

Q.1) Which of the following statements about the applications of stem cells are correct?

1. They can be used to test the drugs for safety and quality.
2. They can be used to treat genetic diseases.
3. They can be used in tissue engineering.
4. They can be used to create lab grown cultured meat.

Select the correct answer from the code given below:

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

Ans) d

Exp) Option d is the correct answer.

Stem cells are undifferentiated cells that have the intrinsic capacity to self-renew, that is, to divide and develop into different types of cells. Since its discovery in the 1960s, stem cell technology has harnessed the power of stem cells to solve problems in the field of medicine.

Statement 1 is correct: Stem cells can be used **to test the safety and effectiveness of new drugs**. This can help speed up the drug discovery process and reduce the need for animal testing.

Statement 2 is correct: Stem cell transplantation (SCT) is used to cure or greatly ameliorate a wide variety of genetic diseases, ranging from inherent defects of haemopoietic cell production or function to metabolic diseases.

Statement 3 is correct: **Stem cells can be used to create new tissues and organs for transplant. This is known as tissue engineering.** Researchers are working on developing techniques to grow replacement organs, such as kidneys and liver, from a patient's own stem cells.

Statement 4 is correct: **The stem cell technology is used to develop lab-grown meat.** This refers to meat that is comprised of animal cells but grown outside of the animal in controlled laboratory settings. To produce cultured meat, stem cells are isolated via simple biopsy from a living animal – chosen based on the meat being produced – and then cultured in vitro, without harming the animal.

Source: <https://www.hindustantimes.com/lifestyle/health/treatment-of-genetic-disorders-here-s-how-stem-cells-can-treat-genetic-diseases-101679382563350.html>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4969512/>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2475566/>

<https://www.labiotech.eu/partner/stem-cell-technology-lab-grown-meat/>

<https://www.mayoclinic.org/tests-procedures/bone-marrow-transplant/in-depth/stem-cells/art-20048117#:~:text=People%20who%20might%20benefit%20from,%2C%20burns%2C%20cancer%20and%20osteoarthritis.>

Q.2) Recently, the Site-Directed Nucleases (SDN) technology was in the news. In this context, consider the following statements:

1. Zinc-Finger Nucleases (ZFNs) is a technique that is used in SDN technology.
2. In all types of SDN technologies (SDN-1, 2 and 3), foreign genetic material is inserted to make changes in DNA.
3. Recently, the Union Ministry of Environment, Forest and Climate Change has exempted crops derived from SDN1 and SDN2 from biosafety assessment requirements.

Which of the statements given above are correct?

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

Ans) b

Exp) Option b is the correct answer.

A decade ago, scientists in Germany and the US discovered a technique which allowed them to ‘cut’ DNA strands and edit genes. For agriculture scientists this process allowed them to bring about desired changes in the genome by using site directed nuclease (SDN) or sequence specific nuclease (SSN). Nuclease is an enzyme which cleaves through nucleic acid – the building block of genetic material.

Statement 1 is correct: Site-directed nucleases (SDNs) are a type of genetic engineering tool that can be used to make precise changes to the DNA sequence of a cell or organism. There are several **different techniques for using SDNs**, including:

- 1) **Zinc Finger Nucleases (ZFNs):** ZFNs are engineered proteins that can recognize and bind to specific DNA sequences. When combined with a nuclease, they can cut the DNA at that specific site. ZFNs are widely used in research and have been used to create genetically modified organisms.
- 2) **Transcription Activator-Like Effector Nucleases (TALENs):** TALENs are similar to ZFNs, but use a different type of DNA-binding protein. TALENs are also widely used in research and have been used to create genetically modified organisms.
- 3) **Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) and CRISPR-associated (Cas) proteins:** CRISPR-Cas systems are a type of bacterial immune system that can be used to target and cut specific DNA sequences. CRISPR-Cas systems have revolutionized genetic engineering and are now widely used in research and industry.

Statement 2 is incorrect: Depending on the nature of the edit that is carried out, the site-directed nucleases (SDN) technology is divided into three categories SDN 1, SDN 2 and SDN 3. SDN1 introduces changes in the host genome’s DNA through small insertions /deletions without introduction of foreign genetic material. In the case of SDN 2, the edit involves using a small DNA template to generate specific changes. **Both SDN1 and SDN2 processes do not involve alien genetic material** and the end result is indistinguishable from conventionally bred crop varieties. On the other hand, **SDN3 process involves larger DNA elements or full length genes of foreign origin** which makes it similar to Genetically modified organisms (GMO) development

Statement 3 is correct: Recently, the Ministry of Environment, Forests and Climate Change has relaxed the rules regarding the GM crops made from the SDN1 and SDN2 technologies. The notification states that **“SDN1 and SDN2 genome-edited products free from exogenous introduced DNA be exempted from biosafety assessment”** in pursuance of rule 20 of the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically engineered Organisms or Cells Rules 1989.

Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4970358/>

<https://pib.gov.in/PressReleasePage.aspx?PRID=1871153>

<https://indianexpress.com/article/explained/everyday-explainers/what-is-genome-editing-technology-how-is-it-different-gm-technology-7846402/>

Q.3) With reference to “Chimeric Antigen Receptor (CAR) T-cell therapy”, consider the following statements:

1. A patient’s own cells cannot be used in the CAR T-cell therapy.
2. In this, T cells are genetically altered in a lab to enable them to locate and destroy cancer cells more effectively.

3. The therapy can help in treating diseases like leukemia and lymphomas.

Which of the statements given above is/are correct?

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

Ans) c

Exp) Option c is the correct answer.

Currently available CAR T-cell therapies are customized for each individual patient. They are made by collecting T cells from the patient and re-engineering them in the laboratory to produce proteins on their surface called chimeric antigen receptors, or CARs. The CARs recognize and bind to specific proteins, or antigens, on the surface of cancer cells.

Statement 1 is incorrect: Unlike chemotherapy or immunotherapy which involve taking drugs, **CAR T-cell therapies use a patient's own cells.** They are modified in the laboratory to activate T-cells and target tumor cells.

Statement 2 is correct: CAR T cell therapy is a type of cancer immunotherapy treatment that uses immune cells called T cells that are genetically altered in a lab to enable them in locating in destroying cancer cells more effectively.

Statement 3 is correct: CAR T treatment can be very effective against some types of cancer, even when other treatments are not working. Since 2017, **six CAR T-cell therapies have been approved by the Food and Drug Administration (FDA).** CAR T-cell therapies are approved for the treatment of blood cancers, including **lymphomas**, some forms of **leukemia**, and, most recently, multiple myeloma.

Source: <https://www.cancer.gov/about-cancer/treatment/research/car-t-cells>

<https://www.ncbi.nlm.nih.gov/books/NBK537294/>

<https://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/immunotherapy/car-t-cell1.html>

Q.4) Consider the following statements with reference to “Molecular Motors”:

1. They are a class of proteins that convert chemical energy into mechanical work.
2. These motors utilize the energy from the hydrolysis of Adenosine triphosphate (ATP) to generate force.
3. Myosins and kinesins are two important examples of molecular motors.

Which of the statements given above is/are correct?

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

Ans) d

Exp) Option d is the correct answer.

Molecular motors, an important class of molecular machines, harness various energy sources to generate unidirectional mechanical motion.

Statements 1 is correct: Molecular motors are a class of proteins that convert chemical energy into mechanical work, enabling various cellular processes such as muscle contraction, vesicle trafficking, and chromosome segregation.

Statement 2 is correct: These motors utilize the energy from ATP hydrolysis to generate force and movement along cytoskeletal filaments such as microtubules and actin filaments.

Statement 3 is correct: There are three major classes of molecular motors: myosins, kinesins, and dyneins, each with distinct structures and functions. For example, myosins are responsible for muscle contraction, while kinesins and dyneins play roles in intracellular transport and cell division.

Source:

<https://www.ncbi.nlm.nih.gov/books/NBK26888/#:~:text=Perhaps%20the%20most%20fascinating%20proteins,to%20move%20steadily%20along%20it.>

https://www.physio-pedia.com/Molecular_Motors

<https://pubs.acs.org/doi/10.1021/acs.chemrev.9b00819>

Q.5) Consider the following statements with reference to the Hallmark Unique Identification Number (HUID):

1. It has been introduced by the Ministry of Statistics and Programme Implementation.
2. It is a 6-digit Alphanumeric code.
3. One cannot sell gold jewelry without the HUID.

Which of the above-given statements are correct?

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

Ans) b

Exp) Option b is the correct answer.

Recently, the Bureau of India Standards (BIS) has prohibited the sale of hallmarked gold jewelry or gold artifacts without the Hallmark Unique Identification Number (HUID).

Statement 1 is incorrect: The Hallmark Unique Identification Number (HUID) is the **initiative of the Bureau of India Standards (BIS) which is the National Standards Body of India under the Department of Consumer Affairs, Ministry of Consumer Affairs, Food & Public Distribution, Government of India.**

Statement 2 is correct: HUID is a six-digit alphanumeric code and forms the part of hallmark which would now consist of 3 marks viz, BIS logo, purity of the article and six-digit alphanumeric HUID. It provides **information of the jeweller** who got the article hallmarked, **their registration number, purity of the article, type of article as well as details of hallmarking centre** which test and hallmark the article.



Statement 3 is correct: The sale of hallmarked gold jewelry or gold artefacts without 6 digit alphanumeric HUID is not be permitted after 31st March 2023 in order to safeguard and protect the consumers and enhance their confidence in purchase of hallmarked gold jewelry with traceability and assurance of quality.

Knowledge Base: As per BIS Rules, 2018, **in case Hallmarked jewelry bought by the consumer is found to be of lesser purity than that marked on jewelry, then the buyer/customer shall be entitled for**

compensation which shall be two times the amount of difference calculated on the basis of shortage of purity for the weight of such article sold and the testing charges.

Source:

<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1904262#:~:text=It%20is%20further%20clarified%20that,traceability%20and%20assurance%20of%20quality.>

Q.6) Consider the following statements with reference to the term “Micro-LED”:

1. Only organic materials are used for the manufacturing of Micro-LEDs.
2. The LED used in this technology is self-illuminating.
3. They have brighter and better color reproduction than OLED display technology.

Which of the statements given above is/are correct?

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

Ans) c

Exp) Option c is the correct answer.

Micro LED is a display technology that uses arrays of tiny LEDs as pixels in a display. These LEDs are much smaller than the ones used in traditional LED displays, which allows for higher resolution, finer image fidelity and more compact displays.

Statement 1 is incorrect: Micro LED differs from OLED in the makeup of the LED materials. The O in OLED stands for organic and refers to the organic materials used in light producing part of the pixel stack.

MicroLED technology changes this to an inorganic Gallium Nitride (GaN) material, which is typically found in regular LED lighting.

Statements 2 and 3 are correct: Micro-LEDs are self-illuminating diodes that have brighter and better color reproduction than Organic Light Emitting Diode (OLED) display technology.

Micro LED TVs can be made up of a number of smaller panels that attach together to form a bigger screen like a Destructicon from Transformers. One can buy a couple of modules to make a smaller TV, and then add more if you move into a bigger house with more space for a TV.

Source: <https://www.androidauthority.com/micro-led-display-explained-805148/>

<https://www.thehindu.com/sci-tech/technology/what-are-microled-displays-and-why-is-apple-shifting-to-it/article66500256.ece>

<https://www.electronicworldtv.co.uk/blog/inorganic-led-the-future-of-television>

<https://www.microled-info.com/microled-vs-oled>

<https://www.businesstoday.in/tech-today/news/story/samsung-showcases-supersized-140-inch-micro-led-tv-at-ces-2023-rip-projectors-359365-2023-01-08>

<https://www.trustedreviews.com/explainer/what-is-micro-led-3435345>

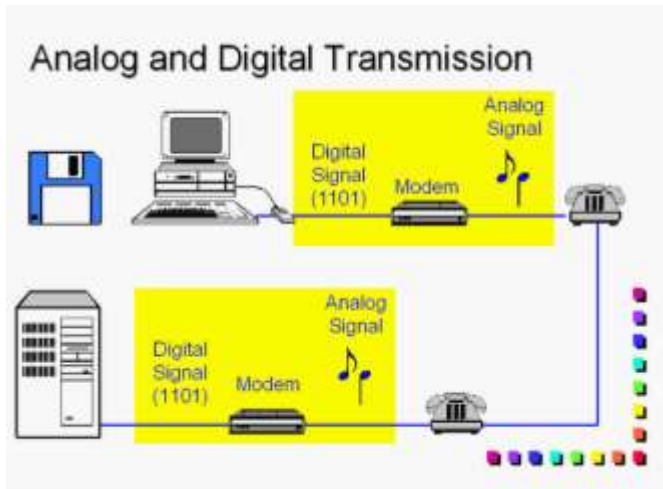
Q.7) With regard to difference between analog and digital data transmission, which of the following statements **is incorrect?**

- a) Analog transmission uses a continuous signal to transfer messages whereas Digital transmission transfers messages discretely.
- b) Analog transmission uses analog signal whose amplitude varies with time, whereas digital transmission uses digital signal whose amplitude is either of two levels i.e., 0 or 1
- c) Analog transmission can broadcast large number of channels simultaneously whereas Digital transmission can broadcast only a single channel at a time.
- d) In analog transmission separating out noise and signal is not possible whereas it is possible in digital communication.

