

20 Direct CA Hits in Prelims 2026

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(Laser-Focus/Pathfinders/Clippings)



FRESHLENS IAS

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1. Interpol Notices

76. Match List I with List II and select the answer using the code given below the Lists :

List I

(INTERPOL
Notice)

List II

(Description)

- | | |
|------------------|---|
| A. Silver Notice | 1. To seek information on unidentified bodies |
| B. Blue Notice | 2. To collect additional information about a person's identity, location, or activities in relation to a criminal investigation |
| C. Black Notice | 3. To provide warning about a person's criminal activities, where the person is considered to be a possible threat to public safety |
| D. Green Notice | 4. To identify and trace criminal assets |

Code :

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

1.1.10. Interpol

1. **News** Interpol issued a **new category of notices (Silver Notice)** issued to *locate and trace criminal assets laundered across borders*.
2. **What is Interpol**
 - a. Interpol, officially **the International Criminal Police Organization**, is the **world's largest international police organization** with **196 member countries**. It was **founded in 1923**.
 - b. It facilitates **worldwide police cooperation against crime**, operating independently but under international law with headquarters in **Lyon, France**.
 - c. It is an **intergovernmental organisation**. Contrary to popular belief, **Interpol is itself not a law enforcement agency**.

Contemporary Affairs for Prelims 2026

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6. Consider the following pairs:

	Interpol Notice	Purpose
I.	Red	To seek the location and arrest of a person wanted for prosecution
II.	Blue	To collect additional information about a person in relation to a criminal investigation
III.	Yellow	To locate missing persons
IV.	Green	To warn about a person's criminal activities

How many of the pairs given above are correctly matched?

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

**FreshLensIAS Full Length
Open Mock Test-3**

2. RBI's Financial Inclusion Index

88. Which one of the following correctly represents the three key sub-indices of the Financial Inclusion Index (FI-Index) of the Reserve Bank of India (RBI) ?

- (a) Credit access, Insurance depth, and Pension coverage
- (b) Banking access, GDP contribution, and Financial literacy
- (c) Access, Usage, and Quality
- (d) Access, Affordability, and Transparency

1.7. RBI's Financial Inclusion Index rises to 67 in 2025 indicating Growth for Everyone

1. **#Context:** The Reserve Bank of India has informed that the **Financial Inclusion Index of the FI index for Financial Year 2025 has improved and stands at 67 percent** as compared to 64.2 percent for FY 2024.
2. It added that **growth was witnessed across all sub-indices**, which include, **Access, Usage and Quality**.
3. The **Access** parameter reflects how easily financial services are available, **the Usage** parameter indicates how frequently and effectively people are using these services, while the **Quality** parameter includes aspects like financial literacy, consumer protection, and reduction in inequalities and service deficiencies.
4. It may be recalled that **RBI had constructed a composite Financial Inclusion Index in consultation with all stakeholders**, including the government and the **first FI index was published in August 2021 for the Financial Year ending March 2021**.
5. The index also *includes data from various sectors such as banking, investments, insurance, postal services, and pensions, making it a comprehensive measure of financial inclusion in the country.*

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3. Bharat Forecast System

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- (a) Credit access, Insurance depth, and Pension coverage
- (b) Banking access, GDP contribution, and Financial literacy
- (c) Access, Usage, and Quality
- (d) Access, Affordability, and Transparency

3.6.5. What is the Bharat Forecast System: world's highest resolution forecasting model

1. **Context:** The India Meteorological Department (IMD) has adopted the Bharat Forecast System (BFS), an indigenously developed weather prediction model boasting a 6-kilometre resolution grid.
 - a. Union Minister of Earth Sciences Dr. Jitendra Singh inaugurated the world's first indigenously developed high-resolution weather forecast systems at a launch ceremony held at Vigyan Bhawan.
2. **Bharat Forecast System (BFS) is a cutting-edge weather model that delivers high-accuracy forecasts at an ultra-fine spatial resolution of 6 kilometres.**
 - a. This places India ahead of global peers such as the United Kingdom, the United States, and the European Union, whose models typically operate at 9 to 14 km resolution.
3. Developed indigenously by the Indian Institute of Tropical Meteorology (IITM), Pune, the BFS replaces the older 12-km resolution model and is now operational at the India Meteorological Department (IMD).
4. The improved forecasting system is made possible with high-performance computing systems 'Arka' and 'Arunika' located at the IITM, Pune and the National Centre for Medium Range Weather Forecasting, Delhi. This allows forecasters to issue timely alerts and fine-tuned predictions across a broad spectrum of weather phenomena, from rainfall to cyclones and heatwaves.
5. According to the IMD, the BFS shows 64% better accuracy than previous models and delivers up to 30% improvement in forecasting extreme weather events such as heavy rainfall.



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4. India AI Impact Summit 2026

1.10. What are the key takeaways from AI summit?

65. Consider the following statements with respect to the AI Impact Summit, 2026 held in New Delhi :

1. The Summit's intellectual framework was based on three foundational Sutras : People, Planning, and Progress.
2. The Preamble of the Summit stresses Democratising AI Resources, which acknowledges the Charter for Democratic Diffusion of AI as a binding framework to support locally relevant innovation and strengthen resilient AI ecosystems while respecting national laws.
3. The New Delhi Declaration on AI Impact was structured around seven Chakras (Pillars), which included Access for Social Empowerment, AI for Science, and Secure and Trusted AI.

Which of the statements given above is/are correct ?

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

Laser Focus (Update) - Jan'26-Mar'26

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1. The AI Impact Summit (Feb 16–20, 2026) held in New Delhi saw participation from global leaders, AI executives, and over five lakh attendees.
2. AI summits have been held annually since 2023, beginning with the Bletchley Park (U.K.) AI Safety Summit. Subsequent editions were held in Seoul (2024) and Paris (2025).
3. Unlike other global forums, these AI summits are not convened by any formal international organisation; host countries pass on responsibility each year.
4. The Paris Summit (2025) marked a shift from a “safety-first” approach to an “innovation-first” approach, especially led by the U.S.
5. India's priorities at the 2026 summit included
 - a. Democratisation of AI access
 - b. Inclusion of Global South and underrepresented languages
 - c. Development of safe and trusted AI systems
6. The summit had multiple thematic working groups such as human capital, inclusion, resilience, innovation, safe AI, and economic development.
7. A major outcome was the signing of the New Delhi Declaration on AI by 88 countries and international organisations, including major powers like the U.S., China, and France.
8. The declaration emphasises:
 - a. Democratic diffusion of AI
 - b. Creation of Global AI Impact Commons (database of AI use-cases)
 - c. Trusted AI Commons (tools, benchmarks, best practices)
 - d. International AI for Science Network
 - e. AI Workforce Development and Reskilling Principles
 - f. Focus on AI for social empowerment and economic growth
9. All commitments under the declaration are **voluntary and non-binding**, encouraging wider global participation.
10. India joined the U.S.-led Pax Silica initiative, aimed at reducing concentration in electronics manufacturing and critical minerals supply chains.
11. India's first domestically trained multi-billion parameter LLMs were launched by Sarvam AI, with open-source intent and government support under the IndiaAI Mission.

What are the key takeaways from AI summit?

What does the New Delhi Declaration say? How many countries are signatories? What were the goals? What is the aim of the Global AI Impact Commons? Apart from Reliance and the Adani Group, which companies have announced investments in domestic AI?

Arjun Deep

The story so far:

The AI Impact Summit from February 16-20 attracted lakhs of visitors, with high-profile AI executives and heads of state visiting New Delhi. On Saturday, 88 countries and international organisations signed the New Delhi Declaration on AI, which stresses that the technology must be democratised to make a difference.

Since when are AI summits being held?

Since 2023, dozens of countries have participated in annual gatherings to discuss AI. Its first instalment in Bletchley Park, the U.K. hosted a small dialogue on safety, where India was represented by then Minister of State for Electronics and Information Technology Jyoti Chadrasekhar. There is no international

The summit is expected to catalyse long-term international partnerships

Global South, such as by expanding representation for languages that have been under-represented in the training of western LLMs (large language models), and that the technology should be “safe and trusted”. On the domestic front, the government sought to project India as an attractive destination for AI infrastructure and research, drum up investor sentiment for putting money into AI, and for encouraging the technology's already-enthusiastic adoption in India, especially in fields such as healthcare, agriculture and education. The names of the working groups convened for this purpose reflect some of these priorities: human capital, inclusion for social empowerment, safe and trusted AI, resilience, innovation, and efficiency, science, democratising AI resources, and AI for economic development and social good.

