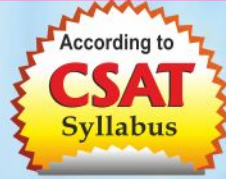




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# 2025

Central and State Civil Services Examinations

**254** General Studies Question Papers

**CHAPTERWISE  
SOLVED PAPER**

# General Studies PREVIEW

# 7

(7<sup>th</sup> in 8  
Part Series)

{ पूर्वावलोकन }  
English Version...

Includes Question Papers from **1990** to **February 2025**  
alongwith **UPPCS Mains** GS Question Papers

# GENERAL SCIENCE



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*Exclusive Focus*

CHAPTERWISE  
**REVISION NOTES**

See Cover Page - 2

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# PREFACE

The book in hand titled "PREVIEW" is the English version of "पूर्वावलोकन". "पूर्वावलोकन" has proved to be one of the most useful book series for Central and State Civil Services Examinations for the last 23 years. It has carved a special place for itself among हिन्दी Medium students for its authenticity and style of presentation.

The English edition of "पूर्वावलोकन" has been prepared keeping in view the requirements of the English medium students. The changes in the examination pattern have been kept in focus. Its contents are thoroughly updated and authenticated with a team of experts. The treatise has been enriched by incorporation of maximum number of questions of different examinations and their authentic explanations.

After the inclusion of CSAT as a compulsory part of civil services examinations by Union and State Public Services Commissions, the objective type questions have been compiled chapter-wise according to CSAT syllabus. In this edition, questions related to states, nations and the world have been compiled together. However, Geography, Polity, Science, Environment, Economics and State Based Questions find a place in a separate section. Thus, all the questions have been compiled in 8 sections, 7 of them are according to central civil services examination (IAS) and the 8<sup>th</sup> section caters to State based questions.

We hope that the book will fulfill the needs of English medium students. We have tried our best to present our highly esteemed and beloved readers an authentic and upto date book on General Studies. Any discrepancy brought to our notice will be taken care of in forth coming Editions. Suggestions for improvement are welcome.

May this book enjoy success unprecedented!!

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# General Studies

# PREVIEW

English  
Version of

# पूर्वावलोकन

## About the Book

In the inaugural English version edition of Purvavalokan series, all the sections are redesigned as per the new syllabus (see the box) of Union and States Public Service Commission preliminary examinations. Following question papers have been included in this edition-

1. IAS preliminary exams conducted by Union Public Service Commission (UPSC) - 1993 to 2024
2. UPPCS, Lower Subordinate & UDA/LDA preliminary exams - 1990 to 2024 (General and Special exams) and UDA/LDA & RO/ARO exams 2010 to 2023, conducted by Uttar Pradesh Public Service Commission (UPPSC).
3. UPPCS Mains examination- from 2002 to 2017 and GIC- 2010 to 2017.
4. PCS and UDA/LDA pre. exams conducted by Uttarakhand Public Service Commission- from 2002 to 2016, PCS pre. 2010 to 2024 and Lower Subordinate (pre) 2010.
5. PCS Mains 2002 & 2006 and UDA/LDA Mains 2007 conducted by Uttarakhand Public Service Commission.
6. PCS pre. conducted by Madhya Pradesh Public Service Commission from 1990 to 2025.
7. Jharkhand PCS pre. 2003, 2011, 2013, 2016, 2021 and 2023.
8. Chhattisgarh PCS pre. - From 2003 to 2008 and from 2011 to 2024.

### CSAT General Studies Paper I Syllabus

1. Current Affairs: Events of national and international importance.
2. History of India and Indian National Movement.
3. Indian and World Geography - Physical, Social, Economic geography of India and the World.
4. Indian Polity and Governance – Constitution, Political System, Panchayati Raj, Public Policy, Rights, Issues, etc.
5. Economic and Social Development – Sustainable Development, Poverty, Inclusion, Demographics, Social Sector Initiatives, etc.
6. General issues on Environmental Ecology, Bio-diversity and Climate Change (no subject specialization required).
7. General Science.

**Note:** This is the syllabus of Union Public Service Commission and Uttar Pradesh Public Service Commission preliminary exams only. Other states (Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand etc.) Public Service Commissions have included their state related information as well in the syllabus.

9. Rajasthan PCS pre. - From 1993 to 2024.

10. Bihar PCS pre. - From 1992 to 2024 (including Re-exam of 2022 and 2024).

● Total 254 question papers of above exams have been included in this compilation. General Studies solutions can be presented in two ways-

1. Year-wise categorization of all examinations papers.

2. Chapter-wise categorization of all examinations paper.

We have opted for the second which is the toughest option for the benefit of aspirants so that all questions can be found as a question treasure. Presentation includes following process-

➔ **First Step-** collection of 254 General Studies MCQ question papers.

➔ **Second Step-** categorization of questions into 8 categories as per the new syllabus.

➔ **Third Step-** categorization of each category into chapters.

➔ **Fourth Step-** exclusion of repeated questions by mentioning the exams.

➔ **Fifth Step-** solution of all the questions with their detailed explanations. All the solutions are provided after referring the reference books and from prestigious subject matter experts/writers or from authenticated websites.

● This edition clearly explains the trend of MCQ questions in each chapter.

● Repeated questions from various examinations are specially highlighted in this edition.

● This compilation provides the most probable questions of upcoming examinations.

● All the questions have been clearly explained in detail with full authenticity.

● Questions of upcoming examinations can be easily accessed from the type of questions on each chapter.

Thus by adopting arduous and complicated process, a treasure of about 32,500 questions have been presented here. Considering the repetitiveness of the questions in various exams, this release will surely benefit the aspirants. Authenticity is our topmost priority so we have verified our solutions with experts multiple times. Nevertheless, if you disagree with any of them please write to us or call on 9335140296 from 12:00 PM (noon) to 8:00 PM (Monday to Friday). After verification process we will communicate with you accordingly.

सम-सामयिक



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# Question Paper Analysis

254 Multiple Choice Questions (MCQ) based question papers of General Studies of Union and State Public Service Commission preliminary and mains are integrated in this release. Detailed list of 254 question papers are as follows:

Exam	No. of Papers	No. of Ques.
IAS Pre exam 2011-2024	100 × 14	1400
IAS Pre exam 1993-2010	150 × 18	2700
UP PCS Pre exam 1998-2024	150 × 28	4200
UP PCS Pre exam 1990-1997	120 × 8	960
UP PCS Mains exam 2002-2003	150 × 2	300
UP PCS Mains exam (including special exams) 2004-2017	150 × 31	4650
UP PSCGIC exam 2010 and 2017	150 × 3	450
UP (UDA/LDA) Pre exam 2001-2006	150 × 3	450
UP (RO/ARO) Pre exam (General and Special exam) 2010-2018, 2021, 2023	140 × 9	1260
UP (UDA/LDA) Mains exam (General and Special exam) 2010-2021	120 × 7	840
UP Lower Subordinate Pre exam (General and Special exam) 1998-2009	100 × 11	1100
UP Lower Subordinate Pre exam (General and Special exam) 2013-2015	150 × 2	300
UP Lower Subordinate Mains exam (General and Special exam) 2013, 2015	120 × 2	240
UPPCS (RI) Pre Exam 2014	100 × 1	100
UP BEO Pre Exam 2019	120 × 1	120
Uttarakhand PCS Pre exam 2002-2024	150 × 9	1350
Uttarakhand (UDA/LDA) Pre exam 2007	150 × 1	150
Uttarakhand PCS Mains exam 2002 & 2006	150 × 2	300
Uttarakhand (UDA/LDA) Mains exam 2007	100 × 1	100
Uttarakhand Lower Subordinate Pre exam 2010	150 × 1	150
Madhya Pradesh PCS Pre exam 1990-2006	75 × 15	1125
Madhya Pradesh PCS Pre exam 2010	150 × 2	300
Madhya Pradesh PCS Pre exam 2012-2025	100 × 14	1400
Chhattisgarh PCS Pre exam 2003-2005	75 × 2	150
Chhattisgarh PCS Pre exam 2008 & 2013 -2024	100 × 13	1300
Chhattisgarh PCS Pre exam 2011	150 × 1	150
Rajasthan PCS Pre exam 1992	120 × 1	120
Rajasthan PCS Pre exam 1993-2012	100 × 11	1100
Rajasthan PCS Pre exam 2013, 2018, 2021 & 2024	150 × 7	1050
Bihar PCS Pre exam 1992-2024	150 × 25	3750
Jharkhand PCS Pre exam 2003-2011	100 × 2	200
Jharkhand PCS Pre exam 2013, 2016, 2021 & 2023	100 × 6	600
Jharkhand PCS Main exam 2016	80 × 1	80
<b>Total</b>	<b>254</b>	<b>32445</b>

After exclusion of repeated questions from above questions of 254 papers around 32,500 questions have been categorized as following:

- ✓ Current Affairs
- ✓ History of India and Indian National Movement
- ✓ Indian and World Geography
- ✓ Indian Polity and Governance
- ✓ Economic and Social Development
- ✓ General issues on Environmental Ecology
- ✓ General Science
- ✓ State Related Question

In this 9<sup>th</sup> edition of **PREVIEW** ( iwokZoyksdu ) series, we are presenting **General Science** in **7<sup>th</sup> section**. As per the new revised format, **4378** questions have been collected from **254** question papers of Union and States Civil Service Examinations. After elimination of **378** repetitive questions, **4000** questions have been included in this section. Repeated questions were given below the original questions so that our aspirants can analyze the trend of repetitive questions.

