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# VIDYASTRA

## PRELIMS SHORT NOTES

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**1979-2024 PYQ ANALYSIS**

**LOGICAL ELIMINATION TECHNIQUES**

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19. Consider the following plants :

1. Groundnut
2. Horse-gram
3. Soybean

How many of the above belong to the pea family?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

2024



PYQs asked by UPSC since 1979 on this theme

44. Consider the following crops of India :

2012

1. Cowpea
2. Green gram
3. Pigeon pea

Which of the above is/are used as pulse, fodder and green manure?

- (a) 1 and 2 only
- (b) 2 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

109. Which one of the following crops enriches the nitrogen content in soil?

1994

- (a) Potato
- (b) Sorghum
- (c) Sunflower
- (d) Pea

3. Which one of the following plants can fix nitrogen from air?

- (a) Rice
- (b) Wheat
- (c) Pea
- (d) Maize

1992



Source used by UPSC for this Question

Source: **Vidyastra Notes**, Article in **The Hindu**

Theme: Vegetation

Current Linkage: [Gujarat to start procurement of groundnut, other crops in October](#)



Solve with Logic and Minimal prior Knowledge

This is a fairly easy question if you know that **Pea family simply means Legume family**. All the given plants as we know are Leguminous, making (c) as the correct answer.



Explanation and Additional content from Source used by UPSC

The **Pea family** (Fabaceae or Leguminosae) includes plants that are **legumes**, known for their **nitrogen-fixing ability** and **characteristic pod-bearing fruits**.

1. **Groundnut** – Belongs to **Fabaceae (Pea family)**.
2. **Horse Gram** – Belongs to **Fabaceae (Pea family)**.
3. **Soybean** – Belongs to **Fabaceae (Pea family)**.



To-the-Point Content for UPSC Prelims 2025 (Direct Questions in UPSC Prelims'24 were from this section)

1. Important Plant Families & Their Economic Importance

1.1 Fabaceae (Leguminosae) – **Legume/Pea Family**

• **Economic Importance:**

- **Food Crops:** Gram, Pea, Soybean, Groundnut.
- **Forage Crops:** Clover, Alfalfa.
- **Timber:** Rosewood (Dalbergia).
- **Dyes:** Indigo (Indigofera).
- **Nitrogen Fixation:** Rhizobium bacteria in root nodules.

1.2 Poaceae (Gramineae) – **Grass Family**

• **Economic Importance:**

- **Cereals:** Rice, Wheat, Maize, Barley, Sorghum, Millet.
- **Forage:** Bamboo, Sugarcane.
- **Beverages:** Sugarcane (*Saccharum officinarum*) for sugar, Rum.
- **Paper Industry:** Bamboo (*Bambusa*).
- **Biofuels:** Switchgrass, Sugarcane ethanol.

1.3 Solanaceae – **Nightshade Family**

• **Economic Importance:**

- **Vegetables:** Potato, Tomato, Brinjal, Chilli.
- **Medicinal Plants:** Belladonna (*Atropa belladonna*), Tobacco (*Nicotiana*).
- **Ornamentals:** Petunia.

1.4 Asteraceae (Compositae) – **Sunflower Family**

• **Economic Importance:**

- **Oilseeds:** Sunflower.
- **Medicinal:** Artemisinin (*Artemisia annua*).
- **Ornamentals:** Marigold (*Tagetes*).

1.5 Brassicaceae (Cruciferae) – **Mustard Family**

• **Economic Importance:**

- **Oilseeds:** Mustard, Rapeseed.
- **Vegetables:** Cabbage, Cauliflower, Radish.

1.6 Euphorbiaceae – **Spurge Family**

• **Economic Importance:**

- **Rubber Production:** *Hevea brasiliensis*.
- **Medicinal Plants:** *Ricinus communis* (Castor oil).

1.7 Liliaceae – **Lily Family**

• **Economic Importance:**

- **Medicinal Plants:** Aloe vera, Garlic, Onion.
- **Ornamentals:** Tulip, Lily.



Clover



Dalbergia



Switchgrass



Belladonna

18. Consider the following :

1. Carabid beetles
2. Centipedes
3. Flies
4. Termites
5. Wasps

Parasitoid species are found in how many of the above kind of organisms ?

- (a) Only two
- (b) Only three
- (c) Only four
- (d) All five

2024

### Source used by UPSC for this Question

Source: [Vidyastra Notes](#), Article in [The Hindu](#)

Theme: Species in News

Current Linkage: [New genus of parasitoid wasp discovered](#)

### Explanation and Additional content from Source used by UPSC

1. **Carabid Beetles** – are **predators**, actively hunting and consuming other insects. They **do not exhibit parasitoid behavior**.
2. **Centipedes** – are **carnivorous arthropods** that kill and consume their prey directly. They **do not rely on a host for development**.
3. **Flies** – Some fly species, **particularly tachinid flies**, are **well-known parasitoids**. Their larvae develop inside host insects, ultimately leading to the host's death.
4. **Termites** – Termites are social insects that feed on wood and other plant matter. They are not known to exhibit parasitoid behavior. However, Certain wasp species, including **members of the Encyrtidae and Dryinidae families**, as well as Strepsiptera, parasitize termites. These parasitoids **lay eggs inside termite workers or soldiers**, where larvae feed on and kill their host. This means that termites do host parasitoids species, making them indirectly involved in parasitoid interactions.
5. **Wasps** – Many wasp species, such as braconid and ichneumonid wasps, are parasitoids. They **lay eggs in or on hosts like caterpillars and other insects**, leading to the host's eventual death.

Thus, Answer can be **either Only two or Only three** depending upon whether UPSC has considered **termites as Parasitoid** or not because **Termites are indirectly involved in parasitoid interactions**.

### Solve with Logic and Minimal prior Knowledge

It is **generally difficult to solve such factual questions** using logic alone. To tackle such questions in exam hall, **please refer to the next section**.

### To-the-Point Content for UPSC Prelims 2025 (Direct Questions in UPSC Prelims'24 were from this section)

1. **Pollination**: [Indian Express](#) [MIT scientists build tiny robotic insect drones to aid pollination](#)

Pollination is the **transfer of pollen from the male anther of a flower to the female stigma**, enabling fertilization and seed production. It is a vital ecological process that sustains plant reproduction and food production.

#### Types of Pollination

##### 1. Self-Pollination (Autogamy)

- **Direct Transfer**: Pollen is transferred within the **same flower or between flowers of the same plant**.
- **Subtypes**: 1. **Cleistogamy**: Flowers remain **closed** (e.g., **Viola, Oxalis**). 2. **Chasmogamy** with prior self-pollination: **Open flowers** where self-pollination occurs before cross-pollination (e.g., **Pea**).

##### 2. Cross-Pollination (Allogamy)

- Pollen is transferred between **flowers of different plants**, enhancing genetic diversity.
- **Agents of Pollination** (Pollinators):
  - **Abiotic Pollination**: 1. **Anemophily** (Wind): Light, dry pollen (e.g., **Maize, Wheat**). 2. **Hydrophily** (Water): Found in submerged aquatic plants (**Vallisneria, Zostera**).
  - **Biotic Pollination**: 1. **Entomophily** (**Insects**): Bees, butterflies (Sunflower, Orchid). 2. **Chiropterophily** (**Bats**): Large, night-blooming flowers (Baobab). 3. **Ornithophily** (**Birds**): Hummingbirds, sunbirds (Bignonia).

**Significance of Pollination**: 1. **Agricultural Productivity**: 75% of global food crops depend on pollinators. 2. **Biodiversity Maintenance**: Facilitates plant genetic diversity and ecosystem stability. 3. **Economic Importance**: Honeybee pollination contributes significantly to commercial agriculture.

**Current Issues in Pollination (India & Global)**: 1. **Pollinator Decline**: Habitat loss, pesticides, and climate change threaten bees and butterflies. 2. **Pollination Deficits**: Reduced crop yields due to pollinator scarcity. 3. **Conservation Initiatives**: The Indian government promotes bee farming through the **National Beekeeping & Honey Mission (NBHM)**.

2. **Invasive Species**: [Indian Express](#) [How invasive species threaten natural ecosystems](#)

Invasive species are **non-native organisms that disrupt local ecosystems**, often outcompeting native species & altering biodiversity.

