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Ancient & Medieval History & Culture Preview

ANCIENT AND MEDIEVAL HISTORY & CULTURE

PRELIMS & MAINS

For Civil Services Exams

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ANCIENT HISTORY

CHAPTER 2 INDUS VALLEY CIVILIZATION

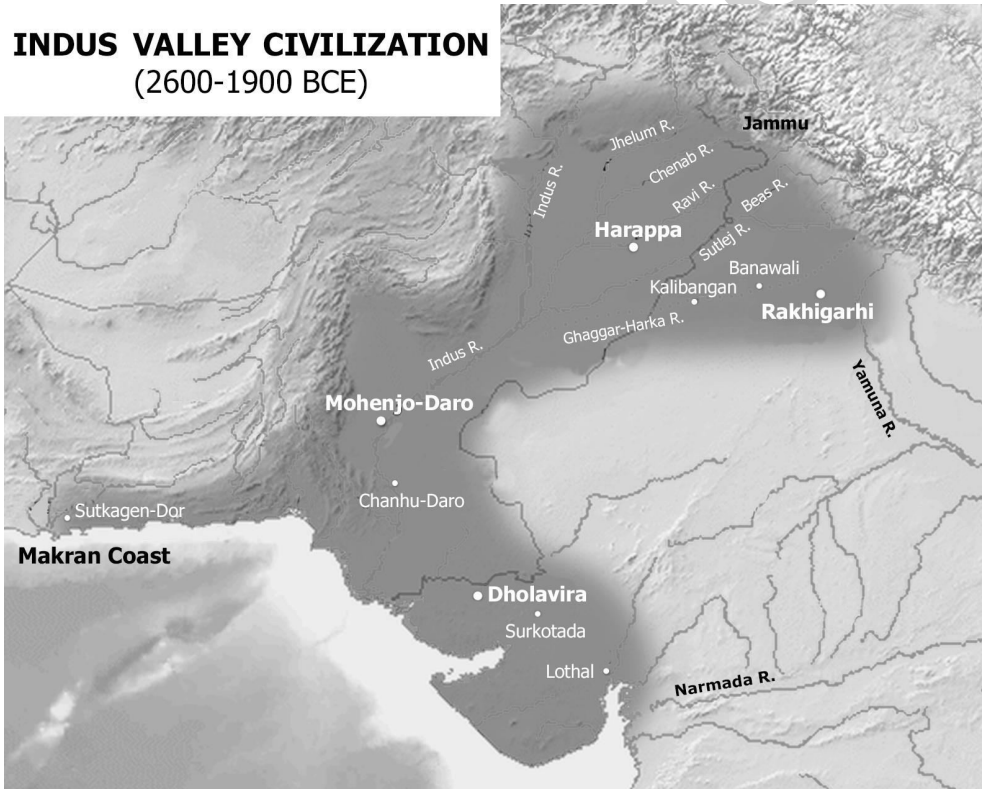
INDUS VALLEY CIVILIZATION

Indus Valley civilization is one of the oldest civilizations, which is believed to exist from 3300 BC to 1300 BC. Indus Valley civilization is called so because the civilization emerged around Indus and its tributaries. Some of the settlements also emerged around Ghaggar–Hakra river. Indus Valley civilization is also referred as the Harappan Civilization because the first city to be excavated (digging up) was Harappa. It was discovered in 1921 at the present day Harappa by the archaeologists Dr Raj Bahadur Daya Ram Sahini and John Marshall. At about the same time, R.D. Banerjee excavated the site of Mohenjodaro in Sindh. Large-scale excavations were carried out at Mohenjodaro under the supervision of Marshall in 1931.

The people of this civilization used bronze predominantly and thus, this time period is referred to as the Bronze age (bronze is an alloy of copper and tin) or Chalcolithic age.

Geographical Extent

The geographical extent of Indus Valley civilization is bigger than ancient Egypt and Mesopotamia. It rose from the Northwest part of the Indian subcontinent and spread Southward and Eastward. It extended from Jammu in the North to Narmada Valley in the South, and from the Makran coast of Baluchistan in the West to Yamuna in the East.



The Indus Valley civilization is classified into three phases:

1. The early phase from 3300 BC to 2600 BC
2. The mature phase (when the civilization was at its peak) from 2600 BC to 1900 BC
3. The late phase from 1900 BC to 1300 BC

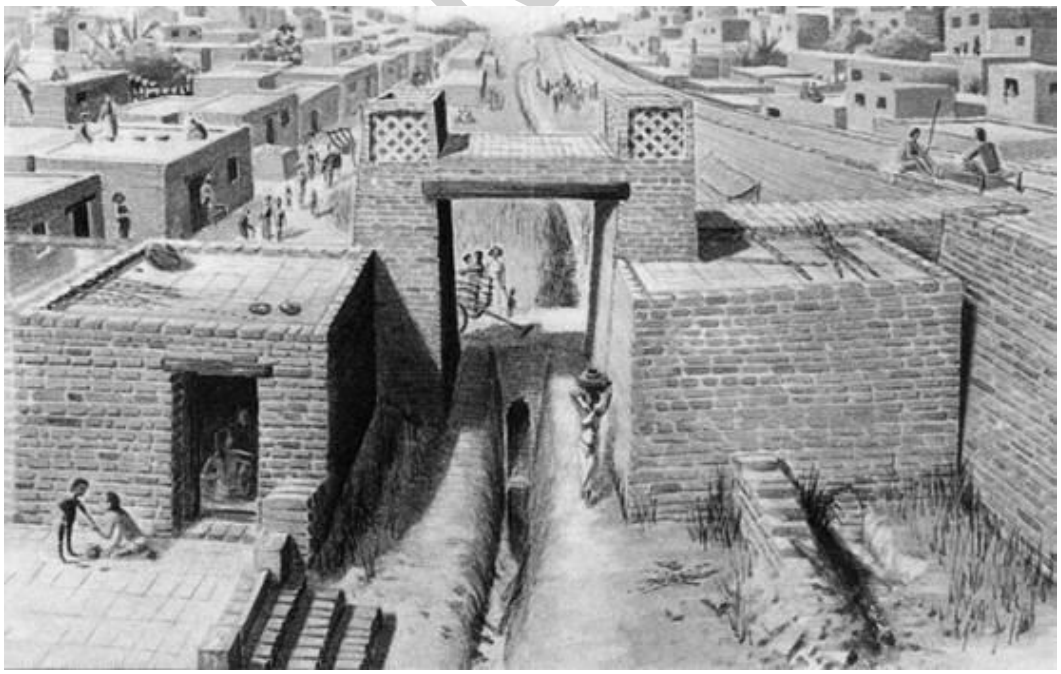
So far, nearly 1400 Harappan sites are known in the subcontinent. These belong to early, mature, and late phases of the Harappan culture. However, the number of the sites belonging to the mature phase is limited. Of these, limited sites can be regarded as towns and these towns are Harappa in Pakistan Punjab; Mohenjodaro (literally means Mound of the Dead Men) Chanhudaro in Sindh, Pakistan; Lothal, Dholavira, and Surkotada in Gujarat; Banawali and Rakhigarhi in Haryana; and Kalibangan in Rajasthan.

Town Planning and Urban Architecture

The ruins of the towns of Indus Valley civilization show signs of remarkable town planning and excellent sanitation system. The towns were usually divided into two parts—citadel, which was constructed on an elevated place and was fortified, and the remaining town. The citadel was built on top of a mound of bricks almost 12 meters high. A large staircase ran up the side of this mound.

Figure 1 Citadel at Mohenjodaro

Several large buildings and structures on the citadel mound suggest that this area may have been used for public gatherings, religious activities, or important administrative activities. Small buildings which were probably homes do exist on the citadel mound; however, they are not common.



The houses inhabited by the common people followed grid system. The streets used to run from North to South and East to West, intersecting each other at right angles. The drainage system was very impressive. Every house had its own courtyard and bathroom. Drains from bathroom were connected to street drains. The street drains were equipped with manholes. Perhaps, no other civilization gave so much attention to health and cleanliness as Harappan did.

Town planning

There were no stone-built houses in the Indus cities. Most of the houses were built of burnt bricks. Unburnt sun-dried bricks were also used in those portions of the houses where the chances of contamination through the water were least. The bricks used to be of the same size. The staircases of big buildings were solid and the rooftops were flat.

Some of the major structures which were found in this civilization are "Great Bath" in Mohenjodaro and "Granary" at Harappa.

Great Bath

The "Great Bath" is a public water tank. The tank measures approximately 12 meters long and 7 meters wide, with a maximum depth of 2.4 meters. Two wide staircases, one from north and one from south, lead down into the tank.

Figure 2 The Great Bath, Mohenjodaro

The floor of the tank is water tight due to finely fitted bricks and use of gypsum plaster on the edges of bricks. To make the tank even more water tight, a thick layer of bitumen (natural tar) was laid along the sides of the tank and presumably also beneath the floor. Two large doors lead into the complex from the South.

A series of rooms are located along the Eastern edge of the building and in one room there is a well that may have supplied some of the water needed to fill the tank. Rainwater may also have been collected for filling the tank, but no inlet drains have been found.

Most scholars agree that this tank would have been used for special religious functions, where water was used to purify and confer the well-being on the bathers.

Great Granary

The remains of great granary have been found at Harappa. The granary measures over 45 meters long and 45 meters wide.

Two rows of six rooms are arranged along a central passageway that is about 7 meters wide. Each room measures 15.2 by 6.1 meters. The rooms were possibly occupied by workers. A wooden superstructure supported by large columns was possibly built on top of the brick foundations, with stairs leading up from the central passage area.

The granary neither possess charred grains nor any storage containers have been found. The interpretation of such structures as granaries is based on comparisons with Roman buildings.

