GATE Environmental Science and Engineering

Sample Paper – 3

Duration: 128 Minutes | **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Environmental Science and Engineering** subject of the GATE paper conducted by the IITs and IISc (General Aptitude and Engineering Mathematics are provided as separate papers).
- **Q1–Q20 carry 1 mark each** and **Q21–Q46 carry 2 marks each**, for a total of **72 marks**.
- Each question carries **negative marking of one-third of its allotted marks**: a wrong 1-mark question costs **0.33** and a wrong 2-mark question costs **0.67**. Unattempted questions carry no penalty.
- Every question here is a single-correct **MCQ**. The real GATE paper also has Multiple Select (MSQ) and Numerical Answer Type (NAT) questions, and **those carry no negative marking**.
- Attempt this paper in one timed sitting of about **128 minutes**, the share this core subject earns at GATE's overall pace of 180 minutes for 65 questions. Unless stated otherwise take $g = 9.81$ m/s^2, unit weight of water $\gamma_w = 9.81$ kN/m^3, dynamic viscosity of water $\mu = 1.0 \times 10^{-3}$ Pa·s and $K_w = 1.0 \times 10^{-14}$ at 25°C.

Environmental Chemistry and Microbiology

Q1. In the nitrogen cycle of a natural water body, the microbial oxidation shown below, in which ammonium is converted first to nitrite and then to nitrate under aerobic conditions, is known as: **[1 mark]**

$$NH_4^+ \xrightarrow{+O_2} NO_2^- \xrightarrow{+O_2} NO_3^-$$

aerobic bacterial oxidation

(A) denitrification

(B) nitrification

(C) ammonification

(D) nitrogen fixation

Q2. Among the plant nutrients supplied to a fresh-water lake, the single nutrient that most commonly limits algal growth and therefore acts as the key trigger of eutrophication is: **[1 mark]**

(A) dissolved carbon

(B) nitrogen

(C) phosphorus

(D) potassium

Q3. A water sample contains ammonia-nitrogen at a concentration of 20 mg/L expressed as N (atomic mass of N $= 14$). Expressed instead as ammonia (molecular mass of $NH_3 = 17$), the concentration is nearest to: **[1 mark]**

(A) 20.0 mg/L as NH_3

(B) 24.3 mg/L as NH_3

(C) 16.5 mg/L as NH_3

(D) 28.0 mg/L as NH_3

Q4. Bacteria that build their cell material using carbon dioxide (inorganic carbon) as their sole carbon source are classified as: **[1 mark]**

(A) heterotrophs

(B) autotrophs

(C) saprophytes

(D) facultative organisms

Q5. The process in which excessive enrichment of a lake with nitrogen and phosphorus triggers dense algal blooms, which on decay deplete the dissolved oxygen and degrade the water body, is called: **[1 mark]**

(A) biomagnification

(B) salinization

(C) acidification

(D) eutrophication

Q6. A lake of volume 1×10^6 m^3 has a total phosphorus concentration of 0.02 mg/L. The total mass of phosphorus stored in the lake water is: **[1 mark]**

(A) 200 kg

(B) 2 kg

(C) 2000 kg

(D) 20 kg

Water Resources and Environmental Hydraulics

Q7. A unit hydrograph is the direct-runoff hydrograph produced by a rainfall excess occurring uniformly over the catchment during a specified duration. The word "unit" in the term refers to: **[1 mark]**

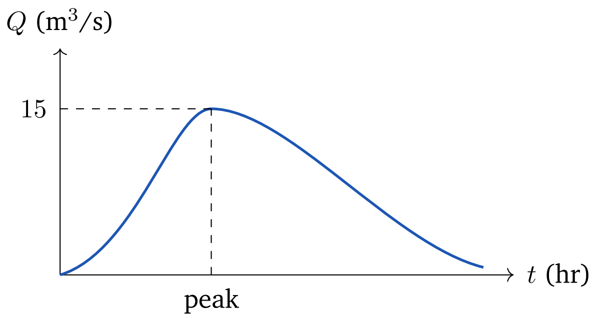
(A) 1 hour of rainfall duration

(B) 1 cm of rainfall excess (net rain)

(C) 1 m^3/s of peak discharge

(D) 1 mm of total rainfall

Q8. A 4-hour unit hydrograph of a catchment has the peak ordinate shown below, equal to 15 m^3/s. For a rainfall excess of 3 cm occurring uniformly over the same 4-hour duration, the peak of the direct-runoff hydrograph is: **[1 mark]**



(A) $15\ \text{m}^3/\text{s}$

(B) $5\ \text{m}^3/\text{s}$

(C) $45\ \text{m}^3/\text{s}$

(D) $60\ \text{m}^3/\text{s}$

Q9. A catchment has an area of $100\ \text{km}^2$. The volume of direct runoff represented by its 1-cm unit hydrograph (i.e. 1 cm of runoff depth spread over the whole catchment) is: **[1 mark]**

(A) $1 \times 10^6\ \text{m}^3$

(B) $1 \times 10^4\ \text{m}^3$

(C) $1 \times 10^8\ \text{m}^3$

(D) $1 \times 10^5\ \text{m}^3$

Q10. In the Muskingum method of flood routing, the storage in a river reach is written as $S = K\,[xI + (1-x)O]$, where I and O are inflow and outflow. In this expression x is the: **[1 mark]**

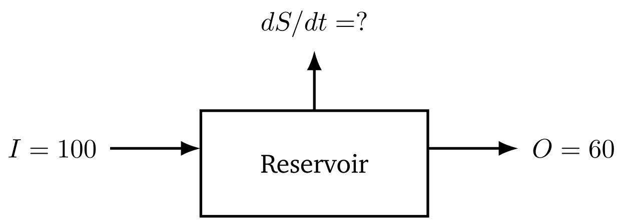
(A) travel time of the flood wave

(B) storage-time constant of the reach

(C) dimensionless weighting factor (between 0 and 0.5)

(D) peak outflow discharge

Q11. During a flood, the inflow to a reservoir is $I = 100\ \text{m}^3/\text{s}$ while the outflow through the spillway is $O = 60\ \text{m}^3/\text{s}$ at the same instant, as shown. By the continuity (storage) equation, the instantaneous rate of change of storage $\dfrac{dS}{dt} = I - O$ is: **[1 mark]**



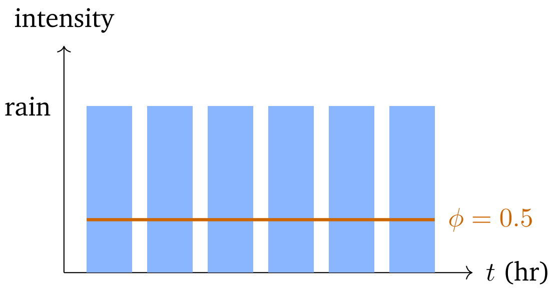
(A) $40\ \text{m}^3/\text{s}$

(B) $160\ m^3/s$

(C) $60\ m^3/s$

(D) $100\ m^3/s$

Q12. A storm of duration 6 hours produces a total rainfall of 8 cm over a catchment whose infiltration loss follows a constant ϕ-index of 0.5 cm/hr, as sketched. The rainfall excess (net rain producing direct runoff) is: **[1 mark]**



