

1. Consider the following statements regarding the commercial production and natural occurrence of Helium:

1. Commercial extraction of helium is economically feasible primarily from natural gas reservoirs containing significant concentrations of helium.
2. Helium found within the Earth's crust is naturally generated through the alpha decay of radioactive elements such as uranium and thorium.
3. Helium released into the atmosphere can be chemically converted into stable liquid compounds through cryogenic fractional distillation.

Which one of the following conclusions based on the above statements is correct?

- A. All three statements are correct.
- B. There is no correct statement.
- C. There are two correct statements that include statement 2.
- D. There is only one correct statement.

Answer: C

Explanation

Statement 1 is Correct.

Commercial production of helium is economically viable mainly from helium-rich natural gas fields. Although helium exists in the atmosphere at nearly 5 ppm, its concentration is too low for economical extraction. Consequently, natural gas reservoirs containing appreciable helium concentrations serve as the principal commercial source.

Statement 2 is Correct.

Helium is produced naturally within the Earth's crust through the alpha decay of heavy radioactive isotopes such as uranium-238, uranium-235, and thorium-232. The emitted alpha particles eventually capture electrons to become helium atoms, which accumulate over geological time in underground natural gas reservoirs.

Statement 3 is Incorrect.

Helium is a chemically inert noble gas and does not form stable compounds under normal conditions. Cryogenic fractional distillation is merely a physical separation process used to isolate gases based on their boiling points; it cannot chemically synthesize helium into compounds. Moreover, atmospheric helium gradually escapes into outer space because of its extremely low atomic mass, making it effectively a non-renewable resource on human timescales.

2. Consider the following statements regarding the Eärendil-1 Mission:

1. The mission is being undertaken by NASA to establish a permanent deep-space communication network.
2. It employs a large deployable orbital reflector designed to redirect sunlight onto selected regions of the Earth after sunset.
3. The satellite is intended to operate in a geostationary orbit directly above the North Pole.

Which one of the following conclusions based on the above statements is correct?

- A. All three statements are correct.
- B. There is no correct statement.
- C. There are two correct statements that include statement 3.
- D. There is only one correct statement.

Answer: D

Explanation

Statement 1 is Incorrect.

The Eärendil-1 Mission is not a NASA initiative and has no connection with deep-space communications. It is a privately developed mission by Reflect Orbital aimed at demonstrating space-based sunlight reflection technology.

Statement 2 is Correct.

The mission utilizes a steerable reflective film that functions as an orbital mirror. It redirects sunlight onto selected locations during twilight or nighttime, demonstrating the concept of providing "sunlight on demand."

Statement 3 is Incorrect.

The satellite is planned to operate in a Low Earth Orbit (LEO) at an altitude of about 625 km with a near-polar inclination of approximately 88°. A geostationary satellite cannot remain stationary over the North Pole because geostationary orbits exist only above the equator.

3. Consider the following statements regarding the funding pattern of the Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PMFME) Scheme:

1. Financial assistance for North-Eastern and Himalayan States is shared equally between the Centre and the States in a 50:50 ratio.
2. General States as well as Union Territories with Legislatures receive complete financial support from the Central Government.
3. Union Territories without Legislatures are required to contribute 40% of the scheme expenditure.

Which one of the following conclusions based on the above statements is correct?

- A. All three statements are correct.
- B. There is no correct statement.
- C. There are two correct statements that include statement 3.
- D. There is only one correct statement.

Answer: B

Explanation

Statement 1 is Incorrect.

Under the PMFME Scheme, North-Eastern and Himalayan States follow a **90:10** funding pattern, with

90% of the expenditure borne by the Central Government and the remaining 10% by the respective State Government.

Statement 2 is Incorrect.

General States receive financial assistance in a **60:40** Centre-State ratio. Although Union Territories receive 100% Central funding, General States do not. Therefore, grouping both under complete Central funding is incorrect.

Statement 3 is Incorrect.

Union Territories, irrespective of whether they possess a legislature, receive **100% funding from the Central Government**. They are not required to contribute any portion of the scheme expenditure.

4. Consider the following statements regarding the Global Liveability Index 2026:

1. The Global Liveability Index is published annually by the United Nations Development Programme (UNDP).
2. Stability constitutes more than half of the overall weight assigned in the index's assessment framework.
3. Indian metropolitan cities such as New Delhi and Mumbai feature among the world's top 50 most liveable cities owing to their strong environmental and healthcare performance.

Which one of the following conclusions based on the above statements is correct?

- A. All three statements are correct.
- B. There is no correct statement.
- C. There are two correct statements that include statement 3.
- D. There is only one correct statement.

Answer: B

Explanation

Statement 1 is Incorrect.