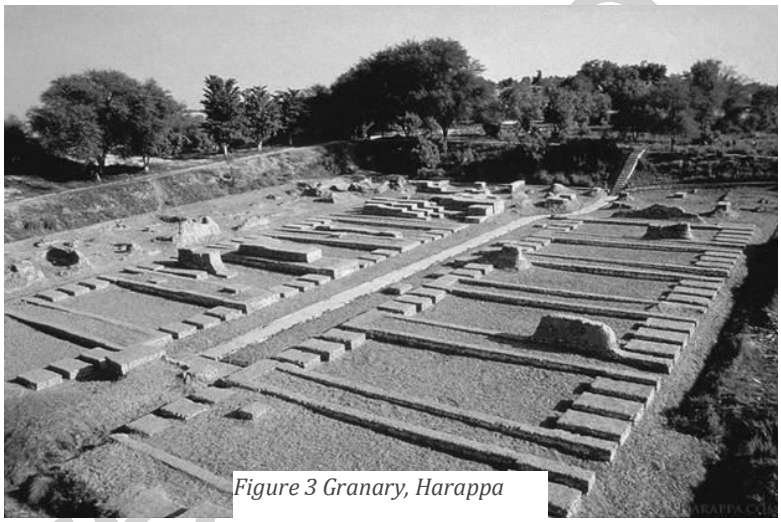


Figure 3 Granary, Harappa

Agriculture

Agriculture is believed to be the main occupation of the Indus Valley people. The discovery of granary lends support to this belief. Most of the agriculture took place during winter. The Indus Valley people produced wheat, barley, rai, peas, sesamum, mustard, rice, and cotton. The Indus Valley people were the earliest people to produce cotton. The Greeks called it Sindon (derived from Sindh) because cotton was first produced in this area.

The important crops cultivated were wheat and barley. The evidence of wheat and barley has been found at Mohenjodaro. In the early times, the region of Indus Valley possessed high natural vegetation. The ruins show no signs of canal irrigation. Iron was discovered around 1000 BC and thus, people of this region used wooden plough.

The houses were constructed at a slightly raised platform, as compared to the streets. The raised houses may be an indication of regular floods in rainy season. Thus, agriculture was

severely hampered during summers.

Domestication of Animals

Although the Harappans practiced agriculture, animals were kept on a large scale. Dogs, cats, oxen, buffaloes, goats, sheep, elephants, and pigs were domesticated. The humped bull was favorite among Harappans. Asses and camels were used to carry loads.

Earlier, it was believed that horses were not tamed by the Indus Valley people but later on the bones and skeletons of horses were found in some regions of the civilization. This made the historians believe that perhaps at the later stage of the civilization, horses were domesticated. The existence of wild animals like rhinoceros, tiger, and bison has also been confirmed.

Trade

Indus Valley civilization was a trading society. Instead of metal money, they followed barter system. Traders had their own seals. They used a uniform script, and standard weights and measures.

There is evidence that the Harappans carried trade within India as well as outside Indian subcontinent. Trade links have been found up till Mesopotamia and Turkey. The Mesopotamian records refer to Indus region as Meluha.

The Harappan cities did not possess the necessary raw material for the commodities they produced and hence depended upon important metals and nonmetals imported from distant places.

Main exports were agricultural products and finished products, such as cotton goods, carnelian beads, pottery, shell, and bone inlays.

Weight system of Harrapans

Excavators have found number of balance weights made up of chert. These weights are in the shape of cube. The most basic weight found most commonly was about 13.65 grams. The other weights were sub-divisions or multiples of this weight. The weights proceeded in a series, first doubling from 1, 2, 4, 8 to 64 and then in decimal multiples of 16. The relation of the common weight with other weights is described below.

Multiples of the smallest unit	1	2	4	8	16		32	64		
Multiples of the 13.65 g unit	1/16	1/8	¼	½	1		2	4		
Idealized Weight	0.85 g	1.75 g	3.45 g	6.85 g	13.65 g		27.35 g	54.65 g		
Larger by a factor of 10					160	200	320	640		
					10	12.5	20	40		
					136.5 g	170.6 6	273.5 g	546.5 g		
Larger by a factor of 100, 100 unit increments					1600		3200	6400	8000	12,800
					100		200	400	500	800
					1.365 kg		2.73 kg	5.46 kg	6.83 kg	10.92 kg

Measurement System

The Harappans also followed measurement system. The length of foot was 13.2 inches and of cubit was 18 inches or 44 cm. Several sticks with measure marks, including one made of bronze, have been discovered. Cubit refers to length of the arm from the elbow to the tip of the middle finger.

Religious Practices

There is no evidence of temple or any other religious structure except the Great Bath and the fire altars at Kalibangan and Lothal.

On the basis of the material remains, it can be deduced that religious practices of Harappan people had many features of the later Hinduism, such as worship of the Mother Goddess, Pashupati Siva, animal worship, tree worship, etc.

A terracotta figure of Mother Goddess has been found at Harappa. A plant is shown growing out of the womb of a woman. The figure represents the goddess of earth.

Figure 4 Terracotta figure of Mother Goddess

The male deity has been depicted with two horns, sitting in a cross-legged position (sitting posture of a yogi). He is surrounded by four wild animals, an elephant, a tiger, a rhinoceros, and a buffalo, and beneath his feet appear two deers. This deity appears similar to Siva of later Hinduism.

Figure 5 Pashupati seal

Moreover, phallic worship was an important element of Harappan culture. Numerous cylindrical cone-shaped stones were found which shows that people worshipped lingam—a symbol of lord Shiva.

There is evidence to prove that people of the Indus Valley civilization also worshipped trees and animals. On one seal, picture of a deity is represented in the midst of the branches of the peepal tree. Peepal tree is worshipped even to this day.

Animals were also worshipped. The most important of them is the humped bull. The inhabitants of the Indus region thus worshipped gods in the form of trees, animals, and human beings.

Burial Practices

Cemeteries at various sites have proven particular burial practices of the Harappans with slight variations. For instance, three types of practices have been found at Mohenjodaro:

1. Complete burials (burial of the whole body along with goods)
2. Partial burials (burial of some bones after the exposure of the body to wild beasts and birds)
3. Post-cremation burials

Another type of burial has been found at Lothal, a pair of skeletons, one male and one female in each case, buried in a single grave. Bodies were placed in the North–South direction, with the head pointing to the North.

Technology

The Harappan civilization is a Bronze Age civilization. Apart from stone tools and implements, people were well acquainted with the use of bronze.

Objects of gold were common. Gold exists in nature as free metal. Thus, it was naturally available. Silver was used for the first time in the Indus civilization and was relatively more common than gold. Arsenic, lead, antimony, and nickel were also used by the Harappan people.

Bronze implements at mass scale have been found, such as axes, chisels, knives, spearheads, etc. The Harappans also practiced boat making.

Seals and Terracotta Figures

Seal is a piece of material with an individual design stamped onto it. Seals are accurate in their size and design. About 2000 seals have been found; these seals were small in size. While most of the seals were square-shaped, rectangular and circular seals were also found. Two main types of seals are seen—first, square with an image and inscription; second, rectangular with an inscription only.

Steatite (in nature of soft mineral) was the most common material used to make seal. Other materials used include agate, chert, copper, and clay. Seals made of gold, silver, and ivory were also found.

Figure 6 Square seal depicting a nude male deity found at Mohenjo-daro Dimensions: 2.65 x 2.7 cm, 0.83 to 0.86 thickness

Most seals have inscriptions in a pictographic script written from left to right. But in some cases the script is written from right to left as well. Seals were primarily used for commercial purpose and might have been used as amulets or for educational purpose.

Terracotta figurines have also been reported from various sites. Figurines made of fire-baked clay are called terracotta which were either used as toys or objects of worship. Terracotta was used mainly by the common people.

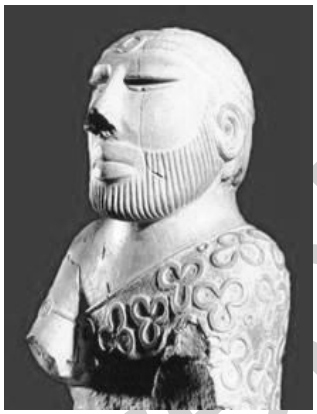
Polity and Society

There is no clear idea about the political organization of the Harappans. There is so sign of any central authority. The total absence of internal wars speaks volumes about the peaceful administration of the Indus state.

Sculpture

Two main sculptures that were extracted from the ruins of Indus Valley are—(i) priest in limestone and (ii) a statue of a "Dancing Girl" in bronze. These sculptures exhibit the level of expertise that the artists of Harappan civilization had achieved in making sculptures.

The ornament on the forehead of the famous "priest-king" sculpture appears to represent an eye bead, possibly made of gold with steatite inlay in the center.



Sculpture of Priest-King found at Mohenjodaro

Dancing girl found at Mohenjodaro

The red sandstone figure of a male torso is another specimen of rock sculpture.

Male torso found at Harappa

Pottery

Harappans were great potters as well. The potteries made by the Harappans can be classified into four types—(i) plain pottery, (ii) painted pottery (which is also known as red and black pottery), (iii) polychrome pottery (very rare), and (iv) perforated pottery. The purpose of different types of pottery was as follows:

- Plain pottery was used for household purpose, mainly for storage of grains and water.
- Miniature vessels were used for decorative purpose.
- Perforated pottery (large hole in the bottom and small holes across the sides of the vessel) might have been used for straining liquor.

Dressing style

Men and women wore clothes of wool and cotton. Men wore robes which left one shoulder bare. Women wore a short skirt that reached up to the knee and it was held by a girdle—a string of beads. Upper classes wore garments with elaborate designs.

Hairstyles

The hair styles of the women were often elaborate, and pigtails were also popular, as in present-day India. Men and women alike had long hair. Men wore beard and moustaches.

Fashion

Bronze mirrors were common. Females at Mohenjodaro used collyrium (eye shadow), face-paint, and other cosmetics. Chanhudaro provides evidence of lipsticks. Bronze razors of various types were used by males.

Ornaments

Harappan people loved ornaments. Both men and women wore ornaments like necklaces, fillets (a band or ribbon worn for binding the hair), armlets, and finger rings. Girdles (belt), earrings, and anklets were worn only by women. Beads made from cornelian, amethyst, quartz, and steatite were produced at a large scale from the factories at Lothal and Chanhudaro. Amulets have been found in large numbers. Probably, the Harappans believed in ghosts and evil forces.

Figure 7Ornaments used by Indus Valley civilization people

Amusements
Children played with toys made of terracotta. Children also played with marbels made out of jasper and chert. Music and dance were popular. Hunting and fishing were common activities. On a few seals, hunting of wild rhino and antelope is shown. Dice was used in gambling.

Harrapan Script
The Harappan script (also known as the Indus script) has not yet been deciphered. The characters are largely pictorial and seem to be in form of meaningful signs. The number of principal signs is about 400.

The inscriptions are mostly written from right to left. This is proven from the fact that many times the symbols were compressed on the left side. This usually happens when the writer is running out of space at the end of the row.