**Characteristics of Invasive Species**: 1. **High Reproductive Rate**: Rapid spread due to lack of natural predators. 2. **Strong Competitive Ability**: Outcompete native species for resources. 3. **Environmental Tolerance**: Adapt to diverse conditions.

#### Impacts of Invasive Species on Native Populations

- **Competition**: Invasive species outcompete natives for food, water, and space (e.g., **Lantana camara** crowds out native plants).
- **Predation & Extinction of Natives**: Exotic predators eliminate native species (e.g., **African Catfish** preying on Indian fish species).

- **Alteration of Ecosystem Dynamics:** 1.Change in fire cycles (**Eucalyptus** intensifies forest fires). 2.Soil degradation (**Prosopis juliflora** depletes groundwater).
- **Spread of Diseases:** Introduced species can be disease carriers (e.g., **Parthenium hysterophorus** causing allergies).
- **Economic & Agricultural Damage:** 1.Crop losses (e.g., **Fall Armyworm** damaging maize in India). 2.Loss of fisheries (e.g., **Tilapia** displacing native fish).

**Current Invasive Species Concerns in India:** 1.Terrestrial: Lantana camara, Prosopis juliflora, Parthenium hysterophorus. 2.Aquatic: Water Hyacinth, African Catfish. 3.Agricultural Pests: Fall Armyworm, Pink Bollworm (cotton pest).

**Control Measures:** 1.Biological Control: Introduction of natural predators. 2.Mechanical Removal: Manual removal and habitat restoration. 3.Legislation: Biological Diversity Act (2002) and strict quarantine regulations.

### 3. Parasitoids in Natural Pest Regulation: [nature.com](https://www.nature.com/articles/nrn1111) [Hymenopteran parasitoid complex and fall armyworm](#)

Parasitoids are insects that **lay their eggs on or inside a host**, leading to its **eventual death**. They play a crucial role in biological pest control, reducing reliance on chemical pesticides.

#### Types of Parasitoids:

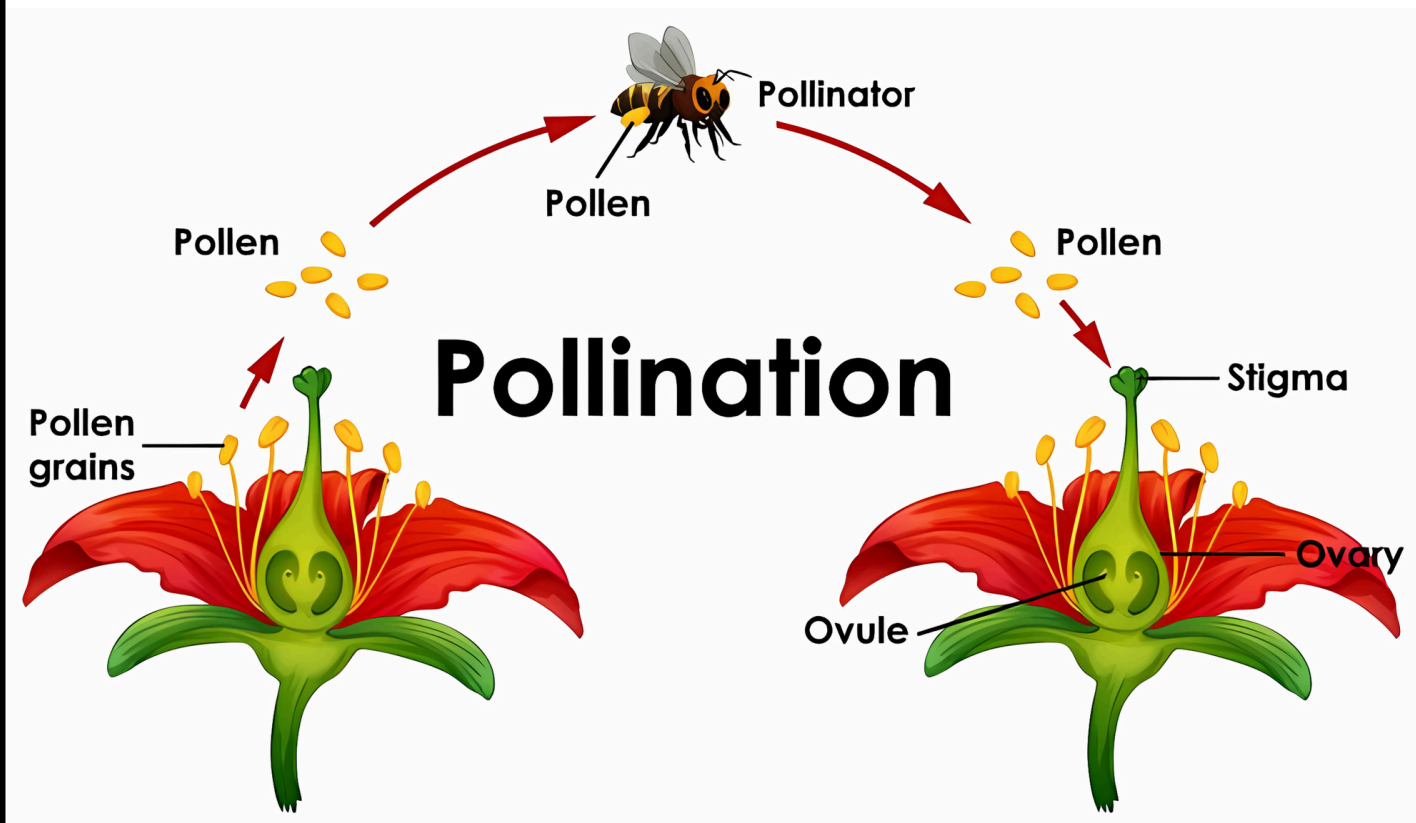
- **Endoparasitoids** – Develop inside the host's body, feeding internally and eventually killing the host.
  - **Example:** Cotesia glomerata (a **Braconid wasp**) developing inside caterpillars.
- **Ectoparasitoids** – Develop outside the host's body, attaching externally while feeding on it.
  - **Example:** Bracon hebetor (a **Braconid wasp**) attacking stored grain pests like moth larvae.

**Common Parasitoid Species in Pest Control:** 1.Wasps (Hymenoptera): Trichogramma species control caterpillar pests. 2.Flies (Diptera): Tachinid flies attack moth and beetle larvae. 3.Beetles (Coleoptera): Carabid beetles prey on crop pests.

**Significance in Agriculture:** 1.Natural Pest Control: Reduces dependency on chemical pesticides. 2.Eco-Friendly: No chemical residue, promotes sustainable farming. 3.Cost-Effective: Farmers save on pest control expenses.

**Examples of Successful Biological Control Using Parasitoids:** 1.Trichogramma wasps controlling cotton **bollworms** in India. 2.Encarsia formosa used to combat **whiteflies** in greenhouses. 3.Braconid wasps introduced to manage **fruit fly** infestations.

**Current Trends in India:** 1.Promotion of **Integrated Pest Management (IPM)** strategies. 2.Research in agricultural universities on indigenous parasitoids. 3.Government initiatives for biological pest control programs.





17. With reference to perfluoroalkyl and polyfluoroalkyl substances (PFAS) that are used in making many consumer products, consider the following statements :

1. PFAS are found to be widespread in drinking water, food and food packaging materials.
2. PFAS are not easily degraded in the environment.
3. Persistent exposure to PFAS can lead to bioaccumulation in animal bodies.

Which of the statements given above are correct ?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

2024

### PYQs asked by UPSC since 1979 on this theme

46. With reference to polyethylene terephthalate, the use of which is so widespread in our daily lives, consider the following statements :

1. Its fibres can be blended with wool and cotton fibres to reinforce their properties.
2. Containers made of it can be used to store any alcoholic beverage.
3. Bottles made of it can be recycled into other products.
4. Articles made of it can be easily disposed of by incineration without causing greenhouse gas emissions.

Which of the statements given above are correct ?

- (a) 1 and 3
- (b) 2 and 4
- (c) 1 and 4
- (d) 2 and 3

2022

74. Bisphenol A (BPA), a cause of concern, is a structural/key component in the manufacture of which of the following kinds of plastics?

- (a) Low-density polyethylene
- (b) Polycarbonate
- (c) Polyethylene terephthalate
- (d) Polyvinyl chloride

2021

75. 'Triclosan', considered harmful when exposed to high levels for a long time, is most likely present in which of the following?

