UPCATET General Studies Sample Paper-1

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. During the 1857 uprising, the revolutionary administration in Bareilly was structurally consolidated under Khan Bahadur Khan. Which specific British officer was assigned the field command to breach these defenses and ultimately recaptured Bareilly in May 1858?

(A) Colin Campbell

(B) Henry Havelock

(C) James Outram

(D) John Nicholson

Q2. The dynamic seasonal shifting of the Intertropical Convergence Zone (ITCZ) over the Indo-Gangetic plains directly influences the onset of the Southwest monsoon. What specific low-pressure structural transition characterizes the ITCZ position over Uttar Pradesh during the peak of July?

(A) Subtropical West Jet Convergence

(B) Monsoon Trough deployment

(C) Tibetan Anticyclone inversion

(D) Mascarene High pressure ridge

Q3. Which of the following archaeological sites situated within the Belan Valley of

Uttar Pradesh provides the definitive, unbroken chronological transition from the Upper Paleolithic directly through the Neolithic phase?

(A) Chopani-Mando

(B) Koldihwa

(C) Mahagara

(D) Sarai Nahar Rai

Q4. The 'Tarai' geomorphic zone extending across northern Uttar Pradesh features dense swampy conditions, high water tables, and thick silty alluvial deposits. Which specific structural tectonic fault demarcates the northernmost limit where this zone interfaces with the Shivalik foothills?

(A) Main Boundary Thrust (MBT)

(B) Himalayan Frontal Fault (HFF)

(C) Main Central Thrust (MCT)

(D) Indo-Gangetic Basinal Fault

Q5. In the structural execution of the Permanent Settlement system (1793) introduced in the Varanasi division of Uttar Pradesh, what precise percentage of the collected rental assets was legally designated to be deposited with the East India Company Treasury?

(A) 50%

(B) 75%

(C) 89%

(D) 91%

Q6. A biological assay measures the accumulation of a persistent lipophilic organochlorine insecticide within an aquatic ecosystem. If the concentration in the primary phytoplankton is 0.04 ppm, what is the most scientifically sound projected concentration inside the tertiary avian predators due to biomagnification dynamics?

(A) 0.01 ppm

(B) 0.04 ppm

(C) 2.50 ppm

(D) 75.0 ppm

Q7. A high-altitude agricultural facility monitors the physiological changes in crops during sudden frost episodes. Which biochemical adaptation directly protects winter-hardy varieties against cellular lysis caused by ice crystal propagation in the extracellular matrix?

(A) Rapid synthesis of hydrophilic osmoprotectant proteins

(B) Sudden accumulation of insoluble starch within the leucoplasts

(C) Upregulation of proton-pumping apical vacuolar ATPases

(D) Structural degradation of the secondary cellulose matrix

Q8. In an enclosed biochemical wastewater processing reactor, specialized anaerobic bacteria convert nitrate ions directly into dinitrogen gas (N_2). Which specific enzyme system catalyzes the rate-limiting terminal step of this global nitrogen cycle pathway?

(A) Nitrate Reductase

(B) Nitrite Oxidoreductase

(C) Nitrous Oxide Reductase

(D) Ammonia Monooxygenase

Q9. During a standard laboratory soil assay, an agronomist applies an intense electrical field to a colloidal solution of montmorillonite clay particles. What physical parameter defines the exact velocity of these suspended particles toward the anode interface?

(A) Hydrostatic Turgor Potential

(B) Zeta Potential

(C) Cation Exchange Saturation Index

(D) Flocculation Threshold Ratio

Q10. Under the structural provisions of Article 356 of the Constitution of India, a state is placed under President's Rule. If both Houses of Parliament fail to pass a resolving statutory approval within the mandatory timeline, what is the exact operational survival period of the initial Proclamation?

(A) 14 days

(B) 30 days

(C) 2 months

(D) 6 months

Q11. During the structural design of the Tenth Five-Year Plan (2002–2007) of India, the Planning Commission shifted its development metrics. What specific core structural element was introduced to differentiate it from previous macroeconomic planning designs?

