UPCATET General Studies Sample Paper-4

Duration: 10 Minutes **Maximum Marks: 80**

Instructions

- This paper contains **20** Multiple Choice Questions.
- Each correct answer carries **+4** mark. Incorrect answer: **−1** marks. Only **one** correct option.
- Unattempted questions carry **0** marks.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. Following the annexation of Awadh, Maulvi Ahmadullah Shah mobilized an extensive underground intelligence and logistics network across Rohilkhand and the Faizabad frontier to challenge British authority. In the immediate buildup to the 1857 uprising, his administrative apparatus instituted an alternative localized tribunal network to handle civil grievances and systematically bypass the East India Company's regulations. Identify the exact institutional nomenclature used by his revolutionary administration for these decentralized parallel courts:

(A) Mahakama-e-Alya

(B) Diwan-e-Khas

(C) Nizamat Adalat

(D) Shahi Kachahri

Q2. The geological stratification of the Bundelkhand granitic complex in southern Uttar Pradesh exhibits deep-seated structural joints. Which specific geomorphological weathering feature dominates the landscape topography around Mahoba and Jhansi districts?

(A) Karst poljes

(B) Tors and inselbergs

(C) Oxbow depressions

(D) Lateritic mesas

Q3. The alignment of the ancient Northern Black Polished Ware (NBPW) trade route interconnected several Mahajanapadas across Uttar Pradesh. Identify the strategic riverine transit junction where the southern trade highway (Dakshinapatha) intersected the Ganges navigation corridor near the Vatsa kingdom boundary:

(A) Kashi

(B) Prayagraj

(C) Shravasti

(D) Ahichchhatra

Q4. An environmental soil analysis of the hydromorphic wetland ecosystems in the Terai belt of northern Uttar Pradesh reveals a highly distinct profile development influenced by seasonal waterlogging. In these perennially saturated lowlands, severe anoxia restricts microbial respiration, forcing a shift to anaerobic pathways where alternative electron acceptors are utilized. This persistent reduction process leads to the formation of a characteristic greenish-grey Gleyic horizon (Bw/Bg) at shallow depths. Identify the primary chemical condition dominant within this waterlogged zone that actively inhibits deep plant root penetration and limits agricultural productivity for non-adapted crops:

(A) High nitrate leaching

(B) Ferrous iron toxicity

(C) Calcium carbonate crusting

(D) Massive silica gelation

Q5. The medieval architecture of the Sharqi Dynasty in Jaunpur showcases a unique structural deviation from typical Delhi Sultanate designs. What specific architectural element replaces the traditional minarets on the main facade of the Atala Masjid?

(A) Fluted corner towers

(B) Monolithic central pillars

(C) Massive battered propylon screens

(D) Concentric corbelled arches

Q6. An agricultural scientist measures the transport rate of photoassimilates through the sieve tubes of an angiosperm stem. If the hydrostatic pressure gradient (ΔP) drops rapidly due to local xylem cavitation, what is the immediate regulatory response of the phloem cellular apparatus?

(A) Deposition of callose plugs

(B) Rapid synthesis of gibberellins

(C) Opening of voltage-gated aquaporins

(D) Hydrolysis of starch in companion cells

Q7. An environmental monitoring station detects a sharp spike in tropospheric photochemical smog indicators within an intensive urban agro-zone. During the complex atmospheric degradation of volatile organic compounds (VOCs) initiated by hydroxyl radicals, a cyclic chain propagation mechanism rapidly converts nitric oxide (NO) to nitrogen dioxide (NO_2). This acceleration bypasses the traditional ozone-consuming titration pathway, leading to a net accumulation of ground-level ozone. Identify the highly reactive, organic oxygen-centered intermediate free radical species that directly oxidizes NO to NO_2 while concurrently regenerating alkoxy radicals to sustain this catalytic smog-forming loop:

(A) Peroxyalkyl radical ($RO_2^{\bullet}$)

(B) Hydroxyl radical ($OH^{\bullet}$)

(C) Singlet oxygen atom ($O(^1D)$)

(D) Hydrogen peroxide radical ($HO_2^{\bullet}$)

Q8. During a routine veterinary diagnostic assay of livestock blood samples, a technician observes an abnormal shift in the oxyhemoglobin dissociation curve. The curve exhibits a significant rightward shift accompanied by a drop in oxygen affinity. Which biochemical trigger is responsible for this physiological transformation?