Ans) c

Exp) Option c is the correct answer.

In analog communication the data is transferred with the help of analog signal in between transmitter and receiver. Any type of data is transferred in analog signal. Any data is converted into electric form first and after that it is passed through communication channel. In digital communication digital signal is used rather than analog signal for communication in between the source and destination. They digital signal consists of discrete values rather than continuous values.



Statement a is correct: Analog transmission uses a **continuous signal** varying in amplitude, phase, or another property that is in proportion to a specific characteristic of a variable. Digital transmission transfers messages **discretely**. These messages are represented by a sequence of pulses via a line code.

Statement b is correct: Analog communication uses analog signal whose amplitude varies continuously with time **from 0 to 100**. Digital communication uses digital signal whose amplitude is of two levels **either Low i.e., 0 or either High i.e., 1**.

Statement c is incorrect: In analog communication **only limited number of channels** can be broadcasted simultaneously whereas Digital transmission can broadcast **large number of channels** simultaneously.

Statement d is correct: Separating out noise and signal in **analog communication is not possible, while** separating out noise and signal in digital communication is possible.

Knowledge Base: In analog communication **noise immunity is poor**, while in digital communication noise immunity is **good**.

In analog communication coding is not possible. In digital **communication coding is possible**. Different coding techniques can be used to detect and correct errors.

Source: <http://www.differencebetween.net/technology/difference-between-analog-and-digital-transmission/#:~:text=%20Difference%20Between%20Analog%20and%20Digital%20Transmission%20,fi>
bre%20optic%20cable%2C%20the%20air%2C%20or...%20More%20

<https://www.geeksforgeeks.org/difference-between-analog-communication-and-digital-communication/>

Q.8) Consider the following statements with reference to the applications of Geospatial Technology:

1. It can be used in industries for supply chain management.
2. It can be used by insurance companies for risk-based assessments.
3. It can be utilized in agriculture to analyze soil data.
4. It can be used for tracking geographical spread of diseases.

Which of the statements given above are correct?

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

Ans) d

Exp) Option d is the correct answer.

Geospatial technologies is a term used to describe the range of modern tools contributing to the geographic mapping and analysis of the Earth and human societies

Statement 1 is correct: Geospatial Technology is used in Supply Chain Management

When a business is trying to keep track of its inventory and supply needs, they need to have the necessary tools for tracking how and when supply replenishment will arrive. When a business can keep track of inventory and shipments with geospatial technology, the supply chain grows, efficiency improves, and business costs are reduced.

Statement 2 is correct: Geospatial technology is used by insurance companies as a predictive model for risk-based assessments. If a certain location has a track record of things like frequent traffic accidents, high crime rates, etc., insurance companies can determine that may be a maximum risk area and define insurance policies specifically designed for that location.

Statement 3 is correct: Geospatial technology is currently being utilized to analyze soil data in order to determine which crops may grow in specific locations. It also helps farmers create more efficient harvesting procedures. Food production has soared and environmental standards have improved with the help of geospatial data.

Statement 4 is correct: Geospatial technologies are also incredibly important for tracking geographical spread of a disease. This can be demonstrated by the COVID-19 global pandemic. Without geospatial technology, the disease would not have been able to be effectively tracked around the world. Geospatial information was used to monitor the outbreak. The COVID-19 dashboard created by Johns Hopkins University is a great example.

Knowledge Base:

Some of the most **common geospatial technologies include:**

- 1) **Remote Sensing:** The geospatial technology used to study objects or surfaces at faraway distances using the images and data collected from space or airborne camera and sensor platforms.
- 2) **Geographic Information Systems (GIS):** It is a framework for gathering, managing, mapping, and analyzing the physical environment data of a specific location on the Earth's surface. GIS uses layers of geographic data to produce spatial analysis and derivative maps or 3D scenes.
- 3) **Global Positioning System (GPS):** It is a navigation system using satellites, a receiver, and algorithms to synchronize location, velocity and time data for air, sea and land travel.

Source: <https://www.studysmarter.co.uk/explanations/human-geography/introduction-to-human-geography/geospatial-technologies/>

<https://mgiss.co.uk/geospatial-technology-applications-and-benefits/>

<https://www.analyticsinsight.net/top-8-applications-of-geospatial-data-in-our-lives/>

<https://www.indiascienceandtechnology.gov.in/geospatial-technology/types-geospatial-technologies>

Q.9) “It is an encrypted portion of the internet that is not indexed by search engines and requires specific configuration or authorization to access. It can be accessed only by using specific browsers, such as TOR Browser.”

The above paragraph best describes which of the following?

- Open web.
- Surface Web
- Dark Web
- Telnet

Ans) c

Exp) Option c is the correct answer.

Options a and b are incorrect: Surface web/open web is the normal web which is visible for all users using internet. The websites on the surface web are indexed by search engines. The user can open websites and gain information. But the interesting thing is that the surface web is only a 4% area of internet that the users use.

Option c is correct: The term Dark Web or Dark Net refers to encrypted online content that is not indexed by conventional search engines. Accessing the dark web can only be done using specific browsers, such as TOR Browser. There is a great deal of privacy and anonymity that comes with using the dark web compared to traditional websites. As its name implies, the dark web is a secret network that exists underground. It's made up of a series of websites that are hidden from the general public. This means they aren't accessible through traditional search engines, such as Google.

Option d is incorrect: Telnet is a network protocol used to virtually access a computer and to provide a two-way, collaborative and text-based communication channel between two machines.



Source: <https://www.kaspersky.com/resource-center/threats/deep-web>

<https://www.techtarget.com/whatis/definition/dark-web>

<https://www.investopedia.com/terms/d/dark-web.asp>

<https://www.hitechnectar.com/blogs/introduction-surface-web-deep-dark-web/>

<https://medium.com/@hackersleague/what-is-surface-web-deep-web-and-dark-web-cdbaf71b30d5>

<https://www.ibm.com/docs/en/aix/7.1?topic=protocols-telnet-protocol>

Q.10) Consider the following statements with reference to the Forest Certification:

1. It is given to the industries that have completed their compensatory afforestation obligation.
2. It is based on standards developed by Forest Stewardship Council (FSC).
3. It will also help to combat desertification and promote forest sustainability.

Which of the above given statements are correct?

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

Ans) b

Exp) Option b is the correct answer.

Statement 1 is incorrect: Forest Certification is a **mechanism for forest monitoring, tracing and labelling timber, wood and pulp products and non-timber forest products**. It is a process through which quality of management from environmental, social and economic perspectives is judged against a series of agreed standards.

Statement 2 is correct: Forest Certification is based on **two major international standards for sustainable management of forests and forest-based products**. One has been developed by **Forest Stewardship Council (FSC)** and the other by Programme for Endorsement of Forest Certifications (PEFC).

Statement 3 is correct: **It is voluntary forest management standard will give impetus to third-party auditing of forest owners for various principles, criteria and indicators**. Forest certification is an important tool to combat desertification and promote forest sustainability.

Source: <https://pib.gov.in/PressReleaseDetailm.aspx?PRID=1834772>

<https://indianexpress.com/article/explained/explained-climate/forests-under-threat-deforestation-investigation-8478180/>

Q.11) Which of the following statements is correct about the term ‘Splinternet’, that has been often mentioned in the media?

- a) It is a part of the internet that is used only for spying activities and for sharing sensitive information.
- b) It is a specific part of the internet which is predominated by the usage of Artificial Intelligence.
- c) It is the internet designed specifically to cater to the needs of people in the Technology industry.
- d) It means that the global internet is fragmented into pieces due to content filtering and censorship by countries.

Ans) d

Exp) Option d is the correct answer.

Recently, Russia is risking the creation of a “splinternet”. Facebook has been blocked entirely by Russian authorities, while Twitter is almost completely cut off.

Option d is correct: **The splinternet is the breaking of one global internet into several smaller and fragmented pieces due to content filtering and censorship**. This division can be caused by religion, politics, government, technology or commerce. The most famous example is China’s “Great Firewall.” When you visit China and go online, you are not on the global Internet. You are on the Chinese government’s so-called “safe” version. You see what they want you to see—and use what services they want you to use.

Option a is incorrect: **A splinter bomb is an explosive device that injures or kills people within its blast radius by dispersing deadly shrapnel**. They can be crafted using any shell or gunpowder type combined with sharp fragments.

Source: <https://www.techtargget.com/whatis/feature/The-splinternet-explained-Everything-you-need-to-know>

<https://indianexpress.com/article/explained/russia-ukraine-war-splinternet-7849249/>
<https://www.internetsociety.org/blog/2022/03/what-is-the-splinternet-and-why-you-should-be-paying-attention/>

Q.12) “It is a quantum mechanical phenomenon. In these, two subatomic particles can be intimately linked to each other even if separated by billions of light-years of space. Despite their vast separation, a change induced in one will affect the other.”

Which of the following phenomenon is mentioned in the above passage?

- a) Quantum Superposition.
- b) Quantum Entanglement.
- c) Quantum Interference.
- d) Quantum Chaos

Ans) b

Exp) Option b is the correct answer.

Quantum Entanglement is the physical phenomenon that occurs when a pair or group of particles is generated and they interact in such a way that the quantum state of each particle of the pair or group cannot be described independently of the state of the others.

Option b is correct: Quantum Entanglement is a quantum mechanical phenomenon. In these two subatomic particles can be intimately linked to each other even if separated by billions of light-years of space. Despite their vast separation, a change induced in one will affect the other. Once you have knowledge of one quantum state, you automatically know the quantum state of any entangled particles. In principle, you could place two entangled particles on opposite ends of the galaxy and still have this instantaneous knowledge, which appears to violate the limit of the speed of light.

Option a is incorrect: The principle of quantum superposition states that a quantum particle can exist in 2 distinct locations at the same time. According to this theory, an quantum particle can exist simultaneously in multiple states, unless the operation of measurement is made.

Option c is incorrect: Quantum interference is when subatomic particles interact with and influence themselves and other particles while in a probabilistic superposition state. It can influence the probability of the outcomes when the quantum state is measured.

Option d is incorrect: Quantum chaos is a branch of physics which studies how chaotic classical dynamical systems can be described in terms of quantum theory. The primary question that quantum chaos seeks to answer is: "What is the relationship between quantum mechanics and classical chaos?".

Chaos theory is an interdisciplinary area of scientific study and branch of mathematics focused on underlying patterns and deterministic laws of dynamical systems that were once thought to have completely random states of disorder and irregularities.

Source: <https://www.space.com/31933-quantum-entanglement-action-at-a-distance.html>

<https://www.livescience.com/what-is-quantum-entanglement.html>

<https://becominghuman.ai/quantum-superposition-and-what-that-means-to-quantum-computation-3fbb5a711b9a>

<https://www.techtarget.com/whatis/definition/quantum-interference#:~:text=Quantum%20interference%20is%20when%20subatomic,the%20quantum%20state%20is%20measured.>

<https://brilliant.org/wiki/quantum-teleportation/>

Q.13) The term “Proof-of-Stake (PoS)” mechanism is best described by which of the following statements?

- a) It is a cryptocurrency consensus mechanism used to verify new cryptocurrency transactions.
- b) It is a method to facilitate credit and debit card transactions by retail customers.

- c) It is a technique for demonstration of a product, service or solution in a sales context.
 d) It is a legal term used in courts, where the Defendant must provide proof in response to the case.

Ans) a

Exp) Option a is the correct answer.

Option a is correct: Proof of stake is a consensus mechanism used to verify new cryptocurrency transactions. Since blockchains lack any centralized governing authorities, proof of stake is a method to guarantee that data saved on the network is valid. A consensus mechanism is a method for validating entries into a distributed database and keeping the database secure. In the case of cryptocurrency, the database is called a blockchain—so the consensus mechanism secures the blockchain. Proof-of-stake reduces the amount of computational work needed to verify blocks and transactions.