- (a) Food preservatives
- (b) Fruit-ripening substances
- (c) Reused plastic containers
- (d) Toiletries

2021

### Source used by UPSC for this Question

Source: **Vidyastra Notes**, Article in **TOI**

Theme: Harmful Chemicals in NEWS

Current Linkage: [Why ICMR has advised against cooking in non-stick pans TOI](#)

### Solve with Logic and Minimal prior Knowledge

This is a **very Simple Question**. If Statement 2 is Correct then Statement 3 must also be correct. If Statement 3 is Correct then Statement 2 must also be correct. Because, **whatever does not degrade, bioaccumulates and whatever bioaccumulates, does not degrade**. Thus, both 2 and 3 must be either **simultaneously correct or incorrect**. Thus, Answer can be either (b) or (d). Also, the Question itself says that it is "used in making many consumer products" and water, food and food packaging materials are the most common consumer products. Hence, **only option (d) can be correct**.

### Explanation and Additional content from Source used by UPSC

1. **Statement 1 is Correct** – PFAS contamination is widespread in drinking water, food, and food packaging due to industrial discharge, contaminated soil, and their use in coatings for water-resistant materials. Studies confirm PFAS presence in **groundwater, fish, dairy products, and packaged foods**.
2. **Statement 2 is Correct** – PFAS have **strong carbon-fluorine (C-F) bonds**, making them highly resistant to biodegradation, photodegradation, and hydrolysis. They **persist in soil, water, and air** for decades, earning the name "**forever chemicals**."
3. **Statement 3 is Correct** – PFAS **accumulate in blood, liver, and tissues of animals and humans** due to slow elimination rates. Bioaccumulation increases health risks, including hormonal disruption, immune suppression, liver damage, and cancer.

### To-the-Point Content for UPSC Prelims 2025 (Direct Questions in UPSC Prelims'24 were from this section)

**Endocrine Disruptors in Household Products:** **NDTV** [Lotions, Sunscreens Linked To Hormonal Disruptions In Children, Study Finds](#)

- Chemicals that interfere with hormonal systems, causing adverse developmental, reproductive, and neurological effects.
- **Daily Life Sources:** Found in detergents, plastics, cosmetics, pesticides, and canned food linings.
- **Health Impacts:** Linked to infertility, thyroid dysfunction, cancer, and developmental disorders.
- **Environmental Impacts:** Persistent in water and soil; bioaccumulates in wildlife, disrupting ecosystems.
- **Examples:** Bisphenol A (BPA), Phthalates, Parabens, Triclosan, Polybrominated Diphenyl Ethers (PBDEs), Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), Nonylphenols and Alkylphenols, Atrazine, Perchlorates, Dioxins, Glycol Ethers.

**Polyurethane:** **The Hindu** [Polyurethane can go a long way in ending plastic menace, says AMCA representative](#)

- Polyurethane is a versatile polymer used in foams, elastomers, and coatings.
- **Daily Life Sources:** Found in mattresses, furniture cushions, insulation, paints, adhesives, and footwear.
- **Health Impacts:** Emits isocyanates and volatile organic compounds (VOCs), causing respiratory irritation and asthma in workers.
- **Environmental Impacts:** Polyurethane (PU) is not biodegradable in its natural state, but can be formulated to be biodegradable.

**Polycyclic Aromatic Hydrocarbons (PAHs):** **Indian Express** [Why repeatedly heating vegetable oils is putting your health at risk](#)

- PAHs are organic compounds with multiple aromatic rings, primarily formed during incomplete combustion.
- **Daily Life Sources:** Found in grilled foods, tobacco smoke, vehicle emissions, and industrial effluents.
- **Health Impacts:** Carcinogenic and mutagenic; linked to lung cancer and DNA damage.
- **Environmental Impacts:** Persistent in the environment; accumulates in soil and water, harming aquatic life.

**Phthalates:** **Deccan Herald** [Test shows toxic chemicals in food containers, toys made of recycled plastic](#)

- Phthalates are plasticizers added to plastics to increase flexibility and durability.
- **Daily Life Sources:** Found in PVC products, cosmetics, toys, food packaging, and medical devices.
- **Health Impacts:** Endocrine disruptors; linked to reproductive issues, hormonal imbalances, and developmental problems.
- **Environmental Impacts:** Leaches into soil and water, causing bioaccumulation in wildlife and disrupting ecosystems.

**Plasticizers:** **The Hindu** [IIT Roorkee uses bacterial enzymes to degrade plasticizers](#)

- Additives that enhance the flexibility, durability, and plasticity of polymers.
- **Daily Life Sources:** Found in PVC pipes, vinyl flooring, cables, and automotive interiors.
- **Health Impacts:** Some, like phthalates, are endocrine disruptors and may cause reproductive health issues.
- **Environmental Impacts:** Non-biodegradable; contributes to plastic pollution and chemical leaching into the environment.

Answers of above UPSC Questions: Ques.17(2024)-d, Ques.46(2022)-a, Ques.74(2021)-b, Ques.75(2021)-d

**99. What is Cas9 protein that is often mentioned in news?**

2019

- (a) A molecular scissors used in targeted gene editing
- (b) A biosensor used in the accurate detection of pathogens in patients
- (c) A gene that makes plants pest-resistant
- (d) A herbicidal substance synthesized in genetically modified crops

**Source used by UPSC for this Question**

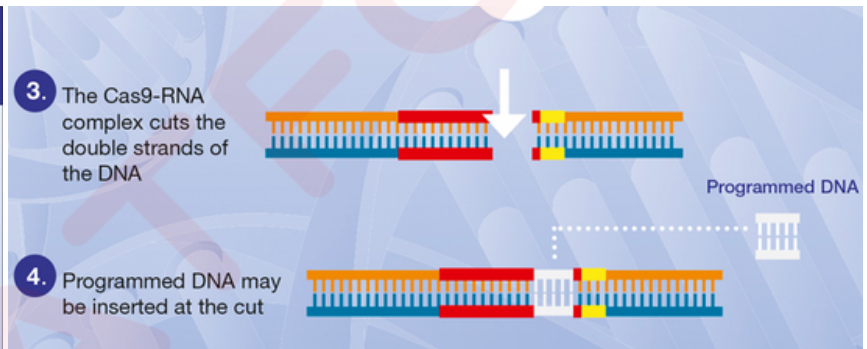
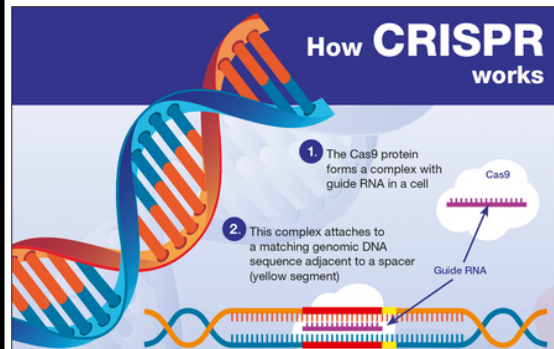
Source: Current Affairs and **PYQ Analysis**.

Theme: Biology (subtheme – Biotechnology and new developments)

Current Linkage: [How safe is CRISPR?](#)

**Explanation and Additional content from Source used by UPSC**

Cas9 is an enzyme that works like a pair of scissors to cut two strands of DNA at a specific location to add, remove or repair parts of DNA. It is used in the context of CRISPR-Cas9 technology, which is a gene editing technology. It involves introduction of a new gene or suppression of some gene through genetic engineering process. CRISPR-Cas9 is compared to 'cut-copy-paste' or 'find-replace' mechanism.



**Solve with Logic and Minimal prior Knowledge**

This is a highly factual question and using elimination techniques is not suggested in such questions. Cas9 was very frequently in news, used together with CRISPR technology. One should be able to answer this correctly, given its frequent appearance in news.

