MISSION X PRESENTS

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GS PAPER III · DEFENCE TECHNOLOGY · PROPULSION SYSTEMS

India Tests First Indigenous Rotating Detonation Engine

NEWS IN BRIEF

- Delhi-based startup D-Propulse, incubated at IIT Madras, successfully hot-fired India's first indigenous 5 kN air-breathing Rotating Detonation Engine (RDE) with an aerospike nozzle at a DRDO facility in Hyderabad on 21-22 July 2026, achieving Technology Readiness Level-5 (TRL-5).
- Unlike conventional jet engines that rely on steady, constant-pressure combustion, an RDE uses continuously travelling detonation waves inside a ring-shaped combustion chamber to burn fuel, improving thermodynamic efficiency with fewer moving parts.
- The engine's design is reported to offer a 15-25% efficiency improvement over conventional engines, with a much smaller core that frees up internal space within a missile airframe.
- D-Propulse aims to reach TRL-7 with a demonstrated sustainer flight by December 2027, and hopes to offer RDE-powered munitions for military user trials by December 2029.

⚡ UNIQUE FACT

The test generated a steady 5 kN of thrust even under reduced airflow conditions, and TRL-5 validation means the technology has moved beyond lab testing into a real, relevant operational environment — a major leap in just about a year since D-Propulse was founded in July 2025.

⚠ UPSC TRAP

Don't confuse a Rotating Detonation Engine (uses continuous, travelling detonation waves) with a Pulse Detonation Engine (which requires repeated fill-detonate-purge cycles) — both are pressure-gain combustion technologies but work differently.

📌 PRELIMS MEMORY BANK

- Developer: D-Propulse (IIT Madras-incubated startup)
- Test date: 21-22 July 2026, DRDO facility, Hyderabad
- Achievement: TRL-5, with 5 kN thrust
- Efficiency gain: 15-25% over conventional engines
- Applications: missiles, UAVs, tactical aircraft

PRACTICE MCQ · UPSC PRELIMS STYLE

India Tests First Indigenous Rotating Detonation Engine

With reference to Rotating Detonation Engines (RDEs), consider the following statements:

1. They rely on steady, constant-pressure combustion similar to conventional jet engines.
2. India's first indigenous air-breathing RDE was tested by a private company at a DRDO facility.
3. RDEs use continuously travelling detonation waves inside a ring-shaped combustion chamber.

Which of the statements given above is/are correct?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 2 and 3 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

An RDE's defining feature is replacing steady constant-pressure combustion with pressure-gain combustion via travelling detonation waves — a statement claiming it relies on steady, constant-pressure combustion describes a CONVENTIONAL engine, the very thing RDEs are designed to improve upon.

② THROUGH FACTUAL KNOWLEDGE

D-Propulse, a private IIT Madras-incubated startup, tested India's first indigenous air-breathing RDE at a DRDO facility in Hyderabad; and RDEs are defined by continuously travelling detonation waves inside an annular combustion chamber.

GS PAPER III · DEFENCE TECHNOLOGY · NAVAL DIPLOMACY

INS Imphal Berths in Oman for Independence Day Celebrations

NEWS IN BRIEF

- More than 200 students from Indian schools in Muscat visited INS Imphal, an indigenously built Indian Navy warship, while it was berthed at Sultan Qaboos Port in Oman on 17 August 2026, as part of celebrations marking India's 80th Independence Day.
- INS Imphal is a stealth guided-missile destroyer, the third of four Project 15B (Visakhapatnam-class) destroyers, built by Mazagon Dock Shipbuilders Limited and commissioned into the Indian Navy in December 2023.
- It is the first Indian warship named after a Northeastern city — Imphal, the capital of Manipur — and is equipped with BrahMos supersonic cruise missiles and indigenous anti-submarine rocket launchers.
- The ship displaces about 7,400 tonnes, stretches 163 metres in length, and can achieve speeds in excess of 30 knots with a range of about 8,000 nautical miles.

⚡ UNIQUE FACT

INS Imphal is the first Indian Navy warship ever to be named after a city from the Northeast, symbolically extending India's naval identity into a region far from the coast.