(A) 8 cm

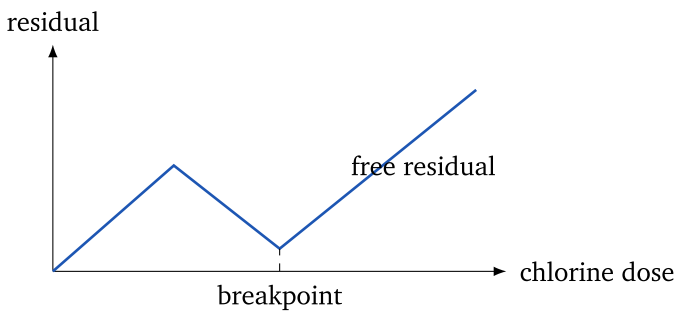
(B) 5 cm

(C) 3 cm

(D) 6 cm

Water Supply and Water Treatment

Q13. The breakpoint-chlorination curve of a water containing ammonia is shown below. Chlorine added *beyond* the breakpoint appears in the water almost entirely as: **[1 mark]**



(A) combined chlorine (chloramines)

(B) chlorine demand

(C) reduced chlorine compounds

(D) free available chlorine residual

Q14. A water-treatment plant treats a flow of 10 MLD and applies a chlorine dose of 2 mg/L for disinfection. The mass of chlorine required per day is: **[1 mark]**

(A) 2 kg/day

(B) 200 kg/day

(C) 10 kg/day

(D) 20 kg/day

Q15. Disinfection performance is often expressed through the CT value, the product of the disinfectant residual concentration C and the contact time T. For a free-chlorine residual of 0.5 mg/L held over a contact time of 30 minutes, the CT value is: **[1 mark]**

(A) 60 mg·min/L

(B) 30 mg·min/L

(C) 15 mg·min/L

(D) 0.5 mg·min/L

Q16. When ammonia is present in water, applied chlorine reacts with it to form chloramines. Compared with free chlorine, the combined chlorine (chloramine) residual so formed provides: **[1 mark]**

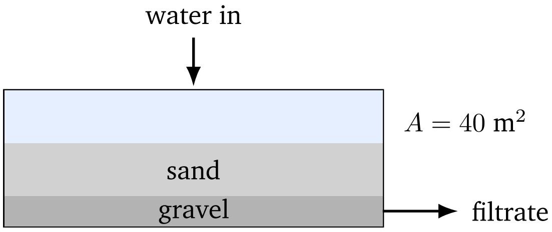
(A) no disinfecting action at all

(B) an instantaneous but very short-lived kill

(C) removal of turbidity rather than pathogens

(D) a weaker but more stable, longer-lasting residual

Q17. A rapid gravity sand filter, shown in section, treats a flow of 4.8 MLD through a bed of plan area 40 m^2. The rate of filtration (surface loading $= Q/A$) is: **[1 mark]**



(A) 120 m/day

(B) 12 m/day

(C) 1200 m/day

(D) 60 m/day

Q18. Turbidity-causing colloidal particles in raw water are destabilised and made to agglomerate by adding a coagulant. The chemical most widely used for this purpose in conventional water treatment is: **[1 mark]**

(A) chlorine gas

(B) quicklime

(C) powdered activated carbon

(D) alum (aluminium sulphate)

Wastewater Treatment and Disposal

Q19. In the activated-sludge process, the food-to-microorganism (F/M) ratio is defined as: **[1 mark]**

(A) the mass of micro-organisms divided by the BOD applied per day

(B) the mass of BOD applied per day divided by the mass of micro-organisms (MLVSS) held in the aeration tank

(C) the BOD removed divided by the BOD applied

(D) the flow rate divided by the tank volume

Q20. An activated-sludge aeration tank of volume $V = 1000$ m^3 operates at a mixed-liquor suspended-solids concentration of $X = 3000$ mg/L. Solids are wasted at a rate of 300 kg/day. Neglecting solids lost in the effluent, the solids retention time (sludge age) $\theta_c = \dfrac{V\,X}{\text{mass wasted per day}}$ is: **[1 mark]**

(A) 30 days

(B) 3 days

(C) 100 days

(D) 10 days

Q21. An activated-sludge aeration tank of volume $V = 800$ m^3 operates at a mixed-liquor suspended-solids concentration of $X = 2500$ mg/L. It receives a flow of $Q = 2000$ m^3/day at an applied BOD of $S_0 = 250$ mg/L. The food-to-microorganism ratio $F/M = \dfrac{Q\,S_0}{V\,X}$ is: **[2 marks]**

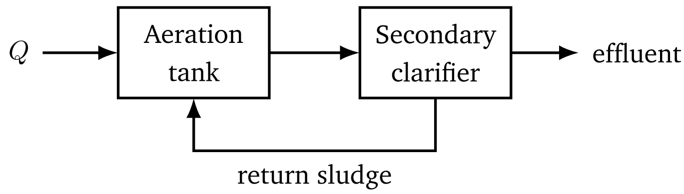
(A) 0.025 per day

(B) 0.25 per day

(C) 2.5 per day

(D) 0.5 per day

Q22. For the activated-sludge unit whose flow scheme is shown, the aeration tank has a volume of $V = 2000$ m^3 and treats a wastewater flow of $Q = 4000$ m^3/day. The hydraulic retention time $t = V/Q$ of the aeration tank is: **[2 marks]**



(A) 2 hr

(B) 24 hr

(C) 12 hr

(D) 6 hr

Q23. In an activated-sludge plant, the return-sludge stream has a suspended-solids concentration of $X_r = 10{,}000$ mg/L and the desired mixed-liquor concentration is $X = 2500$ mg/L. Using $X = X_r \dfrac{R}{1+R}$, where R is the recirculation ratio, the required value of R is: **[2 marks]**

(A) 0.33

(B) 0.25

(C) 3.0

(D) 1.0

Q24. A sewage flow of 5 MLD enters a treatment works carrying a BOD of 300 mg/L. The organic (BOD) load reaching the works, expressed as mass per day, is: **[2 marks]**

(A) 1500 kg/day

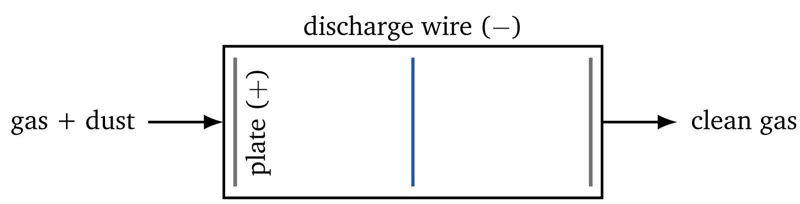
(B) 300 kg/day

(C) 750 kg/day

(D) 3000 kg/day

Air Pollution and Control

Q25. In the electrostatic precipitator sketched below, the fine particulate matter carried in the flue gas is removed by: **[2 marks]**