**To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)**

**Unified Genomic Chip:** **Business Standard** [PM Modi launches Unified Genomic Chip for cattle: How will it help farmers?](#)

- Unified Genomic Chip (UGC) was launched by the Prime Minister along with indigenous sex-sorted semen technology to enhance livestock development in India.
- **Key Features**
  1. **Technology:** A Single Nucleotide Polymorphism (SNP) chip designed specifically for genomic profiling & evaluating Indian cattle breeds.
  2. **Objective:**
    - Direct application of DNA technologies to enhance the genetic potential and productivity of dairy animals.
    - Enables farmers to identify high-quality cattle early and improve efficiency in dairy farming.
  3. **Variants:** Gau Chip for cattle & Mahish Chip for buffaloes.
  4. **Developing Entities:** A consortium led by Department of Animal Husbandry and Dairying (DAHD), under Ministry of Animal Husbandry, Dairying & Fisheries. **Collaborators include:** National Dairy Development Board (NDDB) & National Institute of Animal Biotechnology (NAIB).
- **Applications**
  - **Cattle Breeding:** Assists in the genetic improvement of indigenous breeds.
  - **Livestock Conservation:** Facilitates conservation of native cattle varieties like Gir, Sahiwal, and Kankrej.
  - **Dairy Industry Enhancement:** Improves milk yield and increases farmers' incomes.
  - **Atmanirbhar Bharat Initiative:** Reduces dependency on imported genomic chips.
- **Single Nucleotide Polymorphisms (SNPs)**
  - SNPs are variations in a DNA sequence where a single nucleotide differs from the reference sequence.
  - For example, Guanine (G) may replace Thymine (T) in a DNA segment.
  - **Utility:** Common in genetic research and used for identifying traits or predicting genetic disorders.
- **Other Initiatives for Genetic/Breed Improvement**
  - **Rashtriya Gokul Mission (2014):** Focused on the development and conservation of indigenous bovine breeds.
    - 1. Nationwide Artificial Insemination Programme.
    - 2. Progeny Testing and Pedigree Selection Programme.
    - 3. Delivery of Artificial Insemination services through MAITRIs (Multi-Purpose Artificial Insemination Technicians in Rural India).
    - 4. Establishment of Breed Multiplication Farms.
  - **IndiGau:** India's first Cattle Genomic Chip for preserving pure varieties of breeds like Gir, Kankrej, Sahiwal, and Ongole. Launched by NAIB under the Department of Biotechnology.
  - National Livestock Mission (2014), e-pashuhaar Portal & INAPH (Information Network for Animal Productivity and Health)

Answers of above UPSC Questions: Ques.99(2019)-a, Ques.5(2013)-d, Ques.64(2018)-b



47. Which of the following statements are correct regarding the general difference between plant and animal cells?

1. Plant cells have cellulose cell walls whilst animal cells do not.
2. Plant cells do not have plasma membrane unlike animal cells which do.
3. Mature plant cell has one large vacuole whilst animal cell has many small vacuoles.

Select the correct answer using the code given below :

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

2020

### Source used by UPSC for this Question

Source: Class 9th NCERT – Chapter – The Fundamental Unit of Life  
Theme: Biology (Fundamental Concepts)

### Solve with Logic and Minimal prior Knowledge

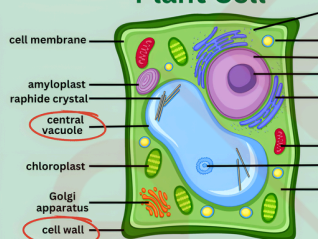
This is a fairly difficult question, but with a basic understanding of any kind of cell (plant or animal) and a little risk-taking, you can solve it. Focus on Statement 2, which says plant cells do not have plasma membranes. If you know even just the basics of biology, you can easily eliminate this statement because the plasma membrane is similar to what skin is to the entire human body. A cell cannot exist without a plasma membrane as it holds the contents of the cell together. Eliminating Statement 2 gives us option (c) as the correct answer.

### To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)

#### PLANT CELL VS ANIMAL CELL

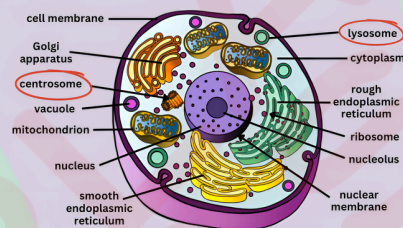
- Cell wall (rigid shape)
- Large central vacuole
- Chloroplasts (autotroph)
- Lack centrosomes
- Lack lysosomes

##### Plant Cell



##### Animal Cell

- No cell wall (irregular shape)
- Numerous small vacuoles
- No chloroplasts (heterotroph)
- Centrioles / centrosomes
- Lysosomes



Basics of Biology is an important theme in UPSC. Following topics are important for UPSC Prelims25:

#### Key Components of a Cell

- **Plasma Membrane:**
  - outermost covering of the cell, separating its contents from the external environment.
  - **Function:** Permits entry and exit of materials through diffusion and osmosis.
- **Nucleus:**
  - contains chromosomes, which hold DNA for inheritance. Functional segments of DNA are called genes.
  - DNA is present as chromatin in non-dividing cells. In prokaryotes (e.g., bacteria), nuclear region lacks a defined membrane and is called a nucleoid. Eukaryotes have a defined nuclear membrane.

#### • Cytoplasm:

- fluid content inside the plasma membrane, containing specialized organelles.

#### • Components:

##### ▪ Endoplasmic Reticulum (ER):

- **Types:** Rough ER (with ribosomes, manufactures proteins) and Smooth ER (involved in protein and lipid formation, detoxification).

##### ▪ Golgi Apparatus:

- **Function:** Storage, modification, and packaging of products in vesicles.

##### ▪ Lysosomes:

- **Function:** Digest foreign materials and worn-out cell organelles, known as the cell's "suicide bags."

##### ▪ Mitochondria:

- **Function:** Known as the powerhouses of the cell, releasing energy in the form of ATP (Adenosine triphosphate). Contains its own DNA (mtDNA).

##### ▪ Plastids (Plant Cells Only):

- **Types:** Chromoplasts (contain pigments like chlorophyll) and Leucoplasts (store starch, oils, and proteins). Also contain their own DNA.

##### ▪ Ribosomes:

- small spherical structures composed of RNA and proteins found in the cytoplasm or attached to the rough endoplasmic reticulum. Sites of protein synthesis: genetic information from mRNA is translated into proteins.

### PYQs asked by UPSC since 1979 on this theme

193. With reference to the recent developments in science, which one of the following statements is **not** correct?
- (a) Functional chromosomes can be created by joining segments of DNA taken from cells of different species.
  - (b) Pieces of artificial functional DNA can be created in laboratories.
  - (c) A piece of DNA taken out from an animal cell can be made to replicate outside a living cell in a laboratory.
  - (d) Cells taken out from plants and animals can be made to undergo cell division in laboratory petri dishes.

2019

11. Which of the following is/are found in plant cells but not in those of animals?

- (a) Plastid & Cellular wall
- (b) Chromosome
- (c) Mitochondria & Golgi apparatus
- (d) Cell wall & lysozyme

1987

85. Match List I with List II and select the correct answer using the codes given below them:

List I	List II
(Plant tissue)	(Function)
A. Sclerenchyma	1. Conduction of water
B. Xylem	2. Transport of food
C. Phloem	3. Mechanical strength
D. Meristem	4. Cell division
	5. Carbon assimilation

- (a) 3 1 2 4
- (b) 1 4 3 5
- (c) 4 2 5 3
- (d) 2 5 4 1

1990

130. Match List I (Physiological processes) with List II (Cell organelles) and select the correct answer by using the codes given below the lists:

List I	List II
I. Photosynthesis	(A) Plasma membrane
II. Mineral uptake	(B) Chloroplast
III. Respiration	(C) Mitochondria
IV. Protein Synthesis	(D) Ribosomes

Codes:

- (a) I-A, II-B, III-C, IV-D
- (b) I-A, II-B, III-D, IV-C
- (c) I-B, II-A, III-C, IV-D
- (d) I-B, II-A, III-D, IV-C

1996

36. In which of the following are **hydrogels** used ?

1. Controlled drug delivery in patients
2. Mobile air-conditioning systems
3. Preparation of industrial lubricants

Select the correct answer using the code given below :

- (a) 1 only
- (b) 1 and 2 only
- (c) 2 and 3 only
- (d) 1, 2 and 3

2024



### Source used by UPSC for this Question

Source: Article in **The Hindu**

Theme: Advanced Materials in NEWS

Current Linkage: [IISc researchers design novel hydrogel to remove microplastics from water](#)



### Explanation and Additional content

1. Hydrogels are widely **used in biomedical applications**, particularly for controlled drug delivery.
2. Hydrogels are **utilized in mobile air-conditioning systems** for their water-absorption and evaporative cooling properties, improving energy efficiency.
3. Hydrogels are **used in the formulation of industrial lubricants**, where their water-retaining and gel-like properties enhance lubrication and reduce wear.



