

# CGPSC - MAINS

## PAPER - 4

शर्मा एकेडमी®

An Institute for IAS/IPS, MPPSC



**GENERAL SCIENCE, APTITUDE TEST,  
LOGICAL REASONING, MENTAL ABILITY  
BEHAVIORAL SCIENCE**

**PAPER – 4**

<b>PART</b>	<b>SUBJECT</b>	<b>PAGE NO.</b>
<p><b>PART - 01</b> <b>General Science:-</b></p>	<p><b>CHEMISTRY :-</b> Rate of chemical reaction and chemical equilibrium - Preliminary knowledge of rate of chemical reaction. Fast and slow chemical reactions. Metals - Position of metals in the periodic table and general properties. Metal, mineral ore. Difference between mineral and ore. Metallurgy concentration, roasting, smelting, refining of ores. Metallurgy of copper and Iron. corrosion of metals. Alloys. Nonmetals - Position of nonmetals in the periodic table and general Properties. Some important organic compounds, some general artificial polymers, polythene, polyvinyl chloride. Teflon soap and detergents. <b>PHYSICS :-</b> Light - nature of light, reflection of light, law of reflection, reflection from plane and curved surface, image formation by plane, convex and concave mirror, relation between focal length and radius of curvature, electric discharge in gases, causes of origin of energy in the Sun, Electricity and its effects - electric intensity, potential- potential difference, electric current Ohm's law. Resistance, specific resistance, influencing factors, combination of resistance and related numerical questions, thermal effect of current and its uses, calculation of power and electrical energy spent. (numerical) precautions observed in electric experiments, Photo electric effect, Solar Cell, Structure, PN Junction, Diode, <b>BIOLOGY :-</b> Transport: transport of mineral and water in plants and animals [in context of human being], structure and function of blood, structure and working of heart, [preliminary knowledge], Photosynthesis- Definition, main steps of the process. light reaction and dark reaction, Respiration - Definition, breathing and respiration, Types of respiration, Aerobic and anaerobic respiration, respiratory organs of animals respiratory system of human being and mechanism of respiration, Human digestive system and digestive process [General information], Control and coordination - Nervous system of human being. Structure and function of human Brain and spinal cord, coordination in plants and animal Phytohormones, endocrine glands hormone and their function. Reproduction and growth - type of reproduction Asexual reproduction, fission, budding, regeneration, artificial vegetative reproduction, layering, cutting, grafting, Parthenogenesis, sexual reproduction in plants, structure of flower and reproduction process, [general information] pollination, fertilization. Human reproductive system and reproduction process, [general</p>	<p>1-220</p>

	information], Heredity and evolution - heredity and variation. Fundamental basis of heredity chromosome and DNA [preliminary information]	
<b>PART - 02 Aptitude Test, Logical Reasoning, Mental Ability :-</b>	Addition, subtraction, multiplication and division of rational numbers. Finding the rational number between two rational numbers. Ratio and Proportion - definition, properties, atemendo, invertendo, componendo etc. and their uses. Commercial Mathematics - Banking, calculation of interest on/in savings account, fixed deposit account and recurring deposit account. Calculation of income tax (for salaried person and excluding house rent allowance). Factorization, LCM, HCF. Vedic Mathematis- addition, subtraction, multiplication, division and checking the answer through bijank. Square, square roots, cube, cube roots, vinculam and its application. The application of vedic mathematics methods in algebra etc., Introduction and creativity of Indian Mathematician - in reference with Aryabhata, Yaraaha mihira, Brahma gupta, Bhaskaracharya, Shrinivas Ramanujan. Mathematical operations, Basic numeracy (numbers and their relations, order of magnitudes etc.). Data interpretation (charts, graphs, tables, data sufficiency etc.) and analysis of data. Arithmetic mean, Median, Mode, Probability. Question related to addition and multiplication theorem on probability. Applied mathematics - Profit and Loss, Percentage, Interest and Averages. Time, speed, distance, river and boat. Analog Test, Odd word, Odd pair of words, Coding & Decoding Test, Relation Test, Alphabet Test, Mathematical Operations, Logical analysis of words, Inserting the missing number or word, Assertion and Reason, Situation reaction test, Figure series, Deletion of elements, General Mental ability.	221-360
<b>PART - 03 Applied &amp; Behavioural Science:-</b>	Role of Information Technology in Rural India, basic knowledge of computer, computers in communication and broadcasting, software development for economic growth. Broad applications of IT. Energy Resources: Demand of Energy, renewable and nonrenewable energy resources of energy, the development and utilization of nuclear energy in the country. Science & Technology developments in India in present, origin of agriculture, Progress of Agricultural Science and its impact, Crop science in India, Fertilizer, Control of pests and disease scenario in India. Bio-diversity and its conservation - General introduction - defination, species and genetic diversity, Bio-geographical classification of India, Importance of Bio-Diversity - Constructive and Distructive application, Importance of social, moral and alternative vision, Global, National and Local level Bio-diversity, India as a mega	361-460

