaemia.
- The abnormal rise in total count in RBC is called polycythaemia.
- Erythrocyte participate in transporting oxygen from lungs to tissue.
- CO₂ is carried in both plasma and RBC as bicarbonate.
- In foetus, erythrocytes are mainly formed in the liver and spleen. But from birth onwards, erythrocytes are formed in red bone marrow.
- Erythrocyte has average life of 120 days.
- Iron and proteins are essential raw material while B₁₂ and folic acid stimulate synthesis and maturation.
- Leukocytes (WBC) are devoid of haemoglobin and are nucleated. Neutrophils and monocytes protect the body against microbes.
- Lymphocytes secrete antibodies in the blood to destroy microbes and their toxin.
- The number of leukocytes per micro litre of blood is called total count of WBC. It is normally 5000 in humans.
- Blood Platelets (thrombocytes) are non nucleated, round or oval, biconvex cell.
- Their normal life span is a week.
- When blood vessel is injured, platelets get clamped at the injured spot and release certain chemicals called Platelet Factor, which promote blood coagulation.
- The extra-cellular fluid is straw-coloured, slightly alkaline, and aqueous called plasma, which is 30%-35% of blood.
- Plasma contains 92% of water. Plasma contain three major classes of plasma protein - albumin, globulin and fibrinogen. It serves as source of protein for tissue cell.
- Albumin and globulin retain water in blood plasma. A fall in plasma protein leads to filtering out of excessive volumes of water from blood to tissue. This is why hands and feet get swollen with accumulated fluid in person suffering from dietary deficiency of protein.
- Plasma functions in transport, body immunity, prevention of blood loss, retention of fluid in blood, maintenance of pH, uniform distribution of heat.

Functions of Blood

1. Transport
 - (a) Respiratory gases
 - (b) Nutrients
 - (c) Waste products
 - (d) Hormones, enzymes, minerals
2. Protective Function
 - (a) Production of antibodies
 - (b) Phagocytosis
 - (c) Clotting mechanism
3. Regulatory Function
 - (a) Body temperature
 - (b) pH balance
 - (c) Fluid balance

Blood Coagulation

- Coagulation is brought about by hydrolysis of soluble fibrinogen of plasma to insoluble fibrin. This is catalysed by an enzyme called thrombin. Fibrin precipitate as network of fibres.
- Thrombin occurs in blood as an inactive globulin called Prothrombin.
- In case of injury, Coagulation promoting substances called Thromboplastins are released, which help in formation of enzyme Prothrombinase. This enzyme hydrolyses prothrombin to thrombin. Ca²⁺ ions are essential for both the activation and action of thrombin.

Blood Groups

- K. Landsteiner classified human beings in four groups on the basis of the reactions of their blood A, B, AB and O.
- Blood compatibility depends upon chemicals called agglutinogen or antigens on the surface of the red cells and chemicals called agglutinin or antibodies in the plasma.
- There are two types of antigen: A and B; and two types of antibody: anti-A and anti-B.
- **Blood group A** has A antigen on its red cells and anti-B antibody in its plasma.
- **Blood group B** has B antigen on its red cells and anti A antibody in its plasma.
- **Blood group AB** has A and B antigen on its red cells and no antibodies in its plasma.
- **Blood group O** has no antigens on its red cells but has both anti-A and anti-B antibodies in its plasma:
- Blood Transfusion. Anti-A plasma agglutinates A red cells, and anti-B plasma agglutinates B red cells. So these combinations of plasma and red cell are incompatible as far as blood transfusion is concerned.

Blood group	Antigen	Antibody	May donate blood to	May receive blood from
A	A	b	A, AB	A, O
B	B	a	B, AB	B, O
AB	A,B	neither	AB	A, B, AB, O
O	neither	a,b	A, B, AB, O	O
		A nor B		

Possible/impossible Blood groups of Children from parents of various Blood Groups

Blood group of parents	Possible blood group of children	Blood group of children not possible
A × A	A or O	B or AB
A × AB	O, A, B, AB	
A × O	A, B, AB	O
B × B	O or A	B or AB
B × AB	A, B, AB	O
B × O	O	A, AB
AB × AB	A, B	O
AB × O	A, B	O
O × O	O	A, B, AB

GENETICS

- The term 'Genetics' was coined by Watson to describe the study of inheritance and variation and the factors controlling them.
- Today the subject has three main subdivisions — Mendelian genetics, population genetics and biochemical genetics.
- Heredity may be defined as the transmission of characteristics from one generation to successive generations of living things.
- The first quantitative study of inheritance was carried out by Gregor Mendel in Garden Peas (*Pisum Sativum*).
- Gene is a unit of heredity.
- The various forms of a gene are called ALLELES.
- Individual organisms in which the members of a pair of alleles are different are said to be Heterozygous.
- Individuals in which the members of a pair of alleles are same are said to be Homozygous.
- The Genotype is the genetic constitution of an organism.
- The observable characteristics of an organism constitutes its phenotype.

- The ability of a gene to have many effects is called Pleiotropy.
- Pedigree analysis is a system to analyse the distribution and movement of traits in the family tree.
- The Chromosome Theory of Inheritance states that Mendelian genes are located on chromosomes, and it is the chromosomes that segregate and independently assort.
- The sexually reproducing animals have, in each of their cells, a set of chromosomes called autosomes and a pair of sex chromosomes (X and Y).
- In human females there are two X chromosomes and in males one X and one Y-Chromosome.
- Har Gobind Khorana, along with his associates, manufactured short DNA molecules having a known sequence of bases.
- These DNA molecules synthesized messenger RNA molecules also of known base sequence. These RNA molecules then directed protein synthesis and from the sequence of the proteins, the codes were directly established. This is a milestone in the history of genetics. For this, Khorana shared with M.W. Nirenberg and R.H. Holley (1968) Nobel prize in medicine.
- **Genetic Disorders**
- **Albinism** : caused by recessive gene, which block the conversion of amino acid tyrosine to melanin. Effect is absence of pigment in skin, hair and iris of eyes.
- **Dowin syndrome** (Mongolism) : caused by trisomy of chromosome 21. Effect is physically and mentally retarded patient.
- **Glycogen storage disease** : caused by recessive autosomal gene, results in defect in enzyme system utilizing sugar glycogen to high-level damage.
- **Hemophilia** : caused by sex-linked recessive gene; produce defective protein, essential for clotting of blood.
- **Huntington's disease** : caused by dominant autosomal gene; lead to progressive deterioration of nervous system. Peculiar feature developed between 30 to 40 years.
- **Klinefelter syndrome** : because of additional X-chromosome; resulted in improper development of testes.
- **Muscular Dystrophy** : caused by sex linked recessive gene, resulted in childhood muscle weakness and atrophy.
- **Phenylketonuria (PKU)** : caused by recessive autosomal gene in homozygous condition, results into accumulation of acid phenylalanine and brain damage. It can be prevented by giving phenylalanine diet.
- **Sickle Cell Anaemia** : caused by recessive gene lead to abnormal haemoglobin molecule.
- **Tay-Sach disease** : caused by autosomal recessive gene resulted in cerebral degeneration, epilepsy, paralysis and blindness.

- **Thalassemia** – (Cooley's anaemia) mostly in children recessive gene resulted in abnormally in haemoglobin.
- **Turner Syndrome** : caused by lack of X chromosome suited in phenotypical female but have rudimentary sex organ and mammary gland.

FOOD AND NUTRITION

Balanced Diet

- A diet is balanced if it contains all the nutrients in the correct amount.
- A balanced diet is related to the state of one's age, health and occupation.
- Carbohydrates, proteins, fats, vitamins and minerals are nutrients.
- Carbohydrates and fat; provide energy.
- Proteins : growth and repair of cellular mechanism.
- Vitamin and minerals: aid vital reaction in cells and tissue.
- Roughage : proper digestion.
- For Pregnant woman and children protein requirement is high.
- For Hard-working adult carbohydrates and fats requirement is high.

Important Facts

- Carbohydrates are more suitable for the production, and energy in the body than protein and fats because carbohydrate molecules contain relatively more oxygen than the others.
- Carbohydrates are supplied to the tissues mainly as blood sugar.
- Carbohydrates are also stored in the tissues as glycogen.
- Athletes, labourers doing heavy work and mountaineers should live on high carbohydrates.
- 1 gm yield 17 KJ or 4.1 K cal.
- Carbohydrates account for 60–80% energy requirement.
- Fats gives twice energy than carbohydrates because it contains less oxygen.
- 1 gm fat oil give 37 kg or 9.45 K Cal.
- Butter, ghee, cheese, milk, egg, yolk, nut, meat are rich sources of fat.
- Fat is insoluble in water and soluble in organic solvent.
- Fats are stored as lipid in our body.
- Few fats cannot be synthesized by our body are called Essential fat. The most important of these is Oleic acid (all vegetable oil contain, except coconut oil).
- Unsaturated fat : Low melting point, more reactive.
- Saturated fat : Occur mostly in animal fat, high melting point, solidify at room temperature.
- The principal nutritional role of proteins is to build tissue structures.

Mineral Deficiency Diseases

Minerals	Sources	Daily Requirement	Functions	Deficiency signs
Calcium	Milk, Cheese, hard water, green vegetables, meat etc	1.0-15 gm	Essential for the formation of bones, teeth, coagulation of milk, contraction of muscle, neuro-muscular excitability	Rickets (malformation of bones), tetany etc.
Potassium	All food stuffs	4 gm	It plays an important role in maintaining intracellular osmotic pressure, intracellular reaction, CO_2 carriage, cardiac and muscular contraction.	Retardation of bone growth, lowering of heart rate, paralysis of muscle, hypotrophy of kidney, sterility.

some of the proteins cannot be synthesized in the animal body and must be supplied with food in adequate amounts. They are called Essential Amino Acid. Other Amino Acids may be synthesized in the body, are called Non-Essential Amino Acid. Eight amino-acids are considered essential for human nutrition. These are methionine, threonine, tryptophan, valine, leucine, isoleucine, lysine and phenylalanine.

These proteins are frequently deficient in one or more essential amino acids. They are considered nutritionally inferior to animal proteins with respect to essential amino acids.

Proteins with respect to essential amino acids.

Linoleic, linolenic and arachidonic acids are essential fatty acids.

Groundnut, beans, cereals (maize and wheat), pulses are source of plant protein.

Copper	Green vegetables, milk, brain, liver, etc.	2 mgm	In blood in the form of haemoglobin, and acts as oxygen store for muscle in the form of myoglobin. It is also related to the tissue oxidation in the form of cytochrome.	It acts as an important component of many enzymes e.g., cytochrome oxidase, tyrosinase, uricase.
Iodine	Common salts, sea weeds, milk, fish etc.	0.05 mgm	It is an essential constituent of the hormone thyroxine. (an active principle of thyroid gland).	Araemia, Wilson's disease
Sodium	Common salt, milk, water, different food-stuffs etc.	5-10 gm	Essential for normal functions of cells, contraction of muscles, excitation of nerves. It helps to maintain blood reaction, formation of HCl of gastric juice, osmotic pressure and absorption.	Gottse Reduction of fat deposit, atrophy of muscles and testis, lung infection, retarded bone formation and growth.
Phosphorus	Cereals, legumes, fish, meat, eggs, liver, kidney etc.	1-1.5 gm	It is an essential constituent of cells, bones and teeth. It takes an essential role in muscular contraction, phosphorylation of sugars, fats, blood coagulation, enzymatic functions of Vitamin B-Complex, regulation of pH of cells, blood and urine etc.	Rickets, Osteomalacia, dysfunction of renal tubules etc.

Parasite	Habitat	Mode of Infection	Effects on Man
Entamoeba histolytica	Colon; in the mucous membrane	Infection by the encysted spores being swallowed with contaminated food or water	Ulceration of the intestine and dysentry
Entameba coli	Colon; in the lumen Buccal cavity; in and around teeth	No cysts formed : -do-	Harmless
Entameba gingivalis	-	infection possibly direct with sputum	-do-
Trypanosoma gambiense and. Trypanosoma rhodesiense	1. Blood 2. Cerebro-spinal fluid	Transmission by Tsetse fly -do-	1. Gambia fever (occurs in Africa) 2. Sleeping sickness (occurs in some African countries)
Leishmania donovani	Bloodcells of the spleen, bone-marrow and liver	Transmission by sandfly	Kala-azar
Trichomonas hominis	Colon	Transmission by sandfly or direct contact	Delhi Sores
Trichomonas buccalis	Mouth	Not definitely known	Diarrhoea
Trichomonas vaginalis	Vagina	-do-	Non-Pathogenic Vaginitis
Giardia intestinalis (=G. lamblis)	Intestine especially of children	-do-	Diarrhoea
Balantidium coli	Colon	By cysts being swallowed with food or water	Balantidial dysentery Malaria
Plasmodium	Red Corpuscles	Transmission by Anopheles	

READ EVERY MONTH

PRATYOGITA KIRAN

RENU GENERAL KNOWLEDGE & WORLD VISION

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Diseases Caused by Protozoans

Disease	Pathogen responsible	Habitat	Mode of transmission and incubation period	Main symptoms of disease
Malaria	Plasmodium	Passes through a developmental phase in liver, re-side in RBCs. and carried by blood to all organs	Transmitted to man by bite of an infected female mosquito.	Three stages : Chills, shivering and rising temperature. Fever stage-fever rises to its maximum, severe headache, pain in back and joints, vomiting; Sweating profuse sweating, fall in temperature, pain relieved.
Amoebic dysentery or Amoebiasis	Entameba histolytica	Large intestine	Transmitted from man to man through ingestion of cysts in stools, and drinking water, vegetables and food contaminated with faeces.	Acute dysentery with blood and mucus in stools, and pain in abdomen. Secondary complications include formation of multiple abscesses in liver, lung, brain, spleen and ulceration of skin, vagina and penis.
Sleeping sickness (Trypanosomiasis)	Trypanosoma brucei	Reaches lymph nodes via lymphatics, blood and intestines, brain	Transmitted by bite of tsetse fly	Fever, severe headache, enlargement of glands at back of neck, rash on the back, and chest, joint pains, swelling of eyelids, ankles and hands, trembling, loss of appetite, no desire to work except sit of sleep, mental disturbances, coma and death. Enlargement of spleen, fever, jaundice, skin becomes dark through pigmentation.
Kala-azar or black sickness	Leishmania	Man comes infected by bite of sandfly		

Kiran's One Liner Approach General Knowledge

IMMUNIZATION SCHEDULE

S.No.	Age	Vaccine	Dose
1.	New born	BCG	-
2.	Within 15 days	O' Polio	-
3.	6th week	DPT and Polio	First dose
4.	10th week	DPT and Polio	Second dose
5.	14th week	DPT and Polio	Third dose
6.	9-12 months	Measles	One dose
7.	18-24 months	DPT and Polio	First booster
8.	15th month-2 years	MMR Vaccine	-
9.	2-3 years	Typhoid	Two doses at one month interval
10.	4-6 years	Dual Antigen and Polio	Second booster
11.	10th year	TT and Typhoid	First booster
12.	16th year	TT and Typhoid	Second booster

BCG - Tuberculosis Vaccine (bacille Calmette Guerin)
DPT - Diphtheria, Pertussis (whooping cough), Tetanus
MMR - Mumps, Measles and Rubella vaccine
TT - Tetanus Toxoid

Diseases caused by Worms

Disease	Pathogen responsible and its habitat	Mode of transmission	Main symptoms of disease
Taeniasis	Taenia solium; Taenia solium; small intestine (jejunum) of man	Part of the life cycle in pig, man gets infected on eating pork, infected stage being mature cyst in pork.	Abdominal discomfort, chronic indigestion, anemia, diarrhea, alternating with constipation
Ancylostasis or Hook-worm disease	Ancylostoma duodenale; small intestine (jejunum) of man	Transmission from person to person, filariform larvae passed out in faeces, man picks up infection walking barefoot on faecally contaminated soil.	Dermatitis; reddish, itchy papule along the path traversed by larvae; severe anaemia; duodenal ulcer, constipation. Patient pale, face puffy with swelling off lower eyelids, oedema of feet and ankle.
Ascaris	Ascaris lumbricoïdes; small intestine (jejunum) of man	Transmission from person to person, ripe eggs passed out in faeces, infection affected by swallowing ripe Ascaris eggs with raw vegetables	Larvae in lung cause pneumonia. May give rise to typhoid like fever causes protein and Vitamin A deficiencies resulting in protein

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Enterobiasis or 'Pinworm' disease	Enterobius vermicularis; caecum and vermiform appendix	Transmission from one person to another by ingestion of eggs in contaminated food or drink. Autoinfection Itching in anus; scratching anus and ripe eggs on fingers transferred to food ingestion of such food.	calorie malnutrition and night blindness respectively. Can cause appendicitis, jaundice by block, dix and biliary passages.
Filariasis	Wuchereria bancrofti; lymphatic vessels and lymph nodes	Part of the life cycle in mosquito in which larvae develop and become infective to man, with mosquito bite larvae deposited on skin which enter through puncture wound and reach lymphatic channels.	Elephantiasis i.e. enormous enlargement certain body parts such as that of leg, scrotum, penis, labia, clitoris, breast, forearm.

