GATE Environmental Science and Engineering

Sample Paper – 10

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, the microbially mediated, two-step aerobic conversion of ammonia first to nitrite and then to nitrate is called: [1 mark]

(A) denitrification

(B) nitrogen fixation

(C) nitrification

(D) ammonification

Q2. A water sample contains magnesium ions at a concentration of 24 mg/L (atomic mass of Mg $= 24$). Expressed as an equivalent concentration of calcium carbonate, the magnesium hardness is: **[1 mark]**

(A) 24 mg/L as $CaCO_3$

(B) 50 mg/L as $CaCO_3$

(C) 100 mg/L as $CaCO_3$

(D) 120 mg/L as $CaCO_3$

Q3. The nutrient element that is most often the limiting factor and is therefore chiefly responsible for the accelerated eutrophication of freshwater lakes is: **[1 mark]**

(A) phosphorus

(B) carbon

(C) silicon

(D) chlorine

Q4. At $25°$C a water sample has a hydroxyl-ion concentration $[\text{OH}^-] = 1 \times 10^{-5}$ mol/L. Taking $K_w = [\text{H}^+][\text{OH}^-] = 1 \times 10^{-14}$, the pH of the water is: **[1 mark]**

(A) 5

(B) 7

(C) 9

(D) 14

Q5. The stabilisation of organic matter by micro-organisms in the absence of free (dissolved) oxygen, producing mainly methane and carbon dioxide, is termed: **[1 mark]**

(A) anaerobic decomposition

(B) photosynthesis

(C) nitrification

(D) aerobic respiration

Q6. The standard biochemical oxygen demand (BOD_5) test is conventionally carried out by incubating the sample in the dark for five days at a controlled temperature of: **[1 mark]**

(A) 37°C

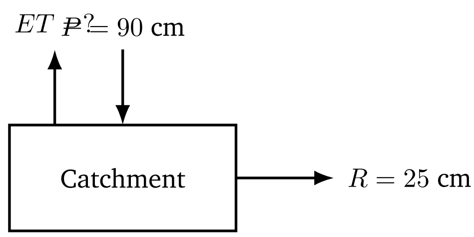
(B) 25°C

(C) 20°C

(D) 4°C

Water Resources and Environmental Hydraulics

Q7. For the urban catchment water balance shown, the annual rainfall is $P = 90$ cm and the annual runoff (including managed stormwater) is $R = 25$ cm. If the change in storage over the year is negligible, the evapotranspiration loss $ET = P - R$ is: **[1 mark]**



(A) 115 cm

(B) 25 cm

(C) 65 cm

(D) 90 cm

Q8. Using the rational formula $Q = \dfrac{C\,i\,A}{360}$ (with i in mm/hr and A in hectares giving Q in m^3/s), a small urban catchment has runoff coefficient $C = 0.45$, design rainfall intensity $i = 50$ mm/hr and area $A = 20$ ha. The peak stormwater runoff Q is: **[1 mark]**

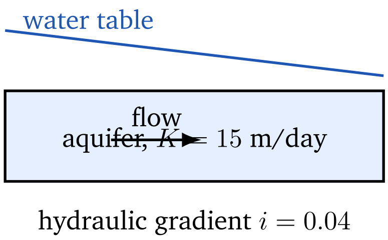
(A) $5.0 \text{ m}^3/\text{s}$

(B) $2.5 \text{ m}^3/\text{s}$

(C) $0.45 \text{ m}^3/\text{s}$

(D) $1.25 \text{ m}^3/\text{s}$

Q9. For the unconfined aquifer shown, Darcy's law gives the specific-discharge (Darcy) velocity as $v = K\,i$, where K is the hydraulic conductivity and i the hydraulic gradient. With $K = 15$ m/day and $i = 0.04$, the Darcy velocity is: **[1 mark]**



(A) 6 m/day

(B) 0.06 m/day

(C) 60 m/day

(D) 0.6 m/day

Q10. A confined aquifer of thickness $b = 15$ m and hydraulic conductivity $K = 30$ m/day carries groundwater under a hydraulic gradient of $i = 0.002$ across a width $W = 500$ m. The volumetric flow $Q = K\,i\,(b\,W)$ through this section is: **[1 mark]**

(A) $450 \text{ m}^3/\text{day}$

(B) $45 \text{ m}^3/\text{day}$

(C) $4500 \text{ m}^3/\text{day}$

(D) $900 \text{ m}^3/\text{day}$

Q11. Among sustainable urban drainage systems (SUDS), the device that is a broad, shallow, gently sloping vegetated channel used to convey and infiltrate stormwater runoff while filtering pollutants is a: **[1 mark]**

(A) swale

(B) secondary clarifier

(C) aeration tank

(D) trickling filter

Q12. Water flows in a wide open drainage channel. By Manning's equation $V = \frac{1}{n} R^{2/3} S^{1/2}$, with Manning's roughness $n = 0.02$, hydraulic radius $R = 1$ m and bed slope $S = 0.0004$, the mean velocity of flow is: **[1 mark]**

(A) 0.02 m/s

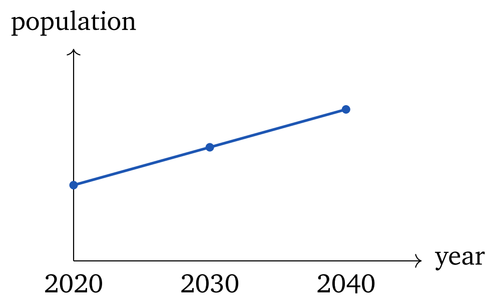
(B) 2.5 m/s

(C) 25 m/s

(D) 1.0 m/s

Water Supply and Water Treatment

Q13. A town's population in the year 2020 is $80{,}000$ and its average decadal increase (arithmetic-increase method) is $8{,}000$ persons, as trended below. The forecast population for the year 2040 is: **[1 mark]**



(A) $96{,}000$

(B) $16{,}000$

(C) $88{,}000$

(D) $80{,}000$

Q14. A city with a population of $200{,}000$ has an average water demand of 150 litres per capita per day (lpcd). The average daily water demand of the city, expressed in million litres per day (MLD), is: **[1 mark]**