(A) filtration through a fabric medium

(B) gravity settling alone

(C) centrifugal (vortex) action

(D) electrically charging the particles and collecting them on oppositely charged plates

Q26. An electrostatic precipitator has a total collecting-plate area of $A = 100$ m^2 and treats a gas flow of $Q = 5$ m^3/s. If the effective particle drift (migration) velocity is $w = 0.1$ m/s, the Deutsch–Anderson efficiency $\eta = 1 - e^{-wA/Q}$ is nearest to: **[2 marks]**

(A) 63%

(B) 95%

(C) 50%

(D) 86.5%

Q27. In India's National Air Quality Index (AQI), a computed AQI value falling in the range 201–300 is placed in the category described as: **[2 marks]**

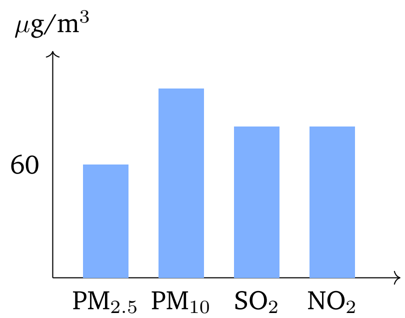
(A) Good

(B) Poor

(C) Satisfactory

(D) Severe

Q28. The National Ambient Air Quality Standards (NAAQS, India) prescribe limits for several pollutants, as the bar chart of 24-hour standards suggests. The 24-hour average standard for fine particulate matter $PM_{2.5}$ (industrial, residential and rural areas) is: **[2 marks]**



(A) 100 $\mu g/m^3$

(B) 40 $\mu g/m^3$

(C) 60 $\mu g/m^3$

(D) 25 $\mu g/m^3$

Q29. Ambient carbon monoxide is measured as 5 ppm by volume. At 25°C (1 atm) the molar volume of a gas is 24.45 litres and the molecular mass of CO is 28. Using $mg/m^3 = ppm \times \frac{M}{24.45}$, the mass concentration is nearest to: **[2 marks]**

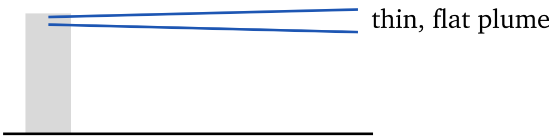
(A) 5.7 mg/m^3

(B) 28 mg/m^3

(C) 2.4 mg/m^3

(D) 11.5 mg/m^3

Q30. When a temperature inversion (a stable, isothermal layer) exists both above and below a chimney, the plume spreads only in the horizontal direction and remains flat and thin. This characteristic plume behaviour is termed: **[2 marks]**



(A) looping

(B) coning

(C) fanning

(D) lofting

Noise Pollution and Environmental Monitoring

Q31. Three identical machines, each producing a sound-pressure level of 60 dB at a receiver, operate simultaneously. Using the energy-addition rule $L = 10\log_{10}\left(n\,10^{L_1/10}\right)$ with $n = 3$, the combined level is nearest to: **[2 marks]**

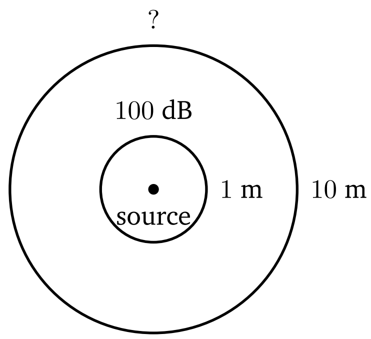
(A) 180 dB

(B) 64.8 dB

(C) 60 dB

(D) 63 dB

Q32. A point noise source produces 100 dB at a reference distance of 1 m. In a free field the level falls by $20\log_{10}(r_2/r_1)$ dB with distance, as the contours below suggest. The sound level at 10 m from the source is: **[2 marks]**



(A) 94 dB

(B) 90 dB

(C) 80 dB

(D) 60 dB

Q33. Under the ambient-noise standards notified in India, the permissible equivalent noise limit for a *residential* area during the *daytime* is: **[2 marks]**

(A) 55 dB(A)

(B) 45 dB(A)

(C) 65 dB(A)

(D) 75 dB(A)

Q34. The day–night average sound level L_{dn} is computed by adding a fixed penalty to every night-time (2200–0700 h) noise reading to account for greater night-time annoyance. This penalty is: **[2 marks]**

(A) 5 dB

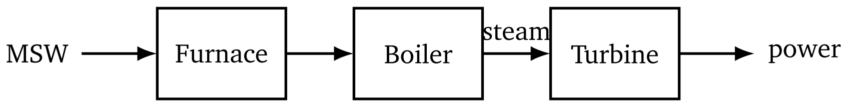
(B) 10 dB

(C) 3 dB

(D) 15 dB

Solid and Hazardous Waste Management

Q35. Municipal solid waste with a net calorific value of 8000 kJ/kg is incinerated at a rate of 100 tonnes/day in the waste-to-energy plant shown. The gross thermal energy released per day is: **[2 marks]**



(A) 8×10^5 MJ/day

(B) 8×10^3 MJ/day

(C) 8×10^8 MJ/day

(D) 8×10^6 MJ/day

Q36. Incineration, as applied to municipal solid waste, is best described as a treatment process that involves: [2 marks]

(A) anaerobic microbial decomposition in a closed digester

(B) aerobic biological composting

(C) spreading and tilling of waste into farmland soil

(D) controlled high-temperature combustion (typically 800–$1000°$C)

Q37. In a modern waste-to-energy (mass-burn) plant, the heat liberated by burning the refuse is used chiefly to: [2 marks]

(A) raise high-pressure steam that drives a turbine to generate electricity

(B) melt and recover ferrous metals from the waste

(C) accelerate aerobic composting of the residue

(D) distil and purify the leachate

Q38. Landfill gas produced by the anaerobic decomposition of buried municipal solid waste typically contains roughly equal proportions of two main gases. The component that makes the gas worth recovering as a fuel is: [2 marks]

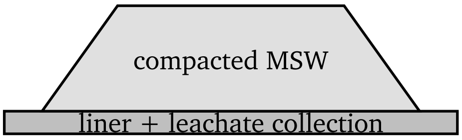
(A) methane (CH_4)

(B) carbon dioxide (CO_2)

(C) nitrogen (N_2)

(D) hydrogen sulphide (H_2S)

Q39. A sanitary landfill, shown in cross-section, receives 200 tonnes/day of municipal solid waste that is compacted in place to a density of 800 kg/m^3. The landfill airspace (volume) consumed per day is: **[2 marks]**



in-place density = 800 kg/m^3

(A) 160 m^3/day

(B) 250 m^3/day

(C) 400 m^3/day

(D) 500 m^3/day

Q40. Wastes bearing hazardous characteristics such as ignitability, corrosivity, reactivity or toxicity must not be placed in an ordinary municipal dump. The engineered facility most appropriate for their land disposal is a: **[2 marks]**

