UNIT–4 : Traditional Knowledge and Intellectual Property Rights (PYQ Solution)

AKTU · Essence of Indian Traditional Knowledge (BNC502 / BNC602) · Solutions by **Chirag Jain**, Ycotes

SECTION A Answers (≈70 Words Each)

Q1. How did the Harappan civilization contribute to early water management techniques? (Jan 2025)

The Harappans built highly advanced water systems. Cities such as Mohenjo-daro and Harappa had brick-lined wells in houses and streets, covered drains along streets with inspection holes, and house soak pits. The Great Bath at Mohenjo-daro was a waterproofed tank. Dholavira (Gujarat) had large reservoirs, channels and stepped wells to store rainwater, and Lothal had a dockyard with a tidal basin. This shows planned water supply, drainage and conservation.

Q2. Who contributes most to mathematics? / Who made significant contributions to mathematics? (May 2026, May 2025)

Ancient and medieval Indian mathematicians contributed greatly. Aryabhata (499 CE) gave the value of pi (3.1416), place value and trigonometric sine tables. Brahmagupta gave rules for zero and negative numbers and solutions of quadratic equations. Bhaskara II wrote *Lilavati* and early calculus ideas, Mahavira and Madhava of Sangamagrama (infinite series for sine, cosine, pi) added more. Srinivasa Ramanujan is the greatest modern contributor, in number theory. India also gave the decimal system and zero.

SECTION B Answers (≈250 Words Each)

Q1. Discuss India's dominance in trade prior to colonization and how it affected global commerce. (Jan 2025)

Before colonial rule, India was one of the world's richest trading nations. Economic historians estimate that India's share of world GDP was about **25 percent** around 1700, and was among the largest in the world for centuries.

Strengths behind its dominance

- **Textiles:** fine cotton (muslin of Dhaka, calico of Calicut, chintz of Masulipatnam), silk (Banaras), shawls (Kashmir) were in demand in Europe, the Middle East and Southeast Asia.
- **Spices:** pepper, cardamom, cinnamon, cloves from Malabar attracted Romans, Arabs and later Portuguese.
- **Other goods:** indigo, sugar, steel (wootz), gems, ivory, rice and perfumes.
- **Shipbuilding and ports:** Lothal, Muziris, Arikamedu, Surat, Calicut, Tamralipti, Cambay.
- **Organised merchant guilds** (shrenis, Chettiars, Banias) with credit instruments, **hundis**, banking and trading networks.

Trade routes

- **Silk Route** (land) and **maritime routes** across the Arabian Sea, Bay of Bengal, Red Sea and Indian Ocean; trade with Rome, Arabia, Persia, China, Southeast Asia (Srivijaya, Funan) and East Africa.
- Roman gold flowed into India, as noted by Pliny.

Effect on global commerce

Effect	Description
Wealth flow	Gold and silver came to India in exchange for goods
Cultural spread	Buddhism, Indian numerals, art and cuisine travelled to Asia
European search for sea route	Portuguese (Vasco da Gama, 1498) and others sought direct India trade, beginning the Age of Discovery
Industry	Indian textiles influenced the world's cotton industry and fashion
Mercantile companies	East India Companies formed to trade with India

Decline: colonial policies, heavy tariffs on Indian goods and flooding of cheap British machine-made cloth deindustrialised India.

Conclusion. India's skilled production, advanced trade networks and rich resources made it a centre of world commerce, which shaped global trade routes and cultural exchange.

Q2. Discuss the contribution of Physics and Chemistry in India. (May 2026, May 2025)

Introduction. India has a long tradition of scientific thought in physics and chemistry, from the ancient atomic ideas to modern Nobel-level research.