### Solve with Logic and Minimal prior Knowledge

In recent years, **UPSC has been consciously trying to ensure** that students **do not misuse option (d)** - All Correct, especially in S&T questions. Keeping this in mind, **if students do not have any knowledge about hydrogels**, it will be difficult to reach at correct answer because the **given uses are very diverse**.



### To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)

1. **Smart Polymers:** [India Today](#) [Indian researchers develop polymers that can self-heal](#)

- Smart Polymers are **polymers that undergo reversible and predictable changes in physical or chemical properties** in response to **external stimuli** such as temperature, pH, light, electric field, or mechanical stress.
- **Uses:** **1. Biomedical:** Drug delivery systems, tissue engineering scaffolds, and biosensors. **2. Textiles:** **Self-cleaning** or adaptive clothing materials. **3. Sensors and Actuators:** For robotics and soft electronics. **4. Environmental:** Water purification, pollutant capture, and responsive coatings. **5. Adhesives:** **Reversible or reusable adhesives** in various industries.
- **Merits:** **1.** High customizability for specific applications. **2.** Ability to operate under various stimuli, enhancing adaptability.
- **Demerits:** **1.** Expensive and complex synthesis. **2.** Limited long-term stability under repeated cycles.

2. **Biopolymers:** [PIB](#) [Demonstration Facility for Biopolymers](#)

- Biopolymers are **naturally occurring or synthetically derived polymers** that are biodegradable and environmentally friendly. These are composed of monomers such as sugars, amino acids, or nucleotides.
- **Types:**
  - a. **Natural Biopolymers:** **1. Polysaccharides:** Starch, cellulose, and chitosan. **2. Proteins:** Collagen, **silk**, and gelatin. **3. Nucleic Acids:** **DNA and RNA.**
  - b. **Synthetic Biopolymers:** **1. Polylactic Acid (PLA):** Derived from lactic acid. **2. Polyhydroxyalkanoates (PHAs):** Bacterial-derived bioplastics. **3. Polycaprolactone (PCL):** **A synthetic biodegradable polyester.**
- **Properties:** **1. Biodegradability:** Decomposes into natural elements. **2. Renewable origin:** Derived from plants, **bacteria**, or animals.
- **3. Mechanical properties:** Vary from soft and flexible to strong and rigid.
- **Uses:** **1. Packaging:** Biodegradable films, containers, and bags. **2. Medical:** Sutures, drug delivery systems, and implants. **3. Agriculture:** Mulch films and **seed coatings.** **4. Textiles:** Eco-friendly fibers. **5. Food Industry:** Edible coatings and encapsulation materials.
- **Merits:** **1.** Reduces environmental impact due to biodegradability. **2.** Supports sustainability through renewable sources.
- **Demerits:** **1.** High production costs compared to conventional polymers. **2.** Mechanical and thermal properties are inferior to synthetic plastics.

3. **Bioinks:** [The Hindu](#) [SCTIMST develops gelatin-modified bioink for 3D bioprinting of tissues](#)

- Bioinks are materials composed of biological molecules, cells & biomaterials **used in 3D bioprinting** to fabricate tissues and organs.
- **Essential Parts:**
  - a. **Biomaterials:** Serve as scaffolds or support for cell growth. Examples: **Hydrogels**, alginate, gelatin, **collagen**, fibrin, hyaluronic acid.
  - b. **Cells:** **Living cells embedded in bioinks** to replicate tissue function. Types: Stem cells, primary cells, or differentiated cells.
  - c. **Bioactive Molecules:** Growth factors, cytokines, or signaling molecules to promote cell differentiation and proliferation.
  - d. **Crosslinking Agents:** Stabilize printed structures by chemically or physically crosslinking the material. **Example: UV light.**
- **Types:** **1.** Natural Bioinks, **2.** Synthetic Bioinks & **3.** Hybrid Bioinks.
- **Uses:** **1. Tissue Engineering:** Fabrication of skin, cartilage, and bone tissues. **2. Regenerative Medicine:** Printing organoids or tissues for transplantation. **3. Disease Modeling:** Creating 3D tissue models for studying disease mechanisms. **4. Drug Testing:** Testing pharmaceuticals on printed tissue constructs to reduce animal testing. **5. Organ Printing (Emerging):** Progress toward printing functional **organs like liver or kidney.**

Answers of above UPSC Questions: Ques.36(2024)-d, Ques.41(2020)-c, Ques.23(2015)-c, Ques.101(1995)-b/d, Ques.79(1988)-a



37. Which one of the following is the exhaust pipe emission from Fuel Cell Electric Vehicles, powered by hydrogen ?

- Hydrogen peroxide
- Hydronium
- Oxygen
- Water vapour



#### Source used by UPSC for this Question

Source: Article in **PIB**

Theme: Renewable Energy Sources

Current Linkage: [Union Minister Hardeep S Puri flags-off 1st Green Hydrogen Fuel Cell Bus](#)



#### Solve with Logic and Minimal prior Knowledge

This is a fairly easy question.

Fuel Cell based Electric vehicles **utilize oxidation reaction of Hydrogen** to produce electricity and we all know that **hydrogen oxidizes to form water**.



#### Explanation and Additional content

- Fuel Cell Electric Vehicles use **hydrogen as a fuel** to generate electricity by **combining hydrogen and oxygen** through an electrochemical reaction.
- The **reaction produces**: Electricity, **Water (H<sub>2</sub>O)** - emitted as **water vapour** and Heat - a byproduct.



#### To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)

- Regenerative Braking System**: **The Hindu** [In an electric vehicle, what is regenerative braking? | Explained](#)
  - Regenerative Braking System is a braking system that **recovers energy during deceleration and stores it for later use**. Converts kinetic energy into electrical energy **instead of wasting it as heat**.
  - Mechanism**: During braking, the vehicle's **electric motor operates in reverse**, acting as a generator. Kinetic energy is converted into electrical energy and **stored in the battery or ultracapacitors**. Reduces reliance on friction brakes, minimizing wear and heat loss.
  - Components**: **1.Electric Motor**: Functions as both a motor and a generator. **2.Power Electronics**: Controls the flow of energy during braking and storage. **3.Energy Storage System**: Typically lithium-ion batteries or supercapacitors.
  - Merits**: **1.Improves energy efficiency** by recovering up to 60% of braking energy. **2.Extends the range** of electric and hybrid vehicles. **3.Reduces brake wear**, lowering maintenance costs. **4.Minimizes carbon emissions** by reducing energy wastage.
  - Uses**: **1.Used in electric vehicles (EVs)**, hybrid vehicles (HEVs), **trains, trams, and e-bikes**. **2.Found in systems like Toyota's Hybrid Synergy Drive and Tesla's regenerative braking in EVs**.
  - Issues**: **1.Effectiveness decreases at lower speeds**. **2.Requires a compatible energy storage system**. **3.Complex integration with traditional friction brakes**.
- Hybrid Electric Vehicles (HEVs)**: **Business Standard** [Hybrid cars 'best solution' until non-fossil energy is widespread](#)
  - Hybrid Electric Vehicles (HEVs) are vehicles powered by a **combination of an internal combustion engine (ICE) & an electric motor**.
  - Types**:
    - a. Mild Hybrid**: ICE dominates; electric motor assists with power boosts (e.g., Honda Insight).
    - b. Full Hybrid**: Electric motor can independently drive the vehicle (e.g., Toyota Prius).
    - c. Plug-In Hybrid (PHEV)**: Larger battery charged externally; operates as an EV over short ranges (e.g., Chevrolet Volt).
  - Key Parts**: **1.Internal Combustion Engine (ICE)**: Provides primary power in most models. **2.Electric Motor**: Assists or independently drives the vehicle. **3.Battery Pack**: Stores energy for the motor; typically lithium-ion or nickel-metal hydride (NiMH). **4.Power Control Unit (PCU)**: Manages power distribution between ICE, motor, and battery. **5.Regenerative Braking System**: Captures energy during braking.
  - Merits**: **1.Fuel efficiency**: Reduces fuel consumption by 20–35%. **2.Lower emissions**: Combines electric drive with ICE for reduced tailpipe emissions. **3.Energy recovery**: Incorporates regenerative braking for enhanced efficiency. **4.Extended range**: Can operate on ICE for long trips when the battery is depleted.
  - Issues**: **1.Higher initial costs than conventional ICE vehicles**. **2.Complex maintenance due to dual powertrains**. **3.Lower battery-only range compared to BEVs or PHEVs**.
  - Uses**: **1.Widely used in personal vehicles (e.g., Toyota Prius, Honda Accord Hybrid)**. **2.Commercial vehicles: Buses, trucks, and taxis**. **3.Increasingly adopted in marine vessels and aviation prototypes**.
- Microbial fuel cells (MFCs)**: **Indian Express** [Scientists claim this soil-powered fuel cell can 'run forever'](#)
  - Microbial fuel cells (MFCs) generate electricity by harnessing the metabolic activity of **microbes that oxidize organic matter**.
  - Features**: **1.Consist of an anode, cathode, and a proton exchange membrane**. **2.Microbes at the anode release electrons** during metabolic processes, which generate current.
  - Uses**: **1.Power generation from wastewater treatment**. **2.Biosensors** for detecting pollutants. **3.Remote power supply for small devices**.
  - Merits**: **1.Simultaneous energy production and waste treatment**. **2.Renewable and sustainable energy source**.
  - Issues**: **1.Low power output limits large-scale applications**. **2.High initial cost of materials like membranes**.



