

Q.1 Which of the following lanthanide ions is colourless in its +3 oxidation state?

- A. Pr^{3+}
- B. Eu^{3+}
- C. Lu^{3+}
- D. Sm^{3+}

Answer: C

Sol:

The correct answer is {C} Lu^{3+} .
Explanation:
The colour in lanthanide ions arises from f-f electronic transitions. For an ion to be colourless, it must have either a completely filled or completely empty f-subshell, as no f-f transitions are possible. Lu^{3+} has the electronic configuration $[\text{Xe}] 4f^{14}$. The f-subshell is completely filled, so it cannot undergo f-f transitions and appears colourless.
Additional Information:
Option {A} is incorrect because $\text{Pr}^{3+} \{[\text{Xe}] 4f^2\}$ has unpaired f-electrons and shows colour.
Option {B} is incorrect because $\text{Eu}^{3+} \{[\text{Xe}] 4f^6\}$ has unpaired f-electrons and shows colour.
Option {D} is incorrect because $\text{Sm}^{3+} \{[\text{Xe}] 4f^5\}$ has unpaired f-electrons and shows colour.

Q.2 Which acid is produced in the human stomach to help the digestion of food?

- A. Sulphuric acid
- B. Tartaric acid
- C. Nitric acid
- D. Hydrochloric acid

Answer: D

Sol: The correct answer is (d) Hydrochloric acid

Explanation:

- The human stomach secretes **Hydrochloric acid (HCl)** to aid in **digestion of food**.
- HCl helps in **breaking down food, activating digestive enzymes like pepsin**, and **killing harmful bacteria**.

Information Booster:

- Secreted by **parietal cells** in the stomach lining.
- Maintains a **stomach pH of 1.5 to 3.5**, which is highly acidic.
- Activates **pepsinogen to pepsin**, essential for protein digestion.
- Provides a **hostile environment for pathogens** ingested with food.
- Supports **absorption of minerals** like iron and calcium.

Q.3 Consider the motion of a rigid body which is pivoted or fixed in some way. The possible motion for such a system is best described by:

- A. combination of rotation and translation
- B. rotation
- C. translation
- D. circular motion

Answer: B

Sol: The correct answer is (b) - Rotation

Explanation:

When a **rigid body is pivoted or fixed**, it **cannot undergo translation** because its position is constrained by the pivot point. The only possible motion for such a system is **rotation about the fixed axis or pivot**.

- The body **rotates** around the pivot point, meaning different points on the body follow circular paths around the fixed point.
- The **center of mass** does not move in space, meaning **no translational motion occurs**.
- This type of motion is seen in systems like **a ceiling fan, a door on hinges, or a seesaw**.

Thus, the motion is best described as **rotation**.

Information Booster:

Conditions for Pure Rotational Motion:

1. **The body is fixed at a pivot point** (e.g., a door on hinges).
2. **Every point in the body moves in a circular path** about the fixed point.
3. **There is no displacement of the center of mass** in space.

Types of Motion for a Rigid Body

A **rigid body** is an object with a fixed shape and size, where all its particles remain at a constant distance from each other during motion. The motion of a rigid body can be classified into three main types:

1. **Translational Motion**
 - Every point in the body moves in **parallel paths** without rotation.
 - All particles of the body have the **same velocity and acceleration** at any given moment.
 - Example: A moving car on a straight road.
2. **Rotational Motion**
 - The body rotates about a **fixed axis**, with all particles following circular paths around that axis.
 - Different points in the body have **different velocities** depending on their distance from the axis of rotation.
 - Example: A ceiling fan or a spinning wheel.
3. **General Plane Motion (Combined Translation and Rotation)**
 - A combination of **both translational and rotational motion**.
 - The body moves in a plane while also rotating about a point.
 - Example: A rolling ball or a bicycle wheel in motion.