Issues abounded, with significant traffic snarls delaying even some speakers from making it to their discussions. On the second day, an exhibitor at the summit's concurrent expo, Calcutta University, passed off a Chinese-made robot as their students' creation. The wide publicity to this caused significant embarrassment to the organisers, who ordered the university to vacate the premises. And on Friday, a group of Indian youth congress members stormed the expo, revealing hidden “distracts and chanting.” “Moji is Compromised,” before being apprehended by the police. The Delhi Police has apprehended the protesters, and is investigating the protest.

What were the investment commitments? Reliance Industries Ltd. announced commitments of ₹10 lakh crore in domestic AI, only slightly more than the Adani Group's similar commitment. Google gave a few fresh details about its existing \$15 billion investment in data centre and AI projects in India, such as a subsea cable system that would directly connect India and the U.S. The event also saw high-profile pacts between OpenAI and the Tata

AI Summit: India makes strong start, yet to arrive



Soumya Rendra Barik

NEW DELHI wrapped up the India AI Impact Summit 2026 on February 21, with its organisers billing it as the world's “safest and most historic” AI summit.

This five-day event, which kicked off on Saturday at Bharat Mandapam, drew heads of state, global tech executives and thousands of visitors — a remarkable feat for a country that is still catching up to the United States and China on the AI frontier. And the result was mixed.

The summit achieved real diplomatic heat, but exposed the limits of both India's AI ambitions and its capacity to host an event of this scale.

The summit postponed New Delhi's growing power in global AI governance discussions, producing a declaration with broader country sign-off than any previous summit in the series. It brought together the most prominent names in AI under one roof and generated large investment commitments.

But at the same time, the summit's voluntary framework, the logistical difficulties that inconvenienced ordinary visitors and delegates alike, and some embassies' around domestic AI claims all pointed to the gap between India's ambitions and its present reality.

For India, the summit was a beginning, not an arrival.

Diplomatic win

The headline outcome of the summit was the New Delhi Declaration on AI Impact, which was endorsed by 88 countries and international organisations, including the U.S., China, Russia, the U.K., France, and a wide range of developing nations.

That count comfortably exceeded the 61 signatories at the previous Paris AI Action Summit in February 2023, and the fact that India's IT Minister Ashwini Vaishnaw was quick to point out. The breadth of endorsement — spanning geopolitical rivals, major economies, and the Global South — gave India grounds to claim it had built a broader consensus than its predecessors.

The declaration's substance, however, is more measured. It lays out a shared vision for collaborative, trusted, and inclusive AI.

The declaration's thrust, are voluntary, with no enforcement mechanism.



PM Narendra Modi

PM Narendra Modi and other delegates attend the CEO Roundtable at the India AI Impact Summit, 2026

Governance, in the sense that Bletchley had originally intended — risk thresholds, safety standards, coordinated oversight of frontier models — was barely on the agenda. What was on the agenda was who gets to build AI, who gets to deploy it, and who gets to profit from it.

Along road, the dog, and lapses

The summit's logistics drew pointed criticism. Delegates were left stranded without food or water during the many security lockdowns that happened over the summit's nearly week-long duration.

Across central Delhi, and beyond, road closures to facilitate VIP movement created prolonged traffic jams, affecting residents, delegates, and in some cases even speakers at the event. Attendees at the venue had to walk several kilometres to reach transportation. The city was not prepared for the scale of attendance the summit attracted.

There were also reputational embarrassments. An Indian university was caught presenting a commercially available Chinese-made humanoid robot of the 19th century as a “next-gen” AI robot. The event's security was also a source of concern, with some of them worried India's sovereignty was a central theme.

The big money government official said that the ability to draw in the big leaders of AI, alongside world leaders, despite India being a bit player in the GenAI space was an achievement.

But the inadequacies of state capacity and the government's inability to accept, translate, coordinate and execute remained



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5. Mission Sudarshan Chakra

60. Consider the following statements about Mission Sudarshan Chakra of India :

1. It aims to enhance India's air defence, ballistic missile defence and aerial offensive capabilities.
2. This Mission is being designed to enhance rapid, precise, and powerful defence responses, reinforcing India's strategic autonomy.
3. One of the aims of this Mission is to cover all public places of India by an expanded nationwide security shield by 2035.

Which of the statements given above is/are correct ?

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

1.11. Mission Sudarshan Chakra : India's Indigenous Air Defence System

1. **News:** Mission Sudarshan Chakra is India's plan to develop an air defence system on the lines of Israel's famous Iron Dome.
2. **What is Mission Sudarshan Chakra?**
 - a. According to a government press release, under this mission, *"by 2035, critical national sites will be equipped with cutting-edge technology and powerful weapon systems."*
 - b. The mission aims not only to neutralise enemy attacks but also to deliver impactful counterstrikes, much like the Sudarshan Chakra. This step will prove to be a milestone in making national security impregnable and enabling targeted strikes against adversaries.
 - c. Basically, **Sudarshan Chakra will be a system of surveillance equipment, jammers, sirens, radars, weapons etc.,** which will identify aerial threats and strike them down before they can attack any Indian site.



6. Vizhinjam Port

24. In what way(s) does the Vizhinjam International Seaport represent a structural shift in India's maritime trade and logistics policy ?

1. By functioning exclusively as a domestic cargo hub to reduce reliance on coastal shipping and eliminate the need for foreign collaborations.
2. By focusing primarily on passenger cruise tourism and heritage shipping to increase Kerala's profile as a maritime heritage destination.
3. By leveraging its natural deep draft and strategic location to reduce dependence on foreign trans-shipment ports, enhance revenue retention, and reposition India in regional maritime trade.

Select the answer using the code given below :

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

5.4.5. Shaping the port of the future (Vizhinjam port)

1. **Context:** India's **first deep water and container transshipment port at Vizhinjam** has been officially inaugurated by the Prime Minister.
2. **An important landmark**
 - a. This port is of **immense significance to India's global maritime trade**. Currently, around **75% of India's transshipment cargo** is handled at ports like **Colombo, Singapore and Klang**.
 - b. Amongst all existing Indian ports, **Vizhinjam is the closest to international shipping routes**, strategically located just 10 nautical miles from the global maritime trading route.
 - c. This **all-weather port** is India's first greenfield port project.
3. **What is a transshipment port?**
 - a. It is a port where **cargo is transferred from one ship to another en route to the final destination**; helps reduce overall shipping costs and time.



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7. Deep Ocean Mission

50. Which of the following statements with regard to India's Deep Ocean Mission is/are correct ?

1. It was launched by the Ministry of Ports, Shipping and Waterways, Government of India.
2. Matsya-6000 has been designed to carry 3 people for deep sea exploration.
3. Samudrayaan is a project under this mission.

Select the answer using the code given below :

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

5.2. How India's 'aquanauts' will undertake deep sea exploration under Samudrayaan Project

1. **Context:** In August, two Indian "aquanauts" travelled deep into the Atlantic Ocean aboard the French vessel, Nautilus. This was in preparation for deep-sea exploration under the upcoming Samudrayaan Project, where India plans to send three humans to depths of 6,000 metres by 2027.
2. **What are Samudrayaan Project's aims?**
 - a. Only a few countries presently possess deep-sea exploration capabilities, including the United States, Russia, China, Japan, and France. India will join this select group of nations with the Samudrayaan Project, which is among the six components of the Deep Ocean Mission approved by the Union Cabinet in 2021.
 - b. At the cost of Rs. 4,077 crores over five years, the mission will:
 - i. Develop technologies for deep sea mining, underwater vehicles and robotics, as and a crewed submersible (which needs support from a larger vehicle)



Samudrayaan: Indian aquanauts' exploration of the deep

ANONIMA DUTT
NEW DELHI, AUGUST 28

EARLIER THIS month, two Indian "aquanauts" travelled deep into the Atlantic Ocean aboard the French vessel, Nautilus. This was in preparation for deep-sea exploration under the upcoming Samudrayaan Project, where India plans to send three humans to depths of 6,000 metres by 2027. Cdr (Retd) Jatinder Pal Singh and R Ramesh travelled to 5,002 metres and 4,025 metres below the sea level, respectively. Just as astronaut Shubhanshu Shukla's learnings from the recent Axiom-4 mission will aid India's Gaganyaan programme for human spaceflight, the dives will inform the deep-sea project.

What does the project aim to do?

With India's 11,098 km-long coastline, the government has long pushed for a blue economy policy which will harness ocean resources for economic growth. The deep ocean is home to several unexplored minerals, fish,

and biodiversity resources. It is also where a crucial medium of modern global telecommunications is found in the form of undersea cables, which are laid on the ocean floor.

