

MAH M Arch CET Environment Sample Paper – 5

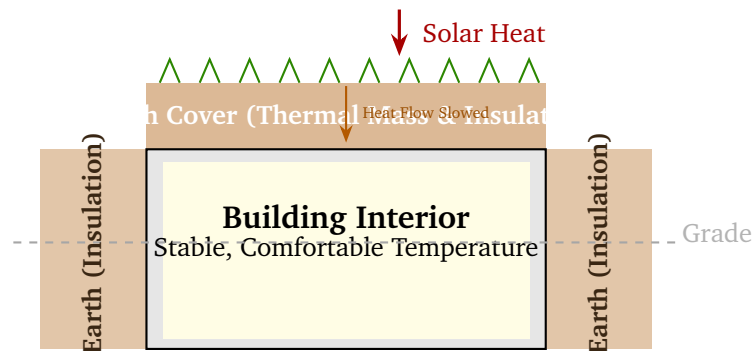
Duration: 12 Minutes | Maximum Marks: 20

Instructions

- This paper contains **10 Multiple Choice Questions (MCQs)**.
- Each question carries **+2 marks** for a correct answer.
- There is **no negative marking** for wrong answers.
- Each question has **one correct option only**.
- Read each question carefully before selecting your answer.
- Time allowed: **12 minutes**. Manage your time wisely.

Questions

Q1. The cross-section below illustrates an earth-sheltered building with soil covering both the roof and the side walls. Which statement **best** describes the primary environmental benefit of this design strategy?



- (A) Earth-covered roofs increase solar heat gain because dark soil is a strong solar absorber, raising indoor temperatures.
- (B) Earth sheltering is primarily used to reduce structural wind loads on exposed facades; thermal performance is a secondary by-product.
- (C) The earth covering provides **thermal mass and insulation**, moderating indoor temperatures by absorbing and slowly releasing heat in summer and retaining warmth in winter.
- (D) Earth-covered walls accelerate thermal bridging through the building envelope, leading to increased heat loss in cold climates.



Q2. Which of the following statements **correctly distinguishes** photovoltaic (PV) panels from solar thermal collectors?

- (A) Photovoltaic panels convert sunlight **directly into electricity** via the photovoltaic effect, while solar thermal collectors convert sunlight **into heat energy** used for water heating or space heating.
- (B) Solar thermal collectors produce electricity through the photovoltaic effect embedded in their metal absorber plates.
- (C) Both PV panels and solar thermal collectors primarily generate electricity for direct supply to the grid.
- (D) Photovoltaic panels heat water by circulating it through semiconductor layers exposed to sunlight.

Q3. Regarding the **Energy Conservation Building Code (ECBC) 2017** in India, which of the following statements is **correct**?

- (A) ECBC 2017 is administered by the Ministry of Environment, Forest and Climate Change (MoEFCC) under the provisions of the Environment Protection Act, 1986.
- (B) ECBC 2017 was enacted under the Electricity Act, 2003 and is implemented by the Central Electricity Authority (CEA).
- (C) ECBC 2017 applies exclusively to government-owned buildings with a connected load exceeding 1000 kW or a contract demand of 500 kVA or above.
- (D) ECBC 2017 is developed and administered by the **Bureau of Energy Efficiency (BEE)** under the Ministry of Power, pursuant to the Energy Conservation Act, 2001.

Q4. What is the **primary objective** of Sustainable Urban Drainage Systems (SuDS)?

- (A) To eliminate all surface water from urban environments through rapid conveyance in deep underground pipe networks.



- (B) To **manage surface water run-off as close to its source as possible**, mimicking natural hydrological processes and thereby reducing flooding, diffuse pollution, and pressure on conventional drainage infrastructure.
- (C) To maximise the speed at which stormwater reaches receiving water bodies in order to prevent localised urban ponding.
- (D) To harvest all incident rainfall exclusively for potable water supply, with no provision for controlled surface discharge.

Q5. Which of the following statements **correctly classifies** the components of an ecosystem into biotic and abiotic categories?