Food Adulteration
► Cereals (wheat) – mud, grit, soapstone
► Dals - Khesari dal, mentil yellow (a dye)
► Haldi – lead chromate
► Dhania – Cowdung, horsedung
► Black Pepper – dried papaya seeds
► Chilli powder – Sawdust, brick powder
► Mustard Seeds – argemone seeds
► Edible Oils – cheaper oil
► Milk – extraction of fat, addition of starch
► Honney – Jaggery, Sugar

Source and role of Principal vitamins	Best Food Source	Function	Deficiency disease
Vitamin A (Fat soluble)	Carrots, Yellow and green vegetables. Other sources include butter, milk, fish, liver oil (Water Soluble)	Synthesis of visual purple of the retina rods. Maintains general health and vigour of epithelial cells. Hence essential for good skin and hair.	Kerophthalmia : drying of cornea and ulceration. Night blindness : inability to see in the dark. Keratinization of epithelial cells .
Thiamine (Vitamin B ₁) (Water Soluble)	Whole grains, yeast, liver, egg, pork, nuts	Carbohydrates metabolism. Ensures normal functioning of the central nervous system.	Beri-beri : Partial paralysis of skeletal muscles and digestive disturbances
Riboflavin (Vitamin B ₂) (Water Soluble)	Cereals, legumes, milk egg, liver, kidney, yeast	Essential carbohydrate and protein metabolism especially in the cells of the eye, skin, intestines, and blood.	Characterised by corneal ulceration and cracking of skin (especially around the lips).
Folic Acid (Water Soluble)	Lean meat, liver, whole grains	Inhibits production of cholesterol and helps in the breakdown of fats, proteins and carbohydrates.	Pellagra : Characterised by dermatitis (skin inflammation), diarrhoea and dementia (loss of intellectual function).
Pyridoxine (Vitamin B ₆) (Water Soluble)	Salmon, yeast, yogurt, corn, spinach, cheese, cereals & legumes. Also synthesised by intestinal bacteria.	Essential for amino acid metabolism. Assists production of antibodies.	Epileptiform seizures observed in children. Symptoms include dermatitis of eyes, nose and mouth; retarded growth.
Cyanocobalamin (Vitamin B ₁₂) (Water Soluble)	Yeast, liver, green leafy vegetables. Synthesized by intestinal bacterial also.	Helps normal production of blood cells. Identified in chromosomes and important reproductive factor. Necessary for red blood cells formation and normal functioning of nervous system.	Macrocycotic anaemia : Production of abnormally large red blood cells.
Ascorbic acid (Vitamin C) (Water Soluble)	Citrus fruits, tomatoes, cabbage.	1. Pernicious anaemia 2. Neuro-psychiatric abnormalities : influences permeability of capillary walls. Develops immunity against disease. Forms collagen.	Scurvy : Swollen gums, teeth loss, bleeding gums.

Calciferol (Vitamin D) (Fat Soluble)	Fish liver oil, egg yolk, milk, butter, and phosphorus. Also synthesized in the skin under the influence of sunlight.	Controls calcium and phosphorus metabolism which contribute to formation of teeth and bones.	Rickets (in infants) (deformed) Osteomalacia (demineralization of bones)
Tocopherol (Vitamin E) (Fat Soluble)	Wheat germ, fresh nuts, seed oils, green leafy vegetables	A ₅ , anti-oxidant which protects lipid membranes against oxygen damage. Assists in the production of prothrombin and other factors that ensure normal clotting of blood.	Deficiency reported in humans. Causes sterility due to delayed clotting time.
Phylloquinones (Vitamin K) (Fat Soluble)	Liver, spinach, cauliflower, green tomatoes.		

			of water), convulsions, paralysis, death.

Disease	Pathogen responsible	Mode of transmission and incubation period	Main Symtoms of the disease
Small Pox	Variola Virus	Direct contact (droplets); Indirect by infected article; 12 days	Onset sudden or gradual. High fever, headache, backache, skin rash on third day, passes through stages of macules (bright red spots), papules, vesicles (with clear fluid), pustules (with pus like fluid) and scabs (dried crusts). Scabs fall off and leave behind pitted pox marks.
Chicken pox	Varicells virus	Direct contact (droplets); Indirect by infected objects; 12-16 days	Fever, cold, skin eruption starts as red spots, vesicles and crusts. Scab formation in 36 hours which fall off within 5 to 20 days.
Common Cold	Rhinovirus	Contact : 2-5 days	Headache, cough, nasal discharge, mild fever.
Rabies (Hydrophobia)	Rabies virus	Bite of a mad (rabid) dog; 2-16 weeks or longer	Headache, nausea, vomiting, fever, fits, somnia, hoarse voice, sight of water sets throat muscles into painful spasms (eat

Kiran's One Liner Approach General Knowledge

Diseases and Associated body part		Allment		Part or region affected		Allment		Part or region affected		Discovery		Year		Person		Country													
1. Arthritis	Joints	2. Bronchitis	3. Carditis	4. Colitis	5. Cystitis	6. Conjunctivitis	7. Dermatitis	8. Gastritis	9. Glossitis	10. Hepatitis	11. Meningitis	12. Myelitis	13. Nephritis	14. Neuritis	15. Otitis	16. Osteomyelitis	17. Peritonitis	18. Rhinitis	19. Tonsillitis	Heart	Lungs	Intestines	Eye	Stomach	Liver	Spine	Nerves	Bones	Nose
Carcinoma	Types of Cancer		Osteoma	Cancer of epithelial cells of the skin and the lining of the internal organs		Glioma	Tumours of the bones		Melanoma	Tumours of the connective tissues in the brain and central nervous system		Lymphoma	Tumours of the pigmented moles found on the skin		Leukaemia (blood cancer)	Uncontrolled proliferation with plenty of immature W.B.C. and lymph gland enlargement; anaemia		Discovery		Year		Person		Country					
Osteoma	Tumours of the bones		Glioma	Tumours of the connective tissues in the brain and central nervous system		Melanoma	Tumours of the pigmented moles found on the skin		Lymphoma	Tumours of lymph glands		Leukaemia (blood cancer)	Uncontrolled proliferation with plenty of immature W.B.C. and lymph gland enlargement; anaemia		Discovery		Year		Person		Country								
Glioma	Tumours of the connective tissues in the brain and central nervous system		Melanoma	Tumours of the pigmented moles found on the skin		Lymphoma	Tumours of lymph glands		Leukaemia (blood cancer)	Uncontrolled proliferation with plenty of immature W.B.C. and lymph gland enlargement; anaemia		Discovery		Year		Person		Country											

Human body at a glance

- Normal blood pressure : 80 to 120
- Teeth : 32
- Volume of Blood : About 7 liters in normal body of about 7% of the total body weight
- Largest part of human brain : cerebrum
- Biggest organ : Liver
- Heart Beat : 72 times in a minute
- Master gland : Pituitary
- Number of Bones : 206
- Number of Muscles : 525
- Number of chromosomes : 46 or 23 pairs

Milestones in Medicine

Discovery	Time	Person	Country
Ayurveda	2000-1000 BC	Atreya	India
Western Scientific Therapy	460-370 BC	Hippocrates	Greece
Yoga	200-100 AD	Patanjali	India
Ashtanga Hridaya	c.550 AD	Vagbhata	India
Sidhayoga	c.750 AD	Vrudukunta Mondino	Italy
Anatomy	1316 AD	Paracelsus	Switzerland
Chemotherapy	1493-1541		

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IMPORTANT FACTS

Streptomycin	1944	Selman Waksman	General Knowledge
Kidney Machine	1944	Kolf	
Chloromycetin	1947	Burkholder	USA
Aureomycin	1948	Duggar	Netherlands
Reserpine	1949	Jal Vakil	USA
Terramycin	1950	Flinay & Others	India
Cryo-Surgery	1953	Henry Swan	USA
Open Heart Surgery	1953	Waiton Lillehei	USA
Pollomyelitis Vaccine	1954	Jonas Salk	USA
Pollomyelitis Vaccine (oral)	1954	Albert Sabin	USA
Oral Contraceptive Pills	1955	Gregory Pincus	USA
Artificial Heart	1957	Willem Korf	Netherlands
Use of artificial heart (for surgery)	1963	Michael de Bakker	USA
Heart Transplant Surgery	1967	Christian Barnard	USA
CAT Scanner	1968	Godfrey Hounsfield	S. Africa
Nuclear magnetic resonance imaging	1971	Raymond Damadian	Britain
Recombinant-DNA technology	1972-73	Paul Berg, H.W. Boyer, S. Cohen	USA
First Test Tube Baby	1978	Steptoe & Edwards	Britain
Positron Emission Tomography	1978	Louis Sokoloff	USA
Gene Therapy on humans	1980	Martin Clive	USA
Small Pox eradicated	1980	W.H.O. Declaration	USA
Genes associated with Cancer	1982	Robert Weinberg & others	USA

Goals to be achieved by 2000-2015 ad per the NHP 2002

Eradicate Polio and Yaws	2005	
Eradicate Leprosy	2005	
Eliminate Kala Azar	2010	
Eliminate Lymphatic Filariasis	2015	
Achieve Zero-level growth of HIV-AIDS	2015	
Reduce mortality by 50% on account of TB, Malaria and other Vector and water-born diseases	2015	
Reduce prevalence of blindness to 0.5%	2015	
Increase utilisation of public health facilities from current level of 20% to 75%	2010	
Reduce IMR to 30/1000 & MMR to 100/100000	2010	
Establish an integrated system of surveillance, national health accounts and health statistics	2010	
Increase health expenditure by Government from 0.9 per cent of the GDP at present to 2 per cent of GDP	2010	
The States to increase expenditure on health sector from 5.5 per cent to 7 % of their Budget	2010	
And further increase to 8%	2010	

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- Anti-histamines control allergic reaction.
 - T-cells respond to antigens by producing clone of T-cells.
 - The Killer T-cell directly attack and destroy antigen.
 - The Helper T-cell act to stimulate antibody production by T-cells, leaving it from attacking the body's own cells. (life of T-cells 4-5 years)
 - Both B-cells and T-cells also produce memory cells and clones.
 - Gene Therapy, in human, is to replace a 'faulty gene' by a healthy functional gene.
 - Cloning is a process of producing many identical clones.
 - Stem cells have ability to divide for indefinite periods in culture and to give rise to specialised cells.
 - The fertilised egg is a totipotent.
 - Eyes capable of focusing the images of objects are possessed by vertebrates and some higher invertebrates like prawn, crab and insects.
 - Many insects such as honey bee, flies, butterflies and moth possess chemoreceptors for taste sensation at their feet.
 - Some mammals like rhesus monkey, dogs, pig and cat possess taste sensation for water. Man does not possess taste buds for tasting water.
 - Kidneys are the urine forming organs of vertebrates.
 - The kidney consists of an outer layer of tissue called renal cortex and an inner tissue called renal medulla.
 - An abnormal rise in arterial blood pressure is called Hypertension. A rise in blood cholesterol may lead to deposition of cholesterol this cause the arteries to lose their elasticity. This is called Atherosclerosis. The stiffened arterial wall fails to exert moderating effect on blood pressure.
 - Hypertension is an abnormally low pressure. It may result from chronic vasodilatation of arterial, anaemia, and blood loss due to bleeding or failure of pumping action of heart.
 - The mast cells store inflammation producing substances such as histamine, which help in defence by attracting phagocytes to injured tissue.
 - Normal blood sugar level: 80-100mg per 100ml of blood.
 - Cholesterol: 50-180mg per 100ml.
 - About 30% of CO₂ entered into RBC, combined with globin part of deoxyhemoglobin to form carbaminohemoglobin.
 - The connective tissue provides structural framework and support to different tissue forming an organ.
 - First man-made cereal is Triticosecale (Rai + wheat).
-
- Milk is rich source of all vitamins except Vitamin C.
 - Vitamin D (skin) & K (liver) can be synthesised by our body.
 - Deficiency of protein, carbohydrates and fats results in 'protein-energy-malnutrition'.
 - Protein deficiency (rejected child) skin crack and become scaly, abdomen swell, hair become reddish.
 - In Kwashiorkor, Marasmus, Marasmus child show all above symptoms besides wasting of muscles.
 - Disease restricted to given region and arising from its specific environment condition are called Endemic disease. Such as goiter in Sub-Himalayan region.
 - Pellagra is common amongst people living on a maize diet, because maize interferes with the absorption of niacin in body.
 - Overdose of water soluble vitamin does not cause any harm.
 - Accumulation of fat soluble Vitamin can be toxic-Disease caused by it is called Hypervitaminosis.
 - Vitamin A accumulate in liver, while Vitamin D promotes high Ca⁺⁺ absorption which damage the kidney where it is deposited.
 - Human eye is sensitive only to wavelength ranging from 380 to 760 nm.
 - Human being, apes, monkey, birds, lizards, turtles and some fishes possess colour vision.
 - Genetically modified DNA fragments are termed as recombinant DNA. These can be cloned and amplified virtually to an unlimited extent.
 - Genetic engineering is essentially the alternation of genetic make-up of cells by deliberate and artificial means.
 - DNA ligase enzymes are used to join DNA fragments.
 - They do so by forming again phosphodiester-bond.
 - New technology like gene gun are also available for vectorless direct gene transfer.
 - Transgenics or transgenic organisms are also called Genetically Modified Organisms (GMOs).
 - Dendrite carry impulse towards the cells, Axon away from the cells.
 - Acetylcholine is the chemical transmitter of impulse between synapses.
 - The ligament connects bone at the joints and hold them in a position.
 - Cartilage is bone but semi-rigid and flexible connective tissue.
 - Bone is solid and strong connective tissue.
 - The matrix is heavily deposited with appatite salts of calcium and phosphorus.
 - Adipose tissue is a connective tissue rich beneath the skin, around kidney in mesentery and bone narrow.

