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Compiled by Arvind KrS

183	14	107	2026
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01 Prelims 2022–2026

02 Prelims 2017–2021

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Science and Tech Prelims Research 2013–2026

Year-wise UPSC Prelims Science and Tech questions with answers and explanations

Prelims 2026 Edition · Compiled November 2026

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UNIT 01

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PRELIMS RESEARCH | GS PAPER 1 | SCIENCE AND TECH

UPSC Prelims Research: Science and Tech 2026

All 16 Science and Tech questions of UPSC Civil Services Preliminary Examination 2026, General Studies Paper 1, with the correct answer and an explanation of every option.

1. Which of the following statements with regard to genetic medicine is/are correct?

1. Genetic medicines correct/compensate for the faulty genes responsible for disease.

2. Engineered viruses and lipid nanoparticles are used as carriers of the genetic medicine.

3. Genetic medicines alter the entire DNA sequence.

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

Answer: (c) 1 and 2 only

Genetic Medicine

- **Genetic medicine** treats disease at its root by acting on **genes or their products (RNA)** rather than only on symptoms. It covers **gene therapy**, **gene editing** (such as CRISPR-Cas9), **RNA-based medicines** (mRNA, antisense oligonucleotides, siRNA) and **cell-based gene therapies** such as CAR-T.
- **Statement 1 is correct.** These medicines work in three main ways:
  - **Replacing** a faulty gene with a healthy copy (for example, adding a working Factor VIII gene in **haemophilia A**).
  - **Silencing or switching off** a harmful gene (siRNA and antisense drugs).
  - **Repairing or editing** the faulty sequence itself (CRISPR base and prime editing).

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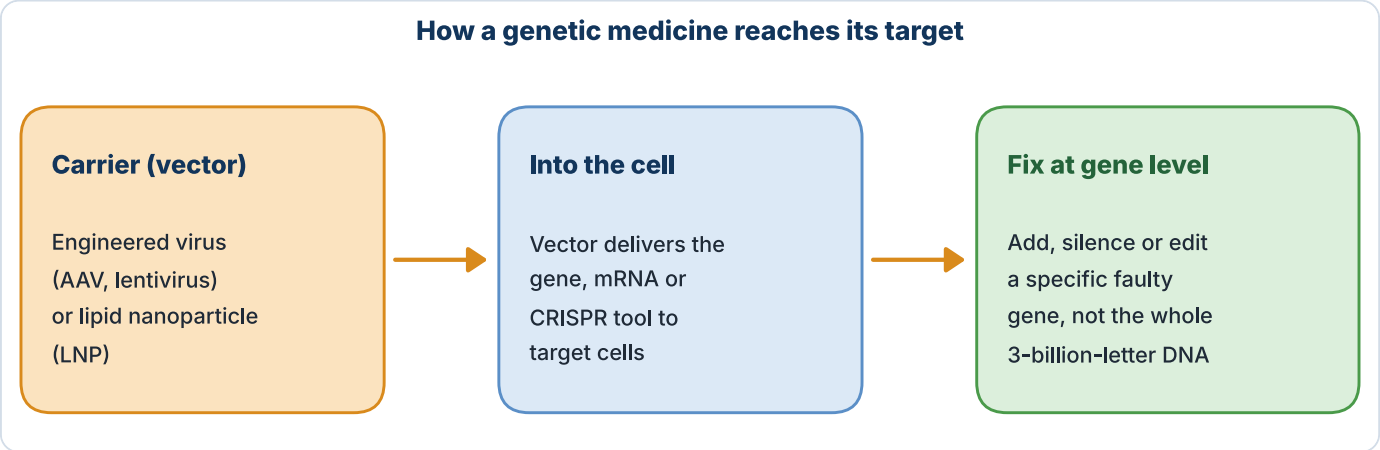
- **Statement 2 is correct.** A gene cannot enter a cell on its own, so it needs a carrier called a **vector**:
  - **Viral vectors**: engineered, disease-free viruses such as **adeno-associated virus (AAV)**, **lentivirus** and adenovirus, which naturally deliver genetic material into cells.
  - **Lipid nanoparticles (LNPs)**: tiny fat bubbles that wrap mRNA or CRISPR components. They carried the **mRNA COVID-19 vaccines** and are used for in-body gene editing.
- **Statement 3 is incorrect.** Genetic medicines act on **specific target genes or short sequences**. They do **not** alter the entire DNA (the whole genome of about **3 billion base pairs**). Most therapies are **somatic**: the change is not passed to children. **Germline editing** (in eggs, sperm or embryos) is banned for clinical use in India and most countries.



How a genetic medicine is delivered and what it changes

India and Recent Milestones

- **NexCAR19** (2023): India's **first indigenous CAR-T cell therapy**, for blood cancers, developed by **IIT Bombay** and Tata Memorial Centre and approved by the CDSCO.
- **Haemophilia A gene therapy**: India's first human trial, at **CMC Vellore** with DBT support, used a **lentiviral vector** to add a working Factor VIII gene.
- **Casgevy** (2023): the world's first approved **CRISPR-based therapy**, for **sickle cell disease** and **beta-thalassaemia**. India runs the **National Sickle Cell Anaemia Elimination Mission** with a goal of elimination by **2047**.

Type	How it works	Example
Gene addition	Adds a healthy copy through a vector	Haemophilia A, SMA (Zolgensma)
Gene silencing	Blocks the faulty gene's RNA	siRNA drugs for amyloidosis
Gene editing	Cuts and repairs the DNA sequence	Casgevy (CRISPR)
Cell therapy	Patient's cells modified outside the body	NexCAR19 (CAR-T)

2. 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.

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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

> **Answer: (b) 1 and 2 only**

Large Language Models (LLMs)

- An **LLM** is an AI model trained on a very large body of text to understand and generate human language. Most modern LLMs use the **Transformer** architecture (introduced in 2017), whose **self-attention** mechanism lets the model weigh how every word in a passage relates to every other word.
- Text is broken into **tokens** (words or word-pieces). The model learns **billions of parameters** (weights) that capture patterns of language.
- **Statement 1 is correct.** An LLM is a **next-token predictor**. For each step it computes a **probability distribution** over its whole vocabulary and then chooses a token. Picking the most likely token is called **greedy decoding**; in practice a **temperature** setting may add some randomness, but the basic method is probability-based prediction.
- **Statement 2 is correct.** Training is a **mathematical optimisation** problem. The model's guesses are compared with the actual next word, the error is measured by a **loss function** (cross-entropy), and the weights are adjusted step by step through **gradient descent and back-propagation** to **minimise prediction error**.
- **Statement 3 is incorrect.** LLMs learn from human-written data, so they can **absorb and repeat the biases** in that data (gender, caste, religion, region, language). They can also **hallucinate**, that is, state false information confidently. Developers reduce this with **RLHF (reinforcement learning from human feedback)**, filtering and testing, but outputs are never guaranteed to be unbiased.

India's AI Push

- **IndiaAI Mission** (approved March 2024, outlay about **₹10,372 crore**): shared GPU compute, datasets platform (**AIKosh**), and support for **sovereign foundation models** trained on Indian languages.
- **BharatGen**: a government-funded multilingual and multimodal LLM initiative led by **IIT Bombay**. **Bhashini** provides AI-based translation across Indian languages.

---

3. Which of the following statements with regard to stealth technology is/are correct?

1. Stealth objects have a very small radar cross-section and are coated with Radar Absorbing Material.

2. Stealth objects can be detected using specific frequencies.

3. Stealth objects are coated with metamaterials to increase the scattering of electromagnetic radiation.

Select the answer using the code given below :

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

> **Answer: (c) 1 and 2 only**

Stealth Technology

- **Stealth (low-observable) technology** makes an aircraft, ship or missile hard to detect by **radar, infrared, sound and sight**. Radar stealth is the most important part.
- **Statement 1 is correct.** Stealth rests on two ideas:
  - **Low radar cross-section (RCS)**: angled, faceted surfaces and internal weapon bays deflect radar waves **away** from the transmitter. A stealth fighter may show an RCS about the size of a **bird or a golf ball**.
  - **Radar Absorbing Material (RAM)**: special coatings (ferrite-based paints, carbon composites) **absorb** radar energy and turn it into heat, so less of it returns.
- **Statement 2 is correct.** Stealth shaping works best against **high-frequency (X-band) fire-control radars**. Long-wavelength **VHF and UHF radars**, where the aircraft's parts are about the size of the wavelength, can still detect it, though less precisely. **Passive radars**, multistatic radars and infrared sensors are other counters.
- **Statement 3 is incorrect. Metamaterials** are engineered materials with properties not found in nature. In stealth, they are used to **bend, absorb or cancel** electromagnetic waves so that **scattering back to the radar is reduced**, not increased. Increasing scattering would make the object easier to detect.

Stealth Platforms

- **Fighters and bombers**: F-22, F-35 and B-2 (USA), J-20 (China), Su-57 (Russia).
- **India**: the **Advanced Medium Combat Aircraft (AMCA)**, a fifth-generation stealth fighter designed by the **Aeronautical Development Agency (ADA)**; the **Ghatak** stealth unmanned combat aircraft; and the **Project 17A (Nilgiri-class)** stealth frigates of the Navy.