⚠ UPSC TRAP

Don't confuse Project 15B (Visakhapatnam-class, INS Imphal's class) with Project 17A (Nilgiri-class frigates) — both are indigenous stealth warship classes, but 15B builds larger guided-missile destroyers while 17A builds relatively smaller frigates.

📌 PRELIMS MEMORY BANK

- Port visit: Sultan Qaboos Port, Muscat, Oman, 17 August 2026
- Occasion: India's 80th Independence Day celebrations
- Class: Project 15B (Visakhapatnam-class) guided-missile destroyer
- Commissioned: December 2023; Builder: Mazagon Dock Shipbuilders Ltd
- Armament: BrahMos cruise missiles, indigenous anti-submarine rockets

PRACTICE MCQ · UPSC PRELIMS STYLE

INS Imphal Berths in Oman for Independence Day Celebrations

With reference to INS Imphal, consider the following statements:

1. It is the first Indian Navy warship named after a city in Northeast India.
2. It belongs to the Project 17A Nilgiri-class of stealth frigates.
3. It is equipped with BrahMos supersonic cruise missiles.

Which of the statements given above is/are correct?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 1 and 3 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

INS Imphal is consistently described as part of Project 15B, the Visakhapatnam-class of guided-missile destroyers — a distinct programme from Project 17A's Nilgiri-class frigates, so attributing it to the wrong project class is a classic ship-classification trap.

② THROUGH FACTUAL KNOWLEDGE

INS Imphal is the first Indian warship named after a Northeastern city; it belongs to Project 15B (Visakhapatnam-class), not Project 17A; and it is armed with BrahMos supersonic cruise missiles.

GS PAPER III · DEFENCE TECHNOLOGY · LOITERING MUNITIONS

Divyastra Mk3 — India's First Jet-Powered Loitering Munition

NEWS IN BRIEF

- Kawa UAV's Divyastra Mk3, described as India's first indigenous jet-powered loitering munition, completed its maiden flight on 11 August 2026, with the achievement publicly announced on 16 August.
- A loitering munition is an unmanned aerial weapon that can circle over a target area for extended periods before striking, combining reconnaissance and strike capability in a single low-cost, expendable platform.
- Divyastra Mk3's jet propulsion, rather than a simpler propeller-driven design, allows for higher speed and greater range compared to most existing loitering munitions, expanding the tactical envelope for precision strikes.
- The maiden flight highlights the growing role of private Indian companies and start-ups in advanced, indigenous defence development, alongside established players like DRDO.

⚡ UNIQUE FACT

The name 'Divyastra' can easily be confused with Mission Divyastra, DRDO's programme that tested India's Agni-5 missile with MIRV (Multiple Independently Targetable Re-entry Vehicle) technology in March 2024 — but the two are entirely unrelated, sharing only their name.

⚠ UPSC TRAP

Don't confuse Divyastra Mk3 (a jet-powered loitering munition by private company Kawa UAV) with Mission Divyastra (DRDO's Agni-5 MIRV missile programme) — despite the identical name, they are completely different weapons systems from different organisations.

📌 PRELIMS MEMORY BANK

- Developer: Kawa UAV (private Indian company)
- Maiden flight: 11 August 2026; announced 16 August 2026
- Type: India's first indigenous jet-powered loitering munition
- Not to be confused with: Mission Divyastra (DRDO's Agni-5 MIRV programme)
- Significance: growing private-sector role in India's defence innovation

PRACTICE MCQ · UPSC PRELIMS STYLE

Divyastra Mk3 — India's First Jet-Powered Loitering Munition

With reference to Divyastra Mk3, recently in the news, consider the following statements:

1. It is a jet-powered loitering munition developed by a private Indian company.
2. It is the same as Mission Divyastra, DRDO's Agni-5 MIRV missile test programme.
3. A loitering munition combines reconnaissance and strike capability, able to circle a target area before striking.