(A) open dump on the town outskirts

(B) ordinary sanitary landfill built for household refuse

(C) secured (engineered) landfill with multiple liners and leachate collection

(D) shallow unlined compost pit

Environmental Management, Sustainability and Climate

Q41. The ISO 14000 family of international standards is concerned primarily with: **[2 marks]**

(A) product quality management

(B) occupational health and safety

(C) environmental management systems

(D) corporate financial auditing

Q42. Within the ISO 14000 family, the single standard that specifies the requirements for an environmental management system (EMS) and against which an organization can be third-party certified is: **[2 marks]**

(A) ISO 9001

(B) ISO 14040

(C) ISO 45001

(D) ISO 14001

Q43. An *environmental audit* of an industrial facility is best described as: **[2 marks]**

(A) a systematic, documented verification to check whether the plant's environmental activities conform to planned arrangements and to legal requirements

(B) the pre-project prediction of impacts before construction begins

(C) the annual statement of the company's profit and loss

(D) a customer-satisfaction market survey

Q44. The "cradle-to-grave" technique that quantifies the total environmental burden of a product across raw-material extraction, manufacture, use and final disposal is called: **[2 marks]**

(A) Environmental Impact Assessment

(B) Life Cycle Assessment

(C) environmental audit

(D) hazard and risk assessment

Q45. An ISO 14001 environmental management system is built on a four-stage continual-improvement loop of planning, implementation, monitoring and corrective action. This management cycle is known as: **[2 marks]**

(A) the DMAIC cycle

(B) the input–output cycle

(C) the Plan–Do–Check–Act (PDCA) cycle

(D) the SWOT cycle

Q46. The international agreement adopted under the UNFCCC in 2015 that commits nations to hold the rise in global average temperature to well below 2°C above pre-industrial levels is the: **[2 marks]**

(A) Paris Agreement

(B) Montreal Protocol

(C) Kyoto Protocol

(D) Basel Convention

Detailed Solutions

Q1.

Solution

Concept – microbial transformations of nitrogen: Different nitrogen conversions are carried out by different micro-organisms; the direction of the change (oxidation vs reduction) fixes the name.

Step 1 – read the reaction shown: Ammonium (NH_4^+) is converted to nitrite (NO_2^-) and then to nitrate (NO_3^-).

Step 2 – classify the change: Nitrogen goes from the -3 state in NH_4^+ to the $+5$ state in NO_3^-; it *loses* electrons, so this is an oxidation.

Step 3 – note the conditions: The oxidation needs oxygen and is done by aerobic autotrophs (*Nitrosomonas* then *Nitrobacter*).

Step 4 – name the process: The aerobic oxidation of ammonium through nitrite to nitrate is nitrification.

Why the other options are wrong:

- A, denitrification: is the reverse (nitrate reduced to N_2) under anaerobic conditions.
- C, ammonification: is the release of ammonia from organic nitrogen.
- D, nitrogen fixation: converts atmospheric N_2 into ammonia.

Final Answer: nitrification $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept – limiting nutrient for eutrophication: Algal growth needs many elements, but the one present in the shortest supply relative to demand controls the extent of the bloom.

Step 1 – recall the nutrient demand of algae: Algae need carbon, nitrogen and phosphorus in large amounts, but carbon (from CO_2/bicarbonate) and nitrogen (some algae fix atmospheric N_2) are usually available.

Step 2 – identify the scarce element in fresh water: Phosphorus has no atmospheric source and is usually present only in trace amounts, so it runs out first.

Step 3 – draw the conclusion: Because it is the scarce, controlling nutrient, phosphorus is normally the limiting nutrient and the prime trigger of fresh-water eutrophication.

Why the other options are wrong:

- A, carbon: is freely available from dissolved CO_2 and carbonates.
- B, nitrogen: can be supplemented by nitrogen-fixing cyanobacteria.
- D, potassium: is a minor nutrient, rarely limiting.

Final Answer: phosphorus $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – expressing ammonia as N or as NH_3: A nitrogen concentration "as N" counts only the nitrogen mass; "as NH_3" counts the whole ammonia molecule, so the two differ by the molar-mass ratio.

Step 1 – write the conversion ratio: Each nitrogen atom (mass 14) sits in an NH_3 molecule (mass 17), so the factor is $\frac{17}{14}$.

Step 2 – multiply the given value: $C_{\mathrm{NH_3}} = 20 \times \frac{17}{14}$

Step 3 – evaluate the ratio: $\frac{17}{14} = 1.214$

Step 4 – complete the multiplication: $C_{\mathrm{NH_3}} = 20 \times 1.214 = 24.3$ mg/L as NH_3

Final Answer: 24.3 mg/L as $NH_3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – carbon source and nutritional class: Micro-organisms are classified by where they get their carbon: from CO_2 (autotroph) or from organic matter (heterotroph).

Step 1 – read the defining feature: The organisms use carbon dioxide, an inorganic carbon source, to build cell material.

Step 2 – match to the definition: Organisms that fix inorganic carbon (CO_2) are, by definition, autotrophs.

Why the other options are wrong:

- A, heterotrophs: use organic carbon, not CO_2.
- C, saprophytes: feed on dead organic matter (a heterotrophic mode).
- D, facultative: describes oxygen tolerance, not the carbon source.

Final Answer: autotrophs $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – nutrient enrichment of water bodies: When a lake receives excess nutrients, primary production surges and the subsequent decay of the biomass consumes oxygen.

Step 1 – follow the chain of events: Excess nitrogen and phosphorus feed heavy algal growth (blooms).

Step 2 – continue the chain: When the algae die, aerobic bacteria decompose them and use up the dissolved oxygen.

Step 3 – name the overall phenomenon: This nutrient-driven ageing and oxygen depletion of a water body is called eutrophication.

Why the other options are wrong:

- A, biomagnification: is the build-up of toxins up a food chain.
- B, salinization: is a rise in dissolved salts.
- C, acidification: is a fall in pH.

Final Answer: eutrophication $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept – mass from concentration and volume: The stored mass of a substance equals its concentration multiplied by the volume of water, with consistent units.

Step 1 – convert the concentration to convenient units: $0.02 \text{ mg/L} = 0.02 \text{ g/m}^3$ (since $1 \text{ mg/L} = 1 \text{ g/m}^3$).

Step 2 – write the mass equation: Mass $= C \times V$

Step 3 – substitute the values: Mass $= 0.02\ \text{g/m}^3 \times 1 \times 10^6\ \text{m}^3$

Step 4 – multiply: Mass $= 2 \times 10^4$ g

Step 5 – convert to kilograms: Mass $= \dfrac{2 \times 10^4}{1000} = 20$ kg

Final Answer: 20 kg $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – definition of the unit hydrograph: The unit hydrograph is a fixed catchment response used to build direct-runoff hydrographs by proportioning and superposition.

Step 1 – recall the standard definition: It is the direct-runoff hydrograph resulting from *one unit* of rainfall excess spread uniformly over the catchment during a stated duration.