The Harrapan inscriptions containing signs are extremely short, making it difficult to judge whether or not these signs constituted a script used to record a language, or even symbolise a writing system. The average length of the inscriptions is less than five signs, the longest being only 26 signs long. There is no known bilingual inscription to help decipher the script, nor does the script show any significant changes over time. In spite of many attempts, 'the script' has not yet been deciphered, but efforts are going on.


Figure 8 Script on a seal

Decline of Harrapan Culture
Harappan civilization came to a sudden end. The exact reason for collapse of this civilization is not known; however, various reasons are hypothesized behind collapse of this civilization:

- Floods may have resulted in collapse of Indus Valley civilization. Earlier, civilization emerged near water bodies. As a result, large floods could have possibly wiped-out Indus Valley civilization.

- Geographically, the region occupied by the Harappan civilization was prone to earthquakes. Repeated earthquakes can be a reason behind decline of the Indus civilization.

- We know that Harappans were traders and not warriors. Thus, the people of the civilization were not prepared for an invasion. The emphasis was on prosperity through economic

development. Unburied skeletal remains were found in Mohenjodaro. Such remains are signs of an aggressive invasion. Aryan invasion may be reason behind the decline of Indus Valley civilization.

- Other possible reasons behind end of this civilization may be drought and spread of disease.

Difference Between Harappan and other West Asian cultures

Harappan culture	Mesopotamian culture
The towns were well planned.	The towns were haphazardly planned.
Had a well-maintained drainage system.	Not much preference was given to sanitation.
Rectangular house with brick-lined bathrooms.	No particular shape for the houses.
Did not have a particular language.	Had their own language.

List of important sites of Indus Valley civilization

Site	District	Province/ State	Country	Excavations/findings
Banawali	Fatehabad district	Haryana	India	Barley, terracotta plough, saw two cultural phases, pre-Harappan and Harappan, similar to that of Kalibangan
Chanhudaro	Nawabshah district	Sindh	Pakistan	Bead-making factory, use of lipstick, only Indus site without a citadel
Dholavira	Kutch district	Gujarat	India	Figure of chariot tied to a pair of bullocks and driven by a nude human, water harvesting and number of reservoirs, use of rocks for constructions, all the three phases of the Harappan culture
Harappa	Sahiwal district	Punjab	Pakistan	Granaries, coffin burial, lot of artifacts, first town which was excavated and studied in detail
Kalibangan (literally meaning black bangles)	Hanumangarh district	Rajasthan	India	Baked/burnt bangles, fire altars, Shiva lingam, small circular pits containing large urns and accompanied by pottery, bones of camel
Lothal	Ahmedabad district	Gujarat	India	Bead-making factory, dockyard, button seal, fire altars, painted jar, earliest cultivation of rice (1800 BC)

Mehrgarh		Balochistan	Pakistan	Earliest agricultural community
Mohenjodaro	Larkana District	Sindh	Pakistan	Great Bath, Great granary, Bronze dancing girl, Bearded prince-king, terracotta toys, Bull seal, Pashupati seal, three cylindrical seals of the Mesopotamian type, a piece of woven cloth, largest site covering 500 hectares.
Surkotada	Kutch district	Gujarat	India	Bones of a horse (only site)
Sutkagendor		Balochistan	Pakistan	Coastal city like Surkotada
Rakhigarhi	Hissar district	Haryana	India	All the three phases of the Harappan culture, second largest site, with an area of 250 hectares

Practice Questions

1. Which one of the following animals was not represented on the seals and/or terracotta art of the Harappan culture?
(a) Cow
(b) Elephant
(c) Rhinoceros
(d) Tiger

2. The earliest evidence of silver in India is found in the
(a) Harappan culture
(b) Palaeolithic culture
(c) Vedic civilization
(d) None of the above

3. The Indus or the Harappan culture is
(a) Neolithic culture
(b) Palaeolithic culture
(c) Chalcolithic culture
(d) Post-Chalcolithic culture

4. Which one of the following archaeologists initially discovered the Mohanjedaro site of the Indus Valley civilization?
(a) Sujohu Marshall
(b) Daya Ram Sahni
(c) Rakhal Das Banerjee
(d) Sir Mortimer Wheeler

5. The Harappa site showing evidence of two cultural phases. Harappan and pre-Harappan, is
(a) Lothal
(b) Mohenjodaro
(c) Chanhudaro
(d) Banawali

Perfecting past prelims

1. Regarding the Indus Valley civilization, consider the following statements: (2011)
1. It was predominantly a secular civilization and the religious element, though present, did not dominate the scene.
2. During this period, cotton was used for manufacturing textiles in India.
Which of the statements given above is/ are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

2. Which of the following characterizes/ characterize the people of Indus civilization? (2013)

1. They possessed great palaces and temples.
2. They worshipped both male and female deities.
3. They employed horse-drawn chariots in warfare.
Select the correct statement/ statements using the codes given below:
(a) 1 and 2 only
(b) 2 only
(c) 1, 2, and 3
(d) None of the statements given above are correct.

3. With reference to the difference between the culture of Rigveda Aryans and Indus Valley people, which of the following statements is/are correct? (2017)
1. Rigvedic Aryans used the coat of mail and helmet in warfare, whereas the people of Indus Valley civilization did not leave any evidence of using them.
2. Rigvedic Aryans knew gold, silver, and copper, whereas Indus Valley people knew only copper and iron.
3. Rigvedic Aryans had domesticated the horse, whereas there is no evidence of Indus Valley people having been aware of this animal.
Select the correct answer using the code given below:
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d)1, 2, and 3

4. Which one of the following is not a Harappan site? (2019)
(a) Chanhudaro
(b) Kot Diji
(c) Sohgaura
(d) Desalpur

5. Which one of the following ancient towns is well-known for its elaborate system of water harvesting and management by building a series of dams and channelizing water into connected reservoirs? (2021)
(a) Dholavira
(b) Kalibangan
(c) Rakhigarhi
(d) Ropar

Answer Keys

Practice Questions

1. (a)	**2.** (a)	**3.** (c)	**4.** (c)	**5.** (d)

Perfecting Past Prelims

1. (c)	**2.** (b)	**3.** (a)	4. (c)	5. (a)

Solutions

Practice Questions

1. (c) R.D. Banerji was an Indian historian and a pioneer of archaeology. He is popular for unearthing Mohenjodaro and for noting similarities between the site at Mohenjodaro and Harappa.

2. (d) Kalibangan (means black bangles) is situated in Northern Rajasthan and Banawali is situated in Hissar district in Haryana. Both the sites saw two cultural phases, pre-Harappan and Harappan.

Perfecting Past Prelims

1. (c) Statement 1 is correct. The only evidence found with any strong connection with religion is "The Great Bath." Though the sculptures of some deities were found but they do not suggest that the Harappan society was dominated by religion.

2. (b) Statement 1 is incorrect because no palaces and temples have been discovered from Harappan sites.
Statement 3 is incorrect: There is little evidence of horse and there is no evidence of horse driven chariot.

3. (a) Statement 2 is incorrect: Harappan men and women wore ornaments made of gold, silver, copper, bronze, and semiprecious stones. So, the Indus Valley people knew the use of copper, bronze, silver, gold, but not iron. Iron was discovered much later around 1000 BC.
Statement 3 is incorrect: Evidence of horse was found at Indus Valley civilization.

4. (c) Sohgaura in Uttar Pradesh is a Mauryan period site.

MEDIEVAL HISTORY

The death of Harshavardhana marks end of ancient history of India. The period that followed is referred as Medieval India. Some remarkable changes that took place in this time period are as follows:

- Political authority in North declined, leading to decentralization of power,
- Emergence of feudalism,
- Advent of Islam,
- Pataliputra lost its importance and Kannauj rose to prominence,
- Emergence of Rajputs.

Feudalism

The dominant social system in which the nobility held lands (jagirs) from the king in exchange for military service, and vassals (holders of land) were in turn tenants of the nobles, while the peasants were obliged to live on their noble's land and give him labor, and a share of the produce, notionally in exchange for military protection.

CHAPTER 12 INDIA AFTER HARSHA

After the death of Harsha, there was no political unity in North India for about 5 centuries. The country was split up into a number of states, which were constantly fighting. Kannauj, the capital of Harsha, was symbol of supremacy. Also, the control over Kannauj implied control over upper Gangetic plains and its rich resources. Three dynasties namely—(i) the Palas, (ii) the Pratiharas, and (iii) the Rashtrakutas fought "tripartite battle" for the supremacy of the North.

Some important dynasties during early medieval period (8th–13th century) were:

The Rashtrakutas (AD 735–973)

The Rashtrakutas were of Kannada origin. They ruled over large parts of Maharashtra and Karnataka.

Terminology of the Time
Rashtras: Several provinces into which Rashtrakuta Empire was divided. These were under the control of rashtrapatis.
Vishayas: Districts; governed by vishayapatis.
Bhukti: Administrative unit at sub-division level, consisting of 50–70 villages. These were under the control of bhogapatis.

Dantidurga (735–756)

- He was the founder of the Rashtrakuta dynasty. He defeated Kritivarman II to gain the control of Chalukyas and founded Rashtakuta dynasty.
- His capital was based in Gulbarga region of Karnataka.
- Dasavatara cave at Ellora was started as a buddhist monastry, but it was converted into a hindu temple under Dantidurga.

Krishna I (756–774)

- He defeated the Gangas and the Eastern Chalukyas of Vengi. Eastern Chalukyas are also known as the Chalukyas of Vengi. They ruled over parts of South India between the 7th and 12th centuries. They were governors of the Chalukyas of Badami in the Deccan region. Subsequently, they became rulers. They ruled the Vengi region of present-day Andhra Pradesh until c. 1130 AD.

Western Ganga was a dynasty of ancient Karnataka, which lasted from about AD 350 to AD 1000. They are known as "Western Gangas" in order to distinguish them from the Eastern Gangas who in later centuries ruled over Kalinga (modern Odisha).

- He built the magnificent rock-cut monolithic Kailasa temple at Ellora.

Dhruva (780–793)

- Defeated Pratiharas and Palas for Kannauj.

Govinda III (793–814)

- He achieved victories over North Indian kingdoms. He was able to occupy Kannauj.
- He even obtained submission from King of Ceylon (Sri Lanka) without even going to battle.