(A) Decreased local temperature

(B) Elevated 2,3-Bisphosphoglycerate

(C) Decreased partial pressure of CO_2

(D) Increased systemic pH value

Q9. A physical chemistry laboratory sets up an electrochemical configuration to measure the contamination of heavy metals in soil run-off water. If the ionic strength of the electrolyte solution is quadrupled, what happens to the thickness of the Debye-Hückel electrical double layer surrounding the colloidal clay particles?

(A) It increases by a factor of four

(B) It increases by a factor of two

(C) It decreases by half

(D) It remains completely unchanged

Q10. The First Administrative Reforms Commission (1966) recommended specific structural adjustments to streamline public sector undertakings in India. Which operational entity did the Commission propose to group interconnected industrial units under a unified policy umbrella?

(A) Joint Sector Holdings

(B) Departmental Undertakings

(C) Statutory Sector Boards

(D) Sector Corporations

Q11. Under the structural provisions of Article 312 of the Constitution of India, the Rajya Sabha passes a resolution to create a new All-India Service. What is the mandatory voting threshold required within the Upper House to legitimize this statutory initiative?

(A) Simple majority of total membership

(B) Absolute majority of members present

(C) Two-thirds of members present and voting

(D) Three-fourths of total effective strength

Q12. An economic assessment of post-independence land reforms in India highlights the microeconomic challenges of tenancy laws. In regions where the tenancy legislation granted permanent ownership rights to sharecroppers, what unintended market failure immediately emerged in the rural credit ecosystem?

(A) Complete collapse of formal cooperative banks

(B) Disappearance of informal tenancy as land collateral

(C) Exponential deflation of agricultural wages

(D) Hyperinflation of minor irrigation input costs

Q13. The 14th Finance Commission introduced an explicit fiscal weightage metric to balance regional environmental parity across Indian states. Which objective parameter was incorporated into the horizontal devolution formula for the very first time during this cycle?

(A) Carbon emission reduction index

(B) Forest canopy cover density

(C) Groundwater depletion mitigation rate

(D) Solid waste management efficiency

Q14. The International Olympic Committee (IOC) recently revised its operational framework concerning the biomechanical evaluation of athletic equipment performance. Which technical metric is now universally regulated to restrict the unfair mechanical energy return in advanced carbon-plated marathon footwear?

(A) Longitudinal bending stiffness

(B) Midsole stack height threshold

(C) Outsole traction coefficient

(D) Heel-to-toe drop ratio

Q15. The Ministry of Culture recently designated an ancient archaeological landscape in Uttar Pradesh for systematic preservation under the digital heritage mapping project. Which site, showcasing pre-Mauryan defensive fortification ramparts and advanced baked brick water conduits, was selected?

(A) Hulaskhera

(B) Sringverpur

(C) Kampil

(D) Sanauli

Q16. The UNESCO Intergovernmental Committee for the Safeguarding of the Intangible Cultural Heritage recently updated its evaluation criteria. Which critical structural parameter must a traditional performing art form demonstrate to qualify for the Emergency Safeguarding List rather than the Representative List?

(A) Absence of commercialized documentation

(B) Disruption of intergenerational transmission modes

(C) Exclusive reliance on localized organic instruments

(D) Absolute geographical isolation of practitioners

Q17. Under the latest international trade agreements tracking carbon-border adjustment mechanisms, agricultural exports from developing nations face stringent verification. Which specific matrix must Indian agro-exporters monitor to prevent punitive tariffs on dairy and livestock shipments?

(A) Embedded methane equivalent emissions

(B) Direct nitrous oxide runoff mass

(C) Net embedded water volume profile

(D) Biomass transformation energy efficiency

Q18. A network engineer configures an advanced routing matrix utilizing IPv6 protocols. During the header compression routine, which specific field within the standard IPv6 base header is eliminated or modified to optimize transit through low-power wide-area networks (LPWANs)?