- Besides fibroblast, macrophages, collagen and elastic fibres, adipose tissue also contain fat cells.
 - The adipose tissue synthesizes, stores and metabolises fat, it prevents heat loss by forming heat insulating layer beneath the skin and forms shock absorbing cushions.
 - The contraction and relaxation of cardiac chamber are respectively known as Systole and Diastole.
 - Human heart beats at the rate of about 70/min respectively.
 - Tachycardia : A rapid heart or pulse rate of over 100/min.
 - Bradycardia : A slow heart rate of below 60/min.
 - The smaller the animal, the higher its metabolic rate and consequently greater is the need for pumping action of the heart.
 - The heart rate increases during exercise, fever and emotions like anger and fear.
- Important Institutes of Medical Research and Biotechnology**
- National Institute of Immunology (NI), New Delhi
 - National Centre for Cell Science (NCCS), Pune
 - National Brain Research Centre (NBRC), New Delhi
 - National Centre for Plant Genome Research, New Delhi
 - National Bioresource Development Board, New Delhi
 - Centre for DNA Finger-Printing and Diagnostics (CDPD), Hyderabad
 - National Institute of Ayurveda, Jaipur
 - National Institute of Homoeopathy, Kolkata
 - National Institute of Unani Medicine, Bangalore
 - National Institute of Siddha Medicine, Chennai
 - National Institute of Naturopathy Medicine, Pune
 - Morarji Desai National Institute of Yoga, New Delhi
 - Rashtriya Ayurveda Vidyapeeth, New Delhi
 - Central Council for Research in Ayurveda and Siddha (CCRAS)
 - Central Council for Research in Unani Medicines (CCRUM)
 - Central Council for Research in Homoeopathy (CCRHI)
 - Central Council for Research in Yoga and Naturopathy (CCRYN)
 - All India Institute of Hygiene and Public Health, Kolkata (W.B. gal)
 - All India Institute of Medical Sciences, New Delhi (Delhi)
 - All India Malaria Institute, Delhi
 - Central Research Institute, Kasauli (Himachal Pradesh)
 - Indian Institute of Experimental Medicine, Kolkata (W. Bengal)
 - Institute of Ayurvedic Studies and Research, Jarrowgarh, (Gujarat)
 - National Institute of Communicable Diseases, Delhi
 - Nutrition Research Laboratory, Coonoor (Tamil Nadu)
 - Tuberculosis Institute, Delhi

AGRICULTURE AND ANIMAL HUSBANDRY

- Agriculture and Domestication of animals constitutes an important stage in the evolution of modern man.
- Agriculture in the evolution of agriculture and large scale use of animal surplus provided a new momentum to the development of human society.
 - India is fortunate enough to possess rich agricultural resources. They include a wide variety of fertile soils, ample water for irrigation and a growing season almost all the year round.
 - The variety of soils and variations in climatic conditions from region to region makes it possible to grow a large number of crops in our country.
 - In our country, different kinds of agriculture are practised in varying environmental conditions.
- TYPES OF CULTIVATION**
1. **Shifting Cultivation**
 - It is a form of primitive agriculture.
 - It is a form of primitive agriculture.
 - It is also known as 'slash and burn' agriculture.
 - Mainly food crops are grown.
 2. **Sedentary Agriculture**
 - Farmers adopt a particular cropping pattern.
 - Livestock farming becomes an integral part of agriculture.
 - Different types of agricultural implements are used.
 3. **Intensive Agriculture**
 - Characterised by small land holdings.
 - Higher inputs of capital and labour per hectare of land.
 - Yield per hectare is quite high.
 - Rice is the main crop.
 4. **Extensive Agriculture**
 - Large scale farming on large holdings.
 - Sophisticated agricultural machines are utilised.
 - Low per hectare productivity but the total production is quite high.
 - Generally adopted in areas of low population density with high man-land ratio.
 5. **Subsistence Agriculture**
 - Sole objective is of sustaining one's family.
 - Specialisation of crops is not possible.
 - The farmers grow as many crops as are required for their household consumption.

6. Commercial Agriculture General Knowledge

- The main aim is to sell the produce in the market.
- An important characteristic is crop specialisation.
- Plantation agriculture is an important form of commercial farming.
- In it equal emphasis is laid on crop production and livestock rearing.
- The main objective is not only to produce cereal crops but also fodder and cash crops on the same scale.
- 8. Dairy Farming**
- Cattle rearing particularly rearing of milk cows in order to meet demand of milk and milk products in urban areas is referred to as dairy farming.
- Dairy is highly labour intensive activity.
- Dairy farming requires large capital.
- Dairy farming in India has been organised on sound footing.
- 9. Truck Farming**
- Cultivation of vegetables for market is known as truck farming.
- It is an intensive farming.
- It is done with the help of irrigation, manure and HYV seeds.
- 10. Horticulture**
- Major products are fruit and flowers.
- There is great regional variation in production of fruits and flowers.

Types of Agriculture based on Management

1. **Peasant Agriculture :** It is organised by the farmers individually. They own the land as well as other factors of production.
2. **Cooperative Farming :** All the members of the cooperative collectively own the factors of production.
3. **State Farms :** The factors of production are owned by the State. In India Suratgarh farm is an example of State Farm.

Important Institutes of Agriculture and Allied Activities

- Central Arid Zone Research Institute, Jodhpur (Rajasthan)
- Cotton Technological Research Laboratory, Mumbai (Maharashtra)
- Central Rice Research Institute, Cuttack (Orissa)

Central Potato Research Institute, Shimla (Himachal Pradesh)
Central Tobacco Research Institute, Thiruvananthapuram
Central Tuber Crops Research Institute, Barrackpore (West Bengal)
Central Soil Salinity Research Institute, Karnal (Haryana)
(Kerala)
Central Inland Fisheries Research Institute, Mandapam Camp
(Tamil Nadu)
Central Institute of Fisheries Technology, Ernakulam (Kerala)
Central Marine Fisheries Research Station, Mumbai (Maharashtra)
Deep Sea Fishing Research Station, Mumbai (Maharashtra)
Central Sheep and Wool Research Statistics, New Delhi
Central Coconut Research Station, Eranakulam (Kerala)
Central Coir Research Institute, Sabour (Bhagalpur, Bihar)
Fruit Research Institute, Mukteshwar and Izatnagar
(UP)
Indian Veterinary Research Institute, Mysore
Indian Agriculture Research Institute, New Delhi
Sugarcane Breeding Institute, Coimbatore (Tamil Nadu)
Indian Council of Agricultural Research (N. Delhi)
Dairy Research Institute, Karnal
Indian Botanical Survey, Kolkata
Jute Research Institute, Barrackpore
Goat Research Institute, Mathura
Sugarcane Research Institute, Lucknow
Bee Research Institute, Pune
Cotton Research Institute, Mumbai
Poultry Training Institute, Bangalore
Silk Research Institute, Mysore
Coffee Research Institute, Chickmagalur
Leather Research Institute, Chennai
Potato Research Institute, Shimla
Tea Research Institute, Jorhat
Rubber Research Institute, Kottayam
Tobacco Research Institute, Rajamundry
International Centre for Plantation Affairs, Bangalore
National Research Institute for Spices, Calicut
Indian Dairy Corporation, Anand

yoursmahboob.wordpress.com

Wheat	: Uttar Pradesh, West Bengal, Punjab, Bihar, Tamil Nadu, Andhra Pradesh
Bajra	: Uttar Pradesh, Punjab, Haryana, Bihar, Maharashtra, Tamil Nadu, Jammu & Kashmir
Ragi	: Karnataka, Tamil Nadu, Rajasthan, Bihar, Maharashtra, Rajasthan, Madhya Pradesh
Jowar	: Karnataka, Tamil Nadu, Rajasthan, Bihar, Maharashtra, Jammu & Kashmir
Maize	: Karnataka, Haryana, Gujarat, Madhya Pradesh
Pulses	: Madhya Pradesh, Uttar Pradesh, Bihar
Barley	: Uttar Pradesh, Rajasthan, Haryana, Bihar
Groundnut	: Gujarat, Andhra Pradesh, Orissa, Karnataka, Gujarat
Sesamum	: Orissa, Karnataka, Tamil Nadu
Rapeseed & Mustard	: Rajasthan, Uttar Pradesh, Haryana
Jute	: West Bengal, Assam, Bihar, Orissa
Cotton	: Maharashtra, Gujarat, Punjab, Andhra Pradesh
Rubber	: Kerala, Karnataka, Tamil Nadu
Sugarcane	: Uttar Pradesh, Maharashtra, Tamil Nadu
Tobacco	: Andhra Pradesh, Gujarat, Bihar
Tea	: Assam, West Bengal, Kerala, Tamil Nadu
Cocoa	: Kerala, Karnataka, Tamil Nadu
Coffee	: Karnataka, Tamil Nadu, Kerala
SPICES	
Pepper	: Kerala, Karnataka, Tamil Nadu
Turmeric	: Andhra Pradesh, Orissa, Tamil Nadu
Coriander	: Rajasthan, Andhra Pradesh
Chillies	: Andhra Pradesh, Maharashtra, Tamil Nadu
Ginger	: Himachal Pradesh, Madhya Pradesh, Maharashtra
Cardamon	: Kerala, Karnataka, Tamil Nadu
FRUITS	
Banana	: Maharashtra, Gujarat, Tamil Nadu, Kerala
Grapes	: Maharashtra, Karnataka, Punjab, Andhra Pradesh, Tamil Nadu, Haryana
Mango	: Maharashtra, Gujarat, Uttar Pradesh, Bihar, West Bengal, Andhra Pradesh
Pomegranate	: Maharashtra
Sapota	: Maharashtra, Gujarat

Types of Irrigation		Dominant areas	
Type	Percentage of Total Irrigated Area	Punjab, Haryana, U.P Tamil Nadu, Andhra Pradesh, Karnataka, Punjab, Haryana, U.P., Bihar, West Bengal	
Tube well irrigation (well irrigation rank)	6%		
Canal irrigation	33%		
Diseases of Major Crops			
Name of the crop	Disease	Pathogen	Symptoms
1. Rice (paddy)	Blast	Fungus, Pyricularia oryzae	Brown boat-shaped lesions (spots) appear on the margins of leaves.
2. Wheat	Rust	Fungus, Puccinia graminis	Yellow, brown or black elongated spots appear on leaves and straws.
3. Sugar-cane	1. Red rot	Fungus Collector-falcatum	Small red spots on leaf mid-rib appear. The pith sugarcane look.
	2. Grassily shoot	Fungus	Production of many tillers from the base.
6. Groundnut	Tikka	Fungus, Cercospora personata	Light brown oval-shaped lesions appear on leaflets, petioles and stems.
7. Mustard	1. White rust	Fungus	White or cream yellow scattered pustules appear on the lower surface of leaves.
	2. Downy mildew	Fungus	Yellow irregular spots appear on leaves. In severe infection, the inflorescence is malformed, twisted and covered with white powder.
4. Chick pea	Wilt	Fungus	The leaves become yellow and dry up Roots turn black and decompose.
5. Pigeon pea	Stem rot	Fungus	Development of brown to dark brown lesions on the stem near soil surface. These lesions girdle the stem and plant dies.

compiled by Sujoy

Plant diseases caused by Mycoplasma

Diseases

Sesamum phyldody

Little leaf diseases

Bunchy top of Papaya

Peanut witches broom

Potato witches broom

Little leaf of Sweet Potato

Sweet Potato witches brown

Asteryellow corn Smut

Spike diseases of Sandalwood

sugar-cane, bacterial blight of rice and sesame leaf spot of rice.

Air-borne diseases : Blast of rice, black stem and coffee rust cause

Soil-borne diseases : Root knot of tomato, tikka disease of ground

nut, smut of bajra and green ear of brinjal.

Insect Pests of Major Crops

Name of the crop	Name of insect-pests	Zoological name	Nature of damage
Rice	1. Gundhy or Rice bug	1. Leptocoris acuta	1. Attack during post-flowering period.
	2. Leaf hopper.	2. Nephrotettix	2. Attack on leaves.
	1. Gujhai weevil	—	1. Grubs feed on the roots and adults cut the growing points. 2. Attack seedlings and in the central shoots.
Wheat	2. Shoot fly	—	1. Larvae bore into the midrib of leaves and make tunnel later on it enters into the growing point and damage it. 2. The caterpillars bore into the central shoot and make tunnel downward. They feed inside the soil issue.
	1. Top borer	1. Scirphophaga nivella	1. Wild Oat (Javri) 2. Grass (Ghaas) 3. Amaranthus (Chaulai) 4. Chenopodium (Bathua) 5. Convolvulus (Hiran Khuri)
	2. Shoot borer	2. Chilo infuscatellus	1. Both nymph and adult suck sap from undesired the leaf.
Sugarcane	3. Sugarcane leaf hopper	3. Pyrrilia perpusilla	The grubs feed on roots. Adult-beetles feed on leaves. Both nymph and adult suck the sap of all the plant parts. Both nymph and adult suck the sap of leaves at the seedling stage. The caterpillars first feed on tender leaves later on male holes in the pods and feed on developing grain.
	—	—	—
	—	—	—

state	Fertilizer per hectare	Rice Production per hectare
Punjab	129	4500
Tamil Nadu	100	2500
Bihar	30	1000
Manipur	9	700

SOME COMMON WEEDS

Some Common weeds found in wheat and rice fields :

Important Weeds of Kharif Season

Important Weeds of Rabi Season

- 1. Saathi (Trianthema)
 - 2. Amaranthus (Chaulai)
 - 3. Wild Sorgbum.
 - 4. Nut grass (Cyperus rotundus)
- 1. Chenopodium album (Bathua)
 - 2. Wild Oat
 - 3. Mandoosi (Phalaris)
 - 4. Hirankhuri (Convolvulus pluricaulis)

Some Common Weedicides

Some Common Fertilizers

Chemical fertilizers	called are :
Nitrogenous fertilizers	1. Ammonium sulphate 2. Ammonium nitrate
Ammonium fertilizers	1. Ammonium nitrate
Phosphatic fertilizers	1. Sodium phosphate 2. Urea 3. Potassium sulphate 4. Potassium nitrate
Calcareous fertilizers	1. Calcium dihydrogen phosphate 2. Ammonium hydrogen phosphate or Ammophos
Potassium fertilizers	1. Ammonium potassium chloride 2. Potassium chloride 3. Potassium chloride 4. Potassium sulphate
Others	1. 2, 4-D (2, 4-Dichlorophenoxy acid) 2. Butachlor 3. MCPA (2-Methyl 2-Chloro 1-Phenoxy Acetic Acid)

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1. D.D.T. (Dichloro Diphenyl Trichloroethane)
2. B.H.C. (Benzene Hexa Chloride)
3. Malathion
4. Copper Oxychloride
5. Sulphur
6. Zinc Phosphide
7. Warfarin
8. Agrosan
9. Ceresan