The King of Ceylon is said to have sent him two statues, one of himself and another of his minister as an act of submission.

Control over Kannauj

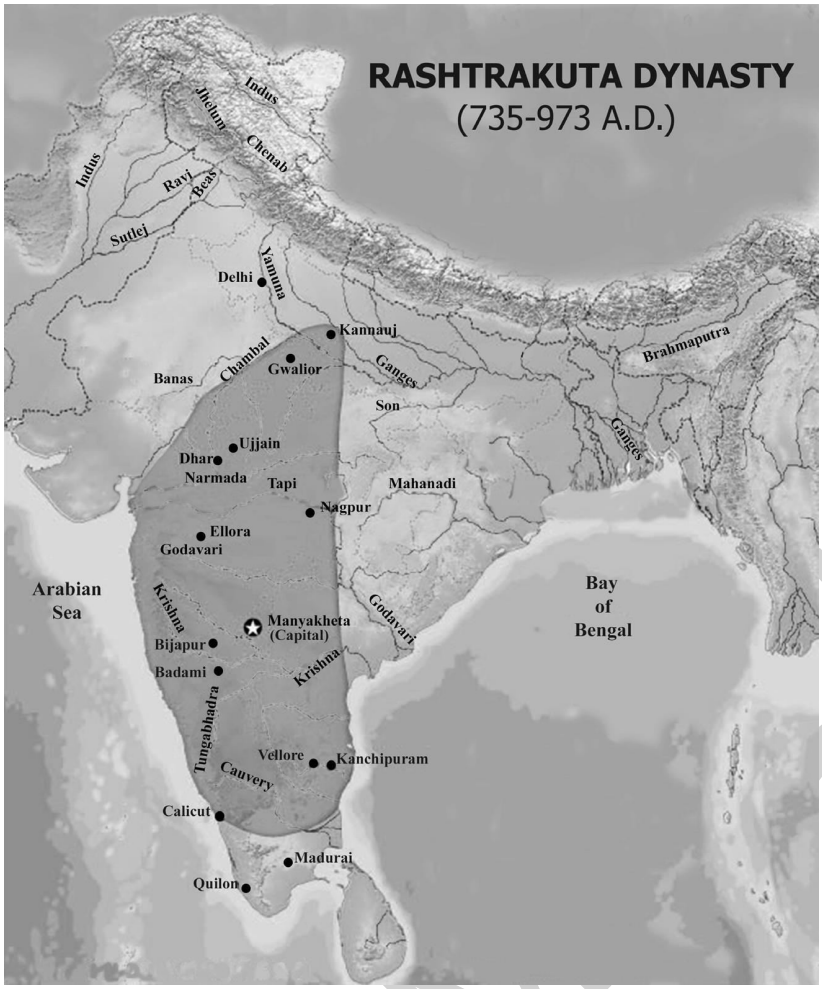
Gurjara-Pratihara ruler Vatsaraja was able to establish his rule over Kannauj. The Pala ruler Dharampala also attempted to establish his authority over Kannauj. Dharampala was however defeated. In the meantime, the Rashtrakuta ruler Dhruva surged northwards and defeated Vatsaraja, taking control over Kannauj.

When the Rashtrakuta ruler advanced back to south, Dharampala was left in control of Kannauj for some time. The struggle between the two northern dynasties continued. Kannauj was again occupied by the Gurjara Pratiharas.

Dharampala tried to take control of Kannauj. However, he was badly defeated at Moongher by Nagabhata II of Gurjara Pratiharas dynasty. However, Nagabhata II was in turn defeated by the Rashtrakuta king Govinda III.

Amoghavarsha-I (814–878)

- Although he lost control over Malwa, his reign saw tremendous cultural development.
- He was converted into Jainism by Jinasena, a Jaina monk. Jinasena wrote *Parsvabhudaya*—a biography of Parsva (23rd Tirathankar). Jinasena is also behind composition of Mahapurana. It is an important Jain text composed largely by Acharya Jinasena and completed by his follower Gunabhadra. Mahapurana consists of two parts. The first part is Adipurana, which was composed by Acharya Jinasena. The second part is Uttarapurana, which was composed by Gunabhadra.
- He wrote the famous Kannada work, *Kavirajamarga*—the first poetic work in Kannada language.
- His daughter, Chandrobalabbe, administered the Raichur doab for some time. It was a rare appointment in Rashtrakuta administration. The Raichur Doab is a triangular region of land in the Southern Indian states of Telangana and Karnataka lying between the Krishna River and its tributary, the Tungabhadra River. The doab is named for the town of Raichur in the Raichur District. "Doab" means land between two rivers.
- He is said to have built the Rashtrakuta capital at Manyakheta/now Malkhed, Gulbarga region, Karnataka.



Indra III (915–927)

- Al-Masudi, an Arab historian and geographer, visited India during his time.

Krishna III (c.939–967)

- He marched against the Cholas and defeated them at Takkolam in the present-day Vellore district of Tamil Nadu.
- He built several temples in the conquered territories including one at Rameswaram in Tamil Nadu.
- In 973 CE, the Rashtrakuta dynasty was overthrown by Taila II, a feudatory of Krisha III. Tailpa II was the descendant of the old Chalukya empire. Taipa II later founded the dynasty of Chalukyas of Kalyani

Cultural Contributions

- The Rashtrakutas widely patronized the Sanskrit literature.
- The Jain literature flourished under their patronage.
- Trivikrama Bhatta was a noted scholar in the court of Indra III. Trivikrama wrote *Nalachampu* in Sanskrit. It has legend that Goddess Saraswati helped him in his effort to compete with a rival in the king's court.
- Halayudha patronized by King Krishna III wrote *Kavirahasya*, a list of verbs with their meanings written in verse.

- Sakatayana patronized by Amoghavarsha I wrote the grammar work called *Amogavritti*.
- In mathematics, ground-breaking theories on algebra, arithmetic, and geometry were postulated by Viracharya, a native of Gulbarga. He was patronized by King Amoghavarsha I. His greatest contribution was *Ganitasarasangraha*.
- The Kannada literature saw its beginning during the period of the Rashtrakutas.
- Pampa was the greatest of the Kannada poets. His famous work was *Vikramarjuna Vijaya*. Vikramarjuna Vijaya is the author's version of the Hindu epic Mahabharata. The story differs from other earlier versions of the epic in that Arjuna alone is the hero, not the other Pandava brothers, and Draupadi is solely Arjuna's wife.
- Ponna, patronized by King Krishna III, wrote *Santipurana*. It was description of the life of the 16th Jain tirthankara Shantinatha. He earned the title Ubhaya Kavichakravathi (supreme poet in two languages) for his command over both Kannada and Sanskrit.

The Solankis (c. 942–1243)

They ruled over Gujarat with capital city Anhilwad (presently Patan).

Mulraj

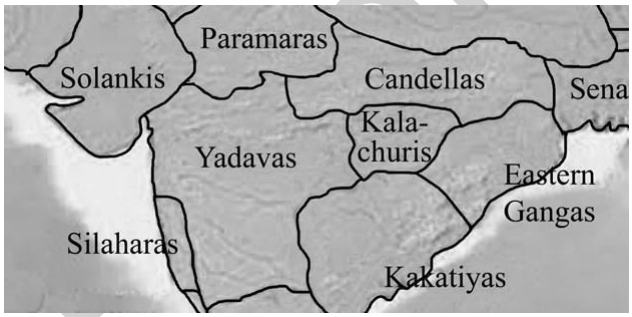
- Founder of the dynasty.
- His period marks the beginning of the Gujarati Culture. His reign marked the start of a period during which Gujarati Culture flowered as manifested in art, architecture, language, and script. It is described as the golden period of Gujarat's history.

Bhim I (c.1021–1063)

- He was defeated by Muhammad (also called Mahmud) Ghazni, who looted and destroyed the famous Somnath temple.

Bhim II (c. 1178–1241)

- Defeated Muhammad Ghori.



The Guhadwalas or Gahadavala (11th–12th century)

- Ruled over Southern Rajasthan up to Kannauj in Uttar Pradesh.

Jaichandra or Jaichand (c.1169–1194)

- His daughter married Rajput King Prithvi Raj Chauhan.
- He helped Muhammad Ghori to defeat Prithvi Raj in AD 1192.
- He was killed by Muhammad Ghori in the battle of Chandawar.

The Chauhans (Chahamanas) (c. 957–1192)

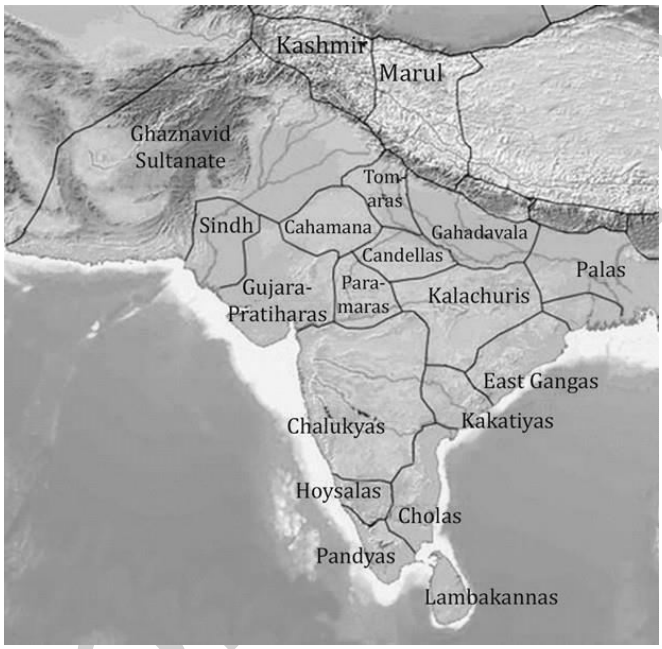
- They ruled over Northern Rajasthan.

Ajay Raj Chauhan

- Founded the capital city of Ajmer.

Prithvi Raj Chauhan (c. AD 1178–1192)

- He built the Qila Rai Pithora in Delhi.
- Married Samyukhta—the daughter of Jaichand.
- Defeated Mohammad Ghori in first battle of Tarain.
- Prithvi Raj Chauhan was killed by Mohammad Ghori with help of Jaichand in the second battle of Tarain.
- Chand Bardai wrote *Prithviraj Raso*—a Brajbhasha epic poem on the life of Prithvi Raj Chauhan. He was the court poet of the king.