The Global Liveability Index is published annually by the **Economist Intelligence Unit (EIU)**, not by the United Nations Development Programme. It evaluates cities across five broad parameters—stability, healthcare, culture & environment, education, and infrastructure.

Statement 2 is Incorrect.

Stability contributes only **25%** of the total score. The EIU assigns the following weights: Stability (25%), Culture & Environment (25%), Healthcare (20%), Infrastructure (20%), and Education (10%). Therefore, stability alone does not account for more than half of the total weight.

Statement 3 is Incorrect.

Indian cities such as New Delhi and Mumbai do not feature among the top 50 most liveable cities globally. They continue to face challenges related to infrastructure, healthcare, environmental quality, and urban stability, resulting in comparatively lower rankings.

5. Consider the following statements regarding India's first hydrogen-powered passenger train:

1. The train has been developed as a completely new system using imported high-speed electric locomotives.
2. It operates on a Hydrogen-Electric Multiple Unit (HEMU) configuration that combines hydrogen fuel cells with an onboard lithium battery.
3. The propulsion system emits water vapour, nitrogen oxides, and heat as its normal exhaust products.

Which one of the following conclusions based on the above statements is correct?

- A. There are two correct statements, including statement 2.
- B. There are two correct statements, namely statements 1 and 3.
- C. All three statements are correct.
- D. There is only one correct statement, namely statement 2.

Answer: D

Explanation

Statement 1 is Incorrect.

India's first hydrogen-powered passenger train has not been built as an entirely new imported system. Instead, Indian Railways has retrofitted an existing Diesel Electric Multiple Unit (DEMU) with hydrogen fuel cell technology under the **Hydrogen for Heritage** initiative.

Statement 2 is Correct.

The train employs a **Hydrogen-Electric Multiple Unit (HEMU)** architecture. Hydrogen fuel cells generate electricity, while an onboard lithium battery stores regenerated energy and supplies additional power during acceleration and other peak-load conditions, thereby improving efficiency and reducing hydrogen consumption.

Statement 3 is Incorrect.

Hydrogen fuel cells generate electricity through an electrochemical reaction between hydrogen and oxygen without combustion. Consequently, the principal by-products are **electricity, water (or water vapour), and heat**, while **nitrogen oxides (NO_x)** are not produced during normal fuel-cell operation.

6. Match the following geographical features of the South China Sea with their corresponding physical descriptions and geopolitical status:

Column I (Feature)	Column II (Description)	Column III (Geopolitical Status)
1. Spratly Islands	X. Triangular reef complex supporting rich marine biodiversity	P. Situated close to the Philippine island of Luzon
2. Paracel Islands	Y. Located in the northwestern part of the South China Sea	Q. Under Chinese control since 1974 but also claimed by Vietnam

Column I (Feature)	Column II (Description)	Column III (Geopolitical Status)
3. Scarborough Shoal	Z. Extensive group of over 100 islands, reefs, cays and shoals	R. Claimed by China, Vietnam, the Philippines, Malaysia and Taiwan

Select the correct answer using the code given below:

- A. 1–Z–R, 2–Y–Q, 3–X–P
- B. 1–Y–P, 2–X–Q, 3–Z–R
- C. 1–X–R, 2–Y–Q, 3–Z–P
- D. 1–Z–P, 2–Y–R, 3–X–Q

Answer: A

Explanation

Spratly Islands (1–Z–R)

The Spratly Islands comprise more than 100 islands, reefs, cays and shoals scattered across the central South China Sea. They constitute one of the world's most disputed maritime regions, with overlapping claims by China, Vietnam, the Philippines, Malaysia and Taiwan, while Brunei claims part of the surrounding Exclusive Economic Zone (EEZ).

Paracel Islands (2–Y–Q)

The Paracel Islands are situated in the northwestern portion of the South China Sea. China has exercised effective control over the islands since 1974 following the Battle of the Paracel Islands, although Vietnam continues to claim sovereignty over them.

Scarborough Shoal (3–X–P)

Scarborough Shoal is a triangular chain of reefs and rocks located approximately 220 km west of Luzon in the Philippines. Although China has exercised effective control over the shoal since 2012, it remains claimed by the Philippines.

7. In the context of modern industrial and technological applications, helium is used for which of the following purposes?

1. Serving as an inert shielding gas during Gas Tungsten Arc Welding (GTAW) to prevent atmospheric contamination.
2. Purging propellant lines and operating pneumatic systems in liquid-fuel launch vehicles.
3. Assisting in optical fibre manufacturing and cooling semiconductor components during fabrication.

Select the correct answer using the code given below:

- A. 1, 2 and 3
- B. 2 and 3 only
- C. 1 and 3 only
- D. 1 and 2 only

Answer: A

Explanation

Statement 1 is Correct.