# I. Physics

## Measurement/Unit

### Notes

- A unit of measurement is a definite magnitude of a quantity, defined and adopted by convention or by law.
- It is used as a standard for measurement of the same kind of quantity.
- Any other quantity of that kind can be expressed as a multiple of the unit of measurement.
- To measure physical quantities four systems are in application as follows :

#### 1. CGS System (Centimetre - Gram - Second System) :

- It is a variant of the metric system based on the
  - Centimetre – unit of length
  - Gram – unit of mass
  - Second – unit of time

#### 2. FPS System (Foot - Pound - Second system) :

- It is also known as the British System of measurement.
- It relates to measuring –
  - Foot – unit of length
  - Pound – unit of mass
  - Second – unit of time

**Note :** 1 Pound is equal to 453.59 grams.

#### 3. MKS system (Metre - Kilogram - Second system) :

- It relates to measuring –
  - Metre – unit of length
  - Kilogram – unit of mass
  - Second – unit of time

#### 4. SI system (International System of Units) :

- It is the modern form of the metric system of measurement.
- It is the most widely used system of measurement.
- It was adopted during the conference on International Weight and Measures, held at Paris (France) in 1960.
- It has seven fundamental or base units.

### Details of Fundamental units :

S.No.	Physical Quantity	S.I. Unit	Abbreviation
1.	Length	Metre	m
2.	Mass	Kilogram	kg
3.	Time	Second	s
4.	Temperature	Kelvin	K
5.	Luminous Intensity	Candela	cd
6.	Electric Current	Ampere	A
7.	Amount of Substance	Mole	mol

### Definition of Units of SI System :

#### 1. Metre (m) :

- The path travelled by light in vacuum during a time interval of  $1/299,792,458$  second. It is defined by taking the fixed numerical value of the speed of light in vacuum 'c' to be  $299,792,458$  m/s.

#### 2. Kilogram (kg) :

- As per old definition, one kg is the mass of Platinum - Iridium prototype kept at Sevres (Paris). Generally, at  $4^{\circ}\text{C}$ , the mass of 1 litre pure water is 1 kilogram.

According to revised definition (which came into force on 20th May, 2019), **the kilogram** is now defined in terms of the Planck constant. It is defined by taking the fixed numerical value of the Planck constant 'h' to be  $6.62607015 \times 10^{-34}$  kg  $\text{m}^2/\text{s}$ . Thus,

$$1 \text{ kg} = \left( \frac{h}{6.62607015 \times 10^{-34}} \right) \text{m}^2 \text{s}$$

#### 3. Second (s) :

- One second equals the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the unperturbed ground state of Caesium (Cs-133) atom. It is defined by taking the fixed numerical value of the caesium frequency to be 9,192,631,770 Hz, which is equal to  $\text{s}^{-1}$ .

#### 4. Ampere :

- As per old definition; given two parallel, rectilinear conductors of negligible circular cross-section positioned 1 metre apart in vacuum, one ampere is the electric current which passes through both of them makes them attract each other by the force of  $2 \times 10^{-7}$  Newton per metre of length.

According to revised definition (which came into force on 20th May, 2019), **the ampere** is defined by taking the fixed numerical value of the elementary charge 'e' to be  $1.602176634 \times 10^{-19}$  As (ampere second). Thus, one ampere is the electric current corresponding to the flow of  $1/(1.602176634 \times 10^{-19})$  elementary charges per second.

#### 5. Kelvin :

- As per old definition, one kelvin equals 1/273.16 of the thermodynamic temperature of the triple point of water.

According to revised definition (which came into force on 20th May, 2019), **the kelvin** is defined by taking the fixed numerical value of the Boltzmann constant 'k' to be  $1.380649 \times 10^{-23}$  kg m<sup>2</sup>s<sup>-2</sup>K<sup>-1</sup>. Thus,

$$1 \text{ K} = \left( \frac{1.380649}{k} \right) \times 10^{-23} \text{ kg m}^2 \text{ s}^{-2}$$

That means one kelvin is equal to the change of thermodynamic temperature that results in a change of thermal energy  $kT$  by  $1.380649 \times 10^{-23}$  Joule (kgm<sup>2</sup>s<sup>-2</sup>).

#### 6. Candela (cd) :

- The candela is the luminous intensity in a given direction of a source that emits monochromatic radiation of frequency  $540 \times 10^{12}$  hertz and has a radiant intensity in that direction of 1/683 w/sr.

#### 7. Amount of Substance - Mole (mol) :

- As per old definition, one mole is the amount of substance composed of as many specified elementary units (molecules)/atoms as there are atoms in 0.012 kg of C-12.

According to revised definition (which came into force on 20th May, 2019), **the mole** is the amount of substance of a system that contains  $6.02214076 \times 10^{23}$  specified elementary entities. This number is the fixed numerical value of the Avogadro constant ' $N_A$ ', when expressed in the unit mol<sup>-1</sup> and is called the Avogadro number.

#### Derived units :

- These units of measurement are derived from the 7 base units, specified by the International System of Units.
- These are either dimensionless or can be expressed as a product of one or more of the base unit, possibly scaled by an appropriate power of exponentiation.
- Some of the coherent derived units in the SI are given special names. Below table lists 22 SI units with special names. Together with the seven base units, they form the core of the set of SI units. All other SI units are combinations of some of these 29 units.

**The 22 SI derived units with special names and symbols**

Derived quantity	Special name of unit	Unit expressed in terms of base units	Unit expressed in terms of other SI units
plane angle	radian	rad = m/m	-
solid angle	steradian	sr = m <sup>2</sup> /m <sup>2</sup>	-
frequency	hertz	Hz = s <sup>-1</sup>	-
force	newton	N = kg m s <sup>-2</sup>	-
pressure, stress	pascal	Pa = kg m <sup>-1</sup> s <sup>-2</sup>	-
energy, work, amount of heat	joule	J = kg m <sup>2</sup> s <sup>-2</sup>	N m
power, radiant flux	watt	W = kg m <sup>2</sup> s <sup>-3</sup>	J/s
electric charge	coulomb	C = A s	-
voltage/electric potential difference	volt	V = kg m <sup>2</sup> s <sup>-3</sup> A <sup>-1</sup>	W/A
capacitance	farad	F = kg <sup>-1</sup> m <sup>-2</sup> s <sup>4</sup> A <sup>2</sup>	C/V
electric resistance	ohm	W = kg m <sup>2</sup> s <sup>-3</sup> A <sup>-2</sup>	V/A
electric conductance	siemens	S = kg <sup>-1</sup> m <sup>-2</sup> s <sup>3</sup> A <sup>2</sup>	A/V
magnetic flux	weber	Wb = kg m <sup>2</sup> s <sup>-2</sup> A <sup>-1</sup>	V s

magnetic flux density	tesla	$T = \text{kg s}^{-2} \text{A}^{-1}$	$\text{Wb/m}^2$
inductance	henry	$H = \text{kg m}^2 \text{s}^{-2} \text{A}^{-2}$	$\text{Wb/A}$
Celsius temperature	degree Celsius	$^{\circ}\text{C} = \text{K}$	-
luminous flux	lumen	$\text{lm} = \text{cd sr}$	$\text{cd sr}$
illuminance	lux	$\text{lx} = \text{cd sr m}^{-2}$	$\text{lm/m}^2$
activity referred to a radionuclide	becquerel	$\text{Bq} = \text{s}^{-1}$	-
absorbed dose, kerma	gray	$\text{Gy} = \text{m}^2 \text{s}^{-2}$	$\text{J/kg}$
dose equivalent	sievert	$\text{Sv} = \text{m}^2 \text{s}^{-2}$	$\text{J/kg}$
catalytic activity	katal	$\text{kat} = \text{mol s}^{-1}$	-

