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GENERAL SCIENCE



for

**State Engineering Services Exams,
SSC, PSUs, Banking, RRB and
Other Exams**

by Mr. B. Singh



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Ph. : 9021300500 | **E-mail:** infomep@madeeasy.in

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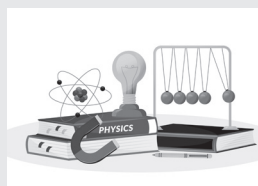
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PHYSICS

Physics is a branch of science which is concerned with all aspects of nature on both the microscopic and macroscopic level. Its scope of study encompasses not only the behavior of objects under the action of forces but also the nature of gravitational, electromagnetic, nuclear forces among others. The ultimate objective of physics is to formulate comprehensive principles that bring together and explain all such phenomena.



Units & Measurement

- Unit is the chosen standard used for measuring a physical quantity.
- There are basically two types of unit:
 - Fundamental Unit:** These units are a set of measurements, defined arbitrarily and from which other units are derived. Examples: meter, kilogram, second, etc.

The fundamental unit of some of the physical quantities are given below:

International System of Units (S.I.)		
Physical	Fundamental	Symbol
Mass	Kilogram	kg
Length	Metre	m
Time	Second	s
Temperature	Kelvin	K
Electric-current	Ampere	A
Luminous intensity	Candela	Cd
Quantity of matter	Mole	mol

Systems of units	Length	Mass	Time
C.G.S. System	Centimetre	Gram	Second
F.P.S. System	Foot	Pound	Second

Systems of units	Length	Mass	Time
M.K.S. System	Metre	Kilogram	Second

- Derived Unit:** All the units which are expressed in terms of fundamental units are known as derived units. Examples: Newton, Joule, etc.
- Internationally, there are four types of unit systems. These are:
 - S.I. Units/System:** It is the modern form of the metric system, and is the most widely used system of measurement. It comprises a coherent system of units of measurement built on seven base units namely kilogram, meter, second, candela, ampere, kelvin and mol.
 - CGS System:** The centimeter-gram-second (CGS) system of units is a variant of the metric system based on centimetre as the unit of length, gram as unit of mass, and the second as the unit of time.
 - FPS System:** The foot-pound-second (FPS) system is a system of units built on three fundamental units: the foot for length, the pound for mass and the second for time.
 - MKS System:** The MKS system of units is a physical system of units that expresses any given measurement using base units of the metre, kilogram, and second.

Measurement of length

- A meter scale is used for lengths from 10^{-3} m to 10^2 m.
- A vernier callipers is used for lengths to an accuracy of 10^{-4} m.
- A screw gauge and a spherometer can be used to measure lengths as less as to 10^{-5} m.
- Parallax method is used to measure large distances, for example the distance of earth from a planet.
- It is very difficult to determine the exact size of molecules however it is possible to estimate the sizes of molecules.

Measurement of Mass

- Mass is a basic property of matter. It does not depend on the temperature, pressure or location of the object in space. The SI unit of mass is kilogram (kg).
- In the case of atoms and molecules, there is an important standard unit of mass, called the unified atomic mass unit (u).

Measurement of Time

- **Atomic standard of time:** It is based on the periodic vibrations produced in a caesium atom. This is the basis of the caesium clock, sometimes called atomic clock, used in the national standards.
- In the caesium atomic clock, the second is taken as the time needed for 9,192,631,770 vibrations of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom. The vibrations of the caesium atom regulate the rate of this caesium atomic clock just as the vibrations of a balance wheel regulate an ordinary wristwatch or the vibrations of a small quartz crystal regulate a quartz wristwatch.

Accuracy, Precision of Instrument, and Errors in measurement

- **Error:** The result of every measurement by any measuring instrument contains some uncertainty. This uncertainty is called an error.

- **Accuracy:** The accuracy of a measurement is a measure of how close the measured value is to the true value of the quantity.
- **Precision:** Precision tells us to what resolution or limit the quantity is measured.