---

4. 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

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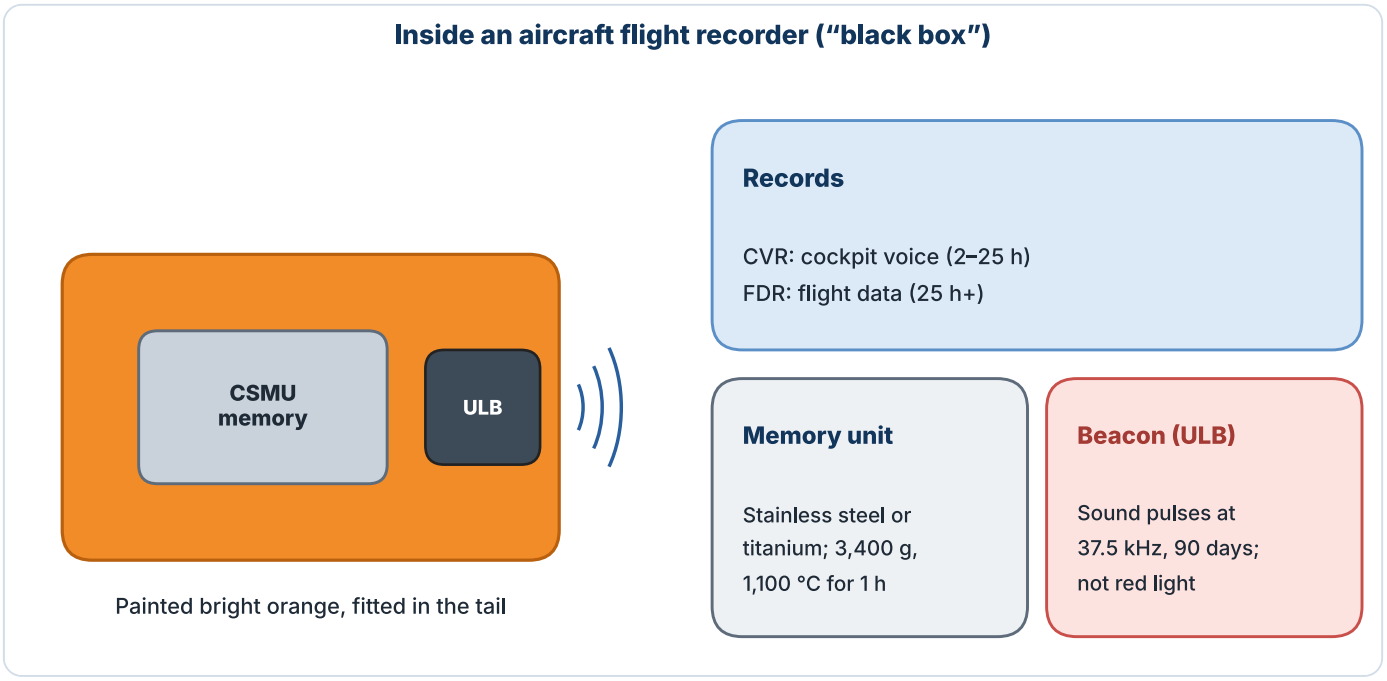
(c) 1 and 2 only
(d) 1, 2 and 3

Answer: (b) 2 and 3 only

Aircraft Black Boxes (Flight Recorders)



Parts of an aircraft flight recorder

- A **black box** is a crash-protected flight recorder. Despite the name it is painted **bright orange** with reflective strips so that it is easy to find in wreckage. Most airliners carry two units, placed in the **tail**, which is the part most likely to survive a crash.
- **Statement 1 is incorrect.** The recorder carries an **Underwater Locator Beacon (ULB)**, also called a **pinger**. It activates on contact with water and sends **acoustic (ultrasonic) pulses at 37.5 kHz**, once every second, which search ships pick up with hydrophones. It does **not** emit red light, because light travels poorly through deep water. ICAO now requires the beacon to work for **90 days** (earlier 30 days).
- **Statement 2 is correct.** The two recorders are:
  - **Cockpit Voice Recorder (CVR)**: pilots’ voices, radio calls, alarms and engine sounds in the cockpit, usually the **last 2 hours** (newer rules require 25 hours).
  - **Flight Data Recorder (FDR)**: altitude, airspeed, heading, engine power, control positions and many other parameters, for at least the **last 25 hours**.
  - Some modern aircraft combine both in one unit, the **Enhanced Airborne Flight Recorder**.
- **Statement 3 is correct.** The data sits on memory boards inside the **Crash-Survivable Memory Unit (CSMU)**, which is housed in **stainless steel or titanium** with thermal insulation. It is built to survive an impact of about **3,400 g**, a fire of **1,100 °C for one hour** and deep-sea pressure.

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In the News

- After the **Air India flight AI171 crash at Ahmedabad (June 2025)**, the recorders were read at the **Aircraft Accident Investigation Bureau (AAIB)** laboratory in New Delhi, India's own facility for decoding flight recorders.

---

5. Which of the following statements with regard to Green Hydrogen is/are correct?

1. It is decarbonized hydrogen obtained from natural gas reforming combined with carbon capture and storage (CCS).

2. It is produced using electrolysis of water with electricity generated by renewable energy.

3. National Green Hydrogen Mission of India aims for abatement of nearly 50 MMT of annual greenhouse gas emissions by 2030.

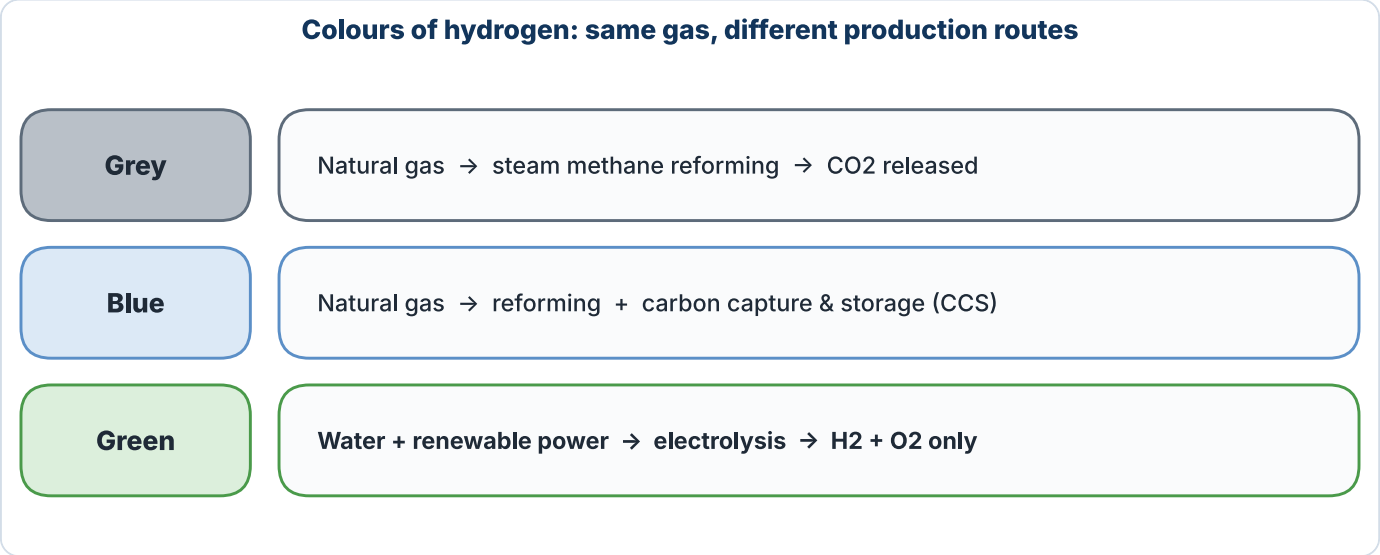
Select the answer using the code given below:

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

> **Answer: (b) 2 and 3 only**

Colours of Hydrogen

- Hydrogen burns without carbon emissions, but its "colour" depends on **how it is produced**:



Grey, blue and green hydrogen compared

Colour	Source and process	Emissions
Grey	Natural gas, steam methane reforming (SMR)	High CO2 released
Blue	Natural gas SMR + carbon capture and storage (CCS)	Low, CO2 captured

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Brown / Black	Coal gasification	Very high
Green	Electrolysis of water using renewable power	Near zero
Pink	Electrolysis using nuclear power	Near zero
Turquoise	Methane pyrolysis (solid carbon by-product)	Low

- **Statement 1 is incorrect.** Hydrogen from **natural gas reforming with CCS** is **blue hydrogen**. It is called "low-carbon" or decarbonised, but it still depends on fossil fuel.
- **Statement 2 is correct. Green hydrogen** is made by **electrolysis**, splitting water (H_2O) into hydrogen and oxygen in an **electrolyser**, using electricity from **solar, wind or other renewable sources**. India's **Green Hydrogen Standard (2023)** treats hydrogen as green if its emissions are **not more than 2 kg CO_2 equivalent per kg of hydrogen**.
- **Statement 3 is correct.** The **National Green Hydrogen Mission** (approved **January 2023**, outlay **₹19,744 crore**) has these targets for **2030**:
  - Green hydrogen production capacity of at least **5 million metric tonnes (MMT) per year**, with about **125 GW** of linked renewable capacity.
  - Abatement of nearly **50 MMT of annual greenhouse gas emissions**.
  - Over **₹8 lakh crore** of investment, about **6 lakh jobs**, and fossil fuel import savings of over **₹1 lakh crore**.
- Components include **SIGHT** (Strategic Interventions for Green Hydrogen Transition: incentives for electrolyser manufacturing and green hydrogen production), pilot projects in steel, shipping and transport, and **Green Hydrogen Hubs**.

---

6. Consider the following statements with regard to involvement of private entities in India's space programme:

1. The Indian National Space Promotion and Authorisation Centre (IN-SPACE) is an autonomous agency formed to facilitate participation of private entities.

2. Agnikul Cosmos launched the world's first flight using 3D-printed rocket engine.

3. Skyroot Aerospace has developed liquid fuel for GSLV.

Which of the statements given above is/are correct?

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

> **Answer: (c) 1 and 2 only**

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Private Players in India's Space Sector

- **Statement 1 is correct.** **IN-SPACe** was created in **June 2020** as a **single-window, autonomous agency under the Department of Space**, headquartered in **Ahmedabad**. It **promotes, authorises and supervises** space activities of non-government entities, and lets them use ISRO's facilities.
- **Statement 2 is correct.** On **30 May 2024**, **Agnikul Cosmos** (incubated at **IIT Madras**) launched **Agnibaan SOrTeD** from its own private launch pad, **Dhanush**, at Sriharikota. It used **Agnilet**, the **world's first single-piece, fully 3D-printed semi-cryogenic rocket engine**, and was India's first launch with a semi-cryogenic engine.
- **Statement 3 is incorrect. Skyroot Aerospace** (Hyderabad) builds its own **Vikram** series of small rockets. In **November 2022**, its **Vikram-S** (mission **Prarambh**) became **India's first privately built rocket** to reach space. Its engines are named **Kalam** (solid) and **Raman** (liquid upper stage). The **GSLV** is ISRO's vehicle, and its cryogenic and liquid stages are developed by ISRO's **Liquid Propulsion Systems Centre (LPSC)**, not Skyroot.