Step 2 – identify what "one unit" means: In the SI/Indian convention the unit depth of rainfall excess is 1 cm.

Step 3 – conclude: Hence "unit" refers to 1 cm of rainfall excess, not to a duration or a discharge value.

Why the other options are wrong:

- A: the duration is stated separately (e.g. a "4-hour" UH); it is not what "unit" means.
- C: the peak discharge is an output, not the unit.
- D: the unit is 1 cm of *excess*, not 1 mm of *total* rainfall.

Final Answer: 1 cm of rainfall excess $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept – proportionality principle of the unit hydrograph: For a rainfall excess of P cm occurring over the unit-hydrograph duration, every ordinate (including the peak) is multiplied by P.

Step 1 – list the data: Unit-hydrograph peak $= 15$ m^3/s, rainfall excess $P = 3$ cm.

Step 2 – apply the scaling factor: $Q_{peak} = P \times (\text{unit peak})$

Step 3 – substitute: $Q_{peak} = 3 \times 15$

Step 4 – evaluate: $Q_{peak} = 45$ m^3/s

Final Answer: $Q_{peak} = 45$ m^3/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q8

Q9.

Solution

Concept – runoff volume under a unit hydrograph: The volume under a 1-cm unit hydrograph equals a uniform runoff depth of 1 cm spread over the whole catchment area.

Step 1 – convert the runoff depth to metres: 1 cm $= 0.01$ m.

Step 2 – convert the area to square metres: $A = 100 \text{ km}^2 = 100 \times 10^6 \text{ m}^2 = 1 \times 10^8 \text{ m}^2$.

Step 3 – write the volume equation: Volume $=$ depth $\times$ area

Step 4 – substitute: Volume $= 0.01 \times 1 \times 10^8$

Step 5 – evaluate: Volume $= 1 \times 10^6$ m^3

Final Answer: 1×10^6 m^3 $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept – Muskingum routing parameters: In $S = K\left[xI + (1-x)O\right]$ the two parameters have distinct roles: K has units of time, while x is dimensionless.

Step 1 – interpret K: K is the storage-time constant, roughly the travel time of the flood wave through the reach.

Step 2 – interpret x: x is a dimensionless weighting factor that fixes the relative influence of inflow and outflow on the stored volume.

Step 3 – state its range: For natural channels x lies between 0 and 0.5 (often 0.2–0.3); $x = 0$ gives pure reservoir (level-pool) storage.

Why the other options are wrong:

- A and B: describe K, not x.
- D: the peak outflow is a routed result, not a parameter.

Final Answer: dimensionless weighting factor (0 to 0.5) $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q10**

Q11.

Solution

Concept – continuity (storage) equation: Conservation of mass for a reservoir gives $\dfrac{dS}{dt} = I - O$: storage rises when inflow exceeds outflow.

Step 1 – list the data: $I = 100$ m^3/s, $O = 60$ m^3/s.

Step 2 – substitute into the equation: $\dfrac{dS}{dt} = 100 - 60$

Step 3 – evaluate: $\dfrac{dS}{dt} = 40$ m^3/s

Step 4 – interpret the sign: The value is positive, so the reservoir is filling at 40 m^3/s.

Final Answer: $\dfrac{dS}{dt} = 40$ m^3/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q11**

Q12.

Solution

Concept – ϕ-index and rainfall excess: The ϕ-index is a constant loss rate; the rainfall excess is the total rainfall minus the loss abstracted over the storm duration.

Step 1 – compute the total infiltration loss: Loss $= \phi \times t = 0.5$ cm/hr $\times$ 6 hr

Step 2 – evaluate the loss: Loss $= 3$ cm

Step 3 – subtract the loss from total rainfall: Excess $= 8 - 3$

Step 4 – evaluate: Excess $= 5$ cm

Final Answer: rainfall excess $= 5$ cm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – the breakpoint-chlorination curve: As chlorine is dosed into water containing ammonia, it is first consumed by reducing agents, then forms chloramines, which are destroyed at the breakpoint; only afterwards does free chlorine build up.

Step 1 – describe the region up to the breakpoint: Below the breakpoint the residual is combined chlorine (chloramines), and near the breakpoint these are oxidised away, so the residual dips.

Step 2 – describe the region beyond the breakpoint: Once all ammonia has been oxidised, any further chlorine added remains as free available chlorine.

Step 3 – read off the answer: Therefore chlorine added beyond the breakpoint appears as free available chlorine residual (the rising straight line at the right of the curve).

Why the other options are wrong:

- A, chloramines: form *before* the breakpoint, not after.
- B, chlorine demand: is the part consumed, not a residual.
- C, reduced compounds: are what remained in the earliest (demand) region.

Final Answer: free available chlorine residual $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept – chemical mass from dose and flow: Mass of chemical per day = dose (mg/L) $\times$ flow (L/day), converted to kilograms.

Step 1 – convert the flow to litres per day: $10\text{ MLD} = 10 \times 10^6$ L/day.

Step 2 – write the mass equation: Mass $=$ dose $\times$ flow

Step 3 – substitute: Mass $= 2$ mg/L $\times\ 10 \times 10^6$ L/day

Step 4 – multiply: Mass $= 2 \times 10^7$ mg/day

Step 5 – convert milligrams to kilograms: Mass $= \dfrac{2 \times 10^7}{10^6} = 20$ kg/day

Final Answer: 20 kg/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept – the CT product: Disinfection is governed by $CT = C \times T$, the residual concentration times the contact time; a larger CT means a greater pathogen kill.

Step 1 – list the data: $C = 0.5$ mg/L, $T = 30$ min.

Step 2 – write the equation: $CT = C \times T$

Step 3 – substitute: $CT = 0.5 \times 30$

Step 4 – evaluate: $CT = 15$ mg·min/L

Final Answer: $CT = 15$ mg·min/L $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept – chloramines as a disinfectant: Combined chlorine (chloramine) is a milder oxidant than free chlorine but it decays much more slowly.

Step 1 – compare the disinfecting strength: Chloramines kill pathogens more slowly and weakly than free chlorine.

Step 2 – compare the persistence: Because they are less reactive, chloramines survive far longer in the distribution network.

Step 3 – state the practical benefit: This makes chloramination useful for maintaining a stable, long-lasting residual to the far ends of the pipe network.

Why the other options are wrong:

- A: chloramines do disinfect, only more slowly.
- B: their action is slow and lasting, not instantaneous and short.
- C: they act on pathogens, not on turbidity.

Final Answer: a weaker but more stable, longer-lasting residual $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept – filtration (surface loading) rate: The rate of filtration is the flow divided by the plan area of the filter bed, Q/A.

Step 1 – convert the flow to litres per day: 4.8 MLD $= 4.8 \times 10^6$ L/day.