	<p>biodiversity nation, Hotspots of Biodiversity, threats to biodiversity, loss of habitat, damage to wildlife, humans and wild animals conflict, India's threatened, endangered and endemic species, Conservation of bio-diversity, Topological and Nontopological conservation. Environmental pollution - Causes, effect and control measures- Air pollution, water pollution, marine pollution, soil pollution, sound/noise pollution, thermal pollution, nuclear pollution. Solid waste management - Urban and Industrial solid waste management: Causes, effect and control, Human role in pollution control.</p>	
--	--	--

## Element, Compound and Mixture

### Matter

As we look at our surroundings, we see a large variety of things with different shapes, sizes and textures. Everything in this universe is made up of material which scientists have named 'matter'. All the things such as stones, clouds, food, stars, plants, even a small drop of water occupy space and have mass. In other words, matter is something which has mass, occupy volume, can have physical resistance, inertia and can be realized by the sense organs.

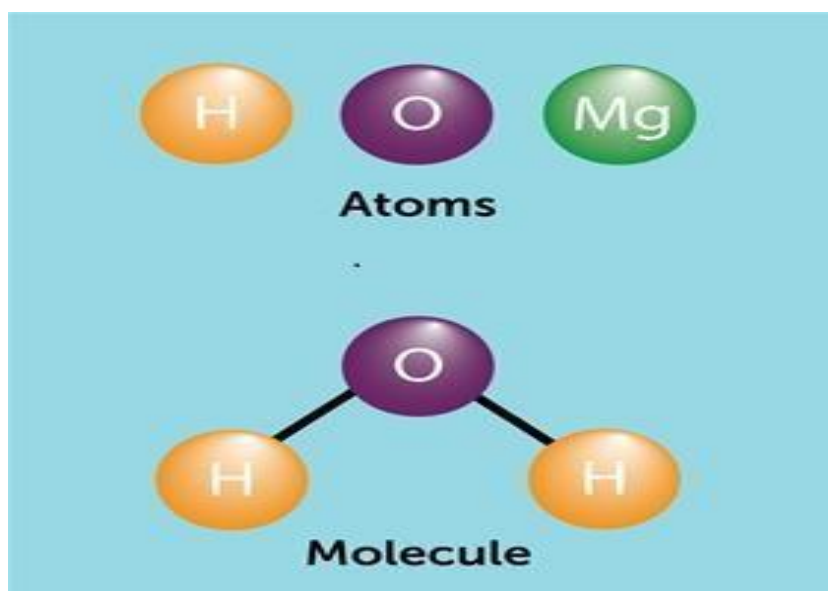
Early Indian philosophers classified matter in the form of five basic elements—the 'Pancha Tatva'—air, earth, fire, sky and water. According to them, everything, living or non-living was made up of these five basic elements.

### Characteristics of Matter

- (i) Matter is made up of very small particles that are beyond our imagination.
- (ii) The particles have space in between them, called the intermolecular space.
- (iii) They are continuously moving, i.e., they possess kinetic energy. As the temperature rises, speed of the particles increases. Due to which the kinetic energy of the particles increases.
- (iv) They attract each other. The force of attraction responsible for keeping them together is called intermolecular force.
- (v) The strength of this force of attraction varies from one kind of matter to another.