- (A) Soil bacteria, fungi, and earthworms are *abiotic* components of an ecosystem because they inhabit the soil substrate.
- (B) Temperature, humidity, and solar radiation are *biotic* components of an ecosystem because they directly influence living organisms.
- (C) **Plants, animals, and microorganisms are biotic components**, while soil, water, sunlight, and atmospheric gases are abiotic components of an ecosystem.
- (D) Producers and decomposers are abiotic components, while consumers constitute the only biotic component of an ecosystem.

Q6. In the context of a building's **carbon footprint**, which statement **correctly defines** operational carbon and embodied carbon?

- (A) **Operational carbon** refers to CO₂ emissions from energy use during the building's occupation (heating, cooling, lighting, equipment), while **embodied carbon** refers to GHG emissions from material extraction, manufacturing, transport, construction, and end-of-life processes.
- (B) Embodied carbon refers to the total carbon sequestered within a building's timber and plant-based materials over its service life.



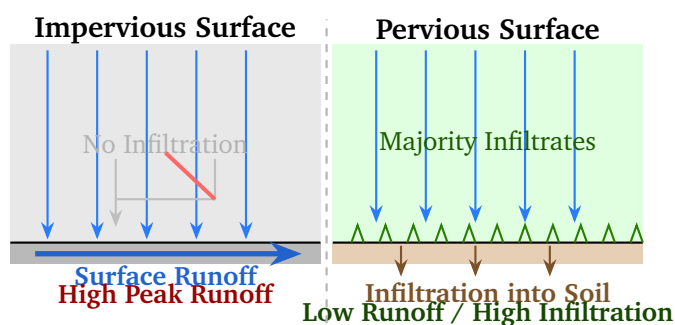
- (C) Operational carbon includes all emissions from the construction phase, material transport to site, and demolition at the end of the building's life.
- (D) Embodied carbon and operational carbon together constitute the building's "occupancy carbon rating" as certified under the GRIHA framework.

Q7. Which statement **best describes** the mechanism by which green belts and buffer zones attenuate noise pollution adjacent to urban and industrial areas?

- (A) Dense concrete noise barriers are always more effective than green belts because vegetation merely reflects sound rather than absorbing it.
- (B) Buffer zones work primarily by reflecting sound waves back to the source using hard, impermeable surfaces embedded within the planting scheme.
- (C) A single row of tall deciduous trees provides maximum year-round noise attenuation because canopy height is the sole determinant of performance.
- (D) Green belts reduce noise through a **combination of sound absorption by foliage, stems, and soil; diffraction and scattering around the vegetation mass; and the psychological barrier effect** that causes occupants to perceive noise levels as lower than measured values.

Q8. The diagram below compares the fate of rainfall on an **impervious** urban surface (left) and a **pervious** surface (right). Based on this comparison, which statement is **correct**?





- (A) Increasing impervious surface cover *reduces* urban stormwater runoff by stabilising the soil surface and preventing erosion-driven sediment loads.
- (B) Higher impervious surface cover **reduces infiltration and significantly increases stormwater runoff volume and peak discharge rates**, contributing to urban flooding and degraded water quality in receiving bodies.
- (C) Impervious surfaces enhance groundwater recharge by channelling all rainfall into subsurface retention ponds connected to the aquifer.
- (D) Urban stormwater runoff is primarily determined by vegetation density, and surface impermeability plays only a minor secondary role.

Q9. Which of the following statements **correctly describes the Water (Prevention and Control of Pollution) Act, 1974?**

- (A) The Act is enforced exclusively by the Ministry of Jal Shakti at the national level; no state-level authority is created under it.
- (B) The Central Pollution Control Board (CPCB) is empowered under the Act to issue discharge consents directly to all individual industries in every state.
- (C) The Act established the **Central Pollution Control Board (CPCB)** at the central level and **State Pollution Control Boards (SPCBs)** at the state level, mandating them to prevent, control, and abate water pollution.
- (D) The Water Act, 1974 applies only to surface water bodies such as rivers and lakes and expressly excludes groundwater from its scope.

Q10. Under the **National Green Tribunal Act, 2010**, which statement **accurately describes** the jurisdiction and powers of the National Green Tribunal (NGT)?