Physics

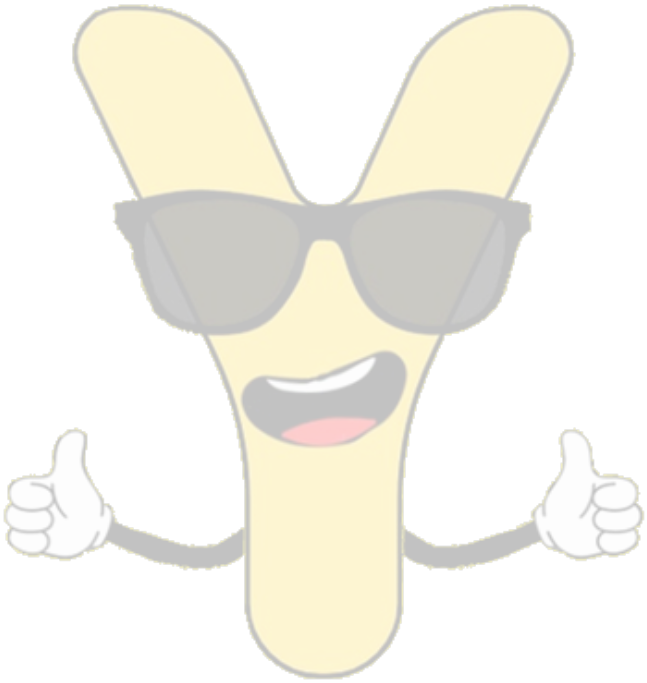
- **Ancient ideas:** Kanada's **Vaisheshika** theory of atoms (paramanu) and the concept of motion; Aryabhata's heliocentric rotation of the earth and explanation of eclipses; Bhaskara's ideas of gravity.
- **Modern period:**
- **J. C. Bose:** radio waves and microwaves, plant response instruments (crescograph).
- **C. V. Raman: Raman effect (1928)**, Nobel Prize 1930.
- **S. N. Bose:** Bose-Einstein statistics, "boson".
- **M. N. Saha:** thermal ionisation equation.
- **Homi Bhabha:** founded nuclear programme; **Vikram Sarabhai:** space research; **S. Chandrasekhar:** Chandrasekhar limit, Nobel 1983.

Chemistry

- **Ancient:** Indus potters, glass, dyes and cosmetics; **wootz steel** and Delhi iron pillar (rust-free), zinc distillation at Zawar, metallurgy, perfumes, soap and ink making.
- **Rasashastra and Ayurveda:** alchemy, preparation of metal medicines (bhasmas), Nagarjuna's *Rasaratnakara*, Charaka and Sushruta, preparation of acids, alkalis, and alloys.
- **Modern: P. C. Ray** (founded Bengal Chemicals, mercurous nitrite), **S. S. Bhatnagar** (CSIR), **Venkatraman Ramakrishnan** (Nobel Chemistry 2009, ribosome structure).

Field	Ancient	Modern
Physics	Atoms (Kanada), astronomy	Raman, Bose, Saha, Bhabha
Chemistry	Metallurgy, rasashastra	Ray, Bhatnagar, Ramakrishnan

Conclusion. Indian contribution in physics and chemistry blends early theoretical insight and practical technology with modern world-class research that supports industry, health and space science.



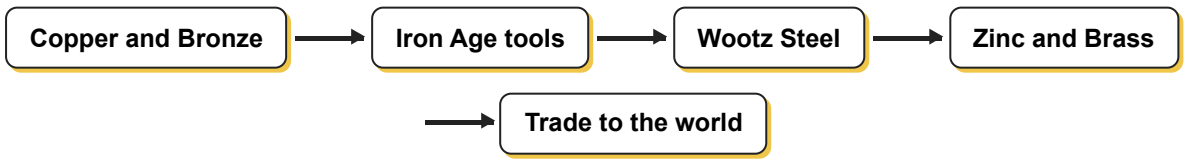
SECTION C Answers (≈500 Words Each)

Q1. Explain how Indian metallurgy techniques contributed to the broader technological advancements in the ancient world. (Jan 2025)

Introduction. India was a pioneer in extracting and working metals from the Chalcolithic age. Its steel and alloys were famous across Asia, Europe and the Middle East.

Major achievements

- **Copper and bronze:** Harappans used copper and bronze (copper + tin) for tools, vessels, the **dancing girl statue** made by the **lost-wax** method.
- **Iron:** iron working from about 1500-1000 BCE (Gandhara, Gangetic plains, Megalithic South India), which enabled strong ploughs, weapons and tools and helped agriculture and the rise of cities.
- **Wootz steel (Ukku):** high-carbon crucible steel made in South India (Tamil Nadu, Telangana, Karnataka), exported to Persia and Rome; it became the basis of the famous **Damascus swords**.
- **Delhi Iron Pillar (c. 4th century CE):** over 7 metres tall, about 6 tonnes, rust-resistant for 1,600 years because of a protective layer of iron hydrogen phosphate.
- **Zinc distillation:** at Zawar (Rajasthan) from about the 12th century (earlier traces) India first produced zinc commercially by distillation, before Europe; brass was produced too.
- **Gold, silver, bell metal:** granulation, filigree, metal casting of the **Chola bronzes** (Nataraja) and the huge **Sultanganj Buddha** (copper).
- **Mining and refining:** gold (Kolar), copper (Khetri), and iron mining described in Arthashastra (Akaradhyaksha) and Rasaratnakara.



