1. How can India benefit from neurotechnology?

Why in News?

- **May 2024:** Neuralink secured US FDA clearance for first-in-human brain–computer interface (BCI) trials.
- Demonstrations include:
    - Moving a computer cursor purely through thought
    - Restoring motor function in paralysed persons via prosthetic control
- This has reignited global debates on:
    - Human augmentation
    - Ownership and privacy of brain data
    - Use of BCIs in warfare and security
- Parallel global developments:
    - **China Brain Project (2016–2030)**
    - **"Neurorights" legislation** emerging in the EU and Chile
- In India:
    - **IIT Kanpur** has created a BCI-controlled robotic arm for stroke survivors
    - Growing focus on the convergence of health-tech, AI and neuro-interfaces

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Relevance

GS 2 – Governance & Social Justice

- Oversight of new medical and neuro-technologies
- Brain data, consent, and human rights
- Cross-border cooperation on neurorights and tech-ethics

GS 3 – Science & Technology / Internal Security

- Frontier technologies: Neuro-AI, BCIs, assistive systems
- Dual-use risks: civil–military fusion, neuroweapons
- Tech race among US–China–EU and implications for India

What is Neurotechnology?

- **Neurotechnology** refers to tools and systems that directly:
    - Record
    - Monitor

  - Stimulate
  - Influence
    brain activity.

- It blends:
  - Neuroscience
  - Artificial Intelligence
  - Biomedical engineering
  - Signal processing

Core Tool: Brain–Computer Interface (BCI)

- **BCI** = A direct channel linking brain signals to an external device.
- Three main functional layers:
  1. **Signal acquisition** – via EEG caps or implanted electrodes
  2. **Signal decoding** – AI/ML models interpret neural activity
  3. **Command execution** – controlling prosthetic arms, wheelchairs, cursors, etc.

Types of BCIs

- **Non-invasive:**
  - EEG-based headsets
  - Safer but less accurate and noisier signals
- **Invasive:**
  - Surgically implanted electrodes
  - High resolution and precision, but with surgical and infection risks

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What Can BCIs Do?

(A) Therapeutic Uses (Already in practice)

- Paralysis → control of robotic limbs and wheelchairs
- **Parkinson's disease** → Deep Brain Stimulation (DBS)
- **Depression** → targeted brain stimulation in treatment-resistant cases
- **Stroke rehabilitation** → aiding recovery of motor pathways
- **Epilepsy** → prediction and suppression of seizures

(B) Diagnostic Uses

- Mapping brain disorders

- Tracking cognitive decline in conditions like Alzheimer's and dementia

(C) Emerging & Experimental Uses

- Brain-controlled gaming and immersive VR
- Monitoring cognitive performance and fatigue
- More seamless human–AI interaction

Global Landscape

(A) United States

- Leads through **NIH's BRAIN Initiative (2013–)**
- Priorities:
    - High-resolution brain mapping
    - Neuro-AI interfaces and advanced BCIs
- Private players:
    - Neuralink
    - BrainGate
    - Synchron

(B) China

- **China Brain Project (2016–2030):**
    - Understanding cognition
    - Brain-inspired AI
    - Neurological disease therapies
- Strong emphasis on **civil–military integration**

(C) Europe & Chile

- Early adopters of **neurorights legislation**, aiming to protect:
    - Mental privacy
    - Freedom of thought and cognitive autonomy
    - Psychological integrity

Why Does India Need Neurotechnology?

(A) Public Health Reasons

- India faces one of the **largest global burdens of neurological illnesses**.

- Between 1990–2019, **stroke** became the highest contributor among neurological disorders.
- Disease load includes:
    - Stroke and spinal cord injuries
    - Parkinson's disease
    - Depression and other mental illnesses

(B) Economic & Strategic Gains

- Neurotechnology lies at the intersection of:
    - Biotechnology
    - AI
    - Medical devices and rehabilitation tech
- Potential gains:
    - Export of affordable med-tech solutions
    - Defence and security applications
    - Expansion of assistive-device markets

Where Does India Stand?