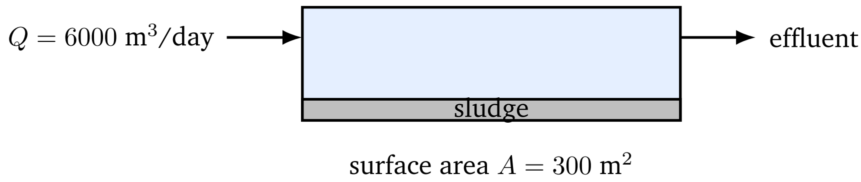
(A) 3 MLD

(B) 150 MLD

(C) 30 MLD

(D) 1.5 MLD

Q15. A rectangular sedimentation tank shown treats a flow of $Q = 6000$ m^3/day and has a plan (surface) area of $A = 300$ m^2. The surface overflow rate (surface loading) $SOR = Q/A$ is: **[1 mark]**



(A) 200 m/day

(B) 20 m/day

(C) 0.05 m/day

(D) 2000 m/day

Q16. The Nalgonda technique, widely used in India for the defluoridation of drinking water, removes excess fluoride by adding lime together with: **[1 mark]**

(A) chlorine gas

(B) powdered activated carbon

(C) alum (aluminium sulphate)

(D) ozone

Q17. A flocculation basin of volume $V = 900$ m^3 receives a flow of $Q = 300$ m^3/hr. The theoretical hydraulic detention (retention) time $t_d = V/Q$ is: **[1 mark]**

(A) 3 hr

(B) 0.33 hr

(C) 1.5 hr

(D) 6 hr

Q18. The removal of dissolved arsenic from contaminated groundwater is most commonly achieved by first oxidising arsenite to arsenate and then co-precipitating and adsorbing it onto: **[1 mark]**

(A) activated silica

(B) powdered activated carbon

(C) sodium chloride crystals

(D) ferric (iron) hydroxide flocs

Wastewater Treatment and Disposal

Q19. The influent to a secondary treatment unit has a BOD of 250 mg/L and the effluent leaving it has a BOD of 25 mg/L. The BOD-removal efficiency of the unit is: **[1 mark]**

(A) 90%

(B) 10%

(C) 25%

(D) 225%

Q20. Which one of the following is a tertiary (advanced) wastewater treatment process specifically capable of removing dissolved solids so that the effluent can be reclaimed for reuse? **[1 mark]**

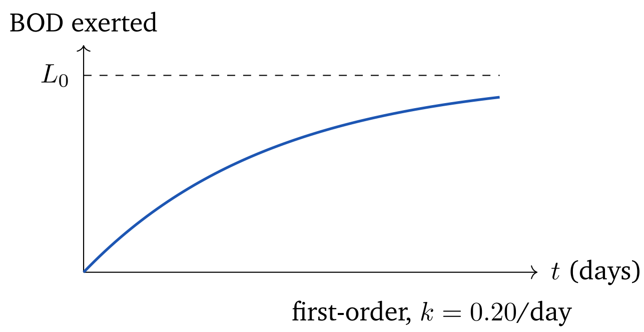
(A) primary sedimentation

(B) reverse osmosis

(C) grit removal

(D) bar screening

Q21. Wastewater has an ultimate (first-stage) BOD of $L_0 = 250$ mg/L and a deoxygenation rate constant $k = 0.20$ day^{-1} (base e). Following the first-order model of the BOD-exertion curve shown, the BOD exerted in 5 days, $y_5 = L_0\left(1 - e^{-kt}\right)$, is nearest to: **[2 marks]**



(A) 92 mg/L

(B) 250 mg/L

(C) 158 mg/L

(D) 205 mg/L

Q22. An activated-sludge aeration tank of volume $V = 800$ m^3 operates with a mixed-liquor suspended-solids concentration of $X = 2500$ mg/L. It receives $Q = 1600$ m^3/day of wastewater 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]**

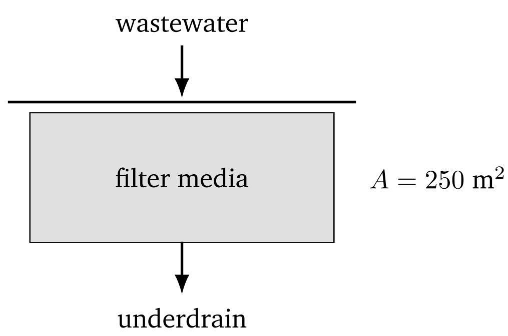
(A) 2.0 per day

(B) 0.2 per day

(C) 0.02 per day

(D) 0.5 per day

Q23. A circular trickling filter, shown in cross-section, has a surface (plan) area of $A = 250$ m^2 and receives a wastewater flow of $Q = 5 \times 10^6$ L/day. The hydraulic loading rate $HLR = Q/A$ is: **[2 marks]**



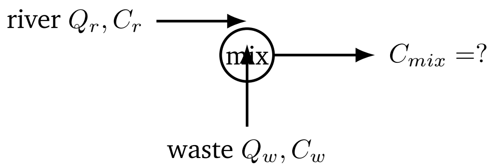
(A) 20 m/day

(B) 0.05 m/day

(C) 200 m/day

(D) 2 m/day

Q24. Treated wastewater is discharged into a stream, as sketched. The waste stream carries $Q_w = 1.0$ m^3/s at a BOD of 180 mg/L and the receiving river carries $Q_r = 9.0$ m^3/s at a BOD of 2 mg/L. Assuming complete mixing, the BOD just downstream of the outfall is nearest to: **[2 marks]**



(A) 182 mg/L

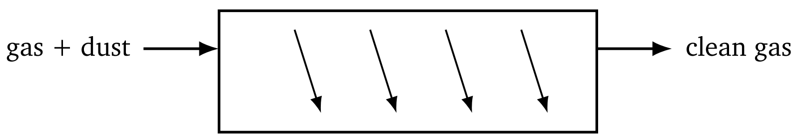
(B) 19.8 mg/L

(C) 90 mg/L

(D) 40 mg/L

Air Pollution and Control

Q25. In the gravity settling chamber shown, a spherical dust particle of diameter $d = 10\ \mu$m $= 1 \times 10^{-5}$ m and density $\rho_p = 2500$ kg/m^3 settles in air of viscosity $\mu = 1.8 \times 10^{-5}$ Pa·s. Neglecting the air density, the terminal settling velocity $v_t = \dfrac{g\,\rho_p\,d^2}{18\mu}$ is nearest to: **[2 marks]**



particle settles under gravity

(A) 0.076 m/s

(B) 0.0038 m/s

(C) 0.0076 m/s

(D) 0.00076 m/s

Q26. A cyclone separator receives a gas carrying a particulate loading of 8 g/m^3 and discharges it at 0.4 g/m^3. The overall collection (removal) efficiency of the cyclone is: **[2 marks]**