Reforms That Opened the Sector

- **New Space India Limited (NSIL)** (2019): ISRO's commercial arm, which also transfers technology (for example, SSLV to industry).
- **Indian Space Policy 2023**: defines roles of ISRO, IN-SPACe, NSIL and private firms.
- **FDI reform (2024)**: up to **74%** automatic route for satellite manufacturing and operations, up to **49%** for launch vehicles, and up to **100%** for components and systems.

---

7. Which of the following statements with regard to drone swarms is/are correct?

1. They use Terahertz band of frequency to communicate with the command centre.

2. Individual drones in the swarm can communicate with other drones in the swarm.

3. GPS Spoofing is a commonly used technique to counter drone swarm attack.

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

> **Answer: (b) 2 and 3 only**

Drone Swarms

- A **drone swarm** is a group of drones that fly and act **together as one system**, using **swarm intelligence** (inspired by flocks of birds and colonies of bees). A swarm can overwhelm air defences by sheer numbers, and it keeps working even if some drones are shot down.
- **Statement 1 is incorrect.** Swarms generally talk to the ground station over ordinary **radio-frequency links** (such as the **2.4 GHz and 5.8 GHz** bands), satellite links or cellular networks. The **terahertz band** (0.1–10

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THz) offers very high data rates but has **very short range** and is easily absorbed by moisture in the air, so it is still at the **research stage** and is not the standard link to a command centre.

- **Statement 2 is correct.** Drones in a swarm form a **mesh (ad hoc) network** and share position, speed and targets **drone-to-drone**. This lets them avoid collisions, keep formation and reassign tasks without a human controlling each drone.
- **Statement 3 is correct.** Swarms depend on **satellite navigation (GPS/GNSS)**. In **GPS spoofing**, fake navigation signals mislead drones about their position so they drift off course, land or crash. It is a common **soft-kill** counter, along with **RF jamming** of control links.

Counter-Swarm Tools

Method	How it works
Soft kill	RF jamming, GPS spoofing, cyber takeover
Hard kill	Guns, missiles, micro-missiles, interceptor drones
Directed energy	High-power lasers and microwaves

- **India**: DRDO tested a **30 kW laser-based Directed Energy Weapon (Mk-II(A))** that shot down drones in **April 2025**, and the indigenous **Bhargavastra** micro-missile counter-swarm system was tested at **Gopalpur, Odisha** in **May 2025**.

---

8. 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

> **Answer: (b) 2 and 3 only**

GenomeIndia Project

- **Statement 1 is incorrect.** The **Human Genome Project** was an international effort (1990–2003), led by the USA, that produced the first reference sequence of the human genome. It was **completed in 2003**. **GenomeIndia** (approved **January 2020**) is a **separate, national project** of India.
- **Statement 2 is correct.** GenomeIndia is **funded by the Department of Biotechnology (DBT)**, Ministry of Science and Technology. It brings together **20 institutions**, coordinated by the **Centre for Brain Research, IISc Bengaluru**.
- **Statement 3 is correct.** Its main aim is to build a **reference catalogue of genetic variation** of Indians. In **January 2025** it completed whole-genome sequencing of about **10,000 healthy individuals** from **83**

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population groups across the country, and the data was made available through the **Indian Biological Data Centre (IBDC), Faridabad**.

Why It Matters

- Most global genome databases come from people of European ancestry, so they miss variants common in India's diverse **tribal, caste and regional groups**.
- An Indian reference helps in **diagnosing genetic diseases**, **predictive and precision medicine**, designing **drugs that suit Indian patients** (pharmacogenomics), and understanding **population history**.
- Related: the **Phenome India** project and India's **Biotechnology for Economy, Environment and Employment (BioE3) Policy (2024)**.

---

9. 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

> **Answer: (c) Both 1 and 2**

National Quantum Mission (NQM)

- Approved by the Union Cabinet in **April 2023** with an outlay of **₹6,003.65 crore** for **2023–24 to 2030–31**, and implemented by the **Department of Science and Technology (DST)**. It makes India one of a few countries with a dedicated quantum mission.
- **Statement 1 is correct.** The mission aims to build **intermediate-scale quantum computers with 50–1,000 physical qubits** within **eight years**, on platforms such as **superconducting and photonic** technology. A **qubit** can be in a **superposition** of 0 and 1, and qubits can be **entangled**, which allows certain problems to be solved far faster than on classical computers.
- Other targets:
  - **Satellite-based secure quantum communication** between ground stations **2,000 km** apart, and inter-city **quantum key distribution (QKD)** over 2,000 km.
  - **Multi-node quantum networks** with quantum memories.
  - High-sensitivity **magnetometers** and **atomic clocks** for precise timing, communication and navigation.
  - **Quantum materials** such as superconductors and topological materials.

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- **Statement 2 is correct.** The mission is carried out through **four Thematic Hubs (T-Hubs)**, announced in 2024:



The four Thematic Hubs of the National Quantum Mission

T-Hub	Lead institution
Quantum Computing	IISc Bengaluru
Quantum Communication	IIT Madras (with C-DOT)
Quantum Sensing and Metrology	IIT Bombay
Quantum Materials and Devices	IIT Delhi

10. 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

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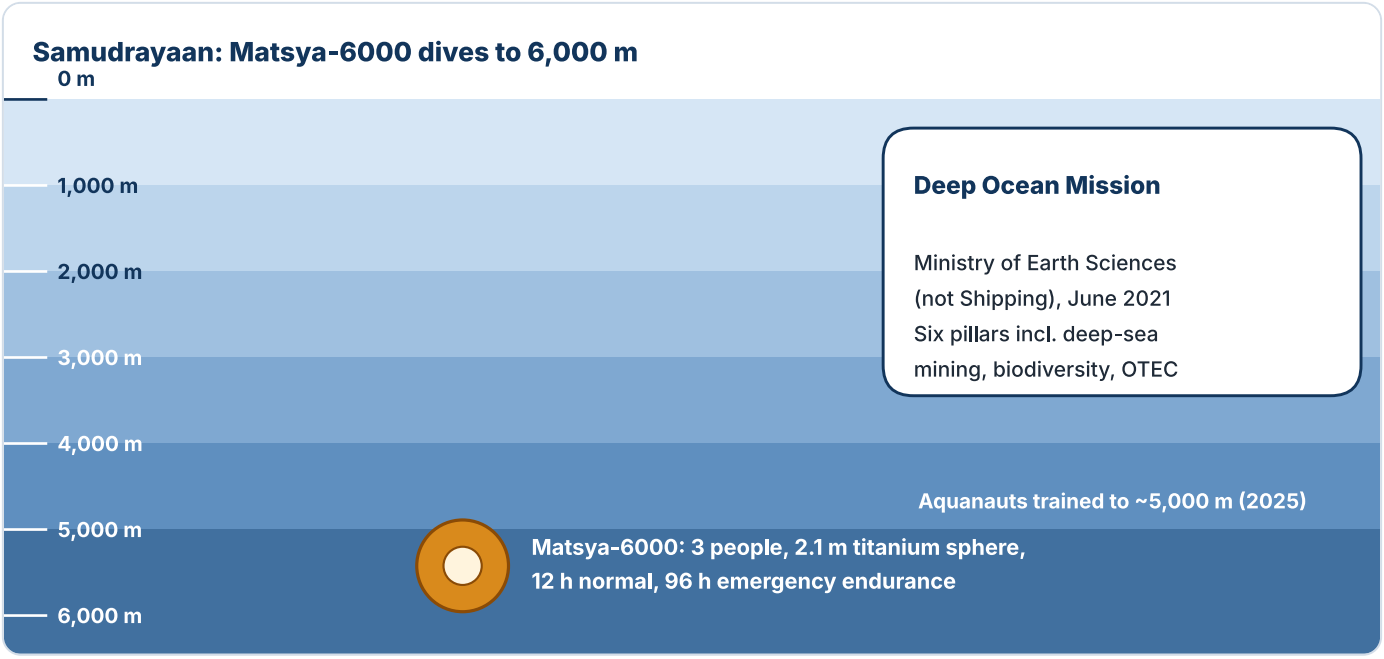
(c) 1 and 2 only
(d) 1, 2 and 3

Answer: (b) 2 and 3 only

Deep Ocean Mission (DOM)



Matsya-6000 and the Deep Ocean Mission

- **Statement 1 is incorrect.** The Deep Ocean Mission was approved in **June 2021** and is run by the **Ministry of Earth Sciences (MoES)**, with an outlay of about **₹4,077 crore** over five years. It supports India's **Blue Economy** vision.
- **Six pillars** of the mission:
  - Technologies for **deep-sea mining** and a **manned submersible**.
  - **Ocean climate change advisory services**.
  - Technologies for exploring and conserving **deep-sea biodiversity**.
  - **Deep ocean survey and exploration**, for example of **hydrothermal mineral deposits** along Indian Ocean ridges.
  - **Energy and freshwater from the ocean** (for example, OTEC-powered desalination).
  - An **advanced marine station** for ocean biology.
- **Statement 2 is correct. Matsya-6000** is India's manned submersible, designed by the **National Institute of Ocean Technology (NIOT), Chennai.** It will carry **three people** to a depth of **6,000 m** inside a **2.1 m titanium-alloy sphere**, with an endurance of **12 hours** in normal operation and **96 hours** in an emergency.
- **Statement 3 is correct. Samudrayaan** is the **manned deep-ocean project** under the mission's first pillar, using Matsya-6000. It will make India one of a handful of countries (with the USA, Russia, France, Japan and China) able to send humans to such depths. Indian aquanauts trained in 2025 with dives to about **5,000 m** in a French submersible.