(A) Introduction of Indicative Planning matrices

(B) State-wise breakdown of developmental targets to monitor regional disparities

(C) Absolute nationalization of commercial agricultural credit lines

(D) Complete elimination of the public sector capital expenditure allocation

Q12. By which precise legal and structural mechanism does the Finance Commission of India calculate the horizontal fiscal devolution coefficient to compensate states featuring severe geographical and cost disabilities?

(A) Fiscal Capacity Distance and Forest/Ecology metrics

(B) Performance-based budgetary allocation indices

(C) Direct population density inversion ratios

(D) Debt-to-GSDP historical compliance coefficients

Q13. The historic zamindari abolition legislations passed in post-independence Uttar Pradesh structurally transformed rural land tenancy patterns. Which specific legal

category of land rights emerged to grant permanent, heritable, and transferable cultivation permissions without revenue intermediaries?

(A) Sirdar tenancy

(B) Bhumidhar with transferable rights

(C) Asami sub-lessee

(D) Adhivasi temporary occupant

Q14. The archaeological excavation campaigns conducted at Sanouli in western Uttar Pradesh exposed a highly sophisticated Bronze Age necropolis. Which specific structural artifact recovered from this site revolutionized the historical understanding of warfare mechanics in ancient India?

(A) Solid-wheeled, copper-sheathed horse-drawn chariots

(B) Iron-reinforced defensive breastplates

(C) Monolithic granaries with sub-floor ventilation

(D) Segmented faience bead necklaces

Q15. In the classical grammar of Hindustani classical music, the Gwalior Gharana structural framework emphasizes a specific compositional presentation format. Which stylistic element directly characterizes this school compared to the Kirana Gharana?

(A) Exclusive focus on continuous, slow sargam-alap patterns

(B) Direct deployment of straight, robust 'Aakar' tans and systematic bandish frameworks

(C) Total elimination of the fast-paced Tarana format

(D) Integration of microtonal Carnatic raga gamakas

Q16. A tracking report analyzes international supply chain disruptions stemming from shifts in maritime choked points. If the Bab-el-Mandeb strait undergoes a total operational closure, which primary agricultural export vector from Northern India is economically impacted?

(A) Basmati rice shipments bound for Western European and Mediterranean ports

(B) Inland tea trade lanes targeting Far East Asian nations

(C) Fresh mango air-freight corridors to South American markets

(D) Pulse imports arriving via Eastern Pacific marine vessels

Q17. During high-performance athletic training optimization, sports scientists evaluate the lactate threshold velocity of marathon athletes. What cellular biochemical event marks the transition beyond this threshold during prolonged physical exertion?

(A) Complete depletion of intramuscular triacylglycerol pools

(B) Intracellular accumulation of pyruvate exceeding the oxidation rate of the citric acid cycle

(C) Structural breakdown of myosin heavy chain complex filaments

(D) Rapid systemic shift to absolute beta-oxidation mechanics

Q18. In the context of modern data network transport layers, what specific structural mechanism does the Transmission Control Protocol (TCP) deploy to dynamically manage sliding window sizes and prevent receiver buffer saturation?

(A) Cyclic Redundancy Checksum adjustment

(B) Flow Control via Explicit Congestion Notification (ECN) bytes

(C) Symmetric Cryptographic key refreshing

(D) Asynchronous Time-Division Multiplexing

Q19. A database architect implements a relational database management system (RDBMS) configured for enterprise logistics. Which mathematical criteria ensures that all non-prime attributes are completely and non-transitively dependent on the primary key structural domain?

(A) First Normal Form (1NF)

(B) Second Normal Form (2NF)

(C) Third Normal Form (3NF)

(D) Boyce-Codd Normal Form (BCNF)

Q20. An agricultural monitoring network deploys Internet of Things (IoT) edge computing nodes across field matrices. Which specialized lightweight application layer protocol is designed for these low-bandwidth, high-latency, and power-constrained remote telemetry connections?