(A) Flow Label

(B) Next Header

(C) Hop Limit

(D) Payload Length

Q19. A computer architect evaluates the latency performance of volatile memory subsystems. During a standard Dynamic Random-Access Memory (DRAM) cell refresh operation, the destructive nature of the initial read charge-sharing phase requires an explicit restoration cycle. Identify the exact hardware operational phase where the active sense amplifiers drive the bitline potentials to their full rails, thereby restoring the degraded charge state of the storage capacitor back to its nominal reference potential before the precharge command can be safely issued:

(A) Column Address Strobe Latency

(B) Row Buffer Write-Back

(C) Burst Chop Modulation

(D) Memory Bus Interleaving Phase

Q20. In cryptography and network security architectures protecting cloud databases, a zero-knowledge succinct non-interactive argument of knowledge (zk-SNARK) relies heavily on a mathematical primitive. Which algebraic system serves as its foundation?

(A) Elliptic curve pairing groups

(B) Non-commutative ring matrices

(C) High-dimensional lattice vectors

(D) Prime field quadratic residues

Detailed Solutions

Q1.

Solution

Concept: During the 1857 Uprising, Maulvi Ahmadullah Shah (famously known as the 'Maulvi of Faizabad') emerged as an outstanding strategist and leader of the resistance against the East India Company. Upon consolidating authority across areas of Awadh and Rohilkhand, the revolutionaries focused on replacing the colonial administrative machinery with an alternative system to gain local legitimacy.

Solution:

Let's analyze the structural nomenclature used by the revolutionary administration:

(a) To challenge the oppressive regulatory courts of the East India Company, Maulvi Ahmadullah Shah's revolutionary government established localized parallel tribunals.

(b) These decentralized courts were named **Shahi Kachahri** (Royal Courts).

(c) The **Shahi Kachahri** network was designed to resolve civil grievances, adjudicate property disputes, and manage law and order using traditional parameters, systematically bypassing British statutory regulations.

(d) Other terms like *Nizamat Adalat* represent the pre-existing provincial criminal courts of the Mughal/Nawabi eras, while *Diwan-e-Khas* refers to the classic imperial hall of private audience.

Final Answer: Shahi Kachahri

Answer: (D)

Go Back to Question 1

Q2.

Solution

Concept: The Bundelkhand upland region in southern Uttar Pradesh is physically characterized by the ancient Bundelkhand Granitic Complex (dating back to the Archean era). This highly stable cratonic block has undergone millions of years of subaerial weathering, denudation, and exfoliating tectonic processes.

Solution:

Let's identify the dominant landforms produced by weathering this granitic complex:

(a) Granite features distinct orthogonal or horizontal joint networks. When subjected to physical weathering and chemical spheroidal exfoliation, the rock joints weather unevenly.

(b) This results in the formation of **tors** (isolated, pile-like jointed blocks of exposed granite) and **inselbergs** (isolated, prominent residual rocky hills rising abruptly from smooth plains).

(c) These **tors and inselbergs** create the distinctive rugged, boulder-strewn landscape topography seen throughout the Mahoba, Jhansi, and Banda districts of southwestern Uttar Pradesh.

(d) Karst features are specific to limestone terrain, oxbow depressions are riverine features, and lateritic mesas require continuous humid tropical cycles capping flat plateaus.

Final Answer: Tors and inselbergs

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept: During the 6th century BCE, the Northern Black Polished Ware (NBPW) cultural phase coincided with the rise of urban centers and major trans-continental trade highways across the Mahajanapadas of Northern India.

Solution:

Let's analyze the geographic intersection points of the ancient trade routes:

(a) The **Uttarapatha** (Northern Highway) ran parallel to the Indo-Gangetic plains, connecting cities like Shravasti and Ahichchhatra.

(b) The **Dakshinapatha** (Southern Highway) wound northward from the Deccan, carrying mineral wealth and commodities toward the heart of the fertile plains.

(c) These two critical trade trajectories converged at **Prayagraj** (located at the confluence of the Ganges and Yamuna rivers), positioned right at the strategic border of the prosperous *Vatsa* kingdom (whose capital was Kausambi).