Option b is incorrect: A Point of sale (POS) is a device that is used to process transactions by retail customers. A cash register is a type of POS. The cash register has largely been replaced by electronic POS terminals that can be used to process credit cards and debit cards as well as cash. A POS may be a physical device in a brick-and-mortar store, or a checkout point in a web-based store.

Option c is incorrect: Proof of concept (POC) is a demonstration of a product, service or solution in a sales context. Proof of concept (POC) is evidence obtained from a pilot project, which is executed to demonstrate that a product idea, business plan, or project plan is feasible. For example, in drug development, clinical trials are used to gather proof of concept for a final product.

Option d is incorrect: Proof of stake is not a legal term used in courts.

Source: <https://www.forbes.com/advisor/investing/cryptocurrency/proof-of-stake/>
<https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-proof-of-stake>
<https://www.investopedia.com/terms/p/proof-stake-pos.asp>
<https://www.investopedia.com/terms/p/point-of-sale.asp>
<https://www.projectmanager.com/blog/proof-of-concept-definition>
<https://www.gartner.com/en/sales/glossary/proof-of-concept-poc->

Q.14) Consider the following statements with reference to '4D printing technology':

1. This technology involves changing the shape or structure of 3D printed objects under the influence of external stimuli.
2. In this technology, time is considered as the 4th dimension.
3. It uses 'smart material' like hydrogel or shape memory polymer as inputs.

Which of the statements given above are correct?

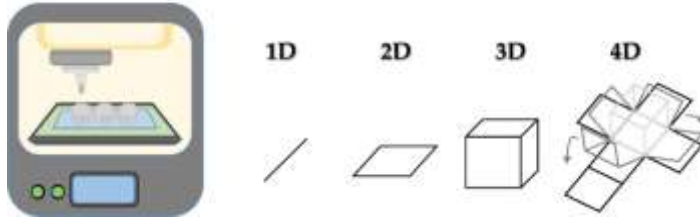
- a) 1 and 2 only
- b) 1 and 3 only
- c) 2 and 3 only
- d) 1, 2 and 3

Ans) d

Exp) Option d is the correct answer.

A 4D printed object is printed just like any 3D printed shape. The difference is that the 4D Printing technology uses programmable and advanced materials that perform a different functionality by adding hot water, light or heat. That's why a non-living object can change its 3D shape and behavior over time.

Progress of 4D Polymer Printing Techniques

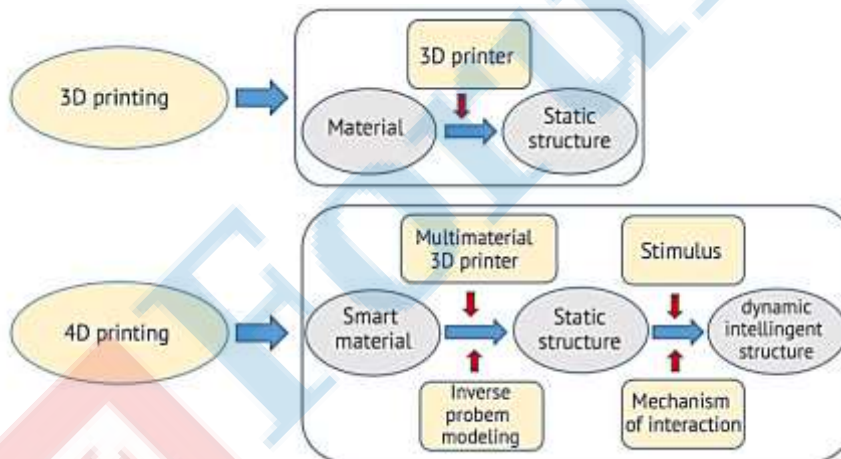


Statement 1 is correct: 4D printing is the process through which a **3D printed object transforms itself into another structure over the influence of external energy input** as temperature, light or other environmental **stimuli**.

4D printing refers to that the shape, property or functionality of 3D printed objects can change over time in response to external stimuli such as water, heat, light, electricity, etc. 4D printing has broad application prospects in many fields such as aerospace, drug delivery, biomedical equipment, and flexible electronic devices, and has been attracting widespread attention. To date, **most of the research on 4D printing involves the shapeshifting of 3D printed materials or structures**.

Statement 2 is correct: 3D Printing is about repeating a 2D structure, layer by layer in a print path, from the bottom to the top, layer by layer until a 3D volume is created. **4D Printing is referred to as 3D printing transforming over time. Thus, a fourth dimension is added: time.** So, the big breakthrough about 4D Printing over 3D Printing technology **is its ability to change shape over time**.

Statement 3 is correct: 4D printing technology uses commercial 3D printers, such as Polyjet 3D printers. **The input is a “smart material”, that can be either a hydrogel or a shape memory polymer.** Thanks to their thermomechanical properties and other material properties, smart materials are given the attributes of shape change and are differentiated from the common 3D printing materials.



Knowledge Base:

Potential Applications of 4D Printing

- 1) Self-repair piping system.
- 2) Self-assembly furniture.
- 3) Medical industry.

Source: <https://www.sculpteo.com/en/3d-learning-hub/best-articles-about-3d-printing/4d-printing-technology/#:~:text=its%20future%20applications,-,What%20is%204D%20Printing%3F,MIT%20Self%2Dassembly%20Lab.>

<https://builtin.com/3d-printing/4d-printing>

Q.15) Consider the following statements with reference to the MSME Competitive Scheme:

1. The scheme is for enterprises to promote lean manufacturing practices.
2. It is an initiative by the Ministry of Commerce.
3. Under this scheme, financial assistance is provided to MSMEs for hiring Lean Manufacturing Consultants.

Which of the above given statements are correct?

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

Ans) c

Exp) Option c is the correct answer.

Recently, Ministry of MSMEs launched the MSME Competitive (LEAN) Scheme to provide a roadmap to global competitiveness for the MSMEs of India.

Statement 1 is correct: The **MSME Competitive (LEAN) Scheme promotes the adoption of lean manufacturing techniques**, which focus on reducing waste, increasing efficiency, and improving product quality.

Statement 2 is incorrect: The **MSME Competitive (LEAN) Scheme is an initiative by the Indian Government's Ministry of Micro, Small and Medium Enterprises** to enhance the competitiveness of these enterprises.

Statement 3 is correct: Under the MSME Competitive (LEAN) Scheme, MSMEs will implement LEAN manufacturing tools like 5S, Kaizen, KANBAN, Visual workplace, Poka Yoka etc under the able guidance of trained and competent LEAN Consultants to attain LEAN levels like Basic, Intermediate and Advanced. **The government will contribute 90% of implementation cost for handholding and consultancy fees.**

Knowledge Base: Lean Manufacturing or Lean Production, known simply as LEAN, is a production practice that considers the expenditure of resources for any goal, other than the creation of value for the end customer, to be wasteful and hence should be eliminated

Source: <https://www.processexcellencenetwork.com/lean-six-sigma-business-performance/articles/what-is-lean>

<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1905561>

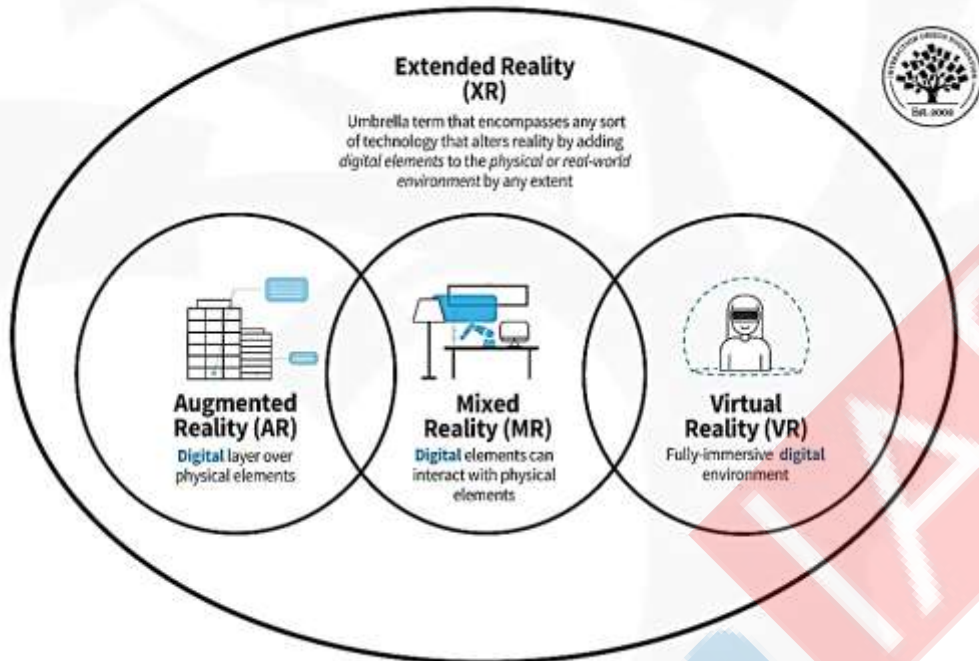
Q.16) “It is an umbrella term for any technology that alters reality by adding digital elements to the physical or real-world environment to an extent. It includes any existing or new technologies that may be created in the future that alter reality, either by blending the digital and the physical world or by creating a fully virtual environment.”

Which of the following options has been described in the above passage?

- a) Augmented Reality
- b) Mixed Reality
- c) Extended Reality
- d) Virtual Reality

Ans) c

Exp) Option c is the correct answer.



Option a is incorrect: In augmented reality, virtual information and objects are overlaid on the real world. This experience enhances the real world with digital details such as images, text, and animation. You can access the experience through AR glasses or via screens, tablets, and smartphones. This means **users are not isolated from the real world and can still interact and see what's going on in front of them**. The most well-known examples of AR are the Snapchat filters that put digital objects such as hats or glasses onto your head.

Option b is incorrect: Mixed reality is a seamless integration of the real world and rendered graphics, which creates an environment in which users can directly interact with the digital and physical worlds together. With MR, real and virtual objects blend, and are presented together within a single display. Users can experience MR environments through a headset, phone or tablet, and can interact with digital objects by moving them around or placing them in the physical world.

Option c is correct: Extended reality (XR) is an umbrella term for any technology that alters reality by adding digital elements to the physical or real-world environment to any extent and includes, but is not limited to, augmented reality (AR), mixed reality (MR) and virtual reality (VR). Therefore, the term extended reality does not refer to any specific technology; it includes any existing or new technologies that may be created in the future that alter reality, either by blending the digital and the physical world or by creating a fully virtual environment.

Option d is incorrect: Virtual reality (VR), the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment. VR applications immerse the user in a computer-generated environment that simulates reality through the use of interactive devices, which send and receive information and are worn as goggles, headsets, gloves, or body suits.

Source: <https://www.interaction-design.org/literature/topics/extended-reality-xr>

<https://blogs.nvidia.com/blog/2022/05/20/what-is-extended-reality/>

<https://www.forbes.com/sites/bernardmarr/2019/08/12/what-is-extended-reality-technology-a-simple-explanation-for-anyone/?sh=2815d6fb7249>

<https://www.britannica.com/technology/virtual-reality>

Q.17) Consider the following statements with reference to Double Asteroid Redirection Test (DART) mission:

1. It is the first-ever space mission to demonstrate asteroid deflection by kinetic impactor.
2. The mission aims to change the orbit of asteroid Bennu.
3. The spacecraft will return to the earth with samples collected from the targeted asteroid.

Which of the statements given above is/are correct?