(A) Key Institutions

- **National Brain Research Centre (NBRC)**
- **Centre for Brain Research, IISc** and similar advanced labs

(B) Academic Innovation

- **IIT Kanpur**:
    - Developed BCI-controlled robotic hand specifically for stroke survivors

(C) Start-up and Innovation Ecosystem

- Example: **Dognosis**
    - Uses neural signals from trained dogs to detect cancer-linked odours
    - Shows cross-over between neuro-AI, animal cognition and diagnostics

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India's Strategic Advantages

- Large, **genetically diverse** population → rich clinical and research datasets
- Strong capabilities in:
    - AI/ML

  - Electronics and embedded systems
  - Biomedical engineering
- Rapidly expanding ecosystem of:
  - Health-tech start-ups
  - Make-in-India medical devices and diagnostics

Overall Assessment

- Neurotechnology has moved from science fiction to **clinical and strategic reality**.
- For India, it offers:
  - A tool to **transform healthcare**, especially neurology and rehabilitation
  - A new domain of **strategic technology competition**
- Without robust regulation and ethical frameworks → the risk of **serious rights violations and misuse**.
- With thoughtful laws, neurorights protection, and accessible innovation → India can emerge as a **global leader in low-cost, inclusive neuro-health solutions**.

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2. DHRUVA Framework

Why in News?

- **May 2025:** Department of Posts proposed **DHRUVA (Digital Hub for Reference and Unique Virtual Address)**.
- A **draft amendment** to the Post Office Act, 2023 has been released to give it legal backing.
- Comes after the launch of **DIGIPIN**, a precise geo-coded digital address system.
- Policy groups like **Dvara Research** have raised concerns on:
  - Privacy
  - Consent
  - Limitations for urban planning and governance

Relevance

GS 2 – Governance

- E-governance and Digital Public Infrastructure (DPI)
- Consent-driven data sharing and privacy safeguards
- Urban service delivery and addressability

- Need for robust data regulation

GS 3 – Infrastructure & Digital Economy

- Logistics optimisation and last-mile connectivity
- Platform economy and gig work
- Smart cities and geospatial management

What is DHRUVA?

- **DHRUVA** is a proposed DPI layer for **standardised digital addresses**.
- It converts physical addresses into **virtual "labels"**, similar to:
    - Email IDs
    - UPI IDs
- Example: instead of writing a long postal address, a user can share:
    - amit@dhruva

Core Aims

- Uniform and interoperable address standard across platforms
- **Consent-based** sharing of address details
- Enabling **service discovery** based on location (who delivers what to your doorstep)
- Better:
    - Governance targeting
    - E-commerce delivery
    - Logistics and emergency services

What is DIGIPIN?

- Designed by **India Post** as a geolocation code.
- A **10-character alphanumeric PIN** mapped mathematically from coordinates.
- Each DIGIPIN represents around **12–14 square metres**.
- Especially useful in:
    - Villages and informal settlements where descriptive addresses are weak or absent
- Use cases:
    - Postal operations

- Disaster response
- Precision-based last-mile delivery

How Will DHRUVA Function?

The ecosystem will involve:

- **Address Service Providers (ASPs):**
  - Issue and manage proxy address labels
- **Address Validation Agencies (AVAs):**
  - Authenticate that an address is genuine and correctly mapped
- **Address Information Agents (AIAs):**
  - Manage user consent and address sharing settings
- **Central Governance Entity:**
  - A Section 8 non-profit modelled somewhat on **NPCI** (which manages UPI), ensuring:
    - Interoperability
    - Neutral governance

Typical Uses

(A) Consent-Based Address Sharing

- Users "tokenise" their physical address in the same way UPI tokenises bank details.
- Users decide:
  - Which entity can see their full address
  - For how long
  - For what purpose

(B) Easy Address Updates

- If a user shifts home, they update it once in DHRUVA:
  - All linked platforms (couriers, platforms, utilities) can receive the updated address with consent.

(C) Logistics & Platform Integration

- Potential use by:
  - E-commerce platforms (Amazon, Flipkart, etc.)
  - Ride-hailing and delivery (Uber, Swiggy, Zomato)

- India Post and private couriers

DHRUVA as Digital Public Infrastructure

It fits into India's DPI architecture:

- **Aadhaar** → identity
- **UPI** → payments
- **DigiLocker** → documents
- **DHRUVA** → address layer

Core principles:

- Publicly governed
- Open and interoperable
- Consent-driven data flows
- Platform-agnostic

Will It Strengthen Urban Governance?

Key critique by Dvara Research:

- DHRUVA ties addresses primarily to **individuals**, not to **independently mapped physical structures**.
- For urban planning, what is needed is **building-level** or **parcel-level** mapping, not just person-address mapping.

