GATE Environmental Science and Engineering

Sample Paper – 6

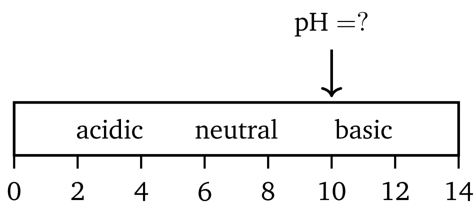
Duration: 128 Minutes   **Maximum Marks: 72**

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. A water sample at 25°C has a hydroxyl-ion concentration $[OH^-] = 1 \times 10^{-4}$ mol/L. Using $K_w = 1 \times 10^{-14}$, its pH on the scale shown is: **[1 mark]**



(A) 10

(B) 4

(C) 7

(D) 14

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) 48 mg/L as $CaCO_3$

(C) 100 mg/L as $CaCO_3$

(D) 12 mg/L as $CaCO_3$

Q3. In most natural waters with pH lying between 4.5 and 8.3, the predominant chemical species responsible for the alkalinity of the water is: **[1 mark]**

(A) carbonate ion (CO_3^{2-})

(B) hydroxide ion (OH^-)

(C) dissolved carbon dioxide (CO_2)

(D) bicarbonate ion (HCO_3^-)

Q4. In the biological nitrification of wastewater, ammoniacal nitrogen is oxidised in two aerobic steps. The final nitrogen species produced at the end of complete nitrification is: **[1 mark]**

(A) nitrate (NO_3^-)

(B) nitrogen gas (N_2)

(C) ammonium (NH_4^+)

(D) nitrite (NO_2^-) only

Q5. For a municipal wastewater the five-day BOD (BOD_5) is measured as 250 mg/L and the chemical oxygen demand (COD) as 500 mg/L. The BOD_5/COD ratio, an index of biodegradability, is: **[1 mark]**

(A) 0.5

(B) 2.0

(C) 0.25

(D) 1.0

Q6. Micro-organisms that can grow and metabolise only in the complete absence of free molecular oxygen, being inhibited or killed in its presence, are termed: **[1 mark]**

(A) obligate aerobes

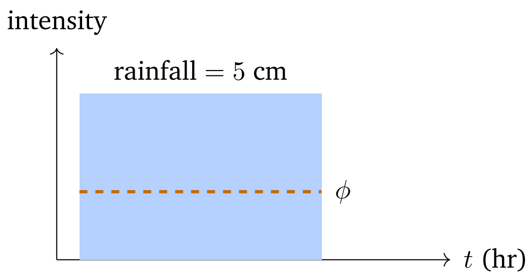
(B) facultative anaerobes

(C) obligate anaerobes

(D) microaerophiles

Water Resources and Environmental Hydraulics

Q7. A uniform-intensity storm lasting 4 hours delivers 5 cm of rainfall on a small catchment, and the resulting surface (direct) runoff is 2 cm, as shown in the hyetograph. Taking the losses as uniform, the average infiltration (ϕ-index) rate is: **[1 mark]**



(A) 1.25 cm/hr

(B) 0.5 cm/hr

(C) 0.75 cm/hr

(D) 2.0 cm/hr

Q8. A storage reservoir has a water-surface area of 2 km^2 and loses water by evaporation at an average rate of 5 mm/day. The volume of water lost by evaporation per day is: **[1 mark]**

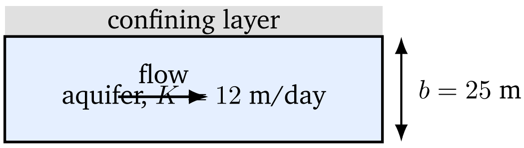
(A) $10{,}000$ m^3/day

(B) $1{,}000$ m^3/day

(C) $100{,}000$ m^3/day

(D) $5{,}000$ m^3/day

Q9. For the confined aquifer sketched, the saturated thickness is $b = 25$ m and the hydraulic conductivity is $K = 12$ m/day. The transmissivity $T = K\,b$ of the aquifer is: **[1 mark]**



(A) 37 m^2/day

(B) 300 m^2/day

(C) 0.48 m^2/day

(D) 2.08 m^2/day

Q10. In a sandy aquifer the Darcy (specific-discharge) velocity is 0.6 m/day and the effective porosity is $n = 0.30$. The actual (seepage or interstitial) velocity of the groundwater, $v_s = v/n$, is: **[1 mark]**

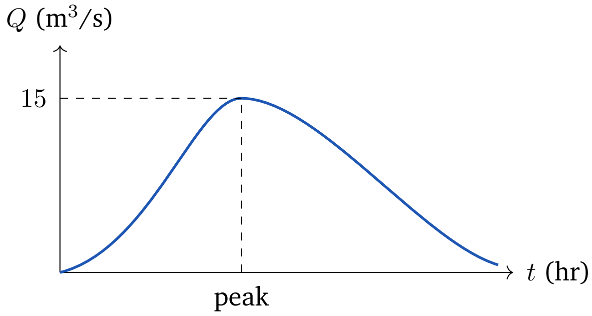
(A) 2 m/day

(B) 0.18 m/day

(C) 0.2 m/day

(D) 1.8 m/day

Q11. A 4-hour unit hydrograph of a catchment has a peak ordinate of 15 m^3/s, as shown. For a rainfall excess of 3 cm occurring uniformly over the same 4-hour duration, the peak of the resulting direct-runoff hydrograph is: **[1 mark]**