River	Important Irrigational and Multipurpose Projects		
	Project	Associated States	
Sutlej	Bhakra Nangal	Haryana, Punjab & Rajasthan	Panamparambilukulam Periyar Godavari Beas
Pawana	Bhima I	Maharashtra & Andhra Pradesh	Panamparambilukulam Alayar Parambikulam Pochampad
Krishna	Bhima II	Maharashtra	Pong Dam Ramu Ganga Ranjit Sagar
Chambal	Chambal	Joint Project of M.P. and Rajasthan	Dam Dam (Thein Dam)
Damodar	Damodar Valley Project	West Bengal and Bihar	Rihand Dam
Chenab	Dulhasti Power Project	Jammu and Kashmir	Sabarmati Sharda Sahayak Sone High Level Canal
Hooghly	Farakka	West Bengal	Tawa Tawa
Gandak	Gandak	Bihar and U.P.	Tehri Dam
Ghataprabha	Ghataprabha	Karnataka	Tungabhadra
Hasdeo	Hasdeo Banga Project	Madhya Pradesh	Ukai
Mahanadi	Hirakund	Orissa	Upper Krishna
Godavari	Jayakwadi	Maharashtra	Upper Penganga
Tapti	Kakrapara	Gujarat	Uti Power Project
Kangsabati and Kumari	Kangsabati	West Bengal	Jhelum
Karjan	Karjan	Gujarat	
Kosi	Kosi	Bihar	
Koyana	Koyana	Maharashtra	
Krishna	Kukadi	Maharashtra	
Ghagras	Krishna Project	Uttar Pradesh	
Ganga	Left Bank Ganga Canal	Uttar Pradesh	
(The irrigation scheme will utilise releases from Hirakund Reservoir)	Mahanadi Delta Scheme	Orissa	
Malaprabha	Malati	Gujarat	
Mayurakshi	Malaprabha	Karnataka	
Krishna	Mayurakshi	West Bengal	
	Nagajunagaram	Andhra Pradesh	

Shifting Cultivation and its Different Names			
Name	Region	Name	Region
Jhuming	India	Ladang	Malaysia
Chengin	Philippines	Milpa	Central America, Mexico
Orissa	Venezuela	Roka	Brazil
Maharashtra	Zaire Basin		
Masole			

ANIMAL HUSBANDRY

- The branch of agriculture which deals with the feeding, shelter, health and breeding of domestic animals is called animal husbandry.
- India has the largest livestock population, accounting for about 57 per cent of the world buffalo population and 15 per cent of the cattle population.
- Due to low economic status of the livestock owners, much of the livestock is reared under sub-optimal conditions.
- Livestock sector provides regular employment to about 11 million in principal status and 8 million in subsidiary status.
- Women constitute 69 per cent of the labour force in livestock sector as against 35 per cent in crop farming.
- Fisheries sector occupies a very important place in the socio-economic development of the country.

compiled by Sujoy

BREEDS OF ANIMALS

Indian breeds of buffaloes	
2.	Bhadawari
3.	Jaffrabadi
4.	Surti
5.	Mehsana
6.	Nagpuri or Ellichpuri
7.	Nili Ravi
COW BREEDS	
Milch Breeds	
1.	Gir
2.	Sahiwal
3.	Red Sindhi
4.	Deoni
Draught breeds	
1.	Malvi
2.	Nageri
3.	Hallikar
4.	Kangayan
General Utility Breeds	
1.	Haryana
2.	Ongole
3.	Kankrej
4.	Tharparkar
GOAT BREEDS	
Breed	
1.	Gaddi
2.	Kashmiri Pashmina
3.	Jamunapari
4.	Beetal
5.	Marwari
6.	Bearari
7.	Malabari
8.	Bengal
PIG BREEDS	
Breeds Distribution	
1.	Desi
2.	Ghor
Exotic Breeds	
3.	Berkshire
4.	Large White Yorkshire

Kiran's One Liner Approach General Knowledge

U.S.A., Switzerland and Denmark

U.K.

U.S.A.

Distribution

Rajasthan, Gujarat

Rajasthan

Bhutan, Punjab

North eastern mountains

Himachal Pradesh

Ladakh

Gurej tehsil, Kashmir

Kol in Kashmir

Lower hills of Himalayas

Jammu region, Kullu/Kangra valleys and Chamba/Mandi areas of H.P.

Mahasu and Kinnaur district of H.P.

Punjab, S. Rajasthan

Bikaner division, Rajasthan

Jodhpur, Jaipur, Pali, Barmer districts

of Rajasthan

Saurashtra and Gujarat

Kathiarwar, Kachchh, S. Rajasthan and N. Gujarat

SE Maharashtra and adjoining A.P.

Nellore district of A.P.

Bellary/Kurnool districts of A.P.

Karnataka state

5.	Landrace
6.	Duroc
7.	DURGA BREEDS
	HORSE BREEDS
	Kashawari
1.	Marwari
2.	Bhutia
3.	Manipuri
4.	Spiti
5.	Zanskar
6.	Sherep BREEDS
7.	Gurel
8.	Kashawari
9.	Caddit
10.	Rampur Bushair
11.	Deccani
12.	Nellore
13.	Bellary
14.	Mandhya
15.	Bandhur

Poultry Breeds
Domestic fowl (Gallus domesticus)
American Type : Plymouth Rock, Red Rhode Island, New Hampshire.
English Type : Sussex, Australorp.
Mediterranean Type : Leghorn, Minorca.
Indian Type : Ghagrus, Busra, Dorki, Asael, Black Bengal, Tellicherry etc.
Asiatic Type : Brahma, Cochinchina, Langshan.

SHEEP AND USES

Breeds	Uses
1. Lohi	Yield good quality wool and milk
2. Rampur Bushair	Fleece is brown in colour, yield superior cloth.
3. Nali	Produce superior wool for making of carpets
4. Bhakarwa	Suitable for the production of high quality woollen shawls
5. Deccani	Gives mutton, wool is not formed
6. Nellore	Gives mutton, wool is not formed
7. Marwari	Produces coarse quality wool.
8. Patanwadi	Produces wool that is used for army hosiery

compiled by Sujoy

- A large section of the Indian population uses fish as food, particularly those living in coastal areas.
- Fish liver oil is rich in Vitamins A and D.
- On the basis of their habitat, fish are mainly divided into categories : (i) Marine Fish (ii) Fresh Water Fish
- **Marine Fishes of India** :- Bombay Duck, Bel, Hilsa, Pomfret, Salmon, Sardine.
- **Fresh Water Fishes of India** :- Catla, Tilapia, Rohu, Muli, Singha, Calbasu.
- India is the third largest producer of fish, and second largest producer of inland fish in the world.
- The fisheries sector provides employment to over 11 million people engaged fully, partially or in subsidiary activities pertaining to the sector.
- Potential of fish production from marine and inland sources has been estimated at 3.9 million tonnes and 4.5 million tonnes respectively.

DISEASES IN ANIMALS

Diseases	Viral Diseases of Animals
Foot and Mouth Disease	Animals
Pox	All cattle
Dermatitis	Cow, Buffalo, sheep, goat, fowl
Disease	Bacterial Diseases of Animals
Fowl Cholera	Poultry Birds
Diarhoea of chick	Poultry Birds
Rinderpest	Cattle
Tuberculosis	Cattle and Birds
Anthrax	Cattle, sheep, goats, pigs

Diseases of Animals Transmitted to Human Beings

- Bacterial Diseases :- Anthrax, Tuberculosis, Brucellosis
- Viral Diseases :- Rabies, Cow Pox, Encephalitis
- Fungal Diseases :- Aspergillosis, Actinomycosis, Ringworm
- Parasitic :- Ascariasis, Amebiasis, Trypanosomiasis

IMPORTANT INSTITUTES

1. Central Sheep Breeding Farm, Hissar
2. Central Fodder Seed Production Farm at Hessarghatta (Karnataka)
3. The Central Institute of Fisheries, Nautical and Engineering Training, Kochi
4. The Central Institute of Coastal Engineering for Fisheries, Bangalore
5. The National Research Centre on Pigs, Guwahati.

- Nanotechnology is the design, characterisation, production and application of structures, devices and systems by controlling shape and size at the nanoscale. Eight to ten atoms span one nanometer (nm).
- Nanoscience is the world of atoms, molecules, macromolecules (large molecules), and nanotechnology, a large set of materials with quantum dots, and nanotechnology, a large set of materials with the help of nanotechnology, a large set of materials with distinct properties (optical, electrical, or magnetic) can be fabricated.
- Nanoparticles take advantage of their dramatically increased surface area to volume ratio. Their optical properties, e.g. fluorescence, become a function of the particle diameter.
- When brought into a bulk material, nanoparticles can strongly influence the mechanical properties, such as the stiffness or elasticity.

BIONANOTECHNOLOGY

- The biological and medical research scientists have exploited the unique properties of nanomaterials for various applications e.g., contrast agents for cell imaging and therapeutics for treating cancer.
- Biological tests measuring the presence or activity of selected substances become quicker, more sensitive and more flexible when certain nanoscale particles are put to work as tags or labels.
- Magnetic nanoparticles, bound to a suitable antibody, are used to label specific molecules, structures or microorganisms. For example, gold nanoparticles tagged with short segments of DNA can be used for detection of genetic sequence in a sample.
- The overall drug consumption and side-effects can be lowered significantly by depositing the active agent in the morbid region only and in on higher dose than needed. This highly selective approach reduces costs and human suffering. The could hold small drug molecules transporting them to the desired location.
- Some potentially important applications include cancer treatment with iron nanoparticles or gold shells.
- Nanotechnology can help to reproduce or repair damaged tissue. This so called "tissue engineering" makes use of artificially stimulated cell proliferation by using suitable nanomaterial-based scaffolds and growth factors.

CHEMISTRY & ENVIRONMENT

- Chemical catalysis and filtration techniques are two prominent examples where nanotechnology already plays a role. The synthesis

sis provides novel materials with tailored properties e.g. nano particles with specific optical properties. Chemical catalytic and influence from nano particles, due to the extremely large surface area.

- The application potential of nanoparticle fuel cell to catalytic converters and influence of nanotechnology on the production of chemical storage devices is also important for the photocatalysis reaction and energy storage devices.
- Nanoporous membranes with extremely small pores smaller than 10 nm are mainly used for the removal of ions or the separation of different chemicals.

ENERGY

- The most advanced nanotechnology projects related to storage, conversion, manufacturing, and enhanced renewable energy sources.
- Nanotechnology can help to increase the efficiency of combustion engines by specifically designed nanostructures.
- The most prominent nanostructured material in fuel cells is the catalyst consisting of carbon supported noble metal particles with diameters of 1-5 nm. Suitable materials for hydrogen storage contain a large number of small nanosized pores. Many nanomaterials like nanotubes, zeolites or aluminates are under investigation.
- Nanotechnology can contribute to the further reduction of combustion engine pollutants by nanoporous filters, which can clean the exhaust mechanically, by catalytic converters based on noble metal particles or by catalytic coatings on cylinder walls.

INFORMATION & COMMUNICATION

- Current high-technology production processes are based on traditional top down strategies, where nanotechnology has already been introduced silently. The critical length scale of integrated circuits is already at the nanoscale (50 nm and below) regarding the gate length of transistors in CPUs or DRAM devices.
- In the modern communication technology traditional analog electrical devices are increasingly replaced by optical or optoelectronic devices due to their enormous bandwidth and capacity, respectively. Two promising examples are photonic crystals and quantum dots.

CONSUMER GOODS is already impacting the field of consumer goods, ranging from easy-to-clean, non-toxic products with novel functions.

Nanotechnology products are different nanoparticle im-

providing scratch-resistant products.

➤ Nanocomposite coating process could be applied in the production, processing, safety to food packaging by placing anti-microbial agents directly on the surface of the coated film.

➤ Nano-composites could increase or decrease gas permeability of different materials as is needed for different products. They can also improve the mechanical and heat-resistance properties and lower the transmission rate.

➤ Oxygen transmission resistant coatings based on nanocomposites. The first sunglasses are on the market. For optics, nanotechnology polymer offers scratch-resistant coatings based on nanofibers. The use of nanofibers with a nanotechnological finish can be washed less frequently and at lower temperatures.

NANO SCIENCE IN INDIA

Nano-Tube Filter: The scientists from Banaras Hindu University have devised a simple method to produce carbon nanotube filters that efficiently remove micro-to nano-scale contaminants from water and heavy hydrocarbons from petroleum. Made entirely of carbon nanotubes, the filters are easily manufactured. The nanotube composition makes the filters strong, reusable, and heat resistant, and they can be cleaned easily for reuse.

Typhoid Detection Kit: Using the nano sensor, developed by Prof. A. K. Sood of IISc, Bangalore, a Typhoid Detection Kit has been developed by DRDE, Gwalior. Typhoid fever caused by *Salmonella Typhi* is a major health problem and an important challenge to health authorities of third world countries due to unsatisfactory water supply, poor sanitary conditions, malnutrition, emergence of antibiotic resistant strains etc.

Gas Flow Induced Generation of Voltage from Solids: Prof. A. K. Sood, professor of Physics at IISc and his student Shankar Ghosh have found that the liquid flow in carbon nano tubes can generate electric current. One of the most exciting applications to emerge from the discovery is the possibility of a heart pacemaker-like device with nanotubes, which will sit in the human body and generate power from blood. Instead of batteries, the device will generate power by itself to regulate defective heart rhythm.

Drug Delivery System: A research group headed by Professor A.N. Maitra of the University of Delhi has developed 11 patentable technologies for improved drug delivery systems using nanoparticles. Four of these processes have been granted U.S. patents. One of the important achievements at the initial stage of drug delivery research was development of a reverse micelles based process for the synthesis of hydrogel and 'smart' hydrogel nanoparticles for en-

- NTPC is a schedule 'A' 'Navratna' company having investment of Rs. 79,336.67 crore.

March, 2004 is 21,749 MW.

POWER TRADING CORPORATION OF INDIA LIMITED

- Power Trading Corporation of India Limited single entity to enter into Power Purchase Agreement by acting as independent Power Producers (IPPs) on one side and under long-term arrangement.
- The Government has also identified PTC as a nodal agency to deal with matters relating to exchange of power between India and neighbouring countries.

POWER GRID CORPORATION OF INDIA LIMITED (PGCL)

- The Power Grid Corporation of India Limited (PGCL) for establishment and operation of regional and national grids to facilitate transfer of power within and across the regions.
- It has been recognised as a mini-ratna category-1 PSU.
- During the year 2003-04, the organisation has earned a net profit of about Rs. 740 crore on a turnover of about Rs.2,783 crore.

TEHRI HYDRO DEVELOPMENT CORPORATION LIMITED

- The Tehri Hydro Development Corporation (THDC) was incorporated on July 12th, 1988 as a joint venture of the Government of India and Government of Uttar Pradesh to execute the 2400 MW Tehri Hydro Power Complex in Tehri Garhwal (Uttarakhand) and also to plan, promote and organize the development and harnessing of hydro-electric projects in Bhagirathi-Bhilkangana Valley as may be entrusted to the Corporation by the Government.
- The Corporation is presently engaged in the implementation of Tehri Hydro Power Complex (2,400 MW) comprising of Tehri Dam and HPP, Stage-1, (1,000 MW) and 400 MW Koteswar HE Project and Tehri Pumped Storage Plant (1,000 MW).
- The project will generate 6,5000 MWs of energy per year on completion of entire Complex (3,568 MWs on completion of Stage-1).
- The project will provide drinking water facilities for Delhi and towns and villages of Uttarakhand and U.P.

POWER FINANCE CORPORATION LIMITED

- The Power Finance Corporation Limited (PFC), New Delhi, was incorporated on July 16th, 1986 and was declared a public financial institution in August 1990.
- The main objectives of the Corporation include financing of power generation projects, transmission and distribution works, re-generation and modernisation of power plants, system improvement

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conservation schemes, maintenance and repair of capital equipment declared as Mini Ratna (Category I) PSU.

DAMODAR ELECTRIFICATION CORPORATION LIMITED

- DFC has been declared as a 'Navratna' company.
- Rural Electrification Corporation Limited (REC) was set up to provide financial assistance to REC is a schedule 'A' organisation.

Rural Electrification Corporation Limited (REC) was set up to provide financial assistance to REC is a schedule 'A' organisation.

SATLUJ JAL VIDYUT NIGAM (SJVN) LTD.