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11. 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

> **Answer: (c) Both 1 and 2**

DHRUV64 Microprocessor

- Launched in **December 2025**, **DHRUV64** was designed by the **Centre for Development of Advanced Computing (C-DAC)** under the **Microprocessor Development Programme** of the Ministry of Electronics and IT (MeitY).
- **Statement 1 is correct.** It is the **third chip fabricated under the Digital India RISC-V (DIR-V) Programme**, which aims to build a family of **RISC-V-based microprocessors** made in India for strategic and commercial use. Earlier C-DAC chips in this line include **THEJAS32** (made in Malaysia) and **THEJAS64** (made at the **Semi-Conductor Laboratory, Mohali**).
- **Statement 2 is correct.** It is **India's first homegrown 1.0 GHz, 64-bit, dual-core microprocessor**. Uses include **5G infrastructure, automotive systems, consumer electronics, industrial automation and the Internet of Things (IoT)**.

Why RISC-V

- **RISC-V** is an **open-source instruction set architecture**: anyone can design chips on it **without paying licence fees**, unlike proprietary designs such as x86 (Intel, AMD) or ARM. This supports **self-reliance** and secure chips for strategic sectors.
- India uses about **20% of the world's microprocessors**. Other Indian processors: **SHAKTI** (IIT Madras, 2018), **AJIT** (IIT Bombay, 2018) and **VIKRAM** (ISRO–SCL, 2025).

12. The Bureau of Indian Standard (BIS) recently introduced a national standard to test and assess bomb disposal system. Which of the following statements with regard to this system is/ are correct?

1. The new standard is known as IS 19445: 2025.

2. It will improve interoperability of equipment across agencies.

3. It was developed by TBRL, DRDO in collaboration with the 30th Central Scientific Research Institute, Russia.

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Select the answer using the code given below :

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

> **Answer: (d) 1 and 2 only**

IS 19445:2025: Bomb Disposal Systems

- **Statement 1 is correct.** The standard **IS 19445:2025 – Bomb Disposal Systems: Performance Evaluation and Requirements** was released by the Union Consumer Affairs Minister at the **National Consumer Day 2025** event at Bharat Mandapam, New Delhi, in **December 2025**. The **Bureau of Indian Standards (BIS)** is the national standards body under the Ministry of Consumer Affairs.
- It covers equipment such as **bomb blankets, bomb baskets and bomb inhibitors**, and sets test methods for **blast loads and splinter effects**, test ranges and acceptance criteria.
- **Statement 2 is correct.** Expected benefits include objective performance criteria, safer operators and bystanders, uniform **procurement, testing and certification**, support for **Make in India**, and **improved reliability and interoperability of equipment across agencies**.
- **Statement 3 is incorrect.** The standard was made by a **consensus-based process** under BIS's **Arms and Ammunition for Civilian Use Sectional Committee (PGD 28)**, through a **Bomb Disposal Systems Panel** convened by the **Terminal Ballistics Research Laboratory (TBRL), DRDO, Chandigarh**. Participants were Indian agencies such as **DRDO, NSG, CAPFs, State Police, BPR&D, Airports Authority of India and NFSU**, along with manufacturers. **No Russian institute** was involved. It was started at the request of the **Ministry of Home Affairs** and TBRL.
- Adoption is **voluntary** for procurement agencies, manufacturers and testing bodies.

---

13. "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

> **Answer: (c) John Clarke**

Nobel Prizes 2025: The Four Names

Laureate	Prize	Born in	University
John Clarke	Physics	UK (Cambridge)	UC Berkeley, USA
Michel H. Devoret	Physics	France (Paris)	Yale and UC Santa Barbara, USA

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Richard Robson	Chemistry	UK (Yorkshire)	University of Melbourne, Australia
Joel Mokyr	Economics	Netherlands (Leiden)	Northwestern University, USA

- **(c) John Clarke: correct.** Born in **Cambridge, UK**, he is a professor at the **University of California, Berkeley**. He shared the **2025 Physics Prize** with **Michel H. Devoret** and **John M. Martinis** "for the discovery of **macroscopic quantum mechanical tunnelling and energy quantisation in an electric circuit**". Their 1984–85 experiments with **superconducting circuits (Josephson junctions)** showed quantum effects in a system large enough to hold in the hand, laying the base for **superconducting qubits** used in quantum computers.
- **(a) Michel H. Devoret: incorrect.** He teaches at American universities but was **born in France**, not the UK.
- **(b) Richard Robson: incorrect.** He was **born in the UK**, but he works at the **University of Melbourne, Australia**, not an American university. He shared the **2025 Chemistry Prize** with **Susumu Kitagawa** and **Omar M. Yaghi** for developing **metal-organic frameworks (MOFs)**, porous materials that can capture CO2, harvest water from desert air and store gases.
- **(d) Joel Mokyr: incorrect.** He is at **Northwestern University, USA**, but was **born in the Netherlands**. He received half of the **2025 Economics Prize** for explaining **innovation-driven economic growth**; the other half went to **Philippe Aghion** and **Peter Howitt** for the theory of growth through **creative destruction**.

---

14. Which of the following statements with regard to India's indigenous new high resolution weather model, the 'Bharat Forecast System,' is/are correct?

1. Its objective is to generate forecasts at the Panchayats cluster level.

2. It was developed by IIT Delhi.

Select the answer using the code given below:

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

> **Answer: (a) 1 only**

Bharat Forecast System (BharatFS)

- Launched by the **Ministry of Earth Sciences** in **May 2025**, BharatFS is described as the **world's highest-resolution operational weather model** for the tropics, with a grid of about **6 km**. Earlier global models used by India ran at about **12 km**.
- **Statement 1 is correct.** The finer grid lets it forecast weather for areas the size of a **cluster of gram panchayats** (a few villages together), so that farmers, disaster managers and local bodies get **local, village-level warnings** for heavy rain, storms and heat.
- **Statement 2 is incorrect.** It was developed by the **Indian Institute of Tropical Meteorology (IITM), Pune**, an institute of the Ministry of Earth Sciences. The **India Meteorological Department (IMD)** uses it for operational forecasts.

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- It uses a **Triangular Cubic Octahedral (TCo) grid** and runs on **Arka**, a supercomputer of about **11.77 petaflops** at IITM Pune. The national weather supercomputer **Arunika** is at NCMRWF, Noida. Both were commissioned under **Mission Mausam** (2024).

---

15. Which one of the following pairs of semiconductor plants in India and their locations is not correctly matched?

(a) CG Power and Industrial Solutions Pvt. Ltd. in partnership with Renesas Electronics and STARS Microelectronics : Gujarat
(b) Tata Semiconductor Assembly and Test Pvt. Ltd. : Assam
(c) HCL-Foxconn Joint Venture India Chip Ltd. : Madhya Pradesh
(d) SicSem Pvt. Ltd. : Odisha

> **Answer: (c) HCL-Foxconn Joint Venture India Chip Ltd. : Madhya Pradesh**

Approved Semiconductor Units under the India Semiconductor Mission

- **(a) correctly matched. CG Power**, with **Renesas Electronics (Japan)** and **Stars Microelectronics (Thailand)**, is setting up an **OSAT** (outsourced semiconductor assembly and test) unit at **Sanand, Gujarat** (approved 2024).
- **(b) correctly matched. Tata Semiconductor Assembly and Test (TSAT)** is building an assembly and test unit at **Jagiroad, Morigaon district, Assam** (approved 2024), the first such plant in North-East India.
- **(c) not correctly matched.** The **HCL–Foxconn joint venture (India Chip Pvt. Ltd.)**, approved in **May 2025**, is at **Jewar, Uttar Pradesh**, near the Noida International Airport in the **YEIDA** area. It will make **display driver chips** for phones, laptops and cars.
- **(d) correctly matched. SiCSem**, with Clas-SiC Wafer Fab (UK), is setting up India's first commercial **silicon carbide (SiC) compound semiconductor** unit at **Bhubaneswar, Odisha** (approved **August 2025**). SiC chips are used in **missiles, defence, EVs, railways and power electronics**.

Unit	Type	Location
Tata Electronics–PSMC (Taiwan)	Fab (wafer plant)	Dholera, Gujarat
Micron Technology	Assembly and test	Sanand, Gujarat
CG Power–Renesas–Stars	OSAT	Sanand, Gujarat
Kaynes Semicon	OSAT	Sanand, Gujarat
Tata (TSAT)	Assembly and test	Jagiroad, Assam
HCL–Foxconn (India Chip)	OSAT, display drivers	Jewar, Uttar Pradesh
SiCSem; 3D Glass Solutions	SiC fab; advanced packaging	Bhubaneswar, Odisha
CDIL	Discrete semiconductors	Mohali, Punjab
ASIP Technologies	OSAT	Andhra Pradesh