#### PYQs asked by UPSC since 1979 on this theme

95. With reference to 'fuel cells' in which hydrogen-rich fuel and oxygen are used to generate electricity, consider the following statements :

- If pure hydrogen is used as a fuel, the fuel cell emits heat and water as by-products.
- Fuel cells can be used for powering buildings and not for small devices like laptop computers.
- Fuel cells produce electricity in the form of Alternating Current (AC).

Which of the statements given above is/are correct?

- 1 only
- 2 and 3 only
- 1 and 3 only
- 1, 2 and 3

60. With reference to green hydrogen, consider the following statements :

- It can be used directly as a fuel for internal combustion.
- It can be blended with natural gas and used as fuel for heat or power generation.
- It can be used in the hydrogen fuel cell to run vehicles.

How many of the above statements are correct?

- Only one
- Only two
- All three
- None

36. Hydrogen fuel cell vehicles produce one of the following as "exhaust"

- NH<sub>3</sub>
- CH<sub>4</sub>
- H<sub>2</sub>O
- H<sub>2</sub>O<sub>2</sub>



## PYQs asked by UPSC since 1979 on this theme

34. From the decline of **Guptas** until the rise of **Harshavardhana** in the early seventh century, which of the following **kingdoms** were holding power in Northern India?

1. The Guptas of Magadha
2. The Paramaras of Malwa
3. The Pushyabhutis of Thanesar
4. The Maukharis of Kanauj
5. The Yadavas of Devagiri
6. The Maitrakas of Valabhi

Select the correct answer using the code given below.

- (a) 1, 2 and 5
- (b) 1, 3, 4 and 6
- (c) 2, 3 and 4
- (d) 5 and 6

2021

2020

24. Consider the following events in the history of India :

1. Rise of Pratiharas under King Bhoja
2. Establishment of Pallava power under Mahendravarman – I
3. Establishment of Chola power by Parantaka – I
4. Pala dynasty founded by Gopala

What is the correct chronological order of the above events, starting from the earliest time ?

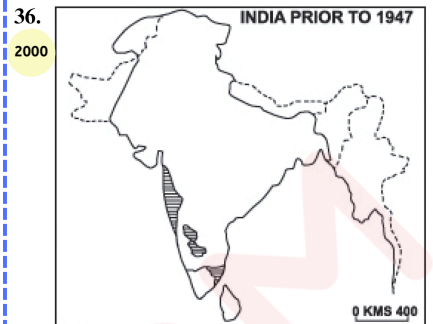
- (a) 2 – 1 – 4 – 3
- (b) 3 – 1 – 4 – 2
- (c) 2 – 4 – 1 – 3
- (d) 3 – 4 – 1 – 2

2006

117. Who among the following laid the foundation of Rashtrakuta Empire?

- (a) Amoghavarsha I
- (b) Dantidurga
- (c) Dhruva
- (d) Krishna I

2000



The given map refers to the kingdom of:

- (a) Akbar at the time of capture of Khandesh in 1601
- (b) Akbar at the time of his death in 1605
- (c) Aurangzeb at the time of capture of Hyderabad
- (d) Aurangzeb at the time of his death in 1707



## Source used by UPSC for this Question

### IGNOU BA Notes

In the post Gupta period, a number of new political powers emerged in different parts of north India. Until the rise of Harsha in the early seventh century four kingdoms effectively held power in northern India: the Guptas of Magadha; the Maukharis of Kanauj; the Pushyabhutis of Thanesar; and the Maitrakas of Valabhi.



## Explanation and Additional content from Source used by UPSC

1. **Later Guptas ruled in Magadha** (modern Bihar) **during the post-Gupta period** (6th–7th century CE). They were prominent in opposing the Maukharis and maintaining control over eastern India.
2. **Paramaras rose to power in Malwa** (modern Madhya Pradesh) **in 9th century CE**, long after the timeline specified in the question.
3. **Pushyabhutis established power in Thanesar** (modern Haryana) **during the 6th century CE**. They rose significantly under Prabhakaravardhana, the father of Harsha.
4. **Maukharis controlled Kanauj** (modern Uttar Pradesh) **in 6th century CE**, succeeding Guptas as significant power in northern India.
5. **Yadavas rose to prominence in Devagiri** (modern Maharashtra) **in the 12th century CE**, far outside the specified timeline.
6. **Maitrakas of Valabhi**, who had been **ruling as feudatories from the last quarter of the fifth century**, became independent in the second half of the sixth century.



## Solve with Logic and Minimal prior Knowledge

It is generally **difficult to solve such factual questions** using logic alone. Please refer to the next section and learn about **Guptas of Magadha**, **Maukharis of Kanauj**, **Pushyabhutis of Thanesar**, **Karkotas of Kashmir**, **Maitrakas of Vallabhi**, **Tomaras of Delhi & Chauhans (Chahamanas)** to tackle such questions in exam hall.



## To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)

**Important Dynasties (IGNOU Notes, A.L. Basham, Upinder Singh, Tamil Nadu, NIOS, NCERTs, Satish Chandra)**

### Later Guptas of Magadha

1. **Origins:**
  - Emerged around the **mid-6th century CE** and ruled **until approximately 675 CE**.
  - A minor **lineage distinct from the Imperial Guptas** but shared the Gupta name.
  - Initially served as feudatories of the Imperial Guptas, similar to the Maukharis.
2. **Key Rulers:**
  - **Krishnagupta:** Founder of the dynasty.
  - **Harshagupta:** Defended against the Hunas.
  - **Jivitagupta I:** Engaged in battles with the Lichchhavis and the Gaudas of Bengal.
  - **Kumaragupta III:** Defeated Maukhari king Isanavarman but faced later setbacks.
  - **Adityasena (672 CE):** Most prominent ruler; assumed the title Maharajadhiraja, ruled Magadha, Anga, and Bengal, and performed three Ashvamedha sacrifices.
3. **Territorial Extent:** Controlled Magadha, Anga, and parts of Bengal; their influence extended into eastern Uttar Pradesh.
4. **Cultural Contributions:** Strong patronage of Vaishnavism; constructed temples such as the **Vishnu temple at Deoghar**.
5. **Decline:**
  - Faced challenges from neighboring powers like Maukharis & eventual decline due to internal conflicts & external pressures.

### Maukharis of Kanauj

1. **Origins:**
  - Emerged as **successors to the Guptas in northern India** during the 6th century CE.
  - **Capital at Kanauj**, which became a major political and cultural center.
2. **Key Rulers:**
  - **Isanavarman (554 CE):** The **real founder of Maukhari supremacy** and assumed the title '**Maharajadhiraja**' according to **Asirgarh copper plate inscription**.
  - **Sarangadhara and Avantivarman:** Played roles in consolidating the kingdom.
3. **Territorial Extent:** Controlled parts of Uttar Pradesh and Bihar, with influence over the central Ganga plains.