The Pratiharas (AD 730–1036)

They were also called Gurjara-Pratiharas as they originated from Gujarat or South Western Rajasthan. They ruled over Madhya Pradesh with capital cities Avanti (modern day Ujjain) and Kannauj.

Nagabhata I

- He was the founder of the dynasty.

Mihirabhoja or Bhoja I (836–882)

- Defeated Rashtrakutas and recovered Kannauj, which remained their capital for almost a century.
- He was a devotee of Vishnu and adopted the title of "Adivaraha."
- Al-Masudi, a native of Baghdad, visited Gujarat after death of Bhoja. He talked about power and prestige of Bhoja.

Mahipala

- The great Sanskrit poet and dramatist, Rajashekhar lived in his court.
- Downfall of Pratiharas started during his reign. Rashtrakuta king, Indra III defeated him and took over Kannuaj.
- Rashtrakutas took control over Gujarat as is mentioned by Al- Masudi in his accounts – 'The Pratihara Dynasty had no access to sea'.

The Chandelas or Candellas (Between 9th and 13th Century)

They ruled over Bundelkhand region of Madhya Pradesh with capital at Khajuraho. Dynasty is also called Jejaka bhukti dynasty (forest tribe with Jejaka as chief deity). The word "bhukti" literally means bhakti. The Chandelas initially ruled as feudatories of the Gurjara-Pratiharas. The greatest contribution of Chandelas has been the construction of Khajuraho temples.

Nannuka (c. 831–845 CE)

- Nannuka, the founder of the dynasty, was the ruler of a small kingdom centered around Khajuraho.
- According to the Chandela inscriptions, Nannuka's successor Vakpati defeated several enemies. Vakpati's sons Jayashakti (Jeja) and Vijayashakti (Vija) consolidated the Chandela power. According to a Mahoba inscription, the Chandela territory was named "Jejakabhukti" after the Jayashakti.

Yashovarman

- Practically, he established Chandelas as sovereign power. However, he continued to acknowledge the Pratihara suzerainty.

Vidyadhara

- He extended the kingdom as far as the Chambal and Narmada rivers.

End of Dynasty in 1315

- Chandela power effectively ended around the beginning of the 13th century, following Chahamana and Ghurid invasions

The Senas (c. AD 1070–c. AD 1230)

- They ruled over parts of Bengal and Bihar.

Lakshmen Sena

- Jaidev, also known as Jayadeva, is famous for his work *Gita Govind*, was his court poet.
- Bakhtiar Khilji defeated him in 1197. It acted as death blow to Buddhism. Senas were the last great patrons of Buddhism.

The Palas (c. AD 750–c. AD 1150)

- They held territories adjoining to Sena kingdom.

Gopala

- Founder of the dynasty.

Dharmapala

- He was defeated by Rashtrakuta King, Dhruva. Dharmapala occupied Kannauj for a brief period after Dhruva returned to Deccan. He took the title Uttarapatha Swamin.
- He revived Nalanda University by setting apart 200 villages for meeting its expenses. The revenue collected from these villages was used to meet expenses of Nalanda University.
- The Buddhist King, Dharmapala, is best known for setting up Vikramshila University.
- Arab merchant, Sulaiman, who visited India in middle of 9th century, talked about wars Dharmapala was engaged in.

Vikramshila University

It was set up in late 8th or early 9th century. Along with Nalanda University, it became the excellent centre of Buddhism studies in India. The Vikramshila University was located at Kahalgaon near Bhagalpur in Bihar.

Atisha Dipankara, who is founder of Sarma tradition in Buddhism (form of Buddhism popular in Tibet), was a scholar at Vikramshila University. The Vikramshila University was destroyed by Bakhtiyar Khilji in AD 1200.

Along with Nalanda (Bihar), Odantapura (Bihar), Somapura (Bangladesh) and Jagaddala (Bangladesh); Vikramashila (Bihar) comprised what is known as the "Five Mahaviharas" or five great schools in Buddhist traditions.

Devapala

- Extended Pala Kingdom toward Pragjyotishpur (Assam) and parts of Odisha.

Mahipala

- He was defeated by Rajendra Chola of the Chola dynasty. Cholas took control of Silk trade with China.

KASHMIR

Kalhana was 12th century author. He wrote a book Rajatarangini in Sanskrit language. It is an account of the history of Kashmir. It tells us about major dynasties which ruled over Kashmir.

The Karkota Dynasty

- First major dynasty to rule Kashmir.
- Its ruler Lalita Aditya Muktapida built Martand Sun Temple in Srinagar.

The Utpala Dynasty

- Its ruler Avantivarman builds a dam on Vitasta (Jhelum) river.

The Poorva Gupta Dynasty

- Diddadevi (a member of the Lohara dynasty), wife of Kshemagupta, is the only woman ruler in history of Kashmir.

KINGDOMS IN SOUTH

Unlike North, lack of fertile land was a major reason for limited growth of kingdoms in South. Limited growth led to rise of multiple powers, claiming control of same fertile regions.

Consequently, there were frequent clashes, leading to rise and fall of numerous kingdoms. In a true sense, the region was united only twice; first under the Cholas and later during Vijayanagara Empire.

Some important kingdoms of south were:

Western Chalukyas of Kalyani (973–1189)
They ruled over Western Deccan with capital at Kalyani, i.e., today's Basavakalyan in Karnataka. They were feudatories of the Rashtrakuta dynasty. Once rose to power, they remained in conflict with the Cholas and also the Eastern Chalukyas of Vengi.

They were finally destroyed by the Hoyasala Empire in 12th century. Western Chalukyas empire has a great contribution in the modern Kannada literature as well as Sanskrit literature.

Tailapa-II
- He founded the dynasty of Chalukyas of Kalyani and killed last ruler of Rastrakuta dynasty Kakka II (Karaka).
- He patronized a Kannada poet Ranna who was one the earliest poets of Kannada language. Ranna, Adikavi Pampa, and Sri Ponna are called three gems of Kannada literature.

Someshwara I
- He established Kalyani as capital and killed Rajadhiraja Chola (Chola king) in the battle of Koppam.

Vikramaditya VI
- He left the maximum number of inscriptions; all the inscriptions are in Kannada.
- He is the main character of a historical poem (*Vikramankadevacharita*) by Bilhana, a Kashmir poet.
- Vijñanesvara, whose work *Mitaksara* is a treatise on inheritance, was a celebrated jurist who lived in the court of Vikramaditya VI.

Kakatiyas (1110–1326)
- They ruled over Andhra Pradesh region with capital at Warangal.

Prolaraja II
- He is considered the real founder of the dynasty.

Ganapati
- He was the most powerful of Kakatiya rulers.
- Motupalli, now in Krishna district, was an important seaport in his kingdom, frequented by foreign merchants.

Yadavas (1187–c. 1312)
They ruled over parts of Maharashtra with capital at Devagiri. They are known as founders of Marathi Culture.

Bhillama V

- He is the founder of the dynasty. In 1187, he defeated the last Chalukya king Someshwara IV and took control over Kalyani.

Raja Ramchandra
- Last ruler.
- Submitted to Alauddin Khilji, when sultan of Delhi crossed the Narmada River.

Hoyasalas (c.1026–c.1342)
They ruled over Southern parts of Karnataka with capital at Belur, later shifted to Halebidu. Their greatest contribution has been the temples of Halebidu as well as in growth of Kannada and Sanskrit literature.

Vittigadev "Vishnuvardhan"
- He was the first major ruler of dynasty.
- He built Chennakeshava temple at Belur.
- He was originally a Jain. He became follower of Vishnu under influence of Ramanuja Acharya.

Veera Ballala III
- He was the last ruler of Hoysala dynasty. He was killed by commander of Alauddin Khilji.

New Chola Dynasty (c. 850–1279)
After the decline of the Sangam period, the Cholas became feudatories in Uraiyur, Tamil Nadu. They became prominent in the 9th century and established an empire comprising the major portion of South India with capital at Tanjore. They also extended their influence in Sri Lanka and the Malay Peninsula. Therefore, they are known as the Imperial Cholas.

Vijayalaya
- He was the founder of the Imperial Cholas. He captured Tanjore from Muttaraiyars, a dynasty of chieftains who ruled either independently or as vassals of the Pallavas, in c. 850.

Aditya
- He ended the Pallava Kingdom by defeating Aparajita.

Parantaka I
- Defeated the Pandyas, took the title Maduraiyum Elamum Konda (one who conquered Madurai).
- He also defeated the ruler of Ceylon.
- Suffered a defeat at the hands of the Rashtrakuta King Krishna III in the famous Battle of Takkolam (in present-day Vellore district of Tamil Nadu).
- He was a great builder of temples. He provided the vimana of the famous Nataraja temple at Chidambaram (in present day Cuddalore district, Tamil Nadu) with a golden roof.
- Uttaramerur inscription that gives a detailed account of the village administration under the Cholas belong to his reign.

Uttaramerur (Uthiramerur) Inscription
Uttaramerur inscription in modern-day Tamil Nadu provide us details of the way in which

the sabha was organized.

The sabha had separate committees to look after irrigation works, gardens, temples, etc. Names of those eligible to be members of these committees were written on small tickets of palm leaf and kept in an earthenware pot, from which a young boy was asked to pick the tickets, one by one for each committee.

All those who wish to become members of the sabha should be owners of land from which land revenue is collected. They should have their own homes.

Eligibility Conditions
■ He should be between 35 and 70 years of age.
■ He should have knowledge of the Vedas.
■ Should be well versed in administrative matters and honest.
■ If anyone has been a member of any committee in the last 3 years, he cannot become a member of another committee.
■ Anyone who has not submitted his accounts, as well as those of his relatives, cannot contest the elections.
The inscription prove that Cholas were pioneers of local self-governance in India.

Rajaraja I (AD 985–1014)

- Defeated Cheras in the naval battle of Kandalur salai and destroyed the Chera navy.
- Rajaraja assumed a number of titles like Mummidi Chola, Jayankonda, and Sivapadasekara.
- He completed the construction of the famous Rajarajeswara temple or Brihadeeswarar temple at Tanjore in AD 1010.
- He also helped in the construction of a Buddhist monastery at Nagapattinam.
- Rajaraja's last military achievement was a naval expedition against the Maldives Islands.
- He entrusted his son Rajendra I to capture Sri Lanka. The Cholas annexed the Northern Sri Lanka as the Sri Lankan King Mahinda V fled away.