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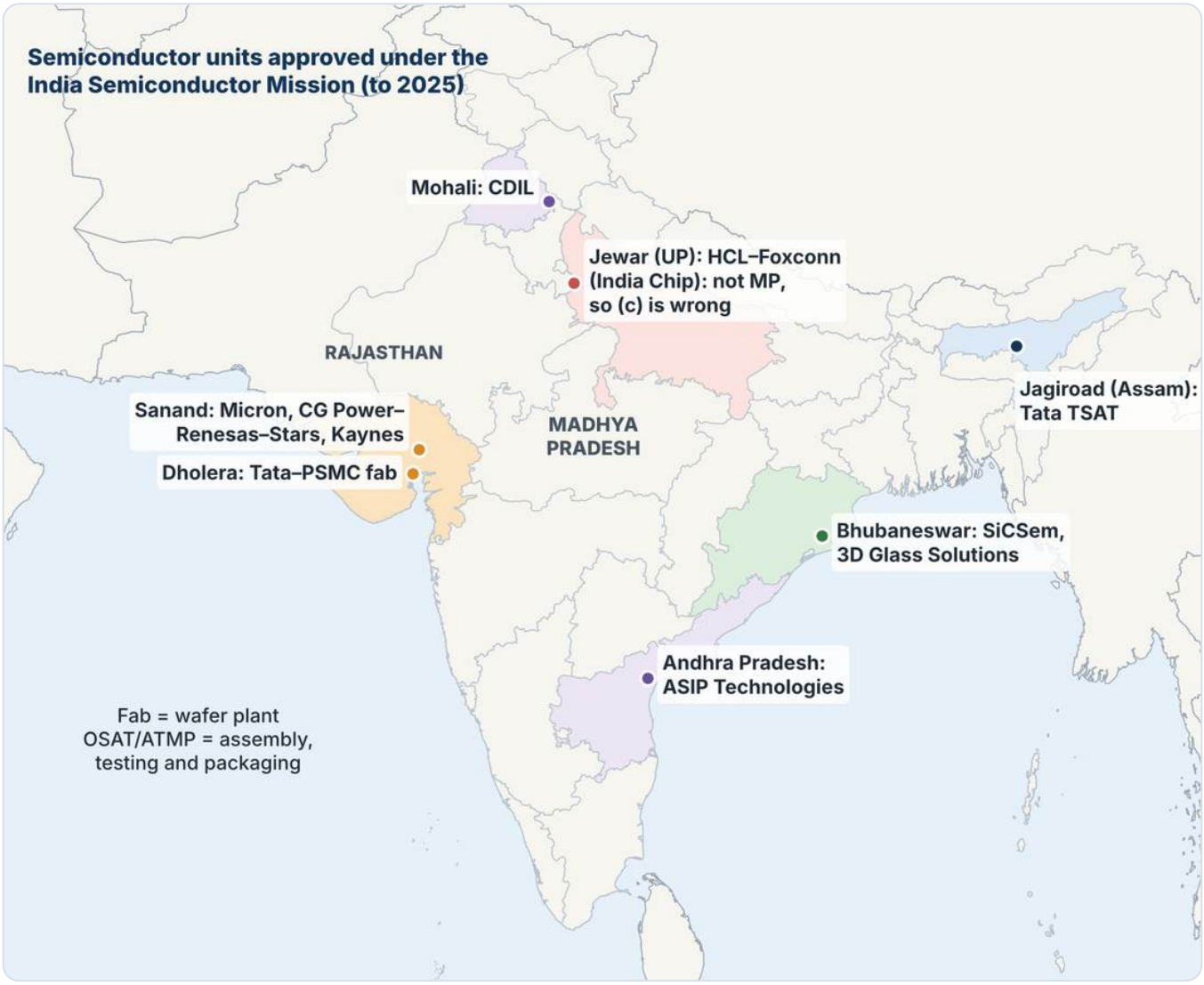

Approved semiconductor units and their locations

- The **India Semiconductor Mission (ISM)**, launched in **December 2021** with **₹76,000 crore**, offers up to **50% fiscal support** of project cost for fabs, display fabs and OSAT/ATMP units.

---

16. Which of the following statements regarding the features of blockchain technology are correct?

1. Records stored in the database may be made visible to relevant stakeholders without risk of alteration.

2. Copies of the entire database are stored on multiple computers on a network, syncing within seconds.

3. Consortium blockchain is a blend of public and private blockchains allowing selective data access.

4. Mathematical algorithms make it impossible to change or delete any data once recorded and accepted.

Select the answer using the code given below:

(a) 1 and 3
(b) 2 and 4 only

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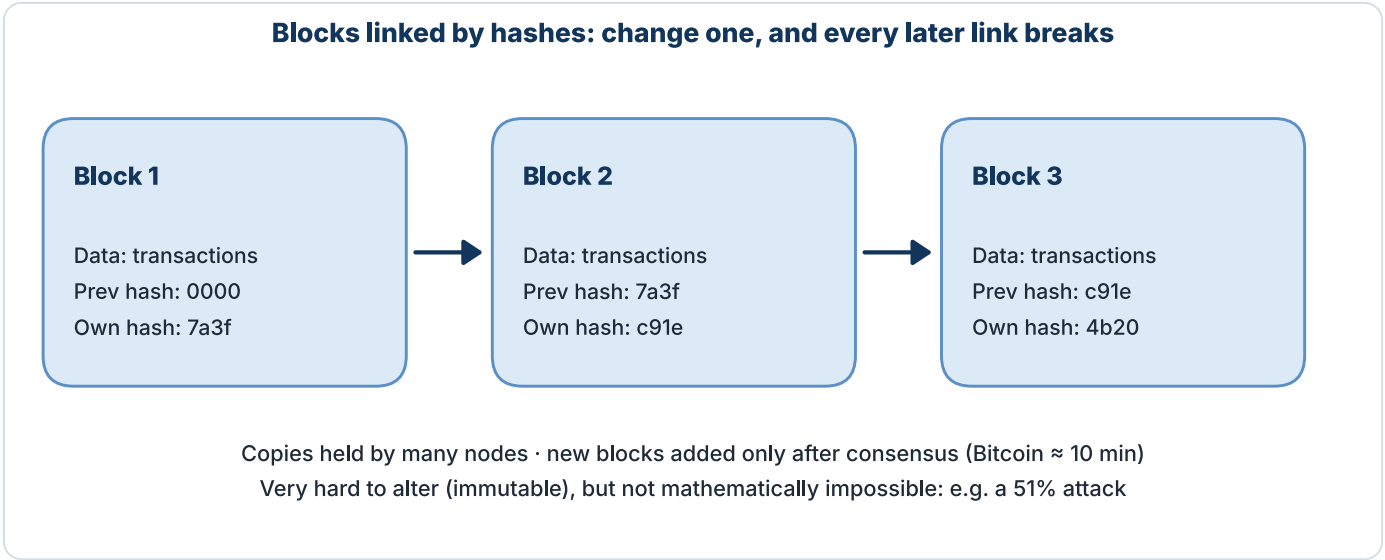
(c) 1, 2 and 4
(d) 1 and 4 only

Answer: (a) 1 and 3

Blockchain Technology

- A **blockchain** is a **distributed ledger**: records are grouped into **blocks**, and each block holds the **cryptographic hash** of the previous one, forming a chain. Changing one block changes its hash and breaks every later link, so tampering is easy to spot.
- **Statement 1 is correct.** Records can be shared with **all relevant stakeholders** (for example, buyer, seller, bank and regulator in a trade), who can view them but cannot alter them on their own. This **transparency with integrity** is the main attraction for land records, supply chains and certificates.
- **Statement 2 is incorrect as worded.** Copies of the ledger are indeed held by many **nodes** on the network. But they do not always sync **within seconds**: new data is added only after the network reaches **consensus**. On Bitcoin, a block is added about **every 10 minutes**, and a payment is usually treated as final after several blocks.
- **Statement 3 is correct.** Types of blockchain:
  - **Public** (permissionless): anyone can join and read, for example Bitcoin and Ethereum.
  - **Private** (permissioned): controlled by one organisation.
  - **Consortium (federated)**: run by a **group of organisations**, such as banks. It **blends public and private features** and allows **selective access** to data.
  - **Hybrid**: one organisation keeps some data private and makes some public.
- **Statement 4 is incorrect.** Cryptography and consensus make data **extremely hard** to change, which is why it is called **immutable**, but **not impossible**. A **51% attack** (control of most of the network's computing power) could rewrite recent blocks, and in a private blockchain the controlling body can agree to change records.
- **India**: the **National Blockchain Framework** of MeitY (2024) and the **Vishvasya** blockchain stack support government uses such as certificates and land records.



How blocks in a blockchain are linked

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UNIT 02
5 CHAPTERS

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UPSC Prelims Research: Science and Tech 2017

All 9 Science and Tech questions of UPSC Civil Services Preliminary Examination 2017, General Studies Paper 1, with the correct answer and an explanation of every option.

Q. Consider the following pairs:

Commonly used/consumed materials Unwanted or controversial chemicals likely to be found in them

1. Lipstick — Lead
2. Soft Drinks — Brominated vegetable oils
3. Chinese fast food — Monosodium glutamate

Which of the pairs given above is/are correctly matched?

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

Answer: (d) 1, 2 and 3

Notes:

- **The Maggi ban:**
  - India's favourite two-minute noodles lost 80% market share due to the **presence of MSG (monosodium glutamate)** as found by a UP food inspector.
  - **Monosodium Glutamate**
    - It is an **excitatory neurotransmitter,** which means it **stimulates nerve cells** to relay its signal.
    - Scientists claim that it leads to **excessive stimulation** of nerve cells and **excessive glutamate** in the brain.

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        - For this reason, MSG has been labelled an excitotoxin.
- **Brominated vegetable oil**
    - It is a **food additive** used in certain **soft drinks** and fruit-flavoured beverages as a **density stabilizer**.
    - Bromine can **irritate the skin** and mucous membranes (the moist lining of the nose, mouth, lungs and stomach).
    - Long-term exposure can cause **neurologic symptoms** such as headache, **memory loss**, and impaired balance or coordination.
- Research by the **Campaign for Safe Cosmetics** and the U.S. Food and Drug Administration (FDA) has found **lead** and **other toxic** metals in a surprising number of **lipsticks**.
    - Exposure to lead has been linked to a host of **health concerns**:
        - **Neurotoxicity**: It has been linked to learning, language and behavioural problems.
        - **Reduced fertility** in both men and women.
        - Hormonal changes and **menstrual irregularities**.
        - **Delayed** onset of **puberty** in girls and the development of testes in boys.

Q. Consider the following statements:

1. In tropical regions, Zika virus disease is transmitted by 'the same mosquito that transmits dengue.
2. Sexual transmission of Zika virus disease is possible

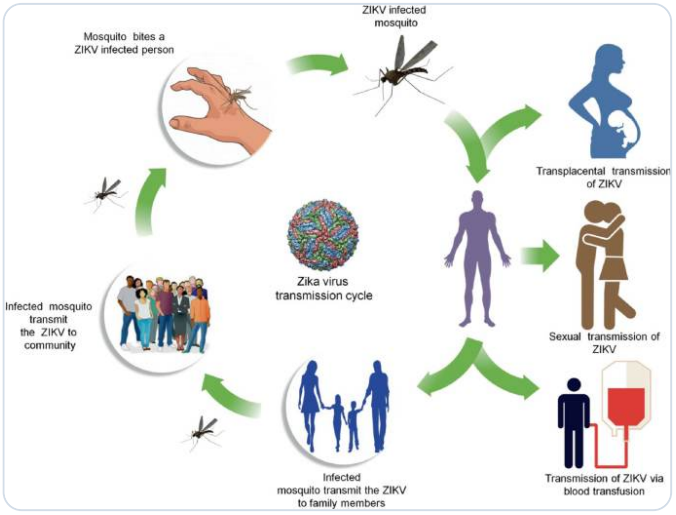
Which of the statements given above is/are correct?