(A) Hypertext Transfer Protocol Secure (HTTPS)

(B) Message Queuing Telemetry Transport (MQTT)

(C) Simple Mail Transfer Protocol (SMTP)

(D) File Transfer Protocol (FTP)

Detailed Solutions

Q1.

Solution

Concept: During the 1857 Indian Uprising, Bareilly in Rohilkhand emerged as a major center of revolutionary resistance under the leadership of Khan Bahadur Khan, a grandson of Hafiz Rahmat Khan. The British launched a coordinated military campaign in the spring of 1858 to systematically recapture these lost territories.

Solution:

Let's review the historical facts regarding the British military commanders involved:

(a) General **Colin Campbell** (later Lord Clyde) was the Commander-in-Chief of the British forces in India charged with crushing the uprising.

(b) After successfully clearing Lucknow, Campbell personally organized and directed a multi-pronged offensive against the revolutionary stronghold at Bareilly in May 1858.

(c) British columns converged on the city, and Campbell's forces defeated Khan Bahadur Khan's defensive lines, resulting in the successful recapture of Bareilly on May 7, 1858.

(d) Other officers like Henry Havelock and James Outram are primarily associated with the relief and defense of Lucknow, while John Nicholson was mortally wounded during the siege of Delhi in September 1857.

Final Answer: Colin Campbell

Answer: (A)

Go Back to Question 1

Q2.

Solution

Concept: The Intertropical Convergence Zone (ITCZ) is a low-pressure belt where the trade winds of the Northern and Southern Hemispheres converge. During the Northern Hemisphere summer, intense solar heating over the South Asian landmass draws the ITCZ far north of the equator.

Solution:

Let's analyze the atmospheric patterns over Northern India during high summer:

(a) By July, the intense thermal heating of the Indo-Gangetic plains shifts the ITCZ northward to sit roughly parallel to the Himalayas, positioning it directly over states like Uttar Pradesh.

(b) In this regional context, this shifted low-pressure axis is termed the **Monsoon Trough**.

(c) The **Monsoon Trough deployment** acts as a giant low-pressure sink that pulls moisture-laden Southwest monsoon winds from the Indian Ocean deep into the Indian subcontinent, driving peak monsoon precipitation across Northern India.

Final Answer: Monsoon Trough deployment

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept: The Belan Valley in the Prayagraj (Allahabad) and Mirzapur districts of Uttar Pradesh is one of the most vital prehistoric regions in South Asia, containing a deep, stratified sequence of human cultural evolution.

Solution:

Let's evaluate the cultural stratifications of the key Belan Valley sites:

(a) **Koldihwa** and **Mahagara** are primarily celebrated for their Neolithic settlements and early evidence of domesticated rice cultivation.

(b) **Sarai Nahar Rai** is a prominent Mesolithic site located in the nearby Pratapgarh district.

(c) The site of **Chopani-Mando**, situated on the banks of the Belan River, provides a complete, stratified, and unbroken sequence of cultural transition. Excavations there trace human occupation continuously from the **Upper Paleolithic**, through the early and late **Mesolithic** (featuring early handmade pottery), and directly into the settled **Neolithic** phase.

Final Answer: Chopani-Mando

Answer: (A)

Go Back to Question 3

Q4.

Solution

Concept: The northern plains of India transition through distinct geomorphic zones moving southward from the outermost Himalayas (Shivalik range). These boundaries are defined by deep structural faults created by the ongoing collision of the Indian and Eurasian tectonic plates.

Solution:

Let's look at the tectonic boundaries of the Himalayan foothills:

(a) The Main Central Thrust (MCT) separates the Greater Himalayas from the Lesser Himalayas, while the Main Boundary Thrust (MBT) separates the Lesser Himalayas from the Shivaliks.

(b) The outermost structural boundary where the Shivalik sedimentary hills meet the flat alluvial Indo-Gangetic plains is the **Himalayan Frontal Fault (HFF)**, also known as the Main Frontal Thrust (MFT).

(c) Right below this fault zone, coarse boulders form the dry Bhabar belt, which transitions immediately into the marshy, high-water-table **Tarai** zone. Therefore, the **Himalayan Frontal Fault (HFF)** marks the true tectonic boundary separating the mountainous Shivaliks from the low-lying northern plains of Uttar Pradesh.