Helium is extensively employed as a shielding gas in Gas Tungsten Arc Welding (GTAW/TIG welding). Its chemical inertness prevents molten metal from reacting with atmospheric oxygen, nitrogen and moisture. Helium also produces a hotter welding arc than argon, making it suitable for welding thick sections of aluminium, copper and other non-ferrous metals.

Statement 2 is Correct.

In the aerospace sector, helium is widely used for purging fuel and oxidizer lines, pressurizing propellant tanks and actuating pneumatic valves. Its inert, non-flammable nature and extremely low boiling point make it ideal for liquid-propellant rocket systems.

Statement 3 is Correct.

Helium plays an important role in advanced manufacturing. It provides a clean atmosphere and efficient cooling during optical fibre drawing and is also used for cooling silicon wafers and other semiconductor components because of its excellent thermal conductivity.

8. Consider the following statements regarding the potential benefits and challenges associated with orbital mirror technology:

1. Redirecting sunlight after sunset could extend the operational period and improve the economic viability of ground-based solar power plants.
2. Large orbital mirrors may increase artificial night-time illumination and interfere with astronomical observations.
3. The use of orbital mirrors could reduce dependence on large-scale battery storage for renewable energy systems.

Which of the following relationships among the above statements is/are correct?

1. Statement 1 is supported by Statement 3.
2. Statement 2 contradicts the approach described in Statement 1.
3. Statements 1 and 3 together indicate a potential economic advantage for clean-energy systems.

Select the correct answer using the code given below:

- A. 1 only
- B. 1 and 2 only
- C. 2 and 3 only
- D. 1 and 3 only

Answer: D

Explanation

Relationship 1 is Correct.

Statement 3 explains that extending sunlight availability through orbital mirrors reduces dependence on battery storage, thereby supporting the economic rationale presented in Statement 1.

Relationship 2 is Incorrect.

Statement 2 highlights a possible environmental and scientific concern, namely increased light pollution and interference with astronomical observations. However, this does not contradict the technological objective described in Statement 1.

Relationship 3 is Correct.

Together, Statements 1 and 3 indicate that extending solar power generation while reducing battery-storage requirements can improve the economic efficiency of renewable energy systems.

9. Consider the following statements regarding the assessment framework of the Global Liveability Index 2026:

1. The **Culture & Environment** category evaluates factors such as climate, censorship, social restrictions and the availability of consumer goods.
2. The **Infrastructure** category includes assessment of public transport, housing, telecommunications and international connectivity.
3. The **Education** parameter carries the same weightage as the **Healthcare** parameter in the final scoring methodology.

Which of the statements given above is/are correct?

- A. 1 and 2 only
- B. 2 and 3 only
- C. 1 and 3 only
- D. 1, 2 and 3

Answer: A

Explanation

Statement 1 is Correct.

The Economist Intelligence Unit (EIU) evaluates the **Culture & Environment** category using indicators such as climate, censorship, social and religious restrictions, corruption, and the availability of consumer goods and recreational opportunities.

Statement 2 is Correct.

The **Infrastructure** component assesses the quality of public transport, road networks, housing, energy supply, telecommunications and international connectivity, making it an important determinant of urban liveability.

Statement 3 is Incorrect.

Healthcare contributes **20%** of the overall score, whereas Education contributes only **10%**. Therefore, Education does not carry the same weight as Healthcare in the index.

10. With reference to the functioning of India's first hydrogen-powered passenger train, consider the following statements:

1. The hydrogen fuel cell supplies continuous electrical power, while an onboard Lithium Ferro Phosphate (LFP) battery delivers additional energy during acceleration and other peak-load conditions.
2. Electrical energy recovered through regenerative braking, along with surplus electricity generated by the fuel cell, is stored in the onboard lithium battery for subsequent use.

Which of the statements given above is/are correct?

- A. 1 only
- B. 2 only
- C. Both 1 and 2
- D. Neither 1 nor 2

Answer: C

Explanation

Statement 1 is Correct.

India's first hydrogen-powered train operates on a hybrid propulsion system. The hydrogen fuel cell continuously generates electricity for normal operation, while the onboard Lithium Ferro Phosphate (LFP) battery provides additional power during acceleration, climbing gradients and other periods of high energy demand, thereby improving efficiency and reducing stress on the fuel cell.

Statement 2 is Correct.

The train incorporates regenerative braking technology. During braking, the traction motors function as generators and convert kinetic energy into electrical energy. This recovered energy, along with surplus electricity produced by the hydrogen fuel cell during periods of low power demand, is stored in the lithium battery for future use, thereby enhancing overall energy efficiency and reducing hydrogen consumption.