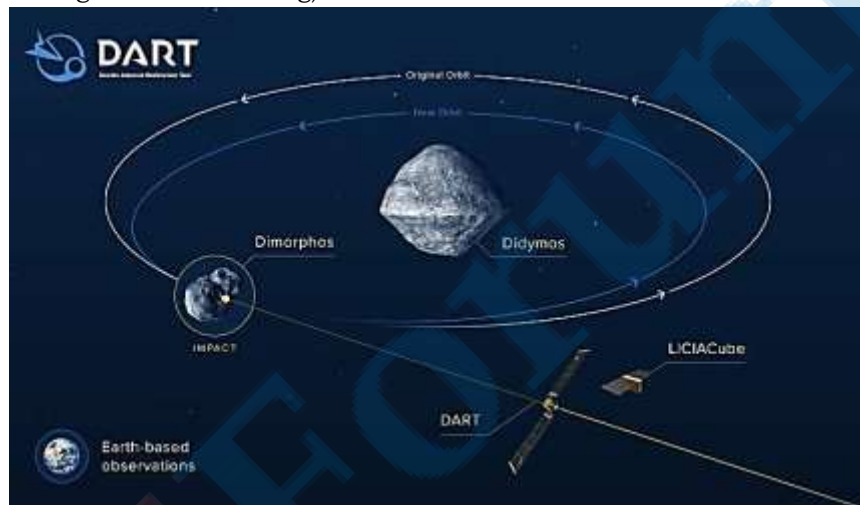
- a) 1 only
- b) 1 and 3 only
- c) 2 and 3 only
- d) 1 and 2 only

Ans) a

Exp) Option a is the correct answer.

NASA's Double Asteroid Redirection Test (DART) mission launched on a SpaceX Falcon 9 rocket from Vandenberg Space Force Base in California successfully impacted its target asteroid, Dimorphos, on Sept. 26, 2022.

Statement 1 is correct: The Double Asteroid Redirection Test (DART) mission is NASA's demonstration of kinetic impactor technology, impacting an asteroid to adjust its speed and path. **DART is the first-ever space mission to demonstrate asteroid deflection by kinetic impactor** (in simplest terms means smashing a thing into another thing).



Statement 2 is incorrect: The DART spacecraft successfully crashed into the asteroid Dimorphos. The impact should have nudged the asteroid slightly and subtly changed its orbit around Didymos, the larger asteroid. While Dimorphos posed no hazard to Earth, DART's successful collision with the asteroid demonstrated one method of asteroid deflection using kinetic impactor technology.

Statement 3 is incorrect: In the mission DART spacecraft was designed to collide with the asteroid Dimorphos to change its orbit. It is a suicide mission, and the spacecraft will be completely destroyed. Thus, the DART spacecraft will not return to the Earth.

Source: <https://www.nasa.gov/press-release/nasa-confirms-dart-mission-impact-changed-asteroid-s-motion-in-space>

<https://dart.jhuapl.edu/Mission/>

<https://indianexpress.com/article/technology/science/nasas-double-asteroid-redirection-test-successful-dart-crashes-into-dimorphos-8174857/>

<https://www.spacefoundation.org/2023/02/08/nasas-double-asteroid-redirection-test-team-2023-space-achievement-award/>

<https://scitechdaily.com/nasas-double-asteroid-redirection-test-dart-mission-receives-space-foundation-achievement-award/>

Q.18) A satellite or spacecraft is most often placed in one of several particular orbits around Earth. In this context, consider the pairs showing various orbits around the earth:

Type of orbit	Mostly used for
1. Geostationary Earth Orbit (GEO)	Telecommunication purposes
2. Sun-Synchronous Orbit (SSO)	To monitor forest fires
3. Low Earth Orbit (LEO)	Satellite imaging
4. Geostationary transfer orbit (GTO)	To transfer satellite from one orbit to another

How many of the above given pairs are correctly matched?

- Only one pair
- Only two pairs
- Only three pairs
- All four pairs

Ans) d

Exp) Option d is the correct answer.

Satellites or spacecraft upon launch are placed in a particular orbit around Earth or sent on an interplanetary journey. The orbit selected depends on what the satellite is designed to achieve. Different types of orbits include Geostationary orbit (GEO), Low Earth orbit (LEO), Medium Earth orbit (MEO), Polar orbit, Sun-synchronous orbit (SSO), Transfer orbits, geostationary transfer orbit (GTO), and Lagrange points (L-points)

Pair 1 is correctly matched: Geostationary Earth Orbit (GEO) is **widely used for telecommunication purposes** because it allows the satellite to remain in a fixed position relative to a point on Earth's surface. It can also be used by weather monitoring satellites, because they can continually observe specific areas to see how weather trends emerge there

Pair 2 is correctly matched: Sun-synchronous orbit (SSO) is a type of polar orbit where a satellite travels over the polar regions and is synchronous with the Sun. This is useful for monitoring areas, taking series of images to investigate weather patterns, predict storms, monitor emergencies such as forest fires or flooding, and accumulate data on long-term problems like deforestation or rising sea levels.

Pair 3 is correctly matched: Low Earth Orbit (LEO) is a close proximity orbit commonly used for satellite imaging and is also used for the International Space Station (ISS) due to the ease of travel for astronauts. However, LEO satellites are less useful for telecommunication tasks as they move too fast across the sky and require significant effort to track from ground stations.

Pair 4 is correctly matched: Geo Transfer orbits (GTO) are a type of orbit that is used to move a satellite or spacecraft from one orbit to another. Satellites launched into space are often placed on a transfer orbit to reach their final orbit using built-in motors and relatively little energy.

Source: https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits

Q.19) Which of the following statements is/are correct about PARAM PORUL, a supercomputer dedicated to the nation under National Supercomputing Mission (NSM)?

- It is a part of joint initiative of Ministry of Electronics and Information Technology (MeitY) and Department of Science and Technology (DST).

2. It is equipped with Direct Contact Liquid Cooling technology.
3. It was inaugurated at the Indian Institute of Science (IISc), Bangalore

Select the correct answer from the code given below:

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

Ans) a

Exp) Option a is the correct answer.

PARAM PORUL is a state-of-the-art supercomputer inaugurated on May 25, 2022, at NIT Tiruchirappalli under the National Supercomputing Mission. The facility has an 838 TeraFlops computing capacity and is equipped with a mix of CPU nodes, GPU nodes, High Memory nodes, High throughput storage, and high-performance Infiniband interconnect.

Statement 1 is correct: PARAM PORUL is a supercomputer dedicated to the nation under the National Supercomputing Mission (NSM), which is a joint initiative of Ministry of Electronics and Information Technology (MeitY) and Department of Science and Technology (DST).

Statement 2 is correct: PARAM PORUL is equipped with Direct Contact Liquid Cooling technology to obtain a high-power usage effectiveness and thereby reducing the operational cost.

Statement 3 is incorrect: PARAM PORUL was not inaugurated at IISc Bangalore. It was inaugurated at NIT Tiruchirappalli.

Knowledge Base:

Direct Contact Liquid Cooling (DCLC) is a cooling technology that uses a liquid coolant, typically water, to directly cool a hot surface, such as a computer chip or server processor. In DCLC, the coolant comes into direct contact with the hot surface, allowing for efficient heat transfer and dissipation. This technology is commonly used in high-performance computing (HPC) applications, such as PARAM PORUL, as it provides a more effective and energy-efficient cooling solution than traditional air-based cooling systems.

Source: <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1828171>

Q.20) Consider the following statements with reference to the Asia Energy Transition Initiative:

1. It is a China-led project aimed at promoting clean energy.
2. The key objective of the initiative is to achieve carbon neutrality in Asia.

Which of the above-given statements is/are correct?

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

Ans) b

Exp) Option b is the correct answer

Japan is eager to assist India in its clean energy transition by incorporating the country into the Asia Energy Transition Initiative (AETI).

Statement 1 is incorrect: The **Asia Energy Transition Initiative is a Japan-led project** aimed at promoting clean and sustainable energy alternatives in the Asia-Pacific region.

Statement 2 is correct: The initiative is initially targeted to supporting countries in the Association of South East Asian Nations (ASEAN) pushing toward net-zero carbon emissions. The **aim is to achieve both sustainable growth and carbon neutrality in Asia.**

Source: <https://www.downtoearth.org.in/news/world/india-japan-to-improve-bilateral-cooperation-towards-clean-energy-transition-88029>

Q.21) Which of the following statements is/are correct about Generative Artificial Intelligence (AI)?

1. It is a subset of artificial intelligence that generate new outputs based on the data they have been trained on.
2. Generative AI uses a type of deep learning called generative adversarial networks (GANs) to create new content.

Select the correct code from the options below:

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

Ans) c

Exp) Option c is the correct answer.

Generative artificial intelligence (AI) describes algorithms (such as ChatGPT) that can be used to create new content, including audio, code, images, text, simulations, and videos. Recent breakthroughs in the field have the potential to drastically change the way we approach content creation.

Statement 1 is correct: Generative artificial intelligence (AI) is a subset of AI that uses machine learning algorithms to generate new data based on existing data inputs.

Statement 2 is correct: Generative AI uses a type of deep learning called generative adversarial networks (GANs) to create new content. A GAN consists of two neural networks: a generator that creates new data and a discriminator that evaluates the data. The generator and discriminator work together, with the generator improving its outputs based on the feedback it receives from the discriminator until it generates content that is indistinguishable from real data.

Source: <https://www.weforum.org/agenda/2023/02/generative-ai-explain-algorithms-work/>

<https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-generative-ai>

<https://www.techtarget.com/searchenterpriseai/definition/generative-AI>

Q.22) With reference to Radio Access Network (RAN), Consider the following statements:

1. RAN is used for connecting end user devices to core network.
2. The demand for RAN will decline due to the emergence of 5G technology.

Which of the following statements is/are correct?

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

Ans) a

Exp) Option a is the correct answer.

Radio Access Networks (RANs) are essential components of telecommunications networks that connect end-user devices to the core network. They are crucial for network operators as they represent significant overall network expenses, perform intensive and complex processing.

Statement 1 is correct: RAN (Radio Access Network) is a component in a telecommunications system that connects end user devices (such as mobile phones) to the core network through radio access links.

Statement 2 is incorrect: The demand for RAN is increasing with the emergence of 5G technology as it requires more RAN infrastructure to provide the promised high-speed and low latency connectivity.

Source: <https://www.redhat.com/en/topics/5g-networks/what-is-radio-access-network>

<https://www.techtarget.com/searchnetworking/definition/radio-access-network-RAN>

Q.23) Which of the following countries participated in Sea Dragon 23 military exercise?

1. United States of America
2. Japan
3. Australia
4. India
5. Canada

Select the correct code from given below:

- a) 1 and 2 only
- b) 2, 3 and 4 only
- c) 1, 2, 4 and 5 only
- d) 1, 2, 3, 4, and 5

Ans) c

Exp) Option c is the correct answer.

The Sea Dragon 23 exercise, a combined anti-submarine warfare training, featured five Indo-Pacific nations, including **the US, Canada, Japan, India, and the Republic of Korea**. The program involved more than 270 hours of in-flight training and exchange of tactics, techniques, and procedures among participants. The exercise is significant in light of the deteriorating regional maritime security environment, particularly around the South and East China Seas.

Source: <https://foreignbrief.com/daily-news/sea-dragon-23-anti-submarine-military-exercise-concludes/>

Q.24) Which of the following statements about Directed Energy Weapons (DEWs) and Hypersonic Weapons are correct?

1. DEWs use directed energy in the form of laser, microwave, or particle beams to destroy targets.
2. DEW are much cheaper to produce when compared with traditional kinetic weapons.
3. Hypersonic weapons travel at speeds greater than Mach 5.
4. Hypersonic cruise weapons have fixed trajectories and limited manoeuvrability.

Select the correct answer using the code given below:

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

Ans) a

Exp) Option a is the correct answer.

DEWs are a ranged weapon that damages its target with highly focused energy without a solid projectile, including lasers, microwaves, particle beams and sound beams. Hypersonic weapons are weapons capable of travelling at hypersonic speed, defined as between five and 25 times the speed of sound.

Statement 1 is correct: DEWs use directed energy in the form of laser, microwave, or particle beams to destroy targets. These weapons are designed to damage or destroy targets by emitting highly focused energy in the form of lasers, microwaves, or particle beams.

Statement 2 is incorrect: DEWs can be expensive to produce and maintain compared with traditional kinetic weapons as they require complex and advanced technology.

Statement 3 is correct: Hypersonic weapons are weapons that can travel at speeds of Mach 5 to Mach 10, which is five to ten times the speed of sound. These weapons can be used to strike targets with high precision and at long ranges.

Statement 4 is incorrect: Hypersonic cruise weapons are highly manoeuvrable and able to change course during flight. They are different from ballistic missiles, which can also travel at hypersonic speeds (of at least Mach 5) but have set trajectories and limited manoeuvrability.