- Satluj Jal Vidyut Nigam (SJVN) Ltd. (formerly Nathpa Jhakri Power Corporation Ltd) was incorporated on May 24th, 1988 as a joint venture of the Government of India and the Government of Himachal Pradesh to plan, investigate, organise, execute, operate and maintain hydro-electric power projects in the Satluj basin in Himachal Pradesh.
- The equity-sharing ratio of Government of India and Government of Himachal Pradesh is 3:1 respectively.
- The 1500 MW, Nathpa Jhakri Hydro-electric Power Project is the first project undertaken by SJVN.

NATIONAL HYDRO ELECTRIC POWER CORPORATION (NHPC)

- NHPC was set up in 1975 to promote the development of hydroelectric power in the Central Sector.
- NHPC is a schedule 'A' enterprise of the Government.
- NHPC has got nine commissioned power stations with installed capacity of 2,475 MW and plans to add 4,357 MW during Tenth Plan.

DAMODAR VALLEY CORPORATION

- The Damodar Valley Corporation (DVC), the first multi-purpose river valley project of the Government of India, was set up in July, 1948 for the unified development of Damodar Valley region spread over the state of Jharkhand and West Bengal.
- DVC's main projects include four dams at Maithon, Panchet, Tilaiya and Konar, with connected hydro-electric power stations (except at Konar), thermal power station at Bokaro 'A', Bokaro 'B', Chandrapura, Durgapur, Meja and also one gas turbine station at Maithon.
- DVC supplies power to coal mines, steel plants, railways and other big industries, besides State Electricity Boards of Jharkhand and West Bengal.
- The total derated capacity of DVC in April, 2004 was 2,761.5 MW comprising 2,535 MW of thermal, 144 MW of hydel and 82.5 MW from gas turbine station.

GAS AUTHORITY OF INDIA LIMITED

- Gas Authority of India Limited (GAIL) is one of the enterprises and ranks among the top 10 public sector corporations in India.
- The company was incorporated in 1984 for handling, distribution and marketing of natural gas.
- The company was assigned the priority task of setting up the country HEJ pipeline.
- Presently GAIL is the largest company in India for processing, transmission and distribution of natural gas.
- GAIL is operating system seven LPG recovery plants at Bijapur I and II in Madhya Pradesh, Vaghotra and Gandhar in Bihar, Lakwa in Assam, Usar in Maharashtra and Aurnajira in U.P.
- **NON-CONVENTIONAL SOURCES OF ENERGY**
- The mineral-based energy, whether coal, mineral, oil or minerals, may not be depended upon as these resources are inexhaustible resources like sunlight, wind, tidal waves, Bio-gas etc.
- Scientists world over are trying to develop and obtain energy and geo-thermal energy sources.
- The importance of increasing the use of renewable energy was recognized in the country in the early 70s.
- The country has today among the world's largest programmes in renewable energy.
- The activities cover all major renewable energy sources of interest, such as bio-gas, bio-mass, solar energy, wind energy, small hydropower and other emerging technologies.
- The Ministry of Non-Conventional Energy Sources (MNES) created in 1992 is the nodal agency of the Government for all matters relating to non-conventional/renewable energy.
- The Ministry has established the following institutions for technology development and application of various renewable energy sources.
- **Energy Centre** : The Centre functions as a National testing and standardize centre for solar energy materials, components and services, takes up collaborative research projects, and provides advisory and consultancy service to industry and users.
- **Sardar Swaran Singh National Institute of Renewable Energy (SSN NIRE)** : An autonomous registered society has been established near Jallandhar in Punjab.
- **Centre for Wind Energy Technology (C-WET)** : It has been established, as an autonomous body (registered society), at Clermont India being a tropical country, has a vast potential of ocean energy.
- The various forms of ocean energy are waves, ocean thermal energy conversion, currents and tides.
- Of these, tides can be harnessed for large developments.
- India is the fourth largest producer in the world of Solar cells and photovoltaic (PV) modules.

India now has a very good R&D base for the development of technologies for small scale and medium/large scale industries, both in the public sector as well as the private sector.

These public sector enterprises include small scale and medium/large scale industries, both in the guidance and help provided to many developing countries for the construction of bio-gas plants.

The world's largest solar steam cooking system for cooking food for the promotion of family type bio-gas plants which aim at producing 15,000 MW of module production.

About 23 MW of module production.

KVIC design, fixed dome type, and bag type portable digester made of rubberised nylon fabric are being propagated under this programme.

Power Stations of India

State	Thermal Power Stations	Hydel Power Stations	Nuclear Power Stations
Andhra Pradesh	Ramagundam (coal) Kothagudem (Super thermal coal) Vijayawada (Super thermal coal) Muddanur	Sivasamudram Upper Sileru Lower Sileru Srisailam	—
Assam	Bongaigaon (oil based) Barauni (oil) Chandrapura (coal) Santaldih (coal)	Kosi, Panchat, Maithon	—
Bihar	Bokaro (coal) Gandhinagar (oil)	Tilaiya	—
Jharkhand	Sabarimala (oil) Dhuvaran (super oil/thermal) (based on Vanakbari, Almendar)	Ukai	Kakrapar
Gujarat	Faridabad (coal) Bhatinda, Ropar	Bhakra Nangal Dehar	—
Haryana	Subernerkhanda	Shamen (naphtha)	—
Punjab	(coal) Talcher (super thermal coal), Balmela	Hirakund	—
Himachal Pradesh			
Odisha			

SPACE SCIENCE IN INDIA

- The foundation of space research in India was laid in 1962 when Government of India entrusted the task of developing a programme on space responsible to its Department of Atomic Energy.
- The Department of Atomic Energy set up a National Committee which identified two major objectives for India's space research programme.
- These objectives were-
 - (i) To utilise space technology for the rapid development of mass communications and education, especially in the far-flung rural areas.
 - (ii) To utilise space technology for the timely survey and management of the country's natural resources.
- During the formative decade of 1960s, space research was conducted by India, mainly, with the help of sounding rockets.
- The Indian Space Research Organisation (ISRO) was formed in 1972.
- In the history of the Indian space programme, 1970s were the era of experimentation during which experimental satellite programmes like Aryabhata, Bhaskara, Rohini and Apple were conducted.
- The success of those programmes led to the era of operationalisation in 1980s during which operational satellite programmes like INSAT and IRS were conducted.
- Today, INSAT and IRS are the major programmes of ISRO.
- Antrix, the commercial arm of ISRO is marketing India's space services globally.

- 1995 : INSAT-2C satellite successfully launched from Sriharikota (May 1) from Kourou, French Guyana.
- 1996 : PSLV-D3 successfully launched in space, by Ariane (May 4) (June 4).
- 1997 : INSAT-2D placed in orbit by Ariane rocket (March 21).
- 1999 : PSLV-C2, the indigenously built Polar Satellite Vehicle was successfully launched from Sriharikota (May 4) (June 4).
- 2000 : INSAT-3B, the first of its kind in III series was successfully launched (March 2000).
- 2001 : On January 24, 2002, INSAT-3C successfully launched fully launched three satellites — TES of India, BRD of Ariane from Kourou, French Launch Vehicle, PSLV-C3 successfully launched by PSLV-C5 successfully launched by On September 20, 2004, GSLV-F-01 successfully launched educational satellite "EDUSAT".
- 2002 : On May 5, 2005, PSLV-C6 successfully launched "CARTOSAT-1".
- 2003 : On July 10, 2006 GSLV-G-2 unsuccessfully launched "INSAT-4C".
- 2004 : On January 10, 2007 PSLV-C-7 successfully launched "CARTOSAT-2".
- 2005 : On April 23, 2007 PSLV-C-8 successfully launched (Italy).
- 2006 : On September 2, 2007 GSLV-F-04 successfully launched INSAT-4CR.
- 2007 : On January 21, 2008 PSLV-C10 successfully launched 'TEKSAR'.
- 2008 : On April 24, 2008 PSLV-C 9 successfully launched 'CARTOSAT-2A'.
- 2008 : On October 22, 2008 PSLV-C-11 successfully launched 'CHANDRAYAN-I'.
- 2009 : On November 23, 2009 PSLV-C-14 successfully launched 'OCEANSAT-2'.
- 2010 : On July 12, 2010 PSLV-C-15 successfully launched 'CARTOSAT-2B', ALSAT-2A, NLS 6.1 AISAT-1, NLS 6.2 TISAT-1 and STUDSAT.
- 2011 : On April 20, 2011 PSLV-C-16 successfully launched RESOURCESAT-2, YOUTHSAT and X-SAT.
- 2011 : On July 15, 2011, PSLV-C-17 successfully launched GSAT-12.

satellite	Date	Type	Launch Vehicle	Result
Ayabhatta	19-04-75	Scientific	Cosmos	Successful
Bhaskara-1	07-06-79	Geosurvey	Cosmos	Successful
Rohini D-1	10-08-79	Geosurvey	S.L.V. 3	Unsuccessful
Rohini D-1	18-07-80	Scientific	S.L.V. 3	Successful
Rohini D-1	31-05-81	Communication	Ariane	Successful
Apple	19-06-81	Geosurvey	Cosmos	Successful
Blaskara-II	20-11-81	Multipurpose	Delta	Successful
IRS-1A	10-04-82	Scientific	S.L.V. 3	Successful
IRS-1A	17-04-83	Multipurpose	ASLV-D2	Successful
IRS-1A	30-08-83	Technical	Space Shuttle	Successful
IRS-1B	24-03-87	Remote sensing	ASLV-D1	Unsuccessful
IRS-1B	17-03-88	Multipurpose	Vostok	Successful
IRS-1A	17-07-88	Technical	ASLV-D2	Successful
IRS-1A	21-07-88	Multipurpose	Ariane-4	Successful
IRS-1D	12-06-90	Multipurpose	Delta	Successful
IRS-1D	29-08-91	Remote sensing	Vostok	Successful
IRS-1B	10-07-92	Multipurpose	Ariane	Successful
IRS-2A	23-07-93	Multipurpose	Ariane	Successful
IRS-2B	20-09-93	Remote sensing	Ariane-4	Successful
IRS-P1	04-05-94	Scientific	PSLV-D1	Successful
IRS-P2	15-10-94	Remote sensing	PSLV-D3	Successful
IRS-2C	07-12-95	Telecom	Ariane	Successful
IRS-1C	28-12-95	Remote sensing	Ariane-4	Successful
IRS-P3	20-03-96	Remote sensing	PSLV-D3	Successful
IRS-2D	20-04-97	Telecom	Ariane	Successful
IRS-1D	29-08-97	Remote sensing	PSLV	Successful
IRS-2E	03-04-99	Multipurpose	Ariane	Successful
INSAT-3B	22-03-2000	Multipurpose	Ariane	Successful
G-SAT-1	18-04-2001	Multipurpose	PSLV-D	Successful
INSAT-3C	24-01-2002	Communication	Ariane-4	Successful
MET-SAT	12-09-2002	Meteorology	PSLVC-4	Successful
INSAT-3A	10-04-2003	Multipurpose	Ariane-5	Successful
INSAT-3E	28-09-2003	Communication	Ariane-5	Successful
SAT-1	17-10-2003	Remote sensing	PSLVC-5	Successful
EDUSAT	20-9-2004	Education	Ariane-5	Successful
CARTOSAT-1	05-05-2005	Cartography	PSLVC-5	Successful
INSAT-4A	22-12-2006	Telecom	Ariane-5	Successful
INSAT-4C	10-07-2006	Telecom	PSLVC-6	Successful
CARTOSTAT-2,	10-01-2007	Multipurpose	PSLVC-7	Successful
LAPAN				
PARSAT	12-03-2007	DTH Services	Ariane	Successful
INSAT-4B	02-09-2007	Telecom	PSLVC-10	Successful
INSAT-4CR	21-01-2008	Remote sensing	PSLVC-9	Successful
TECSAR	24-04-2008	Multipurpose	PSLVC-11	Successful
CARTOSAT-2A	22-10-2008	Obs. of Moon	PSLVC-12	Successful
OCEANSAT-1	23-11-2009	Multipurpose	PSLVC-14	Successful
CARTOSAT-2B	12-07-2010	Remote sensing	PSLVC-15	Successful
RESOURCESAT-2	20-04-2011	Multipurpose	PSLVC-16	Successful
& OTHERS	15-07-2011	Communication	PSLVC-17	Successful

compiled by Sujoy

INDIAN SATELLITE SYSTEM

- 'INSAT' means Indian National Satellite.
- INSAT system started with the launch of INSAT-1A on April 1982 from Cape Canaveral.
- The Indian National Satellite (INSAT) is a multipurpose television broadcasting and data relay nationwide direct, television programme distribution, telecommunication, and radio broadcasting system. The system is a joint venture of Department of Telecommunication, Indian Meteorological Department (IMD), All India Radio (AIR) and Doordarshan. INSAT-1 series were made by the United States (US) for India and launched by foreign rockets.
- INSAT-2 series were made by India and launched by foreign rockets.
- INSAT is one of the largest domestic communication system in the world with six satellites, INSAT-2DT, INSAT-2E, INSAT-3A, INSAT-3B, INSAT-3C and INSAT-3E. The INSAT system includes a few transponders leased from other agencies for meeting the current demands.
- INSAT-3A/3B/3C are all in orbit, while INSAT-3E was launched in September 2003, from Kourou in French Guyana, augmenting India's telecommunication, broadcasting and meteorological services.
- On September 20, 2004, India's Geosynchronous Satellite Launch Vehicle (GSLV) successfully launched EDUSAT, the country's first thematic satellite dedicated exclusively for educational services.
- EDUSAT is specially configured for audio-visual medium, employing digital interactive classroom and multimedia and multi-channel system.
- The satellite has five Ku-band transporters and six C-band transponders.
- EDUSAT provides connectivity for school, college and higher levels of education and also to support non-formal education including developmental communication.

APPLICATIONS OF COMMUNICATION SATELLITES

- The INSAT system was supposed to carry out three independent tasks, namely—
- 1. Tele Communications
- 2. Television and Radio Broadcasting
- 3. Meteorological Observations
- Remote areas and offshore islands have been connected with rest of the nation using INSAT system.
- Interactive education system has been provided a big boost.

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- Nation-wide library networking has been initiated on a large scale.
- INSAT communication services have been used in mobile satellite telephony, telemedicine, computer networking etc.
- INSAT television through INSAT-2C.
- Regions of South-East Asia and Middle-East are now able to receive Indian television broadcasting through INSAT.
- Education from primary level to university level.
- The entire radio networked through INSAT.
- The meteorological data gathering with Very High Resolution Radiometer (VHRR) on board INSAT-2 series has vastly improved.
- INSAT system provides meteorological services through Very High Resolution Radiometer (VHRR) and CCD cameras on some of its spacecraft.
- Cyclone monitoring through disaster warning receivers has been operationalised.

INDIAN REMOTE SENSING SATELLITE SYSTEM

- Today, India has the largest constellation of Remote Sensing Satellites which are providing services both at the national and global levels.
- From the Indian Remote Sensing (IRS) Satellites, data is available in a variety of spatial resolutions starting from 360 metres and highest resolution being 5.8 meters. Besides, the state-of-the-art cameras of IRS spacecraft take the pictures of the Earth in several spectral bands.
- The first Indian Remote Sensing Satellite, IRS-IA was launched on March 17, 1988.
- The second Indian Remote Sensing Satellite IRS-IB was launched on August 29, 1991.
- The Indian Remote Sensing Satellite system, comprising IRS-IC, IRS-ID and IRS-P4 besides IRS-P3, is the largest such system in the world today.
- The Polar Satellite Launch Vehicle PSLV-C5 launched in October 2003 putting into orbit the Indian Remote Sensing Satellite IRS-P6, also known as RESOURCE Satellite-1.
- This is the first time when the PSLV placed a satellite of over 1.30 kg in orbit.
- The Resourcesat is the most sophisticated Remote Sensing satellite of the ISRO.
- Resourcesat has application in agriculture, forestry, land and water resources, and disaster management.
- On May 5, 2005 PSLV-C6 put the 1560 kg CARTOSAT-1 into orbit at a height of 627 km.