Only a few countries, such as the US, Russia, China, Japan, and France, currently possess deep-sea exploration capabilities. India will join this select group of nations with the Samudrayaan Project, which is among the six components of the Deep Ocean Mission approved by the Union Cabinet in 2021.

EXPLAINED SCIENCE

At the cost of Rs. 4,077 crores over five years, the mission will:

- Develop technologies for deep-sea mining and underwater vehicles and robotics, including a crewed submersible;

- Develop an ocean climate change advisory service, with observations and models for future projections of climate variables;
- Look for technological innovations to explore and conserve deep-sea biodiversity;
- Conduct deep ocean surveys, mainly to look for mineral deposits, specifically, polymetallic nodules, which comprise layers of iron and manganese hydroxides and are found

on the ocean floor, often containing materials such as nickel, rare earths and cobalt;

- Develop technologies to derive energy and freshwater from the ocean; and
- Establish an advanced marine station for developing capacities in ocean biology and engineering.

The National Institute of Ocean Technology, as the coordinating agency, is developing the submersible for the Samudrayaan Project.

What is Matsya-6000?

It is the vehicle that will take the aquanauts into the deep. Designed somewhat like a big fish, it will comprise a "personnel sphere" with a diameter of 2.1 metres to house the humans. The vehicle will be capable of sustaining three humans for 12-hour missions (in case of emergencies, systems aboard can sustain them for up to 96 hours). For the initial test, carrying humans to a 500-metre depth, a steel sphere will be used. A wet test was conducted off the coast of Chennai in February.

Steel, however, is not strong enough to bear the atmospheric pressure at 6,000 metres un-



The Matsya-6000 will dive to depths of up to 6,000 m. **RB**

der the sea, which is 600 times that on the surface. The actual personnel sphere for Matsya-6000 will be made of a titanium alloy.

What are the challenges of deep-sea exploration?

In the depths of the ocean, environmental conditions are extremely inhospitable for hu-

mans. Several factors have to be considered:
Vessel development: The first challenge is developing a vehicle capable of sustaining life in the deep sea. A titanium alloy with 80 mm thickness was chosen due to its strength. But titanium is rare, and not many countries are willing to share their reserves.

Dr M Ravichandran, Secretary of the Ministry of Earth Sciences, said, "When we say 80mm thickness, it has to be precisely the same across the sphere. Even a 0.2mm deviation could lead to the collapse of the structure under such intense pressures." The sphere is to be fabricated through a precise technique called electron beam welding, where a focused beam of high-velocity electrons melts and joins the materials. The Indian Space Research Organisation (ISRO) will carry out this process.

Maintaining environment: Given that the aquanauts will be restricted to the personnel sphere, life-support systems will be needed to maintain the environment within. They must ensure that the oxygen levels remain at a certain level and the carbon dioxide levels are managed, with equipment known as scrubbers absorbing the harmful gas.

The spheres will also be equipped with packed re-breather oxygen systems, which will be deployed during an emergency. They can recirculate exhaled air after removing carbon dioxide and adding oxygen, similar to systems used by deep-sea divers.

Aquanaut health: The aquanauts must be physically fit to conduct the missions well and handle any emergencies. They also tend not to eat or drink a lot before and during their mission as they cannot access washrooms. During his nine-hour-long dive, Cdr Singh limited his diet to some dry fruits.

Acoustic communication: Radio waves, the basis of day-to-day communications, cannot be used for deep-sea communications. Acoustic telephones, which carry information-laden sound waves to a receiver placed just underneath the surface of the water, are used instead. Given other countries' reticence to share this technology, India has developed its own acoustic telephone. An initial test at a harbour failed because factors such as the temperature and salinity of the water also impact its efficacy. But the indigenous acoustic phone worked well in the open ocean.

8. National Critical Minerals Mission and Rare Earth Elements

95. Which of the following statements about Rare Earth Elements (REEs) and Critical Minerals is/are correct ?

1. Modern technological innovations including Artificial Intelligence, robotics and space exploration extensively utilise Rare Earth Elements (REEs).
2. China has the highest share in mining of REEs followed by India.
3. The Government of India launched the National Critical Mineral Mission (NCMM) in 2025 to establish a robust framework for self-reliance in the critical mineral sector.
4. Rare Earth Elements are a set of 13 metallic elements.

Select the answer using the code given below :

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

4.4. Others

4.4.1. Ministry of Mines classifies Barytes, Felspar, Mica and Quartz as Major Minerals

1. **#Context:** The Ministry of Mines vide gazette notification dated 20th February, 2025 has shifted minerals **Barytes, Felspar, Mica and Quartz** from the **list of minor minerals to the category of major minerals**.
2. This move follows the recent approval of the **National Critical Mineral Mission by the Union Cabinet on 29th January, 2025**. The Mission envisages exploration and mining of critical minerals within the country including recovery of these minerals from mines of other minerals, overburden and tailings
3. **Quartz, Felspar and Mica** are found in **pegmatite rocks**, which are an important source of many *critical minerals such as Beryl, Lithium, Niobium, Tantalum, Molybdenum, Tin, Titanium, Tungsten*, etc.
4. These minerals have vital role in various new technologies, in energy transition, spacecraft industries, healthcare sector, etc.

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Rare Earth Elements (REEs)

- Rare earth elements (REEs), despite the name, are not particularly scarce
- According to the International Energy Agency (IEA), they comprise 17 metals, typically grouped into light rare earths (LREEs) — including lanthanum, cerium, praseodymium, neodymium, samarium, and europium — and heavy rare earths (HREEs) such as gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium, and yttrium; promethium is excluded as it is radioactive and does not occur in mineable quantities
- They are critical components in clean energy technologies such as electric vehicles and wind turbines, as well as in defence applications; also essential for high-tech devices including smartphones and hard drives
- Although deposits exist in countries such as Brazil, Australia, and India, China holds nearly half of global reserves
- Launch scheme to support States to establish 3 dedicated Chemical Parks on a cluster plug-and-play model via the challenge route

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9. Dhruv64 Microprocessor

79. Which of the following statements about DHRUV64 is/are correct ?

1. It is the third chip fabricated under the DIR-V Programme with an overall aim to enable the creation of microprocessors for India.
2. It is India's first homegrown 1.0 GHz, 64-bit dual-core microprocessor.

Select the answer using the code given below :

- (a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Inside the DHRUV64 microprocessor

Who developed the DHRUV64 chip? What are the other chips within India's ecosystem of processors? What aspects have the Ministry of Electronics and Information Technology not revealed about DHRUV64? What are some schemes started by the government to advance indigenous fab technologies?

EXPLAINER

Yashwanth Mahalingam

The story so far
In December 15, the Ministry of Electronics and Information Technology (MEITY) announced the launch of DHRUV64, an indigenous microprocessor that it said would strengthen the national indigenous processor pipeline. Its purported applications span the breadth of electronics to industrial automation.

What is DHRUV64?
The DHRUV64 chip is a fully indigenous microprocessor developed by the Centre for Development of Advanced Computing (CDAC) under MEITY's Microprocessor Development Programme.

The microprocessor is a general-purpose device for electronics - a 64-bit, dual-core processor that runs at 1 GHz. These specifications could mean the processor is fast enough to run operating systems while also being efficient enough for embedded deployment.

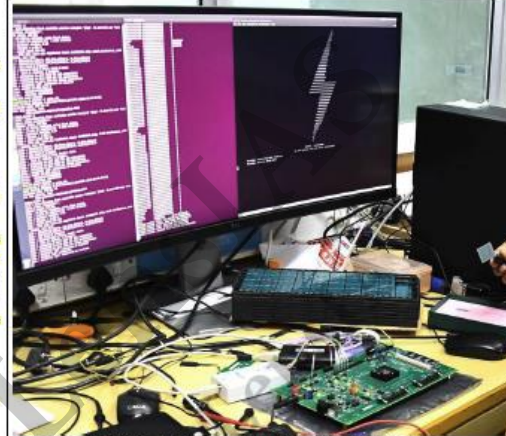
India is a major market for processors yet continues to depend on imported designs and supply chains. To this end, the Indian government has pitched for a "homegrown processor technology". Such processors sit at the base of everything from telecom networks to industrial control. So whatever controls their design, production, and supply pathways will also control security assumptions and resilience during export controls or supply shocks.

What do DHRUV64 specs mean?
DHRUV64 is not a chip meant only for simple sensing or appliance logic. In general, 64-bit designs are used when users want modern operating systems and contemporary software.