Source: <https://theprint.in/india/defence-industry-should-work-on-directed-energy-hypersonic-weapons-iaf-chief/1461852/> <https://www.indiatimes.com/explainers/news/explained-what-are-directed-energy-weapons-and-hypersonic-weapons-597340.html> <https://www.voanews.com/a/what-are-hypersonic-weapons-and-who-has-them-/6492459.html>
<https://www.prnewswire.com/news-releases/global-directed-energy-weapons-dew-market-sizeshare-estimated-to-reach-usd-22-10-billion-by-2032--at-9-2-cagr-growth-polaris-market-research-301793284.html>

Q.25) Consider the following statements with reference to the Suspension of Operation (SoO) agreement, seen in the news recently:

1. It is a pact between the Indian government, the Assam state government, and various armed insurgent groups.
2. The pact was first signed in 2008 to initiate a political dialogue with the insurgent groups.
3. As per the agreement, the government forces would not launch any operations against insurgent groups.

Which of the above given statements are correct?

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

Ans) b

Exp) Option b is the correct answer.

Statement 1 is incorrect: The **Suspension of Operation (SoO) agreement is a pact between the Indian government, the Manipur state government,** and various armed insurgent groups in Manipur.

Statement 2 is correct: The agreement aims to maintain peace and pave the way for negotiations, providing an opportunity for these groups to join the political mainstream. **Signed in 2008, the SoO has been extended periodically, with the most recent extension in 2021, and covers 25 Kuki and Zomi armed groups.** In February 2023, the Manipur government decided to withdraw from the SoO agreement, citing violations and a lack of commitment from the armed groups.

Statement 3 is correct: The important terms under the pact are that security forces, including state and central forces, are not to launch any operations, nor can the underground groups.

The signatories of United People's Front (UPF) and Kuki National Organisation (KNO) shall abide by the Constitution of India, the laws of the land and the territorial integrity of Manipur. They are prohibited from committing all kinds of atrocities, extortion, among others. The agreement's primary goal is to establish and maintain peace by suspending armed hostilities between the parties involved.

Source: <https://indianexpress.com/article/explained/explained-politics/what-is-the-soo-agreement-manipur-govt-withdrew-from-8494829/>

Q.26) With reference to Solid Fuel Ducted Ramjet (SFDR) booster, consider the following statements:

1. It has been developed by Defense Research and Development Organization (DRDO)
2. It enables the missiles to intercept aerial threats.
3. It can help in developing long range air to air missiles.

Which of the above given statements are correct?

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

Ans) d

Exp) Option d is the correct answer.

Defense Research and Development Organization (DRDO) successfully flight tested Solid Fuel Ducted Ramjet (SFDR) booster at the Integrated Test Range (ITR), Chandipur off the coast of Odisha on April 08, 2022. The test successfully demonstrated the reliable functioning of all critical components involved in the complex missile system and met all the mission objectives.

Statement 1 is correct: The SFDR has been developed by Defense Research and Development Laboratory, Hyderabad in collaboration with other DRDO laboratories such as Research Centre Imarat, Hyderabad and High Energy Materials Research Laboratory, Pune.

Statement 2 is correct: Solid Fuel Ducted Ramjet (SFDR) booster enables the missiles to intercept aerial threats at very long range at supersonic speeds.

Statement 3 is correct: It will provide DRDO with a technological advantage that will enable it to develop long-range air-to-air missiles. At present, such technology is available only with a handful of countries in the world.

Source: <https://pib.gov.in/PressReleasePage.aspx?PRID=1814813>

Q.27) Which of the following statements about the Pralay missile are correct?

1. It is India's first tactical quasi-cruise missile.
2. It was developed as a derivative of the Prahaar missile program.
3. It has a range of 150-500 kilometres.

Select the correct answer using the code given below:

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

Ans) b

Exp) Option b is the correct answer.

India's Defense Ministry has approved the indigenous short-range ballistic surface-to-surface missile, Pralay, which will provide Indian military the ability to strike enemy positions and key installations in actual battlefield areas.

Statement 1 is incorrect: Pralay is India's first tactical quasi-ballistic missile (not a quasi-cruise) missile that has been developed by India and is capable of evading interceptor missiles.

Statement 2 is correct: It is derived from the Prahaar missile program, which was first tested in 2011, and has been developed according to the specifications and requirements of the Indian Army.

Statement 3 is correct: One of the key features of the Pralay missile is its range. It has a range of 150-500 kilometers, which makes it a potent weapon for the Indian military. In addition to its range, the missile is also capable of carrying a conventional warhead of about 350 kg to 700 kg, which makes it highly effective in combat situations.

Source: <https://theprint.in/defence/pralay-indias-first-tactical-quasi-ballistic-missile-a-step-towards-own-rocket-force/1283224/>

Q.28) Which of the following statements about Kamikaze Drones are correct?

1. They are unmanned aerial vehicles that are designed to collide with their target.
2. They are also known as Loitering Munitions.
3. Kamikaze drones are much more expensive than cruise missile.

Select the correct code from the following:

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

Ans) a

Exp) Option a is the correct answer.

Kamikaze drones are unmanned aerial vehicles (UAVs) that are designed to crash into a target, effectively becoming a suicide weapon. In recent years, there has been an increase in the use of kamikaze drones in conflicts, including in the ongoing war between Russia and Ukraine.

Statement 1 is correct: Kamikaze drones, also known as suicide drones, are unmanned aerial vehicles (UAVs) that are designed to collide with their targets. They are equipped with explosive warheads and can be remotely operated or pre-programmed to fly to a specific target.

Statement 2 is correct: Kamikaze drones are also known as loitering munitions. This is because they can fly around an area for an extended period of time, waiting for a target to appear. They are equipped with sensors that allow them to identify and track targets, and can be directed to attack specific targets.

Statement 3 is incorrect: Kamikaze drones are typically smaller and cheaper than traditional cruise missiles, and are often built from off-the-shelf commercial drones. They can be equipped with explosives or other types of payloads, and can be remotely controlled or programmed to autonomously seek out and attack a target.

Source: <https://timesofindia.indiatimes.com/world/rest-of-world/what-are-kamikaze-drones-the-new-worry-for-ukraine-in-defending-against-russia/articleshow/94912735.cms>

<https://indianexpress.com/article/explained/everyday-explainers/kamikaze-drones-russia-ukraine-war-explained-8209717/>

Q.29) Which of the following statements about GSAT 7 series satellites are **incorrect**?

1. They are remote sensing satellites.
2. GSAT-7A is primarily designed for use by the Indian Army.
3. They are inducted into the Low Earth orbit (LEO)

Select the correct answer using the code given below:

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

Ans) d

Exp) Option d is the correct answer.

GSAT-7 is a communication satellite designed by ISRO to provide a wide range of communication services, including low bit rate voice and high bit rate data communication. It is intended to serve a vast oceanic region as well as the Indian land-mass. The satellite's payload is compatible with ISRO's I-2.5K bus and features a multiband communication configuration.

Statement 1 is incorrect: The GSAT 7 series satellites are communication satellites, specifically designed to provide secure and real-time communication to the Indian armed forces, particularly the Indian Navy.

Statement 2 is incorrect: While the GSAT 7 series of satellites are primarily used by the Indian Navy, **GSAT-7A** is actually designed for use by the Indian Air Force (IAF) and provides secure and reliable communication to the IAF's airborne early warning and control (AEW&C) system. **GSAT 7B, which is yet to be launched is for primary use of Indian Army.**

Statement 3 is incorrect: They are placed into a geosynchronous orbit (not LEO), around 36,000 km above Earth.

Source: https://www.isro.gov.in/GSAT_7.html <https://timesofindia.indiatimes.com/india/after-navy-iaf-army-to-get-dedicated-satellite-gsat-7b-as-mod-inks-rs-3k-cr-deal-with-nsil/articleshow/99129740.cms?from=mdr> <https://indianexpress.com/article/explained/explained-the-gsat-7b-and-indias-other-military-satellites-7834659/>

Q.30) Consider the following statements with reference to the Erythritol:

1. Erythritol is used as a sugar substitute in food and beverages due to its low-calorie content.
2. One of the challenges of Erythritol is that it raises blood sugar levels.

Which of the above given statements is/are correct?

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

Ans) a

Exp) Option a is the correct answer.

According to recent research, Erythritol, a popular artificial sweetener, is associated with an increased risk of heart attack and stroke.

Statement 1 is correct: Erythritol is a sugar alcohol (or polyol) that is used as a sugar substitute in food and beverages due to its sweet taste and low-calorie content. It is naturally occurring in small amounts in certain fruits and fermented foods, but most commercial erythritol is produced by fermenting glucose with the help of specific yeast or fungi.

Statement 2 is incorrect: Erythritol has about 70% of the sweetness of table sugar (sucrose) and has a glycemic index of zero, which means it does not raise blood sugar levels. Additionally, it has minimal impact on insulin levels, making it a popular choice for people with diabetes or those following low-carb diets. Erythritol is also non-cariogenic, meaning it does not contribute to tooth decay.

Source: <https://www.naturallysweet.com.au/glycemic-index>

<https://www.healthline.com/nutrition/erythritol>

Q.31) Consider the following statements about Imaging X-ray Polarimetry Explorer, often seen in news:

1. It will study the polarization of X-rays from different types of celestial objects.
2. It is a joint initiative of NASA and Japan Aerospace Exploration agency (JAXA).
3. It is the first X-ray observatory to be launched in space.

Which of the statements given above is/are correct?

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

Ans) b

Exp) Option b is the correct answer.

NASA's Imaging X-ray Polarimetry Explorer, or IXPE, is a space observatory built to discover the secrets of some of the most extreme objects in the universe – the remnants of supernova explosions, powerful particle streams spit out by feeding black holes, and more.

Statement 1 is correct: IXPE is NASA's first mission to study the polarization of X-rays from many different types of celestial objects. Measuring the polarization of X-rays traces the story of where this light came from, including the geometry and inner workings of its source.

Statement 2 is incorrect: IXPE is an international collaboration between NASA and the Italian Space Agency (and not JAXA). Hundreds of engineers and scientists from more than 12 countries worked together to make IXPE a reality.

Statement 3 is incorrect: IXPE is not the first X ray observatory/telescope. There have been several earlier space telescopes and observatories like, Chandra X-ray observatory, XMM-Newton (European Space Agency's X-ray observatory).

Knowledge Base:

IXPE carries three identical telescopes. Each telescope includes a set of cylindrical mirrors, or optics, and a sensitive detector. The mirrors collect X-rays from celestial objects and focus them onto the detectors, which make an image of the incoming X-rays and measure the polarization. All three mirror sets are separated from their corresponding detectors by a deployable 12-foot (3.7-meter) boom.

IXPE builds on the discoveries of NASA's Chandra X-ray Observatory and other space telescopes by measuring the amount and direction of polarization of X-ray light. IXPE's polarization measurements will help scientists answer questions such as:

- 1) How do black holes spin?
- 2) Was the black hole at center of the Milky Way actively feeding on surrounding material in the past?
- 3) How do pulsars shine so brightly in X-rays?
- 4) What powers the jets of energetic particles that are ejected from the region around the supermassive black holes at the centers of galaxies?

Source: https://www.nasa.gov/mission_pages/ixpe/overview.html

Q.32) In the context of Dark Sky Reserves, recently seen in news, consider the following statements.

1. It is an area where light pollution is monitored, to allow better observation of sky at night.
2. A Dark Sky Reserve is to be set up at Hanle in Ladakh.
3. Currently, no Indian site has been certified as International Dark Sky Reserve by International Dark Sky Reserve Association (IDA).

Which of the statements given above are correct?

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

Ans) d

Exp) Option d is the correct answer.

A dark-sky preserve (DSP) is an area, usually surrounding a park or observatory that is kept free of artificial light pollution. The purpose of a dark sky preserve is generally to promote astronomy.

Statement 1 is correct: A dark sky reserve is an area where light pollution is monitored. Basically, there are several restrictions around the reserve where humans are not allowed to have any loud source of light. So, it allows better observation of skies at night for astronomy.

Statement 2 is correct: Recently, in a first-of-its-kind initiative, the Department of Science & Technology (DST) has announced the setting up of India's first Dark Sky Reserve in Hanle, Ladakh. Hanle,

which is about 4,500 metres above sea level, hosts telescopes and is regarded as one of the world's most optimal sites for astronomical observations.

Statement 3 is correct: The International Dark Sky Association (IDA) is a U.S.-based non-profit that designates places as International Dark Sky Places, Parks, Sanctuaries and Reserves, depending on the criteria they meet. Currently no Indian site is certified by IDA as an International Dark Sky Reserve.

Knowledge Base: The Indian Astronomical Observatory at Hanle also houses several telescopes like, the Himalayan Chandra Telescope (HCT), High Energy Gamma Ray telescope (HAGAR), the Major Atmospheric Cherenkov Experiment Telescope (MACE), GROWTH-India, etc.