Motions

Basics of Motion

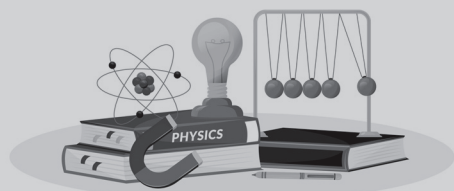
A body is said to be in motion if it changes its position with respect to its surroundings as time goes on. A body is said to be at rest if it does not change its position with time, with respect to its surroundings.

Types of Motion

- When a particle or a body moves along a straight path, its motion is Rectilinear or translatory motion.
- When a particle or a body moves in a circular path, its motion is circular motion. When a body spins about its own axis, it is said to be in rotational motion.
- When a body moves to and fro or back and forth repeatedly about a fixed point in a definite interval of time, it is said to be in vibrational or oscillatory motion.

Position, Path length and Displacement

- **Reference point:** In order to specify position, we need to use a reference point and a set of axes. Generally rectangular coordinate system consisting of three mutually perpendicular axes, labeled X, Y, and Z-axes. The point of intersection of these three axes is called origin (O) and serves as the reference point.
- **Frame of reference:** To measure time, we position a clock in this system. This coordinate system along with a clock constitutes a frame of reference.
- If one or more coordinates of an object change with time, we say that the object is in motion. Otherwise, the object is said to be at rest with respect to this frame of reference.
- **Path length:** Path length is distance traveled by body from one point to another. Path length is a



Previous Years' Questions & Practice Questions

- 1.** What is a light year?
 (a) A year which passed on without difficulties
 (b) Year dedicated by UNO to "light"
 (c) Time measured in astronomical units
 (d) Distance travelled by light in one year

[APPSC (AEE) : 2016]

Ans. (d)

- 2.** One coulomb of charge is contributed by how many electrons?
 (a) 0.625×10^{19} (b) 1.6×10^{19}
 (c) 10^{19} (d) 1.6×10^{12}

[BPSC (AE) : 1995]

Ans. (a)

- 3.** When n number of resistances each of value r are connected in parallel, then the resultant resistance is x . When these n resistances are connected in series, their total resistance is
 (a) nx (b) n^2x
 (c) x/n (d) rnx

[BPSC (AE) : 1995]

Ans. (b)

- 4.** One kWh is the same as
 (a) 36×10^5 watt (b) 36×10^5 erg
 (c) 36×10^5 joule (d) 36×10^5 BTU

[BPSC (AE) : 1995]

Ans. (c)

- 5.** Which of the following do common microwave ovens use to generate energy?
 (a) Thermostat
 (b) Magnetron
 (c) Particle accelerator
 (d) Superconductors

[BPSC (AE) : 1995]

Ans. (b)

- 6.** What is Maglev?
 (a) A supernova
 (b) A system of transport
 (c) The tallest building
 (d) A telescope

[BPSC (AE) : 1995]

Ans. (b)

- 7.** Who among the following discovered superconductivity?
 (a) H. K. Onnes
 (b) Walther Meissner
 (c) Robert Ochshenfeld
 (d) John Bardeen

[BPSC (AE) : 1995]

Ans. (a)

- 8.** Lightning strikes sometimes explode trees, because
 (a) the lightning bolt strikes very fast
 (b) the leaves become electrically discharged during the lightning strike
 (c) the water inside the tree evaporates too rapidly
 (d) there is bio-magnetic repulsion

[BPSC (AE) : 1995]

Ans. (c)

- 9.** Who among the following invented the crescograph?
 (a) C. V. Raman
 (b) Homi J. Bhabha
 (c) Jagadish Chandra Bose
 (d) S. Ramanujan

[BPSC (AE) : 1995]

Ans. (c)

CHEMISTRY

2

Chemistry is the science of molecules and their transformations. It is the science not so much of the one hundred elements but of the infinite variety of molecules that may be built from them. It is the study of matter and the chemical reactions between substances. Chemistry is also the study of matter's composition, structure, and properties.