The specified performance is low compared to top-tier consumer standards. Today's state-of-the-art smartphones and laptop processors tend to coordinate many more CPU cores with higher peak clock speeds. They also include specialised blocks like the Graphics Processing Units (GPUs), which can effectively handle on-the-fly learning workloads.

This said, a lot of contemporary computing in the modern world doesn't demand top-tier CPUs. These applications include base station infrastructure, industrial controllers, routers, and many automotive modules. They prize reliability and lower hardware-software integration. At the same time, so the technology realisation. The latter wrote, "These are fields in which established players already offer mature products, and accompanying software and hardware development ecosystems. Even the most periodic Indian electronics manufacturer would surely find it hard to put the DHRUV64 as the top of their list of materials shipping. India therefore has plenty left to do if DHRUV64 is going to win customers."

What processors is India working on?
According to MEITY, DHRUV64 is part of the Indian ecosystem of processors, including SHAKTI from IIT Madras, AIT from IIT Bombay, VIKRAM from the IISc-Semiconductor Lab, and THIRAS64 from CDAC (2025). The roads these processors address include strategic operations, control systems in factories, spaceflight systems, and industrial automation. MEITY has also pitched DHRUV64 as a platform on which



Author's insight: I was there at the DHRUV64 project RISC-V lab at IIT Madras in Chennai in 2025, not a secret.

satellites, academics, and industry can build and test products on, "without relying on foreign processors", and can develop protection for new system architectures at lower cost. This is commendable because all processors everywhere, from the Intel Core series to the ARM processors to RISC-V, are designed to be as efficient as possible. This is not a new goal, but it is a goal that is often overlooked.

What is DHRUV64?
DHRUV64 (pronounced "druh-uv") is a set of instructions that a processor understands. A processor is like a cook who can only make the dishes written down in a recipe book. This book is the instruction set: it lists commands like "add two numbers", "move data from memory", "compare two values", "jump to another part of a program", etc.

RISC-V is an open instruction set, which means its core rules are publicly available and anyone can design a chip that follows them without paying a license fee for the instruction set itself. This is different from instruction sets that are controlled by a company and licensed to others. Then the chip designers will need to purchase licenses, sign contracts, etc. This is why governments and research groups sometimes prefer RISC-V.

RISC-V is also modular: designers can use it with a small standard core, then add extra features like faster arithmetic or security features depending on what the chip is meant for. But different cores can speak the same base language while still being fine-tuned for different tasks. DHRUV64 is tied to the Digital India RISC-V (DIRA) programme, which aims to build a portfolio of RISC-V-based microprocessors for industrial, military, and consumer technologies. THIRAS64 was the first India-developed chip RISC-V to be fabricated (in Malaysia), and

THIRAS64 was the second, made at SCL, Mohali. DHRUV64 is the third on this list. However, MEITY hasn't said where DHRUV64 was fabricated, which leaves doubts about the supply chain.

What is not known about DHRUV64?
MEITY's announcement of DHRUV64 is then on the engineering information required to judge the chip's readiness. There are five issues in particular.

First, the date about the chip's performance hasn't been contextualised in measurable terms. The headline specs, that is, 1 GHz, 64-bit, dual-core, are not accompanied by benchmarks, details of the memory subsystem (for example, cache sizes and memory controller features), input/output capabilities, and the performance per watt. The MEITY statement also says the design includes "modern architectural features" and "advanced multithreading capability" but doesn't specify what they stand.

Second, the statement claims the processor's "modern fabrication leverages technologies used for high-performance chips" but doesn't specify the founding, packaging, yield or reliability inputs. Applications in the telecommunications and automotive sectors require these details because they're used to determine the chip's lifetime reliability and failure rates.

Third, MEITY's claim that the chip is "fully indigenous" is ambiguous. The note highlights RISC-V's open architecture and "no licence cost". However "indigenous" can also mean an indigenous instruction set, indigenous core microarchitecture, indigenous system-on-chip integration, indigenous toolchains, indigenous fabrication or indigenous ownership of critical IP blocks.

Fourth, the announcement doesn't address questions relevant to the Digital

THE GIST

➤ The DHRUV64 chip is a fully indigenous microprocessor developed by the Centre for Development of Advanced Computing (CDAC) under MEITY's Microprocessor Development Programme.

➤ DHRUV64 is tied to the Digital India RISC-V (DIRA) programme, which aims to build a portfolio of RISC-V-based microprocessors for industrial, military, and consumer technologies.

➤ The 'Chips to Startups' programme, with an outlay of ₹200 crore over five years, the Design Linked Incentive scheme, and the MDP-2 initiative are intended to improve access to manufacturing facilities and training.

tor Mission (ISM) 2.0 and electronics

produce equipment/materials, design full-stack IP, and strengthen supply chains

00 crore has been made for ISM 2.0 for FY 2026-27, with a strong emphasis on industry-led research and training technology development and create a future-ready skilled workforce

s Components Manufacturing Scheme outlay to ₹40,000 crore

ve become critical to the functioning of modern economies

bone of energy networks, financial markets, and telecommunications; they enable manufacturing units, hospitals, and satellites

industry is dominated by a few countries, including Taiwan, South Korea, Japan, China, and the United States
uces over 60% of the world's semiconductors and nearly 90% of the most advanced chips, leaving global supply chain
nal shocks and geopolitical tensions

India's semiconductor journey is the launch of DHRUV64, a fully indigenous 64-bit microprocessor developed by C-processor Development Programme (MDP)

chitectural principles, DHRUV64 delivers improved efficiency, multitasking capability, and reliability, enabling sectors such as 5G infrastructure, automotive electronics, industrial automation, consumer devices, and the Internet

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27-Page 2

10. CBDC (e-Rupee)

90. Which one of the following statements about Unified Payments Interface (UPI) and Central Bank Digital Currency (Digital Rupee) is **not** correct?

- (a) UPI is a real-time payment system but Digital Rupee is akin to sovereign paper currency.
- (b) In case of UPI, settlement for end users happens instantly as the money gets immediately debited or credited but in case of Digital Rupee, there is no settlement as the wallet balance gets transferred to another wallet.
- (c) UPI transactions are recorded by banks and reflected in bank statements but in case of Digital Rupee, no data is captured in bank statements as transactions are from one wallet to another.
- (d) In both the cases (UPI and Digital Rupee), the liability lies with the users and their respective banks.

4.18. What is RBI nudging India to do at BRICS?

1. **#Context:** The Reserve Bank of India has reportedly proposed using Central Bank Digital Currencies (CBDCs) for cross-border payments among BRICS nations.
2. The proposal is linked to India's upcoming BRICS chairmanship in 2026, where it may push for a CBDC-based payment framework across member countries.
3. The BRICS includes Brazil, Russia, India, China, South Africa, and newer members such as Egypt, Ethiopia, Iran, UAE, and Indonesia.
4. If implemented, this would create a large alternative payments network beyond traditional systems.
5. **CBDCs**
 - a. CBDCs are digital forms of sovereign currency issued and regulated by central banks



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- b. In India, the RBI has introduced the e-rupee, which is equivalent to physical currency (₹1 = ₹1), exists in digital wallets, not bank accounts and uses blockchain (distributed ledger technology).
- c. CBDCs can enable faster, cheaper, and direct transactions between countries without intermediaries.
- d. Countries like Russia and Iran face restrictions in the SWIFT network.
- e. CBDCs provide an alternative payment channel.
6. **CBDCs can be programmed for:**
 - a. Specific uses (e.g., subsidies)
 - b. Geographic or sectoral restrictions
 - c. Expiry conditions
7. CBDC can help India and BRICS reduce reliance on the US dollar-dominated global financial system.

28. Which of the following are features of the Digital Rupee (e₹)?

- I. It can be transacted 24 hours a day, 7 days a week.
- II. A minimum balance is required to maintain an e₹ wallet.
- III. It supports decimal or fractional value payments up to two decimal places.
- IV. There are no charges or fees for using e₹.

Select the correct answer using the code given below.