Rajendra I (AD 1014–1044)

- Mahinda V attempted to recover the Northern part of Ceylon. Rajendra defeated him and made whole of Sri Lanka a part of the Chola Empire.
- His most famous expedition was to North India. The Chola army crossed the Ganges by defeating Mahipala I of Bengal. To commemorate his successful North-Indian campaign, he founded the city of Gangaikonda Cholapuram and constructed the famous Rajesvaram temple in that city.
- Rajendra I assumed various titles like Mudikondan, Gangaikondan, Kadaram Kondan, and Pandita Cholan.
- He built Gangaikonda cholapuram temple dedicated to Lord Shiva (presently in Ariyalur district of Tamil Nadu).

Kulottunga I

- During his reign, Sri Lanka became independent.
- He sent a large embassy of 72 merchants to China.
- He became famous by abolishing tolls and earned the title–Sungam Tavirtta Cholan.
- He was a staunch follower of Shaivism and persecuted Ramanuja, a great Vaishnava saint.

- Jayamkondar's *Kalingattuparani* a Tamil poem describes the Kalinga war fought by Kulottunga I.

Rajendra III

- He was the last Chola king. The Chola territory was absorbed into the Pandya Empire.

Terminology of the Time

Perundanam/Ssirudanam: Various officials in the administrative machinery.
Puravuvarithinaikkalam: The land revenue department.
Kaikkolaperumpadai: The royal troops.
Velaikkarar: Personal troops to defend the king.
Kadagams: Military cantonments.
Nadu/Kurram: A group of villages. It was under the administration of Nattar.
Valanadu: A number of kurrams constituted a valanadu. It was under Periyanattar.
Nagaram: The town. It was under the administration of a council called Nagarattar.
Mandalam: The province. Several Valanadus made up one Mandalam. At the height of the Chola Empire, there were eight to nine of these provinces including Sri Lanka.
Ur: General assembly of the village.
Pulaiyas: A name used for a social group considered "outcastes" by Brahmanas
Vellalas: Non-brahman peasant proprietors
Agraharas: Rent-free villages settled by the Brahmanas.
Vellanvagai: Land of non-Brahmana peasant proprietors.
Brahmadeya: Land gifted to Brahmanas.
Shalabhoga: Land for the maintenance of a school.
Devadana/Tirunamattukkani: Land gifted to temples.
Pallichchhandam: Land donated to Jaina institutions.

Life Under Cholas

- Caste system was widely prevalent during the Chola period, Valangai and Idangai being

two major caste divisions.

- The practice of "sati" was prevalent among the royal families.
- The devadasi system or dancing girls attached to temples emerged during this period.
- Both Saivism and Vaishnavism continued to flourish during the Chola period.
- The temples remained centre of economic activity during this period.
- The weaving industry, particularly the silk-weaving at Kanchi, flourished. Uraiyur was famous for pearls and spices trade.
- *Sivakasintamani* written by Thiruthakkadevar and Kundalakesi, belonged to 10th century.
- The *Ramayana* composed by Kamban and the *Periyapuranam* by Sekkilar are the two masterpieces of this age.
- The *Moovarula* written by Ottakuthar depicts the life of three Chola kings.
- The *Nalavenba* was written by Pugalendi.

Practice Questions

1. One consistent feature found in the history of Southern India was the growth of small regional kingdoms rather than large empires because of
(a) the absence of minerals like iron
(b) too many divisions in the social structure
(c) the absence of vast areas of fertile land
(d) the scarcity of manpower

2. Which one of the following pairs of composers in different languages and their works on the Mahabharata theme are correctly matched?
(a) Sarladasa–Bengali
(b) Kasirama–Oriya
(c) Tikkana– Marathi
(d) Pampa– Kannada

3. "Rajatarangini" written by Kalhan is associated with which of the following?
(a) Chandragupta reign
(b) Anthology of lyrics
(c) History of Kashmir
(d) Reign of Krishna Devaraya

4. In ancient and early Medieval India Agrahara denoted
(a) Jaina monastic establishment
(b) Secular land grants
(c) Tax free land gifted to temples
(d) Tax free village possessed by Brahmanas

5. Which one of the Chola kings conquered Ceylon?
(a) Aditya I
(b) Rajaraja I
(c) Rajendra
(d) Vijayalaya

6. Which Chola ruler built Brihadeshwara temple (also known as Rajarajeshwar temple) at Tanjore in year 1010?
(a) Vijayalaya
(b) Rajendra I
(c) Rajendra III
(d) Rajaraja

7. A lot of details regarding the village administration under the Cholas are provided by the inscriptions at?
(a) Thanjavur
(b) Uraiyur
(c) Aihole
(d) Uthiramerur

8. What was "Kurram" in the Chola administration?
(a) Province
(b) Fertile land
(c) District
(d) Group of villages

9. During the Cholas, Uraiyur was famous for?
(a) Cotton
(b) Ship building
(c) Pearls
(d) Spices

Perfecting Past Prelims

1. Who among the following laid the foundation of Rashtrakuta Empire? (2006)
(a) Amoghavarsha I
(b) Dantidurga
(c) Dhruva
(d) Krishna I

2. Which one of the following was a very important seaport in the Kakatiya Kingdom? (2017)
(a) Kakinada
(b) Motupalli
(c) Machilipatnam (Masulipatnam)
(d) Nelluru

3. Consider the following events in the history of India: (2020)
1. Rise of Pratiharas under King Bhoja
2. Establishment of Pallava power under Mahendravarman – 1
3. Establishment of Chola power by Parantaka – 1
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

4. With reference to Indian history, consider the following texts: (2022)
1. Nettipakarana
2. Parishishtaparvan
3. Avadanashataka
4. Trishashtilakshana Mahapurana
Which of the above are Jaina texts?
(a) 1, 2 and 3
(b) 2 and 4 only
(c) 1, 3 and 4
(d) 2, 3 and 4

5. Consider the following pairs: (2022)

King	Dynasty
1. Nannuka	Chandela
2. Jayashakti	Paramara
3. Nagabhata II	Gurajara-Pratihara
4. Bhoja	Rashtrakuta

How many pairs given above are correctly matched?
(a) Only one pair
(b) Only two pairs
(c) Only three pairs
(d) All four pairs

6. Consider the following dynasties: (2023)
1. Hoysala
2. Gahadavala
3. Kakatiya
4. Yadava
How many of the above dynasties established their kingdoms in early eighth century AD?
(a) Only one
(b) Only two
(c) Only three
(d) None

Answer Keys

Practice Questions

1. (c)	**2.** (d)	**3.** (c)	**4.** (d)	**5.** (c)
6. (d)	**7.** (d)	**8.** (d)	**9.** (c)	

Perfecting Past Prelims

1. (b)	**2.** (b)	3. (c)	4. (b)	5.(b)
6. (d)				

Solutions

Practice Questions

2. (d) Sarladasa- Oriya
Kasirama – Bengali
Tikkana – Telugu

Perfecting Past Prelims

3. (c) 2-4-1-3
1. Rise of Pratiharas under King Bhoja: 9th Century CE (836–882 CE)

2. Establishment of Pallava power under Mahendravarman – 1: 7th Century CE (600–630 CE)
3. Establishment of Chola power by Parantaka – 1: 10th Century CE (907–955 CE)
4. Pala dynasty founded by Gopala: 8th Century CE (750s–770s CE)
Hence, the chronology is 2-4-1-3.

4. (b) 1. Nettipakarana : It is a Buddhist scripture, sometimes included in the Khuddaka Nikaya of Sutta Pitaka. So, point 1 is not correct.

2. Parishishtaparvan : It is a 12th century Sanskrit mahakavya by Acharya Hemachandra. He was a contemporary of the Chaulukyan king Kumarapala. The text gives details of early Jaina teachers. So, point 2 is correct.

3. Avadanashataka : It is a collection of 100 Buddhist legends (avadana: type of Buddhist literature telling deeds/events of the past and subsequent lives of Buddha). So, point 3 is not correct.

4. Trishashtilakshana Mahapurana : It is an important Jain text composed by Acharya Jinasena. He was in the court of Amoghavarsha, a famous Rashtrakuta king. Famous for quotation about the nature of God as non-creator in Jainism. So, point 4 is correct.
Therefore, option (b) is the correct answer.

5.(b) Pair 1 is correctly matched: Nannuka (831-845 CE) was the founder of Chandela dynasty, who ruled in the Jejakabhukti region (Present day Madhya Pradesh).

Pair 2 is incorrectly matched: Jayashakti was a 9th century ruler from the Chandela dynasty of Central India.

Pair 3 is correctly matched. Nagabhata (795-833 CE) was an Emperor from Gurjara-Pratihara dynasty, after ascending throne of his father Vatsraja.

Pair 4 is not correctly matched. Bhoja (1010-1055 CE) popularly known as Raja Bhoj Parmar was a king from the Paramara dynasty.

Therefore, option (b) is the correct answer.

6.(d) None
- Yadavas (1187–c. 1312)
- The Guhadwalas or Gahadavala (11th–12th century)
- Kakatiyas (1110–1326)
- Hoyasalas (c.1026–c.1342)

Hence, none of the above dynasties established their kingdoms in early eighth century AD.

CULTURE

CHAPTER 19 SCIENCE AND TECHNOLOGY

India has always been a great contributor in the field of science and technology. From making the best steel in the world to teaching the world to count, India has a strong tradition of science and technology. India has been the land of sages and seers, but it has also produced great scholars and scientists, long before the modern laboratories were set up and research works were being done.

SCIENCE AND TECHNOLOGY DEVELOPMENT IN ANCIENT INDIA

Since ancient times, India has made significant contribution in the field of science and technology. Some of the important contributions made by Indians are as follows.

Astronomy

In ancient times, religion and astronomy used to go hand in hand. The planets were considered as gods, so their movements were closely observed. The study of planets proved to be very beneficial for the agricultural activities on account of their connection with changes in seasons. Some of the main contributions of the astronomers are as follows:

- **Explanation of lunar and solar eclipse:** The scientific explanation of solar and lunar eclipse was first given by Aryabhatta around 1500 years ago.
- **Distance between the earth and the moon:** Aryabhatta calculated the exact distance between the earth and the moon.
- **Movement of planets:** Aryabhatta measured the circumference of earth and also pointed out that sun is stationary and earth rotates on its axis and revolves around the sun. Aryabhatta also calculated the position of planets. Furthermore, Varahamihira stated that the moon revolves around the earth. He even explained the movement of various planets.
- **Attraction force among celestial bodies:** In the 12th century, Bhaskaracharya quoted that objects fall on the earth due to the force of attraction by the earth. The earth, planets, constellations, moon and sun are held in their orbits due to this force of attraction among celestial bodies.