- (A) The NGT has jurisdiction over all civil cases involving **substantial questions relating to the environment**, including enforcement of any legal right relating to the environment, and has the power to provide relief, compensation, and remediation orders for damage to persons and property.
- (B) The NGT was established under the Environment Protection Act, 1986, and has authority to impose criminal penalties including imprisonment for environmental violations.
- (C) The NGT has appellate jurisdiction only over decisions made by the Ministry of Environment, Forest and Climate Change, and cannot entertain original petitions from aggrieved parties.
- (D) NGT orders can be directly enforced by municipal corporations and state governments without any further involvement of the civil court machinery.



Detailed Solutions

Sol. 1.

Solution

Concept: Earth sheltering exploits two physical properties of soil—high thermal mass (specific heat capacity) and low thermal conductivity—to buffer buildings against external temperature extremes.

Step 1 – Thermal Mass: Soil absorbs large quantities of heat during the day (summer daytime) without undergoing large temperature swings. This heat is released gradually overnight, smoothing out temperature peaks and preventing overheating of the interior.

Step 2 – Insulation: Soil has a relatively low thermal conductivity (approximately $0.5\text{--}2.0\text{ W/m}\cdot\text{K}$, compared with $\sim 1.7\text{ W/m}\cdot\text{K}$ for concrete). A thick earth layer significantly retards heat flow through the roof and walls, reducing both summer heat gain and winter heat loss—thereby cutting mechanical heating and cooling loads.

Why other options are wrong:

- (A) While bare dark soil does absorb solar radiation, in well-designed earth-sheltered buildings the roof is planted with vegetation, lowering surface temperatures through evapotranspiration. The dominant benefit is thermal mass and insulation, not increased heat gain.
- (B) While the soil load does affect structural design, the primary environmental benefit cited in passive design literature is always thermal performance, not wind load mitigation.
- (D) Earth covering reduces, not accelerates, thermal bridging. It acts as an additional resistance layer, slowing—not shortcutting—heat flow through the envelope.

Final Answer: Option (C) is correct. Earth covering provides thermal mass and insulation, moderating indoor temperatures throughout the year and reducing energy demand.

Answer: (C) [Go Back to Q1](#)



Sol. 2.

Solution

Concept: Solar energy can be harnessed in two fundamentally different ways: converting photons to electrons (photovoltaics) or converting sunlight to heat (solar thermal). These operate on entirely different physical principles.

Step 1 – Photovoltaic (PV) Effect: PV panels use semiconductor materials (typically monocrystalline or polycrystalline silicon). When photons with sufficient energy strike the semiconductor's p-n junction, they dislodge electrons, generating a direct electric current (DC). An inverter then converts this to AC for building use or grid export.

Step 2 – Solar Thermal Collectors: Flat-plate or evacuated-tube collectors use a dark absorber plate to capture solar radiation as heat. A heat-transfer fluid (water or glycol solution) circulates through tubes in the collector, carrying thermal energy to a storage tank for domestic hot water, space heating, or industrial process heat. No electricity is generated by the collector itself.

Why other options are wrong:

- **(B)** Solar thermal collectors work through heat exchange and convection, not the photovoltaic effect. The absorber plate is a heat collector, not a semiconductor.
- **(C)** Standard solar thermal collectors produce *heat*, not electricity. Only concentrating solar power (CSP) systems convert solar heat into electricity via a turbine, but these are large-scale utility plants, not building-integrated solar thermal collectors.
- **(D)** PV panels generate electricity, not heat. Water heating is exclusively a solar thermal function in building applications.

Final Answer: Option (A) is correct. PV panels produce electricity via the photovoltaic effect; solar thermal collectors produce heat via solar absorption and heat exchange.

Answer: (A) [Go Back to Q2](#)



Sol. 3.

Solution

Concept: The Energy Conservation Building Code (ECBC) sets minimum energy performance standards for the design of new commercial buildings in India. Understanding its legislative basis and administering authority is important for environmental design practice.

Step 1 – Legislative Basis: ECBC 2017 is issued under the **Energy Conservation Act, 2001**, which empowers the Bureau of Energy Efficiency (BEE) to prescribe norms and standards for energy consumption. It is not enacted under the Environment Protection Act 1986 or the Electricity Act 2003.

Step 2 – Administering Body: BEE, under the **Ministry of Power (MoP)**, Government of India, developed the original ECBC in 2007 and revised it in 2017 to incorporate updated energy efficiency requirements across building envelope, lighting, HVAC, and solar integration.