- (a) I, III and IV
- (b) I, II and IV
- (c) I, II, III and IV
- (d) II and III only

**FreshLensIAS Open-Test 3-
Q28**

Laser-Focus-Jan-March-26-Update

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11. Strait of Hormuz

30. Ships from which of the following countries have to cross the Strait of Hormuz to reach out to the Indian Ocean ?

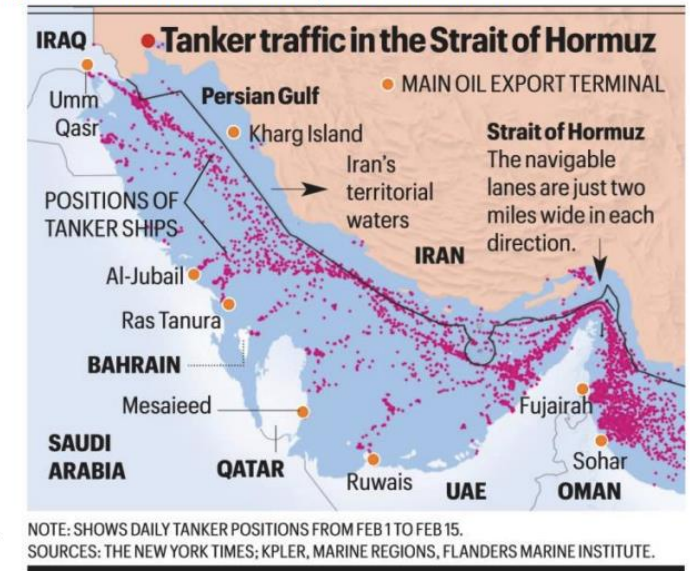
1. Bahrain
2. Syria
3. Qatar
4. Egypt

Select the answer using the code given below :

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

3.4. Strait of Hormuz oil flows dry up: How this affects India, and the options ahead

1. **#Context:** The ever-widening conflict involving Iran, US and Israel has severely disrupted oil and gas flows through the Strait of Hormuz — a critical artery for global energy supply.
2. The Strait of Hormuz, the world's most important oil transit chokepoint, is a narrow waterway between Iran and Oman that connects the Persian Gulf with the Gulf of Oman and the Arabian Sea.
3. It handles approximately one-fifth of global liquid petroleum consumption and global LNG trade.
4. Around 15 million barrels of crude pass through the Strait every day. While some pipelines exist in the Gulf states to bypass the waterway, their capacity is limited.
 - a. Even at full utilisation, nine million barrels per day (bpd) — or 9% of global demand — would remain structurally at risk if the strait is closed, according to industry experts.



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12. EU members

75. Which of the following countries are members of the European Union ?

1. Belarus
2. Poland
3. Germany
4. Switzerland

Select the answer using the code given below :

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

7. The **India-European Union (EU) leaders' summit, which will build on the European Commission President Ursula von der Leyen's visit to India earlier this year**, is set to take place next February. In the six months leading up to it, the two sides will be meeting roughly once a week to discuss cooperation in several areas.

Key points to note regarding India-European Union Relations:

- a. EU is **India's largest trading partner**; *India is EU's largest trading partner in the Global South.*
 - b. India's **share in EU trade is still below 2.5%**; Indian investment in EU is only €10 billion.
 - c. Signed **EU–India Connectivity Partnership in 2021**.
 - d. Flagship initiative: **India–Middle East–Europe Economic Corridor (IMEC)** which is **multimodal project integrating maritime, rail, energy, digital networks**.
 - e. **Strategic Dialogue on Foreign & Security Policy launched in June 2025**. Topics: maritime security, cybersecurity, counterterrorism, non-proliferation.
 - f. Note: **EU doesn't have a standing army** but coordinates defence projects.
- 



13. Black Boxes

44. Which of the following statements with regard to Black Boxes used in modern aircrafts is/are correct ?

1. They carry a beacon emitting red light pulses to facilitate underwater detection.
2. They record both the cockpit voice and flight data.
3. Their memory units are made using either stainless steel or titanium.

Select the answer using the code given below :

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

• AVIATION

Despite damage, black boxes hold key to Pawar air crash probe

Anagha Jayakumar
New Delhi, February 17

WEEKS AFTER the Learjet 45 aircraft carrying Maharashtra Deputy Chief Minister Ajit Pawar and four others crashed on January 28, the Aircraft Accident Investigation Bureau (AAIB) said Tuesday that both flight recorders or "black boxes" had sustained fire damage. While data was successfully retrieved from one recorder, the agency has sought foreign technical assistance for the rest.

"Both recorders were exposed to intense heat for a prolonged period during the accident and sustained fire damage. The Digital Flight Data Recorder (DFDR), manufactured by L3-Communications, has been successfully downloaded at the AAIB Flight Recorder Laboratory. The Cockpit Voice Recorder (CVR), manufactured by Honeywell, is undergoing detailed technical examination. Assistance has

been sought from the Accredited Representative of the State of Manufacture for specialised support in data retrieval," the AAIB said.

Initial information from the crash site indicated that low visibility conditions in the area might have played a role in the accident. The data from the recorders, along with the wreckage, are expected to help reconstruct the events leading up to the crash, whose cause remains unknown.

What are black boxes?

The black box, or aircraft flight recorder, has been around in some form since the 1930s, when French engineer François Hussenot originated a data recorder equipped with sensors that would optically project around 10 parameters onto a photographic film. The film ran continuously in a box constructed to prevent any light from entering it, lending it the name "black box". The name has endured ever since,

The two recorders

- Aircraft today typically have two black boxes: the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR).

- The CVR records radio transmissions and other sounds in the cockpit, including flight crew noises and engine noises.

- The FDR records technical details such as altitude, air-speed, vertical acceleration, etc.

even though the external metal casing has always been orange, to help its speedy identification and retrieval.

The invention of the box, however, is credited to Australian jet fuel expert David Ronald de Mey Warren, who was reportedly inspired by a miniature recorder he had seen at a trade fair. In 1956, he created a prototype he called the ARL Flight Memory Unit, which could store up to four hours of voice and flight instrument data.

How do black boxes help understand plane crashes?

Most aircraft today are mandatorily equipped with two black boxes, the cockpit voice recorder (CVR) and the flight data recorder (FDR). The CVR records radio transmissions and other sounds in the cockpit. The FDR, on the other hand, records more than 80 different types of technical details pertaining to the flight itself.

The FDR data helps investigators to re-

construct the flight by generating a video simulation. This helps them visualise the aircraft's altitude, power settings, instrument readings and other flight characteristics. It typically takes 10-15 days to analyse the data recovered from the black boxes after a crash.

How do black boxes withstand crashes?

The recorders are stored inside a unit made of a strong material such as steel or titanium, and are insulated from extreme heat, cold, and wetness. These boxes are equipped towards the tail end of the aircraft, which usually sustains the least impact from a crash.

These recorders are equipped with a beacon that can send out ultrasound signals for 30 days, which becomes handy when planes crash into water bodies. However, in some cases, like the Malaysian Airlines MH370 flight, the recorders weren't found.

CA Clippings Compilation- Feb 2026

14. National Quantum Mission

49. Which of the following statements with regard to the National Quantum Mission (NQM) is/are correct ?

1. It aims at developing intermediate-scale quantum computers with 50 – 1000 physical qubits.
2. Its implementation includes setting up of four Thematic Hubs (T-Hubs) in academic and national R&D institutes across India.

Select the answer using the code given below :

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

9.57. National Quantum Mission (NQM)

Flagship initiative approved in 2023 with ₹6,003.65 crore outlay (2023–31) to make India a global leader in quantum technology; led by the Department of Science and Technology; aims to develop 50–1000 qubit quantum computers, secure quantum communication (2000+ km), and advanced quantum sensors.

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15. Large Language Models

42. Which of the following statements with regard to Large Language Models (LLMs) used in machine learning is/are correct ?

1. LLMs assign probabilities to the next possible words and then pick the one with the highest probability.
2. LLMs process data through mathematical optimization to minimise prediction errors.
3. LLMs produce unbiased outputs.

Select the answer using the code given below :

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

How are Indian firms training LLMs?

Why is training a Large Language Model on Indian soil with Indian capital a challenge? How has the IndiaAI Mission subsidised efforts to conduct training in India? Why is a Mixture of Experts (MoE) architecture inexpensive than other comparable models?

EXPLAINER

Aroon Deep

The story so far:

At the AI Impact Summit, the Bengaluru-based startup Sarvam AI released two Large Language Models (LLMs), which are the foundation for AI systems that power services like Google's Gemini and OpenAI's ChatGPT. The two models were trained on 35 billion and 105 billion parameters respectively, and were less power- and compute-intensive than comparable models, while demonstrating improvements over other models in Indian languages, Pratyush Kumar, a Sarvam co-founder said.

How are LLMs trained?

LLMs are trained and operated on clusters of Graphics Processing Units (GPUs). The combined cost of the GPUs and the electricity needed to run them long enough to train a model, run into millions of dollars. The gist for this mill is data, largely scraped from the Internet, where English, European languages and East Asian languages like Korean and Japanese are more richly represented than Indian languages.