Step 2 – divide by the bed area: $\frac{Q}{A} = \frac{4.8 \times 10^6 \text{ L/day}}{40 \text{ m}^2} = 1.2 \times 10^5 \text{ L/(m}^2\text{·day)}$

Step 3 – convert litres to cubic metres: $1.2 \times 10^5 \text{ L/(m}^2\text{·day)} = 120 \text{ m}^3\text{/(m}^2\text{·day)}$

Step 4 – express as a velocity: $120 \text{ m}^3\text{/(m}^2\text{·day)} = 120$ m/day, a typical rapid-sand-filter rate.

Final Answer: 120 m/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept – coagulant selection: Coagulation neutralises the negative surface charge of colloids so they can flocculate; a trivalent metal salt does this efficiently.

Step 1 – recall the mechanism: A coagulant supplies highly charged cations (Al^{3+} or Fe^{3+}) that compress the double layer and destabilise the colloids.

Step 2 – identify the common coagulant: Aluminium sulphate (alum) is the coagulant used most widely in conventional treatment plants.

Why the other options are wrong:

- A, chlorine: is a disinfectant/oxidant, not a coagulant.
- B, quicklime: adjusts pH and softens water; it is not the primary coagulant.
- C, activated carbon: adsorbs taste, odour and organics, not a coagulant.

Final Answer: alum (aluminium sulphate) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – definition of the F/M ratio: The food-to-microorganism ratio compares the daily supply of "food" (BOD) with the standing mass of "eaters" (micro-organisms) in the tank.

Step 1 – identify the "food": The food is the BOD applied per day, $Q\,S_0$ (flow times influent BOD).

Step 2 – identify the "micro-organisms": The micro-organisms are represented by the MLVSS mass in the aeration tank, $V\,X$.

Step 3 – form the ratio: $F/M = \dfrac{\text{BOD applied per day}}{\text{mass of micro-organisms in the tank}} = \dfrac{Q\,S_0}{V\,X}$.

Why the other options are wrong:

- A: is the inverse (M/F), not F/M.
- C: BOD removed/applied is the removal efficiency.
- D: flow/volume is the reciprocal of detention time.

Final Answer: BOD applied per day ÷ mass of MLVSS in the tank $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept – solids retention time (sludge age): The sludge age is the mass of solids held in the system divided by the mass of solids removed (wasted) per day.

Step 1 – compute the solids held in the tank: $V\,X = 1000\text{ m}^3 \times 3000\text{ mg/L}$

Step 2 – convert this to kilograms: Since $1\text{ mg/L} = 1\text{ g/m}^3$, $V\,X = 1000 \times 3000\text{ g} = 3 \times 10^6\text{ g} = 3000\text{ kg}$.

Step 3 – write the sludge-age equation: $\theta_c = \dfrac{V\,X}{\text{mass wasted per day}}$

Step 4 – substitute: $\theta_c = \dfrac{3000\text{ kg}}{300\text{ kg/day}}$

Step 5 – evaluate: $\theta_c = 10$ days

Final Answer: $\theta_c = 10$ days $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept – computing the F/M ratio: $F/M = \dfrac{Q\,S_0}{V\,X}$; keep the concentration units the same top and bottom so they cancel.

Step 1 – form the numerator (food loading): $Q\,S_0 = 2000\ \text{m}^3/\text{day} \times 250\ \text{mg/L} = 5 \times 10^5\ (\text{mg/L})\cdot\text{m}^3/\text{day}$

Step 2 – form the denominator (biomass): $V\,X = 800\ \text{m}^3 \times 2500\ \text{mg/L} = 2 \times 10^6\ (\text{mg/L})\cdot\text{m}^3$

Step 3 – divide: $F/M = \dfrac{5 \times 10^5}{2 \times 10^6}$

Step 4 – evaluate: $F/M = 0.25$ per day

Step 5 – sense check: A value of 0.25/day lies in the normal conventional activated-sludge range (0.2–0.4/day).

Final Answer: $F/M = 0.25$ per day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept – hydraulic retention time: The hydraulic retention time is the tank volume divided by the flow through it, $t = V/Q$.

Step 1 – list the data: $V = 2000\ \text{m}^3$, $Q = 4000\ \text{m}^3/\text{day}$.

Step 2 – substitute: $t = \dfrac{2000}{4000}$

Step 3 – evaluate in days: $t = 0.5$ day

Step 4 – convert to hours: $t = 0.5 \times 24 = 12$ hr

Final Answer: $t = 12$ hr $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept – recirculation ratio and MLSS: A mass balance at the aeration-tank inlet gives $X = X_r \dfrac{R}{1+R}$; solving it yields the required return ratio.

Step 1 – substitute the known concentrations: $2500 = 10{,}000\,\dfrac{R}{1+R}$

Step 2 – divide both sides by $10{,}000$**:** $\frac{2500}{10{,}000} = \frac{R}{1+R}$

Step 3 – simplify the left side: $0.25 = \frac{R}{1+R}$

Step 4 – cross-multiply: $0.25(1+R) = R$

Step 5 – expand: $0.25 + 0.25R = R$

Step 6 – collect R **terms:** $0.25 = R - 0.25R = 0.75R$

Step 7 – solve for R**:** $R = \frac{0.25}{0.75} = 0.33$

Final Answer: $R = 0.33 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – organic (BOD) mass loading: The BOD load in mass per day equals the BOD concentration times the flow, in consistent units.

Step 1 – convert the flow to litres per day: 5 MLD $= 5 \times 10^6$ L/day.

Step 2 – write the load equation: Load = BOD × flow

Step 3 – substitute: Load $= 300$ mg/L $\times 5 \times 10^6$ L/day

Step 4 – multiply: Load $= 1.5 \times 10^9$ mg/day

Step 5 – convert milligrams to kilograms: Load $= \frac{1.5 \times 10^9}{10^6} = 1500$ kg/day

Final Answer: 1500 kg/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept – principle of the electrostatic precipitator: An ESP separates particles by giving them an electric charge and then attracting them to a collecting electrode of opposite polarity.

Step 1 – charging step: A high-voltage discharge electrode ionises the gas and imparts a negative charge to the suspended particles.

Step 2 – collection step: The charged particles migrate under the electric field and deposit on the earthed (positive) collecting plates, from which they are rapped off.

Step 3 – identify the mechanism: Thus removal is by electrostatic charging and collection, not by filtration, gravity or centrifugal force.

Why the other options are wrong:

- A: filtration through fabric describes a baghouse.
- B: gravity settling describes a settling chamber.
- C: centrifugal action describes a cyclone.

Final Answer: electrical charging and collection on charged plates $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept – Deutsch–Anderson efficiency of an ESP: $\eta = 1 - e^{-wA/Q}$, where w is the drift velocity, A the collecting area and Q the gas flow.

Step 1 – form the exponent group: $\dfrac{wA}{Q} = \dfrac{0.1 \times 100}{5}$

Step 2 – evaluate the numerator: $0.1 \times 100 = 10$

Step 3 – divide by the flow: $\dfrac{10}{5} = 2$

Step 4 – substitute into the efficiency equation: $\eta = 1 - e^{-2}$

Step 5 – evaluate the exponential: $e^{-2} = 0.135$

Step 6 – complete the calculation: $\eta = 1 - 0.135 = 0.865 = 86.5\%$

Final Answer: $\eta \approx 86.5\% \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept – categories of the National Air Quality Index: India's AQI runs from 0 to 500 in six bands, each with a descriptive label from "Good" to "Severe".