(d) This riverine transit junction allowed merchants to seamlessly transition between overland highways and the busy Ganges navigation corridor.

Final Answer: Prayagraj

Answer: (B)

Go Back to Question 3

Q4.

Solution

Concept: Gleying occurs in soils that are waterlogged for extended periods. When oxygen is completely depleted by microbial activity, the soil environment becomes highly reducing, altering the chemical state of metals like iron.

Solution:

Let's trace the biochemical adjustments in anoxic wetland soils:

(a) In the perennially saturated lowlands of the Terai belt, anoxia forces microbes to use ferric iron (Fe^{3+}) as an alternative electron acceptor, reducing it into highly soluble **ferrous iron (Fe^{2+})**.

(b) This accumulation of reduced iron gives the Gleyic horizon its characteristic greenish-grey color.

(c) In these perennially waterlogged horizons, the excessive concentration of soluble Fe^{2+} leads to severe **ferrous iron toxicity**.

(d) This toxic chemical condition damages root tissue, blocks essential nutrient uptake, and inhibits deep root penetration for standard, non-adapted agricultural crops, limiting overall soil productivity.

Final Answer: Ferrous iron toxicity

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: The Sharqi architecture style of Jaunpur (14th–15th century) developed a distinct provincial character that departed from the imperial conventions of the Delhi Sultanate, creating massive structures with independent aesthetic elements.

Solution:

Let's evaluate the structural features of the Atala Masjid facade:

(a) A notable characteristic of the Sharqi style is the complete absence of traditional, isolated minarets at the front corners of the prayer hall facade.

(b) Instead, the central bay of the main facade is dominated by a **massive, battered propylon screen** (a monumental pylon or pylon-like gateway structure with sloping walls).

(c) This towering propylon screen stands directly in front of the main dome, concealing it from the front courtyard and giving the mosque entrance a unique, majestic appearance that came to define Sharqi religious architecture.

Final Answer: Massive battered propylon screens

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept: According to the Münch pressure-flow hypothesis, organic solutes move through phloem sieve tubes driven by a hydrostatic pressure gradient (ΔP) generated between source and sink tissues. This phloem transport system is mechanically linked to the high-tension water column running through adjacent xylem vessels.

Solution:

Let's trace the response to an abrupt pressure drop in the vascular bundle:

(a) When cavitation occurs in the xylem, the sudden release of tension can break the hydraulic balance, causing a rapid drop in the adjacent phloem's hydrostatic pressure.

(b) To prevent the loss of sap or a complete reversal of translocation flow, the phloem must seal off the affected areas immediately.

(c) The phloem cellular apparatus responds by triggering the **deposition of callose plugs** (a β-1,3-glucan polymer) at the sieve plates.

(d) This callose deposition, along with the aggregation of structural P-proteins, acts like an emergency structural valve, quickly blocking the sieve pores to isolate the damaged vascular segment.

Final Answer: Deposition of callose plugs

Answer: (A)

Go Back to Question 6

Q7.

Solution

Concept: Photochemical smog forms through complex, sunlight-driven reactions involving nitrogen oxides (NO_x) and volatile organic compounds (VOCs). The rapid generation of ground-level ozone relies on converting NO to NO_2 without consuming existing ozone molecules.

Solution:

Let's break down the atmospheric radical chain propagation mechanism:

(a) Hydroxyl radicals ($OH^\bullet$) react with ambient hydrocarbons (RH) to yield alkyl radicals ($R^\bullet$), which instantly combine with molecular oxygen (O_2) to produce a **peroxyalkyl radical ($RO_2^\bullet$)**.

(b) This highly reactive, organic oxygen-centered intermediate ($RO_2^\bullet$) directly attacks nitric oxide, oxidizing it:

$$RO_2^\bullet + NO \rightarrow RO^\bullet + NO_2$$

(c) This step converts NO to NO_2 while regenerating an alkoxy radical ($RO^\bullet$) to keep the catalytic smog cycle spinning.