Mathematics

The Indians made three very distinct and notable contributions in the field of Mathematics. These include the notations system, the decimal system, and the use of zero. Not only this, the Indians were also well aware of the use of weights and measurements and trigonometry.

- **The Notation System:** The notation system was developed by Bhaskara I in the 7th century. Earlier, the numbers were not written in figures but in words or allegories (picture form) and organized in verses. For example, one was written as Moon, two was written as twins or eyes, five was denoted as the five senses, and so on.

The Indian notation system was adopted by the Arabs and through them it spread to the western world. The Indian numerals are called Arabic numerals in English, while the Arabs themselves called their numerals *Hindsa*. Numerals are found in inscriptions of Asoka, which

were written in the third century BC.

- **The Decimal System:** Indians were the first ones to use the decimal system. The world famous astronomer and mathematician Aryabhatta was well acquaint with it, and one of the students of his astronomical school, Bhaskara I was the first mathematician to write the numbers in the decimal or positional system.

- **Use of Zero:** The concept of Zero was first given by an unknown Indian Mathematician. Since the time of its discovery, the Indian mathematicians considered zero as a separate numeral, and it was used in this sense in arithmetic sums. The Arabs learnt and adopted it from India and spread it to Europe.

- **Weights and Measurements:** The study of the constructions in the Harappan civilization shows that the north-western Indians had a sound knowledge of measurement and geometry. This knowledge may have benefitted the Vedic people as well. The evidence of Indian people's knowledge of these standards appears in *Sulvasutra* (texts on geometry). In the second century BC, Apastamba produced a practical geometry for the construction of altars at which the king could offer sacrifices. It describes acute angle, obtuse angle, and right angle.

- **Trigonometry:** The rules for finding out the area of triangle, which led to the origin of trigonometry, were given by Aryabhatta.

Chemistry

Indian craftsmen have contributed much to the progress of chemistry. Indian dyers were able to invent long-lasting colors. The colors made in India were so lasting and lustrous that they are still intact in the caves of Ajanta. Indians were first ones to discover blue colour.

Similarly, Indians were experts in the art of making steel. This craft was first developed in India. The steel made by the craftsmen was so good that it was exported to many different parts of the world, from the early times itself. Later, it came to be known as wootz. The steel swords made by the Indian craftsmen were of such superior quality that no other country could match up with that. They were in great demand in the entire region from Asia to Eastern Europe.

Medicine

In ancient societies, the remedies recommended were full with magical charms and spells; therefore, the medicines could not be developed along the scientific lines. Indian physicians studied human anatomy very closely. They devised methods through which the diseases could be diagnosed and then cured. The earliest mention of medicines has been given in the Atharvaveda.

In the 2nd century AD, India produced two famous scholars of the Ayurveda – Sushruta and Charaka. Sushruta (the father of surgery) composed his text *Sushruta Samhita* during this period in which he mentions the procedures and instruments involved in surgery. Sushruta also mentioned methods to sterilize the instruments after the surgery.

He describes the method of operating cataract, stone depositions in body, and several other

ailments. He even mentions about plastic surgery in his book. In the treatment of diseases, he has laid special emphasis on diet and cleanliness. Some of the surgeries performed by him include nose surgery, removal of dead fetus, and removing stone from the urinary bladder.

Charaka wrote Charaka Samhita. This book is considered as an encyclopedia of Indian medicine. It discusses the procedures of Ayurveda and lays down the concept of balance among three *doshas* (universal principles) called *Vata* (wind), *Pitta* (fire), and *Kapha* (water).

The book describes various types of fever, leprosy, hysteria (*mirgi*), and tuberculosis. It also dealt with the *Kayachikitsa* (Internal medicine) branch of Ayurveda. The book contains the names of a large number of herbs and plants that were to be used as medicine.

Charaka placed special emphasis on diagnosis of disease, anatomy of the human body and development and causes of malfunctioning of the human body.

Navigation

Indians obtained the knowledge of navigation, and they contributed to the craft of ship making. The history of Indian shipbuilding begins right from the time of Indus Valley Civilization. The Rigveda, one of the four Vedas, documents the various parts of a vessel.

SCIENCE AND TECHNOLOGY IN MEDIEVAL PERIOD

India had a rich tradition of science and technology. Al-Biruni (first Islamic scientist) blamed the decline of Indian science to the arrogance and growing narrow mindedness of the Brahmans. He made a deep study of Hindu sciences.

Science and Technology in Sultanate Period

After the Turks came in India, a number of interactions took place between the Islamic or the Arab science and Indian science. Many new technologies were born, such as, paper, spinning wheel, cotton carders bow, a better version of the water wheel, and widespread use of the iron stirrup (iron pieces suspending from a narrow strip of leather which help in mounting and riding the horse). The Sultans of Delhi were very much interested in the use of machines or mechanical instruments like pulleys and piers (raised structure in a body of water).

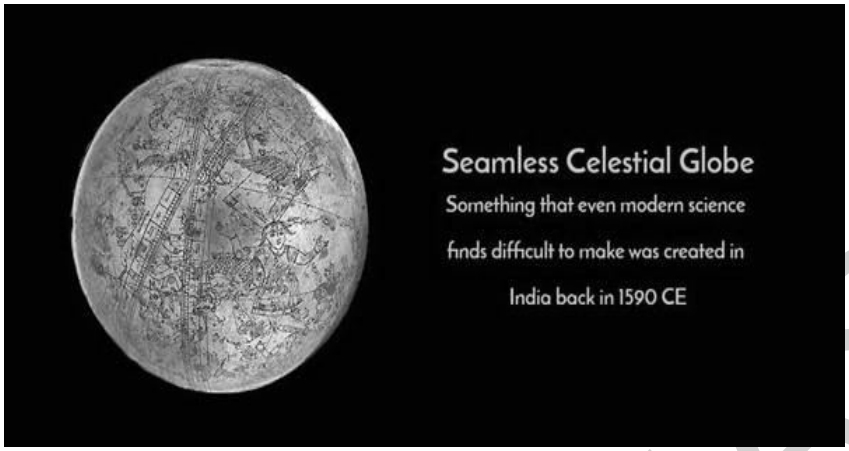
Some of the Turkish rulers were involved in some humanitarian works as well. Sultan Firoz Shah Tughlaq set up hospitals for free treatment of poor and also encouraged physicians in the development of Unani Medicine.

Science and Technology Under Mughals Astronomy

Astronomy

The 16th and 17th centuries witnessed a fusion between Islamic astronomy and Indian astronomy. Islamic observational techniques and instruments were combined with Hindu computational techniques, while there appears to have been little concern for theoretical astronomy. The Mughals were interested in the development of astronomy, so, they patronized astronomers in their royal courts. The works produced were mainly astronomical tables and calendars.

Humayun built a personal observatory near Delhi. The instruments and observational techniques used by the Mughals were mainly influenced from the Islamic tradition. Mughals invented one of the most incredible astronomical instruments – the seamless celestial globe.



Fariduddin Munajjum was the first astronomer in Shah Jahan's court who compiled *Zije Shah Jehani*. It was a compilation of various astronomical tables. The first section dealt with various calendars, second section dealt with spherical astronomy or positional astronomy, and third section of the tables dealt with the determination of the motions of the planets and their positions in the sky.

Contribution of Maharaja Sawai Jai Singh To Astronomy

Maharajah Sawai Jai Singh (1688–1743) also known as Jai Singh II was an astronomer of the first order. He thought that the nation needed to be educated on the subject of astronomy and also he found the astronomical tables, used at that time, to be defective. So, for that purpose, he constructed observatories at Delhi, Jaipur, Mathura, Banaras, and Ujjain. In his five observatories, Hindu and Muslim observers were employed. His observations were remarkably accurate, and thus, a set of astronomical tables called *Zijey Jadid Muhammad Shahee* was produced.

This set of tables produced by Maharajah Sawai Jai Singh, dealt with calendars, determination of heavenly bodies and the motions of the sun, moon and the rest of the planets, eclipses of the sun and moon, the appearance of the new Moon, etc.

One of the astronomical observatory that was constructed by Sawai Jai Singh and still exist in Jaipur and Delhi is Jantar Mantar. The Jantar Mantar at Delhi has three instruments within the observatory namely – Samrat yantra, Jayaprakash yantra, and, Misra Yantra.

Jantar Mantar observatory, New Delhi

The observatory in Jaipur consists of 14 major geometric devices for scientific purposes like for measuring time, foreseeing eclipses, tracking stars' location, determining the celestial altitudes and related ephemerides (helps in revealing the positions of naturally occurring astronomical objects), and determining the declinations of planets.

Samrat Yantra, Jaipur

Waterworks

The Mughal emperors were famous for their promotion of the construction of great irrigation systems through which they were able to increase the cultivated lands in their reign. The yields of the crops were high, and thus, the net revenue base of the empire also increased.

The first Mughal emperor to have constructed water channels in gardens and orchards was Babur. This tradition was continued by his grandson Akbar. Akbar built monumental waterworks that helped in irrigation of Fatehpur Sikri. He even made a dam with 13 gates that helped in the creation of an artificial lake in the time of monsoons.

During the time of Shah Jahan, the irrigation system was even more popularized. He ordered the construction of two notable canals – Nahr-i-Faiz and Shah Nahr. These canals drew water from Yamuna River and helped in keeping the lands fertile. During his reign, Agra had come

to be known as the Waterfront garden city.

Mathematics

At the suggestion of Akbar, Faizi (an honorable poet in Akbar's court) translated Bhaskaracharya's work on mathematics in Persian language. His book contained theorems of arithmetic and algebra.

One of the major contributions made in the field of mathematics is by the distinguished family of Ustad Ahmad Lahori (architect of Taj Mahal and Red Fort). He had three sons and all of them made contribution in topics like arithmetic, algebra, measurement, geometry, properties of numbers, etc.

Maharaja Sawai Jai Singh made his contribution not only in the field of astronomy, but also in the field of mathematics. His most important contribution was in the field of trigonometry.