### Some derived units in the SI expressed in terms of base units

Derived quantity	Derived unit expressed in terms of base units
area	$\text{m}^2$
volume	$\text{m}^3$
speed, velocity	$\text{m s}^{-1}$
acceleration	$\text{m s}^{-2}$
wavenumber	$\text{m}^{-1}$
density, mass density	$\text{kg m}^{-3}$
surface density	$\text{kg m}^{-2}$
specific volume	$\text{m}^3 \text{kg}^{-1}$
current density	$\text{A m}^{-2}$
magnetic field strength	$\text{A m}^{-1}$
amount of substance concentration	$\text{mol m}^{-3}$
mass concentration	$\text{kg m}^{-3}$
luminance	$\text{cd m}^{-2}$

### Other measures of Length unit :

- i. 1 millimetre =  $10^{-3}$  metre
  - ii. 1 centimetre =  $10^{-2}$  metre
  - iii. 1 kilometre = 1000 metre
  - iv. 1 Angstrom ( $\text{\AA}$ ) =  $10^{-10}$  metre
- A unit of length to measure very small distances like wavelength, atomic and ionic radius or size of molecules and spacing between planes of atoms in crystals.
- v. **Nanometre** –
    - 1 nanometre is one billionth of a metre, equal to  $10^{-9}$  metre.
    - It is used to measure extremely small objects such as atomic structures or transistors found in modern CPUs.
  - vi. **Micron** –
    - It is the previous name of micrometre.
    - 1 micron is equal to  $10^{-6}$  m.
    - It is represented by ( $\mu$ ).
    - It is used to measure cell size.
  - vii. **Astronomical Unit** –
    - Astronomical unit is usually used to measure distances within our solar system.

- An astronomical unit (AU) is the average distance between Earth and Sun.
- It equals to approximately 150 million kilometre or  $1 \text{ AU} = 1.496 \times 10^{11}$  metre.

### viii. Light-year –

- A light-year is a distance that light travels in vacuum in one Julian year.
- It is a unit of length used to express astronomical distances.
- 1 light-year is equal to  $= 3 \times 10^8 \text{ m/s} \times 365.25 \times 24 \times 60 \times 60 \text{ s}$   
 $= 9.461 \times 10^{15}$  metre.
- Julian year : In Astronomy, a Julian year is a unit of measurement of time defined as exactly 365.25 days of 86400 SI seconds each.

### ix. Parsec –

- A Parsec is an astronomical term used to measure large distances to astronomical objects outside the solar system.
- A Parsec is defined as the distance at which one astronomical unit subtends an angle of one arcsecond, which corresponds to  $648000/\pi$  astronomical units.
- 1 Parsec is equal to  $3.0857 \times 10^{16}$  metre, or
- 1 Parsec is equal to 3.262 light-years.

## Question Bank

### 1. In the following which is fundamental physical quantity?

- (a) Force (b) Velocity  
(c) Electric current (d) Work  
(e) None of the above/More than one of the above

66<sup>th</sup> B.P.S.C. (Pre) (Re. Exam) 2020

Ans. (c)

In physics, there are seven fundamental physical quantities (which are measured in base or fundamental units) : length, mass, time, electric current, temperature, luminous intensity and amount of a substance.

### 2. The unit of power is –

- (a) Hertz (b) Volts  
(c) Watt (d) Neutron

U.P.P.S.C. (GIC) 2010

Ans. (c)

In physics, power is the rate of doing work or of transferring heat or electrical energy i.e. the amount of energy transferred or converted per unit time.

$$\text{Power (P)} = \frac{\text{Work (w)}}{\text{Time (t)}}$$

The SI unit of power is watt, which is equal to joule per second. Power is always represented in watt (W) or Kilowatt (KW).

**3. The unit of electric power is :**

- (a) Ampere (b) Volt  
(c) Coulomb (d) Watt  
(e) None of the above / More than one of the above

**65<sup>th</sup> B.P.S.C. (Pre) 2019**

**64<sup>th</sup> B.P.S. (Pre) 2018**

**Ans. (d)**

Electric power is the rate, per unit time, at which electrical energy is transferred by an electric circuit. The SI unit of electric power is watt. Ampere is the unit of electric current, volt is the unit of electrical potential and coulomb is the unit of electric charge in the SI system.

**4. The unit of the force is –**

- (a) Faraday (b) Fermi  
(c) Newton (d) Rutherford

**M.P.P.C.S. (Pre) 1990**

**Ans. (c)**

The SI unit of Force is 'Newton' or kg.m/sec<sup>2</sup>.

Force = mass × acceleration

In physics, something that causes a change in the motion of an object is called force. The modern definition of force (an object's mass multiplied by its acceleration) was given by Isaac Newton in his laws of motion.

**5. The unit of work is :**

- (a) Joule (b) Neutron  
(c) Watt (d) Dyne

**U.P.P.C.S. (Pre) 1996**

**Ans. (a)**

When a force acts to move an object, then work done by the force is equivalent to the product of force and displacement in the direction of force. It is a scalar quantity. The SI unit of work is Newton metre, which is also called as joule. Joule is also the unit of Energy.

**6. Frequency is measured in :**

- (a) hertz (b) metre/second  
(c) radian (d) watt  
(e) None of the above / More than one of the above

**64<sup>th</sup> B.P. S.C. (Pre) 2018**

**Ans. (a)**

The Hertz (symbol : Hz) is the derived unit of frequency in the International System of Units (SI system) and is defined as one cycle per second.

**7. What is measured in hertz?**

- (a) Frequency (b) Energy  
(c) Heat (d) Quality  
(e) None of the above/More than one of the above

**65<sup>th</sup> B.P.S.C. (Pre) 2019**

**Ans. (a)**

See the explanation of above question.

**8. The term GHz is the indicator of which feature of the computer?**

- (a) Number of Pixels (b) Resolution  
(c) Speed (d) Storage

**Uttarakhand P.C.S. (Pre) 2024**

**Ans. (c)**

GHz stands for gigahertz, which is a unit of frequency in the International System of Units (SI). It's equal to one billion hertz and is used to measure how quickly an electronic device operates. When it comes to computers, GHz measures the speed at which electronic components process instructions from software. The term GHz (gigahertz) primarily indicates the clock speed or processing speed of a computer's central processing unit (CPU) i.e. the number of cycles CPU executes per second.

**9. The SI unit of electrical resistivity of conductor is –**

- (a) Faraday (b) Volts  
(c) Ampere (d) Ohm

**M.P.P.C.S. (Pre) 1993**

**Ans. (\*)**

Electrical resistivity is an intrinsic property that quantifies how strongly a given material opposes the flow of electric current. A low resistivity indicates a material, that readily allows the movement of electric charge. The SI unit of electrical resistivity is ohm-meter ( $\Omega\text{m}$ ). It is commonly represented by the –

Greek letter  $\rho$  (rho) defined as  $\left[ \rho = \frac{RA}{l} \right]$

Here,

R = electrical resistance of the material

l = Length, A = Cross section area,  $\rho$  = resistivity

As per other options, Faraday is the SI unit of Capacitance, Volt is the SI unit of Electric Potential, Ampere is the SI unit of Electric Current while Ohm is the SI unit of Electrical Resistance (not resistivity).

10. 'Ohm-meter' is unit of :

- (a) Resistance (b) Conductance  
(c) Resistivity (d) Charge  
(e) None of the above/More than one of the above

66<sup>th</sup> B.P.S.C. (Pre) (Re. Exam) 2020

Ans. (c)

See the explanation of above question.

11. What is the unit of measure of magnetic field?

- (a) Cobalt (b) Ampere  
(c) Ohm (d) Tesla

70<sup>th</sup> B.P.S.C. (Pre) (Re-Exam) 2024

Ans. (d)

A magnetic field (sometimes called B-field) is a physical field that describes the magnetic influence on moving electric charges, electric currents, and magnetic materials.

In electromagnetics, the term magnetic field is used for two distinct but closely related vector fields denoted by the symbols **B** and **H**. In the International System of Units (SI), the unit of **B**, magnetic flux density (also called magnetic B-field), is the tesla (Symbol : T; in SI base units : kilogram per second squared per ampere), which is equivalent to newton per ampere-meter. The unit of **H**, magnetic field strength, is ampere per meter (A/m). B and H differ in how they take the medium and/or magnetization into account.