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- Kiran's One Liner Approach General Knowledge**
- CARTOSAT-1 is the heaviest Remote Sensing Satellite orbited by a PSLV.
 - TECSAR is the Remote Sensing Satellite to be orbited by a PSLV.
 - C-10.

APPLICATIONS OF REMOTE SENSING

- IRS imagery is used for agricultural crop acreage and damage assessment.
- It has important application in drought warning, flood casting of reservoirs and surface water harvesting use.
- Forest survey and management areas to optimise recovery are other allied uses in this regard.
- With regard to the applications in planning and location and the consequent suggestions for mitigation measures, IRS imagery has also been used for mineral prospecting and data is being used for urban planning, flood prone areas.
- The first Indian Satellite Launch vehicle was SLV-3.
- The first successful flight of SLV-3 took place from the Sriharikota range in July 1980. It carried a small Indian built satellite Rohini 1 and placed it a near -earth orbit.
- Two more successful launches of SLV-3 were conducted in May, 1981 and April, 1983 with the Rohini Satellites.
- **AUGMENTED SATELLITE LAUNCH VEHICLE (ASLV)**
- ASLV represents the next stage in India's Launch Vehicle Development Programme.
- ASLV was an improved version of SLV-3.
- The ASLV was derived from the SLV-3 with the addition of two boosters.
- ASLV was 24 metres high and its capacity reached 150 kg payload in LEO.
- The first two flights of ASLV carrying SROSS-1 and SROSS-2 satellites respectively, failed. The first flight was in March, 1987 and second in July, 1988.
- The third launcher ASLV-D 3, was launched in May, 1992 carrying the SROSS-3 satellite. The satellite was successfully placed in low earth orbit of 400 km.
- The final ASLV-D 4 was launched in May, 1994 and was a success.
- **POLAR SATELLITE LAUNCH VEHICLE (PSLV)**
- PSLV was designated to carry much heavier satellites of the IRS class to Polar Sun-Synchronous orbits.

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THE PSLV IS A 4-STAGE LAUNCHER MEASURING 44 METRE HIGH WITH A 2.8 METRE DIAMETER AND WEIGHING 275 TONES.

- The PSLV-D2 launch in October, 1994 successfully placed IRS-P2 in the first developmental launch in PSO.

- The PSLV-C2 in May, 1999 lifted and placed three satellites—the IRS-P4, the Korean KITSAT-3 and the German TUBSAT in PSO.

- The PSLV-C3 in October, 2001 placed three satellites - the Indian TES, the Belgian PROBA and the German BIRD.

- India's Space Programme reached new heights, the successful launch of the 44.4 metre tall four-stage PSLV C-6 carrying the CARTOSAT-1 and HAMSAT satellite, on May, 2005.

- The PSLV-C7 in October, 2006 successfully placed the Indian IRS-P5 in GTO.

- The PSLV-C8 in October, 2007 successfully placed the Indian IRS-P6 in GTO.

- The PSLV-C9 in October, 2008 successfully placed the Indian IRS-P7 in GTO.

- The PSLV-C10 in October, 2009 successfully placed the Indian IRS-P8 in GTO.

- The PSLV-C11 in October, 2010 successfully placed the Indian IRS-P9 in GTO.

- The PSLV-C12 in October, 2011 successfully placed the Indian IRS-P10 in GTO.

- The PSLV-C13 in October, 2012 successfully placed the Indian IRS-P11 in GTO.

- The PSLV-C14 in October, 2013 successfully placed the Indian IRS-P12 in GTO.

- The PSLV-C15 in October, 2014 successfully placed the Indian IRS-P13 in GTO.

- The PSLV-C16 in October, 2015 successfully placed the Indian IRS-P14 in GTO.

- The PSLV-C17 in October, 2016 successfully placed the Indian IRS-P15 in GTO.

- The PSLV-C18 in October, 2017 successfully placed the Indian IRS-P16 in GTO.

- The PSLV-C19 in October, 2018 successfully placed the Indian IRS-P17 in GTO.

- The PSLV-C20 in October, 2019 successfully placed the Indian IRS-P18 in GTO.

CRYOGENIC TECHNOLOGY

- A cryo engine used liquid hydrogen and liquid oxygen as propellants. It is called cryo engine because both these gases are required to be cooled to extremely low temperatures, called Cryogenic temperature.
- It is in GSLV that Cryogenic engines have been used for the first time.
- Cryogenic engines provides two important benefits i.e., greater thrust power and lower weight of propellants, due to which it is possible to carry additional payload.
- Cryogenic technology is crucial for the success of the GSLV programme as it seeks to place a 2500 kg satellite in a 36000km high geostationary orbit.

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ANTRIX, the con-
troller of the ANTRIX

for marketing Indian arm of ISBC

- ANTRIX** also provides IRS specific data through Space Imaging, a key agency launched by PSLV. Through ANTRIX, Telemetry, Tracking and Command equipment, the Indian ground stations have already been successful. **IMPORTANT TERMINOLOGY**

 - Space** : The vast and limitless region which exists beyond the earth's atmosphere.
 - Space Exploration** : The collection of information about the planet in outer space is called 'space exploration'.
 - Satellite** : A satellite is a celestial object which revolves round a planet - Natural satellites and Man-made satellites. The satellites are of two types- Natural path or elliptical path.
 - Orbit** : The closed path of a satellite around the earth is called its orbit. The orbit of a satellite may be circular or elliptical in shape.
 - Pogee** : It is the farthest point from the earth on the orbit of a satellite.
 - Aphelion** : It is the nearest point from the earth on the orbit of a satellite.
 - Inclination** : The inclination of the orbit of a satellite is the angle made by the orbit of the satellite with the equator of the earth.
 - Low Earth Orbit (LEO) Satellites** : The satellite is stationed at relatively low altitude (ranging between 200 to 900 kms) above the surface of the earth. They have an elliptical orbit.
 - Polar Orbit Satellites** : Such satellites move from pole to pole i.e., from North Pole to South Pole and vice versa. These satellites have near circular orbit in a pole to pole direction.
 - Synchronous Satellites** : A satellite that always appears in a fixed position vis-a-vis sun is called a 'sun-synchronous satellite'.
 - Geo-stationary Satellite** : Geo-stationary orbit is at a height of about 36000 km. It is a circular and equatorial orbit. Communication satellites are normally geo-stationary satellites.
 - Rocket Propellants** : Rocket fuels or rocket propellants are special fuels which are highly compact, having very high calorific value, burn extremely rapidly, and leave no residue on burning. There are two types of rocket propellants, solid rocket propellants and liquid rocket propellants. The solid rocket propellants are a mixture of solid hydrocarbon and a solid oxidising agent. Most of the solid propellants used in rocket are liquid.

ATOMIC RESEARCH

- E.g. of rocket Propellants - Ammonium, Alcohol, Hydrazine, Kerosene oil, Paraffin Wax, Old Ammonia.
 - Methyl Hydrazine.

INSTITUTIONS ASSOCIATED WITH SPACE RESEARCH

 - Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram
 - ISRO Satellite Centre, Bangalore
 - ISRO Application Centre (ISAC), Ahmedabad
 - Space Centre, Sriharikota, Andhra Pradesh (the main launch centre of ISRO)
 - Sriharikota Propulsion Systems Centre, Mahendragiri (Tamil Nadu), Liquid Propulsion and Bangalorapuram
 - Thrivananthapuram and Educational Communication Unit (Ahmedabad)
 - Development and Tracking and Command Network, Bangalore
 - ISRO Telemetry, Master Control Facility at Hassan in Karnataka
 - Master Control Systems Units, Thiruvananthapuram
 - ISRO Inertial Systems Laboratory, Ahmedabad
 - Physical Research Laboratory, Ahmedabad

ATOMIC RESEARCH

 - Pandit Jawaharlal Nehru and Dr. Homi J. Bhabha laid the foundation for Nuclear Energy Programme in India.
 - India's nuclear research programme aims to develop and utilise nuclear energy for peaceful purposes such as power generation, applications in agriculture, medical sciences, industry and other areas.
 - The objectives of India's nuclear energy programme have been defined in the Atomic Energy Act of 1948.
 - The Department of Atomic Energy (DAE) was created in 1954.

ATOMIC RESEARCH INSTITUTES AND OTHER ORGANISATIONS

Research Centre

 - Bhabha Atomic Research Centre (BARC) – Mumbai
 - Indira Gandhi Centre for Atomic Research (IGCAR) – Kalpakkam
 - Centre for Advanced Technology (CAT) – Indore
 - Variable Energy Cyclotron Centre (VECC) – Kolkata
 - Atomic Minerals Directorate for Exploration and Research (AMD) – Hyderabad

Industrial Organisations

 - Heavy Water Board (HWB) – Mumbai
 - Nuclear Fuel Complex (NFC) – Hyderabad
 - Board of Radiation and Isotope Technology (BRIT) – Mumbai

Public Sector Undertakings

 - Nuclear Power Corporation of India Ltd. (NPCIL) – Mumbai
 - Uranium Corporation of India Ltd. (UCIL) – Jadugoda (Jharkhand)
 - Indian Rare Earth Ltd. (IRE) – Mumbai
 - Electronics Corporation of India Ltd. (ECIL) – Hyderabad

Aided Institutes

- DAE financially supports seven autonomous institutes
- Tata Institute of Fundamental Research (TIFR) – Mumbai
- Saha Institute of Nuclear Physics (SINP) – Kolkata
- Institute of Physics (IOP) – Bhubaneswar
- Institute of Mathematical Sciences (IMSc) – Chennai
- The Institute for Plasma Research (IPR) – Ahmedabad
- Department of Science and Technology provides grants-in-aid in 16 autonomous scientific research institutions engaged in basic and applied aspects of research in basic and applied sciences.
- **Bose Institute, Kolkata** is devoted to fundamental and applied aspects in the fields of biological sciences, medicine, engineering, technology, providing and demonstrating biomedical sciences and technology; developing advanced medical specialties and standards of patient care in advanced medical specialities and developing high standard graduate training programme of the highest quality in these fields.
- **Shri Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram**—developing biomedical engineering and technology; providing and demonstrating high standard of studies on solid state physics, material sciences, theoretical physics, spectroscopy, energy research, chemistry including biological chemistry, polymer science etc.
- **Indian Institute of Astrophysics, Bangalore**—research in energy as well as interdisciplinary areas of astrophysics and related bodies and development of instruments used in astrophysical studies.
- **Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore**—research in frontier areas of chemistry, physics of materials, computational fluid dynamics, geodynamics, condensed matter theory, animal behaviour genetics etc.
- **Raman Research Institute, Bangalore**—research in basic sciences such as astronomy, astrophysics, liquid crystals etc.
- **S.N. Bose National Centre for Basic Sciences, Kolkata**—promoting advanced studies in selected branches of basic sciences.
- **Birbal Sahni Institute of Palaeobotany, Lucknow**—research in the area of palaeobotany, its relevance in modern context.
- **Indian Institute of Geomagnetism, Mumbai**—observing and understanding some of physical processes taking place in the innermost crusts of the earth as well as phenomena occurring in the sun and in near earth and interplanetary space.
- **Wadia Institute of Himalayan Geology, Dehradun**—basic research in areas of biostratigraphy, petrology and geochemistry, sedimentology, tectonics of the Himalayan regions.

NUCLEAR POWER PROGRAMME

The Department of Atomic Energy (DAE) is following a three stage programme which envisages building of, on a commercial scale, pressurised Heavy Water Reactors (PHWRs), Fast Breeder reactors (FBRs) and Thorium based reactors.

FIRST STAGE : PHWR PROGRAMME

- It took off in the sixties. Initially two boiling reactors were set up at Tarapore in Maharashtra.
- The station was commissioned in 1969 and was collaborative venture with General Electric of USA.
- The PHWR programme commenced with the building of two pressurised heavy water reactors (PHWRs) at Rawatbhata (Rajasthan).
- These reactors built partly with Canadian collaboration, started commercial production in 1972 and 1980.
- Later, in 1984 and 1986 two indigenous PHWRs were commissioned at Kalpakkam (Tamil Nadu). With this, the Department achieved comprehensive capability in the design, construction and operation of PHWRs.
- With its R & D endeavour and the support of the Indian industry, DAE standardized 220 megawatt PHWR design.
- The Nuclear Power Corporation of India Limited (NPCIL), a public sector undertaking of DAE, is responsible for the design, construction and operation of nuclear power reactors.
- Two such reactor units were commissioned at Narora (Uttar Pradesh) in 1989 and 1991.
- The design of the 220 megawatt atomic power reactors was further improved, and the indigenous technology of PHWR reached commercial maturity with the commissioning of two 220 megawatt power reactors at Kakrapar (Gujarat) in 1992 and 1995 and two each at Kaiga (Karnataka) and Rawatbhata in 1999 and 2000.

- With a total installed capacity of 3260 MW, 15 reactors—2 boiling water reactors (BWR) and one 540 MW PHWR and one 540 MW, 15 MW PHWR each at Kakra (3&4) in Tamil Nadu (Russia), under heavy construction by the Nuclear Power Corporation. These will add 3,420 MW to take the total installed capacity for setting up an atomic power plant in India.
- India has entered into an agreement with the Russian Pressurised water reactors of 1,000 MW comprising first pour of the reactor concrete on March 31, 2002, acquired an experience of about 20-reactor years of nuclear plant operation.
- The average capacity factor of the plants has also touched high of 89 per cent.
- DAE has an ambitious nuclear power programme aiming at attaining an installed nuclear power capacity of 20,000 MWe by 2020.

SECOND STAGE : FAST BREEDER REACTOR PROGRAMME

- The research and development in the field of Fast Breeder Reactor (FBR) undertaken in the early sixties at Trombay, marked the beginning of the second stage of the Nuclear Power Programme. To develop R&D capabilities in the field of fast reactors, the actor Research Centre (now Indira Gandhi Centre-for Atomic Research, IGCAR) was set up in 1971 at Kalpakkam.
- The Centre commenced work on setting up the 40MWt (13MW Fast Breeder Test Reactor (FBTR) in 1972.
- The reactor attained criticality in October, 1985. The critical components of the reactor were manufactured in India.
- Its fuel, that used mixed carbides of Uranium and Plutonium, was developed at Trombay.
- This is the first fast reactor of its kind in the world that uses such a fuel core.
- These fast breeder systems produce more fuel than what they consume FBRS can increase fuel utilisation by about sixty times what is possible with PHWRs.
- Thus, FBRS generate electricity and build up fuel inventory.
- The design of 500 MW sodium cooled Prototype Fast Breeder Reactor (PFBR) is ready and its construction is underway, with the Government giving its nod.

reactors—2 boiling water reactors (BWR) and one 540 MW PHWR are under heavy construction by the Nuclear Power Corporation. These will add 3,420 MW to take the total installed capacity for setting up an atomic power plant in India.

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The Prototype Fast Breeder Reactor is being constructed by the Bhartiya Nabhikya Vidyut Nigam Ltd. (BHAVINI).