Consent Paradox:

- Because address data becomes **personal data**, every use needs consent.
- If many citizens withhold consent:
  - The resultant datasets are fragmented and incomplete
  - Urban local bodies lose accurate information for planning water, roads, sanitation, etc.

Global Contrast:

- In advanced economies, digital addressing typically:
  - Maps buildings and land parcels
  - Is not directly tied to a personal profile
- This allows extensive urban analytics without constant consent friction.

Governance and Legal Concerns

- There is no dedicated, comprehensive law yet to govern:
    - Large-scale address data collection
    - Geo-identity profiling
- Risks include:
    - Surveillance via address–identity linkage
    - Profiling through location-based service histories
    - "Function creep" from welfare delivery to policing or taxation without safeguards

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Potential Benefits (If Well-Designed)

- Rapid emergency response (ambulances, disaster teams)
- Smarter service discovery and address validation
- Reduced fraud in addresses and KYC
- Lower logistics costs and mis-deliveries
- Inclusion of unformalised rural habitations in formal address networks

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Key Risks

- Erosion of privacy and location anonymity
- Increased potential for state and corporate surveillance
- Data concentration in large platforms
- Exclusion of citizens who cannot or do not navigate digital consent systems

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Strategic Takeaway

- DHRUVA could become the **address layer** of India's digital stack, linking geography to services.
- But if it is not backed by clear legislation, structure-focused mapping, and **privacy-by-design**, it may evolve into a **high-risk surveillance infrastructure**.
- Success demands:
    - Independent mapping of physical structures
    - Strong firewalls between personal identity and location data
    - Statutory oversight and accountability

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3. Crypto Transactions Crossed ₹51,000 Crore in 2024–25

Why in News?

- In **FY 2024–25**, total crypto transaction value in India exceeded **₹51,000 crore**, a **41% year-on-year increase**.
- Data was tabled in the Rajya Sabha by the Finance Ministry.
- Government collected **₹511.8 crore** through **1% TDS** on such trades.
- Growth trend:
    - 2022–23: ₹22,130 crore
    - 2023–24: ₹36,270 crore
    - 2024–25: ₹51,180 crore

Relevance

GS 3 – Economy

- Growth of the digital and crypto economy
- Taxation challenges for new asset classes
- Black money, money laundering, FEMA issues
- Financial stability and speculative booms

GS 2 – Governance & Regulation

- Regulatory gap in crypto assets
- Responsibility of the State in protecting investors
- Global coordination on digital financial flows

What is Cryptocurrency?

- A form of **digital asset** secured by:
    - Cryptographic methods
    - Distributed ledgers (blockchain)
- In India, crypto is treated as a **Virtual Digital Asset (VDA)**, not as legal tender.
- It is taxed like an asset/investment, not recognised as currency.

What Are Virtual Digital Assets (VDAs)?

- Defined for tax purposes to include:
    - Cryptocurrencies like Bitcoin, Ether etc.
    - Non-Fungible Tokens (NFTs)

  - Other similar cryptographic tokens
- Excludes:
  - RBI's **Central Bank Digital Currency (e₹)**

How is Crypto Taxed in India?

Legal framework:

- Tax provisions introduced in **Finance Act 2022**, embedded in the Income Tax framework.

Tax rules:

- **30% flat tax** on profits from transfer of VDAs
  - No adjustment of losses against other income
  - No carrying forward of losses
- **1% TDS** on each transaction at the time of transfer
  - Applicable even when the trade yields a loss

How Was the ₹51,180 Crore Figure Calculated?

- Government's TDS collection: **₹511.8 crore**
- Since TDS = **1% of transaction value**:
  - Total value = ₹511.8 crore × 100 = **₹51,180 crore**

What Does This Growth Tell Us?

- Despite:
  - Steep 30% tax
  - High-frequency 1% TDS
- Crypto trading is **expanding rapidly**, indicating:
  - Strong retail participation, especially youth
  - Growing preference for alternative, high-risk assets
  - Easy access through mobile trading apps and influencers

Why is Crypto Growing Despite Heavy Taxation?

- Global bull phases in crypto markets create FOMO.
- User-friendly apps reduce barriers to participation.

- Narrative of crypto as:
    - Hedge against inflation
    - High-return speculative bet
- The tax regime has not fully dissuaded short-term or thrill-based trading.

Economic Implications

(A) Revenue

- TDS and profit tax create a new, non-traditional revenue stream.