Q.4 The term 'Carbon footprint' means

- A. A region which is rich in coal mines
- B. The amount of reduction in the emission of CO₂ by a country
- C. The use of Carbon in manufacturing industries
- D. The amount of greenhouse gases produced by our day-to-day activities

Answer: D

Sol: The term **Carbon Footprint** refers to the **total amount of greenhouse gases (GHGs)** — primarily **carbon dioxide (CO₂)**, **methane (CH₄)**, and **nitrous oxide (N₂O)** — that are **emitted directly or indirectly** by human activities. These gases are measured in **carbon dioxide equivalents (CO₂e)** to indicate their global warming potential. It quantifies the **impact of individual, organizational, or national activities** on climate change, including emissions from:

- Transportation (cars, flights, shipping)
- Electricity consumption
- Food production and consumption
- Industrial and manufacturing processes
- Waste generation and disposal

Q.5 Which pair of Non-Metal – Atomicity is NOT correct?

I. Hydrogen – Monoatomic

II. Oxygen – Diatomic

- A. Only I
- B. Neither I nor II
- C. Only II
- D. Both I and II

Answer: A

Sol: Correct Answer: (a) Only I
Explanation:

- Hydrogen is diatomic (H₂), not monoatomic.
- Therefore, the pair *Hydrogen – Monoatomic* is incorrect.
- Oxygen (O₂) is correctly represented as diatomic, meaning two atoms of oxygen combine to form one molecule.

Information Booster:

- Diatomic molecules contain two atoms of the same or different elements (e.g., H₂, O₂, N₂, Cl₂).
- Monoatomic elements exist as single atoms, e.g., noble gases (He, Ne, Ar, Kr, Xe).
- Hydrogen, Oxygen, Nitrogen, Chlorine, Fluorine, Bromine, and Iodine are diatomic in nature.
- Atomicity = number of atoms present in a molecule.
- Example: O₃ (ozone) → triatomic; P₄ (phosphorus) → tetra-atomic.

Q.6 Apart from nucleus of the cell, which two cell organelles have their own DNA and Ribosomes?

- A. Plastids and Mitochondria
- B. Mitochondria and Lysosomes
- C. Plastids and Golgi bodies
- D. Mitochondria and Golgi bodies

Answer: A

Sol: The correct answer is (A) Plastids and Mitochondria.

Explanation:

Apart from the nucleus, plastids (especially chloroplasts) and mitochondria are the only two cell organelles that have their DNA and ribosomes.

1. Mitochondria ("Powerhouse of the Cell")

- Contains circular DNA, similar to bacterial DNA.
- Has 70S ribosomes, allowing it to synthesize its proteins.
- Involved in cellular respiration and ATP production.

2. Plastids (Chloroplasts in Plants)

- Found in plant cells and some protists.
- Contain their own DNA and 70S ribosomes, enabling them to replicate independently.
- Responsible for photosynthesis (in chloroplasts) and pigment synthesis.

Since both mitochondria and plastids possess their DNA and ribosomes, the correct answer is Option A.

Information Booster:

Endosymbiotic Theory

- Suggests that mitochondria and chloroplasts originated from ancient prokaryotic cells that were engulfed by larger cells in a symbiotic relationship.
- Evidence:
 - Both have double membranes, similar to bacterial cells.
 - Both contain circular DNA, unlike the linear DNA in the nucleus.

- Both have **70S ribosomes**, like prokaryotes (whereas eukaryotic ribosomes are 80S).
- They **divide by binary fission**, similar to bacteria.

Additional Knowledge:

- **Lysosomes lack DNA and ribosomes**; they only contain digestive enzymes.
- **Golgi bodies** do not have **DNA or ribosomes**; they function in **protein modification and transport**.
- **Golgi bodies lack DNA and ribosomes**.

Q.7 Which one among the following correctly stands for SSL encryption with regard to banking websites?

- A. Secure Socket Layer encryption
- B. Superior Safety Level encryption
- C. Server-to-Server Linked encryption
- D. Safety Server Level encryption

Answer: A

Sol: **SSL** stands for **Secure Socket Layer**. It is a cryptographic protocol that provides secure communication over the internet by encrypting the data exchanged between a web browser and a server. Banking and e-commerce websites use **SSL** (now succeeded by **TLS**) to protect sensitive information such as login credentials and card details. The presence of **https://** and a padlock icon indicates an active **SSL/TLS** connection.