(d) Because this reaction bypasses the standard titration pathway ($NO + O_3 \rightarrow NO_2 + O_2$), the accumulated NO_2 can photolyze freely under sunlight ($NO_2 + h\nu \rightarrow NO + O$), releasing free oxygen atoms that combine with O_2 to drive a net build-up of ground-level ozone.

Final Answer: Peroxyalkyl radical ($RO_2^\bullet$)

Answer: (A)

Go Back to Question 7

Q8.

Solution

Concept: The oxyhemoglobin dissociation curve illustrates how hemoglobin binds and releases oxygen in response to varying partial pressures of oxygen (pO_2). A rightward shift means hemoglobin has a lower affinity for oxygen, making it easier to unload oxygen into peripheral tissues.

[Image of oxyhemoglobin dissociation curve right shift]

Solution:

Let's review the biochemical factors that cause a rightward shift in this curve (the Bohr effect and related adaptations):

(a) Factors that stabilize the low-affinity deoxygenated state (T-state) of hemoglobin shift the curve to the right.

(b) These biochemical triggers include:

- Increased partial pressure of carbon dioxide (pCO_2)
- Decreased pH (increased acidity/hydrogen ion concentration)
- Increased local tissue temperature
- **Elevated 2,3-Bisphosphoglycerate (2,3-BPG)**

(c) **2,3-BPG** binds explicitly to the central cavity of the hemoglobin tetramer, stabilizing the T-state. This interaction directly drops hemoglobin's oxygen affinity and causes a significant rightward shift, aiding oxygen delivery during periods of tissue hypoxia.

Final Answer: Elevated 2,3-Bisphosphoglycerate

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept: According to the Debye-Hückel theory for electrical double layers surrounding charged colloidal particles, the thickness of the diffuse double layer (often called the Debye length, κ^{-1}) is inversely proportional to the square root of the ionic strength (I) of the bulk electrolyte solution.

Solution:

Let's evaluate this relationship mathematically using the Debye length equation:

$$\kappa^{-1} = \sqrt{\frac{\varepsilon_r \varepsilon_0 k_B T}{2 N_A e^2 I}} \propto \frac{1}{\sqrt{I}}$$

(a) Let the initial thickness be κ_1^{-1} at an initial ionic strength I_1.

(b) If the ionic strength is quadrupled, the new ionic strength becomes $I_2 = 4I_1$.

(c) Substituting this value into our proportionality ratio gives:

$$\kappa_2^{-1} \propto \frac{1}{\sqrt{4I_1}} = \frac{1}{2\sqrt{I_1}} = \frac{1}{2}\kappa_1^{-1}$$

(d) Increasing the ion concentration compresses the electrical double layer around the colloidal clay particles, causing its overall thickness to **decrease by half**.

Final Answer: It decreases by half

Answer: (C)

Go Back to Question 9

Q10.

Solution

Concept: The First Administrative Reforms Commission (1966), chaired initially by Morarji Desai, evaluated the organizational design of public sector undertakings (PSUs) to improve operational autonomy while maintaining public accountability.

Solution:

Let's analyze the structural recommendations of the 1966 Commission:

(a) The Commission noticed that many public sector units operated as isolated entities, leading to fragmented policies, duplicated efforts, and poor coordination in related industries.

(b) To fix this, the Commission proposed creating **Sector Corporations**.

(c) These **Sector Corporations** were designed to act as unified holding companies, grouping interconnected industrial units (e.g., iron and steel, coal, or chemicals) under a single broad policy umbrella. This structure streamlined multi-unit management while protecting day-to-day operational flexibility from direct ministerial interference.

Final Answer: Sector Corporations

Answer: (D)

Go Back to Question 10

Q11.

Solution

Concept: Article 312 of the Constitution of India grants special powers to the Rajya Sabha (the Upper House of Parliament) regarding the creation of new All-India Services common to both the Union and the States.

Solution:

Let's look at the statutory voting requirements laid down in Article 312:

(a) To protect the principles of federalism, a new All-India Service cannot be created by a regular legislative act alone. It must be initiated by the Rajya Sabha, which represents the states.

(b) Article 312 specifies that the Rajya Sabha must pass a formal resolution declaring that the creation of a new service is necessary or expedient in the national interest.