(B) Capital Flight & Illicit Flows

- Cross-border crypto transfers can:
    - Bypass traditional banking
    - Pose FEMA and money-laundering concerns

(C) Financial Stability

- High retail exposure to volatile instruments raises risk of:
    - Household balance sheet stress
    - Market contagion in extreme downturns

Policy Challenges

- No dedicated regulator for crypto exchanges and assets.
- Lack of robust investor protection measures.
- Risks include:
    - Money laundering and terror financing
    - Tax evasion via offshore exchanges and private wallets
    - Pump-and-dump manipulation and fraud

Key Takeaway

- Crypto has evolved in India from a grey area hype to a **taxed, large-volume asset class**.
- The ₹51,000+ crore figure reflects effective tax capture **and** deepening systemic exposure.
- The regulatory framework must now move beyond taxation to:
    - Investor protection

- AML controls
- Clear institutional oversight

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4. Nahargarh Biological Park Incident

Why in News?

- **8 December 2025:** A safari vehicle caught fire inside **Nahargarh Biological Park** near Jaipur.
- A bus carrying 15 tourists experienced an engine blaze that spread quickly.
- All passengers were evacuated in time by the driver and forest staff; the vehicle was destroyed.
- Reported widely, including by *The Indian Express*.
- Incident has reopened discussions on:
  - Safety standards in eco-tourism
  - Liability for vehicle maintenance
  - Fire risks linked to mechanised tourism in forested areas

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Relevance

GS 2 – Governance

- Public safety in tourist operations
- Responsibility of State agencies and private contractors
- Administration of forest and eco-tourism services

GS 3 – Environment & Disaster Management

- Fire hazards in forest landscapes
- Eco-tourism vs conservation trade-offs
- Climate impacts on fire risk

Biological Park and Safari Basics

- **Biological Park:**
  - A designated forest area used for:
    - Wildlife conservation
    - Research and awareness
    - Regulated tourism

- **Wildlife Safari:**
    - Controlled movement of tourists using:
        - Buses
        - Open jeeps
    - Operated under forest department oversight and eco-tourism rules
- **Nahargarh Biological Park:**
    - Located along the **Aravalli** near Jaipur, Rajasthan
    - Notified in 2016 as part of the larger Nahargarh forest corridor
    - Intended to:
        - Provide semi-natural habitats for species
        - Reduce dependence on city zoos
    - Managed by the **Rajasthan Forest Department**

What Happened?

- A safari bus with 15 tourists developed smoke and then a full engine fire while inside the park.
- Immediate steps:
    - Driver stopped the vehicle and evacuated passengers.
    - Forest rescue team reached quickly.
- Result:
    - Tourists remained safe
    - The bus burnt completely

Governance and Regulatory Gaps

- No standardised **national** code for safari vehicle safety.
- Common gaps:
    - Absence of on-board fire suppression systems
    - No automatic engine cutoff for faults
    - Infrequent or poorly audited fitness checks
- Many safari vehicles are:
    - Run by private operators or via PPP models
    - Subject to weak maintenance and safety oversight

Legal & Judicial Context

- Safari tourism functions under the:
    - **Wildlife (Protection) Act, 1972**
    - State rules for eco-tourism
- The Supreme Court in the **T.N. Godavarman** line of cases has emphasised:
    - Strict control on tourism in forests
    - Regulated vehicle movement to reduce ecological damage

Eco-tourism vs Conservation

- States promote safaris to:
    - Generate revenue
    - Create local jobs
- But rapid, commercialised tourism can cause:
    - Infrastructure strain inside forests
    - De-prioritisation of safety norms
    - Stress and disturbance to wildlife
- The Nahargarh fire showcases how **safety and risk management** have lagged behind tourism expansion.

Conclusion

The incident in Nahargarh Biological Park spotlights an under-regulated eco-tourism model where commercial growth has outpaced fire safety, maintenance norms, and environmental risk governance.

5. Gallbladder Cancer in the Gangetic Belt

Why in News?