Final Answer: Himalayan Frontal Fault (HFF)

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: The Permanent Settlement system, introduced by Governor-General Lord Cornwallis in 1793, fixed land revenue demands in perpetuity. It converted traditional revenue collectors (Zamindars) into absolute landlords, subject to strict revenue division rules.

Solution:

Let's review the legal revenue split dictated by the Permanent Settlement:

(a) Under the statutory terms of the settlement, the total rental assets collected by a Zamindar from the tenant cultivators were split into eleven equal parts.

(b) Ten out of eleven parts—amounting to exactly **89%** ($\frac{10}{11}$) of the total collections—were legally required to be deposited directly into the East India Company Treasury.

(c) The remaining one part—equal to **11%** ($\frac{1}{11}$)—was retained by the Zamindar as remuneration for managing collections. This rigid framework was applied to Bengal, Bihar, and extended into the Varanasi division of modern Uttar Pradesh.

Final Answer: 89%

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept: Biomagnification refers to the progressive increase in the concentration of persistent, lipophilic (fat-soluble), and non-biodegradable substances (such as organochlorine insecticides) at higher trophic levels in a food chain.

Because these compounds are not easily metabolized or excreted, they accumulate in the fatty tissues of organisms. When predators consume prey, they ingest the accumulated toxins of all the organisms lower in the food chain. Typically, the concentration of the chemical increases by roughly a factor of 10 to 100 times (often averaging about a 10-fold increase per trophic level) as energy moves up the ecological pyramid: Phytoplankton (Producers: 0.04 ppm) $\rightarrow$ Zooplankton $\rightarrow$ Small Fish $\rightarrow$ Large Fish $\rightarrow$ Top Avian Predators

Solution: Given the initial concentration in the primary producers (phytoplankton) is 0.04 ppm:

$$\text{Trophic Level 1 (Phytoplankton)} = 0.04 \text{ ppm}$$

$$\text{Trophic Level 2 (Primary Consumers / Zooplankton)} \approx 0.04 \times 10 = 0.4 \text{ ppm}$$

$$\text{Trophic Level 3 (Secondary Consumers / Small Fish)} \approx 0.4 \times 10 = 4.0 \text{ ppm}$$

$$\text{Trophic Level 4 (Tertiary Consumers / Avian Predators)} \approx 4.0 \times 10 = 40.0 \text{ ppm to } 75.0 \text{ ppm}$$

Evaluating the given options:

- (A) 0.01 ppm and (B) 0.04 ppm represent a decrease or no change, which contradicts biomagnification.
- (C) 2.50 ppm only accounts for a very minor increase across three trophic transfers.
- (D) 75.0 ppm perfectly aligns with a strong biomagnification factor ($\approx$ 1875$\times$ overall increase from producer to tertiary predator, falling well within standard ecological dynamics for stable organochlorines like DDT).

Therefore, 75.0 ppm is the only scientifically sound projected concentration.

Final Answer: 75.0 ppm

Answer: (D)

Go Back to Question 6

Q7.

Solution

Concept: When temperatures drop below freezing, ice crystals expand within the extracellular spaces of plant tissues. This ice formation draws pure water out of the cells, causing severe intracellular dehydration and mechanical stress that can rupture cell membranes (cellular lysis).

Solution:

Let's evaluate how cold-hardy plants adapt to avoid this damage:

(a) To protect their cells from collapsing, freeze-tolerant crops initiate a rapid protective biochemical response.

(b) They trigger the **rapid synthesis of hydrophilic osmoprotectant proteins** (such as late embryogenesis abundant [LEA] proteins, dehydrins, and antifreeze proteins) alongside soluble sugars like sucrose and proline.

(c) These highly hydrophilic molecules accumulate within the cytoplasm and extracellular matrices. They bind water molecules tightly, depressing the freezing point of the cell fluids and preventing large, sharp ice crystals from propagating, thereby shielding cell membranes from physical rupture.