Step 1 – recall the AQI bands: 0–50 Good, 51–100 Satisfactory, 101–200 Moderate, 201–300 Poor, 301–400 Very Poor, 401–500 Severe.

Step 2 – locate the given range: The band 201–300 corresponds to the "Poor" category.

Why the other options are wrong:

- A, Good: is 0–50.
- C, Satisfactory: is 51–100.
- D, Severe: is 401–500.

Final Answer: Poor $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – Indian NAAQS for PM$_{2.5}$: The National Ambient Air Quality Standards fix both a 24-hour and an annual limit for each pollutant.

Step 1 – recall the two PM$_{2.5}$ limits: The annual average limit is $40\ \mu\text{g/m}^3$ and the 24-hour average limit is $60\ \mu\text{g/m}^3$.

Step 2 – pick the one asked for: The question asks for the 24-hour average, which is $60\ \mu\text{g/m}^3$.

Why the other options are wrong:

- A, 100: is the 24-hour standard for PM$_{10}$, not PM$_{2.5}$.
- B, 40: is the *annual* PM$_{2.5}$ standard.
- D, 25: is the WHO guideline, not the Indian NAAQS value.

Final Answer: $60\ \mu\text{g/m}^3 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q28

Q29.

Solution

Concept – converting ppm to mg/m^3: $\text{mg/m}^3 = \text{ppm} \times \dfrac{M}{24.45}$ at $25°\text{C}$ and 1 atm, where M is the molecular mass.

Step 1 – list the data: $\text{ppm} = 5$, $M = 28$ (CO), molar volume $= 24.45$ L.

Step 2 – form the numerator: $\text{ppm} \times M = 5 \times 28 = 140$

Step 3 – divide by the molar volume: $\dfrac{140}{24.45} = 5.73$

Step 4 – state the result: Concentration $\approx 5.7\ \text{mg/m}^3$

Final Answer: $\approx 5.7\ \text{mg/m}^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – plume types and atmospheric stability: The shape of a chimney plume reflects the vertical temperature structure of the surrounding air.

Step 1 – describe the stated condition: A stable, isothermal (inversion) layer surrounds the plume both above and below it, so vertical motion is strongly suppressed.

Step 2 – deduce the spreading pattern: With vertical mixing choked off, the plume spreads only sideways and stays thin and flat.

Step 3 – name the plume: This flat, horizontally spreading plume in a stable layer is called a fanning plume.

Why the other options are wrong:

- A, looping: occurs in a strongly unstable (super-adiabatic) atmosphere.
- B, coning: occurs in neutral conditions.
- D, lofting: occurs when the air is unstable above and stable below.

Final Answer: fanning $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept – energy addition of equal sound sources: Sound levels add on an energy (not decibel) basis; for n equal sources the combined level rises by $10\log_{10} n$ above the single-source level.

Step 1 – write the addition formula: $L = L_1 + 10\log_{10} n$

Step 2 – substitute $L_1 = 60$ dB and $n = 3$: $L = 60 + 10\log_{10} 3$

Step 3 – evaluate the logarithm: $\log_{10} 3 = 0.477$

Step 4 – multiply by 10: $10 \times 0.477 = 4.77$

Step 5 – add to the base level: $L = 60 + 4.77 = 64.8$ dB

Step 6 – note the physics: Levels do *not* simply add arithmetically, so 180 dB is wrong.

Final Answer: $L \approx 64.8$ dB $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – free-field distance attenuation of a point source: For a point source the level falls off as $\Delta L = 20\log_{10}\left(\frac{r_2}{r_1}\right)$ (inverse-square spreading).

Step 1 – form the distance ratio: $\frac{r_2}{r_1} = \frac{10}{1} = 10$

Step 2 – compute the attenuation: $\Delta L = 20\log_{10}(10) = 20 \times 1 = 20$ dB

Step 3 – subtract from the reference level: $L_{10\,\text{m}} = 100 - 20$

Step 4 – evaluate: $L_{10\,\text{m}} = 80$ dB

Final Answer: 80 dB $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept – Indian ambient-noise standards: The Noise Pollution (Regulation and Control) Rules set day and night limits by area category.

Step 1 – recall the residential daytime limit: For a residential zone the daytime (6 a.m.–10 p.m.) limit is 55 dB(A).

Step 2 – place the other categories for contrast: Residential night is 45; commercial is 65 (day)/55 (night); industrial is 75 (day)/70 (night).

Step 3 – pick the asked value: The residential daytime limit is 55 dB(A).

Why the other options are wrong:

- B, 45: is the residential *night* limit.
- C, 65: is the commercial daytime limit.
- D, 75: is the industrial daytime limit.

Final Answer: 55 dB(A) $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept – the day–night level L_{dn}: L_{dn} averages the 24-hour noise energy but weights the night period more heavily because night noise is more disturbing.

Step 1 – recall the night window: The night period runs from 2200 to 0700 hours.

Step 2 – state the penalty: Every night-time hourly level is increased by a 10 dB penalty before energy averaging.

Step 3 – justify: The 10 dB weighting reflects the greater annoyance of a given noise at night than by day.

Why the other options are wrong:

- A, 5 dB: is the evening penalty used in the separate L_{den} metric.
- C, 3 dB: is a doubling of energy, not the L_{dn} night weighting.
- D, 15 dB: is not the standard value.

Final Answer: 10 dB $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept – thermal energy from incineration: The gross energy released per day equals the net calorific value times the mass of waste burnt per day, in consistent units.

Step 1 – convert the daily mass to kilograms: $100 \text{ tonnes/day} = 100 \times 1000 = 1 \times 10^5$ kg/day.

Step 2 – write the energy equation: $E = (\text{calorific value}) \times (\text{mass per day})$

Step 3 – substitute: $E = 8000 \text{ kJ/kg} \times 1 \times 10^5 \text{ kg/day}$

Step 4 – multiply: $E = 8 \times 10^8$ kJ/day

Step 5 – convert kilojoules to megajoules: $E = \dfrac{8 \times 10^8}{10^3} = 8 \times 10^5$ MJ/day

Final Answer: 8×10^5 MJ/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q35

Q36.

Solution

Concept – what incineration is: Incineration is a thermal treatment that oxidises the combustible fraction of waste at high temperature, reducing its volume and destroying pathogens and organics.

Step 1 – identify the mechanism: It is combustion (rapid oxidation) carried out under controlled conditions.

Step 2 – recall the operating temperature: Municipal-waste incinerators run at about $800\text{–}1000^{\circ}$C to ensure complete burnout.

Step 3 – conclude: Hence incineration is controlled high-temperature combustion.

Why the other options are wrong:

- A, anaerobic decomposition: describes digestion, a biological process.
- B, composting: is aerobic biological stabilisation, not combustion.
- C, land application: is a disposal method, not a thermal one.