- A December 2025 investigative public health study described **Gallbladder Cancer (GBC)** as an “invisible epidemic” in India’s **Ganga basin**.
- Key concerns:
    - India accounts for nearly **10%** of global GBC cases
    - Around **70% of patients are women**
    - Strong geographical clustering in:

    - Uttar Pradesh
    - Bihar
    - West Bengal
    - Assam
- Research links GBC to:
    - River and groundwater pollution
    - Chronic arsenic and heavy-metal exposure
- Governance lapses identified:
    - Weak enforcement by **CPCB**
    - Insufficient monitoring by **Central Ground Water Board**
    - Limited coverage of **National Cancer Registry Programme** in rural belts

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Relevance

GS 2 – Governance

- Failures in public health surveillance
- Environmental regulation and enforcement
- Non-notifiable status of many cancers
- Policy neglect of concentrated disease hotspots

GS 3 – Environment & Health

- River and groundwater contamination
- Heavy metal and arsenic toxicity
- Environment-linked cancers
- Industrial and agricultural regulatory gaps

What is Gallbladder Cancer?

- A highly aggressive malignancy of the **gallbladder**.
- Early disease is often silent; most cases are detected at **Stage III or IV**.
- Characteristics:
    - Rapid spread to liver and lymph nodes
    - Very poor prognosis once advanced
    - Five-year survival in late-stage disease is **below 10%**

Why is GBC Concentrated in the Gangetic Belt?

- GBC shows a tight spatial cluster along the **Ganga basin**.
- Main environmental drivers:
    - **Arsenic contamination** in groundwater
    - **Cadmium, lead and other metals** from industrial discharge
    - Long-term pesticide residues on crops
    - Use of **adulterated cooking oils**, especially mustard oil
- Exposure routes:
    - Drinking contaminated groundwater
    - Eating fish from polluted rivers
    - Cooking habits involving unsafe oils
- Chronic carcinogen exposure builds silently over decades before cancer manifestation.

Why Are Women Disproportionately Affected?

- Around **70% of GBC cases** are female.
- Contributing factors:
    - Repeated heating and re-use of cooking oil
    - Handling contaminated water for domestic tasks
    - Higher cumulative exposure in kitchens and household environments
    - Nutritional deficiencies and anaemia
    - Social norms delaying hospital visits and diagnosis
- Hospital records (e.g., Tata Memorial):
    - Over **80%** of female GBC patients present at **Stage III or IV**.

Socio-Economic Impact

- Typical treatment cost: **₹8–12 lakh** per patient.
- Consequences:
    - Catastrophic health expenditure
    - Drop-out from treatment due to unaffordability
    - Deepening intergenerational poverty
- The GBC belt overlaps with:

- High multidimensional poverty
- Poor sanitation
- Gender inequality and limited health access

Governance Failures at the Centre

(A) Environmental Regulation

- Lax enforcement of:
  - Effluent norms for industrial discharge
  - Water quality standards in rivers
- Limited remediation of contaminated aquifers.
- Persistent dumping into the Ganga and tributaries.

(B) Health Surveillance

- Cancer registries cover **less than 10%** of India's population.
- The **National Cancer Registry Programme** is heavily hospital-based:
  - Misses large rural populations
  - Underestimates disease burden in poor communities

Why GBC is an "Invisible" Epidemic

- Cancer is **not a notifiable disease** at the national level:
  - No mandatory reporting of GBC clusters
  - No systematic tracking of region-wise incidence spikes
- Result:
  - Weak preventive programme design
  - Low policy visibility despite high mortality and suffering

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What Must be Done?

- Make cancer a **notifiable disease** across India.
- Integrate:
  - Cancer surveillance with **Namami Gange** and river-cleaning efforts
- Strengthen:
  - Groundwater testing and real-time public data
  - Strict audits of industrial waste discharge

- Build community-level interventions:
    - Low-cost screening and ultrasound camps at district hospitals
    - Regular water testing and public disclosure
    - Women-focused awareness and early-warning programmes
- Frame a **gender-sensitive cancer strategy** for high-risk states.

Global Lessons

- **Bangladesh:** systems for monitoring contaminants in fish and water
- **Vietnam & Philippines:** national residue monitoring in aquaculture
- In India, many stringent residue controls apply mainly to **exports**, not to domestic consumption, leaving internal populations more vulnerable.

Public Health Interpretation & Conclusion

- GBC in the Gangetic belt is primarily an **environmental and governance-driven cancer**, not an unavoidable biological fate.
- It reflects:
    - Systematic tolerance of pollution
    - Neglect of women's health
    - Under-reporting due to weak registries
- Making cancer notifiable would be a powerful trigger for:
    - Better measurement
    - Stronger policy focus
    - Earlier prevention and treatment

What gets measured gets governed — and what gets governed can eventually be prevented.