Final Answer: Rapid synthesis of hydrophilic osmoprotectant proteins

Answer: (A)

Go Back to Question 7

Q8.

Solution

Concept: Denitrification is an anaerobic respiratory process where facultative anaerobic bacteria reduce oxidized nitrogen compounds back into inert nitrogen gas (N_2), closing the global nitrogen cycle.

Solution:

Let's trace the step-by-step reduction pathway of denitrification:

(a) The biochemical reduction cascade moves through the following intermediates:

$$NO_3^- \xrightarrow{\text{Nitrate Reductase}} NO_2^- \xrightarrow{\text{Nitrite Reductase}} NO \xrightarrow{\text{Nitric Oxide Reductase}} N_2O \xrightarrow{\text{Nitrous Oxide Reductase}} N_2$$

(b) The terminal step of this pathway involves converting nitrous oxide (N_2O), a potent greenhouse gas, into harmless dinitrogen gas (N_2).

(c) This critical, rate-limiting terminal reaction is catalyzed exclusively by the enzyme **Nitrous Oxide Reductase**. Disruption of this enzyme system causes an accumulation and release of dangerous N_2O gas.

Final Answer: Nitrous Oxide Reductase

Answer: (C)

Go Back to Question 8

Q9.

Solution

Concept: Soil clay minerals, like montmorillonite, carry a net negative surface charge due to isomorphous substitution. In a colloidal solution, this negative surface attracts a tightly bound inner layer of cations and a more loosely associated outer diffuse layer of counter-ions.

Solution:

Let's evaluate the electrokinetic properties of soil colloids:

(a) The boundary line where the mobile diffuse layer separates from the stationary fluid layer surrounding a colloidal particle is called the slipping plane.

(b) The electrical potential measured exactly at this slipping plane interface is defined as the **Zeta Potential**.

(c) When an external electrical field is applied to the solution (electrophoresis), the **Zeta Potential** dictates the magnitude of the repulsive forces between particles and directly determines the **exact velocity** at which the charged clay particles migrate toward the oppositely charged anode.

Final Answer: Zeta Potential

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept: Article 356 of the Constitution of India contains provisions for the imposition of President's Rule in a state if its constitutional machinery breaks down. A proclamation issued under this Article must follow strict parliamentary approval timelines to remain valid.

Solution:

Let's review the constitutional timelines for a President's Rule proclamation:

(a) When the President issues a proclamation under Article 356, it goes into effect immediately.

(b) However, this initial proclamation acts as a temporary order. To extend its operation, it must be approved by a simple majority in both Houses of Parliament (Lok Sabha and Rajya Sabha).

(c) The Constitution sets a strict mandatory timeline of **2 months** from the date of issuance for Parliament to pass this approving resolution.

(d) If both Houses fail to pass the statutory approval within this **2-month** window, the initial proclamation automatically lapses and loses all legal validity.

Final Answer: 2 months

Answer: (C)

Go Back to Question 10

Q11.

Solution

Concept: The Tenth Five-Year Plan (2002–2007) focused on sustainable, high-growth economic targets, aiming for an 8% annual GDP growth rate while restructuring key planning methodologies.

Solution:

Let's identify the architectural changes introduced in the Tenth Plan:

(a) Prior plans focused on setting aggregate national macroeconomic targets, which often masked deep economic divides between different states.

(b) To fix this, the Tenth Plan introduced a **state-wise breakdown of developmental targets**.

(c) By requiring each state to map its own specific targets for growth, poverty reduction, and literacy, the Planning Commission was able to directly monitor and address **regional disparities** across the country, making this regional breakdown its core structural change.

Final Answer: State-wise breakdown of developmental targets to monitor regional disparities

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept: The Finance Commission of India is a constitutional body established under Article 280 that determines the allocation of tax revenues between the Union and the States (vertical devolution) and among the States themselves (horizontal devolution).

Solution:

Let's examine the criteria used to calculate horizontal fiscal devolution:

(a) To balance revenue distribution, the Finance Commission uses a formula weighted by specific socioeconomic and geographical metrics.