Pharmacy

Mughal emperors kept various eminent *Hakims* in their royal courts. These hakims helped in the development of Unani medicine. With the help of this royal patronage, the hakims were able to develop various books in which the preparation and quantities of drugs in a given prescription were specified.

Metallurgy

Indians were great at the art of making alloys. Zinc was not known in Europe at that time, but it was extracted in India. Different alloys were made like brass, steel, bronze, etc., which were used in making weapons. These kinds of weapons were produced in a plant called *Karkhana*. Another dimension of metallurgy was production of gold, silver, and copper coins.

Muhammad Salih Thattvi headed the task of creating a massive, seamless celestial globe using a secret wax casting method. Arabic and Persian inscriptions were inscribed on it. Twenty other such globes were produced during the Mughal Empire. It is considered a major feat in metallurgy.

Rocket

Akbar was the first one to use metal cylinder rockets. They were particularly used against the elephants used in war. In the year, 1657, during the Siege of Bidar, Prince Aurangzeb's forces fired rockets and grenades while scaling the walls.

Even gunpowder was used in rockets. Some rockets went in air and some went along the surface. Tipu Sultan and his father are considered to be the pioneers in the use of solid fuel rocket technology and missiles for military use. They developed a military tactic in which they used to attack the soldiers of the enemy with rocket brigades.

Damascus Steel

Akbar opened large workshops for producing the best quality sword blades. Damascus steel swords that were considered the sharpest blades ever used in battle in South Asia by Akbar.

Cannon Foundry

Jaigarh Fort, Amber, Jaipur became one of the world's most efficient cannon foundries during the reign of the Mughal Emperor Shah Jahan, mainly because Iron ore mines were in abundance in the vicinity of the fort. Jaigarh Fort had a massive wind tunnel that sucked air from the high mountains into its furnace creating temperatures as high as 2400°F.

During the reign of the Mughal Emperor Aurangzeb, cannon production reached its peak. One of the most impressive Mughal cannons is known as the *Zafar baksh*, which is a rare composite cannon.

Important Astronomers and Mathematicians in Ancient Indian History

Aryabhatta (476–550 AD)
He was born in 476 AD, in present day Patna, Bihar. At the age of 23, he wrote the book *Aryabhatiya* that covered both mathematics and astronomy. The concept of "ZERO" was given by an unknown Indian. His most significant contribution was development of this concept of "ZERO". The discovery of zero enabled him to find out the exact distance between the Earth and the Moon. He is also acknowledged for calculating the rough value of "π". He rejected the popular view that Earth is immovable. In fact, he was the first to assert that the Earth is round and is suspended in space and that it rotates on its axis and orbits the sun. He even gave the scientific explanation of solar and lunar eclipses. He was even able to develop basic trigonometry.

Varahamihira (505–587 AD)
Born in Avanti (India) region, Varahamihira was an Indian astronomer, mathematician, and astrologer who spent his life in Ujjain. His well-known work that belongs to the 6th century AD is called the *Brihat- Samhita*. He used several Greek words to explain the movement of planets and some other astronomical observations. He made a great contribution in a wide range of subjects like astrology, planetary movements, eclipses, rainfall, clouds, architecture, growth of crops, domestic relations, etc. His main work is the book *Panch-Siddhantika* (*Pañcasiddhāntikā)* that summarizes the five earlier astronomical treaties, such as the *Surya Siddhanta*, *Romaka Siddhanta*, *Paulisa Siddhanta*, *Vashishtha Siddhanta*, and *Paitamaha Siddhanta*. He even stated that the moon revolves around the earth, and the earth revolves around the sun.

Brahmagupta (598–670 AD)
He was one of the most important students of Aryabhatta's astronomical school. He was the first to give the rules to compute with zero. He introduced negative numbers and operations of zero into mathematics.

He was able to give properties of a quadrilateral in a circle (cyclic quadrilateral). He has authored two books on mathematics and astronomy namely –*Brahma-Sphuta Siddhanta* and *The Khandakhadyaka*. It was because of his work that the Arabs came to know about the mathematical system.

Bhaskara I (600–680 AD)
He was the second most important student of Aryabhatta's astronomical school. He was born in Maharashtra. He was the first mathematician to write the numbers in the decimal or positional system, with a circle for the "ZERO". Until then the numbers were not written in figures

but in words or allegories and organized in verses. For example, one was given as Moon, two was written as twins or eyes, five was denoted as the five senses, so on and so forth. In 629 AD, he explained the book *Aryabhatiya*. It is the oldest known work in Sanskrit on mathematics and astronomy. In his explanation, he referred to 33 verses dealing with mathematics.

Baudhayana (8th century BC)
He was a mathematician who lived around 800 BC. He is the author of earliest *Sulvasutra,* which contains calculation of value of pi, Pythagoras theorem, and calculating square root of 2. He is credited with calculating pi and what is now called the "Pythagoras theorem" before Pythagoras had developed it. He was a man of very considerable learning and probably wrote the *Sulvasutra* to provide rules for religious rites.

Mahaviracharya (9th century)
A Jain mathematician, he was born in Bihar, India. He simplified the concepts given by the above given mathematicians. He separated astrology from mathematics. He introduced the method of finding the least common multiple (LCM) of given numbers. He wrote *The Ganit-Sar-Sangraha* that is the first textbook on Arithmetic in present day form. He devised formulae that approximated area and perimeters of ellipses and found methods to find out squares and cube roots of given numbers. He asserted that the square root of a negative number did not exist. He developed terminologies for concepts such as equilateral and isosceles triangle, rhombus, circle, and semi-circle.

Bhaskaracharya (1114–1185)
Also known as Bhaskara II, born in the remote village of Jalgaon in Maharashtra, he was the first one to discover gravity, 500 years before Sir Isaac Newton. His note on the force of gravity says "Objects fall on the earth due to a force of attraction by the earth. Therefore, the Earth, planets, constellations, Moon and Sun are held in their orbits due to this attraction." He authored a book *Siddhanta-Shiromani* with detailed descriptions of planetary positions, eclipses, cosmography, astronomical equipment and mathematical techniques.

He introduced the cyclic method (a reference to the cyclic nature of the algorithm) to solve algebraic equations. This method was rediscovered 6 centuries later by the European mathematicians who called it inverse cycle.

Practice Questions

1. Who among the following is not associated with medicine in India?
(a) Dhanvantri
(b) Bhaskaracharya
(c) Charaka
(d) Susruta

2. Who among the following anticipated Newton's theory by declaring that all things face gravitational pull of the earth?
(a) Aryabhata
(b) Varahamihira
(c) Baudhayana
(d) Bhaskaracharya

3. Who among the following is credited for undertaking first plastic surgery in Indian sub-continent?
(a) Saumilla
(b) Sudraka
(c) Bhaskara
(d) Susrutha

4. Match List I with List II and select the correct answer by using the codes given below the lists:

List I	List II
1. Visakhadatta	(A) Medicine
2. Varahamihira	(B) Drama
3. Charaka	(C) Astronomy
4. Brahmagupta	(D) Mathematics

Codes:
(a) 1 - A, 2 - C, 3 - D, 4 - B
(b) 1 - B, 2 - A, 3 - C, 4 - D
(c) 1 - B, 2 - C, 3 - A, 4 - D
(d) 1 - C, 2 - B, 3 - A, 4 – B

5. Consider the following statements regarding number "Zero":
1. The concept of zero was given by Aryabhatta.
2. Varahamihira was the first to give the rules to compute with zero.
3. Bhaskara I used circle for the first time for zero.
Which of the statements given above is/are correct?
(a) 3 only
(b) 2 and 3
(c) 1 and 3
(d) 1 and 2

Perfecting Past Prelims

1. Match List I with List II and select the correct answer using the codes given below the lists: (2006)

List I (Finding/Invention/Calculation)	List II (Work)
A. Time taken by the Earth to orbit the Sun	1. Aryabhatta
B. Calculation of the value of π (pi)	2. Bhaskaracharya
C. Invention of the digit zero	3. Budhayana
D. The game of snakes and ladders	4. Gyandev

Code:

A B C D

(a) 2 4 1 3

(b) 1 3 2 4

(c) 2 3 1 4

(d) 1 4 2 3

2. What does Baudhayan theorem (Baudhayan Sulva Sutra) relate to? (2008)

(a) Lengths of sides of a right-angled triangle

(b) Calculation of the value of pi

(c) Logarithmic calculations

(d) Normal distribution curve

3. With reference to the scientific progress of ancient India, which of the statements given below are correct? (2012)

1. Different kinds of specialised surgical instruments were in common use by 1st century AD.
2. Transplant of internal organs in the human body had begun by the beginning of 3rd century AD.
3. The concept of sine of an angle was known in 5th century AD.
4. The concept of cyclic quadrilateral was known in 7th century AD.

Select the correct answer using the codes given below:

(a) 1 and 2 only

(b) 3 and 4 only

(c) 1, 3, and 4 only

(d) 1, 2, 3, and 4

Answer Keys

Practice Questions

1. (a)	2. (d)	3. (d)	4. (c)	5. (a)

Perfecting Past Prelims

1. (b)	2. (b)	3. (c)		

Solutions

Practice Questions

5. (a) Statement 1 is incorrect: The concept of zero was given by an unknown Indian.
Statement 2 is incorrect: Brahmagupta was the first to give the rules to compute with zero.

Perfecting Past Prelims

1. (b) The 13th century poet saint Gyandev created the game of Snakes & Ladders. It was originally known as 'Mokshapat'. The ladders in the game represent virtues and the snakes indicate vices. In time, the game witnessed several modifications, but its meaning remains the same, i.e., good deeds take people to heaven and evil to a cycle of re-births.

3. (c) Statement 1 is correct: Different kinds of specialized surgical instruments were in common use by 1st century AD. We have learnt that in ancient India it was Sushrut who is known to be the first surgeon. He not only used surgical instruments, but also has documented plastic surgery. The historians have not been able to assign a definite period to
Sushruta. The era of Sushrut is most probably BC and definitely it was prior to 1st century AD.

Statement 2 is incorrect: Sushruta mentioned the plastic surgery in which the flaps of skins are replaced. However, there is no source that talks about transplant of internal organs.

Statement 3 is correct: This is a correct statement and hints towards Aryabhatta's Surya Siddhanta. Aryabhata has given the sine of angle.

Statement 4 is correct: Brahamgupta gave the formula for the area of the cyclic quadrilateral.