Source: <https://www.iap.res.in/?q=iao.htm>

<https://timesofindia.indiatimes.com/travel/travel-news/ladakhs-hanle-is-indias-first-dark-sky-reserve/articleshow/96267024.cms>

<https://www.thehindu.com/sci-tech/science/india-to-have-first-astronomy-dark-reserve-in-ladakh/article65849890.ece#:~:text=In%20a%20first-of-its-kind%20initiative%2C%20the%20Department%20of%20Science,the%20world%E2%80%99s%20most%20Optimal%20sites%20for%20astronomical%20observations.>

<https://www.darksky.org/our-work/conservation/idsp/reserves/>

Q.33) A joint international collaboration led by NASA launched the James Webb Space Telescope, which is the world's largest, most powerful, and most complex space science telescope ever built. Since its launch it has amazed astronomy community with its observations and space images. In this context, which of the following observations have been made by the James Webb Space Telescope?

1. It has observed the Pillars of Creation, where new stars are forming within dense clouds of gas and dust.
2. It spotted a set of concentric rings around a giant, distant star WR140.
3. It observed colourful auroras and massive storms on the planet Jupiter.
4. It captured an image of Einstein Ring in space.

Select the correct answer from the codes given below.

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

Ans) d

Exp) Option d is the correct answer.

The James Webb Space Telescope is the world's largest, most powerful, and most complex space science telescope ever built. Webb will solve mysteries in our solar system, look beyond to distant worlds around other stars, and probe the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency. It made several astonishing observations in the recent times.

Option 1 is correct: It has captured a lush, highly detailed landscape – the iconic Pillars of Creation – where new stars are forming within dense clouds of gas and dust. The three-dimensional pillars look like majestic rock formations, but are far more permeable. These columns are made up of cool interstellar gas and dust that appear – at times – semi-transparent in near-infrared light.



Image on right by the Hubble telescope and on left by the James Webb telescope.

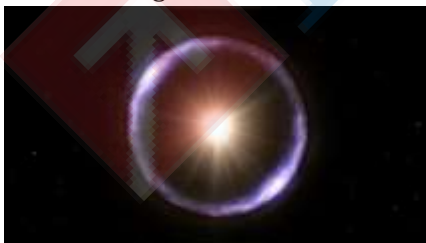
Option 2 is correct: The James Webb Space Telescope spotted a set of concentric angular rings around a giant, distant star, recently. A new study shows that, the first visible evidence of starlight pushing dust around, and exhibits the strange environment of the star WR140, which is in fact a system of two stars that orbit each other.



Option 3 is correct: The new images clicked by the observatory has presented Jupiter's massive storms, colourful auroras and faint rings.



Option 4 is correct: It has snapped a perfect shot of an "Einstein ring." The stunning halo is the result of light from a distant galaxy passing through warped space-time surrounding another galaxy aligned between the distant light source and Earth.



Source: <https://www.space.com/news/live/james-webb-space-telescope-updates>

<https://www.nasa.gov/feature/goddard/2022/nasa-s-webb-takes-star-filled-portrait-of-pillars-of-creation>

<https://webb.nasa.gov/index.html>

Q.34) Consider the following statements about Geomagnetic Storm, a natural phenomenon:

1. A geomagnetic storm is a disturbance of the Earth's magnetic field caused by solar emission like Coronal Mass Ejections.
2. A Geomagnetic storm can lead to the occurrence of high-rise tsunamis on Earth.
3. The severity of geomagnetic storms is ranked by the World Meteorological Organization.

Which of the statements given above is/are correct?

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

Ans) b

Exp) Option b is the correct answer.

A geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth. These storms result from variations in the solar wind that produces major changes in the currents, plasmas, and fields in Earth's magnetosphere.

Statement 1 is correct: According to NASA, a geomagnetic storm refers to the disruptions to the Earth's magnetic field caused by solar emissions. When a Coronal Mass Ejection (CME) or a high-speed solar stream reaches our planet, it slams into the magnetosphere. The Earth's magnetosphere is created by our magnetic fields, and it usually protects us from the particles emitted by the Sun.

Statement 2 is incorrect: According to the National Oceanic and Atmospheric Administration (NOAA), a Geomagnetic storm or a solar storm does not directly lead to occurrence of tsunamis on the Earth. For a tsunami to be unleashed on Earth, there has to be an earthquake rumbling below the ocean floor that displaces water and generates a colossal, ultra-fast wave through the entire water column.

Statement 3 is incorrect: The severity of geomagnetic storms is NOT ranked by the World Meteorological Organization. Rather, the National Oceanic and Atmospheric Administration (NOAA) Geomagnetic Storm Scale indicates the severity of geomagnetic storms. It is denoted by a G followed by a number from 1 to 5, with 1 being a minor event, and 5 being an extreme event. NOAA is a US government agency.

Source : <https://indianexpress.com/article/technology/science/severe-geomagnetic-solar-storm-8517938/>

<https://www.swpc.noaa.gov/phenomena/geomagnetic-storms>

<https://www.livescience.com/can-solar-storms-cause-tsunamis>

Q.35) Consider the following statements with reference to the Vernal Equinox:

1. The Vernal Equinox marks the beginning of spring in the Southern Hemisphere.
2. In the Northern Hemisphere, the vernal equinox corresponds to the beginning of autumn.
3. During the vernal equinox, the Sun is positioned directly above the Earth's equator.

Which of the above given statements is/are correct?

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

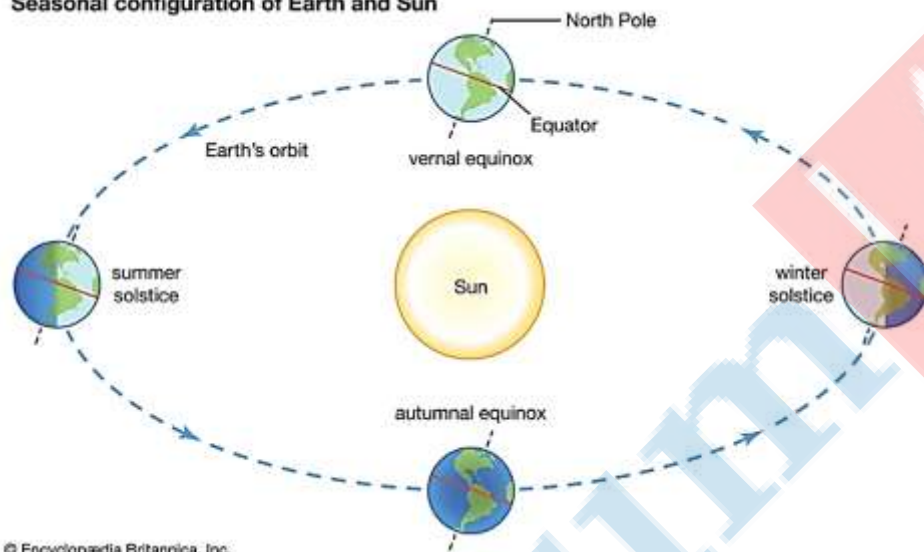
Ans) b

Exp) Option b is the correct answer.

Statements 1 and 2 are incorrect: A vernal equinox is an astronomical event that marks the beginning of spring in the Northern Hemisphere. It occurs around March 20th or 21st each year, when the tilt of Earth's axis is neither toward nor away from the Sun. In the Southern Hemisphere, the vernal equinox corresponds to the beginning of autumn, as the seasons are reversed. In this case, the event is referred to as the autumnal equinox and occurs around September 22nd or 23rd each year.

Statement 3 is correct: During the vernal equinox, the Sun is positioned directly above the Earth's equator. As a result both hemispheres receive an almost equal amount of sunlight. After the spring equinox, the northern hemisphere tilts closer to the sun in March, resulting in more hours of daylight, with earlier sunrises and later sunsets.

Seasonal configuration of Earth and Sun



© Encyclopædia Britannica, Inc.

Source:

[https://www.weather.gov/cle/Seasons#:~:text=The%20Equinox%20\(Vernal%20%26%20Autumnal\)&text=These%20events%20are%20referred%20to,noon%20on%20these%20two%20equinoxes.](https://www.weather.gov/cle/Seasons#:~:text=The%20Equinox%20(Vernal%20%26%20Autumnal)&text=These%20events%20are%20referred%20to,noon%20on%20these%20two%20equinoxes.)

Q.36) Which of the statements given below is correct with reference to Cruise missiles and Ballistic missiles?

- Unlike a Cruise Missile, the flight path of Ballistic Missile is within the atmosphere.
- Compared to Cruise missiles, the payload capacity is much limited in case of Ballistic missiles.
- Both ballistic missiles and cruise missiles can be launched from aircraft, ships, and submarines.
- Prithvi is a Cruise missile while Nirbhay is a Ballistic missile.

Ans) c

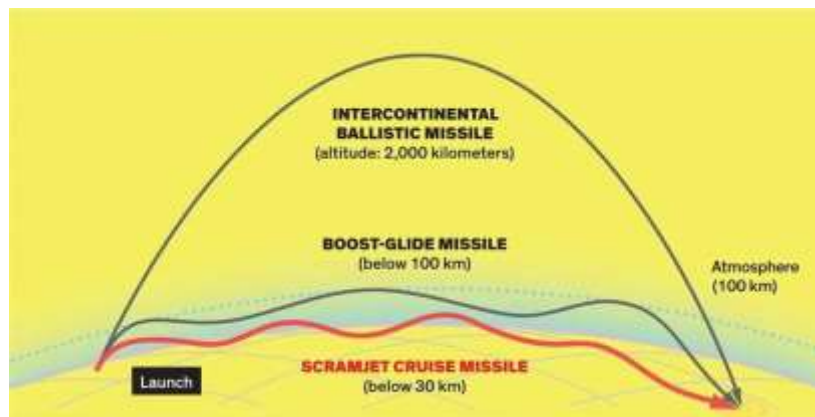
Exp) Option c is the correct answer.

Missile is a weapon that is self-propelled or directed by remote control, carrying conventional or nuclear explosive. There are two major types of Missiles- Ballistic and Cruise.

Any missile is called **Ballistic** when the trajectory it follows is ballistic.

A ballistic trajectory is the path of any object that is launched but with no active propulsion during its actual flight. Thus, in such missiles the trajectory has to be fully determined by a given initial velocity, effects of gravity, air resistance and earth's motion.

Cruise Missile is a guided missile where the target is pre-set. It is basically used against terrestrial targets. Such missiles are designed to deliver a large warhead over long distances with high precision.



Option a is incorrect. Cruise missile flies with in earth's atmosphere and use jet engine technology. Cruise missiles are known specifically for low-level flight which is staying relatively close to the surface of the earth to avoid detection from anti-missile systems. Ballistic missile travels well outside earth's atmosphere. They are launched directly into the upper layers of the earth's atmosphere. They travel outside the atmosphere, where the warhead detaches from the missile and falls towards a predetermined target.

Option b is incorrect. Payload capacity is limited in Cruise missiles. Cruise missile usually carries a single payload while Ballistic missiles can carry more than one payload (Multiple Independently targetable Re-entry Vehicle). Ballistic missile can carry huge payload. For instance, Dongfeng-41 (DF-41) is China's ICBM which have a maximum payload capacity of 2,500 kg.

Option c is correct. Both ballistic missiles and cruise missiles can be launched from aircraft, ships, and submarines in addition to land-based silos and mobile platforms. An advanced variant of BrahMos missile with indigenous sub-systems was test-fired from the Integrated Test Range off Odisha coast in January. A joint venture of India-Russia, the supersonic cruise missile can be launched from all platforms - land, aircraft, ships and submarines.

Option d is incorrect. Prithvi, Agni, Dhanush range missiles are Ballistic while BrahMos and Nirbhay missiles are cruise missiles.

Prithvi is India's first indigenously developed ballistic missile under IGMDFP.

It is a short-range ballistic missile (SRBM) with a single-stage, two engines, and liquid-fuel propulsion. The Prithvi missile project has three versions for the Indian Army, Air Force, and Navy to use. Prithvi I, Prithvi II, and Prithvi III are the three variants of the Prithvi missile series that have been developed.