### Particles of Matter

Matter has mainly two particles





## Atoms

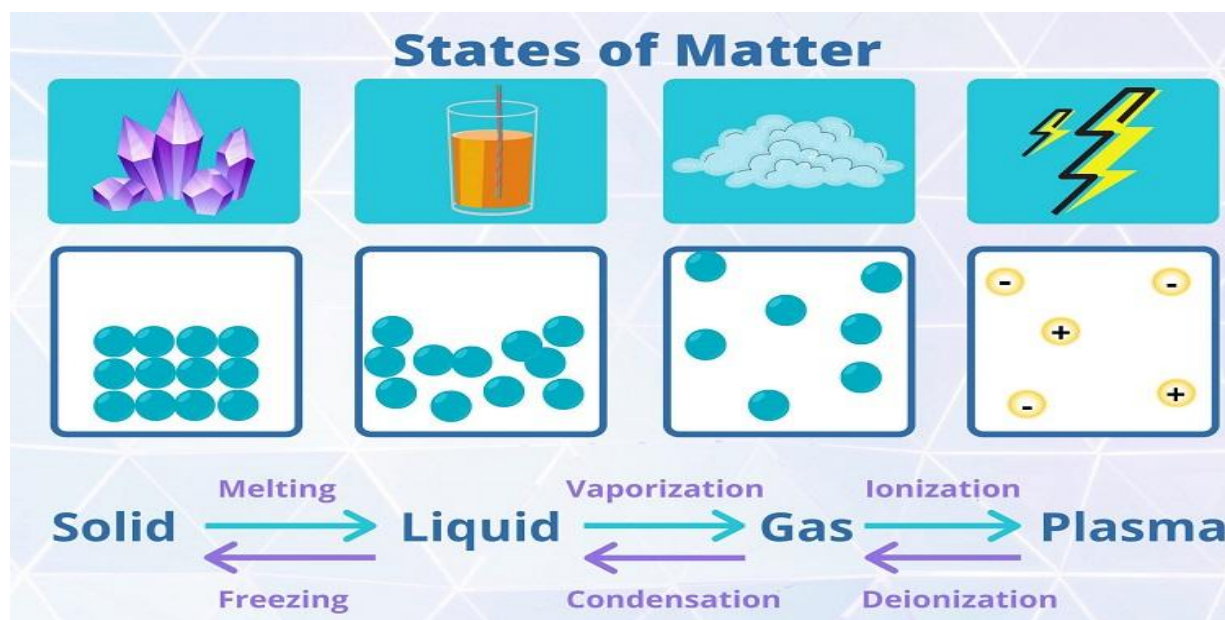
The word atom has been derived from Greek word atoms meaning indivisible. An atom is the smallest particle of an element that may or may not exist independently and retain all its chemical properties i.e., takes part in chemical reactions. Atoms of different elements have different masses and chemical properties.

## Molecules

A molecule is a group of two or more atoms that are chemically bonded together. It can be defined as the smallest particle of an element or a compound that is capable of independent existence and shows all the properties of that substance. However, it does not take part in a chemical reaction.

## States of Matter

Matter exists in three different states– solid, liquid and gas these states of matter arise due to the variation in the extent of intermolecular forces and intermolecular space.

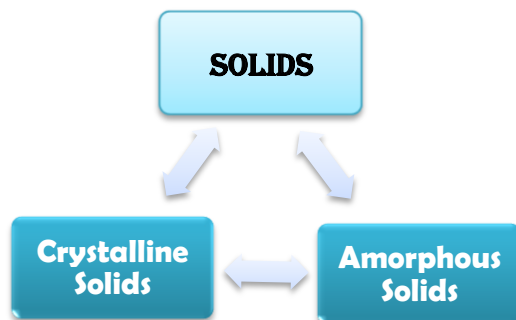


### 1) The Solid State

In this state of matter, the substances have definite mass, volume and shape, e.g., wood, table, pen, book, etc. The intermolecular space in between the constituent particles of solid state is small, but the intermolecular forces are strong. Thus, the constituent particles such as atoms, molecules or ions cannot move but can only oscillate about their mean position. This is the reason why solids are incompressible and rigid i.e., have definite shape and size. Because of the presence of strong intermolecular forces, these are highly dense and generally have high melting point.