Matter

- Anything that has mass and occupies space is called matter. Matter can be classified on the basis of physical state and chemical constitution. In the physical state it is found in the form of solids, liquids and gases. These three forms of matter are found because of intermolecular force (force among atoms and molecules).
- Solids have a definite shape because of strong intermolecular force. The molecular force is not so strong in liquids, and therefore, liquids do not have a definite shape and have fluidity. Because of extremely weak intermolecular force, gases move freely and can occupy any space. According to chemical composition, matter can be classified into elements, compounds and mixtures.

Composition of Matter

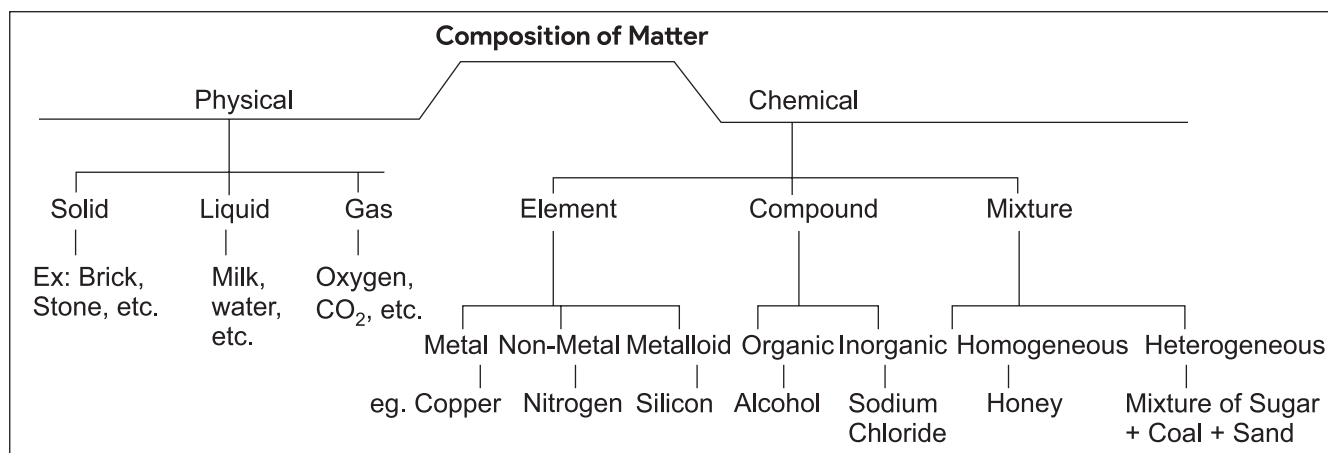
- **Substance:** A substance is a matter which cannot be separated into other kinds of matter by any physical force.
- **Element:** It is the purest form of a substance which cannot be broken into simpler substances

by any chemical or physical process. Only one kind of atom is present in an element. There are 118 known elements, out of which 27 are man-made.

Elements can be divided into three groups: metals, non-metals and metalloids.

1. **Metals:** Any chemical element that is an effective conductor of electricity and heat can be defined as a metal. These are 90 in number.
2. **Non-metals:** These are substances that do not exhibit such characteristic properties of metals as hardness, mechanical adaptability, or the ability to conduct electricity. There are 24 non-metals, out of which 12 found in solid state, one in liquid (Br) state and 11 in gaseous state.
3. **Metalloids:** Metalloids possess the characteristics of both metal and non-metal, e.g. Silicon (Si), Germanium (Ge) and Antimony (Sb).

- **Compound:** Two or more elements chemically combined to form a substance is called a compound.



- **Mixture:** More than one substance (elements or/and compounds) is combined together to form a mixture. It can be separated by physical processes into two or more substances.

Classification of mixture is done under two categories:

- (i) **Homogeneous mixture:** A homogeneous mixture, which is also called a solution, has a uniform composition throughout. For example: Air with nitrogen and oxygen as two main constituents, honey, a solution of salt or sugar, etc.
- (ii) **Heterogeneous mixture:** A mixture which consists of basically distinct parts, each with different properties, is called a heterogeneous mixture. For example: When oil is mixed with water it forms a heterogeneous mixture.