Source: <https://www.britannica.com/technology/missile#ref264829>

<https://www.19fortyfive.com/2022/01/crusie-missiles-vs-ballistic-missiles-whats-the-difference/>

<https://science.howstuffworks.com/difference-ballistic-cruise-missile.htm>

<https://armscontrolcenter.org/wp-content/uploads/2017/04/Ballistic-vs.-Cruise-Missiles-Fact-Sheet.pdf>

Q.37) Consider the following statements about NISAR satellite, recently seen in news:

1. It is a Low Earth Orbit (LEO) observatory designed to map the entire globe in 12 days.
2. It is a collaboration mission between Indian Space and Research Organisation (ISRO) and European Space Agency (ESA).
3. It will be launched by GSLV expendable launch vehicle of ISRO.

Which of the statements given above is/are correct?

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

Ans) d

Exp) Option d is the correct answer.

NISAR is a joint Earth-observing mission between NASA and the Indian Space Research Organization (ISRO) with the goal to make global measurements of the causes and consequences of land surface changes using advanced radar imaging.

Statement 1 is correct: NASA-ISRO SAR (NISAR) is a Low Earth Orbit (LEO) observatory which will map the entire globe in 12 days and provide spatially and temporally consistent data for understanding changes in Earth's ecosystems, ice mass, vegetation biomass, sea level rise, ground water and natural hazards including earthquakes, tsunamis, volcanoes and landslides.

It carries L and S dual band Synthetic Aperture Radar (SAR), which operates with Sweep SAR technique to achieve large swath with high resolution data. The SAR payloads mounted on Integrated Radar Instrument Structure (IRIS) and the spacecraft bus are together called an observatory.

Statement 2 is incorrect: NISAR is a joint Earth-observing mission between the Indian Space Research Organization (ISRO) and NASA (and not ESA). NASA and ISRO signed a partnership to collaborate and launch NISAR on Sept. 30, 2014. The mission is targeted to launch in 2024. NASA is providing the mission's L-band synthetic aperture radar, a high-rate communication subsystem for science data, GPS receivers, a solid-state recorder and payload data subsystem. ISRO is providing the spacecraft bus, the S-band radar, the launch vehicle and associated launch services.

Statement 3 is correct: The NISAR Observatory will be launched from Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota on the southeast coast of the Indian peninsula, on the GSLV expendable launch vehicle contributed by ISRO. The target launch readiness date is January 2024.

Source: <https://www.isro.gov.in/NISARSatellite.html>

<https://nisar.jpl.nasa.gov/mission/isro-partnership/>

<https://www.thehindu.com/news/national/nisar-satellite-to-map-himalayas-seismic-zones/article66738274.ece>

Q.38) Consider the following statements about Sounding Rockets, often seen in news:

1. Sounding rockets are used to test/probe new components or subsystems to be used in actual satellite or launch systems.
2. Currently, Sounding Rockets utilise mixed both solid and liquid propellant in propulsion systems.
3. Recently, India has launched its first indigenous sounding rocket.
4. RH-200 is a sounding rocket belonging to Rohini series of rockets.

Which of the statements given above are correct?

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

Ans) a

Exp) Option a is the correct answer.

Space activities in the country started during early 1960s with the scientific investigation of upper atmosphere and ionosphere over the geo magnetic equator that passes over Thumba near Thiruvananthapuram, using small sounding rockets.

Statement 1 is correct: Sounding rockets are used for probing the upper atmospheric regions and for space research. They also serve as easily affordable platforms to test or prove prototypes of new components or subsystems intended for use in launch vehicles and satellites.

Statement 2 is incorrect: Presently Sounding rockets are single to multistage solid propellant rockets (and not mixed propellant rockets). Unlike GSLVs, the Sounding rockets only have solid propellant

propulsion system. Sounding rockets take their name from the nautical term "to sound," which means to take measurements.

Statement 3 is incorrect: The Indian Space Programme began with the launch of the first sounding rocket from Thumba near Thiruvananthapuram, Kerala on 21 November 1963. The first rockets were two-stage rockets imported from Russia (M-100) and France (Centaure). **ISRO started launching indigenously made sounding rockets from 1965.**

Statement 4 is correct: ISRO has developed a series of sounding rockets called Rohini series, important among them being RH-200, RH-300 and RH-560, number in the name indicating the diameter of the rocket in mm. 1545 RH-200 rockets have been launched so far (as of 27 Feb 2023).

Source:

<https://www.isro.gov.in/soundingRockets.html#:~:text=Sounding%20rockets%20are%20one%20or,in%20launch%20vehicles%20and%20satellites>.

https://www.isro.gov.in/100TH_SoundingRockets.html#:~:text=1545%20RH%2D200%20rockets%20have%20been%20launched%20so%20far.

Q.39) Which of the following statements best explain the term 'Quaoar', recently seen in news?

- It is a distant nebula observed by the Hubble space telescope.
- It is a minor planet observed in the Kuiper belt.
- It is a Quantum resistant cryptocurrency.
- It is a newly developed Quantum key distribution technology for Secure Communications.

Ans) b

Exp) Option b is the correct answer.

Astronomers have recently spotted a ring around a Pluto-sized minor planet called Quaoar in the outer reaches of the solar system. It is located in the Kuiper belt, at the edge of our solar system. Quaoar (named after a god of creation in Native American mythology) has a moon of its own, which is known as Weywot. The rings of the planet are positioned at a distance of over seven planetary radii (distance between a planet's centre and its surface) which is much further away from other planets that possess rings.

According to the study, the ring lies far away from the Roche limit – a mathematically determined distance beyond which rings aren't supposed to exist. Planetary rings possess small chunks of ice and other materials that orbit a larger object. Only Saturn, Jupiter, Uranus and Neptune, including two other minor planets, Chariklo and Haumea, are known to possess rings.

Many astronomers and space agencies like ESA (European Space Agency) have recognised it as a dwarf planet. However, International Astronomical Union (IAU) is yet to recognize it as a dwarf planet. According to IAU, a dwarf planet is an object in orbit around the Sun that is large enough to pull itself into a nearly round shape but has not been able to clear its orbit of debris. Aside from Pluto, there are four currently recognised dwarf planets in our Solar System: Ceres, Haumea, Makemake and Eris.

Source: <https://www.thehindu.com/sci-tech/science/astronomers-astonished-by-ring-around-frigid-distant-world-quaoar/article66488828.ece>

<https://www.iau.org/public/themes/pluto/#n6>

Q.40) A term 'MoMo Pregnancy' was recently seen in news. Which one of the following options correctly describes its meaning?

- This type of pregnancy occurs when the twins share the same placenta, amniotic sac and fluid but different umbilical cord.
- This pregnancy occurs as a result of the placenta forming in the uterus without a fetus to support.
- This type of pregnancy occurs when a fertilized egg implants in the fallopian tube instead of the uterus.
- This is a pregnancy in which one egg meets one sperm and one fetus develops.

Ans) a

Exp) Option a is the correct answer.

A US woman recently gave birth to two pairs of identical twins within six months of each other. Such twins, known scientifically as 'MoMo', an abbreviation for monoamniotic–monochorionic, are some of the rarest types of twins. Such MoMo twin pregnancies have a high risk of fetal complications.

Option a is correct: In a MoMo pregnancy, the twins are known to share the same placenta, amniotic sac and fluid. But they have different umbilical cords. They share everything except umbilical cords, which can easily become entangled in a single sac. Unfortunately, there is a high rate of stillbirths associated with MoMo twins. A mother gives birth to MoMo twins when a single fertilised ovum or egg leads to identical twins and these twins share the same placenta and amniotic sac. MoMo twins are mainly identified by ultrasound in the early pregnancy months.

Option b is incorrect: A complete molar pregnancy occurs as a result of the placenta forming in the uterus without a fetus to support. A partial molar pregnancy occurs when two sperm fertilize one egg, but two fetuses do not develop. The placenta is abnormal, and the fetus has too many chromosomes which always results in a spontaneous abortion as the fetus cannot develop safely.

Option c is incorrect: Tubal pregnancy is a type of ectopic pregnancy. This type of pregnancy occurs when a fertilized egg implants in the fallopian tube instead of the uterus. This type of pregnancy is not viable and must be terminated if a miscarriage does not occur naturally on its own.

Option d is correct: Singlet pregnancy is a pregnancy in which one egg meets one sperm and one fetus develops.

Source: https://www.emedicinehealth.com/what_are_the_types_of_pregnancy/article_em.htm
<https://indianexpress.com/article/lifestyle/health/us-woman-birth-momo-twins-rarest-of-rare-pregnancies-condition-8474768/>

Q.41) Consider the following statements about Artemis I, a lunar space mission often seen in news:

1. Its objective is to build a long-term human presence on moon.
2. It is a crewed mission that carried 4 astronauts on board including a woman.
3. It was launched by NASA's Space Launch System (SLS) rocket.

Which of the statements given above is/are correct?

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

Ans) a

Exp) Option a is the correct answer.

Artemis I, formerly Exploration Mission-1, will be the first integrated test of NASA's deep space exploration systems: the Orion spacecraft, Space Launch System (SLS) rocket and the ground systems at Kennedy Space Center in Cape Canaveral, Florida.

Statement 1 is correct: Artemis I is the first in a series of increasingly complex missions to build a long-term human presence at the Moon for decades to come. It is named after the sister of Apollo in Greek mythology. It is NASA's successor to the Apollo lunar missions from fifty years ago.

Statement 2 is incorrect: Artemis I is an uncrewed mission of NASA. The primary goals for Artemis I are to demonstrate Orion's systems in a spaceflight environment and ensure a safe re-entry, descent, splashdown, and recovery prior to the first flight with crew on Artemis II. **Artemis II will be a crewed mission carrying 4 astronauts including a woman.**

Statement 3 is correct: It was launched by NASA's Space Launch System (SLS) rocket, the most powerful rocket in the world. SLS is designed specifically for deep space missions for humans. It will travel 280,000 miles from Earth, thousands of miles beyond the Moon over the course of about a four to six-week mission. Source : <https://www.nasa.gov/feature/around-the-moon-with-nasa-s-first-launch-of-sls-with-orion>
<https://indianexpress.com/article/explained/explained-sci-tech/attempt-no-3-for-artemis-1-with-the-promise-of-a-new-space-age-nasa-8270447/>

Q.42) We have been using nuclear energy for generation of electricity/power. Many of the nuclear power plants use nuclear fission. However, scientists have also promoted using nuclear fusion for generating power in recent past. In this context, Consider the following statements about the advantages of using nuclear fusion for power generation:

1. It doesn't produce any high activity or long-lived radioactive waste.
2. It doesn't pose any risk of meltdown or nuclear chain reaction.
3. The fuel used for fusion cannot be enriched and exploited to make nuclear weapons.

Select the correct answer using the codes given below.

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

Ans) d

Exp) Option d is the correct answer.

Nuclear fusion is the process by which two light atomic nuclei combine to form a single heavier one while releasing massive amounts of energy. Fusion reactions take place in a state of matter called plasma – a hot, charged gas made of positive ions and free-moving electrons with unique properties distinct from solids, liquids or gases. The sun, along with all other stars, is powered by this reaction.

ITER (International Thermonuclear Experimental Reactor) is an international nuclear fusion research and engineering megaproject aimed at creating energy through a fusion process similar to that of the Sun. It uses Tokomak reactor to carry out fusion reaction.

Statement 1 is correct: The Nuclear fusion reactors produce no high activity, long-lived nuclear waste. The activation of components in a fusion reactor is anticipated to be low enough for the materials to be recycled or reused within 100 years. However, fission reactors release radioactive wastes like, uranium mill tailings and spent (used) reactor fuel.

Statement 2 is correct: If any disturbance occurs, it is difficult to reach and maintain the precise conditions necessary for fusion, as the plasma cools within seconds and the reaction stops. Hence, a reactor meltdown cannot occur. The quantity of fuel present in the vessel at any one time is enough for a few seconds only and there is no risk of a chain reaction. Unlike in fission reactors, where risk of meltdown is very high. For example, Chernobyl and Fukushima disaster in fission reactors.

Statement 3 is correct: Fusion doesn't employ fissile materials like uranium and plutonium. (Radioactive tritium is neither a fissile nor a fissionable material.) There are no enriched materials in a fusion reactor like ITER that could be exploited to make nuclear weapons.

Knowledge Base:

Nuclear fission is the process of breaking large atomic nuclei into smaller atomic nuclei to release a large amount of energy. This is generally used in all the nuclear power plants in the world for generating power/electricity. Fusion releases several times the energy generated by fission, making it a far more powerful process.