10th December 2025: Daily MCQs

Q1. With reference to neurotechnology and Brain–Computer Interfaces (BCIs), consider the following statements:

1. Non-invasive BCIs typically use EEG to record brain activity from outside the skull.
2. Invasive BCIs offer higher precision than non-invasive BCIs but involve surgical risks.
3. BCIs can only be used for motor rehabilitation and have no diagnostic applications.

Which of the statements given above is/are correct?

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

Answer: (a)

Explanation:

- **Statement 1** is correct – Non-invasive BCIs usually use EEG headsets to capture brain signals.
- **Statement 2** is correct – Invasive BCIs use implanted electrodes and thus have higher precision but carry surgical complications.
- **Statement 3** is incorrect – BCIs can also be used for *diagnostic* purposes like mapping neurological disorders and tracking cognitive decline.

Q2. In the context of the proposed DHRUVA digital addressing system, which of the following is/are correct?

1. It aims to convert physical addresses into virtual labels similar to UPI IDs.
2. DIGIPIN is a geo-coded alphanumeric code that represents a small area derived from latitude–longitude.
3. DHRUVA is designed to permanently link addresses to individuals, eliminating the need for consent-based access.

Select the correct answer using the code below:

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

Answer: (a)

Explanation:

- **Statement 1** is correct – DHRUVA intends to provide address "labels" like name@entity similar in spirit to UPI handles.
- **Statement 2** is correct – DIGIPIN is a 10-character alphanumeric pin mathematically derived from geo-coordinates, representing a small unit area.
- **Statement 3** is incorrect – DHRUVA is explicitly framed as *consent-based*, where users control who can access their actual address data.

Q3. With reference to Virtual Digital Assets (VDAs) and crypto taxation in India, consider the following statements:

1. Crypto-assets such as Bitcoin and Ether are treated as Virtual Digital Assets under the Income Tax framework.

2. Profits from transfer of VDAs are taxed at a flat 30% rate, and losses from such transactions can be set off against other income.
3. A 1% Tax Deducted at Source (TDS) is levied on the transaction value of VDAs at the time of transfer.

Which of the statements given above is/are correct?

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

Answer: (b)

Explanation:

- **Statement 1** is correct – Cryptocurrencies like Bitcoin and Ether are classified as VDAs for tax purposes.
- **Statement 2** is incorrect – Although taxed at 30%, losses from VDAs **cannot** be set off against other income or carried forward.
- **Statement 3** is correct – 1% TDS is imposed on the total transaction value at the time of transfer, irrespective of profit or loss.

Q4. Consider the following pairs:

Protected Area / Park – Correct description

1. Nahargarh Biological Park – Biological park located along the Aravalli range near Jaipur, developed for semi-natural habitat-based conservation and regulated safari tourism.
2. Desert National Park – Mangrove conservation site located along the Gulf of Kutch.
3. Kaziranga National Park – High-altitude trans-Himalayan cold desert ecosystem.

How many of the above pairs are correctly matched?

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

Answer: (a)

Explanation:

- **Pair 1** is correct – Nahargarh Biological Park is indeed located near Jaipur in the Aravallis and used for eco-tourism and conservation.
- **Pair 2** is incorrect – Desert National Park is in Rajasthan's Thar desert, not a mangrove site.

- **Pair 3** is incorrect – Kaziranga is a floodplain grassland and wetland ecosystem in Assam, not a cold desert.

So, only **one** pair is correctly matched.

Q5. With reference to Gallbladder Cancer (GBC) in India, which of the following statements is/are correct?

1. The disease shows a strong geographic concentration in the Gangetic belt and parts of the North-East.
2. Environmental exposure to arsenic and heavy metals has been implicated in its etiology.
3. Cancer is currently a notifiable disease across India, ensuring complete and real-time reporting of all GBC cases.

Select the correct answer using the code below:

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

Answer: (a)

Explanation:

- **Statement 1** is correct – GBC is heavily clustered in Uttar Pradesh, Bihar, West Bengal, Assam and the wider Ganga basin.
- **Statement 2** is correct – Long-term exposure to arsenic and other heavy metals in contaminated water and food is a key suspected driver.
- **Statement 3** is incorrect – Cancer is **not** yet a nationally notifiable disease, which contributes to under-reporting and weak surveillance.

Mains: Gallbladder cancer in India's Gangetic belt has been described as an "environmental, gendered and governance-driven epidemic". Analyse this statement with reference to environmental pollution, gendered vulnerabilities, weaknesses in health surveillance, and policy measures needed to address such disease clusters. 250 words.