Which of the statements given above is/are correct?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 1 and 3 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

Reports explicitly warn against confusing the two systems despite their identical name — Divyastra Mk3 is a private company's loitering munition, while Mission Divyastra is DRDO's unrelated Agni-5 MIRV programme, so a statement equating them directly contradicts this clarification.

② THROUGH FACTUAL KNOWLEDGE

Divyastra Mk3 is a jet-powered loitering munition developed by Kawa UAV, distinct from DRDO's Mission Divyastra; and a loitering munition by definition can circle over a target area before striking.

GS PAPER III · BIOTECHNOLOGY · MOLECULAR BIOLOGY

Scientists Pinpoint How Cells Begin Copying DNA

NEWS IN BRIEF

- Researchers at the MRC Laboratory of Medical Sciences (LMS) and collaborators have identified one of the earliest steps in DNA replication — the precise moment a cell first 'unzips' its DNA to begin copying its genome — published in Nature Communications on 27 July 2026.
- The study reveals how the MCM2-7 helicase, a molecular motor enzyme, is activated and initiates DNA 'melting' at near base-pair resolution, identifying a molecular gate that prepares DNA for copying.
- Helicase is an ATP-powered enzyme that unwinds double-stranded DNA by breaking hydrogen bonds between complementary base pairs, functioning like a zipper travelling along the DNA to create a 'replication fork.'
- Because helicase activity underpins DNA replication, repair and transcription in all living cells, a clearer picture of how it switches on could inform research into cancers and diseases linked to faulty DNA replication control.

⚡ UNIQUE FACT

Researchers have compared the helicase's unwinding action to a 'six-piston molecular engine', where each of six protein subunits works in a precise, coordinated sequence to physically pry apart the DNA double helix.

⚠ UPSC TRAP

Don't confuse helicase (which physically unwinds and separates the two DNA strands) with DNA polymerase (which reads each separated strand and builds the new complementary strand) — the two enzymes work together but perform distinct jobs.

📌 PRELIMS MEMORY BANK

- Study published: Nature Communications, 27 July 2026
- Institution: MRC Laboratory of Medical Sciences (LMS) and collaborators
- Key enzyme: MCM2-7 helicase
- Function: unwinds DNA using ATP energy, creates the 'replication fork'
- Relevance: underpins DNA replication, repair and transcription in all cells

PRACTICE MCQ · UPSC PRELIMS STYLE

Scientists Pinpoint How Cells Begin Copying DNA

With reference to the enzyme helicase, consider the following statements:

1. It builds a new complementary DNA strand by reading an already-separated template strand.
2. It uses energy derived from ATP hydrolysis to unwind double-stranded DNA.
3. The MCM2-7 helicase has been studied for its role in initiating DNA replication.

Which of the statements given above is/are correct?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 2 and 3 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

Building a new complementary strand from a template is the job of DNA polymerase, not helicase — helicase's role is strictly to physically separate the two existing strands, so attributing strand-building to helicase conflates two distinct enzymes in the replication process.

② THROUGH FACTUAL KNOWLEDGE

Helicase unwinds DNA using ATP-derived energy, breaking hydrogen bonds between strands; and the MCM2-7 helicase complex has been specifically studied for how it activates and initiates DNA replication.

GS PAPER III · BIOTECHNOLOGY · DRUG DISCOVERY

RK-251 — India's Smart Cancer Prodrug

NEWS IN BRIEF

- Indian researchers announced RK-251 on 19 August 2026, a 'smart' cancer prodrug developed through a collaboration led by Dr Asis Bala of the Institute of Advanced Study in Science and Technology and Dr K.P. Bhabak of IIT Guwahati.
- RK-251 is designed as a prodrug — a compound that stays inactive in healthy tissue and only becomes active once triggered by a specific chemical signal, in this case reactive oxygen species (ROS), present at higher levels inside cancer cells than in normal tissue.
- When ROS activates RK-251 inside the tumour microenvironment, it releases NBDHEX, an anticancer compound that blocks proteins cancer cells rely on for survival, while aiming to spare healthy cells from exposure to the active drug.
- The drug has so far only been tested in preclinical, laboratory-based studies and has not yet entered human clinical trials; further studies are required before any regulatory clearance.