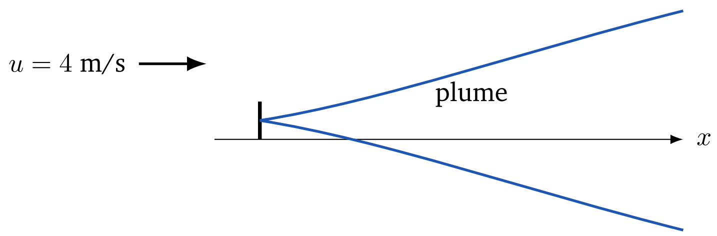
(A) 95%

(B) 5%

(C) 50%

(D) 90%

Q27. A continuous ground-level point source emits a pollutant at $Q = 120$ g/s into a wind of speed $u = 4$ m/s. For the Gaussian plume shown, the ground-level centre-line concentration is $C = \dfrac{Q}{\pi\,\sigma_y\,\sigma_z\,u}$; at the downwind location $\sigma_y = 40$ m and $\sigma_z = 20$ m, the concentration is nearest to: **[2 marks]**



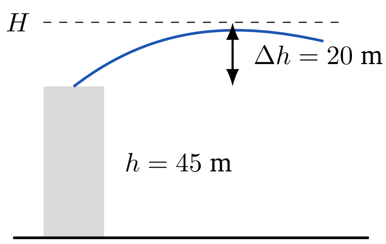
(A) 11.9 mg/m^3

(B) 6.0 mg/m^3

(C) 3.0 mg/m^3

(D) 1.2 mg/m^3

Q28. For the chimney shown, the physical stack height is $h = 45$ m and the buoyant plume rises a further $\Delta h = 20$ m above the stack top before levelling off. The effective stack height $H = h + \Delta h$ is: **[2 marks]**



(A) 45 m

(B) 65 m

(C) 25 m

(D) 90 m

Q29. Airborne biological particles such as bacteria, fungal spores, viruses and pollen that are of particular concern for indoor air quality are collectively termed: **[2 marks]**

(A) bioaerosols

(B) fly ash

(C) photochemical smog

(D) particulate lead

Q30. Ambient nitrogen dioxide is measured as 0.05 ppm by volume. At $25°$C (1 atm) the molar volume of a gas is 24.45 litres and the molecular mass of NO_2 is 46. Using $\mu g/m^3 = \text{ppm} \times \dfrac{M}{24.45} \times 1000$, the mass concentration is nearest to: **[2 marks]**

(A) $46\ \mu g/m^3$

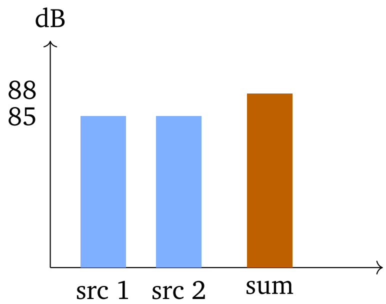
(B) $50\ \mu g/m^3$

(C) $24.45\ \mu g/m^3$

(D) $94\ \mu g/m^3$

Noise Pollution and Environmental Monitoring

Q31. Two identical machines each produce a sound-pressure level of 85 dB at a point. When both operate together, the combined level $L = 10\log_{10}\big(10^{L_1/10} + 10^{L_2/}$ is (as suggested by the energy addition shown): **[2 marks]**



(A) 85 dB

(B) 170 dB

(C) 91 dB

(D) 88 dB

Q32. At a receiver, one source produces 90 dB and a second produces 84 dB. The combined sound level, using $L = 10\log_{10}(10^{9.0} + 10^{8.4})$, is nearest to: **[2 marks]**

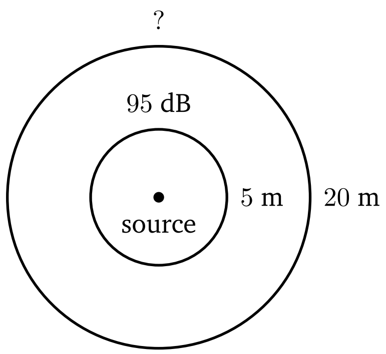
(A) 90 dB

(B) 91 dB

(C) 174 dB

(D) 96 dB

Q33. A point noise source produces 95 dB at a distance of 5 m. In a free field the level falls by 6 dB for every doubling of distance, as the contours below suggest. The sound level at 20 m from the source is: **[2 marks]**



(A) 89 dB

(B) 71 dB

(C) 83 dB

(D) 95 dB

Q34. Which one of the following is an example of noise control at the *source*, rather than along the transmission path or at the receiver? **[2 marks]**

(A) erecting a roadside barrier wall

(B) issuing ear plugs to exposed workers

(C) planting a road-side green belt

(D) fitting an engine with a muffler (silencer)

Solid and Hazardous Waste Management

Q35. A city has a population of $400{,}000$ and a per-capita municipal solid-waste (MSW) generation rate of 0.6 kg/person/day. The total MSW generated per day, expressed in tonnes, is: **[2 marks]**

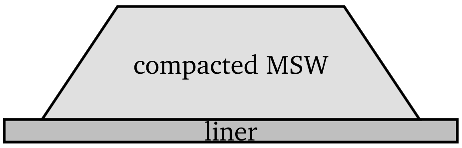
(A) 240 tonnes/day

(B) 24 tonnes/day

(C) 120 tonnes/day

(D) 400 tonnes/day

Q36. A sanitary landfill, shown in cross-section, receives 150 tonnes/day of MSW that is compacted to an in-place density of 600 kg/m^3. The landfill airspace (volume) needed for one year (365 days) of this waste is nearest to: **[2 marks]**



in-place density = 600 kg/m^3

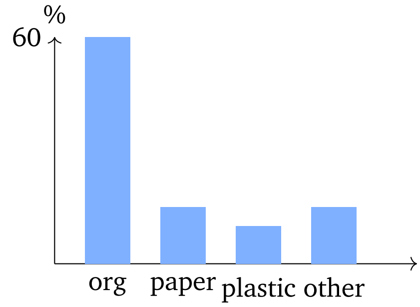
(A) $182{,}500$ m^3

(B) $91{,}250$ m^3

(C) $45{,}625$ m^3

(D) $60{,}833$ m^3

Q37. The bar chart shows the composition of a city's MSW: organic (compostable) 60%, paper 15%, plastic 10% and other 15%. If the total MSW is 200 tonnes/day, the mass of the compostable (organic) fraction is: **[2 marks]**



(A) 60 tonnes/day

(B) 30 tonnes/day

(C) 200 tonnes/day

(D) 120 tonnes/day

Q38. In the integrated solid-waste-management hierarchy, which one of the following is the *most* preferred (highest-priority) option? **[2 marks]**