Answers of above UPSC Questions: Ques.34(2021)-b, Ques.24(2020)-c, Ques.117(2006)-b, Ques.36(2000)-a, Ques.38(1994)-d



#### 4. Cultural Contributions:

- Actively promoted Sanskrit literature and temple construction.
- Contributed to the rise of Kanauj as a significant political center.

#### 5. Decline: The Malava king **Devagupta attacked Kanauj** and killed Grahavarman bringing the **Maukhari kingdom to an end.**

#### Pushyabhutis of Thanesar

##### 1. Origins:

- Initially a small dynasty ruling from Thanesar in Haryana during the 6th century CE.
- **Rose to prominence under Harsha Vardhana.**

##### 2. Key Rulers:

- **Prabhakaravardhana:**
  - Established the dynasty's power by defeating neighboring rulers.
- **Harsha (c. 606–647 CE):**
  - Unified northern India after the fall of the Guptas and Maukharis.
  - Known for his administrative efficiency and patronage of arts.

##### 3. Territorial Extent:

- Controlled a vast empire stretching from Punjab to Bengal and parts of the Deccan.

#### 4. Cultural Contributions:

- **Harsha's patronage:**
  - Authored plays like **Nagananda and Ratnavali.**
  - Supported Buddhist institutions like Nalanda.
- Court of Harsha included luminaries like **Banabhatta**, author of **Harshacharita.**

##### 5. Decline:

- Harsha's empire fragmented after his death due to lack of a strong successor.
- Absorbed into regional kingdoms like the Pratiharas and Rashtrakutas.

#### Karkotas of Kashmir

##### 1. Origins:

- Emerged in Kashmir in the 7th century CE.
- Linked to **Naga Karkota**, considered both a deity and a kinsman of the ruling family.

##### 2. Key Rulers:

- **Lalitaditya Muktapida (8th century CE):**
  - A powerful ruler who expanded the kingdom and launched extensive military campaigns.
  - Defeated numerous rulers, including those of Kannauj.
- **Jayapida:** Undertook campaigns against the eastern countries and **Kanyakubja**, defeating multiple chieftains.
- **Vajraditya:** Known for resisting Arab invasions.

##### 3. Territorial Extent:

- Controlled Kashmir and extended influence into parts of Punjab and the Gangetic plains.

##### 4. Decline:

- The dynasty ended in 855–856 CE, **succeeded by the Utpala dynasty.**

#### Maitrakas of Vallabhi

##### 1. Origins:

- Emerged from the remnants of the Gupta Empire; initially subordinates of the Guptas.

##### 2. Key Rulers:

- **Shiladitya I:**
  - Celebrated for his administrative ability and compassion.
  - Held grand Buddhist assemblies and built temples.

##### 3. Cultural Contributions:

- Prominent patronage of Buddhism, especially in temple construction.
- **Vallabhi became an important center of Buddhist learning.**

##### 4. Territorial Extent: Ruled from Vallabhi, extending influence over Gujarat and surrounding regions.

##### 5. Decline: Disappeared from historical records by the 8th century CE.

#### Tomaras of Delhi

##### 1. Origins:

- **An early Rajput dynasty** ruling from Delhi (Dhillika) in the 8th–12th centuries CE.
- Initially **subordinates of the Gurjara-Pratiharas.**

##### 2. Key Rulers:

- **Anangapala II:** Established Lal Kot. Credited with the construction of the **Anang Tal reservoir.**

##### 3. Cultural Contributions: Initiated construction of waterworks like the **Anangpur dam and Surajkund reservoir.**

##### 4. Decline: Overthrown by the Chauhans in the 12th century.

#### Chauhans (Chahamanas)

##### 1. Origins:

- Initially **vassals of the Gurjara-Pratiharas**; later established independence in the 7th century CE.
- **Early capital at Shakambhari** (modern Sambhar near Jaipur).

##### 2. Key Rulers:

- **Vigraharaja IV:**
  - Expanded the kingdom and conquered Delhi from the Tomaras.
- **Prithviraja III (Rai Pithora):**
  - Known for his valor in the **Battle of Tarain (1191 and 1192 CE)**, defeating and later defeated by **Muhammad of Ghor.**

##### 3. Territorial Extent: Dominated Rajasthan and parts of Haryana and Delhi.

##### 4. Cultural Contributions: Promoted Sanskrit literature; associated with the epic **Prithviraja Raso** by Chand Bardai.

##### 5. Decline: Ended after **Prithviraja III's defeat at the Second Battle of Tarain in 1192 CE.**

63. Which one of the following is a work attributed to playwright Bhasa ?

- (a) *Kavyalankara*
- (b) *Natyashastra*
- (c) *Madhyama-vyayoga*
- (d) *Mahabhashya*



PYQs asked by UPSC since 1979 on this theme

64. The oldest Hindu epic is:

- (a) *Mahabhashya*
- (b) *Ramayana*
- (c) *Ashtadhyayi*
- (d) *Mahabharata*

1988

2024

41. With reference to the history of ancient India, Bhavabhuti, Hastimalla and Kshemeshvara were famous

- (a) Jain monks
- (b) playwrights
- (c) temple architects
- (d) philosophers

2021

10. Which one of the following books of ancient India has the love story of the son of the founder of Sunga dynasty?

- (a) *Swapnavasavadatta*
- (b) *Malavikagnimitra*
- (c) *Meghadoota*
- (d) *Ratnavali*

2016

### Source used by UPSC for this Question

**Upinder Singh (Ancient and Early Medieval India)**

Bhasa, another important playwright, was author of works such as the *Madhyamavyayoga*, *Duta-Ghatotkacha*, *Dutavakya*, *Balacharita* and *Charudatta*. Shudraka's *Mrichchhakatika* and Bharavi's *Kiratarjuniya* are among the other prominent literary works of the period. Bhatti's *Ravanavadha* (7th century) illustrates the rules of grammar while telling the story of Rama's life. Other great



### Explanation and Additional content from Source used by UPSC

Bhasa is one of the earliest known Sanskrit dramatists, and his works have been recognized for their profound impact on classical Indian drama. His play *Madhyama-vyayoga* is based on episodes from the *Mahabharata*, making it a notable contribution to Indian dramatic literature. It is among the thirteen plays attributed to him.



### Solve with Logic and Minimal prior Knowledge

It is generally difficult to solve such factual questions using logic alone. Please refer to the next section and learn about Important Literary Works & their Authors to tackle such questions in exam hall.



### To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)

**Important Literary Works & their Authors (Upinder Singh, IGNOU Notes, A.L Basham, K. Krishna Reddy, Makkhan Lal)**

1. Panini

- **Ashtadhyayi**: A seminal treatise on Sanskrit grammar, comprising 3,996 aphorisms (sutras). Composed in the 5th or 4th century BCE, it establishes the framework for classical Sanskrit grammar.

2. Patanjali

- **Mahabhashya**: A commentary on Panini's *Ashtadhyayi*, expanding and clarifying its rules. Reflects the linguistic, cultural, and philosophical milieu of its time.

3. Bhasa

- **Madhyama-vyayoga**: A one-act play based on a *Mahabharata* episode, focusing on the conflict between Bhima and his son.
- **Dutaghatotkacha**: Depicts the story of Ghatotkacha delivering a message from the Pandavas.
- **Urubhanga**: Centers on Duryodhana's defeat, offering a sympathetic portrayal of his character.
- **Balacharita**: Explores Krishna's childhood.
- **Swapnavasavadatta**: A romantic drama involving the king Udayana and queen Vasavadatta.

4. Katyayana: Author of **Varttika's (commentaries)** on Panini's Grammar

5. Jaimini

- **Purva Mimamsa Sutras**: A foundational text of Mimamsa school of Hindu philosophy. Emphasizes importance of rituals (yajnas) as a means to achieve dharma. Explores the philosophy of Vedas, focusing on interpretation of mantras & Brahmanas.

6. Nagasena

- **Milinda-panha**: Dialogue between Nagasena, a Buddhist monk, & Indo-Greek King Menander (Milinda). Explores Buddhist philosophy through logical & ethical discussions. Covers topics such as impermanence, selflessness & nature of nirvana.

7. Pingala

- **Chandahsastra**: A treatise on Sanskrit prosody (chandas), detailing poetic meters. Introduces the binary numeral system and combinatorics in analyzing poetic patterns.

8. Baudhayana

- **Baudhayana's Sulbasutras**: Ancient texts focusing on geometry and the construction of sacrificial altars. Contain some of the earliest references to the Pythagorean theorem and geometrical principles.