Step 3 – Applicability: ECBC 2017 applies to all new commercial buildings with a connected load of **100 kW or above**, or a contract demand of 500 kVA or above. It is not restricted to government buildings, and the threshold is 100 kW (not 1000 kW).

Why other options are wrong:

- (A) MoEFCC administers environmental regulations; ECBC is an energy efficiency code under MoP/BEE with no connection to MoEFCC.
- (B) CEA deals with technical standards for grid safety and generation; it has no role in building energy codes.
- (C) The threshold is 100 kW connected load, not 1000 kW, and ECBC applies to all commercial building types, not only government-owned ones.

Final Answer: Option (D) is correct. ECBC 2017 is administered by BEE under the Ministry of Power, pursuant to the Energy Conservation Act, 2001.

Answer: (D) [Go Back to Q3](#)



Sol. 4.

Solution

Concept: Sustainable Urban Drainage Systems (SuDS) emerged as an alternative to conventional “grey” piped drainage that rapidly conveys stormwater away from sites, exacerbating downstream flooding and pollution.

Step 1 – Source Control Philosophy: The core principle of SuDS is to intercept, slow, store, and clean run-off *at or near where rain falls*, before it accumulates into large, fast-moving flows. This mimics the natural hydrological cycle— infiltration, evapotranspiration, and slow release.

Step 2 – Techniques and Benefits: SuDS measures include permeable paving, green roofs, rain gardens, bioretention cells, swales, detention and retention basins, and infiltration trenches. They deliver four co-benefits: (i) reduced flood risk, (ii) improved water quality (pollutant removal), (iii) amenity and biodiversity enhancement, and (iv) reduced pressure on conventional sewer networks.

Why other options are wrong:

- (A) Rapid conveyance through deep underground pipes is the conventional “grey drainage” approach that SuDS is specifically designed to replace.
- (C) Rainwater harvesting is one component within some SuDS schemes, but it is not the primary defining objective.
- (D) Maximising conveyance speed is the antithesis of SuDS; SuDS deliberately slow and attenuate flows.

Final Answer: Option (B) is correct. SuDS manage run-off as close to its source as possible, mimicking natural drainage and delivering multiple sustainability co-benefits.

Answer: (B) [Go Back to Q4](#)

Sol. 5.

Solution

Concept: An ecosystem consists of all living organisms and their non-living environment in a defined area, interacting as a functional unit. The two fundamental categories of components are *biotic* (living) and *abiotic* (non-living).

Step 1 – Biotic Components: All living organisms belong to the biotic category, regardless of their role or habitat. This includes:

- **Producers:** Autotrophs—green plants, algae, cyanobacteria—that fix solar



energy through photosynthesis.

- **Consumers:** Heterotrophs—herbivores, carnivores, omnivores—that obtain energy by consuming other organisms.
- **Decomposers/Detritivores:** Bacteria, fungi, and earthworms that break down dead organic matter. *Note:* earthworms and soil microbes are biotic, even though they live within the soil (an abiotic medium).

Step 2 – Abiotic Components: All non-living physical and chemical factors form the abiotic category: temperature, light intensity, water, soil minerals, atmospheric gases (O_2 , CO_2 , N_2), pH, wind, humidity, and topography.

Why other options are wrong:

- (A) Bacteria, fungi, and earthworms are living organisms; they are *biotic*, irrespective of their soil habitat.
- (B) Temperature, humidity, and solar radiation are physical energy factors; they are *abiotic*, not biotic.
- (D) Both producers (plants) and decomposers (fungi, bacteria) are living organisms; all three trophic levels are biotic. The biotic category is not limited to consumers.

Final Answer: Option (C) is correct. Plants, animals, and microorganisms are biotic; soil, water, sunlight, and atmospheric gases are abiotic components of an ecosystem.

Answer: (C) [Go Back to Q5](#)

Sol. 6.

Solution

Concept: Whole-life carbon accounting in buildings distinguishes clearly between emissions arising *during occupation* (operational carbon) and those associated with the building fabric across its full lifecycle (embodied carbon). This distinction is central to the RIBA 2030 Climate Challenge, LEED v4.1, BREEAM, and emerging Indian green building standards.