Important Key Points:

- 1. **SSL = Secure Socket Layer** (original name by Netscape).
- 2. Current version is **TLS** (Transport Layer Security), but the term SSL is still widely used.
- 3. It works at the **transport layer** and encrypts the entire communication channel.
- 4. Certificates are issued by trusted **Certificate Authorities (CAs)** to verify website identity.

Knowledge Booster:

- (b) Superior Safety Level encryption → Made-up term; no such protocol exists.
- (c) Server-to-Server Linked encryption → Incorrect and meaningless in this context.
- (d) Safety Server Level encryption → Completely fabricated; not a real protocol.

Q.8 Which team topped the 38th National Games 2025 medal tally?

- A. Maharashtra
- B. Services Sports Control Board (SSCB)
- C. Haryana
- D. Karnataka

Answer: B

Sol:

Ans. (b) Services Sports Control Board (SSCB)

Sol. SSCB topped the 38th National Games 2025 with 121 medals (68 gold, 26 silver, and 27 bronze), continuing its dominance in recent editions.

Information Booster:

- The 38th National Games were hosted by Uttarakhand from January 26, 2025, to February 14, 2025, with the opening ceremony held in Dehradun.
- SSCB won the Raja Bhalindra Singh Trophy by securing the highest number of gold medals (68).
- Maharashtra finished in second place with 201 medals (54 gold, 71 silver, and 76 bronze).
- The 38th National Games followed the theme "Green Games," focusing on sustainability, e-waste medals, and tree plantations for medalists.
- The mascot "Mauli" was inspired by the Himalayan Monal, the state bird of Uttarakhand.
- Meghalaya will host the 39th edition of the National Games in February or March 2027.

Q.9 What is India's Human Development Index (HDI) value in the 2025 Human Development Index Report?

- A. 0.685
- B. 0.575
- C. 0.690
- D. 0.675

Answer: A

Sol: The correct answer is: (A) 0.685

Explanation:

- In the 2025 United Nations Development Programme (UNDP) report, India’s Human Development Index (HDI) value for the year 2023 is 0.685.
- India ranked 130 out of 193 countries in that report.

Information Booster:

- The threshold for “high human development” category is $HDI \geq 0.700$.
- India moved from rank 133 in 2022 to 130 in 2023.
- HDI is a composite index of **life expectancy, education (mean & expected years of schooling), and gross national income per capita**.
- India remains in the “medium human development” category in this report.
- Progress in India’s HDI is driven by improved life expectancy, schooling years and income per capita.

Additional Knowledge:

- India’s HDI value in 2022 was 0.676 before increasing to 0.685.
- The UNDP report title is “**A Matter of Choice: People and Possibilities in the Age of AI**”.
- While HDI improved, India still faces significant inequality—its **inequality-adjusted HDI (IHDI)** shows a gap.
- Regional neighbours: China’s rank and HDI are higher than India’s; South Asian nations lag behind or are near India’s level.
- Moving into “high human development” status ($HDI \geq 0.700$) remains a key target for India’s long-term development goals.

Q.10 When the speed of any object exceeds the speed of sound, it is said to be travelling at which speed?

- A. Subsonic
- B. Supersonic
- C. Hyposonic
- D. Infrasonic

Answer: B

Sol:

The correct answer is (b) Supersonic.

When an object travels faster than the speed of sound in a given medium, it is said to be traveling at supersonic speed. The speed of sound, also known as Mach 1, varies depending on the medium (e.g., approximately 343 meters per second in air at sea level and at 20°C). Objects moving at supersonic speeds produce shock waves, leading to phenomena such as sonic booms.

Additional Information:

- **Subsonic** : Subsonic speeds are those below the speed of sound. Most commercial aircraft operate at subsonic speeds.
- **Hyposonic** : This term is not commonly used in the context of describing speeds relative to the speed of sound.
- **Infrasonic** : Infrasonic refers to sound waves with frequencies below the audible range for humans (below 20 Hz), not to speed.

Q.11 In optics, which term refers to the opening of the diaphragm of a lens that spatially limits the propagation of light?

- A. Collimator
- B. Aperture
- C. Apostilb
- D. Meniscus

Answer: B

Sol:

The correct answer is (b) Aperture.