12. Which of the following is equivalent to tesla ?

- (a) Ampere per Newton  
(b) Newton per coulomb  
(c) Newton per ampere-second  
(d) Newton per ampere-meter

70<sup>th</sup> B.P.S.C. (Pre) 2024

Ans. (d)

The tesla (symbol : T) is the standard unit of magnetic flux density (also known as magnetic induction or magnetic B-field) in the International System of Units (SI). One tesla is equal to one weber per square meter (1 Wb/m<sup>2</sup>) or one Newton per ampere-meter (1N/amp.m). The unit is named after Nikola Tesla, a Serbian-American inventor and electrical engineer.

13. Which of the following pairs is NOT correctly matched?

- | Quantity                               |   | S.I. Unit |
|--|---|-----------|
| (a) Power of lense                     | – | Diopter   |
| (b) Pressure                           | – | Pascal    |
| (c) Activity of radio-active substance | – | Curie     |
| (d) Heat                               | – | Joule     |

U.P. P.C.S. (Pre) 2022

Ans. (c)

Unit of radioactivity is defined as the activity of a quantity of radioactive material where one decay takes place per second. The SI unit of radioactivity is becquerel (Bq) and this term is named after Henri Becquerel. Curie (Ci) is the old U.S. unit (non-S.I. unit) of radioactivity. Other pairs are correctly matched.

14. Light-year is the unit of –

- (a) Distance (b) Time  
(c) Speed of light (d) Intensity of light

U.P. U.D.A./L.D.A. (Pre) 2013

R.A.S./R.T.S. (Pre) 1997

M.P.P.C.S. (Pre) 2008

Jharkhand P.C.S. (Pre) 2013, 2023

66<sup>th</sup> B.P.S.C. (Pre) (Re. Exam) 2020

66<sup>th</sup> B.P.S.C. (Pre) 2020

Ans. (a)

Light-year is a unit of astronomical distance equivalent to the distance that light travels in one year, which is  $9.46 \times 10^{15}$  metres.

15. A light-year is the –

- (a) Year which had maximum sunlight  
(b) Year in which workload was very light  
(c) Distance travelled by light in one year  
(d) Mean distance between Sun and Earth

U.P. Lower Sub. (Mains) 2013

Ans. (c)

See the explanation of above question.

16. 'Light-Year' is –

- (a) The year in which February has 29 days  
(b) The distance travelled by light in one year  
(c) The time which sun rays take to reach the earth  
(d) The time in which a spacecraft reaches moon from the earth

U.P. U.D.A./L.D.A. (Pre) 2010

Ans. (b)

See the explanation of above question.

17. Which one of the following is a reason why astronomical distances are measured in light-years?

- (a) Distances among stellar bodies do not change  
(b) Gravity of stellar bodies does not change  
(c) Light always travels in straight line  
(d) Speed of light is always same

I.A.S. (Pre) 2021

Ans. (d)

A light-year is the distance a beam of light travels in a vacuum in one Julian year. The speed of light is constant in a vacuum (not even affected by gravity). And that is where all the stellar bodies are present, in a vacuum. The speed of light is constant throughout the universe and is known to high precision. That is why all astronomical distances are measured in light-years. One light-year is equal to  $9.461 \times 10^{15}$  metre.

# II. Chemistry

## Atomic Structure

### Notes

#### Kanad (कणाद) :

- Kanad, also known as Kashyap, Uluka and Kanabhuk, was an Indian natural scientist and Philosopher, who founded the **Vaishesika School of Indian Philosophy**.
- Estimated to have lived sometimes between 6th century to 2nd century BC, little is known about his life. He is known for developing the foundation of an atomistic approach of the universe.
- He suggested that everything can be subdivided, but this subdivision can not go on forever and there must be smallest entities (Parmanu) that cannot be divided, that are eternal, that aggregate in different ways to yield complex substances and bodies with unique identity, a process that involves heat and this is the basis for all material existence.

#### Dalton's Atomic Theory :

- In the beginning of 19th century, Dalton proposed that all matters are composed of atoms which are indivisible and indestructible building blocks.
- All atoms of an element are identical.
- Different elements have atoms of different size and mass.
- Atoms are neither created nor could be destroyed. This implies that during chemical reactions, no atoms are created or destroyed.
- Atoms of different elements combine in a fixed ratio to form compounds.
- The formation of new products (compounds) results from the rearrangements of existing atoms.

#### Drawbacks of Dalton's Atomic Theory –

- It was proved that an atom is not indivisible. An atom can be subdivided into electrons, protons and neutrons. But remember that atom is the tiniest particle that takes part in a chemical reaction.

#### Fundamental Particles of Atom :

##### (i) Electron-

- An electron is negatively charged sub-atomic particle.
- It can be either free (not attached to any atom) or bound to the nucleus of an atom.

- Electrons in atoms exist in spherical shells of various radii, representing energy levels.
- The charge on an electron is (-)  $1.6022 \times 10^{-19}$  coulomb.
- Its symbol is  $e^-$  or  $\beta^-$ .
- The electron has a mass that is approximately  $1/1837$  that of the proton or  $9.109 \times 10^{-31}$  kg.
- It was discovered by J.J. Thomson (1897).
- Atomic mass unit of the electron is 0.0005486.

##### (ii) Proton –

- A proton is a positively charged sub-atomic particle.
- Its symbol is p or  $p^+$ .
- The charge on a proton is (+)  $1.6022 \times 10^{-19}$  coulomb.
- Its weight is  $1.6726 \times 10^{-27}$  kg.
- Its atomic mass unit is 1.00727.
- It was first discovered by Goldstein as anode rays (1886) and finally identified and named by Rutherford (1919).

**Note :** The number of electrons is equal to the number of protons in an atom with an equal charge of opposite nature. Hence the atom is neutral.

##### (iii) Neutron –

- It is a neutral sub-atomic particle so its name is neutron.
- It is represented by symbol n or  $n^0$ .
- Its mass is slightly larger than that of proton i.e 1.0087 amu.
- It was discovered by James Chadwick (1932).

**Note :** Atomic mass unit (amu) is defined as precisely  $1/12$  of the mass of an atom of Carbon-12.

#### Constitution of Atomic Nucleus :

- The atomic nucleus is the small, dense region consisting of proton and neutrons at the center of an atom.
- The proton & neutron jointly called nucleon.
- It was discovered by Ernest Rutherford (1911) based on the Geiger - Marsden gold foil experiment (1909).
- Protons and neutrons are bound together to form a nucleus by the nuclear force.

### Atomic Number (Z) :

- The symbol of atomic number (Z) is a conventional symbol possibly came from the German word Atomzahl which means atomic number.
- Atomic number of an element is the number of protons in the nucleus of its atom.
- It is the characteristic of a chemical element and determines its place in the periodic table.
- The atomic number of each element is certain and constant.
- Atoms of different elements are with different atomic number.
- The atomic number of Hydrogen is 1, it means it has one proton in its nucleus.

### Mass Number (A) :

- (A) has been derived from German word Atomge which means atomic weight.
- The total number of protons and neutrons in an atom's nucleus is known as its mass number.
- It determines the atomic mass of atoms.
- A mass number of atom = No. of protons + No. of neutrons in nucleus of an atom.
- It represents the total number of nucleons in the nucleus of an atom.
- The mass number is not a fundamental character of the element.
- An element may have atoms with different mass number.

### Atomic Weight :

- The atomic weight of an atom is approximately equal to its mass number.

Atomic weight  $\approx$  Mass number (A)

Atomic weight  $\approx$  No. of protons in nucleus + No. of neutrons in the nucleus.

### Isoelectronic :

- The ions and atoms with an equal number of electrons are known as isoelectronic.
- The electronic configuration of these ions and atoms are the same. For example –
  - a. Ne  $\rightarrow$  2,8
  - b. Na<sup>+</sup>  $\rightarrow$  2,8
  - c. Mg<sup>++</sup>  $\rightarrow$  2,8
  - d. F<sup>-</sup>  $\rightarrow$  2,8(Each ion/atom with same electronic configuration of 10 electrons)

### Isotopes :

- Isotopes are atoms of a chemical element that have the same atomic number but are with different atomic mass.
- The place of isotopes is same in the periodic table as they have the same atomic number.

### Isotopes of Hydrogen (three isotopes) –

Isotope	No. of protons/ Atomic Number	No. of neutrons	Atomic Mass
Protium ( ${}_1\text{H}^1$ )	1	0	1
Deuterium ( ${}_1\text{H}^2$ )	1	1	2
Tritium ( ${}_1\text{H}^3$ )	1	2	3

**Isotopes of oxygen**– There are three isotopes of oxygen viz.  ${}_8\text{O}^{16}$ ,  ${}_8\text{O}^{17}$ ,  ${}_8\text{O}^{18}$ .