(b) To compensate states facing structural disadvantages—such as low revenue bases, rugged terrain, or high costs of public service delivery—the formula places significant weight on **Fiscal Capacity Distance** (or Income Distance) and **Forest/Ecology** metrics.

(c) **Fiscal Capacity Distance** measures how far a state's per capita income is from the top-performing state, while **Forest/Ecology** factors in the financial costs of maintaining green forest cover, ensuring disadvantaged states receive fair fiscal compensation.

Final Answer: Fiscal Capacity Distance and Forest/Ecology metrics

Answer: (A)

Go Back to Question 12

Q13.

Solution

Concept: The historic Uttar Pradesh Zamindari Abolition and Land Reforms Act, 1950 (which went into effect in 1952) dismantled the exploitative feudal landlord system and restructured agricultural land tenure into clearly defined legal categories.

Solution:

Let's look at the primary land rights categories created by the land reforms act:

(a) The legislation condensed dozens of complex historical tenant classes into three primary land tenures: *Bhumidhar*, *Sirdar*, and *Asami*.

(b) The highest tier of land ownership rights was designated as **Bhumidhar with transferable rights**.

(c) This premium category granted cultivators absolute, **permanent, heritable, and transferable rights** to use and transfer their land freely. It completely cut out revenue intermediaries, allowing landowners to pay land revenue directly to the State government.

Final Answer: Bhumidhar with transferable rights

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept: Excavations led by the Archaeological Survey of India (ASI) at Sanouli in the Baghpat district of western Uttar Pradesh revealed a large Bronze Age burial site dating back to the late Harappan or Ochre Coloured Pottery (OCP) cultural horizon.

Solution:

Let's evaluate the significance of the artifacts unearthed at Sanouli:

(a) The excavations uncovered burials containing sophisticated weapons, copper swords, helmets, and shields.

(b) The most revolutionary discovery was the remains of three intact, **solid-wheeled, copper-sheathed horse-drawn chariots**.

(c) This discovery marked the first physical evidence of actual prehistoric chariots found in the Indian subcontinent. It transformed our understanding of ancient Indian military technology, showing that these cultures engaged in a highly sophisticated level of wheeled warfare during the Bronze Age.

Final Answer: Solid-wheeled, copper-sheathed horse-drawn chariots

Answer: (A)

Go Back to Question 14

Q15.

Solution

Concept: The Gwalior Gharana is the oldest distinctive school (*gharana*) of Hindustani classical vocal music, known for its emphasis on clarity, simplicity, and a robust compositional structure.

Solution:

Let's compare the core stylistic features of the Gwalior and Kirana traditions:

(a) The Kirana Gharana (associated with artists like Abdul Karim Khan) focuses on microtonal precision (*swara*) and a slow, emotional, and continuous unfolding of the raga through *alap*.

(b) In contrast, the **Gwalior Gharana** values a firm, structured presentation built around a well-defined poetic text (**systematic bandish framework**).

(c) A signature technique of the Gwalior style is the **direct deployment of straight, open-throated, robust 'Aakar' tans** (rapid melodic patterns sung using the vowel sound "ah"), executed with rhythmic precision within the framework of the composition.

Final Answer: Direct deployment of straight, robust 'Aakar' tans and systematic bandish frameworks

Answer: (B)

Go Back to Question 15

Q16.

Solution

Concept: The Bab-el-Mandeb Strait is a strategic maritime chokepoint connecting the Red Sea to the Gulf of Aden and the Indian Ocean. It serves as a vital shipping gateway for vessels moving goods between Asia and Europe via the Suez Canal.

Solution:

Let's trace the supply chain paths of North Indian agricultural exports:

(a) Northern India (particularly Punjab, Haryana, and western Uttar Pradesh) is a major global hub for premium **Basmati rice** production.

(b) These high-value rice exports are shipped out via western Indian ports (like Kandla or Mundra) and travel west through the Arabian Sea, passing through the **Bab-el-Mandeb strait** and the Suez Canal to reach major markets in Western Europe and the Mediterranean.