## Classification of Solids

These can be classified into two groups-



- (i) **Crystalline Solids** They consist of a large number of crystals. In a crystal, the arrangement of particles is regular e.g., sodium chloride, diamond, quartz (crystalline), graphite, etc.
- (ii) **Amorphous Solids** They consist of particles of irregular shape. The arrangement of particles in amorphous solid is disordered. e.g., glass, rubber and plastics. Amorphous solids are also called **pseudo solids or super cooled liquids**.



## Everyday Science

- ✓ The shape of a rubber band changes when some external force is applied but it regains shape when the force is removed. Further, if excessive force is applied, it breaks i.e., it is rigid and have definite shape. That's why it is consider as a solid.
- ✓ A sponge is compressible but considered as a solid because of the presence of air filled holes. When force is applied, the air expels out and it gets compressed.
- ✓ We can easily move our hand in air or water (less easily than air) but for doing the same in a solid block of wood, a karate expert is required. This is because of higher extent of intermolecular forces in between the particles of solids.
- ✓ Although ice is a solid but it floats over water due to its less density than water. This is because of the pressure of air filled spaces due to weaker H-bonding.

## 2) The Liquid State

In this state, the substances have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept. e.g., water, oil, milk, etc. The upper surface of the liquids is always planar whatever be the shape of the container. Liquids flow and change their shape, so they are not rigid and are called **fluids** (substance which can flow).

In liquids, intermolecular forces are no longer strong enough to hold the particles together, that's why they are less densely compressed. However, the forces are still sufficient so that particles cannot escape each other's environment, so they have sufficient mobility and fixed volume.

### 3) The Gaseous State

In this state, matters have no fixed shape and volume. They only occupy the shape and size of the container in which they are kept. e.g., air, H<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub> etc. In gaseous state, the intermolecular forces are very weak, so the intermolecular spaces between the molecules are very large. This is the reason that gases are highly compressible as compared to solids and liquids. Gases also flow in the container in which they are kept, so they are also called **fluids**.

Further, gases expand more as compared to liquids and solids when heated due to the weaker intermolecular forces as compared to liquids and solids.

- **Gaseous Pressure** In the gaseous state, the particles move about randomly at high speed. Due to this they hit each other and also the walls of the container. That's why gases exert pressure on the walls of the container.

### Two More States of Matter

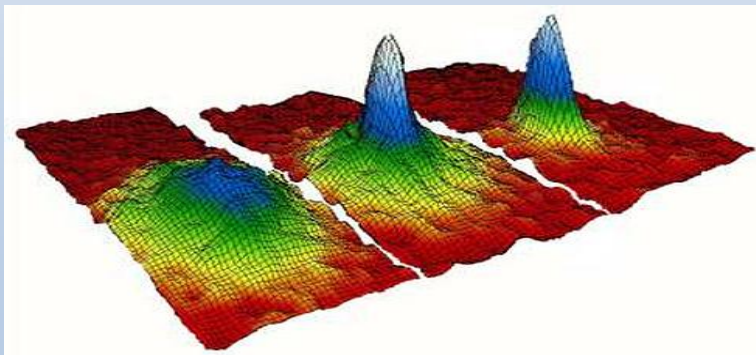
Now-a-days, there is a discussion on two more states of matter, but these states occur only in extreme conditions of temperature and pressure. These are

#### **Plasma**

It consists of super energetic and super excited particles. These particles are in the form of ionized gases. The fluorescent tube (filled with helium or any other gas) and neon sign bulbs (filled with neon) consist of plasma. The sun and the stars glow because of the presence of plasma in them. The plasma is created in stars because of very high temperature.