### Isobars :

- Isobars are atoms of different chemical elements having the same number of nucleons (Atomic mass), but their atomic numbers are different.  
Example –  ${}_1\text{H}^3$  &  ${}_2\text{He}^3$
- The place of isobars is different in the periodic table because their atomic number differs.

### Isoeutronic or Isotones :

- Different element's atom with the same number of neutrons are called Iseutronic or Isotones.  
Example –
  - a.  ${}_1\text{H}^3$  and  ${}_2\text{He}^4$  – Both have same number of neutrons i.e. 2 neutrons.
  - b.  ${}_{14}\text{Si}^{30}$ ,  ${}_{15}\text{P}^{31}$ ,  ${}_{16}\text{S}^{32}$  – All with the same number of neutrons i.e. 16 neutrons.
  - c.  ${}_6\text{C}^{13}$ ,  ${}_7\text{N}^{14}$  – both have the same number of neutrons i.e. 7 neutrons.

### Radioactivity :

- Radioactivity is a natural phenomenon which occurs in unstable elements.
- These elements have spontaneous disintegration character.
- Such elements are called radioactive substances.
- $\alpha$ ,  $\beta$  &  $\gamma$  rays are emitted from the atoms of radioactive substances. These are known as radioactive rays.
- Radioactivity is a nuclear reaction, not a chemical reaction.
- It was discovered by Henry Becquerel in Uranium.
- In 1898 Marie Curie and her husband Pierre Curie discovered a radioactive element Polonium.
- In 1902, Marie Curie discovered Radium from the ore of uranium Pitch Blend ( $\text{U}_3\text{O}_8$ ).

### Difference between alpha, beta & gamma rays

S.N.	Character	$\alpha$ -Rays	$\beta$ -Rays	$\gamma$ -Rays
1.	Nature	(i) These are nuclei of helium. (ii) These are with two units of positive charge. (iii) Its mass is equal to the atomic mass of nucleus of helium atom (4 amu). (iv) It is represented by ${}_2\text{He}^{4++}$ , $\alpha^{++}$ or $\alpha$ .	(i) These are fast-moving electrons. (ii) They carry negative charge. (iii) Its weight is 0.0005486 amu. (iv) It is represented by $-\beta^0$ or ${}_{-1}e^0$ .	(i) These are electromagnetic radiations. (ii) These are neutral in nature.
2.	Velocity	Velocity of alpha ( $\alpha$ ) rays is approximately equal to 1/10th of the velocity of light.	Velocity of beta ( $\beta$ ) rays is approximately equal to the velocity of light.	Velocity of gamma ( $\gamma$ ) rays is equal to the velocity of light.
3.	Penetrating Power	Penetrating power is very low. These can penetrate 0.002 cm thick Aluminium sheet.	Penetrating power is much greater than alpha rays due to their high speed. These can penetrate 0.2 cm. thick Aluminium sheet.	Due to non - material nature (Electromagnetic radiation) and very high speed the penetrating power of these rays are greater. These rays can penetrate 100 cm thick Aluminium sheet.
4.	Ionising Power	$\alpha$ -rays have very high power to ionize gases.	$\beta$ -rays ionise gases to lesser extent. 100 times less than $\alpha$ -rays.	These are weak ionizer of gases. 100 times less than $\beta$ -rays.
5.	Effect of electric and magnetic field	$\alpha$ -rays are deflected towards negative charged plate. $\alpha$ -rays are also deflected in magnetic field.	$\beta$ -rays are deflected towards positive charged plate. $\beta$ -rays are also deflected in magnetic field.	$\gamma$ -rays are not deflected in electric and magnetic fields.

### Question Bank

#### 1. Who is regarded as the Father of Modern Chemistry?

- Rutherford
- Einstein
- Lavoisier
- C.V. Raman
- None of the above/More than one of the above

Ans. (c)

French nobleman and chemist Antoine Lavoisier is regarded as the 'Father of Modern Chemistry'. Lavoisier is most noted for his discovery of the role oxygen plays in combustion. He recognized and named oxygen (1778) and hydrogen (1783), wrote the first extensive list of elements and helped to reform chemical nomenclature.

#### 2. Dalton's atomic theory successfully explained :

- Law of conservation of mass.
  - Law of constant composition.
  - Law of radioactivity.
  - Law of multiple proportion.
- (a) (ii), (iii) and (iv)                      (b) (i), (ii) and (iii)  
(c) (i), (ii) and (iv)                        (d) (i), (iii) and (iv)

**70<sup>th</sup> B.P.S.C. (Pre) 2024**

Ans. (c)

John Dalton's atomic theory states that all matter is made of atoms, which are indivisible particles. Dalton's theory was based on experiments and observations of gases. Postulates of Dalton's atomic theory are as follows :

- All matter is made of atoms.
- Atoms of the same element are identical in size, mass, and other properties.

- Atoms of different elements differ in size, mass, and other properties.
- Atoms cannot be created or destroyed.
- Compounds are formed when two or more different types of atoms combine.
- A chemical reaction is a rearrangement of atoms.

Dalton's theory provided a scientific basis for understanding why elements combine in certain proportions to form compounds. It also explained the law of constant composition, conservation of mass, and the law of multiple proportions.

**3. Who was the first one to propose a model for the structure of an atom ?**

- (a) E. Goldstein                      (b) Rutherford  
(c) Neils Bohr                        (d) J.J. Thomson

**70<sup>th</sup> B.P.S.C. (Pre) 2024**

**Ans. (d)**

J.J. Thomson was the first scientist to propose a model for the structure of an atom, suggesting a positively charged sphere with negatively charged electrons embedded within it, often referred to as the 'plum pudding' model. Thomson's model, proposed in the late 19<sup>th</sup> century, envisioned the atom as a sphere of positive charge with negatively charged electrons scattered throughout, similar to plums in a pudding. Thomson's model was a direct result of his discovery of the electron, a subatomic particle with a negative charge, which challenged the previous understanding of the atom as a fundamental, indivisible unit. Thomson's model was later superseded by more sophisticated models, such as Rutherford's nuclear model (with a positively charged nucleus and orbiting electrons), and then Bohr's model, which introduced the concept of quantized energy levels.

**4. The positively charged part at the centre of an atom is called as :**

- (a) Proton                                (b) Neutron  
(c) Electron                              (d) Nucleus  
(e) None of the above/More than one of the above

**63<sup>rd</sup> B.P.S.C. (Pre) 2017**

**Ans. (d)**

The positively charged part at the centre of an atom is called as nucleus. The atomic nucleus is the small, dense region consisting of proton and neutron at the centre of an atom.

**5. Constituents of atomic nucleus are –**

- (a) Electron and proton  
(b) Electron and neutron

- (c) Proton and neutron  
(d) Proton, neutron and electron

**U.P. P.C.S. (Pre) 1996**

**41<sup>st</sup> B.P.S.C. (Pre) 1996**

**43<sup>rd</sup> B.P.S.C. (Pre) 1999**

**Ans. (c)**

The constituents of an atom are protons, neutrons and electrons. The protons and neutrons (nucleons) are found in the nucleus of atoms. The nucleus of an atom is surrounded by electrons.

**6. The nucleus of an atom consists of :**

- (a) electrons and neutrons    (b) electrons and protons  
(c) protons and neutrons    (d) electrons only  
(e) None of the above/More than one of the above

**67<sup>th</sup> B.P.S.C. (Pre) (Re. Exam) 2022**

**Ans. (c)**

See the explanation of above question.

**7. Which among the following is an incorrect option?**

- (a) Atom is electrically neutral due to presence of protons and electrons inside the nucleus.  
(b) Electrons are negatively charged and have negligible mass.  
(c) Atomic number is the number of protons in an atom of an element.  
(d) Isotopes are useful as nuclear fuel, in medical field, in carbon dating, etc.  
(e) None of the above/More than one of the above

**67<sup>th</sup> B.P.S.C. (Pre) 2022**

**Ans. (a)**

An atom consists of a positively charged nucleus, surrounded by one or more negatively charged particles called electrons. The atomic nucleus consists of protons and neutrons while electrons revolve around the nucleus. The positive charges in an atom equal the negative charges, so the atom has no overall charge, it is electrically neutral. Statements of options (b), (c) and (d) are correct.

**8. Which of the following statement about molecular structure is correct :**

- (a) Neutron and electron are found inside the nucleus and protons revolves around the nucleus.  
(b) Electron and proton are inside the nucleus and neutron revolve around the nucleus.