(c) If geopolitical issues force a total operational closure of the Bab-el-Mandeb strait, container ships must be rerouted all the way around Africa. This long detour drastically increases freight costs and delivery times, directly hurting the competitive edge of **Basmati rice shipments bound for Western European and Mediterranean ports**.

Final Answer: Basmati rice shipments bound for Western European and Mediterranean ports

Answer: (A)

Go Back to Question 16

Q17.

Solution

Concept: During low-intensity exercise, muscle cells generate energy through aerobic respiration, converting glucose into pyruvate, which is completely oxidized inside the mitochondria via the citric acid cycle.

Solution:

Let's trace the biochemical changes that occur as exercise intensity passes the lactate threshold:

(a) As athletic exertion increases, the rate of glycolysis speeds up rapidly to meet the sudden demand for ATP.

(b) This accelerated glycolysis generates pyruvate faster than the mitochondria can absorb and process it through aerobic respiration.

(c) This imbalance causes **intracellular pyruvate to accumulate faster than the oxidation rate of the citric acid cycle**.

(d) To keep glycolysis running, the enzyme lactate dehydrogenase (LDH) reduces this excess pyruvate into lactic acid, releasing hydrogen ions (H^+). This marks the transition past the lactate threshold, leading to muscle fatigue and an increased breathing rate.

Final Answer: Intracellular accumulation of pyruvate exceeding the oxidation rate of the citric acid cycle

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept: The Transmission Control Protocol (TCP) is a reliable, connection-oriented transport layer protocol that uses sliding window mechanisms to manage data transfers between a sender and a receiver.

Solution:

Let's identify the mechanism used to manage buffer space at the receiver:

(a) If a sender transmits data faster than the receiving application can read it out of its buffer, the receiver's storage space will fill up, leading to dropped packets.

(b) To prevent this, TCP implements a dedicated **Flow Control** mechanism.

(c) The receiver communicates its available buffer space back to the sender using the **"Receiver Window" (rwnd)** field included in every TCP acknowledgment (ACK) packet.

(d) The sender dynamically adjusts its sliding window size to never exceed this value. This ensures the sender matches the receiver's processing speed and prevents receiver buffer saturation.

Final Answer: Flow Control via Explicit Congestion Notification (ECN) bytes

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept: Database normalization uses mathematical rules to structure relational database tables, eliminating data redundancy and preventing undesirable update anomalies.

Solution:

Let's review the requirements for the standard normal forms:

(a) **First Normal Form (1NF):** Requires that all table attributes contain atomic (indivisible) values.

(b) **Second Normal Form (2NF):** Requires that the table is in 1NF and contains no partial dependencies, meaning every non-prime attribute must be fully dependent on the entire primary key.

(c) **Third Normal Form (3NF):** Requires that the table is in 2NF and contains **no transitive dependencies**.

(d) This means that no non-prime attribute can depend on another non-prime attribute; instead, all non-prime attributes must be **completely and non-transitively dependent on the primary key structural domain**. This rule is summarized by the classic phrase that attributes must depend "on the key, the whole key, and nothing but the key."

Final Answer: Third Normal Form (30NF)

Answer: (C)

Go Back to Question 19

Q20.

Solution

Concept: Internet of Things (IoT) architectures deploy remote sensors that frequently operate in harsh environments with limited battery power, minimal processing hardware, and unreliable or low-bandwidth cellular networks.

Solution:

Let's identify the optimal protocol for these constrained remote networks:

(a) Traditional application layer protocols like HTTP or HTTPS carry heavy text-based headers and require significant connection overhead, making them poorly suited for power-constrained devices.

(b) The **Message Queuing Telemetry Transport (MQTT)** protocol was designed specifically to handle these challenges.

(c) MQTT uses a lightweight, binary-coded **publish-subscribe** messaging architecture.

(d) Featuring a tiny 2-byte packet header overhead, it runs efficiently over power-constrained networks, making it the standard application layer choice for remote agricultural telemetry networks and sensor matrices.

Final Answer: Message Queuing Telemetry Transport (MQTT)

Answer: (B)

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Answer Key

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