- The Prototype Fast Breeder Reactor is being constructed by the Bhartiya Nabhikya Vidyut Nigam Ltd. (BHAVINI). Nuclear Reactors based on Pressurized Heavy Water technology (PHWR) used in energy production, while in Fast Breeder Reactors, natural Uranium utilisation increases to over 75 per cent.
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THIRD STAGE : THORIUM BASED REACTORS

- The third stage of the Indian Nuclear Power Programme, envisaging the use of Thorium for power generation, has already begun. The efforts have resulted in the successful design and operation of 30kW (Normal Power) reactor Kamini, at IGCAR, which uses Uranium-233 fuel obtained from irradiated Thorium. The reactor is being used for irradiation of specimens for experimental/forensic purposes.
- The technologies relating to the production of Uranium-233 have been established.
- Thorium fuel bundles have also been successfully used in the nuclear power programme. Bhabha Atomic Research Centre (BARC) has been developing the 300 MW Advanced Heavy Water Reactor (AHWR).
- The reactor, a vertical pressure tube type cooled by light water and moderated by heavy water, incorporates several passive features in line with the concept of innovative advanced reactor systems.
- AHWR, which will use both Thorium-Uranium-233 and Thorium plutonium mixed oxide as fuel, is in technology development phase.

INDIA'S NUCLEAR REACTORS

- 4 August, 1956 Apsara – first research reactor in Asia, attains critically at Trombay.
- 10 July, 1960 CIRUS – the 40 MWt research reactor attains critically.
- 14 January, 1961 Research reactor ZERLINA attains critically, it was decommissioned in 1983.
- 2 October, 1969 Tarapore atomic power station starts commercial operation.
- 18 May, 1972 Research reactor PURNIMA-1 attains critically.
- 30 November, 1972 Unit-1 of Rajasthan atomic power station at Kota begins commercial operation.

yoursmahboob.wordpress.com

- 1 November, 1980 Unit-2 of Rajasthan atomic power station attains commercial.
- 27 January, 1984 Unit-1 of Madras atomic power station goes commercial.
- 10 May, 1984 Research reactor PURNIMA-I, fuelled by Uranium-233, attains criticality.
- 8 August, 1985 Research reactor PURNIMA-II, fuelled by Uranium-235, attains criticality.
- 18 October, 1985 Fast Breeder Test Reactor (FBTR) at Kalpakkam attains critically.
- 12 March, 1986 Units-2 of Madras atomic power station attains criticality.
- 12 March 1989, Unit-1 of Narora atomic power station goes commercial.
- 9 November, 1990 Research reactor PURNIMA-III, a Uranium-233 fuelled reactor, attains critically.
- 24 October, 1991 Unit-2 of Narora atomic power station attains critically.
- 3 September, 1992 Unit-1 of Kakrapara atomic power station attains critically.
- 8 January, 1995 Unit-2 of Kakrapara atomic power station attains critically.
- 20 October, 1996 Kalpakkam mini reactor (KAMINI), with Uranium-233 fuel, attains critically at IGCAR, Kalpakkam.
- 24 September, 1999 Unit-2 of Kalga atomic power station attains critically.
- 24 December, 1999 Unit-3 of Rajasthan atomic power station attains critically.
- 26 September, 2000 Unit-1 of Kalga atomic power station attains critically.
- 3 November, 2000 Unit-4 Rajasthan atomic power station attains critically.

Nuclear Reactors Under Construction		
Name	Location	Capacity (MWe)
Rajasthan Atomic Power Station (RAPS-3 and 4)	Rawatbhatta (Rajasthan)	440
Kalga Atomic Power Station (KGS 3 and 4)	Karnataka	440
Kakrapar Atomic Power Station (KAPS-3)	Surat (Gujarat)	440
Kudankulam Atomic Power Station (KAPS-1 and 2)	Kanyakumari (Tamil Nadu)	2000

- ### DEFENCE UNDERTAKINGS
- Eight Public sector undertakings currently function under the Department of Defence Production.
1. **The Hindustan Aeronautics Limited (HAL)**
 - HAL was set up in 1964 with its corporate office at Bangalore.
 - It is the largest public sector undertaking under the Department of Defence Production.
 - The HAL's products range consists of aircraft, engines, accessories, avionics, structures for aerospace vehicles, satellites and industrial and marine gas turbine engines.
 - The HAL has established joint ventures BAE-HAL, Indo-Russian Aviation Ltd., with international participation.
 2. **Bharat Electronics Limited (BEL)**
 - It was established in 1954 and its corporate office is in Bangalore.
 - BEL has nine units in the country.
 - It is engaged in the design, development and manufacture of sophisticated state-of-the-art electronics equipments for the use

Heavy Water Plants	Capacity
Nangal (Punjab)	14
Tuticorin (Tamil Nadu)	49
Baroda (Gujarat)	45
Kota (Rajasthan)	85
Talcher (Orissa)	very little
Taj (Maharashtra)	100
Munuguru (Andhra)	185
Hazira (Gujarat)	100

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of defence services, para military organisations and other government users like AIR, Doordarshan, Police Wireless, Department of Telecommunications.

3. The Bharat Earth Movers Limited (BEML)

- It was established in May, 1964 and commenced its operations from January, 1965.

4. Garden Reach Ship-builders and Engineers Limited (GRSE)

- The Government of India acquired it in 1960 with its corporate office at Kolkata.
- The GRSE builds and repairs warships at BML, Kollam, Mysore, Kolar Gold Fields (KGF) and Bangalore.
- Its product range includes frigates carrier, oil tankers, auxiliary vessels, attack craft, high technology ship borne equipment, petrol pumps, diesel engines etc.

5. Goa Shipyard Limited (GSL)

- The GSL is located at Vasco-da-Gama.
- It primarily builds small and medium size Naval vessels and repair ships and vessels.
- The company has undertaken construction, repair, refit of variety of vessels for the Indian Navy and the Coast Guard as well as non-defence sectors.

6. The Bharat Dynamics Limited (BDL)

- It was set up in 1970 with corporate office at Hyderabad for manufacture of guided missiles.
- The company has two units at Kachanbagh and Medak.
- It possesses the capability to produce advanced guided missile systems.
- The BDL is the prime production agency for missile weaponry systems.

7. Mishra Dhatu Nigam Limited (MDHANI)

- It is located at Hyderabad and incorporated on November 20, 1973 with the primary objective of ushering in self reliance in special metals and alloys for strategic sectors like Defence, Space and Atomic Energy as well as hi-tech commercial industries in India.

Defence Research and Development Organisation (DRDO)

- Defence Research and Development Organisation (DRDO) was formed in 1958 by amalgamating Technical Development Establishments (TDEs) of the Indian Army and the Directorate of Technical Development and Production (DTDP) with the Defence Science Organisation (DSO).

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laboratories are engaged in a variety of Defence technologies covering various disciplines like aeronautics, armaments, electronics, combat vehicles, engineering systems, missiles, advanced computation, naval systems etc.

DRDO INTEGRATED GUIDED MISSILE DEVELOPMENT PROGRAMME

Integrated Guided Missile Development Programme (IGMDP) was launched in 1983. Its objective was to design and build missiles indigenously with its help of technologies already available in the country.

➤ the missile systems to be designed and developed were-

➤ the missile Surface to Surface Missile 'PRITHVI';
➤ Tactical Surface to Air Missile 'AGNI'

1. Intermediate Range Surface to Air Missile 'TRISHUL'

2. Short Range Surface to Air Missile 'AKASH'

3. Medium Range Missile 'NAG'

4. Anti Tank Guided Missile

INDIAN MISSILE SYSTEMS

(A) AGNI

- AGNI is an intermediate range ballistic missile (IRBM).
- It can carry a payload of 500-1000 kg upto a range of 1000-2500 km.
- It can carry both conventional and nuclear war head.
- It can be launched from a platform and can also be mounted on road-mobile launchers.
- AGNI-I has a range of about 700 km.
- AGNI-II is a two stage solid propellant missile with a range of 2000 to 2500 km.
- AGNI-III has a 3500 km plus range.
- The missile had advanced features like Global Positioning System.

(B) PRITHVI

- PRITHVI is a surface to surface battlefield tactical missile, having a range of upto 250 km.
- PRITHVI can carry a 500 kg payload upto 250 km or a 1000 kg payload upto 150 km.
- It can carry both conventional and nuclear warhead.
- PRITHVI-I has a strike range of 150 km with a one tonne warhead. It has been fully inducted into the army.
- PRITHVI-II or the airforce version of Prithvi has undergone several successful tests.
- PRITHVI-III or naval version of Prithvi, also called DHANUSH has been successfully test-fired.

(C) TRISHUL

- TRISHUL is a surface to air missile having a short range of 500 metres to 9 km.
- It has a radar guided surveillance, tracking and guidance mechanism for accurate interception of targets.

- It can be used by Army, Navy, and Airforce.
- TRISHUL has undergone several successful test flights.

(D) AKASH

- 'AKASH' is a surface to air missile having a range of 25 km.
- It is a multi-target air defence weapon that can target four enemy aircrafts of missiles at a time.
- It will be the first Indian missile system to use Scramjet principle for its propulsion.
- AKASH was test-fired for the first time on August 14, 1990 from the Interim Test Range, Chandipur.
- The quick reaction Air Defence Missile 'AKASH' has undergone several consecutive successful flight trials in guide mode.

(E) NAG

- NAG is an anti-tank missile having a range of 4 km.
- NAG is a third generation missile having 'fire and forget' capability.
- It can be fired at night and during bad weather conditions as it uses imaging infrared guidance.
- First test of NAG missile was conducted on November 23, 1990.

OTHER TECHNOLOGICAL ACHIEVEMENTS IN DEFENCE SECTOR

ELECTRONIC WARFARE SYSTEM

- India announced the development of the first ever indigenously built and largest integrated electronic warfare system on January 19, 2004.
- The system has been named as "Samyukta" and it is the first state-of-the-art integrated electronic warfare system for the army.
- Defence research laboratories have already developed similar system for the navy called "Sangraha" and for the Air Force called "Tempest".

BRAHMOS

- It is a supersonic cruise missile, jointly developed by India and Russia.
- It is the first and only supersonic cruise missile that uses liquid ramjet technology.
- Brahmos-II, the land to land version of the supersonic cruise missile was test-fired for the first time in the Army configuration in a desert range in Rajasthan on December 21, 2004.

'ASTRA' MISSILE TEST-FIRED

- India successfully test-fired a prototype of the beyond visual range (BVR) air to air missile 'Astra' from the Chandipur interim test range.
- The 'Astra' missile is being developed indigenously to arm all fighters in the IAF's inventory, including the Light Combat Aircraft (LCA) when it becomes fully operational by around 2010.

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The 3.8 m long 'Astra' version has a strike range of 25-40 km.

► 'Sarab' is India's first indigenously built civilian aircraft.

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S.No.	Type	Range
1.	Inter Continental Launched Ballistic Missile (I.C.B.M.)	upto 14,800 km upto 9,100 km
2.	Submarine Launched Ballistic Missile (S.L.B.M.)	upto 500 km upto 900 km
3.	Medium Range Ballistic Missile (S.R.B.M.)	
4.	Short Range Ballistic Missiles	

ANTARCTICA

- Antarctica lies completely in the southern hemisphere with the south pole almost in its centre.
- Antarctica is the only continent which is completely frozen and is therefore known as the 'White Continent.'
- Antarctica is the coldest and loneliest landmass on the earth.
- The mainland of Antarctica was first discovered in 1820, but real exploration began only in the twentieth century.
- About 99 per cent of the continent remains covered permanently with ice, the average thickness being approximately two to five kilometers.
- Queen Maud Range divides the continent almost into two equal parts.
- Mount Erebus is the only live Volcano in Antarctica.
- Vegetation mainly consists of lichens nad mosses.
- The climate in Antarctica is severe. At the south pole the lowest temperature has been recorded at -95°C during winter. Mid summer temperature normally does not rise about 0°C.
- It is summer in Antarctica from November to February. The sun never sets during this period. On the other hand, during winter May August the sun never rises.
- About 70 per cent of world's supply of fresh water is stored in the ice-caps and ice-sheets of Antarctica.
- Antarctica provides unique opportunities to scientists to learn more about earth. This continent therefore is called a 'Continent for Science'.
- The highest mountain of the continent is the Vinson Massif (5,139 metres) in Ellsworth land.
- The highest point in eastern Antarctica is Kirkpatrick (4,528 metre) in the Trans-Antarctica Mountains.

- Antarctica is One Liner Approach General Knowledge**
- The climate is delimited by the Antarctic circle (60°32'S) and January.
 - The continent is studded with more than 50 scientific stations operated by various Nations.
 - The Antarctica Treaty** India signed the Antarctica Treaty of 1959 and became a member of the Antarctica club in 1983.
 - Bodies connected with Antarctica Treaty**
 - SCAR : Scientific committee on Antarctica Research.
 - COMNAP : Council of Managers of National Antarctic Logistic Operations.
 - SCALOP : Standing Committee on Antarctic Logistic Operations.
 - The Antarctica Expeditions
 - So far 23 scientific expeditions have been launched on a regular basis.
 - Two expeditions to the southern oceans for carrying out research in the thrust area of polar science viz Weddel Sea Expedition, Krill Expedition for assessment of Krill Resources in Antarctica water, were also undertaken.
 - The Indian station 'Maitri' is situated in the Central Droning Maud land of east Antarctica.
 - From 1999 onwards the Indian scientific expeditions to Antarctica are launched from cape town, South Africa.
 - Scientific experiments being carried out at Antarctica are in the field of measurements of Green House gases, tele seismic studies, permanent GPS tracking at Maitri, study of crack propagation on ice sheet, communication at Maitri and polar logistics
 - Latest Developments**
 - 30.10.2004** :- The National Centre for Antarctic and Ocean Research (NCOR) is to open a state of the art National Ice core laboratory in its campus providing an antarctic like atmosphere for acquiring scientific knowledge. This would be the first of its kind in south Asia.
 - 13.11.2004** :- Indian plans its third permanent station in Antarctica. Estimated at a cost of Rs. 15 crore, it is expected to be completed over next 3 to 4 Antarctic summers. This station follows the earlier Indian stations, 'Dakshin Gangotri' and 'Maitri' stations.
 - 08.02.2005** :- India to set up another station at Antarctica to address the geopolitical, economic and scientific needs of the country more effectively. Scientists have already been working on these issues from the existing station 'Maitri.'