(A) sanitary landfilling

(B) waste reduction (reduce) at source

(C) mass-burn incineration

(D) open dumping

Q39. A mass-burn incinerator receives 200 tonnes/day of MSW and leaves an ash residue equal to 25% of the input mass. The mass of ash (bottom + fly ash) produced per day is: **[2 marks]**

(A) 200 tonnes/day

(B) 50 tonnes/day

(C) 150 tonnes/day

(D) 25 tonnes/day

Q40. The liquid that forms as water percolates through a landfill and becomes contaminated with dissolved and suspended matter from the waste, requiring collection and treatment, is called: **[2 marks]**

(A) digestate

(B) compost

(C) sludge

(D) leachate

Environmental Management, Sustainability and Climate

Q41. The benefits that people obtain from ecosystems, such as crop pollination, natural water purification, flood control and climate regulation, are collectively known as: **[2 marks]**

(A) carbon credits

(B) ecosystem services

(C) carrying capacity

(D) biomagnification

Q42. The measure of the variety of living organisms, encompassing diversity at the genetic, species and ecosystem levels within a given area, is termed: **[2 marks]**

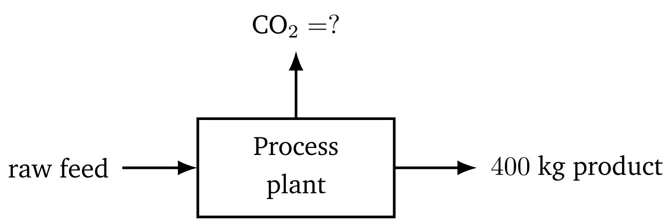
(A) turbidity

(B) salinity

(C) biodiversity

(D) alkalinity

Q43. For the process shown, a plant emits 3 kg of CO_2 for every kilogram of product and manufactures 400 kg of product each day. The daily CO_2 emission, obtained from the mass balance, is: **[2 marks]**



(A) 400 kg/day

(B) 1.2 tonnes/day

(C) 800 kg/day

(D) 3 tonnes/day

Q44. Conservation of a species within its natural habitat, for example by protecting it inside a national park, wildlife sanctuary or biosphere reserve, is called: **[2 marks]**

(A) ex-situ conservation

(B) in-situ conservation

(C) cryopreservation in a gene bank

(D) captive breeding in zoos

Q45. The international treaty adopted at the 1992 Rio Earth Summit specifically for the conservation of biological diversity, its sustainable use and the fair sharing of benefits from genetic resources is the: **[2 marks]**

(A) Montreal Protocol

(B) Kyoto Protocol

(C) Ramsar Convention

(D) Convention on Biological Diversity

Q46. A species whose removal would trigger a disproportionately large change in its ecosystem, often collapsing the structure of the whole community, is known as a: **[2 marks]**

(A) invasive species

(B) indicator species

(C) endemic species

(D) keystone species

Detailed Solutions

Q1.

Solution

Concept – microbial steps of the nitrogen cycle: Different micro-organisms carry out distinct transformations of nitrogen; each has a specific name.

Step 1 – identify the direction of change: Ammonia (NH_3/NH_4^+) is being oxidised, first to nitrite (NO_2^-) and then to nitrate (NO_3^-).

Step 2 – recall the responsible organisms: *Nitrosomonas* oxidises ammonia to nitrite, and *Nitrobacter* oxidises nitrite to nitrate.

Step 3 – name the overall aerobic process: This oxygen-requiring, two-step oxidation is called nitrification.

Why the other options are wrong:

- A, denitrification: is the reverse, reducing nitrate to nitrogen gas under anoxic conditions.
- B, nitrogen fixation: converts atmospheric N_2 into ammonia/organic nitrogen.
- D, ammonification: releases ammonia from organic nitrogen.

Final Answer: nitrification $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept – expressing hardness as $CaCO_3$: The hardness due to an ion equals its concentration multiplied by the ratio of the equivalent weight of $CaCO_3$ (50) to the equivalent weight of that ion.

Step 1 – equivalent weight of magnesium: Magnesium has valency 2, so its equivalent weight is $\frac{24}{2} = 12$

Step 2 – form the conversion factor: factor $= \frac{50}{12} = 4.1667$

Step 3 – multiply the magnesium concentration by the factor: Hardness $= 24 \times 4.1667$

Step 4 – evaluate: Hardness $= 100$ mg/L as $CaCO_3$

Final Answer: 100 mg/L as $CaCO_3 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – limiting nutrient and eutrophication: Eutrophication is the over-enrichment of a water body with nutrients that triggers excessive algal growth. The nutrient in shortest supply relative to demand controls that growth.

Step 1 – compare nutrient availability in freshwater: Carbon (from CO_2/bicarbonate) and nitrogen are usually abundant, but phosphorus is naturally scarce in most freshwater systems.

Step 2 – identify the limiting nutrient: Because algae need phosphorus and it is the scarce element, a small extra input of phosphorus can unlock a large algal bloom.

Why the other options are wrong:

- B, carbon: is rarely limiting because atmospheric CO_2 replenishes it.
- C, silicon: limits only diatoms, not eutrophication in general.
- D, chlorine: is not a growth-limiting plant nutrient.

Final Answer: phosphorus $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept – ion product of water: At 25°C, $[H^+][OH^-] = K_w = 1 \times 10^{-14}$, and $pH = -\log_{10}[H^+]$.

Step 1 – rearrange for $[H^+]$: $[H^+] = \dfrac{K_w}{[OH^-]}$

Step 2 – substitute the values: $[H^+] = \dfrac{1 \times 10^{-14}}{1 \times 10^{-5}}$

Step 3 – subtract the exponents: $[H^+] = 1 \times 10^{-14-(-5)} = 1 \times 10^{-9}$ mol/L

Step 4 – take the negative logarithm: $pH = -\log_{10}(10^{-9}) = 9$

Step 5 – interpret: A pH of 9 (> 7) indicates a basic water, consistent with the high $[OH^-]$.

Final Answer: $pH = 9 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept – anaerobic decomposition: Organic matter can be stabilised either with oxygen (aerobic) or without it (anaerobic). The oxygen-free pathway is used in digesters and sanitary landfills.

Step 1 – note the stated condition: The process occurs *in the absence of free (dissolved) oxygen*.

Step 2 – recall the products: Anaerobic breakdown yields chiefly methane (CH_4) and carbon dioxide (CO_2), the biogas mixture.

Step 3 – name the process: Stabilisation of organics without oxygen, producing methane and CO_2, is anaerobic decomposition (digestion).