Separation of Matter

Filtration, sublimation, decantation, chromatography, crystallization, etc. are some of the methods by which substances can be separated from a mixture.

- **Filtration:** It is a process of separating a suspended solid, such as a precipitate, from the liquid in which it is already suspended by straining it through a porous medium that can be penetrated easily by liquids.
- **Sublimation:** Heating certain substances which directly change into vapour without changing into liquid. For example: Camphor, Ammonium chloride (NH_4Cl), etc.
- **Decantation:** This process is applied to a mixture in which one compound is a liquid and the other an insoluble solid heavier than the liquid.
- **Crystallization:** For the separation and purification of solid substances, this method is most widely used.

DO YOU KNOW

- The melting point of an alloy is less than that of its constituent elements due to the presence of impurities.
- The boiling point of alcohol is lower than that of water.



- **Evaporation:** Evaporation is the process of change of liquid into a gas. Evaporation takes place at all temperatures. Wet clothes dry even in shadow due to evaporation.

Difference between Evaporation and Boiling

Evaporation	Boiling
Evaporation takes place spontaneously at all temperatures.	Boiling takes place only at a definite temperature (boiling point) at which the vapour pressure of the liquid is equal to the atmospheric pressure.
Evaporation takes place only at the surface of the liquid.	Boiling takes place even below the surface of the liquid in the form of bubbles.

Atoms and Molecules

- In 1803, John Dalton propounded the atomic theory, according to which an atom is indivisible and this concept remained predominant up to the end of the 19th century. But later atomic models and atomic theories proved that atoms are divisible and they have a definite internal configuration and composition.
- Atomic models like Rutherford's model and Bohr's model have confirmed that the atoms are composed of a number of micro particles like electron, proton and neutron. Apart from electron, proton and neutron, some micro particles such as positron, meson and neutrino are also present.

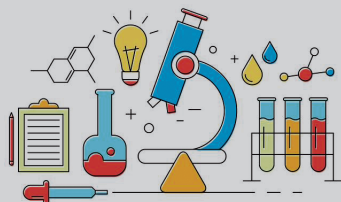
Atom and Molecule:

The atom of an element is that smallest particle which takes part in a chemical reaction but doesn't exist in a free state. Similarly, the molecule of an element or compound is that smallest particle which doesn't take part in a chemical reaction but exists in a free state.

Laws of Chemical Combination

There are three important laws of chemical combination. These are :

1. Law of conservation of mass (or matter).
2. Law of constant proportions.
3. Law of multiple proportions.



Previous Years' Questions & Practice Questions

- 1.** Natural ripening of climacteric fruits (like apple) occurs due to
- release of ethylene and increased rate of respiration
 - release of ethylene and decreased rate of respiration
 - release of acetylene and increased rate of respiration
 - release of acetylene and decreased rate of respiration

[APPSC (AEE) : 2016]

Ans. (a)

- 2.** Scramjet uses the following fuel:
- Hydrogen
 - Aviation fuel
 - White Kerosene
 - Butadine

[APPSC (AEE) : 2016]

Ans. (a)

- 3.** The following are the half-lives of 4 active isotopes. Which one of the following is the most languages to handle?
- 3 billion years
 - 100 years
 - 0.01 minute
 - 30 days

[BPS (AE) : 1995]

Ans. (c)

- 4.** Which of the following is used in pencils?
- Phosphorus
 - Carbon
 - Graphite
 - Lead

[BPS (AE) : 1995]

Ans. (c)

- 5.** The chemical name of the product 'Teflon', also used in non-stick cookware, is
- polytetrafluoroethylene
 - polycarbontetrafluoroethylene

- polyfluoroethylene
- polytetrafluoroethyl

[BPS (AE) : 1995]

Ans. (a)

- 6.** Photovoltaic cells are generally made of
- selenium
 - phosphorous
 - silicon
 - uranium

[BPS (AE) : 1995]

Ans. (c)

- 7.** Which of the following is known as Marsh gas?
- Methane
 - Ethane
 - Butane
 - Acetylene