Progress of Indian metallurgy

Contribution to the wider world

Technique	Spread and impact
Wootz steel	Damascus steel, sword-making in Middle East and Europe, later influenced modern crucible steel
Iron technology	Tools and weapons across Southeast Asia
Zinc production	Brass and later industrial zinc in Europe (William Champion, 1738, learned process from India)
Lost-wax casting	Sculpture traditions in Asia
Trade	Metal goods exported to Rome, Arabia and Southeast Asia

Significance: metals gave India military strength, agricultural productivity and art; scientific study of the Delhi pillar and wootz is still done by metallurgists.

Conclusion. Indian metallurgy combined advanced knowledge, craft skill and trade, so it strongly influenced the technology and economies of the ancient world.

Q2. How did the medicinal systems in India, particularly Ayurveda, develop and influence other civilizations? (Jan 2025)

Introduction. Ayurveda ("science of life") is the oldest Indian medical system, rooted in the **Atharva Veda** and **Rig Veda**, and organised in classical texts. It treats the whole person: body, mind and spirit.

Development

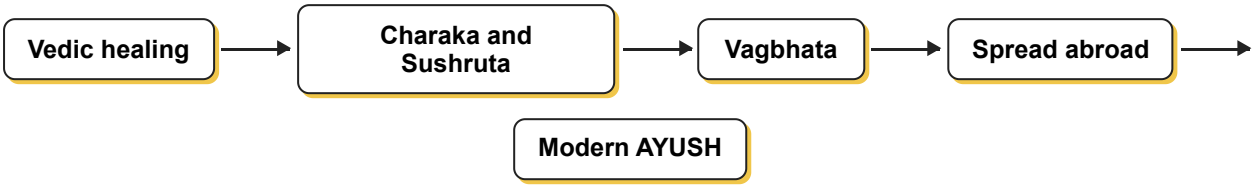
- **Vedic stage:** healing hymns and herbs of the Atharva Veda.
- **Classical stage: Charaka Samhita** (internal medicine), **Sushruta Samhita** (surgery), **Ashtanga Hridaya** and **Ashtanga Sangraha** of Vagbhata, compiled c. 1000 BCE-500 CE.
- **Later:** Madhava Nidana (diagnosis), Bhavaprakasha, Rasashastra (mineral medicines), and Unani (Persian-Arabic), Siddha (Tamil) and Sowa-Rigpa linked systems.

Principles

- **Tridosha: Vata, Pitta and Kapha**; health is their balance.
- **Dhatus** (tissues), **malas** (wastes) and **agni** (digestion).
- **Eight branches (Ashtanga):** internal medicine, surgery, ENT, paediatrics, toxicology, psychiatry, rejuvenation, aphrodisiacs.

- **Treatment:** diet, herbs, **Panchakarma** detox, yoga, lifestyle and seasonal routines.

Sushruta's surgery: over 120 instruments, **rhinoplasty (plastic surgery)**, cataract surgery, fractures, and dissection training; he is called the "Father of Surgery".



Growth of Ayurveda

Influence on other civilizations

Region	Influence
Greece and Rome	Ideas of humours, drugs such as pepper, ginger
Persia and Arabia	Charaka and Sushruta translated into Arabic and Persian; Baghdad physicians (Al-Razi, Avicenna) used Indian knowledge
Tibet, China, Southeast Asia	Buddhist monks carried Ayurvedic practices (Tibetan medicine, Sri Lanka, Thailand)
Europe	Plastic surgery techniques of the 18th century followed Indian rhinoplasty
Modern world	Yoga, herbal medicines (turmeric, ashwagandha), wellness tourism

Conclusion. Ayurveda developed into a systematic science of prevention and cure that enriched medicine across the ancient world, and it remains a respected holistic system today.

Q3. Discuss the agriculture/agricultural system in ancient India. (May 2026, May 2025)

Introduction. Agriculture was the base of the ancient Indian economy. From the Neolithic period of Mehrgarh (7000 BCE) farming developed through the Harappan, Vedic, Mauryan and Gupta periods into an organised system.

Phases

- **Harappan:** wheat, barley, peas, sesame, cotton (first in the world), dates; wooden ploughs (terracotta plough model at Banawali), granaries at Harappa and Lothal.