Why the other options are wrong:

- B, photosynthesis: builds organics using light, not the reverse.
- C, nitrification: is aerobic oxidation of ammonia.
- D, aerobic respiration: requires oxygen and yields mainly CO_2 and water, not methane.

Final Answer: anaerobic decomposition $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept – standard BOD_5 test conditions: BOD is measured under fixed, reproducible conditions so results are comparable worldwide.

Step 1 – recall the incubation period: The standard test runs for 5 days (hence BOD_5).

Step 2 – recall the incubation temperature: The bottle is held in the dark at $20°C$, a temperature representative of natural streams and one that keeps microbial rates standard.

Step 3 – reason out why the dark and $20°C$: Darkness prevents algal photosynthesis from adding oxygen, and the fixed temperature standardises the reaction rate.

Why the other options are wrong:

- A, 37°C: is body temperature, used for pathogen culture, not BOD.
- B, 25°C and D, 4°C: are not the standard BOD incubation temperature.

Final Answer: 20°C $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept – catchment water balance: Over a period with negligible change in storage, rainfall is partitioned into evapotranspiration and runoff, so $P = ET + R$, giving $ET = P - R$.

Step 1 – list the data: $P = 90$ cm, $R = 25$ cm, $\Delta S \approx 0$.

Step 2 – rearrange the balance: $ET = P - R$

Step 3 – substitute the values: $ET = 90 - 25$

Step 4 – evaluate: $ET = 65$ cm

Final Answer: $ET = 65$ cm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept – rational formula for peak runoff: $Q = \dfrac{C\,i\,A}{360}$ gives Q in m^3/s when i is in mm/hr and A in hectares.

Step 1 – list the data: $C = 0.45$, $i = 50$ mm/hr, $A = 20$ ha.

Step 2 – form the numerator: $C\,i\,A = 0.45 \times 50 \times 20$

Step 3 – multiply step by step: $0.45 \times 50 = 22.5$

$22.5 \times 20 = 450$

Step 4 – divide by 360**:** $Q = \dfrac{450}{360}$

$Q = 1.25$ m^3/s

Final Answer: $Q = 1.25$ m^3/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept – Darcy's law: The specific discharge (Darcy velocity) is the product of hydraulic conductivity and hydraulic gradient, $v = K\,i$.

Step 1 – list the data: $K = 15$ m/day, $i = 0.04$.

Step 2 – substitute: $v = 15 \times 0.04$

Step 3 – evaluate: $v = 0.6$ m/day

Final Answer: $v = 0.6$ m/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept – Darcy discharge through an aquifer section: The flow equals the Darcy velocity times the cross-sectional area, $Q = K\,i\,(b\,W)$, where $b\,W$ is the area normal to flow.

Step 1 – list the data: $K = 30$ m/day, $i = 0.002$, $b = 15$ m, $W = 500$ m.

Step 2 – compute the cross-sectional area: $A = b\,W = 15 \times 500 = 7500$ m^2

Step 3 – compute the Darcy velocity: $v = K\,i = 30 \times 0.002 = 0.06$ m/day

Step 4 – multiply velocity by area: $Q = 0.06 \times 7500$

$Q = 450$ m^3/day

Final Answer: $Q = 450$ m^3/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – SUDS conveyance features: Sustainable urban drainage systems (SUDS) manage stormwater near its source, slowing, storing and cleaning runoff rather than piping it away quickly.

Step 1 – match the description: A broad, shallow, gently sloping, vegetated channel that conveys and infiltrates runoff while filtering pollutants describes a swale.

Step 2 – note its function: The grass lining slows flow, promotes infiltration and traps sediment, reducing both peak flow and pollution.

Why the other options are wrong:

- B, secondary clarifier; C, aeration tank; D, trickling filter: are all wastewater-treatment units, not stormwater conveyance features.

Final Answer: swale $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept – Manning's velocity equation: $V = \dfrac{1}{n} R^{2/3} S^{1/2}$.

Step 1 – list the data: $n = 0.02$, $R = 1$ m, $S = 0.0004$.

Step 2 – evaluate $R^{2/3}$: $R^{2/3} = 1^{2/3} = 1$

Step 3 – evaluate $S^{1/2}$: $S^{1/2} = \sqrt{0.0004} = 0.02$

Step 4 – form the coefficient: $\dfrac{1}{n} = \dfrac{1}{0.02} = 50$

Step 5 – multiply the three factors: $V = 50 \times 1 \times 0.02$

$V = 1.0$ m/s

Final Answer: $V = 1.0$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept – arithmetic-increase method of population forecast: Population grows by a constant amount each decade, so $P_n = P_0 + n\overline{x}$, where $\overline{x}$ is the average decadal increase and n the number of decades.

Step 1 – count the decades from 2020 to 2040: $n = \dfrac{2040 - 2020}{10} = 2$ decades

Step 2 – compute the total increase: $n\overline{x} = 2 \times 8000 = 16000$

Step 3 – add to the base population: $P = 80000 + 16000$

$P = 96000$

Final Answer: $P = 96{,}000 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept – average daily water demand: Total demand equals per-capita demand times population.

Step 1 – list the data: Per-capita demand $= 150$ L/person/day, population $=$ 200000.

Step 2 – multiply: Demand $= 150 \times 200000$

Step 3 – evaluate in litres per day: Demand $= 30{,}000{,}000$ L/day

Step 4 – convert to million litres per day: Demand $= \dfrac{30{,}000{,}000}{10^6} = 30$ MLD

Final Answer: 30 MLD $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept – surface overflow rate: The surface overflow rate (surface loading) of a settling tank is the flow divided by the plan area, $SOR = Q/A$, and has units of velocity (m/day).

Step 1 – list the data: $Q = 6000$ m^3/day, $A = 300$ m^2.

Step 2 – substitute: $SOR = \dfrac{6000}{300}$

Step 3 – evaluate: $SOR = 20$ m/day

Step 4 – interpret: Particles with a settling velocity of at least 20 m/day will be fully removed.

Final Answer: $SOR = 20$ m/day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept – Nalgonda defluoridation technique: Excess fluoride in drinking water causes fluorosis and must be removed. The Nalgonda process is a low-cost Indian method based on coagulation.

Step 1 – recall the chemicals added: Lime (for alkalinity/pH) and alum (aluminium sulphate, the coagulant) are dosed, sometimes with bleaching powder for disinfection.

Step 2 – recall the removal mechanism: Alum forms aluminium hydroxide flocs that adsorb and co-precipitate fluoride, which then settles out.