Kiran's One Liner Approach General Knowledge

- | The Antarctica Expedition | | Led by | Features |
|---------------------------|----------------|-----------------------|--|
| First | 6 Dec. 1981 | Dr. S.Z. Qasim | Set up the unmanned weather station 'Dakshin Gangotri'. Wireless communication established. Rock Samples were also collected. |
| Second | 1 Dec. 1982 | Dr. V.K. Raina | Site for base camp was identified after survey for the first time two women, Dr. Aditi Pant and Dr. Sudipti Senapati took part in the expedition. |
| Third | 3 Dec. 1983 | Dr. H.K. Gupta | Geological and seismological surveys were conducted. Three cottages, at a distance of 70 km from Dakshin Gangotri were built. A thirteen member team stayed back for winter studies. |
| Fourth | 4 Dec. 1984 | Dr. B.B. Bhattacharya | Information about weather and climate was collected. |
| Fifth | 30 Nov. 1985 | Dr. M.K. Kaul | Maitri Structure accomplished along with pestoctic establishment of winter-camp at Maitri. |
| Sixth | 26 Nov. 1986 | Dr. Arun Patlekar | Studies conducted on Oceanography, ozonehole, non-conventional wind energy. |
| Seventh | Nov. 1987 | R. Sengupta | Maitri Structure established along with pestoctic establishment of winter-camp at Maitri. |
| Eighth | Nov. 1988 | R. Ravindra | Permanent Lab at Maitri, Green house for horticultural study. |
| Ninth | Nov. 1989 | A.K. Hanjura | SODAR, SOUND Detection and Ranging System established. |
| Tenth | Dec. 1990 | S. Mukheij | Across Ozone relationship established. |
| Eleventh | Nov. 1991 | V.K. Dhargalkar | Maitri contributors to International ROSA project. |
| Twelfth | Dec. 1992 | G.Sudhakar Rao | Biogeochemical Parameters of lakes included. |
| Thirteenth | Dec. 1993 | S.D. Sharma | Email links with Maitri established. |
| Fourteenth | Dec. 1994 | A. Chaturvedi | Geological Mapping of 3,000 Sq. Km. |
| Fifteenth | Dec. 1995 | A.L. Kapoor | Environment clean up operation conducted. |
| Sixteenth | Dec. 1996 | K.R. Sivan | Permanent analog VLF Monitoring Station Established. |
| Seventeenth | Dec. 1997 | MV Polarbird | Ajey Dhar Land-Route established beyond the Orwin mountain to the south. |
| Eighteenth | Dec. 1998 | MV Magdalena | Arun Chaturvedi First expedition from South Oldendorff Africa. Permanent Environment Lab. |
| Nineteenth | Dec. 1999 | M.J. D'souza | Seismic station was upgraded. |
| Twenty First | Dec. 2000 | R.P.C. Pandey | Installation of Telemedicine Operation is going on. |
| Twenty Second | 6 Jan. 2002 | R. P. Lal | Recommended by Cape Town of South Africa. |
| Twenty Third | December, 2003 | Dr. Arun H. Hunchinal | Previous Research work will be sustained. |
| Twenty Fourth | December, 2004 | — | Landed at Antarctica on January 9, 2006. |
| Twenty Fifth | December, 2006 | L. Prem Kishore | 26th expedition team released by C.M. Rund of sea pole from Goa. |
| Twenty Sixth | 9 Jan, 2007 | Joy Paul | |

ECOLOGY & ENVIRONMENT

ECOLOGY

- The term **Ecology** is coined by famous biologist Ernest Haeckel from two Greek words **οίκος** and **λόγος** meaning habitat and study respectively.
- Ecosystem is a self sustaining, structural and functional unit of biosphere.
- It is an open system and depends upon solar energy from outside as its energy source.
- The concept of Ecosystem is first propounded by A.G. Tansley in 1935.

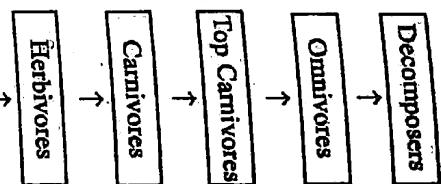
STRUCTURE OF ECOSYSTEM

- An ecosystem consists of two major components biotic and abiotic.
- (a) **Abiotic component** : The abiotic components are **inorganic** (carbon, nitrogen, sulphur, carbon dioxide etc.), **organic** (lipids, carbohydrates etc.) substances and **climatic factors** such as air, water, light, temperature etc.
- (b) **Biotic Component** : These are discussed below :
 - (i) **Producers** are the chlorophyll bearing plants such as algae, grass and trees. These are also called **autotrophes**.
 - (ii) **Consumers** are the organisms, whose food requirements are met by feeding on other organisms. They are referred to as heterotrophs.
 - Those who feed directly on plants (autotrophs) are called **herbivores** (grasshopper, rabbit etc.).
 - The animals who feed on herbivores are known as **carnivores** (hawk, lions).
 - The organisms which can feed on both plants and animals are **omnivores** (fox, humans, cockroaches)
 - (iii) **Decomposers** are mainly bacteria and fungi.

FOOD-CHAINS AND FOOD-WEBS

- The process of food transfer from the source in plants through a series of organisms, with repeated eating and being eaten, is called a **food-chain**.
- The shorter the food chain, the greater is the available energy.
- A simple generalized food chain is :
 - Producers → herbivores → Carnivores
- The network of food chains is called a **food web**.

TROPHIC LEVELS



BIODIVERSITY

- The variety and variability of all animals, plants and micro-organisms found on earth is called bio-diversity.
- India is one of the 12 megadiversity countries of the world for its great diversity of plant life, especially the angiosperms.

WILDLIFE PROTECTION

- At present, the protected area network comprises 92 national parks and 500 sanctuaries covering an area of 1.56 lakh sq. km.
- The Wildlife (Protection) Act, 1972 adopted by all States except Jammu and Kashmir (which has its own Act), governs wildlife conservation and protection of endangered species. This Act prohibits trade in rare and endangered species.
- An Inter state Committee has been set up to review the Wildlife (Protection) Act, 1972 and other laws. India is a signatory to the Convention on International Trade in Endangered Species (CITES) of wild flora and fauna.
- The Wildlife (Protection) Amendment Bill 2002 was passed by the Parliament during the Winter Session, 2002.
- Under Project Tiger, launched on 1 April 1973, 27 Tiger Reserves have been set up in 17 states covering an area of about 37,761 sq. km.
- Under the Project Elephant, which was launched in February 1992, 14 Elephant reserves have been set up during the year.
- A Central Zoo Authority has been set up to look after the management of zoological parks in the country.

compiled by Sujoy

Name of the Tiger Reserves in States with Year of Creation and Area			
Sl. No.	Year of Creation	State Reserve	Total Area (in Sq Km)
1.	1973-74 1999-2000	Bandipur	856
2.	1973-74	Corbett	642
3.	1973-74	Kanha	1316
4.	1973-74	Manas	1334
5.	1973-74	Melghat	2750
6.	1973-74	Palamu	2840
7.	1973-74	Ranthambore	1677
8.	1973-74	Simplipal	1026
9.	1973-74	Sunderbans	1334
10.	1978-79	Peryar	279
11.	1978-79	Sariska	2585
12.	1982-83	Buxa	777
13.	1982-83	Indravati	866
14.	1982-83	Nagartajunsagar	759
15.	1982-83	Namdapha	3568
16.	1987-88· 1999-2000	Dudhwa	1985
17.	1988-89	Kalakad-Mundanthurai	551
18.	1989-90	Vaikom	800
19.	1992-93	Pench	840
20.	1993-94	Tadoba Andhari	758
21.	1993-94	Bandhavgarh	620
22.	1994-95	Panna	1162
23.	1994-95	Damphra	542
24.	1998-99	Bhadra	500
25.	1998-99	Pench	492
26.	1999-2000	Pakhui-Nameri	257
27.	1999-2000	Bori, Satpura, Pachmarhi	1206
			1486
		Total	37761

Important Wildlife Sanctuaries and National Parks of India

Wildlife Sanctuaries & National Park	State	Species of Animals
Kaziranga National Park, Jorhat	Assam	Rhinoceros, wild buffalo, bison, sambar, swamp deer, hog deer, wild pig, elephants
Manas Wildlife Sanctuary, Barpeta	Assam	Elephants, leopards, wild buffalo, swamp deer, hog deer, sambar, Thamin (Sangai), brow antlered deer, hog deer, wild boar, panther, fishing cats, and water birds.
Keibul Lam Joo National Park	Manipur	

Mangrove**Mangroves in India**

Northern Andaman and Nicobar
Sunderbans
Bhitar Kanika
Loringa
Krishna Estuary
Godavari Delta
Mahanadi Delta

Pichavaram
Point Calimere
Gulf of Kutch
Coondapur
Achhra
Ratnagiri
Vembanad

State

Andaman and Nicobar
West Bengal
Orissa
Andhra Pradesh
Andhra Pradesh
Orissa
Tamil Nadu
Goa
Gujarat
Karnataka
Maharashtra
Kerala

INSTITUTES RELATED TO FORESTS AND WILDLIFE

- Forest Research Institute, Dehra Dun
- Institute of Arid Zone Forestry Research, Jodhpur
- Institute of Rain and Moist Deciduous Forests, Jorhat
- Institute of Wood Sciences and Technology, Bangalore
- Tropical Forestry Research Institute, Jabalpur
- Temperate Forest Research Centre, Shimla
- Institute of Forest Genetics and Tree Breeding, Coimbatore
- Institute of Social Forestry and Eco-rehabilitation, Coimbatore
- Institute of Forestry Research and H.R. Development, Allahabad
- Centre for Forest Productivity, Ranchi
- Advanced Centre for Bio-technology and Mangrove Forests, Hyderabad
- Indian Plywood Industries Research and Training Institute, Bangalore
- Indian Institute of Forest Management, Bhopal
- Wildlife Institute of India, Dehradun (Uttarakhand)
- Salim Ali Centre for Ornithology and Natural History, Coimbatore (Tamil Nadu)

NATIONAL INSTITUTIONS DEVOTED TO OCEAN RESEARCH

1. National Institute of Ocean Technology, Chennai
2. National Centre for Antarctic and Ocean Research, Vasco-da-Gama, Goa

SURVEYS OF NATURAL RESOURCES

1. Botanical Survey of India (BSI), Kolkata (1890)
2. Zoological Survey of India (ZSI), Kolkata (1916)
3. Forest Survey of India (FSI), Dehra Dun (1981)

SOME ENVIRONMENTAL LEGISLATIONS OF INDIA

- **Environmental (Protection) Act, 1986** : In the wake of Bhopal tragedy, the Government of India enacted the Environment Protection Act, 1986 (EPA) under Article 253 of the Constitution.

Kiran's One Liner Approach General Knowledge

The purpose of the Act is to act as an "umbrella" legislation co-ordinating the activities of various Central and State authorities established under previous laws, such as Water Act & Air Act.

The Wildlife (Protection) Act, 1972 :- The Act provides for the protection of Wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto. It extends to the whole of India, except the State of Jammu and Kashmir.

The Conservation Act, 1986 :- It has been enacted to check indiscriminate deforestation/diversion of forest land for non-forest purposes.

Forest Insurance Act, 1991 : It provides for mandatory insurance for the purpose of providing immediate relief to the persons affected by accidents occurring while handling any hazardous substances.

The National Environmental Tribunal Act, 1995, It seeks to constitute a Tribunal with Benches to award compensation for damage to persons, property and the environment arising out of any activity involving hazardous substances.

INSTITUTIONS RELATED TO ECOLOGY AND ENVIRONMENT

- Institute for Ecological Sciences, Bangalore
- Centre for Mining Environment, Dhanbad
- Centre for Environmental Education, Ahmedabad
- Centre for Environmental Education Centre, Chennai
- CPR Environmental Education Centre, Chennai
- C.P.R. Environmental Education Centre for Ornithology and Natural History, Coimbatore
- Salim Ali Centre for Environmental Management of Degraded Ecosystems, Delhi
- Centre for Environmental Management and Research Institute, Thiruvananthapuram

POLLUTION**Water Pollution**

- The oceans are the biggest ecosystems and the largest economic resource of our planet.
- The oceans are increasingly turning into huge dumping areas of all kinds of garbage.
- Eight per cent of all pollution in the seas comes from land-based activities.
- Three-quarters of the world's mega cities are located by the sea and 40 per cent of the world's population now lives within 60 km of the seacoasts.
- By 2010, 80 per cent of the world's population will live within 100 km of the coast. Death and disease caused by the polluted coastal waters costs the global economy \$12.8 billion a year. Rivers that run into them carry silt, untreated sewage, industrial wastes and rubbers from the interior areas of the land.
- Oil pollution in particular is an inevitable consequence of the dependence of a rapidly growing population on oil-based technology. The biological and physical effects of oil pollution include reduction in light transmission, dissolved oxygen reduction, smothering, asphyxiation, disgusting smells, scum deposits on beaches, damage to water birds and marine organisms, and a food chain by

toxic components finally reaching organisms through consumption.

- An estimated 21 million barrels of oil runs into the ocean every year from street run-off, effluents from factories and accidentally spilled from ships into the sea every year.

- An undesirable change in the physical, chemical or biological characteristics of air is called air pollution.

- The pollution of air may be caused by natural processes, man activities.

- **Air Pollution due to Natural Processes**

- (i) Gases released along with lava from volcanic eruptions.
- (ii) Smoke from forest fires and fog.
- (iii) Winds and storms
- (iv) Decomposition of plant and animal remains.

- The main cause of air pollution is the smoke emitted by various sources power stations etc. due to which the air gets filled with soot, carbondioxide and carbon monoxide.

- **Particulate Matters in the Atmosphere**

- Particulates are finely divided solid or liquid particles suspended in the air. e.g., Dust, Smoke, Fumes, Mist, Spray, Fly-ash.
- Air contains a large number of particulates.
- A small fraction of the particulates present in the air are metallic particles. Mainly these are of Lead, Mercury, Arsenic, Zinc, Iron, and Tin metals.
- The two metallic particles which are extremely harmful for human beings are those of lead and mercury.

Acid Rain

- The acidic gases like sulphur dioxide and nitrogen dioxide present in polluted air produces acid rain.
- The sulphur dioxide gas present in polluted air forms sulphuric acid whereas nitrogen dioxide gas present in polluted air forms nitric acid, which then falls to the earth with rain water.
- When acid rain falls over a historical monument then the acid present in it reacts chemically with the marble (CaCO_3) of the monument and damages it slowly.

Noise Pollution

- The disturbance produced in our environment by the undesirable sounds of various kinds is called noise pollution.
- Important sources of noise pollution are machines in factories, means of transport, various types of electrical gadgets at home etc.
- The unit of measurement of the intensity of sound is decibel (dB). The human ear is sensitive to sounds having intensities from 0 decibel to 180 decibel.

Kiran's One Liner Approach General Knowledge

Noise Scale		
1. Breathing in the trees	10 db	20-30 db
2. Wind	20 db	30 db
3. Whisper	35 db	35 db
4. Ticking Clock street	50-60 db	50-60 db
5. House Music	60 db	60 db
6. Radio conversation	60 db	60 db
7. Loud conversation	60-80 db	60-80 db
8. Office noise	60-80 db	60-80 db
9. Children playing	80 db	80 db
10. Lawn mower	60-90 db	60-90 db
11. Vacuum cleaner	60-90 db	60-90 db
12. Traffic noise	85-90 db	85-90 db
13. Sports car	90-100 db	90-100 db
14. Heavy truck traffic	100 db	100 db
15. Motor Cycle	105 db	105 db
16. Pneumatic drill	110 db	110 db
17. Thunderstorm	110 db	110 db
18. Rock Music (electrically amplified)	120 db	120 db
19. Aircraft noise	90-120 db	90-120 db
20. Jet take-off (at 100 m distance)	120 db	120 db
21. Jet engine (at 25 m distance)	140 db	140 db
22. Jet engine (from a short distance)	140-170 db	140-170 db
23. Space Vehicle launch	140-170 db	140-170 db

Pollution due to Heavy metals

Heavy Metal	Sources	Impact
Mercury	Mining, paper-pulp, thermal plants, cement, cosmetics, electrical equipment Coal mining	Minimata disease (disease of nervous system)
Iron	Skin becomes sensitive to light	Learning disability, mental retardation
Lead	Mining, coal, automobile, paper, dyeing, petro-chemicals etc.	Bronchial Asthma, allergies
Chromium	Tannery, thermal plants, mining, fertiliser, textile, photography	Itai Itai disease (fragile bones)
Cadmium	Coal, Nuclear Power plants, batteries, ceramics, toys	Dermatitis, Pneumonia
Nickel	Mining, fertilisers, thermal plants, chocolate, automobile, electroplating	