Step 1 – Operational Carbon (Regulated and Unregulated Energy): These are GHG emissions from the energy consumed *while the building is in use*—space heating and cooling, ventilation, hot water, lighting, and plug/process loads. They are addressed through energy-efficiency measures in the building envelope, HVAC systems, and renewable energy generation.



Step 2 – Embodied Carbon (Lifecycle Stages A, B, C): Following the EN 15978 / BS EN ISO 21930 framework, embodied carbon covers:

- **Upstream (A1–A3):** Raw material extraction, product manufacturing.
- **Construction process (A4–A5):** Transport to site, on-site construction activities.
- **In-use (B1–B5):** Maintenance, repair, replacement, refurbishment.
- **End-of-life (C1–C4):** Deconstruction, transport, waste processing, disposal.

Why other options are wrong:

- **(B)** Carbon *stored* in timber is carbon sequestration, a separate biogenic carbon accounting concept. It is not what “embodied carbon” means.
- **(C)** Construction-phase emissions and material transport are embodied carbon stages (A4–A5), not operational carbon.
- **(D)** “Occupancy carbon rating” is not a recognised standard term in any Indian or international green building certification system.

Final Answer: Option (A) is correct. Operational carbon = energy-use emissions during occupation; embodied carbon = lifecycle emissions from materials, construction, and end-of-life.

Answer: (A) [Go Back to Q6](#)

Sol. 7.

Solution

Concept: Noise attenuation by green belts and buffer zones involves multiple interacting physical and psychoacoustic mechanisms, distinguishing them from simple solid barriers.

Step 1 – Absorption: Leaves, branches, stems, bark, and especially the leaf-litter and soil layer absorb sound energy by converting acoustic energy into slight frictional heat. Dense, multi-layered planting—combining a ground layer of shrubs with a tree canopy—is more effective than a single layer. Evergreen species maintain performance year-round.

Step 2 – Diffraction and Scattering: The irregular, porous structure of vegetation diffracts sound waves around individual leaves and branches, scattering energy in multiple directions and reducing the coherent sound reaching the re-



ceiver.

Step 3 – Ground Effect: The soft, porous soil beneath a green belt absorbs sound at grazing incidence (low-angle propagation), providing additional attenuation over and above that from the vegetation canopy.

Step 4 – Psychological Barrier Effect: Research (Watts et al., 1999; Gidlof-Gunnarsson & Ohrstrom, 2007) demonstrates that the mere visual presence of a green belt causes listeners to perceive noise levels as lower than measured dB(A) values—a non-acoustic benefit unique to green infrastructure.

Why other options are wrong:

- (A) Solid concrete barriers work primarily by reflection and diffraction over the barrier top; they do not absorb. Vegetation works primarily by absorption and scattering. The statement incorrectly characterises vegetation.
- (B) Reflection back to the source is the mechanism of solid walls; vegetation absorbs and scatters rather than reflecting coherently.
- (C) A single row of deciduous trees provides only 1–3 dB(A) attenuation and loses foliage in winter, greatly reducing year-round performance. Effective green belts require wide (minimum 30 m), multi-species, multi-layered planting.

Final Answer: Option (D) is correct. Green belts attenuate noise through absorption, diffraction/scattering, ground effect, and the psychological barrier effect.

Answer: (D) [Go Back to Q7](#)

Sol. 8.

Solution

Concept: Urbanisation replaces natural permeable surfaces (soil, grassland, forest) with impervious surfaces (roads, rooftops, car parks, paved plazas), fundamentally disrupting the urban hydrological cycle.

Step 1 – Reduced Infiltration: Impervious surfaces prevent rainfall from percolating into the soil. The natural infiltration pathway is blocked, reducing groundwater recharge and lowering base flow in urban streams during dry periods.

Step 2 – Increased Runoff Volume and Peak Flow: Water that cannot infiltrate becomes direct surface runoff. The NRCS Curve Number (CN) method quantifies this: as impervious cover rises, the CN increases, directly raising both total runoff



volume and peak discharge for a given storm event. Research (Arnold & Gibbons, 1996) shows that catchments with $>75\%$ impervious cover can generate runoff volumes $5\text{--}6\times$ greater than forested catchments receiving the same rainfall.

Step 3 – Urban Flooding and Pollution: Elevated peak flows exceed the capacity of conventional drainage networks, causing urban flooding. Runoff also transports surface pollutants—oils, heavy metals, nutrients, bacteria—into receiving water bodies, degrading water quality.