Why the other options are wrong:

- A, chlorine gas: is a disinfectant, it does not remove fluoride.
- B, activated carbon: adsorbs organics and taste/odour, not the primary Nalgonda reagent.
- D, ozone: is an oxidant/disinfectant, not a fluoride coagulant.

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

Answer: (C) Go Back to Q16

Q17.

Solution

Concept – hydraulic detention time: The theoretical detention (retention) time is the tank volume divided by the flow rate, $t_d = V/Q$.

Step 1 – list the data: $V = 900 \text{ m}^3$, $Q = 300 \text{ m}^3/\text{hr}$.

Step 2 – substitute: $t_d = \dfrac{900}{300}$

Step 3 – evaluate: $t_d = 3 \text{ hr}$

Final Answer: $t_d = 3 \text{ hr} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept – arsenic removal from groundwater: Dissolved arsenic exists as arsenite [As(III)] and arsenate [As(V)]. As(V) is far easier to remove because it adsorbs strongly to iron surfaces.

Step 1 – oxidation step: An oxidant (air, chlorine or permanganate) first converts As(III) to As(V).

Step 2 – removal step: Iron salts are added; the As(V) co-precipitates with and adsorbs onto ferric (iron) hydroxide flocs, which are then settled and filtered out.

Why the other options are wrong:

- A, activated silica: is a coagulant aid, not the arsenic-binding medium.
- B, activated carbon: has poor capacity for arsenate.

- C, sodium chloride: does not bind arsenic at all.

Final Answer: ferric (iron) hydroxide flocs $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – removal efficiency: Efficiency compares the amount removed with the amount entering, $\eta = \dfrac{C_{in} - C_{out}}{C_{in}} \times 100\%$.

Step 1 – list the data: $C_{in} = 250$ mg/L, $C_{out} = 25$ mg/L.

Step 2 – find the amount removed: $C_{in} - C_{out} = 250 - 25 = 225$ mg/L

Step 3 – divide by the inlet value: $\eta = \dfrac{225}{250}$

Step 4 – convert to a percentage: $\eta = 0.90 \times 100 = 90\%$

Final Answer: $\eta = 90\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – tertiary treatment for reuse: Tertiary (advanced) treatment follows secondary treatment and targets residual dissolved solids, nutrients and pathogens so the water can be reclaimed.

Step 1 – test each option against the goal: Removing *dissolved* solids needs a membrane or ion process, not a settling or screening step.

Step 2 – identify the process: Reverse osmosis pushes water through a semipermeable membrane, rejecting dissolved salts and giving high-quality reclaimed water.

Why the other options are wrong:

- A, primary sedimentation: removes only settleable solids (primary stage).
- C, grit removal and D, bar screening: are preliminary steps for coarse/heavy material.

Final Answer: reverse osmosis $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept – first-order BOD exertion: The BOD exerted by time t follows $y_t = L_0\left(1 - e^{-kt}\right)$, where L_0 is the ultimate BOD and k the deoxygenation rate.

Step 1 – list the data: $L_0 = 250$ mg/L, $k = 0.20$ day^{-1}, $t = 5$ days.

Step 2 – form the exponent: $kt = 0.20 \times 5 = 1.0$

Step 3 – evaluate e^{-kt}: $e^{-1.0} = 0.3679$

Step 4 – form the fraction exerted: $1 - e^{-kt} = 1 - 0.3679 = 0.6321$

Step 5 – multiply by L_0: $y_5 = 250 \times 0.6321$

$y_5 = 158.0$ mg/L

Final Answer: $y_5 \approx 158$ mg/L $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – food-to-microorganism ratio: The F/M ratio measures the organic load applied per unit mass of micro-organisms, $F/M = \dfrac{Q\,S_0}{V\,X}$.

Step 1 – list the data: $Q = 1600$ m^3/day, $S_0 = 250$ mg/L, $V = 800$ m^3, $X = 2500$ mg/L.

Step 2 – form the numerator (food applied): $Q\,S_0 = 1600 \times 250 = 400000$

Step 3 – form the denominator (mass of organisms): $V\,X = 800 \times 2500 = 2000000$

Step 4 – divide: $F/M = \dfrac{400000}{2000000}$

$F/M = 0.2$ per day

Final Answer: $F/M = 0.2$ per day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept – hydraulic loading rate of a trickling filter: The hydraulic loading rate is the flow per unit plan area, $HLR = Q/A$, expressed as a velocity (m/day).

Step 1 – convert the flow to m^3/day: $Q = 5 \times 10^6$ L/day $= \dfrac{5 \times 10^6}{1000} = 5000$

m^3/day

Step 2 – list the area: $A = 250$ m^2

Step 3 – divide: $HLR = \dfrac{5000}{250}$

Step 4 – evaluate: $HLR = 20$ m/day

Final Answer: $HLR = 20$ m/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept – complete-mixing mass balance: When two streams merge and mix completely, the mixed concentration is the flow-weighted average, $C_{mix} = \dfrac{Q_w C_w + Q_r C_r}{Q_w + Q_r}$.

Step 1 – list the data: $Q_w = 1.0$ m^3/s, $C_w = 180$ mg/L; $Q_r = 9.0$ m^3/s, $C_r = 2$ mg/L.

Step 2 – compute the load from the waste stream: $Q_w C_w = 1.0 \times 180 = 180$

Step 3 – compute the load from the river: $Q_r C_r = 9.0 \times 2 = 18$

Step 4 – add the loads and the flows: total load $= 180 + 18 = 198$

total flow $= 1.0 + 9.0 = 10$

Step 5 – divide: $C_{mix} = \dfrac{198}{10} = 19.8$ mg/L

Final Answer: $C_{mix} \approx 19.8$ mg/L $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept – Stokes-law terminal settling velocity: For a small particle in the laminar (Stokes) regime, $v_t = \dfrac{g\,\rho_p\,d^2}{18\mu}$ when the fluid density is negligible.

Step 1 – list the data: $g = 9.81$ m/s^2, $\rho_p = 2500$ kg/m^3, $d = 1 \times 10^{-5}$ m, $\mu = 1.8 \times 10^{-5}$ Pa·s.

Step 2 – square the diameter: $d^2 = (1 \times 10^{-5})^2 = 1 \times 10^{-10}$ m^2

Step 3 – form the numerator: $g\,\rho_p\,d^2 = 9.81 \times 2500 \times 1 \times 10^{-10}$

$= 24525 \times 1 \times 10^{-10} = 2.4525 \times 10^{-6}$

Step 4 – form the denominator: $18\mu = 18 \times 1.8 \times 10^{-5} = 3.24 \times 10^{-4}$

Step 5 – divide: $v_t = \dfrac{2.4525 \times 10^{-6}}{3.24 \times 10^{-4}}$

$v_t = 7.57 \times 10^{-3}$ m/s ≈ 0.0076 m/s

Final Answer: $v_t \approx 0.0076$ m/s $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept – collection efficiency: The collection efficiency is the fraction of the incoming particulate load that is captured, $\eta = \dfrac{C_{in} - C_{out}}{C_{in}} \times 100\%$.