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

Answer: (c) Both 1 and 2

Zika Virus

- Zika virus is primarily transmitted by the bite of an infected mosquito from the **Aedes genus, mainly Aedes aegypti,** in **tropical and subtropical regions**. Its name comes from the Ziika Forest of Uganda, where the virus was first isolated in 1947.
- Aedes mosquitoes usually bite during the day, peaking during early morning and late afternoon/ evening. **This is the same mosquito that transmits dengue, chikungunya and yellow fever.**



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- Zika virus is **also transmitted from mother to fetus** during pregnancy, **through sexual contact, transfusion of blood and blood products, and organ transplantation**.
- The infection, known as **Zika fever** or Zika virus disease, often causes no or only mild symptoms, similar to a very mild form of dengue fever.
- **No vaccine is yet available** for the prevention or treatment of Zika virus infection. **While there is no specific treatment**, paracetamol (acetaminophen) and rest may help with the symptoms.

Q. What is the purpose of 'evolved Laser Interferometer Space Antenna' (eLISA) project?

(a) To detect neutrinos

(b) To detect gravitational waves

(c) To detect the effectiveness of missile defence system

(d) To study the effect of solar flares on our communication systems

Answer: (b) To detect gravitational waves

evolved Laser Interferometer Space Antenna (eLISA)

- The evolved Laser Interfermoter Space Antenna (eLISA) is a mission aiming at **exploring the Gravitational Universe from space** for the first time.
- It involves scientists from **eight European countries** – Denmark, France, Germany, Italy, The Netherlands, Spain, Switzerland, and the UK – **as well as the support of several US-based ones.**
- The eLISA mission consists of a "Mother" and two "Daughter" spacecrafts. These will orbit the Sun in a **triangular configuration**. The **three satellites will form a precision interferometer, with the two Daughter spacecrafts connected to the Mother one by 1 million km long laser beams**. This interferometer will be capable of detecting gravitational waves at frequencies in the range of 0.1 mHz to 1 Hz.
- Such a frequency interval is not accessible on Earth due to arm length limitations and to noise caused by the terrestrial gravity gradient noise: in this sense, eLISA will complement the efforts of ground-based gravitational-wave detectors.

Q. The terms 'Event Horizon', 'Singularity', `String Theory' and 'Standard Model' are sometimes seen in the news in the context of

(a) Observation and understanding of the Universe

(b) Study of the solar and the lunar eclipses

(c) Placing satellites in the orbit of the Earth

(d) Origin and evolution of living organisms on the Earth

Answer: (a) Observation and understanding of the Universe

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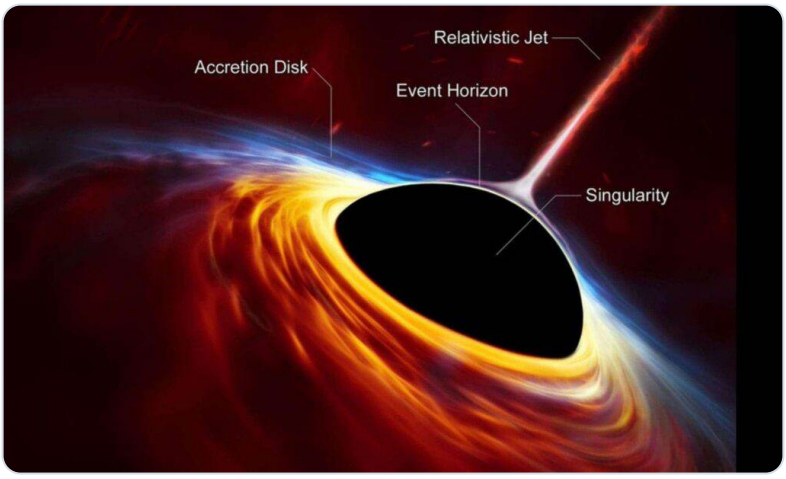

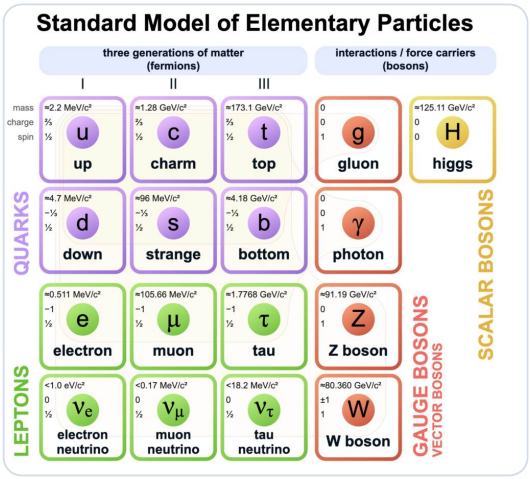

Standard Model

- The Standard Model of particle physics is the theory **describing three of the four known fundamental forces** (electromagnetic, weak and strong interactions – excluding gravity) in the universe and classifying all known elementary particles.
- It was developed in stages throughout the latter half of the 20th century, through the work of many scientists worldwide, with the current formulation being finalized in the mid-1970s upon experimental **confirmation of the existence of quarks**.
- Since then, proof of the top quark (1995), the tau neutrino (2000), and the Higgs boson (2012) have added further credence to the Standard Model. In addition, the **Standard Model has predicted various properties of weak neutral currents and the W and Z bosons** with great accuracy.

Singularity

- A singularity refers to a place in the universe where **our laws of physics simply break down.**
- The term first came into popular use in Albert Einstein's 1915 Theory of General Relativity. In the theory, a singularity **describes the center of a black hole, a point of infinite density and gravity within which no object inside can ever escape, not even light**.

Event horizon

- The **event horizon is a boundary that marks the outer edge of black holes**. It is the point at which nothing, not even light, can escape.
- Because light can't escape, **black holes themselves neither emit nor reflect it**, and nothing about what happens within them can reach an outside observer. But astronomers can observe black holes thanks to light emitted by surrounding matter that hasn't yet dipped into the event horizon.

Accretion Disk

- The **main light source from a black hole is a structure called an accretion disk.**

Q. What is the application of Somatic Cell Nuclear Transfer Technology?

(a) Production of biolarvicides

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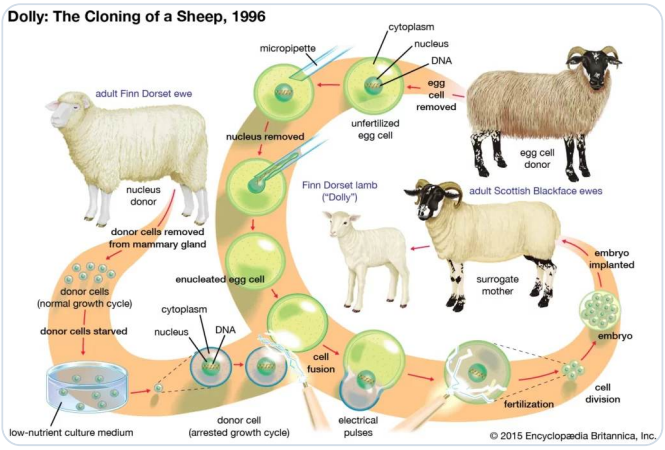
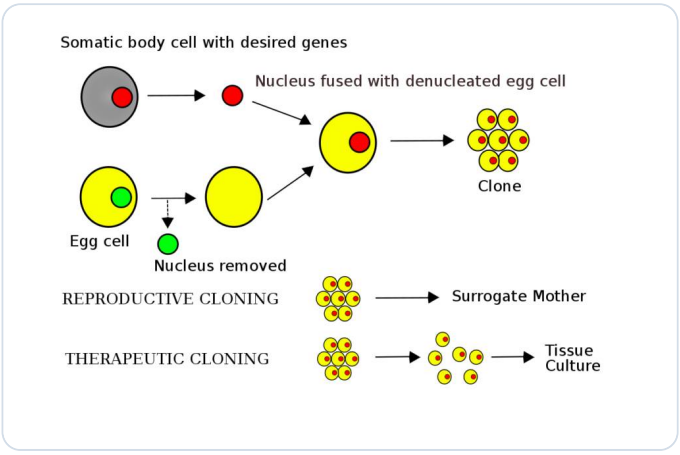
(b) Manufacture of biodegradable plastics

(c) Reproductive cloning of animals

(d) Production of organisms free of diseases

Answer: (c) Reproductive cloning of animals





Somatic cell nuclear transfer

- Somatic cell nuclear transfer (SCNT) is a laboratory **technique for cloning for creating an ovum with a donor nucleus.**
  - **Cloning** is the production of an exact **copy of** a **complete organism,** any other **living part,** or **a cell**.
- **Somatic Cell Nuclear Transfer Technology** was used for the first time by **Ian Wilmut** and his colleagues at the Roslin Institute in Edinburgh for **cloning** the sheep **"Dolly"** on 5th July **1996** and was the **first mammal** to be cloned.
- **Technology of Somatic Cell Nuclear Transfer:**
  - A somatic cell is isolated and extracted from an adult female.
  - Then the nucleus and all of its DNA from an egg cell is removed.
  - After that the nucleus from the somatic cell is transferred to the egg cell.
  - After being inserted into the egg, the somatic cell nucleus is reprogrammed by the host cell and is stimulated with a shock.
  - The egg cell, with its new nucleus, will behave just like a freshly fertilised egg.
  - It developed into an embryo, which is implanted into a surrogate mother.
- **Potential Applications of Somatic Cell Nuclear Transfer:**
  - **Stem cell research-** Somatic cell nuclear transplantation is being used in stem cell research. These cells are deemed to have a pluripotent potential because they have the ability to give rise to all of the tissues found in an adult organism. This could be used in therapies or disease research. This allows stem cells to create any cell type, which could then be transplanted to replace damaged or destroyed cells.
  - **Organ transplants-** Another application of SCNT stem cell research to generate tissues or even organs for transplant into the specific patient. The resulting cells would be genetically identical to the somatic cell donor, thus avoiding any complications from immune system rejection.