This creates a twofold challenge for training an LLM on Indian soil with Indian capital: for one thing, with scarce data sources, many LLMs either perform worse when operating on Indian languages, or burn more "tokens" on inference to translate sentences into English (and translating responses back) to perform better. Since machine translation has improved dramatically for Indian languages, this remains the gold standard for many LLMs. Secondly, since capital is also scarce, efforts to train an LLM by Indian firms targeting Indian users can be challenging, especially if there is no immediate business use case for doing so.

Using translations as a fulcrum can be a



New innovations: Prime Minister Narendra Modi with Sarvam co-founder Pratyush Kumar at the AI Impact Summit, at Bharat Mandapam, in New Delhi on February 19, 2024.

challenge for developers who want to leverage local LLMs – like Sarvam's 35 billion parameter model, which was shown off in a demo during the summit's research symposium working on a feature phone – where suboptimal performance in Indian languages can impact adoption and quality of performance.

Has there been government support?

The IndiaAI Mission has subsidised efforts to conduct training in India, by commissioning over 36,000 GPUs in data centres operated by Indian firms like Yotta, and allowing researchers and startups to run training and inference workloads at a relatively nominal fee. The government gave Sarvam access to 4,096 GPUs from its common compute cluster, and the subsidy so far is estimated at

almost ₹100 crore. The "bill of materials" for this cluster is ₹246 crore, though these GPUs can probably be continued to be used by others.

The Ministry of Electronics and Information Technology has encouraged domestic LLM development for many reasons. The main one is a belief that foreign-developed LLMs can't possibly find the capabilities or the business case to develop the capacity to work well with Indian languages. Additionally, encouraging talent that can train LLMs has been seen as important to foster the Indian AI ecosystem.

As such, Sarvam's announcement of its two models is a significant development in India's own quest to develop a powerful and relatively inexpensive LLM. When China's DeepSeek developed its R1

LLM, the entire AI industry quickly adopted its techniques, as it saved on cost for training and inference without compromising output quality. The government has sought to spark a similar cost advantage.

Mr. Kumar of Sarvam said that the LLM was trained "from scratch," and that the model would be made open source. However, while it has been made available on an app named Indus, it is not available on platforms like Hugging Face, making it difficult for outside experts to scrutinise the claims the firm has made.

What is the MoE architecture?

A key breakthrough for AI models seeking to function locally was the Mixture of Experts (MoE) architecture. When the first LLMs trained on hundreds of billions or even over a trillion parameters were launched, inference was typically run by "activating" all parameters, making queries expensive. But an MoE model only activates a fraction of the overall parameters of a model, making it run faster and also consume a lower level of computing resources.

Even 105 billion parameters, Sarvam acknowledges, "is significantly smaller than the frontier models powering global consumer chat applications today," and the firm says it is "intentionally focused on accuracy, usefulness, efficiency, and alignment for the Indian context before training bigger foundational models".

As such, the answers are not as in-depth as a response from paid versions of Gemini or ChatGPT. That part will come later, Sarvam says, when it has the necessary investments to put money into a larger training run.

Another LLM developed and trained on the common compute cluster was by BharatGen, the IIT Bombay-incubated firm that was able to train a "multilingual" 17 billion parameter model. That model, the firm says, is for use in sectors like education and healthcare. Grant.ai, another firm, launched a small text-to-speech model.

THE GIST

LLMs are trained and operated on clusters of Graphics Processing Units (GPUs). The combined cost of the GPUs and the electricity needed to run them long enough to train a model, run into millions of dollars.

The IndiaAI Mission has subsidised efforts to conduct training in India, by commissioning over 36,000 GPUs in data centres operated by Indian firms like Yotta.

A key breakthrough for AI models seeking to function locally was the Mixture of Experts (MoE) architecture.

16. Mangroves

23. Which of the following best explain(s) the rationale for protecting mangrove ecosystems in the context of climate resilience ?

1. Mangroves reduce tidal energy and store freshwater, making them ideal sites for paddy cultivation in saline estuarine belts.
2. Their salt-sensitive roots filter seawater, making mangroves key to converting coastal land into freshwater aquaculture zones.
3. By withstanding tidal surges and offering biomass resources, mangroves function both as natural bio-shields and livelihood bases for rural communities.

Select the answer using the code given below :

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

Telegram – <https://t.me/cathatmatters>

Restoring mangroves can turn the tide on India's coastal security

In spite of mounting threats to mangroves, India is also the epicentre of a number of inspiring efforts to protect and revive mangrove ecosystems; with the right mix of stewardship, scientific support, and policy attention, they are showing that mangroves can not only survive, but also thrive

Pritya Rangamathan

Across India's coasts, from the languid channels of the Sundarbans delta to Mumbai's stifled creeks, mangroves form a barrier between land and sea. These coastal forests are critical in India's pursuit of climate resilience, biodiversity conservation, and the empowerment of coastal communities.

However, in the face of urban expansion, climate change, and development, how are India's mangroves surviving – and who is protecting them?

Mangroves matter
Mangrove swamps are forested wetlands characterised by trees that can tolerate saline water. They serve as natural barriers, protecting coastal communities from cyclones, tidal surges, and erosion. During natural disasters like the 2004 Indian Ocean tsunami and recurring cyclones in the Bay of Bengal, mangroves have been known to attenuate damage to coastal infrastructure and biodiversity and have saved thousands of lives.

Their role in biodiversity conservation is significant as well. Mangroves provide breeding and nursery grounds for fish, crustaceans, molluscs, and migratory birds. These salt-tolerant forests also store significant amounts of blue carbon (the carbon captured by marine and coastal ecosystems), helping mitigate climate change by trapping carbon dioxide from the atmosphere in their roots and soil.

The mangroves of India cover more than 4,900 sq. km, including estuaries, deltas, and the coasts of West Bengal, Odisha, Tamil Nadu, Gujarat, and Karnataka, among other States. For coastal communities, especially traditional fishers and honey gatherers, mangroves are intimately linked to livelihoods and cultural practices.

Yet they are increasingly threatened by urban expansion, aquaculture, pollution, and changing climate patterns. This isn't the case in India alone; around the world, more than half of all mangrove ecosystems are at risk of collapse by 2050, according to a recent report from the International Union for the Conservation of Nature (IUCN).

In spite of these mounting threats, however, India is also the epicentre of a growing number of inspiring efforts to protect and revive mangrove ecosystems. With the right mix of stewardship, scientific support, and policy attention, they are showing that mangroves can not only survive, but also thrive.

Mangroves in Tamil Nadu
In recent years, efforts to restore mangroves across Tamil Nadu have seen remarkable progress, driven by a combination of government initiatives, community participation, and scientific planning. Once severely degraded by shrimp farming, industrial pollution, and altered hydrology, the State's estuaries and coasts are today witnessing a slow but steady comeback.

Under the Green Tamil Nadu Mission and other coastal restoration programmes, the districts of Thanjavur, Tiruvarur, and Cuddalore, among others, have significantly expanded mangrove cover. As a result, Tamil Nadu's mangroves doubled its mangrove extent – from 4,500 hectares to more than 9,000



Mangrove swamps are forested wetlands characterised by cyclones, tidal surges, and erosion. www.earthcam.com

hectares between 2021 and 2024 – and has been leading coastal ecosystem recovery in India. In early 2017, the M.S. Swaminathan Research Foundation in Chennai, in collaboration with local village committees and the Tamil Nadu Forest Department, began a project to restore 115 hectares of degraded mangroves in the Pattanamachi estuary of Muthupattinam. After thorough site assessments and community engagement, the team dug 19 major canals to restore tidal flow. Then team members planted more than 4.3 lakh *Avicennia* seeds from Muthupattinam and 6,000 *Rhizophora* propagules from Pichavaram, successfully regenerating a once-degraded landscape into a thriving mangrove forest.

Yet another success story from Tamil Nadu is the restoration of a green belt of mangroves near Buckingham Canal in Kuthavaram. Under the Green Tamil Nadu Mission, the Forest Department planted 12,500 mangrove seedlings from five species in 2024 with the help of scientific experts. The restoration involved removing invasive *Prosopis juliflora* weeds before planting the mangroves, with the goal of restoring Chennai's natural shield against cyclones and storm surges.

Conservation in Mumbai
In early 2025, Amazon's Right Now Climate Fund partnered with Hasteen Regeneration and the Brihanmumbai Municipal Corporation to launch a \$12 million (₹10.3 crore as of July 24, 2025)

Until the late 1980s, the value of mangroves was primarily understood by the communities that lived around them and relied on them for fishery resources and their livelihoods. But today, the word "mangroves" has become a buzzword, whether in the area of disaster risk reduction in coastal areas, climate adaptation through carbon sequestration, enhancement of coastal fishery resources, or the conservation of shoreline bird sanctuaries, to name a few.