Step 1 – list the data: $C_{in} = 8$ g/m^3, $C_{out} = 0.4$ g/m^3.

Step 2 – find the amount collected: $C_{in} - C_{out} = 8 - 0.4 = 7.6$ g/m^3

Step 3 – divide by the inlet load: $\eta = \dfrac{7.6}{8}$

Step 4 – convert to a percentage: $\eta = 0.95 \times 100 = 95\%$

Final Answer: $\eta = 95\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept – Gaussian plume, ground-level centre-line concentration for a ground-level source: $C = \dfrac{Q}{\pi\, \sigma_y\, \sigma_z\, u}$.

Step 1 – list the data: $Q = 120$ g/s, $u = 4$ m/s, $\sigma_y = 40$ m, $\sigma_z = 20$ m.

Step 2 – form the denominator: $\pi\, \sigma_y\, \sigma_z\, u = \pi \times 40 \times 20 \times 4$

Step 3 – multiply the numbers inside: $40 \times 20 = 800$

$800 \times 4 = 3200$

$\pi \times 3200 = 10053$

Step 4 – divide: $C = \dfrac{120}{10053} = 0.01194$ g/m^3

Step 5 – convert to mg/m^3: $C = 0.01194 \times 1000 = 11.9$ mg/m^3

Final Answer: $C \approx 11.9$ mg/m$^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q27

Q28.

Solution

Concept – effective stack height: The effective stack height is the physical stack height plus the plume rise, $H = h + \Delta h$.

Step 1 – list the data: $h = 45$ m, $\Delta h = 20$ m.

Step 2 – add: $H = 45 + 20$

Step 3 – evaluate: $H = 65$ m

Step 4 – interpret: The plume behaves as if released at 65 m, which lowers the maximum ground-level concentration.

Final Answer: $H = 65$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q28

Q29.

Solution

Concept – bioaerosols and indoor air quality: Indoor air can carry biological particles that cause allergies, asthma and infections.

Step 1 – match the description: Airborne bacteria, fungal spores, viruses and pollen are biological in origin.

Step 2 – name the collective term: Such airborne biological particulate matter is called bioaerosols.

Why the other options are wrong:

- B, fly ash: is an inorganic combustion residue.
- C, photochemical smog: is a gaseous/aerosol chemical mixture formed in sunlight.
- D, particulate lead: is a metallic pollutant, not biological.

Final Answer: bioaerosols $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – converting ppm (by volume) to mass concentration: $\mu\text{g/m}^3 = \text{ppm} \times \dfrac{M}{24.45} \times 1000$, where M is the molecular mass and 24.45 L is the molar volume at $25°$C, 1 atm.

Step 1 – list the data: ppm $= 0.05$, $M = 46$ (NO_2).

Step 2 – form the ratio $M/24.45$: $\dfrac{46}{24.45} = 1.8814$

Step 3 – multiply by the ppm value: $0.05 \times 1.8814 = 0.09407$

Step 4 – multiply by 1000: $0.09407 \times 1000 = 94.07\ \mu\text{g/m}^3$

Final Answer: $\approx 94\ \mu\text{g/m}^3 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept – logarithmic addition of equal sound levels: Sound levels add on an energy basis, $L = 10\log_{10}\left(10^{L_1/10} + 10^{L_2/10}\right)$. Doubling the energy adds $10\log_{10} 2 \approx 3$ dB.

Step 1 – note the two levels: $L_1 = L_2 = 85$ dB.

Step 2 – express energies: $10^{85/10} = 10^{8.5}$ each, so the sum is $2 \times 10^{8.5}$.

Step 3 – take the logarithm: $L = 10\log_{10}(2 \times 10^{8.5}) = 10\,(\log_{10} 2 + 8.5)$

Step 4 – substitute $\log_{10} 2 = 0.301$: $L = 10\,(0.301 + 8.5) = 10 \times 8.801$

Step 5 – evaluate: $L = 88.0$ dB (i.e. $85 + 3$)

Final Answer: $L = 88$ dB $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept – adding two unequal sound levels: $L = 10\log_{10}\left(10^{L_1/10} + 10^{L_2/10}\right)$.

Step 1 – list the levels: $L_1 = 90$ dB, $L_2 = 84$ dB.

Step 2 – write the energies: $10^{90/10} = 10^{9.0} = 1.000 \times 10^9$

$10^{84/10} = 10^{8.4} = 2.512 \times 10^8$

Step 3 – add the energies: $1.000 \times 10^9 + 0.2512 \times 10^9 = 1.2512 \times 10^9$

Step 4 – take the logarithm: $\log_{10}(1.2512 \times 10^9) = 9.0973$

Step 5 – multiply by 10**:** $L = 10 \times 9.0973 = 90.97 \approx 91$ dB

Final Answer: $L \approx 91$ dB $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q32

Q33.

Solution

Concept – inverse-square attenuation of a point source: In a free field the level falls by 6 dB each time the distance from a point source doubles.

Step 1 – find the number of doublings from 5 **m to** 20 **m:** $5 \to 10$ m is one doubling; $10 \to 20$ m is a second doubling, so $n = 2$.

Step 2 – compute the total drop: $\Delta L = 6 \times n = 6 \times 2 = 12$ dB

Step 3 – subtract from the reference level: $L_{20} = 95 - 12$

Step 4 – evaluate: $L_{20} = 83$ dB

Final Answer: $L_{20} = 83$ dB $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept – source, path and receiver noise control: Noise control acts at three places: at the source (reduce generation), along the path (block transmission) or at the receiver (protect the listener).

Step 1 – classify each option: A barrier wall and a green belt act on the *path*; ear plugs act at the *receiver*.

Step 2 – identify the source control: A muffler (silencer) fitted to an engine reduces the noise where it is generated, so it is control at the source.

Why the other options are wrong:

- A, barrier wall and C, green belt: interrupt the transmission path.
- B, ear plugs: protect the receiver only.

Final Answer: fitting a muffler (silencer) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept – total MSW generation: Total daily waste equals the per-capita generation rate times the population.

Step 1 – list the data: Population $= 400000$, rate $= 0.6$ kg/person/day.