9. Ashvaghosha

- **Buddhacharita**: A poetic biography of Buddha, chronicling his life and teachings.
- **Saundarananda**: Explores the theme of renunciation through the story of Nanda, Buddha's half-brother.

10. Bharata Muni:

- **Natyashastra**: A comprehensive treatise on drama, dance, and music. Lays out the principles of stagecraft, aesthetics (rasa theory), and dramaturgy. Considered the foundational text for Indian performing arts.

11. Bhamaha

- **Kavyalankara**: Foundational text on poetics, emphasizing rhetorical devices.

12. Pampa

- **Pampa's Adi Purana**: Narrative of the first Tirthankara, Rishabha.
- **Vikramarjunavijaya**: A retelling of the *Mahabharata* story.

13. Vararuchi

- **Prakritaprakasha**: A grammar of the Prakrit language.

14. Vagabhata

- **Ashtangahridaya**: Comprehensive Ayurvedic text.

15. Nammalvar

- **Tiruvaymoli**: A Vaishnavite devotional poem forming part of the *Nalayira Divya Prabandham*.

Answers of above UPSC Questions: Ques.63(2024)-c, Ques.64(1988)-b, Ques.41(2021)-b, Ques.10(2016)-b





## PYQs asked by UPSC since 1979 on this theme

64. Sanghabhuti, an Indian Buddhist monk, who travelled to China at the end of the fourth century AD, was the author of a commentary on :
- Prajnaparamita Sutra
  - Visuddhimagga
  - Sarvastivada Vinaya
  - Lalitavistara

2024

77. Milindapanho is in the form of a dialogue between the King Menander and the Buddhist monk
- Nagasena
  - Nagarjuna
  - Nagabhatta
  - Kumarilabhatta

1997

56. India maintained its early cultural contacts and trade links with Southeast Asia across the Bay of Bengal. For this pre-eminence of early maritime history of Bay of Bengal, which of the following could be the most convincing explanation/explanations ?
- As compared to other countries, India had a better ship-building technology in ancient and medieval times
  - The rulers of southern India always patronized traders, brahmin priests and Buddhist monks in this context
  - Monsoon winds across the Bay of Bengal facilitated sea voyages
  - Both (a) and (b) are convincing explanations in this context

2011



### Source used by UPSC for this Question

#### Upinder Singh (Ancient and Early Medieval India)

Many Indian monks who travelled to China during these centuries belonged to Kashmir (Dutt [1962], 1988: 294–310). They included Sanghabhuti, author of a commentary on the *Sarvastivada Vinaya*, who was in China in 381–84 CE. The monk Punyatratna travelled to central Asia along with his student Dharmayasha and translated several Sarvastivadin texts between 397 and 401 CE. From



### Explanation and Additional content from Source used by UPSC

- Prajnaparamita Sutra**: One of the foundational Mahayana texts focusing on the concept of shunyata (emptiness).
- Visuddhimagga**: Written by Buddhaghosha in the 5th century CE, this text is a comprehensive manual of Theravada Buddhism.
- Sarvastivada Vinaya**: Sanghabhuti authored a commentary on the Vinaya of the Sarvastivada school, a significant early Buddhist tradition. Sanghabhuti's work contributed to its spread and understanding in China during the late 4th century CE.
- Lalitavistara**: A Mahayana text; semi-legendary biography of the Buddha, heavily influenced by the Sarvastivada school.



### Solve with Logic and Minimal prior Knowledge

This question can be easily solved with the information given in the question itself, options' analysis and etymology. Sanghabhuti was a monk. A monk is closely associated with texts like the Vinaya, which govern monastic discipline.

- Prajnaparamita Sutra** -> A Mahayana text on wisdom (prajna), not directly related to monastic conduct -> Eliminated.
- Visuddhi** means purification. **Visuddhimagga** - A meditation manual by Buddhaghosa, unrelated to Sanghabhuti. -> Eliminated.
- Sarvastivada Vinaya** -> Vinaya deals with monastic discipline, central to a monk's expertise. -> Possible.
- Lalitavistara** -> means "elaboration of the play" or "story of the Buddha.", not linked to monastic discipline -> Eliminated.



### To-the-Point Content from Sources used by UPSC (Direct Questions in UPSC Prelims'24 from this section)

Comprehensive Buddhist Literature (Upinder Singh, A.L. Basham, IGNOU Notes, NIOS, Romila Thapar, NCERTs)  
Canonical Literature

- Tripitaka (Three Baskets)**:
  - Vinaya Pitaka**: Rules for monks & nuns in the Sangha. Includes the Patimokkha (a list of monastic offenses and atonements).
  - Sutta Pitaka**: Buddha's discourses in dialogue form. Organized into five Nikayas:
    - Digha Nikaya**: 34 long discourses, including Brahmajala Sutta (on views) & Mahaparinibbana Sutta (Buddha's last days).
    - Majjhima Nikaya**: 152 middle-length discourses, such as Satipatthana Sutta and Cula-Malunkiyovada Sutta.
    - Samyutta Nikaya**: Thematic discourses grouped by subject, e.g., Bojjhanga Samyutta (seven factors of enlightenment).
    - Anguttara Nikaya**: Numerical teachings, e.g., Ekaka-Nipata (ones) to Dasaka-Nipata (tens).
    - Khuddaka Nikaya**: Includes Jatakas (Buddha's previous lives), Dhammapada (ethical verses), Theragatha/Therigatha (monk/nun songs) & Nettipakarana (guidelines for interpreting teachings).
  - Abhidhamma Pitaka**: Philosophical and psychological analysis of teachings.
- Councils and Preservation**:
  - 1st Council** (Rajagriha, 483 BCE): under King Ajatashatru; Mahakassapa led recitation of Vinaya and Sutta Pitakas.
  - 2nd Council** (Vaishali, 383 BCE): under Kalashoka; monks debated relaxation of rules, like handling money.
  - 3rd Council** (Pataliputra, 250 BCE): under Ashoka; Moggaliputta Tissa oversaw standardization of Buddhist texts & missions.
  - 4th Council** (Kashmir, 1st century CE): Convened under King Kanishka; led by Vasumitra (who was helped by Asvaghosha); focused on Mahayana doctrines and Sanskrit texts.

#### Mahayana Literature

- Mahayana Sutras**: Prajnaparamita Sutras: Includes Ashtasahasrika Prajnaparamita, teachings on perfection of wisdom; Saddharma Pundarika Sutra (Lotus Sutra): Emphasizes universal salvation; Vimalakirti Nirdeśa Sutra: Explores layperson's role in Mahayana practice; Avatamsaka Sutra: Interdependence of phenomena; Saddharmalankara: Virtues of Buddha's teachings.
- Philosophical Texts**: Nagarjuna's Mula-Madhyamaka-Karika: Foundational text of Madhyamaka school; Asanga's Yogacharabhumih: Basis of Yogachara school.

#### Vajrayana (Tantric) Literature

- Tantras**: Guhyasamaja Tantra and Hevajra Tantra: Rituals, esoteric teachings, and visualization practices. Emphasis on mantras (Om Mani Padme Hum), mandalas, and tantric rituals.
- Notable Scholars**: Abhayakaragupta: Vajrayana texts and Tibetan translations; Atisa Dipankara: Reformed Vajrayana practices.

#### Historical Narratives

- Biographies of Buddha**: Nidanakatha (Pali), Lalitavistara in Gatha (Sanskritized Prakrit), Mahavastu (Sanskrit-Prakrit), and Buddhacharita (Sanskrit, 1st–2nd CE).
- Avadana Texts**: Stories emphasizing virtuous deeds including the Avadanashataka and Divyavadana.
- Mahavamsa and Dipavamsa**: Chronicles of Buddhist history in Sri Lanka.

#### Philosophical Contributions

- Doctrines**: Shunyata (Emptiness): Central to Madhyamaka philosophy; Dependent Origination: Interconnectedness of phenomena
- Principles of Logic and Knowledge**: Dignaga's Pramanasamuccaya: Formal logic in Buddhist thought.

Lay and Devotional Literature: Dhammapada: Ethical verses summarizing the Buddha's teachings; Sigalovada Sutta: Guidance on lay ethics; Milindapanha: Dialogue between King Milinda and monk Nagasena on Buddhist philosophy.

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