# III. Biology

## Subdivisions of Biology

### Notes

- The word 'Science' comes from the Latin word 'scientia', meaning 'knowledge'.
- Science is the systematic knowledge of the physical or material world gained through observation and experimentation.
- Science has been classified into – (1) Natural Science and (2) Social Science.
- Natural Science has further classified into – (i) Physical Science and (ii) biological Science which has been further divided into many branches and sub-branches.
- **Lamarck** and **Treviranus** introduced the term '**biology**' independently in modern sense in 1802.

### Branches and Subbranches of Biology

**Zoology** – Detailed study of different living and extinct animals.

**Botany** – Detailed study of plants and their life.

**Palaeontology** – The study of history of life on Earth as based on fossils. Fossils are the remains of plants, animals, fungi, bacteria and single celled living things that have been found in layers of rock materials or impressions of organisms preserved in rocks.

**Palaeobotany** – Study of plant fossils.

**Ecology** – The branch of biology that deals with the relation of organisms to one another and to their physical surroundings.

**Genetics** – The study of heredity or how the characteristics of living things are transmitted from one generation to the next. Every living thing contains the genetic material that makes up DNA molecule. This material is passed on when organism reproduces. The basic unit of heredity is '**Gene**'.

**Physiology** – Study of normal functions of living creatures and their parts.

**Pedology** – It is the study of soils in their natural environment. It deals with pedogenesis, soil morphology and soil classification.

**Edaphology** – It concerns with the influence of soils on living things, particularly plants.

**Gerontology** – Study of the social, cultural, physiological, cognitive, and biological aspects of ageing, or the scientific study of old age, the process of ageing and the particular problems of old people.

**Ethology** – It is the scientific and objective study of non-human animal behaviour usually with a focus on behaviour under natural conditions, and viewing behaviour as an evolutionary adaptive trait.

**Bionics** – It is the study of mechanical systems that function like living organisms or parts of living organisms. Bionics is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology. The word 'bionic' was coined by Jack E. Steele in 1958.

**Bionomics** – The study of the mode of life of organisms in their natural habitat and their adaptations to their surroundings. Bionomics is the comprehensive study of an organism and its relation to its environment. It is also referred as 'ecology'.

**Bionomy** – Branch of biology concerned with the laws of life.

**Biometry** – It is also known as biostatistics. It is the development and application of statistical and mathematical methods to analyse the data results from biological observations and phenomenon.

**Phrenology** – The detailed study of the shape and size of the cranium as a supposed indication of character and mental abilities.

**Anthology** – Study of flowers.

**Agrostology** – It deals with the scientific study of true grasses. It is also called **Graminology** – Scientific study of grasses (the family Poaceae or Gramineae).

**Palynology** – The study of pollen grains and other spores especially as found in archaeological or geological deposits. Pollen extracted from such deposits may be used for radiocarbon dating and for studying past climates and environments by identifying plants then growing.

**Oncology** – A branch of biology that deals with the prevention, diagnosis and treatment of tumours/cancer.

**Teratology** – The scientific study of congenital abnormalities and abnormal formations.

**Osteology** – It is the scientific and detailed study of the structure of bones, skeletal elements, teeth, microbone, morphology etc.

**Chondriology** – A branch of anatomy that deals with cartilage.

**Serology** – The scientific study or diagnostic examination of blood serum, especially with regard to the response of the immune system to pathogens or introduced substances.

**Pathology** – The science of the causes and effects of diseases, especially the branch of medicine that deals with the laboratory examination of samples of body tissue for diagnostic or forensic purposes.

**Parasitology** – Parasitology is the study of parasites (viruses, bacteria, fungus, worms, insects), their hosts and the relationship between them. Parasites are organisms that use other species of plants and animals as a host. The hosts provide the environment in which the parasite lives.

**Virology** – Virology is the study of viruses - submicroscopic, parasitic particles of genetic material contained in a protein coat and virus - like agents.

**Bacteriology** – Study of the morphology, ecology, genetics and biochemistry of bacteria as well as many other aspects related to them.

**Entomology** – A branch of zoology that deals with insects.

**Malacology** – Malacology is the branch of invertebrate zoology that deals with the study of the Mollusca, the second -largest phylum of animals in terms of described species after the arthropods. Molluscs include snails and slugs, clams, octopus, and squid (largest invertebrate) and numerous other kinds, many of which have shells made of calcium carbonate.

**Ichthyology** – Ichthyology, also known as fish science, is the branch of zoology that deals with fishes.

**Serpentology** – A branch of zoology that studies snakes.

**Herpetology** – Herpetology is the branch of zoology which deals with the study of reptiles and amphibians such as snakes, turtles, lizards, tortoises, crocodilians etc. It deals with their behaviour, geographic ranges, physiologies, development, genetics etc.

**Ornithology** – Ornithology is a branch of zoology that deals with the study of birds.

**Dermatology** – A branch of medicine concerned with the diagnosis and treatment of skin, nails and hair diseases.

**Trophology** – Study of nutrition. A nutritional approach that advocates specific combinations of foods as central to good health and weight loss.

**Cell biology** – Cell biology is a branch of biology that studies the structure and function of the cell, which is the basic unit of life.

**Histology** – The branch of biology dealing with the study of the microscopic structure of tissues.

**Embryology** – A branch of biology concerned with the study of embryos and their development.

**Phycology or Algology** – A branch of biology which deals with the scientific study of seaweeds and other algae.

**Mycology** – A branch of biology which deals with the scientific study of fungi.

**Lichenology** – It is the study of lichens, symbiotic organisms made up of an intimate symbiotic association of a microscopic alga (or a cyanobacterium) with a filamentous fungus (mycobiont).

### Main Terminologies and related by-products

**Apiculture** – The raising and care of bees for commercial (honey production) and agricultural purposes (cross pollination).

**Aviculture** – The breeding and rearing of birds.

**Aquaculture** – The rearing of aquatic animals or the cultivation of aquatic plants for food.

**Algaculture** – Algaculture is a form of aquaculture involving the farming of species of algae. Algae are used in wastewater treatment facilities, reducing the need for greater amounts of toxic chemicals. Algae can be used to capture fertilizers in run off from farms, when subsequently harvested, the enriched algae itself can be used as fertilizer. Microalgae are called phytoplanktons.

**Pisciculture** – The controlled breeding and rearing of fishes.

**Agriculture** – The science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool and other products.

**Sericulture** – The production of silk and the rearing of silkworms for this purpose.

**Silviculture** – Silviculture is the practice of controlling the growth, composition, health and quality of forests to meet diverse needs and values.

**Spongiculture** – The cultivation and growing of sponges.

**Horticulture** – Horticulture is the science and art of growing fruits, vegetables, flowers and crops like spices, condiments and other plantation crops.

**Floriculture** – Floriculture or flower farming, is a discipline of horticulture concerned with the cultivation of flowering and ornamental plants for gardens and for floristry, comprising the floral industry.

**Olericulture** – Olericulture is the science of vegetables growing, dealing with the culture of non-woody (herbaceous) plants for food.

**Arboriculture** – Cultivation of trees and shrubs.

**Pomology** – The science that deals with fruit and fruit growing.

**Agronomy** – A branch of agriculture dealing with crop production and soil management.

**Vermiculture** – The cultivation of earthworms, especially in order to use them to convert organic waste into fertilizer.

**Ostriculture** – The breeding of oysters for food and pearls.

**Heliculture** – It is also known as snail farming. It is the process of raising land snails especially for human use, either to use their flesh to eat or to obtain snail slime for use in cosmetics and snail eggs for human consumption as a type of caviar.

**Viticulture** – Cultivation and harvesting of grapes.

**Mariculture** – Mariculture is a specialized branch of aquaculture involving the cultivation of marine organisms (animal and plant) for food and other products.

**Moriculture** – Moriculture is the science of mulberry cultivation for silk production because silk worm (*Bombyx mori*) reared on it.

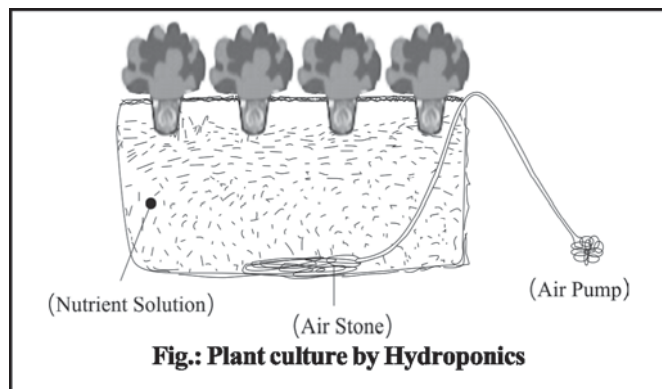
**Citriculture** – Cultivation of citrus fruit trees.