Source: <https://www.iter.org/sci/Fusion>

<https://www.iaea.org/newscenter/news/what-is-nuclear-fusion>

Q.43) With reference to the Hyperloop Technology, consider the following statements:

1. The Hyperloop is a highly rapid means of mass transit that can move people as well as cargo.
2. It operates on the principle of shooting passenger pods or compartments through an airtight tube that is partially vacuumed.
3. The propulsion is done through magnetic levitation, with the air capsules or pods gliding or levitating over the tracks.

Which of the statements given above are correct?

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

Ans) d

Exp) Option d is the correct answer.

Statement 1 is correct. A new, extremely quick means of public transit called the hyperloop can move passengers and cargo via a pod in a vacuum. Inside a vacuum tube, a capsule carrying people moves at more than 1200 km/h. There is a low-pressure area inside this vacuum tube. These tubes are supported by sturdy pylons that are capable of withstanding earthquakes and crashes.

Statement 2 is correct. It functions on the principle of shooting passenger pods or compartments through an airtight tube that is partially vacuumed. Regenerative braking, solar energy, and wind power are some of the renewable energy sources utilised.

Statement 3 is correct. The propulsion is done through magnetic levitation, with the air capsules or pods gliding or levitating over the tracks. The train travels along these guided magnetic rails, which can control the vehicle's speed. Since there are no moving parts for any of the engine's functionality, these are clean, smooth, almost noiseless, and can reach very high speeds.

Source: <https://tumhyperloop.com/about-hyperloop/>

Q.44) Consider the following statements regarding fuel cells.

1. To produce electricity efficiently, fuel cells utilize the chemical energy of the fuels.
2. Since there are no carbon dioxide emissions from hydrogen fuel cells, they can address some climate challenges.

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

Ans) c

Exp) Option c is the correct answer.

Statement 1 is correct. A fuel cell generates electricity cleanly and effectively by utilising the chemical energy of hydrogen or other fuels. Electricity, water, and heat are the only byproducts if hydrogen is the fuel. In terms of the range of potential applications, fuel cells are unique and can run on a variety of fuels and feedstocks and can power devices as big as utility power stations and as small as laptop computers.

Statement 2 is correct. Due to the fact that hydrogen fuel cells emit only water and no carbon dioxide, they can effectively address significant climate change concerns. Compared to traditional combustion-based technologies, which are currently used in many power plants and vehicles, fuel cells offer a number of advantages. In contrast to conventional combustion engines, fuel cells run more efficiently and are capable of directly converting the chemical energy in fuel into electrical energy at efficiencies of more than 60%.

[https://www.energy.gov/eere/fuelcells/fuel-](https://www.energy.gov/eere/fuelcells/fuel-cells#:~:text=How%20Fuel%20Cells%20Work,)%E2%80%94sandwiched%20around%20an%20electrolyte)

[cells#:~:text=How%20Fuel%20Cells%20Work,\)%E2%80%94sandwiched%20around%20an%20electrolyte](https://www.energy.gov/eere/fuelcells/fuel-cells#:~:text=How%20Fuel%20Cells%20Work,)%E2%80%94sandwiched%20around%20an%20electrolyte)

Q.45) Consider the following statements regarding the recently released World Air Quality Report:

1. It was released for the first time in 2022 by the World Health Organisation.
2. India was among top 5 in the list of countries with the worst air quality index.
3. New Delhi has been declared as the most polluted city in the world.

Which of the statements given above is/are **incorrect**?

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

Ans) d

Exp) Option d is the correct answer.

Statement 1 is incorrect: The World air quality report was released for the fifth time in 2022. Fifth **Annual World Air Quality Report was released by Swiss air quality technology company, IQAir**, states that roughly 60% of cities in India included in the report recorded annual PM2.5 levels at least seven times higher than the WHO guidelines.

Statement 2 is incorrect: According to the report, **India has ranked eighth in the list of countries with the worst air quality index** and 12 of the 15 most polluted cities in Central and South Asia are in India.

Statement 3 is incorrect: **Lahore was the most polluted city in the world**, followed by Hotan in China, and **Bhiwadi in Rajasthan. New Delhi** is the second most polluted **capital city** in the world, with N'Djamena in Chad topping the list.

Source: <https://www.thehindu.com/news/national/india-ranks-eighth-among-countries-with-the-worst-air-quality-index-world-air-quality-report/article66618661.ece>

Q.46) With reference to the Large Hadron Collider (LHC), consider the following statements:

1. The LHC is world's largest and the most powerful particle accelerator.
2. It is situated in the city of Stockholm.
3. Inside the accelerator, two high-energy particle beams travel in opposite direction, at close to the speed of light before they are made to collide.
4. The LHC is a Joint collaboration of National Aeronautics and Space Administration (NASA) and European Space Agency (ESA).

Which of the above statements are correct?

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

Ans) c

Exp) Option c is the correct answer.

Statement 1 is correct. The largest and most powerful particle accelerator in the world is known as the Large Hadron Collider (LHC). It became operational on September 10, 2008, and it continues to be the most recent addition of the CERN accelerator complex. The LHC, which is operated by CERN (the European Organisation for Nuclear Research), is one of the biggest science experiments in the world.

Statement 2 is incorrect. The 27 km long LHC is a circular pipe that is **situated close to Geneva**, Switzerland, on the Franco-Swiss border. The LHC is made up of a 27-kilometre-long ring of superconducting magnets and other accelerating components that serve to increase the energy of the particles as they travel through the system.

Statement 3 is correct. The LHC consists of a 27-kilometre ring of superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way. **Inside the accelerator, two high-energy particle beams travel at close to the speed of light before they are made to collide. The beams travel in opposite directions in separate beam pipes** – two tubes kept at ultrahigh vacuum. .

Statement 4 is incorrect. The LHC experiment is under control of CERN (European Council for Nuclear Research, and not a collaboration between NASA and ESA

Source: <https://www.home.cern/science/accelerators/large-hadron-collider>
<https://cds.cern.ch/record/532705/files/malo06.pdf>

Q.47) With reference to the Urea, consider the following statements:

1. Nano Urea is developed by the Indian Farmers and Fertilizer Cooperative (IFFCO), a multi-state cooperative society.
2. IFFCO Nano Urea is the only nano fertiliser recognised by the Indian government and included in the Fertilizer Control Order (FCO).
3. Subsidy burden on account of urea import constitutes 60-70% of the overall urea subsidy paid in a year by the governments.

Which of the statements given above are correct?

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

Ans) a

Exp) Option a is the correct answer.

Statement 1 is correct. The Indian Farmers and Fertiliser Cooperative (IFFCO), a multi-state cooperative society based in New Delhi, developed nano-urea, which the government is promoting as a panacea to help farmers become less dependent on packaged urea. According to field trials, a single 500 ml bottle of Nano Urea liquid can compensate for a 45 kg sack of urea granules.

Statement 2 is correct. The only nano fertiliser recognised by the Indian government and included in the Fertilizer Control Order (FCO) is IFFCO Nano Urea. It is developed and patented by IFFCO. Its availability to crops has increased by more than 80% due to its small size (20-50nm).

Statement 3 is incorrect. Over the years, urea imports have increased steadily, from 5.48 million tonnes (MT) in 2016-17 to 9.8 MT in 2020-21, and the subsidy burden resulting from these imports makes up 26% of the total urea subsidy paid in a year by the government.

Source: <https://www.financialexpress.com/economy/nano-urea-could-save-rs-25000-cr-in-fertilisers-subsidy-annually-nbsphouse-panel/3018109/>
<https://www.iffco.in/en/nano-urea-liquid-fertilizer#:~:text=IFFCO%20Nano%20Urea%20is%20the,least%201%20bag%20of%20Urea.>

Q.48) Consider the following statements about Synthetic Biology:

1. Synthetic Biology is an area of science which involves redesigning organisms for useful purposes.
2. Synthetic Biology can be utilised for developing microorganism which helps in Bioremediation of pollutants.
3. Synthetic Biology doesn't involve introduction of any foreign or new gene to the target organism.

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

Ans) a

Exp) Option a is the correct answer.

Statement 1 is correct. Synthetic biology is that field of science which involves redesigning organisms for useful purposes by engineering them to have new abilities. Researchers as well as companies working in synthetic biology harnessing nature's power to address issues in agriculture, manufacturing, and medicine.

Statement 2 is correct. Synthetic biology goals generally seek to redesign organisms so that they can create a substance, such as a medicine or fuel, or acquire a new ability, such as the ability to sense something in the environment. Here are a few examples of what scientists have produced with synthetic biology:

- 1) To remove pollutants from our water, soil, and air, microorganisms are used in bioremediation.
- 2) Beta-carotene, a nutrient normally associated with carrots that prevents vitamin A deficiency, is produced by rice that has been modified. Every year, between 250,000 and 500,000 children lose their vision due to vitamin A deficiency, which also significantly increases the risk of dying from infectious infections.
- 3) A sustainable, eco-friendly substitute to the real roses that perfumers use to develop luxury scents is yeast that has been engineered to produce rose oil.

Statement 3 is incorrect. Synthetic biology and another approach called "genome editing" both require changing an organism's genetic code, although certain people distinguish between the two approaches based on how that alteration is done. **In synthetic biology, large segments of DNA are often stitched together and inserted into the genome of an organism. These synthesized DNA segments may contain genes that are already present in other organisms, or they may be completely new.**

In genome editing, scientists generally use tools to make smaller changes to the organism's DNA. Genome editing tools can be utilized to delete or add small segments of DNA in the genome.

Reverse definition is written in the statement 3 hence it is incorrect.

Source: <https://www.genome.gov/about-genomics/policy-issues/Synthetic-Biology#:~:text=Synthetic%20biology%20is%20a%20field,them%20to%20have%20new%20abilitie%20s>

Q.49) In humans, DNA can be extracted from which of the following specimens?

1. Fingernails
2. Skin
3. Hair
4. Blood
5. Saliva

Select the correct answer using the code given below:

- a) 1, 2, 3 and 4 only
- b) 1, 2, 3 and 5 only
- c) 2, 3, 4 and 5 only
- d) 1, 2, 3, 4 and 5

Ans) d

Exp) Option d is the correct answer.

DNA extraction is used to extract a useable DNA sample for further examination. Commercial extraction kits are available and provide all components necessary for extraction. DNA can be extracted from different biological samples, such as;

- 1) **Fingernail material** - can serve as an important source of DNA. Because of the special composition and structure of fingernails that embody DNA in keratinized cells, DNA extraction procedures are more complex than usual protocols applied for fresh somatic cells.
- 2) **Skin** - DNA can be extracted from skin cells, skin cells from the lower layers produce the best result.
- 3) **Hair** - **Hair roots contain genomic DNA** while hair shafts contain mitochondrial DNA.

4) Blood – **Blood is an excellent source of human DNA.** DNA is present in white blood cells of humans, but **not red blood cells** which lack nuclei.

5) Saliva – **DNA comes from white blood cells and buccal epithelial cells** (cheek cells) in the saliva.

Source: <https://forensicdnaproject.weebly.com/dna-extraction.html#:~:text=%20DNA%20extraction%20%201%20Blood%20%E2%80%93%20The,of%20nucleated%20cells.%20These%20cells%20are...%20More%20>

<https://www.sciencedirect.com/science/article/pii/S1525157814000671#:~:text=In%20forensic%20analysis%2C%20fingernail%20material%20can%20serve%20as,than%20usual%20protocols%20applied%20for%20fresh%20somatic%20cells.>

<https://www.sciencedirect.com/science/article/pii/S1525157814000671#:~:text=In%20forensic%20analysis%2C%20fingernail%20material%20can%20serve%20as,than%20usual%20protocols%20applied%20for%20fresh%20somatic%20cells.>

Q.50) Consider the following statements regarding Siang Uying Festival:

1. It is an important festival of the Khasi community in Meghalaya.
2. During this festival, all male members of a family go on a hunting spree for one week.

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

Ans) b

Exp) Option b is the correct answer.

Statement 1 is incorrect: The colourful Siang Uying Festival is an important festival of the Adi community of Boleng, Arunachal Pradesh.

Whereas the most important festival of the Khasis in Manipur is **Ka Shad Suk Mynsiem** or Dance of the joyful heart. It is an annual thanksgiving dance held in Shillong in April.

Statement 2 is correct: In this festival, it is customary for **all male members of a family** to go on a **hunting spree (open season) and stay in the jungles for one week**. When they return home, they come back with various kills such as deers, birds, squirrels, fish etc. The children perform “Yakjong” (house to house) wearing colorful traditional attire and bless the house where they perform.

Source: <https://eastsiang.nic.in/culture-heritage/>

<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1902396>