Why other options are wrong:

- (A) Impervious cover *dramatically increases* runoff; it does not reduce it. While it may reduce soil erosion from bare ground, the overall hydrological impact is negative.
- (C) Impervious surfaces prevent infiltration entirely; they *reduce* groundwater recharge, not enhance it.
- (D) Surface impermeability is the primary and most direct driver of increased urban runoff, as demonstrated by decades of urban hydrology research. Vegetation density is a contributing factor but secondary to surface cover type.

Final Answer: Option (B) is correct. Higher impervious surface cover reduces infiltration and significantly increases stormwater runoff volume and peak discharge rates.

Answer: (B) [Go Back to Q8](#)

Sol. 9.

Solution

Concept: The Water (Prevention and Control of Pollution) Act, 1974 was India's landmark legislation specifically targeting water pollution. It created a permanent two-tier institutional architecture for pollution control.

Step 1 – Institutional Framework:

- **Section 3:** Constitutes the **Central Pollution Control Board (CPCB)** with headquarters in Delhi, tasked with advising the Central Government, laying down national standards for water quality and effluent discharge, and coordinating the activities of SPCBs.
- **Section 4:** Directs each State Government to constitute a **State Pollution Control Board (SPCB)**, which is the primary regulatory authority within



its state—issuing, renewing, and revoking “consent to establish” (CTE) and “consent to operate” (CTO) for industrial units.

Step 2 – Consent Management: Under Sections 25–26, no industry may discharge effluents into a water body without obtaining the SPCB’s consent. CPCB sets minimum national standards; SPCBs may prescribe stricter state standards.

Why other options are wrong:

- (A) The Ministry of Jal Shakti was created in 2019; the Water Act 1974 created CPCB/SPCBs as autonomous statutory bodies, not the Ministry. Enforcement authority lies with these boards, not the Ministry.
- (B) CPCB does not directly issue consents to individual industries—that is an SPCB function. CPCB handles national coordination and appellate matters.
- (D) The Water Act 1974 covers *all* forms of water pollution, including groundwater contamination. Section 2(j) defines “stream” broadly to include underground water.

Final Answer: Option (C) is correct. The Water Act 1974 established CPCB at the central level and SPCBs at the state level to prevent, control, and abate water pollution.

Answer: (C) [Go Back to Q9](#)

Sol. 10.

Solution

Concept: The National Green Tribunal Act, 2010 established the NGT as a specialised fast-track judicial body for environmental justice. India was the third country in the world (after Australia and New Zealand) to establish a dedicated environmental tribunal.

Step 1 – Original Jurisdiction (Section 14): The NGT has original jurisdiction over civil cases involving “substantial questions relating to environment” arising from implementation of the scheduled Acts—Environment Protection Act 1986, Forest Conservation Act 1980, Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981, Biological Diversity Act 2002, and the Public Liability Insurance Act 1991.

Step 2 – Powers and Relief (Section 15): The NGT may grant the following relief: (i) relief and compensation to victims of pollution; (ii) restitution of prop-



erty damaged; (iii) restitution of the environment. It may also order closure of polluting units and direct deposits into an Environment Relief Fund.

Step 3 – Nature of the Tribunal: The NGT is a *civil* tribunal; it does not impose criminal penalties. Orders are enforceable as decrees of a civil court. Appeals against NGT orders lie to the **Supreme Court of India** (Section 22), not to High Courts.

Why other options are wrong:

- (B) The NGT was established by the *NGT Act 2010*, not by the Environment Protection Act 1986. It also has no power to impose criminal penalties such as imprisonment.
- (C) The NGT has *original* jurisdiction (not merely appellate) over a wide range of environmental civil cases. It can directly hear petitions from citizens, NGOs, and other affected parties.
- (D) NGT orders are enforced as civil court decrees through the established judicial machinery; municipal corporations do not have independent authority to execute NGT orders.

Final Answer: Option (A) is correct. The NGT has civil jurisdiction over substantial environmental questions and can grant relief, compensation, and environment restoration orders.

Answer: (A) [Go Back to Q10](#)

Answer Key

Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans
1	C	2	A	3	D	4	B	5	C
6	A	7	D	8	B	9	C	10	A