Step 2 – multiply: MSW $= 400000 \times 0.6 = 240000$ kg/day

Step 3 – convert kilograms to tonnes: MSW $= \dfrac{240000}{1000} = 240$ tonnes/day

Final Answer: 240 tonnes/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q35

Q36.

Solution

Concept – landfill airspace from mass and density: Volume equals mass divided by in-place (compacted) density; the annual mass is the daily mass times the number of days.

Step 1 – find the annual mass: $M = 150 \times 365 = 54750$ tonnes/year

Step 2 – convert to kilograms: $M = 54750 \times 1000 = 5.475 \times 10^7$ kg

Step 3 – divide by the in-place density: $V = \dfrac{5.475 \times 10^7}{600}$

Step 4 – evaluate: $V = 91250\ \text{m}^3$

Final Answer: $V \approx 91{,}250\ \text{m}^3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q36

Q37.

Solution

Concept – fraction of a waste stream: The mass of a component equals its percentage share times the total mass.

Step 1 – list the data: Organic share $= 60\% = 0.60$, total MSW $= 200$ tonnes/day.

Step 2 – multiply: organic mass $= 0.60 \times 200$

Step 3 – evaluate: organic mass $= 120$ tonnes/day

Step 4 – interpret: This compostable fraction is the feedstock available for aerobic composting or biomethanation.

Final Answer: 120 tonnes/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept – integrated solid-waste-management (ISWM) hierarchy: The hierarchy ranks management options from most to least preferred: reduce $>$ reuse $>$ recycle/compost $>$ energy recovery $>$ disposal (landfill).

Step 1 – locate the top of the hierarchy: Preventing waste in the first place (source reduction) avoids all downstream handling, so it ranks highest.

Step 2 – match to the option: Waste reduction (reduce) at source is the most preferred choice.

Why the other options are wrong:

- A, sanitary landfilling and C, incineration: are lower-priority disposal/recovery options.
- D, open dumping: is the least acceptable and environmentally the worst.

Final Answer: waste reduction (reduce) at source $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q38

Q39.

Solution

Concept – incinerator ash residue: The ash produced equals the ash-fraction times the mass of waste burned.

Step 1 – list the data: Input $= 200$ tonnes/day, ash fraction $= 25\% = 0.25$.

Step 2 – multiply: ash $= 0.25 \times 200$

Step 3 – evaluate: ash $= 50$ tonnes/day

Step 4 – interpret: This bottom-plus-fly ash residue itself needs safe (often secure landfill) disposal.

Final Answer: 50 tonnes/day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – landfill leachate: As rain and moisture percolate through buried waste, they dissolve and carry away contaminants.

Step 1 – match the description: The contaminated liquid draining from a landfill, rich in dissolved and suspended matter, is leachate.

Step 2 – note its management: A liner and a leachate-collection system capture it for treatment, preventing groundwater pollution.

Why the other options are wrong:

- A, digestate: is the residue from anaerobic digestion.
- B, compost: is the stabilised solid product of aerobic decomposition.
- C, sludge: is the settled solids from water/wastewater treatment.

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

Answer: (D) Go Back to Q40

Q41.

Solution

Concept – ecosystem services: Healthy ecosystems provide society with a range of benefits, grouped as provisioning, regulating, supporting and cultural services.

Step 1 – match the examples: Pollination, water purification, flood control and climate regulation are all benefits people derive from nature.

Step 2 – name the collective term: Such benefits are called ecosystem services.

Why the other options are wrong:

- A, carbon credits: are tradable emission permits, an economic instrument.
- C, carrying capacity: is the maximum population an environment can sustain.
- D, biomagnification: is the build-up of toxins along a food chain.

Final Answer: ecosystem services $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – biodiversity: Biodiversity describes the variety of life, considered at three nested levels.

Step 1 – recall the three levels: Genetic diversity (within species), species diversity (number and variety of species) and ecosystem diversity (variety of habitats and communities).

Step 2 – match to the definition given: The variety of living organisms across genes, species and ecosystems is exactly biodiversity.

Why the other options are wrong:

- A, turbidity and B, salinity: are physical water-quality parameters.
- D, alkalinity: is a chemical buffering capacity of water.

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

Answer: (C) Go Back to Q42

Q43.

Solution

Concept – emission from an emission factor: Total emission equals the emission factor (mass of pollutant per unit product) times the production rate.

Step 1 – list the data: Emission factor $= 3$ kg CO_2/kg product, production $= 400$ kg/day.

Step 2 – multiply: $CO_2 = 3 \times 400$

Step 3 – evaluate in kilograms: $CO_2 = 1200$ kg/day

Step 4 – convert to tonnes: $CO_2 = \dfrac{1200}{1000} = 1.2$ tonnes/day

Final Answer: 1.2 tonnes/day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept – in-situ versus ex-situ conservation: Conservation strategies are classed by *where* the species is protected.

Step 1 – define in-situ: In-situ means “on site”, protecting the species within its own natural habitat.

Step 2 – match to the examples: National parks, wildlife sanctuaries and biosphere reserves protect species in place, so they are in-situ conservation.

Why the other options are wrong:

- A, ex-situ; C, cryopreservation in a gene bank; D, captive breeding in zoos: all conserve species *away* from the natural habitat and are ex-situ methods.

Final Answer: in-situ conservation $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept – the Convention on Biological Diversity (CBD): Different treaties target different environmental problems; the one for biodiversity was opened at the 1992 Rio Earth Summit.

Step 1 – recall the CBD’s three objectives: Conservation of biodiversity, its sustainable use, and fair and equitable sharing of benefits from genetic resources.

Step 2 – match to the question: These are exactly the aims described, so the treaty is the Convention on Biological Diversity.

Why the other options are wrong:

- A, Montreal Protocol: phases out ozone-depleting substances.
- B, Kyoto Protocol: sets greenhouse-gas reduction targets.
- C, Ramsar Convention: protects wetlands specifically, not biodiversity as a whole.

Final Answer: Convention on Biological Diversity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q45

Q46.

Solution

Concept – keystone species: Some species exert an influence on their ecosystem far larger than their abundance would suggest.

Step 1 – match the description: A species whose removal causes a disproportionately large, often cascading, change in community structure fits the keystone definition.

Step 2 – give the idea: Like the keystone of an arch, it holds the community together; remove it and the structure collapses.

Why the other options are wrong:

- A, invasive species: is a non-native that spreads and harms, not defined by structural support.
- B, indicator species: signals environmental conditions.
- C, endemic species: is restricted to one geographic area.

Final Answer: keystone species $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q46

Answer Key

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