- **Vedic period:** iron ploughshare, oxen, cow dung manure; Rig Veda mentions ploughing and irrigation; Atharva Veda refers to rain and seeds. Crops: yava (barley), rice (vrihi), wheat.
- **Mauryan:** Arthashastra describes **Sitadhyaksha** (superintendent of agriculture), royal farms, water tax, famine relief. Megasthenes praised irrigation and fertility.
- **Gupta and medieval:** Krishi Parashara, **Brihat Samhita** (Varahamihira) on weather forecasting and plant care; **Vrikshayurveda** of Surapala on plant diseases.

Techniques

- **Irrigation:** wells, tanks, canals, check dams, Sudarshana lake (Girnar, Chandragupta), Kallanai dam (Cholas), Persian wheel (araghatta) in medieval times.
- **Soil and crops:** soil classification, crop rotation, mixed farming, seed treatment with ghee, honey and milk.
- **Manure:** cow dung, compost, green manure.
- **Calendar:** farming guided by seasons, monsoon prediction and astronomy.
- **Crops:** rice, wheat, barley, pulses, millets, cotton, sugarcane, spices, indigo.
- **Animals:** cattle for ploughing and dairying, horses, elephants.



Steps in ancient farming

Land and society: village was the unit; land taxes (bhaga, one-sixth of produce); land grants (agrahara, brahmadeya); farmers belonged mainly to the Vaishya and Shudra classes; guilds supported trade of grain.

Features: sustainability, organic inputs, water harvesting, cattle-based economy.

Conclusion. The ancient Indian agricultural system was scientific, sustainable and state-supported, and many of its ideas, such as organic farming and water harvesting, are being revived today.

Q4. Write short notes on (i) Mathematics in India (ii) Water management in India. (May 2026, May 2025)

(i) Mathematics in India

India has a continuous mathematical tradition from the Vedic period to the present.

- **Vedic and Sulba:** Sulba Sutras (Baudhayana, Apastamba) give geometric rules for altars, including the **Pythagorean theorem** and square root of 2.
- **Number system:** the **decimal place-value system and zero** were developed in India and carried by Arabs to Europe ("Hindu-Arabic numerals").
- **Classical period: Aryabhata** (*Aryabhatiya*, 499 CE): value of pi 3.1416, sine tables, algebra, rotation of Earth. **Brahmagupta** (*Brahmasphutasiddhanta*, 628 CE): rules of zero and negatives, quadratic equations. **Mahavira** (850 CE): LCM, permutations.
- **Medieval: Bhaskara II** (*Lilavati*, *Bijaganita*, 1150): arithmetic, algebra, early calculus. **Madhava of Sangamagrama** (14th century): infinite series for sin, cos, tan and pi (Kerala School); Nilakantha.
- **Modern: S. Ramanujan** (number theory, partitions, infinite series), D. R. Kaprekar, Harish-Chandra.
- **Other:** Pingala's binary system and Pascal's triangle (Meru Prastara); Vedic mathematics for calculation.

Mathematician	Contribution
Aryabhata	Pi, sine, place value
Brahmagupta	Zero rules
Bhaskara II	Lilavati, calculus ideas
Madhava	Infinite series
Ramanujan	Number theory

(ii) Water management in India

India has always valued water, recorded in the Vedas, which call water "sacred".

- **Harappan:** wells, drains, Great Bath, and Dholavira's reservoirs and channels.
- **Maurya and later:** Sudarshana lake (Girnar), canals; Arthashastra rules on water tax, dams and irrigation boards.
- **Medieval kingdoms: Kallanai** (Grand Anicut) on the Kaveri by the Cholas; tanks (eri) of Tamil Nadu; Bhoj Tal (Bhopal), Pushkar and Hampi water systems.
- **Traditional systems by region: stepwells** (baoli, vav) in Gujarat and Rajasthan, **johads** and **kunds**, **tankas** in Rajasthan, **kuls** in Himachal, **bamboo drip irrigation** in Meghalaya, **ahar-pyne** in Bihar, **zabo** in Nagaland, **khadin** in Jaisalmer, **bhandaras** in Maharashtra.

- **Principles:** local rainwater harvesting, community ownership, groundwater recharge and reuse.
- **Modern relevance:** Jal Shakti Abhiyan, Atal Bhujal Yojana, check dams and watershed programmes revive these methods.

Conclusion. Indian mathematics gave the world zero and the decimal system, and Indian water management offers sustainable, community-based models useful for today's water scarcity.