Final Answer: controlled high-temperature combustion $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept – energy recovery in a mass-burn plant: A waste-to-energy plant captures the combustion heat in a boiler and converts it to electricity through a steam cycle.

Step 1 – follow the energy path: Burning refuse heats water in a boiler to produce high-pressure steam.

Step 2 – convert heat to work: The steam expands through a turbine, which drives a generator to make electricity.

Step 3 – state the main use: Thus the heat is used chiefly to raise steam that generates power.

Why the other options are wrong:

- B: metal recovery is a materials step, not the use of the heat.
- C: composting does not apply to burnt residue.
- D: leachate purification is unrelated to combustion heat.

Final Answer: raise steam to drive a turbine and generate electricity $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept – composition and value of landfill gas: Anaerobic decomposition of organic waste in a landfill produces a gas that is roughly half methane and half carbon dioxide, with traces of other gases.

Step 1 – identify the combustible component: Methane (CH_4) is flammable and has a high calorific value.

Step 2 – note the non-fuel component: Carbon dioxide does not burn, so it adds no fuel value.

Step 3 – conclude: The methane content is what makes landfill gas worth collecting and using as a fuel.

Why the other options are wrong:

- B, CO_2: is incombustible.
- C, N_2: is inert.
- D, H_2S: is only a trace, corrosive and odorous, not the fuel.

Final Answer: methane (CH_4) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept – landfill airspace from mass and density: The volume occupied equals the mass of compacted waste divided by its in-place density.

Step 1 – convert the daily mass to kilograms: $200 \text{ tonnes/day} = 200 \times 1000 = 2 \times 10^5 \text{ kg/day}$.

Step 2 – write the volume equation: $V = \dfrac{\text{mass}}{\text{density}}$

Step 3 – substitute: $V = \dfrac{2 \times 10^5 \text{ kg/day}}{800 \text{ kg/m}^3}$

Step 4 – evaluate: $V = 250 \text{ m}^3\text{/day}$

Final Answer: $250 \text{ m}^3\text{/day} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – disposal of hazardous waste: Wastes that are ignitable, corrosive, reactive or toxic need containment far stricter than ordinary refuse to keep contaminants out of soil and groundwater.

Step 1 – state the requirement: The facility must have multiple impervious liners, a leachate-collection and treatment system, and monitoring wells.

Step 2 – name the facility: Such an engineered containment is a secured (engineered) hazardous-waste landfill.

Why the other options are wrong:

- A, open dump: gives no containment at all.
- B, ordinary sanitary landfill: is designed for household refuse, not hazardous streams.
- D, unlined compost pit: is for biodegradable organics and offers no protection.

Final Answer: secured (engineered) landfill with liners and leachate collection $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept – scope of the ISO 14000 series: Each major ISO series addresses one management theme; ISO 14000 is the environmental family.

Step 1 – recall what ISO 14000 covers: It provides the framework for environmental management systems, environmental auditing, labelling and life-cycle assessment.

Step 2 – state the primary concern: Its central purpose is environmental management within an organization.

Why the other options are wrong:

- A, quality management: is the ISO 9000 family.
- B, occupational health and safety: is ISO 45001.

- D, financial auditing: is outside the ISO management-system scope.

Final Answer: environmental management systems $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q41

Q42.

Solution

Concept – the certifiable EMS standard: Within ISO 14000 only one standard sets *requirements* against which an organization is audited and certified; the others are guidance documents.

Step 1 – separate requirement from guidance: ISO 14001 states the EMS requirements; ISO 14004 and ISO 14040 give guidance and LCA principles respectively.

Step 2 – identify the certifiable one: Certification is granted against ISO 14001.

Why the other options are wrong:

- A, ISO 9001: is the quality-management standard.
- B, ISO 14040: covers life-cycle assessment principles, not EMS certification.
- C, ISO 45001: covers occupational health and safety.

Final Answer: ISO 14001 $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q42

Q43.

Solution

Concept – what an environmental audit is: An environmental audit is a management check, carried out after operations are running, to verify compliance with plans and law.

Step 1 – note the key features: It is systematic, documented and objective, and it compares actual performance against planned arrangements and regulatory limits.

Step 2 – distinguish it from prediction: It looks at the *existing* facility, unlike an EIA, which predicts impacts *before* a project starts.

Step 3 – match to the option: Option A captures exactly this verification role.

Why the other options are wrong:

- B: pre-project prediction is an EIA.
- C: profit and loss is a financial audit.
- D: a market survey is unrelated.

Final Answer: a systematic, documented compliance verification $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – cradle-to-grave analysis: Assessing every stage of a product's life, from raw material to disposal, is the defining feature of life-cycle assessment.

Step 1 – read the description: The method covers extraction, manufacture, use and final disposal, i.e. "cradle to grave".

Step 2 – name it: This whole-life environmental accounting is Life Cycle Assessment (LCA).

Why the other options are wrong:

- A, EIA: evaluates a specific project or site, not a product's full life.
- C, environmental audit: checks an operating facility's compliance.
- D, risk assessment: quantifies the likelihood and consequence of hazards.

Final Answer: Life Cycle Assessment $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept – the continual-improvement cycle of an EMS: ISO 14001 is structured around a repeating loop that plans, implements, checks and then corrects, driving continual improvement.

Step 1 – list the four stages: Plan (set objectives), Do (implement), Check (monitor and measure), Act (review and correct).

Step 2 – name the cycle: These four stages form the Plan–Do–Check–Act (PDCA) cycle, also called the Deming cycle.

Why the other options are wrong:

- A, DMAIC: is a Six-Sigma quality tool.

- B, input–output: is an accounting/analysis model.
- D, SWOT: is a strategic-analysis tool, not the EMS improvement loop.

Final Answer: Plan–Do–Check–Act (PDCA) cycle $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q45

Q46.

Solution

Concept – the 2015 UNFCCC climate agreement: Several international treaties address different environmental issues; only one, adopted in 2015, sets the global temperature goal.

Step 1 – recall the 2015 treaty: The Paris Agreement (COP21, 2015) commits parties to limit warming to well below $2°$C, pursuing $1.5°$C.

Step 2 – confirm the framework: It is adopted under the UNFCCC and relies on nationally determined contributions.

Why the other options are wrong:

- B, Montreal Protocol: protects the ozone layer (1987).
- C, Kyoto Protocol: is the 1997 emission-reduction treaty, not the $2°$C-goal agreement.
- D, Basel Convention: controls transboundary movement of hazardous waste.

Final Answer: Paris Agreement $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q46

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	B	4	B	5	D
6	D	7	B	8	C	9	A	10	C
11	A	12	B	13	D	14	D	15	C
16	D	17	A	18	D	19	B	20	D
21	B	22	C	23	A	24	A	25	D
26	D	27	B	28	C	29	A	30	C
31	B	32	C	33	A	34	B	35	A
36	D	37	A	38	A	39	B	40	C
41	C	42	D	43	A	44	B	45	C
46	A								