- The aperture of a lens is the opening through which light passes.
- It regulates the amount of light that enters the lens and reaches the camera sensor or film.
- It also affects depth of field and the sharpness of an image.
- By adjusting the aperture size, photographers can control the exposure and the artistic effect of their photographs.
- A **collimator** is an optical device used to align or parallel light beams.
- It typically consists of a lens or a curved mirror to make light rays parallel.
- Collimators are used in various optical instruments and systems, such as telescopes, lasers, and optical testing equipment.

Facts to remember:

- **Apostilb** is a unit of luminance, which measures the brightness of a surface.
- In optics, a meniscus refers to the curved surface formed by a liquid in a container or by a lens that has one convex and one concave surface. L
- **Meniscus** lenses are commonly used in eyeglasses and optical instruments to correct vision and control the direction of light rays.

Q.12 What milestone did Virat Kohli achieve in the 2025 IPL season (as of 15 April, 2025)?

- A. Hitting 500 sixes in the IPL
- B. Scoring 10,000 runs in the IPL
- C. Registering a combined total of 1000 fours and sixes in IPL history
- D. Winning 5 IPL titles

Answer: C

Sol: Correct Answer: (C) Registering a combined total of 1000 fours and sixes in IPL history

Explanation:

- Virat Kohli became the **first batter in IPL history** to hit **1000 boundaries** (the combined total of fours and sixes).
- This milestone reflects his long-standing consistency and dominance in the tournament over many seasons.

Information Booster:

- The record was recognised during the 2025 edition of IPL.
- Boundaries are key metrics of dominance in T20 cricket—this milestone underlines both Kohli’s longevity and elite stroke-play capability.
- Kohli also surpassed other major statistical markers in IPL 2025, including being the first batter to score 1000+ runs against four different opponents.

Q.13 The frequency of a sound wave is 50 Hz and its wavelength is 4 m. What is the speed of the sound wave?

- A. 400 m/s
- B. 80 m/s
- C. 100 m/s
- D. 200 m/s

Answer: D

Sol:

Given,
frequency = 50 Hz,
wavelength = 4 m.
As we know, the velocity of wave = Frequency Wavelength
= 50 x 4
= 200 m/s.
Therefore, the distance travelled by the sound wave in 3 s $200 \times 3 = 600$ m.

Q.14 Which of the following is NOT a function of the mammalian liver?

- A. Production of bile
- B. Storage of glycogen
- C. Detoxification of blood
- D. Production of digestive enzymes

Answer: D

Sol:

The correct answer is Production of digestive enzymes. **Explanation** The liver produces bile {which emulsifies fats} but does not produce digestive enzymes like amylase, protease, or lipase. These are produced by the salivary glands, stomach, pancreas, and small intestine. **Additional Information**
· {a} Production of bile is a primary function of the liver.

- {b} The liver stores glucose in the form of glycogen.
- {c} The liver detoxifies various metabolites and drugs.

Q.15 Biome, largest recognizable assemblage of animals and plants on the Earth, is controlled mainly by :

- A. Biological activity
- B. Landforms
- C. Climate
- D. Soil

Answer: C

Sol: The correct answer is (c) Climate

Explanation:

- Climate is the primary factor that governs the formation, distribution and characteristics of global biomes.
- Temperature and precipitation patterns determine the vegetation type, which in turn supports specific animal communities.
- Variations in climate due to latitude and altitude lead to distinct biomes like tundra, deserts, grasslands, and tropical forests.
- Climate influences productivity, biodiversity and species adaptation in each biome.
- Major global biome patterns closely correspond with global climatic zones.

Information Booster:

- Terrestrial biomes are broadly classified based on long-term climate patterns.
- Climate affects soil formation, vegetation structure, and animal diversity.

Additional Knowledge:

Biological activity (Option a)

- Refers to living organisms within a biome.
- It is influenced by climate rather than controlling it.
- Organisms adapt to climatic conditions, not vice versa.

Landforms (Option b)

- Influence local climates (e.g., rain shadows in mountains) but do not determine global biome patterns.
- Only modify regional or local distribution of biomes.

Soil (Option d)

- Soil characteristics depend largely on climate (e.g., tropical red soils, tundra permafrost).
 - Soil influences vegetation but is not the primary determinant of biome boundaries.
-