(c) This resolution requires a specific voting threshold: it must be supported by **not less than two-thirds of the members present and voting**.

(d) Once this threshold is met, Parliament gains the constitutional authority to establish the new service by law.

Final Answer: Two-thirds of members present and voting

Answer: (C)

Go Back to Question 11

Q12.

Solution

Concept: Post-independence tenancy reforms aimed to protect vulnerable sharecroppers by regulating rents, providing security of tenure, and granting land ownership rights to long-term tenants.

Solution:

Let's look at the microeconomic impact of these land laws on the rural credit market:

(a) In traditional rural economies, informal moneylenders routinely used land lease agreements or the value of future crop shares as implicit collateral to back small agricultural loans.

(b) When land reforms granted permanent ownership rights to sharecroppers, landlords lost the ability to evict tenants, and informal tenancy agreements became legally high-risk or unenforceable.

(c) This caused an immediate market failure: the **disappearance of informal tenancy as land collateral**.

(d) Afraid of losing ownership rights to their properties permanently, landowners stopped leasing out land openly. This froze informal lease markets and cut off poor tenants' access to traditional credit lines.

Final Answer: Disappearance of informal tenancy as land collateral

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: The Fourteenth Finance Commission (2015–2020), chaired by Dr. Y. V. Reddy, introduced structural updates to the horizontal fiscal devolution formula to compensate states for maintaining public goods that benefit the entire nation.

Solution:

Let's look at the new horizontal devolution criteria introduced in this cycle:

(a) Previous Finance Commissions used general population, area, and income distance metrics to distribute revenue among states.

(b) Recognizing that protecting green ecosystems carries significant economic costs and limits industrial development, the 14th Finance Commission introduced an explicit environmental parameter.

(c) This objective parameter was **Forest Canopy Cover Density**, assigned a dedicated weight of 7.5% in the horizontal distribution formula. This change rewarded states for maintaining dense forest environments, marking the first time a direct green canopy metric was integrated into fiscal devolution.

Final Answer: Forest canopy cover density

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept: The introduction of advanced, high-stack marathon running shoes featuring hyper-resilient polymer foams and embedded carbon-fiber plates revolutionized long-distance running performance, raising regulatory questions about mechanical advantages.

Solution:

Let's look at the technical limits established by international sports governing bodies:

(a) The carbon-fiber plate embedded within modern running midsoles acts like a lever, optimizing the ankle joint's biomechanical working angle and reducing energy loss during toe-off.

(b) To prevent shoes from acting like literal mechanical springs, the International Olympic Committee (IOC) and World Athletics introduced strict structural limits.

(c) The foundational rule sets a firm **midsole stack height threshold** (capped at a maximum thickness of **40 mm** for road events). This limit controls the total volume of energy-returning foam a shoe can contain, ensuring a level playing field.

Final Answer: Midsole stack height threshold

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept: Uttar Pradesh contains several historical settlements dating back to the Vedic and Mahajanapada periods. Modern digital heritage initiatives use advanced mapping to preserve these ancient engineering layouts.

Solution:

Let's evaluate the engineering features of the historic sites listed:

(a) **Sringverpur**, located near Prayagraj, is celebrated for its highly advanced, multi-tank baked brick water filtration and tank network dating to the late 1st century BCE.

(b) Excavations at this ancient landscape uncovered massive pre-Mauryan defensive fortification ramparts alongside an intricate, **advanced baked brick water conduit system** designed to manage water flow from the Ganges River channel.

(c) This exceptional hydraulic engineering site was selected for systematic preservation under the digital heritage mapping project to document its early architectural design.

Final Answer: Sringverpur

Answer: (B)

Go Back to Question 15

Q16.

Solution

Concept: The UNESCO convention for safeguarding Intangible Cultural Heritage uses different inventory structures depending on the stability and survival risk of a traditional art or cultural expression.

Solution:

Let's identify the core requirement for the Emergency Safeguarding List:

(a) The *Representative List* celebrates and raises awareness of viable cultural traditions that continue to thrive within communities.

(b) The *List of Intangible Cultural Heritage in Need of Urgent Safeguarding* is reserved for expressions facing immediate threats to their survival.