[BPS (AE) : 2001]

Ans. (a)

- 8.** An element has atomic number 13. Which of the following statements concerning the element is right?
- The element has 13 protons
 - The element is placed in the first period of the periodic table
 - The element is placed in the fourth period of the periodic table
 - The element is transition metal

[BPS (AE) : 2001]

Ans. (a)

- 9.** The correct classification of elements was given by
- Dobereiner
 - Odiling
 - Mendeleev
 - Robert Boyle

[BPS (AE) : 2001]

Ans. (c)

LIFE SCIENCE

Life science refers to the study of living organisms including, microbes, human beings, animals, fungi, and plants. It is the science of life forms and living processes. The world comprises an amazing diversity of living organisms.



Basics of Biology

Animals

Classification of animals

- When any plane passing through the central axis of the body divides the organism in two halves that are approximately mirror images it is called Radial symmetry and the animals showing radial symmetry are called *Radiata*.
- When the body can be divided into identical left and right halves in only one plane. This kind of symmetry is called bilateral symmetry and such animals are called *Bilateria*.
- Almost 99 percent of animals are invertebrates (animals without backbone) and the remaining represents the vertebrates (animals with backbone). Also, the animals are categorised into two major groups, non-chordates and chordates, on the basis of the presence or absence of *notochord* at some stage in their life.
- The animal kingdom is divided into 35 Phyla (singular: Phylum) of which 11 are considered as major Phyla.

1. Phylum Protozoa (Unicellular Protist Animals)

- They are microscopic organisms in which a single cell performs all the vital activities.
- They are aquatic (fresh water and marine) and cosmopolitan in distribution. Some forms are parasitic. The protozoan cell body is either naked, (for example, amoeba) or surrounded

by a non-rigid pellicle (Cellulose is absent in pellicle).

- Different types of locomotory organs are found in protozoans.
- Locomotory organs are absent in the parasitic forms (Sporozoa) of protozoans.
- Most protozoans are free-living and aquatic. They are holozoic and feed largely on bacteria, microscopic algae and minute animals such as rotifers or on other protozoans including members of their own species. Some protozoans are holophytic i.e. they prepare their own food by photosynthesis (e.g. Euglena). The parasitic protozoans feed on materials obtained from the hosts (e.g. Monocystis).

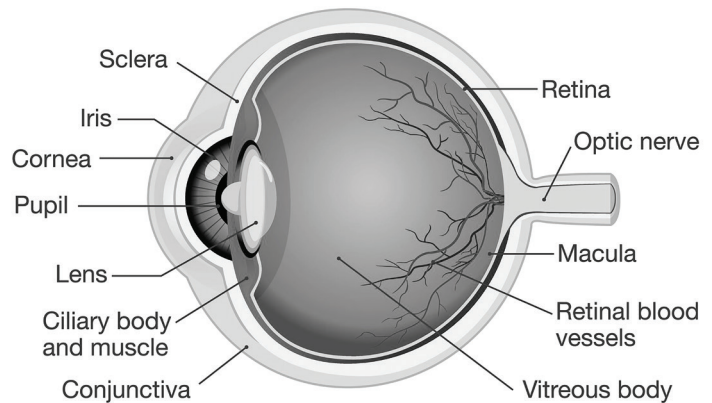
Examples:

- (i) **Free living:** Euglena, Amoeba, Paramecium, Noctiluca and Elphidium.
- (ii) **Parasitic:** Monocystis, Entamoeba, Plasmodium, Trypanosoma and Giardia.

2. Phylum Porifera (Pore Bearing Animals)

- These are commonly known as *sponges*. They are the most primitive group of multicellular animals. About 5000 species of sponges are known. Most of them are marine and remain attached to rocks. A few live in fresh water.
- The sponges are *diploblastic*.
- Sponges reproduce *asexually* by fragmentation.