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- **Therapeutic applications-** SCNT have ample scope of success in therapy and curing diseases. It can be used to treat diseases like diabetes, Parkinson's disease etc. In 2014, the New York Stem Cell Foundation was successful in creating SCNT stem cells derived from adult somatic cells. One of these lines of stem cells was derived from the donor cells of a type 1 diabetic. These insulin producing cells could be used for replacement therapy in diabetics, demonstrating real SCNT stem cell therapeutic potential.
- **Reproductive cloning-** Somatic Cell Nuclear Transfer technique is currently the basis for cloning animals (such as the famous Dolly the sheep), and has been theoretically proposed as a possible way to clone humans. But there are moral and ethical objections against reproductive cloning. In 2018, the first successful cloning of primates using somatic cell nuclear transfer, (the same method as Dolly the sheep), was successfully done with the birth of two live female clones .
- **Preservation of endangered species-** Interspecies nuclear transfer (iSCNT) is a means of somatic cell nuclear transfer used to facilitate the rescue of **endangered species**, or even to **restore species after their extinction**.

- Somatic cell nuclear transfer can be both boon and bane. It might help in many ways but it also has its share of effects which might include reduction of gene diversity, Nature's rule like survival of fittest, ethical and moral issues. If got into wrong hands (Terrorists, crime syndicate) it might prove to be a disaster in waiting. Thus caution is needed with proper regulation for its usage.

Q. With reference to agriculture in India, how can the technique of 'genome sequencing', often seen in the news, be used in the immediate future?

1. Genome sequencing can be used to identify genetic markers for disease resistance and drought tolerance in various crop plants.
2. This technique helps in reducing the time required to develop new varieties of crop plants.
3. It can be used to decipher the host-pathogen relationships in crops

Select the correct answer using the code given below:

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

> **Answer: (d) 1, 2 and 3**

Genome Sequencing

- Genome sequencing is figuring out the **order of DNA nucleotides, or bases, in a genome**—the order of Adenine, Cytosine, Guanines, and Thymine that make up an organism's DNA.
  - A **genome is a complete set of DNA** that contains all of the genes of an organism. The human genome is made up of a tiny chromosome in the **cell's mitochondria** and 23 pairs of chromosomes that are found in the nucleus of the cell. A genome contains all of the information required for a person to develop and function.

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- **Whole Genome Sequencing**:
  - All organisms (bacteria, plants, and mammals) have their **own genetic code**, or genome, which is made up of nucleotide bases. **Whole genome sequencing is a laboratory procedure used to determine the order of bases in the genome of an organism in a single step**.
- **Significance of Genome Sequencing**:
  - Genome sequencing has become an important tool in **pharmacogenomics, clinical diagnosis, and translational vaccine development.**
    - Whole genome sequencing provides detailed and precise data for identifying outbreaks sooner.
      - Additionally, whole genome sequencing is used to characterize bacteria as well as **track outbreaks.**
    - Dramatic advancements in **DNA-sequencing** technologies have massively reduced the time and cost required to sequence an entire human genome.
    - Genomic information has been instrumental in identifying **inherited disorders** and characterizing the mutations that drive **cancer progression.**
- **Applications of Genome Sequencing:**
  - **Biological research:** The ability to read genetic sequences is extremely useful in biological research because the base sequence contains information for making proteins as well as **regulating gene functions.**
  - **Forensics:** Sequencing has proven to be a powerful tool in forensics. Because differences in **DNA and RNA** sequences can differentiate organisms down to species and individual levels, it can help to classify diseases, identify **therapeutic targets**, and customize treatments.
  - **Diagnostics:**
    - **Pre-natal screening:** It has also been used in prenatal screening to determine whether the foetus has any **genetic disorders or anomalies.**
    - **Evaluate disorders:** Genome sequencing has been used to assess rare disorders, preconditions for disorders, and even cancer from a genetic viewpoint, rather than as diseases of specific organs.
  - **Drug Efficacy: Genome sequencing can provide information about drug efficacy or adverse drug effects.**
    - The relationship between drugs and the genome is called **pharmacogenomics.**
  - **Vaccine development:** Sequencing of viruses (e.g. **ebola, coronavirus**) and bacteria has led to the development of vaccines against them, once knowing their variants or strains.
    - Genomic data of pathogens could reveal hidden pathways of transmission.
  - **Population Studies:Advanced analytics and AI** could be applied to critical datasets generated by collecting genomic profiles across the population, allowing for a better understanding of disease causation and potential treatments.
    - This is especially relevant for **rare genetic diseases,** where large datasets are required to find statistically significant correlations.
  - **Agriculture and food security:** Genome sequencing has the power to revolutionize food security and sustainable agriculture by reducing the risks from disease outbreaks, and improving agriculture through effective plant and animal breeding, detecting multiple pathogens, etc.

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Genome India

- Genome India is a national project **launched in 2020.** It is funded by the **Department of Biotechnology,** and spearheaded bythe **Centre for Brain Research (CBR)**.
- In the first phase of the study, the project aims to identify genetic variations in **10,000** representative individuals from across India using whole genome sequencing.
- **Project aimed to:**
  - Create an exhaustive catalogue of genetic variations in Indians.
  - Create a reference haplotype structure for Indians.
  - Create low-cost genome-wide arrays for research and diagnostics.
  - Create a biobank for DNA and plasma samples for future research.
- **Significance:** Creating an Indian genome database allows researchers to learn about genetic variants unique to India's population groups and use this information to **tailor drugs and therapies.**
  - **Objective:** To **"unravel the genetic underpinnings of chronic diseases** currently on the rise in India.

IndiGen Programme

- The IndiGen programme launched in **2019 aims to** undertake whole genome sequencing of thousands of individuals representing diverse ethnic groups from India.
  - The **goal is to** enable genetic epidemiology and develop public health technology applications using population genome data.
  - IndiGen is endorsed by the **Council for Scientific and Industrial Research (CSIR).**
  - The outcomes of the **IndiGen** will be utilized towards understanding the genetic diversity on a population scale, making available genetic variant frequencies for clinical applications, and enabling genetic epidemiology of diseases.

Indian Initiative on Earth Bio-Genome Sequencing

- The project was launched in 2020 and is part of the **Earth Biogenome Project.** The project will allow for the collection and preservation of endangered and economically significant species.
  - The genetic information that has been decoded will also be useful in preventing biopiracy.
  - The initial phase of **IIEBS** will include the whole genome sequencing of 1,000 plant and animal species, which will take five years to complete.
  - The **Jawaharlal Nehru Tropical Botanic Garden and Research Institute** (JNTBGRI) plays a key role in a nationwide project to decode the genetic information of all known species of plants and animals in the country.

Q. In India, it is legally mandatory for which of the following to report on cyber security incidents?

1. Service providers
2. Data centers
3. Body corporate

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Select the correct answer using the codes given below:

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

Answer: (d) 1, 2 and 3

Cybersecurity incidents

- Cybersecurity incidents mean **any real and suspected adverse event in relation to cybersecurity that violates an explicitly or implicitly applicable security policy** resulting in unauthorized access, denial of services, unauthorised used of computer resources for processing or storage of data or changes in data without authorization.
- In India, section 70-B of the **Information Technology Act, 2000 (the "IT Act")** gives the Central Government the power to appoint an agency of the government to be called the Indian Computer Emergency Response Team (**CERT**) to report such incidents.
- **Rule 12 of the CERT Rules gives every person, company or organisation have the option to report cybersecurity incidents to the CERT-In.**
- It also places an obligation on them to mandatorily report the following kinds of incidents as early as possible:
  - Targeted scanning/probing of critical networks/systems;
  - Compromise of critical system/information;
  - Unauthorized access to IT system/data;
  - Defacement of website or intrusion into a website and unauthorized changes such as inserting malicious code, links to external websites, etc.;
  - Malicious code attacks such as spreading of virus/worm/Trojan/botnets/spyware;
  - Attacks on servers such as database, mail, and DNS and network devices such as routers;
  - Identity theft, spoofing and phishing attacks;
  - Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks;
  - Attacks on critical infrastructure, SCADA systems and wireless networks;
  - Attacks on applications such as e-governance, e-commerce, etc's.

Challenges Posed by Cyber Attacks on India

- **Critical Infrastructure Vulnerability:** India's critical infrastructure, such as power grids, transportation systems, and communication networks, is vulnerable to cyber attacks that can **disrupt essential services** and endanger public safety and national security.
  - For example, in October 2019, there was an attempted cyber-attack on the **Kudankulam Nuclear power plant.**
- **Financial Sector Threats:** The financial sector in India faces a high risk of cyberattacks from cybercriminals who seek to profit from stealing or extorting money. Attacks on banks, financial

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institutions, and online payment systems can cause financial losses, identity theft, and a loss of trust in the financial system.

  - For instance, in March 2020, a malware attack on the City Union Bank's **SWIFT system** led to unauthorised transactions worth USD 2 million.