**Vegeculture** – The cultivation of vegetables, also the cultivation of plants, especially root crops, propagated by vegetative means.

**Aeroponics** – A plant-cultivation technique without soil, in which the roots hang suspended in the air while nutrient solution is delivered to them in the form of a fine mist.

**Aeroculture** – A method of growing plants without soil by suspending them above sprays that constantly moisten the roots with water and nutrients.

**Hydroponics** – It is a method of growing plants without soil by instead of using mineral nutrient solutions in a water solvent (see fig.).



## Question Bank

### 1. Study of Zoology deals with :

- (a) Living animals only
- (b) Living plants only
- (c) Both living and dead animals
- (d) Both living and dead plants

U.P.P.C.S. (Pre) 1995

Ans. (c)

Zoology is a branch of biology. It deals with the study of both living and extinct animals including their structure, embryology, evolution, classification, habits, and distribution. Aristotle is known as 'Father of Zoology'.

### 2. Match the following List-I to List-II and by using the given codes in below list. Choose the correct answer.

List -I	List- II
<b>A. Birds</b>	<b>1. Palaeobiology</b>
<b>B. Inheritance</b>	<b>2. Ecology</b>
<b>C. Environment</b>	<b>3. Ornithology</b>
<b>D. Fossil</b>	<b>4. Genetics</b>

Code :

	A	B	C	D
(a)	1	3	4	2
(b)	3	4	2	1
(c)	4	2	1	3
(d)	2	4	1	3

U.P. Lower Sub. (Pre) 1998

Ans. (b)

The correctly matched order is given below :

Study of Birds	–	Ornithology
Study of Inheritance	–	Genetics
Study of Environment	–	Ecology
Study of Plant Fossils	–	Palaeobiology

### 3. The study of the flower is known as :

- (a) Phrenology
- (b) Anthology
- (c) Agrostology
- (d) Palynology

Jharkhand P.C.S. (Pre) 2003

Ans. (b)

Phrenology	–	Study of human skull
Anthology	–	Study of flowers
Agrostology	–	The study of grasses
Palynology	–	Study of pollen grains and other spores

4. The scientific study of insects is known as :

- (a) Ichthyology (b) Entomology  
(c) Parasitology (d) Malacology

Uttarakhand U.D.A./L.D.A. (Pre) 2003

Ans. (b)

Ichthyology – Study of fish  
Entomology – Scientific study of insects  
Parasitology – Study of parasitic organisms  
Malacology – Study of molluscs and its shells

5. Which of the following subjects of data set is associated with the study of concerning population and humanity?

- (a) Ecology (b) Genetics  
(c) Demography (d) Virology

U.P.P.C.S. (Pre) 1994

U.P.G.I.C2017

Ans. (c)

Ecology - Study of interrelationship between organisms and environment  
Genetics - Study of heredity and variation  
Demography - Statistical study of populations including human beings  
Virology - Study of viruses

6. The comparative study of the different cultures and the scientific explanation is known as–

- (a) Ethnology (b) Ethnography  
(c) Ethology (d) Ethics

R.A.S./R.T.S. (Pre) 1994

Ans. (a)

Ethnology – Science dealing with different races of mankind.  
Ethnography – A study of specific culture.  
Ethology – Study of the animal behaviour.  
Ethics – Study of ethical duties.

7. The study of properties and method of biological systems found in nature and use of this knowledge in mechanical world is known as-

- (a) Bionics (b) Bionomics  
(c) Bionomy (d) Biometry

R.A.S./R.T.S. (Pre) 1994

Ans. (a)

Bionics – Study of properties and method of biological systems found in nature and use of this knowledge in mechanical world.  
Bionomics – Comprehensive study of an organism and its relation to its environment.  
Bionomy – Study of laws of life  
Biometry – Statistical study of biological problem.

8. Under Palaeobotany, one studies –

- (a) Fossil of animals (b) Algae  
(c) Fungi (d) None of these

Uttarakhand P.C.S. (Pre) 2005

Ans. (d)

Palaeobotany is the branch of palaeontology or palaeobiology dealing with the recovery and identification of plant remains from geological contexts and their use for the biological reconstruction of past environments. In India, Prof. Birbal Sahni is known as Father of Indian Palaeobotany.

9. Rearing silk worms is known as –

- (a) Apiculture (b) Horticulture  
(c) Sericulture (d) Floriculture

Uttarakhand U.D.A./L.D.A. (Pre) 2003

Ans. (c)

Apiculture – Rearing bees  
Horticulture – Study of fruit and flower producing plants  
Sericulture – Rearing silk worm  
Floriculture – Study of flowers for decoration work

10. Honey bees are used in :

- (a) Sericulture (b) Tissue culture  
(c) Apiculture (d) Pisciculture

Uttarakhand P.C.S. (Mains) 2002

Ans. (c)

Honey bees are used in apiculture.

11. Which one of the following is not correctly matched?

- | Cultivation               | Nomenclature of Cultivation |
|---------------------------|-----------------------------|
| (a) Flower Cultivation    | – Floriculture              |
| (b) Crop Cultivation      | – Agronomy                  |
| (c) Vegetable Cultivation | – Horticulture              |
| (d) Fruit's Cultivation   | – Pomology                  |

U.P. Lower Sub. (Pre) 2015

Ans. (c)

Horticulture is a special branch of agriculture. Pomology, olericulture, and floriculture come under this branch. The name floriculture and pomology used in option (b) and (d) are of specific terminology. In option (c) the word horticulture has been used for the cultivation of vegetables. The specific terminology for cultivation of vegetables should be 'Olericulture'. If all the names used in the given options are considered in literal sense then option (c) is not correctly matched because the word olericulture should be used in place of horticulture. The word crop has a wide ranged vocabulary containing all types of crops like eatable, non-eatable and animal foods etc. Thus the word 'agronomy' correctly matched for crop cultivation.

**12. The study related to the plants being used as vegetable is called –**

- (a) Floriculture (b) Pomology  
(c) Horticulture (d) Olericulture

**Uttarakhand P.C.S. (Pre) 2010**

**Ans. (d)**

Olericulture is the science of vegetable growing, dealing with the culture of non-woody (herbaceous) plants for food.

**13. Which of the following is not correctly matched?**

- (a) Apiculture – Honey bee  
(b) Sericulture – Silkworm  
(c) Pisciculture – Insect of lakh  
(d) Horticulture – Flower

**U.P. Lower Sub. (Pre) 2004**

**Ans. (c)**

Pisciculture is related to the fish hatchery. Other options are correctly matched.

**14. Which of the following pairs is correctly matched? (word and meaning)**

- (a) Lexicography – Compilation of dictionary  
(b) Philology – Collection of postal stamps  
(c) Entomology – Study of human body  
(d) Iconography – Study of insects

**Chhattisgarh P.C.S. (Pre) 2008**

**Ans. (a)**

Lexicography – Compilation of dictionary  
Philology – Study of language structure and its history  
Entomology – Study of insects  
Iconography – Study of idols/arts etc.

**15. Lexicography is related to :**

- (a) Structure of human body  
(b) Compilation of dictionary  
(c) Secret of handwriting  
(d) Teaching of pictures & models.

**Jharkhand P.C.S. (Pre) 2003**

**Ans. (b)**

Lexicography is related to a glossary of language design, compilation, and evaluation of general dictionaries.

**16. Which one of the following is produced through viticulture :**

- (a) Silk (b) Earthworm  
(c) Honey (d) Grapes

**U.P.P.C.S. (Mains) 2003**

**Ans. (d)**

Viticulture is the science, production, and study of grapes. It deals with the series of events that occur in the vineyard.

**17. What is Vermiculture?**

- (a) The science of raising worms  
(b) The science of studying animals  
(c) The science of studying fishes  
(d) The science of killing worms

**56<sup>th</sup> to 59<sup>th</sup> B.P.S.C. (Pre) 2015**

**Ans. (a)**

Vermiculture is the process of managing and cultivating earthworms. Earthworms can help turning organic waste into nutrient-rich soil for your garden.

**18. In Vermiculture, the worm used is-**

- (a) Tapeworm (b) Silkworm  
(c) Threadworm (d) Earthworm

**U.P.P.C.S. (Mains) 2005**

**Ans. (d)**

See the explanation of above question.