- Ciliary muscle alters the shape of the lens for near or far vision.
- The focal length of the eye lens is controlled by contraction and relaxation of ciliary muscles.
- Focusing of image is brought about by altering lens curvature.
- The function of *iris* is to alter the size of pupil.
- Pupil is the black hole in the centre of the iris.
- Pupil is the area through which light enters the eyeball.
- *Atropine* is a chemical used by doctors to dilate the pupil. The third and inner coat of the eye is called *retina*.
- The primary *function* of retina is *image formation*. It consists of a nervous tissue layer and a pigmented layer. The retina is composed of several layers of cells, each containing a characteristic type of cell. First, there is the photoreceptor layer containing the photosensitive cells, the *rods*, and *cones*, partially embedded in the microvilli of pigmented epithelium cells of the choroids.
- The image falling on retina is *real* and *inverted*.
- The rod cells are more *sensitive* towards light as compared to cone cells. *Rods* are used for vision in *dim light* (scotopic vision), having no ability to detect *colour* whereas, cones are used for *bright light vision* (photopic vision), with the ability to make coloured image of the object.
- The photosensitive chemical substance or the pigment in rods, is called *rhodopsin* and those in cones are called *cone pigments*, specific for the basic colours blue, green and red. Thus, cones are of three different types, short wavelength-sensitive (blue) cones, medium wavelength-sensitive (green) cones, long wavelength-sensitive (red) cones.
- The visual pigments for colour vision are *erythropsin* (sensitive to red), *chloropsin* (sensitive to blue).
- Colour blindness (also called *daltonism*) is caused by the absence of one of these types of *cones*.
- Only human beings, apes, monkeys, birds, lizards, turtles and some fishes possess colour vision. But most domestic mammals and *sharks* do not possess colour vision.
- The eyes of carnivores like cat, dog, lion, seal, etc. glow in night. It is due to *tapetum lucidu*, a reflecting layer next to retina.
- Human eye is sensitive to *electromagnetic spectrum* between 4000Å-7000Å wavelength.
- Eyes are most sensitive to *yellow-green* colour having wave length approximately 5550Å.
- Stereoscopic vision (3-dimensional) is found in human beings.
- The normal eye is known as *emmetropic*.





Previous Years' Questions & Practice Questions

1. Deficiency of which of the following results in goitre and cretinism?

- (a) Folic acid (b) Vitamin A
(c) Iodine (d) Zinc

[APPSC (AEE) : 2016]

Ans. (c)

2. World Health Organization recommends exclusive breast feeding from the date of birth of the infant up to the age of

- (a) 3 months (b) 6 month
(c) 9 months (d) 2 year

[APPSC (AEE) : 2016]

Ans. (d)

3. Cerebral malaria is caused by

- (a) Plasmodium falciparum
(b) P. ovale
(c) P. malariae
(d) None of the above

[BPSC (AE) : 1995]

Ans. (a)

4. The full form of HIV is

- (a) Human immunodeficiency virus
(b) Human immunopositive virus
(c) Human immune virus
(d) None of the above

[BPSC (AE) : 1995]

Ans. (a)

5. The origin of life on this earth was written by

- (a) Charles Darwin
(b) Wallace
(c) Alexander Oparin
(d) Gregor Mendel

[BPSC (AE) : 2001]

Ans. (c)

6. Ascorbic acid is

- (a) Vitamin B (b) Vitamin C
(c) Vitamin D (d) Vitamin E

[BPSC (AE) : 2001]

Ans. (b)

7. The liver stores food in the form of

- (a) albumen (b) glycogen
(c) glucose (d) proteins

[BPSC (AE) : 2001]

Ans. (b)

8. With increasing temperature, the respiratory rate will

- (a) increase
(b) decrease slowly
(c) decrease rapidly
(d) remain unaffected

[BPSC (AE) : 2001]

Ans. (a)

9. An artery differs from a vein in having

- (a) narrow lumen
(b) thicker walls
(c) valves to control direction of blood flow towards heart
(d) None of these

[BPSC (AE) : 2001]

Ans. (c)

10. In the human body, the number of bones is

- (a) 205 (b) 306
(c) 206 (d) 305

[BPSC (AE) : 2001]

Ans. (c)