- **Data Breaches and Privacy Concerns:** As India moves towards a digital economy, the amount of personal and government data stored online increases. This also increases the risk of data breaches, where hackers access and leak sensitive information. Data breaches can have serious consequences for the privacy and security of individuals and organisations.
  - For example, in May 2021, the personally identifiable information (PII) and test results of 190,000 candidates for the 2020 Common Admission Test (CAT), used to select applicants to the IIMs, were leaked and put up for sale on a cybercrime forum.
- **Cyber Espionage:** Cyber espionage is the use of cyber attacks to spy on or sabotage the interests of other countries or entities. India, like other countries, is a target for cyber espionage activities that aim to steal confidential information and gain a strategic edge. Cyber espionage can affect India's national security, foreign policy, and economic development.
  - For example, in 2020, a cyber espionage campaign called Operation SideCopy (a Pakistani threat actor) was uncovered, which targeted Indian military and diplomatic personnel with malware and phishing emails.
- **Advanced Persistent Threats (APTs):** APTs are complex and prolonged cyber attacks, usually carried out by well-resourced and skilled groups. These attacks are designed to infiltrate and remain hidden in the target's network for a long time, allowing them to steal or manipulate data, or cause damage.
  - APTs are difficult to detect and counter, as they use advanced techniques and tools to evade security measures.
  - For example, in February 2021, a cyber security firm called RedEcho revealed that a China-linked APT group had targeted 10 entities in India's power sector, with malware that could potentially cause power outages.
- **Supply Chain Vulnerabilities:** Supply chain vulnerabilities refer to the weaknesses in the software or hardware components that are used by government and businesses for their operations. Cyber attackers can exploit these vulnerabilities to compromise the systems and services that depend on these components, and cause widespread damage.
  - For example, in December 2020, a global cyberattack on SolarWinds, a US-based software company that provides network management tools, affected several Indian organisations, including the **National Informatics Centre (NIC),** the Ministry of Electronics and Information Technology (MeitY), and Bharat Heavy Electricals Limited (BHEL).

Initiatives Regarding Cyber Security

- **Indian Initiatives:**
  - **National Cyber Security Policy:** This policy aims to build a secure and resilient cyberspace for citizens, businesses, and the government. It outlines various objectives and strategies to protect cyberspace information and infrastructure, build capabilities to prevent and respond to cyber attacks, and minimise damages through coordinated efforts of institutional structures, people, processes, and technology.

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- **Cyber Surakshit Bharat Initiative:** This initiative was launched to raise awareness about cyber crimes and create safety measures for Chief Information Security Officers (CISOs) and frontline IT staff across all government departments.
- **Indian Cyber Crime Coordination Centre (I4C):** This centre was established to provide a framework and eco-system for law enforcement agencies to deal with cyber crimes in a comprehensive and coordinated manner. It has seven components, namely:
  - National Cyber Crime Threat Analytics Unit
  - National Cyber Crime Reporting Portal
  - National Cyber Crime Training Centre
  - Cyber Crime Ecosystem Management Unit
  - National Cyber Crime Research and Innovation Centre
    National Cyber Crime Forensic Laboratory Ecosystem
  - Platform for Joint Cyber Crime Investigation Team.
- **Cyber Swachhta Kendra (Botnet Cleaning and Malware Analysis Centre):** This centre was launched in 2017 to create a secure cyberspace by detecting botnet infections in India and notifying, enabling cleaning and securing systems of end users to prevent further infections.
- **Computer Emergency Response Team – India (CERT-In):** It is an organisation of the MeitY which collects, analyses and disseminates information on cyber incidents, and also issues alerts on cybersecurity incidents.
- **Critical information infrastructure (CII):** It is defined as a computer resource, the destruction of which, shall have debilitating impact on national security, economy, public health or safety.
  - The government has established the **National Critical Information Infrastructure Protection Centre (NCIIPC)** to protect the CII of various sectors, such as power, banking, telecom, transport, government, and strategic enterprises.
- **Defence Cyber Agency (DCyA)**: The **DCyA** is a tri-service command of the Indian Armed Forces that is responsible for handling cyber security threats. It has the capability to conduct cyber operations, such as hacking, surveillance, data recovery, encryption, and countermeasures, against various cyber threat actors.

- **Global Initiatives:**
  - **Budapest Convention on Cybercrime:** It is an **international treaty** that seeks to address Internet and computer crime by harmonizing national laws, improving investigative techniques, and increasing cooperation among nations. It came into force on 1st July 2004. **India is not a signatory** to this convention.
  - **Internet Governance Forum (IGF)**: It brings together all stakeholders i.e., government, private sector and civil society on the Internet governance debate.
  - **UNGA Resolutions:** The **United Nations General Assembly** established two processes on the issues of security in the information and communication technologies (ICT) environment.
    - The **Open-ended Working Group** (OEWG) through resolution by Russia
    - The **Group of Governmental Experts** (GGE) through resolution by USA

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Q. Organic Light Emitting Diodes (OLEDs) are used to create digital display in many devices. What are the advantages of OLED displays over Liquid Crystal displays?

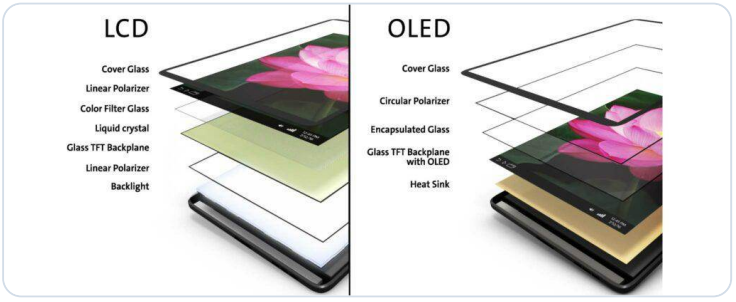
1. OLED displays can be fabricated on flexible plastic substrates.
2. Roll-up displays embedded in clothing can be made using OLEDs.
3. Transparent displays are possible using OLEDs.

Select the correct answer using the codes given below:

(a) 1 and 3 only
(b) 2 only
(c) 1, 2 and 3
(d) None of the above statement is correct

Answer: (c) 1, 2 and 3

Organic Light Emitting Diodes (OLEDs)



- Organic light emitting diodes (devices) or OLEDs are **monolithic, solid-state devices that typically consist of a series of organic thin films sandwiched between two thin-film conductive electrodes**.
- OLEDs are used **to create digital displays** in devices such as television screens, computer monitors, and portable systems such as smartphones and handheld game consoles. A major area of research is the development of **white OLED devices** for use in solid-state lighting applications.
- **OLEDs use organic materials to emit light**, rather than traditional backlighting used in LCD displays. This allows for **less power consumption, better contrast, deeper blacks, and more vibrant colors.**
- Attractive features of Organic light emitting diodes **(OLEDs)** displays using plastic substrate are:
  - They are **ultrathin** and **light**.
  - Besides, it can be **fabricated on flexible plastic** to utilize the flexibility of the substrate.
  - Also can be fabricated on **Roll-up displays** embedded in clothing and
  - **Transparent displays** are also possible.
- The **key issue** in achieving such displays is how to **protect** OLEDs from **oxygen** and **moisture.**

Liquid-crystal display (LCD)

- A liquid-crystal display (LCD) is **a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers**.
- **Liquid crystals do not emit light directly** but instead **use a backlight or reflector** to produce images in color or monochrome.
- LCD uses fluorescent tubes to lighten the picture, but can't provide a clearer picture as LED delivers.

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- In LCD display, **it consists of millions of pixels** made of crystal and arranged in a rectangular grid. In LCD it has backlights that provide light to each pixel. Each pixel has a **red, green, and blue (RGB)** sub-pixel that can be turned on or off. When all of the sub-pixels are turned off, then it's black and when all the sub-pixels are turned on 100%, then it's white.
- LCD is a combination of two states of matter, the **solid and the liquid**. The solid part is crystal and this liquid and crystal together make the visible image. LCD consists of two layers which are two polarized panels- **filters and electrodes**. LCD screen works by blocking the light rather than emitting the light. There are two types of pixel grids in LCD:
  - **Active Matrix Grid**– It is a newer technology. In smartphone with LCD display uses this technology.
  - **Passive Matrix Grid**– It is an older technology. Some older devices used this technology.

Q. Which of the following statements is/are correct regarding Smart India Hackathon 2017?

1. It is a centrally sponsored scheme for developing every city of our country into **Smart Cities** in a decade.
2. It is an initiative to identify new digital technology innovations for solving the many problems faced by our country.
3. It is a programme aimed at making **all the financial transactions** in our country completely digital in a decade.

Select the correct answer using the code given below :

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

> **Answer: (b) 2 only**

Smart India Hackathon:

- Smart India Hackathon (SIH) was **started in the year 2017.** It was launched as a competition to **develop innovative digital technologies** to solve the issues of central government and ministries.
- It aims to inculcate the **culture of product innovation, problem-solving and out-of-the-box thinking among students.**
- It is an initiative by the **Ministry of Education, All India Council for Technical Education (AICTE)**, Persistent Systems and Inter Institutional Inclusive Innovation Centre (i4C).
- It engages the youth of the country directly in the nation-building process.
- Smart India Hackathon theme is **"No problem is too big, No idea is too small".**

Atal Mission for Rejuvenation and Urban Transformation (AMRUT):

- It is a **centrally sponsored scheme** launched by the **Ministry of Housing and Urban Affairs** in 2015.
- The main objective of AMRUT is to **provide basic amenities to urban areas** and improve the standard of living and quality of life of the poor and downtrodden people of urban areas.

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- As of the first phase, about 500 cities have been covered.
- **Purpose:**
  - To ensure that **every household has access to a tap** with the assured supply of water and a **sewerage connection.**
    - The **Priority zone of the Mission** is water supply followed by sewerage.
  - To increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks).
  - To **reduce pollution** by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling).
- **Components:**
  - Capacity building, reform implementation, water supply, sewerage and septage management, storm water drainage, urban transport and development of green spaces and parks.
    - The **reforms** aim at improving delivery of citizen services, bringing down the cost of delivery, improving financial health, augmenting resources and enhancing transparency. It also includes **replacement of street lights with LED lights.**

Digital India:

- The program aimed at making **all financial transactions in our country completely digital is part of the Digital India** initiative and making towards a cashless transaction.
- The money transfer is done through Debit/ Credit cards, mobile wallets, Electronic Clearing Services (ECS), National Electronic Fund Transfer (NEFT), and Immediate Payment Service (IMPS), and so on.
- The Ministry responsible for promotions of digital transactions including digital payments is the **Ministry of Electronics and Information Technology**.

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