The turning point
Although the United Nations Development Programme and UNESCO initiated a regional project on mangrove research in 1988, it was in 1989 that M.S. Swaminathan proposed a leading role for mangroves in managing the impact of climate change in coastal areas. At the Climate Change and Human Responses conference in Tokyo in 1989, he explained that rising sea levels due to climate change would cause a salinisation of land and water resources in coastal areas, leading to the loss of food production and employment. A rise in the frequency of cyclones due to rising sea surface temperatures causes the loss of life, livelihoods, and natural resources. As a response, M.S. Swaminathan suggested immediate action for the sustainable management of mangrove wetlands. This was based on the principles of ecology, economics, and equity as well as research on the utilisation of mangrove genetic resources to develop new saline-tolerant crops (by transferring genes for salinity tolerance from mangroves to rice and other crops). A series of important developments found M.S. Swaminathan playing a pivotal role in mangrove restoration, conservation and management.

Thanks to M.S. Swaminathan's initiatives, the International Society for Mangrove Ecosystems (ISME) was established in 1990 in Okinawa, Japan – M.S. Swaminathan served as its Founding President till 1993.

He co-created the Charter for Mangroves and included it in the World Charter for Nature, prepared by the United Nations Conference on Environment and Development in 1992. To this

providing paid employment in planting and maintenance activities.

By focusing both on ecological recovery and socio-economic resilience, this project exemplifies how corporate-backed, nature-based solutions can advance biodiversity protection in India's rapidly urbanising coastal zones.

Gujarat's success
Gujarat has become a national leader in mangrove restoration under the Indian government's Mangrove Initiative for



Selvam Vaithilingam

is a former Executive Director of the M.S. Swaminathan Research Foundation, and has four decades of experience in mangrove research and management

Mangrove forests, once considered to be marshy land, now occupy a central position in the coastal ecosystem and climate mitigation moves

developmental activities continue to ravage our coasts, the need to protect what remains and restore what is lost has never been more urgent. Mangroves are the first line of defence against storms, and they also shelter fisheries and store carbon.

(Pritya Rangamathan is a doctoral student and researcher at the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru. pritya.ecology@gmail.com)

day, this charter serves as a basis for mangrove conservation efforts at the global level.

The ISME conducted an assessment of the economic and environmental values of mangrove forests, including those in India, as well as the current state of their conservation. The ISME also organised a series of workshops on mangrove conservation and sustainable utilisation, published a manual of mangrove ecosystem restoration, and produced a World Mangrove Atlas. These activities, slowly but surely, transformed the common perception of what mangroves are: from an idea of them being marshy land waiting for conversion to other uses to their being central to a multiple-use coastal ecosystem. The ISME is promoting applied research, providing training to various stakeholders, and acting as a centre of knowledge products on mangroves.

Global infrastructure for conservation
Another vital contribution of M.S. Swaminathan was the development of the GLOM Mangrove database and Information System (GLOMIS), a searchable database on mangrove experts, research, and species, including the Mangrove Ecosystem Information Services, which focused on documenting genetic resources. In 1992, a team of scientists surveyed and evaluated 23 mangrove sites in South, Southeast Asia, and Oceania over nine countries, with scientific inputs from M.S. Swaminathan, to establish a global network of Mangrove Genetic Resource Centres. These centres are now conserved, monitored and managed as 'Protected Areas' by the respective governments.

At the national level, M.S. Swaminathan was instrumental in revolutionising India's management of mangroves. India has a long history of mangrove management, dating back to 1783. However, this period was marked by extensive clearance and reclamation of the Sundarbans mangrove forests, primarily for agriculture and settlements. The practice of clear-felling as a system of mangrove management was widespread in India from the British colonial period until 1980, when the Indian Forest (Conservation) Act was enacted.

The working plans prepared by the British, and later by the State Forest Departments of independent India, showed that attempts to restore mangroves in clear-felled areas yielded minimal results. On the other hand, local communities were blamed for the poor results. Here, researchers from the M.S. Swaminathan Research Foundation, under the guidance of M.S. Swaminathan, played a key role.

Participatory research during 1993 and in the following years, first with the Tamil Nadu Forest Department and then with other States and local communities, revealed that changes in the biophysical conditions of the mangroves, due to the clear-felling system of management, were the primary reason for their degradation rather than resource utilisation by local communities. Based on this scientific evidence, a hydro-ecological method of mangrove restoration – commonly referred to as the fishbone canal method – was developed and pilot-tested in the mangroves of Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal.

This method later evolved into a Joint Mangrove Management programme, which the then Ministry of Environment and Forests, evaluated in 2000 through a committee and recommended for replication in all suitable areas. This resulted in more investment by the Central and State governments for mangrove restoration and conservation. The immense role played by mangroves during the 1999 Odisha super cyclone and the 2004 Indian Ocean tsunami, in reducing the loss of life and damage to property and natural resources, paved the way for valuing large-scale restoration of mangroves, in India and globally.

Rise in mangrove cover
World Mangrove Day (July 26) is also an occasion to look at whether there has been change. The India State of Forest Report (ISFR) 2023 says that the total mangrove cover in India is 4,991.68 km², which accounts for 0.15% of the country's total geographical area. If one compares the ISFR 2019 to the ISFR 2023, there has been a significant increase, of 16.68 km², in the country's mangrove coverage.

17. Madhav National Park

32. With reference to Madhav National Park, which of the following statements is/are correct ?

1. It was declared a Tiger Reserve in India in 2025.
2. Sakhya Sagar, which is designated as a Ramsar Site, is situated within this National Park.
3. Its area is shared between Madhya Pradesh and Rajasthan.

Select the answer using the code given below :

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

Madhav National Park becomes India's 58th Tiger Reserve

The Hindu Bureau
BHOPAL

The Centre declared the Madhav National Park in Madhya Pradesh as the country's 58th tiger reserve on Sunday, with Union Environment Minister Bhupender Yadav making the announcement. The newly added Tiger Reserve is also the ninth from the State to get the recognition.

Mr. Yadav posted on X, "58th roar and counting! Thrilled to announce that the country has added the 58th Tiger Reserve to its tally with the latest entrant

being Madhya Pradesh's Madhav Tiger Reserve. This is Madhya Pradesh's 9th Tiger Reserve."

Located in Shivpuri district in the Chambal region of Madhya Pradesh, the reserve has a population of five tigers at present, including two cubs born recently.

Three tigers, including two females, were introduced to the Madhav National Park in 2023 as part of the tiger reintroduction project in the State.

Two more tigers
Madhya Pradesh Chief Minister Mohan Yadav could



Conservation counts: The reserve has five tigers at present, including two cubs that were born recently. ANI

soon release two more tigers into the reserve.

"With historic emphasis

laid on restoring the ecological diversity on planet Earth by PM Shri Narendra

Modi ji, India continues to make great strides in environmental protection and wildlife conservation. I congratulate all wildlife lovers and conservationists. The development is a testament to the relentless efforts of our forest officials who are selflessly working towards the cause," the Union Minister said in his post.

Applauding the move, Mr. Modi said that India was blessed with wildlife diversity and a culture that celebrated wildlife.

"Amazing news for wildlife lovers! India is blessed with wildlife diversity and

a culture that celebrates wildlife. We will always be at the forefront of protecting animals and contributing to a sustainable planet," he said on social media platform X.

The Chief Minister also thanked the Prime Minister for the development.

"Heartfelt thanks to the Hon'ble Prime Minister for your visionary leadership in designating Madhav National Park as India's 58th and MP's 9th Tiger Reserve! Madhya Pradesh is proud to lead wildlife conservation and protect our biodiversity," the Union Minister wrote.

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18. Genome India Project

48. Which of the following statements with regard to GenomeIndia Project is/are correct ?

1. It is a part of the Human Genome Project.
2. The project is funded by the Department of Biotechnology (DBT), Government of India.
3. Its primary aim is to build a catalogue of genetic diversity of the Indian population.

Select the answer using the code given below :

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

India releases compilation of 10,000 human genomes from 83 population groups

The 'Genome India' database will be available to researchers across the world; it will serve as a template for investigations into disease, drug therapy; PM says it will strengthen biotech economy

Jacob Koshy
NEW DELHI

India has completed and made available a year-long compilation of 10,000 human genomes representing 83 population groups, making up about 2% of the country's 4,600 population groups, as a database. This collection will serve as a template of future investigations into disease and drug therapy.

The 'Genome India' database, as it is known, will now be available to researchers across the world for investigation and is housed at the Indian Biological Data Centre (IBDC), in Faridabad, Haryana.