**19. Genetics deals with-**

- (a) Mendel's laws (b) Organic evolution  
(c) DNA structure (d) Heredity and variations

**53<sup>rd</sup> to 55<sup>th</sup> B.P.S.C. (Pre) 2011**

**Ans. (d)**

Genetics is the study of genes, heredity and genetic variations in living organisms.

**20. The study of Gerontology, is related to which of the following?**

- (a) Child infant (b) Female  
(c) Disease of skin (d) Old age

**M.P.P.C.S. (Pre) 1993**

**Ans. (d)**

The scientific study of old age, the process of ageing and the particular problems of old people is called Gerontology.

**21. The branch of study dealing with old age and ageing is called**

- (a) Oncology (b) Gerontology  
(c) Teratology (d) Ornithology

**U.P. Lower Sub. (Pre) 2008**

**Ans. (b)**

Gerontology is the study of the social, psychological, cognitive and biological aspects of ageing. Oncology is the branch of medical science that deals in treating people suffering from cancer. Teratology is the study of abnormalities of physiological development. Ornithology is a branch of zoology that is related to the study of birds.

22. The study of ageing is known as –  
 (a) Gerontology (b) Ethnology  
 (c) Anthropology (d) Thanatology  
 U.P.P.C.S. (Mains) 2014

Ans. (a)

See the explanation of above question.

23. Pedology is the science related to the study of :  
 (a) Atmosphere (b) Soil  
 (c) Pollutants (d) Seeds  
 R.A.S./R.T.S. (Pre) 1999

Ans. (b)

Pedology deals with the study of soil formation, soil morphology, and soil classification.

24. Study of bones, are under which branch of science?  
 (a) Osteology (b) Orology  
 (c) Serology (d) Geology  
 U.P.P.C.S. (Pre) 1990

Ans. (a)

Osteology	–	Study of bones
Orology	–	Study of mountains
Serology	–	Study of serum
Geology	–	Study of internal structure of the earth and matter found inside it

25. The study of bones is done under the branch of science called  
 (a) Geology (b) Serology  
 (c) Orology (d) Osteology  
 (e) None of the above/More than one of the above  
 65<sup>th</sup> B.P.S.C. (Pre) 2019

Ans. (d)

See the explanation of above question.

26. The study of snakes is known as :  
 (a) Serpentology (b) Ornithology  
 (c) Herpetology (d) Ichthyology  
 Uttarakhand P.C.S. (Mains) 2002

Ans. (a)

Serpentology is a branch of Zoology, which deals with the study of snakes. Ornithology is a branch of Zoology that deals with the study of birds. Herpetology is the branch of Zoology related to the study of amphibians (including frogs, toads, salamanders, newts and Gymnophiona) and reptiles (including snakes, lizards, turtles, terrapins, tortoises, crocodilians and the tuataras). Ichthyology also known as fish science, is the branch of biology devoted to the study of fish.

27. Find out the odd one out from the following :  
 (a) Physiology (b) Psychology  
 (c) Pathology (d) Bacteriology  
 Uttarakhand U.D.A./L.D.A. (Pre) 2007

Ans. (b)

Physiology, Pathology, and Bacteriology are the branches of biology, whereas Psychology is the study of mind and behaviour and is different from the other three.

28. What is hydroponics?  
 (a) Growing plant without soil  
 (b) Grafting plant  
 (c) Study of vegetables  
 (d) Soil conservation  
 U.P.P.C.S. (Mains) 2009

Ans. (a)

Hydroponics is a subset of hydroculture and is a method of growing plant using mineral nutrients solutions in water without soil.

## Evolution of Life

### Notes

- Earth formed around 4.54 billion years ago, approximately at one-third of the age of universe by accretion from the solar nebula.
- Several theories/postulations have been propounded in reference to the origin of life on Earth, but most accepted theory among them is the 'Oparin-Haldane Theory'.

#### **Oparin-Haldane Theory of Origin of Life :**

- According to this theory life originated on early Earth through physico-chemical processes of atoms combining to form molecules, which in turn reacting to produce inorganic and organic compounds. Organic compounds interacted to produce all types of macromolecules which organized to form the first living system or cells.
- Thus, according to this theory 'life' originated upon our Earth spontaneously from non-living matter. First inorganic compounds and then organic compounds were formed in accordance with ever-changing environmental conditions. This is called chemical evolution which cannot occur under present environmental conditions upon Earth. Conditions suitable for origin of life existed only upon primitive Earth.

- Hypothesis given by Oparin about origin of life is also known as Materialistic Theory which was published in his book '**Origin of Life**'.
- Modern views regarding the origin of life include both chemical evolution and biological or organic evolution.

### A. Chemical Evolution (Chemogeny) :

#### 1. The Atomic Phase :

- Early Earth had innumerable atoms of all those elements (e.g. hydrogen, oxygen, carbon, nitrogen, sulphur, phosphorus) which are essential for the formation of protoplasm. Atoms were segregated in three concentric masses according to their weight -
- (a) The heaviest atoms of iron, nickel, copper, etc. were collected in the centre of the Earth.
  - (b) Medium weight atoms of sodium, potassium, silicon, magnesium, aluminium, phosphorus, chlorine, fluorine, sulphur etc. were collected in the core of the Earth.
  - (c) The lighter atoms of nitrogen, hydrogen, oxygen, carbon etc. formed the primitive atmosphere.

#### 2. Formation of Inorganic Molecules :

- Free atoms combined to form inorganic molecules such as H<sub>2</sub> (hydrogen), N<sub>2</sub> (nitrogen), H<sub>2</sub>O (water vapour), CH<sub>4</sub> (methane), NH<sub>3</sub> (ammonia), CO<sub>2</sub> (carbon dioxide), etc. Hydrogen atoms were most numerous and most reactive in primitive atmosphere.
- Hydrogen atoms also combined with nitrogen forming ammonia (NH<sub>3</sub>). So the water and ammonia were probably the first inorganic molecules of primitive Earth.

#### 3. Formation of Simple Organic Molecules (Monomers) :

- The early inorganic molecules interacted and produced simple organic molecules such as simple sugars (e.g. ribose, deoxyribose, glucose etc.), nitrogenous bases (e.g. purines, pyrimidines), amino acids, glycerol, fatty acids etc.
- Terrestrial rains must have fallen. As the water rushed down, it must have dissolved away and carried with it salts and minerals, and ultimately accumulated in the form of oceans. Thus ancient oceanic water contained large amounts of dissolved NH<sub>3</sub>, CH<sub>4</sub>, HCN, nitrides, carbides as well as various gases and elements.
- Some external sources must have been acting on the mixture for reactions. These external sources might be (i) solar radiations such as ultraviolet rays (UV rays), X-rays etc., (ii) energy from electrical discharges like lightning, (iii) high energy radiations are other sources of energies (probably unstable isotopes on primitive Earth).

There was no Ozone layer at that time in the atmosphere.

- A soup like broth of chemicals formed in oceans of the early Earth, from which living cells are believed to have appeared, was termed by Haldane as **prebiotic soup**, also called hot dilute soup. Thus the stage was set for combination of various chemical elements. Once formed, the organic molecules accumulated in water, because their degradation was extremely slow in absence of any life or enzyme catalysts.
- The formed molecules accumulated in ocean bounded by a covering forming coacervates which have the capacity to self-replication.

### Experimental evidence for Abiogenetic Molecular Evolution of Life :

- **Stanley Miller** in 1953, who was then a graduate student of **Harold Urey** at the University of Chicago, demonstrated it clearly that ultraviolet radiation or electrical discharges or heat or combination of these can produce complex organic compounds from a mixture of methane, ammonia, water and hydrogen. The ratio of methane, ammonia and hydrogen in Miller's experiment was 2 : 1 : 2.
- Miller circulated four gases : methane, ammonia, hydrogen and water vapour in an airtight apparatus and passed electrical discharges in it from electrodes at 800°C. Then he passed the mixture through a condenser.
- He circulated the gases continuously in this way for one week and then analysed the chemical composition of the liquid inside the apparatus. He found a large number of simple organic compounds including some amino acids such as alanine, glycine and aspartic acid.
- Miller conducted the experiment to test the idea that organic molecules could be synthesized in a reducing environment.
- It is considered that the essential building blocks such as nucleotides, amino acids etc. of living organisms could thus have formed on the primitive Earth.
- Early life on Earth formed around 4.0 billion years ago.
- Membrane bound prokaryotes originated around 3.8 billion years ago, which were previously **heterotrophs** and later on became **autotrophs**. Autotrophs were just like the blue-green algae of modern period.
- Approximately 2.0 billion years ago eukaryotic cells were formed, from which all the organisms (except bacteria) of our planet evolved.



# घटना चक्र



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