11. Consider the following statements regarding the composition, evolution and institutional framework of the G7 (Group of Seven):

1. The inclusion of Russia transformed the G7 into the G8 during the late 1990s, and this expanded format has continued without interruption ever since.
2. The European Union participates in G7 meetings as a fully integrated but non-enumerated member of the forum.
3. The communiqués and declarations adopted at G7 Summits are legally binding on non-member developing countries.

Which one of the following conclusions based on the above statements is correct?

- (a) There are two correct statements, that include statement 2.
- (b) There are two correct statements, that are statements 1 and 3.

(c) All three statements are correct.

(d) There is only one correct statement, that is statement 2.

Answer: (d)

Explanation

Statement 1 is Incorrect.

Russia formally joined the group in 1998, leading to the formation of the G8. However, following Russia's annexation of Crimea and violation of Ukraine's sovereignty in 2014, its participation was indefinitely suspended. Since then, the forum has continued as the G7.

Statement 2 is Correct.

The European Union participates as a fully integrated institutional member in G7 discussions and ministerial meetings. Although it is not counted among the seven member countries, it actively contributes to the forum's deliberations and policy coordination.

Statement 3 is Incorrect.

G7 declarations and summit communiqués are political commitments rather than legally binding instruments. They do not possess legal authority over non-member countries or the international community.

12. Consider the following statements:

Statement-I: The Great Indian Bustard is regarded as a flagship indicator species representing the ecological health of India's dry grassland and semi-arid scrub ecosystems.

Statement-II: Indicator species are highly sensitive to ecological disturbances; therefore, changes in their population often reflect the overall condition and conservation status of the ecosystem they inhabit.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.

(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.

(c) Statement-I is correct but Statement-II is incorrect.

(d) Statement-I is incorrect but Statement-II is correct.

Answer: (a)

Explanation

Statement-I is Correct.

The Great Indian Bustard is one of India's most important flagship and indicator species for grassland ecosystems. Its population trends provide valuable insights into the ecological condition of semi-arid grasslands and scrub habitats.

Statement-II is Correct.

Indicator species are selected because they are highly responsive to environmental changes. Habitat degradation, fragmentation, excessive agricultural expansion, invasive species or infrastructure development directly affect their survival and reproductive success.

Statement-II correctly explains Statement-I because the conservation status of the Great Indian Bustard serves as a reliable measure of the ecological integrity of grassland ecosystems.

13. In the context of virology and modern vaccine development, the term "viral interference" refers to:

- (a) A process in which host cells spontaneously alter their genetic material to prevent viral attachment.
- (b) The blockage of blood vessels caused by synthetic nanoparticles present in vaccines.
- (c) A biological phenomenon in which one virus replicates more efficiently within a host and suppresses the replication of other simultaneously infecting or vaccine-derived viral strains.
- (d) The transmission of viruses through electromagnetic fields and high-voltage power transmission systems.

Answer: (c)

Explanation

Option (c) is Correct.

Viral interference is a well-recognized virological phenomenon in which one viral strain dominates replication inside the host, thereby suppressing the growth of other co-infecting or co-administered viral strains. This phenomenon is particularly significant in the development of multivalent live-attenuated vaccines, such as dengue vaccines.

If one viral component replicates much more efficiently than the others, the immune system develops a stronger immune response against the dominant strain while generating comparatively weaker immunity against the suppressed strains. Such an imbalanced immune response may reduce vaccine efficacy and, in diseases such as dengue, may increase the risk of **Antibody-Dependent Enhancement (ADE)**.

Why the other options are incorrect:

- **Option (a):** Host cells do not spontaneously mutate their genome to block all viral attachment.
- **Option (b):** Viral interference has no relation to nanoparticle-induced vascular blockage.
- **Option (d):** Viruses are not transmitted through electromagnetic fields or electrical transmission lines.

14. The term "Velvet Divorce" in international relations refers to:

- (a) The peaceful settlement of maritime boundary disputes between India and neighbouring coastal countries.
- (b) The withdrawal of the Russian Federation from the G8 following geopolitical developments.
- (c) The peaceful dissolution of Czechoslovakia into the independent Czech Republic and Slovak Republic in 1993.
- (d) The abolition of colonial pilgrimage taxation arrangements under the East India Company.

Answer: (c)

Explanation

Option (c) is Correct.

The **Velvet Divorce** refers to the peaceful and negotiated dissolution of **Czechoslovakia** on **1 January 1993**, resulting in the emergence of two independent sovereign states—the **Czech Republic** and the **Slovak Republic**. The separation occurred without armed conflict, making it one of the most peaceful examples of state partition in modern history.

Following independence, Slovakia established several national honours, including the **Order of the White Double Cross** in 1994, to recognize individuals who contribute significantly to strengthening Slovakia's international relations.