#### **Bose-Einstein Condensate (BEC)**

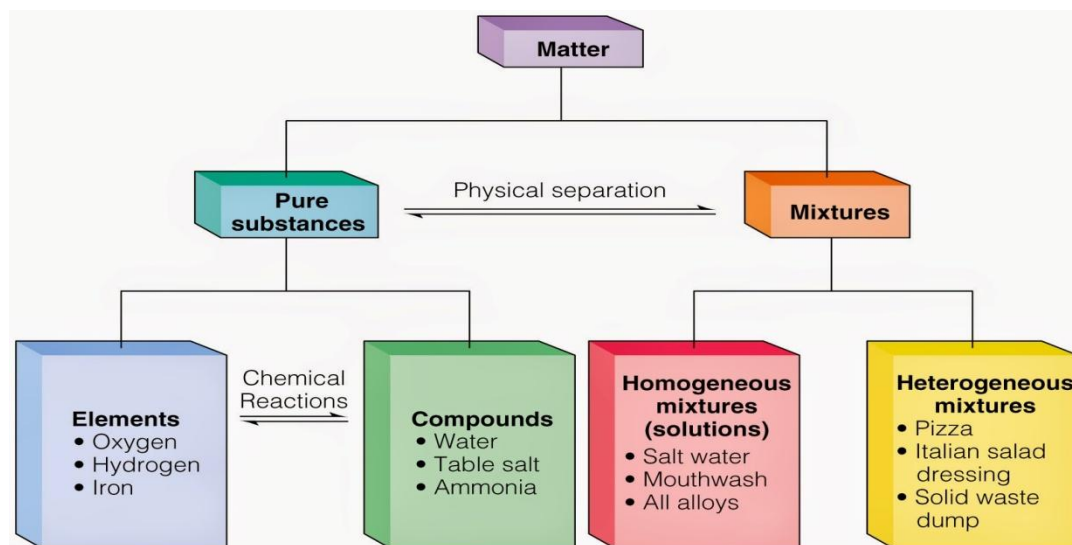
This state is named after the name of scientists Satyendra Nath Bose (India) and Albert Einstein. The BEC is formed by cooling a gas of extremely low density, about one-hundred-thousandth the density of normal air, to super low temperatures. In 2001, Eric A. Cornell, Wolfgang Ketterle and Carl E. Wieman of USA received the Nobel Prize in Physics for achieving 'Bose-Einstein Condensate'.





## Chemical Classification of Matter

On the basis of chemical composition, matter can be classified as-



## Element

**Robert Boyle** was the first scientist to use the term element in 1661. Antoine Laurent Lavoisier (1743-94), a French chemist defined an element as a basic form of matter that cannot be broken down into simpler substances by any physical chemical process. In fact, an element is that fundamental matter which is composed of only one kind of atoms.

Elements can be solids like Aluminum (Al), Iron (Fe), Gold (Au), Silver (Ag) etc, liquids like Mercury (Hg), Bromine (Br), etc and gases like Argon (Ar), Helium (He), Oxygen (O), Hydrogen (H), etc.

Presently, there are 118 elements out of which 98 are naturally occurring and rest is artificially made.

### Symbols for Some Elements

Element Symbol	Symbol	Element Symbol	Symbol	Element Symbol	Symbol
Aluminum	Al	Copper	Cu	Nitrogen	N
Argon	Ar	Fluorine	F	Oxygen	O
Barium	Ba	Gold	Au	Potassium	K
Boron	B	Hydrogen	H	Silicon	Si
Bromine	Br	Iodine	I	Silver	Ag
Calcium	Ca	Iron	Fe	Sodium	Na
Carbon	C	Lead	Pb	Sulphur	S
Chlorine	Cl	Magnesium	Mg	Uranium	U
Cobalt	Co	Neon	Ne	Zinc	Zn

Symbols have been taken from the names of elements in Latin, German or Greek. The first letter of a symbol is always written as a capital letter and the second letter as a small letter.

Elements can be normally divided into metals, non-metals and metalloids. We will describe their properties later.