⚡ UNIQUE FACT

RK-251 is engineered to stay 'silent' until it enters a cancer cell's specific chemical environment — meaning the same molecule that is inert and harmless in healthy tissue becomes an active cancer-killing agent only inside a tumour.

⚠ UPSC TRAP

RK-251 remains a preclinical, laboratory-stage finding — don't mistake it for an approved or clinically tested cancer treatment; it has not yet been tested in humans.

📌 PRELIMS MEMORY BANK

- Announced: 19 August 2026
- Developers: Dr Asis Bala (IASST) and Dr K.P. Bhabak (IIT Guwahati)
- Type: prodrug, activated by reactive oxygen species (ROS)
- Active compound released: NBDHEX
- Stage: preclinical only; not yet in human clinical trials

PRACTICE MCQ · UPSC PRELIMS STYLE

RK-251 — India's Smart Cancer Prodrug

With reference to RK-251, recently in the news, consider the following statements:

1. It is designed to remain active in both healthy and cancerous tissue equally.
2. It is activated by reactive oxygen species, which are present at higher levels in cancer cells.
3. It has already completed human clinical trials and received regulatory clearance.

Which of the statements given above is/are correct?

(a) 2 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 2 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

RK-251 is explicitly designed as a prodrug that stays inactive in healthy tissue and activates only inside tumour cells — a statement claiming equal activity in both tissue types erases this core selectivity feature. Since reports state it has not yet entered human trials, a claim of completed trials overstates its development stage.

② THROUGH FACTUAL KNOWLEDGE

RK-251 remains inactive in healthy tissue and is activated specifically by reactive oxygen species found at higher levels in cancer cells; and it has not yet entered human clinical trials or received regulatory clearance.

GS PAPER III · BIOTECHNOLOGY · PUBLIC HEALTH

Ervebo Vaccine Doses Arrive in Ebola-Hit DR Congo

NEWS IN BRIEF

- The Democratic Republic of the Congo received over 16,000 doses of the Ervebo Ebola vaccine on 22 August 2026, the first tranche of 70,000 doses pledged by the WHO and partners, as the country battles what officials call the fastest-growing Ebola outbreak in history.
- Ervebo is licensed specifically for the Zaire ebolavirus species, but the current DRC outbreak is caused by the Bundibugyo virus, a different Ebola species for which no vaccine is currently approved.
- WHO has stressed it remains unknown whether Ervebo will protect against the Bundibugyo strain, though early laboratory and animal data suggest it may offer some protection; 20,000 of the allocated doses will be used in a late-stage clinical trial specifically to test this.
- The DRC outbreak has already claimed more than 2,500 lives out of over 5,000 confirmed cases, making it the country's deadliest Ebola outbreak on record.

⚡ UNIQUE FACT

Even though Ervebo was never designed or licensed for the Bundibugyo strain currently causing the outbreak, health authorities are deploying it anyway on the strength of promising early data — turning this vaccine rollout into a real-time clinical trial for a use it wasn't originally built for.

⚠ UPSC TRAP

Don't assume Ervebo is licensed or proven effective against the Bundibugyo virus — it is officially licensed only for the Zaire ebolavirus species; its use against Bundibugyo in this outbreak is experimental and under active clinical trial.

📌 PRELIMS MEMORY BANK

- Doses delivered: 16,250 (of 70,000 pledged), arrived 22 August 2026
- Manufacturer: Merck (MSD)
- Licensed for: Zaire ebolavirus (not Bundibugyo, the current outbreak strain)
- Trial component: 20,000 doses for a late-stage trial against Bundibugyo
- Outbreak toll: 2,500+ deaths, 5,000+ confirmed cases (DRC's deadliest ever)

PRACTICE MCQ · UPSC PRELIMS STYLE

Ervebo Vaccine Doses Arrive in Ebola-Hit DR Congo

With reference to the Ervebo vaccine and the 2026 Ebola outbreak in the Democratic Republic of the Congo, consider the following statements:

1. Ervebo is officially licensed for use against the Bundibugyo strain of Ebola virus.
2. The current DRC outbreak is caused by the Bundibugyo virus, a different species from that which Ervebo targets.
3. A portion of the delivered Ervebo doses will be used in a clinical trial to test its effectiveness against the Bundibugyo strain.