A first analysis of the genomes estimates around 27 million low-frequency (or relatively rare) variants, with 7 million of them not found in similar reference databases around the world. Certain population groups show higher frequencies of alleles, or different versions of the same gene. Over the last two de-



A major focus of the Indian reference genomes is to have researchers study diseases. GETTY IMAGES

CADES, many countries have created databases of the genomes of their population – for a variety of purposes including estimating disease risks, adverse drug reactions, establishing genealogy and DNA-profiling databases.

However, a major focus of the Indian reference genomes is to have researchers study diseases. "The discoveries from Genome India are not just scientific

– they hold the potential for targeted clinical interventions, advancing precision medicine for better healthcare," said Union Minister of State (Independent charge) for Science and Technology Jitendra Singh, at an event here to announce the project.

Researchers wishing to access the genomes must send in a proposal that will be perused by an independent panel with a commit-

ment that will adhere to data sharing and privacy policies. Though the database stores information on population groups, this data will not be classified by the names of castes or tribes but will be numerically coded, Rajesh Gokhale, Secretary, Department of Biotechnology, told *The Hindu*.

Describing the project as "historic", Prime Minister Narendra Modi, in a video address, said this paved the way for India strengthening the biotechnology economy as well as biotechnology-based manufacturing.

Experts said that while only a small fraction of India's population groups were studied, the door was open to expanding the database to a million genomes. "Though costs are a limiting factor, a million would dramatically scale insight into India's genetic diversity," said Kumaraswamy Thangaraj of the Centre for Cellular Microbiology, Hyderabad and one of the project leaders.

63. With reference to the organisations under the Government of India, consider the following details :

Sl. No.	Organisation	Function	Controlling Union Ministry
1.	Central Economic Intelligence Bureau (CEIB)	To coordinate between various law enforcement agencies	Ministry of Home Affairs
2.	Serious Fraud Investigation Office (SFIO)	To investigate complex corporate frauds	Ministry of Finance
3.	Central Bureau of Investigation (CBI)	To preserve values in public life and ensure the health of the national economy	Ministry of Personnel, Public Grievances and Pension

In how many of the above rows are the given details correctly matched ?

- (a) 1
(b) 2
(c) 3
(d) None

19. Serious Fraud Investigation Office (SFIO)

9.15. Serious Fraud Investigation Office (SFIO)

Serious Fraud Investigation Office, is India's specialized agency under the Ministry of Corporate Affairs (MCA) that investigates complex corporate frauds and white-collar crimes, bringing together experts in law, accounting, banking, and forensics to tackle large-scale financial misconduct and ensure corporate accountability.

Established with statutory powers by the Companies Act, 2013, it has regional offices and focuses on serious cases requiring multi-disciplinary expertise, coordinating with other government bodies for effective prosecution.

Laser-Focus-Jan-March 2026- Update

Telegram – <https://t.me/cathatmatters>

20. John Clarke

81. 'X', born in the UK, was conferred the Nobel Prize in 2025. He was a professor in an American university when this prize was announced. Identify 'X' :

- (a) Michel H. Devoret
- (b) Richard Robson
- (c) John Clarke
- (d) Joel Mokyr

Trio win Nobel for revealing quantum physics in action

Done in mid-1980s, experiments set stage for development of quantum computers

AMITABH SINHA
NEW DELHI, OCTOBER 7

VERY SMALL particles, atomic or smaller, behave in ways that are very different compared to objects we encounter in everyday lives. This behaviour, extremely counter-intuitive at times, are described by laws of quantum mechanics.

These individual particles seemingly exist at multiple places at the same time (superposition) or appear to pass magically through physical barriers like a wall (tunnelling). These properties are normally not exhibited by large objects though they comprise these same small particles.

This year's Nobel Prize in

physics has gone to three scientists who showed that it was possible even for large systems, made up of billions of these small particles, to exhibit quantum behaviour under controlled conditions. John Clarke, Michel Devoret and John Martinis have been awarded the prize "for the discovery of macroscopic quantum mechanical tunnelling and energy quantisation in an electric circuit".

Their work, done in mid-1980s, set the stage for the development of quantum computers, which is one of the most active areas of scientific research right now.

Tunnelling
John Clarke, Michel Devoret and John Martinis were working together at the University of

California, Berkeley when they performed a series of experiments in 1984 and 1985 on special electric circuits. Martinis was a PhD candidate, Devoret a post-doctoral fellow and Clarke was their professor and supervisor.

For their experiments, they used a set up very similar to one that had won a Nobel in Physics for Brian Josephson in 1973. It involved an electric circuit contain-

ing two superconductors. The two superconductors were separated by a thin insulator.

Under normal circumstances, this circuit would not allow the flow of current. But the use of superconductors allows the flow of current – a discovery that won Josephson the Nobel Prize, and gave the superconductor-insulator-superconductor set up the name Josephson junction.

"Superconductivity, in a sense, is a quantum behaviour. All the electrons in the material move together in a coordinated way as if part of a single quantum wave. In the kind of electric set up that Josephson had created, the electric current exhibits a tunnelling effect, which is not unexpected for a quantum particle," explained Rajamani Vijayaraghavan, an associate professor in the Department

of Condensed Matter Physics and Material Sciences at the Tata Institute of Fundamental Research. Vijayaraghavan obtained his PhD under Devoret and has collaborated with the other two winners as well.

Josephson's work was revealing and gave rise to a whole range of new applications, for example in precise measurements of fundamental physical constants and magnetic fields.

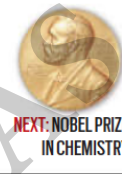
Prediction and Confirmation

Influenced by the predictions of another Nobel winning physicist Tony Leggett who had suggested that quantum behaviour on a macroscopic level could be observed in a Josephson junction kind of set-up, the trio began working to validate this experimentally. They used a similar set-up as that of Josephson but had to take meticulous care to isolate the entire set-up from its environ-

ment to avoid any interference. What they were able to demonstrate is an entire circuit, not just the electrons in the Josephson junction, exhibited quantum behaviour. The circuit could exhibit certain discrete energy levels each corresponding to a particular value for current, resistance, or in-between energy states. This is a distinctly quantum behaviour. The circuit could demonstrate quantum tunnelling.

"This was the first time quantum tunnelling was demonstrated on a macroscopic scale. However, it did not catch the imagination at that time. From a perspective, I would say it set the stage for quantum computing, or qubits, units of information in a quantum computer," he said.

2025 NOBEL PRIZE IN PHYSICS



NEXT: NOBEL PRIZE IN CHEMISTRY



JOHN CLARKE, 83
University of California, Berkeley, USA. PhD from the University of Cambridge, United Kingdom.



MICHEL H. DEVORET, 72
Yale University, New Haven, and University of California, Santa Barbara, USA. PhD from Paris-Sud University, France.



JOHN M. MARTINIS, 67
University of California, Santa Barbara, USA. PhD 1987 from University of California, Berkeley.

4.4. How the Physics Nobel-winning experiment shaped quantum computing

1. **Context:** The Royal Swedish Academy of Sciences has awarded the Nobel Prize in Physics to John Clarke, Michel H. Devoret, and John M. Martinis "for the discovery of macroscopic quantum mechanical tunnelling and energy quantisation in an electric circuit."

a. Their work sounds esoteric at first glance, but its significance runs deep. They showed that quantum "weirdness" – normally confined to atoms and subatomic particles – can reveal itself in electrical circuits big enough to hold in one's hand. It's a discovery that bridges the invisible world of the very small with the tangible one we inhabit.



2. In the mid-1980s, Clarke, Devoret, and Martinis used superconducting circuits cooled to near absolute zero, where electric current flows with zero resistance. At the heart of their setup was a Josephson junction – two superconductors separated by a thin insulating layer. Under these conditions, pairs of electrons (called Cooper pairs) can tunnel across the barrier, behaving as a single quantum system.

- a. When they passed a current through such a circuit, the entire system acted like a macroscopic particle.
- b. It could "escape" from one quantum state to another – tunnelling through an energy barrier and producing a tiny measurable voltage.
- c. They also found that the system absorbed and released energy only in discrete steps, confirming energy quantisation in a man-made circuit.

3. Macroscopic quantum circuits are more than scientific curiosities. They form the backbone of technologies like quantum computing, quantum cryptography, and ultra-precise sensors. Their experiments helped scientists learn how to preserve quantum coherence – the fragile property that allows quantum systems to remain in superpositions without collapsing into classical states.

Applications:

- a. **Superconducting qubits:** Their circuits became the blueprint for qubits in today's quantum computers. Their work directly enabled platforms developed by Google, IBM, and others

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