(c) To qualify for this emergency designation, a cultural expression must demonstrate a severe **disruption of intergenerational transmission modes** (such as a lack of young apprentices, the passing of elderly master practitioners, or a breakdown in oral teaching traditions). Without immediate international intervention, the art form faces complete extinction.

Final Answer: Disruption of intergenerational transmission modes

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept: Carbon-border adjustment mechanisms (CBAM) apply environmental tariffs to carbon-intensive imports to prevent companies from bypassing emissions targets by moving production to regions with weaker climate policies.

Solution:

Let's identify the critical emission focus for livestock and dairy exports:

(a) While heavy industries like steel and cement are judged primarily on carbon dioxide (CO_2) emissions, the agricultural sector faces different verification metrics under international trade frameworks.

(b) For dairy and livestock shipments, the primary environmental impact stems from enteric fermentation and manure management.

(c) Consequently, exporters must carefully monitor and report the **embedded methane equivalent emissions** associated with their supply chains to avoid punitive border tariffs.

Final Answer: Embedded methane equivalent emissions

Answer: (A)

Go Back to Question 17

Q18.

Solution

Concept: Low-Power Wide-Area Networks (LPWANs), such as LoRaWAN or NB-IoT, operate under tight energy constraints and small maximum transmission unit (MTU) sizes. Running standard IPv6 over these networks requires header compression techniques (like 6LoWPAN) to reduce packet overhead.

Solution:

Let's examine the structure of the 40-byte standard IPv6 base header:

(a) The IPv6 base header contains fields like Version, Traffic Class, Flow Label, Payload Length, Next Header, Hop Limit, Source Address, and Destination Address.

(b) In a highly constrained LPWAN environment, the **Payload Length** field can be entirely eliminated or compressed during header adaptation.

(c) Because the underlying link layer protocol already calculates and provides the frame length information at the network interface layer, the upper transport layer can deduce the **Payload Length** without needing to transmit this field explicitly in every packet header.

Final Answer: Payload Length

Answer: (D)

Go Back to Question 18

Q19.

Solution

Concept: Dynamic Random-Access Memory (DRAM) stores each bit of data as an electrical charge within a tiny capacitor. Because these capacitors naturally leak charge over time, DRAM requires regular refresh cycles to preserve data integrity.

Solution:

Let's trace the hardware stages of a DRAM access and refresh sequence:

(a) When a row is activated, the charge from the storage capacitor shares its potential with the bitline. This charge-sharing phase is destructive, significantly degrading the original charge state of the capacitor.

(b) To prevent data loss, the active sense amplifiers detect this small change, compare it to a reference voltage, and amplify the signal.

(c) During the **Row Buffer Write-Back** phase, these sense amplifiers drive the bitlines to their full voltage rails (logical high or low).

(d) This full voltage potential flows back through the open access transistor, completely recharging the storage capacitor to its nominal reference potential. Once this restoration is complete, a precharge command can be safely issued to clear the lines for the next cycle.

Final Answer: Row Buffer Write-Back

Answer: (B)

Go Back to Question 19

Q20.

Solution

Concept: Zero-knowledge succinct non-interactive arguments of knowledge (zk-SNARKs) use advanced cryptographic structures to let one party prove a statement is true without revealing any underlying data.

Solution:

Let's isolate the foundational mathematical primitive used in these protocols:

(a) To achieve non-interactive proofs and brief verification times, zk-SNARKs require a mathematical system that supports non-linear evaluations of encrypted data.

(b) This capability is provided by **elliptic curve pairing groups** (bilinear pairings over specific cryptographic elliptic curves, such as BN254 or BLS12-381).

(c) These bilinear pairings allow a system to securely verify multiplications of hidden values across different algebraic groups, providing the core mathematical engine that makes modern zk-SNARK architectures possible.

Final Answer: Elliptic curve pairing groups

Answer: (A)

Go Back to Question 20

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	D	2	B	3	B	4	B	5	C
6	A	7	A	8	B	9	C	10	D
11	C	12	B	13	B	14	B	15	B
16	B	17	A	18	D	19	B	20	A