Which of the statements given above is/are correct?

(a) 2 and 3 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 2 and 3 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

Every report on this rollout stresses Ervebo's licensing is specific to the Zaire ebolavirus species, while explicitly noting its effectiveness against Bundibugyo remains unproven — exactly why a trial is being run alongside deployment — so a claim of official licensing for Bundibugyo contradicts this stated uncertainty.

② THROUGH FACTUAL KNOWLEDGE

Ervebo is licensed specifically for the Zaire ebolavirus; the current DRC outbreak is caused by the distinct Bundibugyo virus; and 20,000 of the delivered doses are earmarked for a late-stage trial testing effectiveness against Bundibugyo.

GS PAPER III · BIOTECHNOLOGY · PUBLIC HEALTH

CCHF Virus Found Circulating Widely Across DR Congo

NEWS IN BRIEF

- A new serosurvey published in Emerging Infectious Diseases found Crimean-Congo Hemorrhagic Fever Virus (CCHFV) exposure across 25 provinces of the Democratic Republic of the Congo, with 4.4% human and 28.9% animal seroprevalence, flagging the eastern highlands as a key biosecurity risk zone.
- CCHF is a tick-borne viral haemorrhagic fever with a case fatality rate ranging from 10% to 40%, spread mainly through the bite of infected Hyalomma ticks or direct contact with the blood or tissues of infected livestock during or after slaughter.
- The virus can also spread from person to person through unprotected contact with the blood or bodily fluids of an infected patient, making it a particular risk for healthcare workers treating CCHF cases.
- There is currently no safe, widely available vaccine against CCHF for either humans or animals; the virus has also been detected spreading into parts of southern Europe, including Italy, Spain, France and Portugal.

⚡ UNIQUE FACT

The DRC serosurvey found nearly 29% of domestic animals tested showed past CCHFV exposure — more than six times the human seroprevalence rate — highlighting how the virus circulates far more widely in livestock than is reflected in reported human cases.

⚠ UPSC TRAP

Don't assume CCHF spreads only through tick bites — direct contact with infected animal tissue during slaughter, and even person-to-person transmission via infected blood or bodily fluids, are equally important transmission routes, especially in healthcare settings.

📌 PRELIMS MEMORY BANK

- Causative agent: CCHF virus (a Nairovirus, family Bunyaviridae)
- Case fatality rate: 10-40%
- Primary vector: Hyalomma ticks
- DRC serosurvey: 4.4% human, 28.9% animal seroprevalence, 25 provinces
- No vaccine currently available for humans or animals

PRACTICE MCQ · UPSC PRELIMS STYLE

CCHF Virus Found Circulating Widely Across DR Congo

With reference to Crimean-Congo Hemorrhagic Fever (CCHF), consider the following statements:

1. It is caused by a virus belonging to the family Bunyaviridae.
2. It can only be transmitted through the bite of an infected tick.
3. A safe, widely available vaccine currently exists for human use against CCHF.

Which of the statements given above is/are correct?

(a) 1 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

✓ **Correct Answer: (a) 1 only**

SOLUTION EXPLAINED

① THROUGH LOGICAL ANALYSIS

CCHF's transmission routes explicitly include direct contact with infected animal tissue during slaughter and person-to-person spread via bodily fluids, not ticks alone — restricting transmission to tick bites only ignores these equally significant routes. Health authorities explicitly state no safe vaccine is currently available, directly contradicting a claim that one exists.

② THROUGH FACTUAL KNOWLEDGE

CCHF virus belongs to the Bunyaviridae family; transmission occurs via tick bites, contact with infected animal tissue, and person-to-person contact with bodily fluids; and there is currently no safe, widely available vaccine for human use.