(A) 15 m^3/s

(B) 60 m^3/s

(C) 45 m^3/s

(D) 5 m^3/s

Q12. A rectangular open channel of width 3 m carries water at a depth of 1.2 m with a mean velocity of 1.5 m/s. Using the continuity relation $Q = AV$, the discharge in the channel is: **[1 mark]**

(A) 4.5 m^3/s

(B) 5.4 m^3/s

(C) 3.6 m^3/s

(D) 10.8 m^3/s

Water Supply and Water Treatment

Q13. In a reverse-osmosis (RO) unit used for desalting brackish water, fresh water is driven through a semipermeable membrane by applying a hydraulic pressure on the feed side that must be greater than the: **[1 mark]**

(A) osmotic pressure of the feed solution

(B) atmospheric pressure

(C) saturation vapour pressure of water

(D) capillary pressure in the membrane pores

Q14. A city with a population of $250{,}000$ 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]**

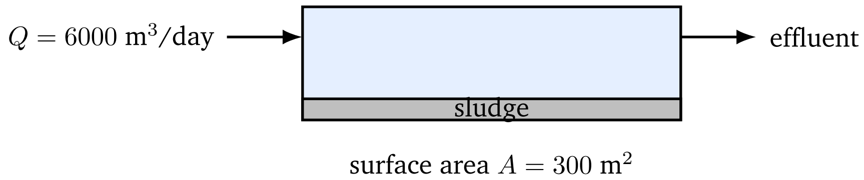
(A) 3.75 MLD

(B) 37.5 MLD

(C) 375 MLD

(D) 15 MLD

Q15. The 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) 0.05 m/day

(B) 50 m/day

(C) 20 m/day

(D) 200 m/day

Q16. An ultrafiltration (UF) membrane module produces 48 m^3/day of permeate through a total membrane area of 20 m^2. The permeate flux $J = Q_p/A$ of the module is: **[1 mark]**

(A) 2.4 m^3/(m^2·day)

(B) 24 m^3/(m^2·day)

(C) 0.42 m^3/(m^2·day)

(D) 960 m^3/(m^2·day)

Q17. A granular activated-carbon (GAC) contactor used for taste and odour removal has an empty-bed volume of 20 m^3 and treats a water flow of 5 m^3/hr. The empty-bed contact time (EBCT) $= V/Q$ of the contactor is: **[1 mark]**

(A) 0.25 hr

(B) 100 hr

(C) 4 hr

(D) 2 hr

Q18. Adsorption of a dissolved organic pollutant onto activated carbon is often described by the Freundlich isotherm $x/m = K\,C^{1/n}$. In this expression the quantity x/m represents the: **[1 mark]**

(A) equilibrium concentration of pollutant left in solution

(B) adsorption rate constant of the carbon

(C) specific surface area of the carbon

(D) mass of pollutant adsorbed per unit mass of carbon

Wastewater Treatment and Disposal

Q19. A wastewater sample has a five-day BOD (BOD_5) of 200 mg/L and a deoxygenation rate constant $k = 0.23$ day^{-1} (base e). Using $BOD_5 = L_0\left(1 - e^{-kt}\right)$, the ultimate first-stage BOD L_0 is nearest to: **[1 mark]**

(A) 137 mg/L

(B) 200 mg/L

(C) 250 mg/L

(D) 293 mg/L

Q20. In an anoxic biological reactor treating wastewater, denitrifying bacteria use nitrate as the terminal electron acceptor. The main nitrogen-containing end product released to the atmosphere by biological denitrification is: **[1 mark]**

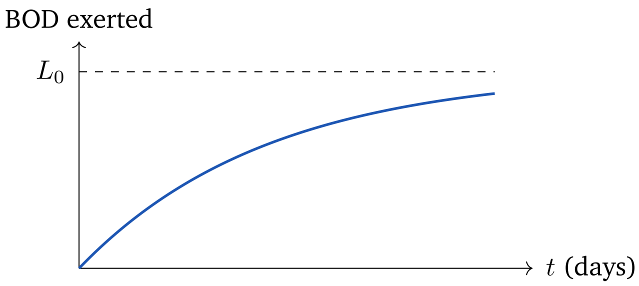
(A) nitrogen gas (N_2)

(B) ammonia (NH_3)

(C) nitrite (NO_2^-)

(D) nitrous oxide (N_2O) only

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 BOD-exertion curve shown, the BOD exerted in 3 days, $y_3 = L_0\left(1 - e^{-kt}\right)$, is nearest to: **[2 marks]**



first-order, $k = 0.20$/day

(A) 137 mg/L

(B) 250 mg/L

(C) 113 mg/L

(D) 55 mg/L

Q22. In a 30-minute settling-column test on mixed liquor, a 1-litre sample with a mixed-liquor suspended-solids concentration of MLSS $= 2500$ mg/L settles to a sludge volume of 250 mL. The Sludge Volume Index $SVI = \dfrac{SV_{30}\,(\text{mL/L}) \times 1000}{\text{MLSS (mg/L)}}$ is: **[2 marks]**

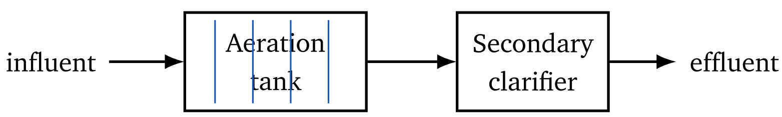
(A) 250 mL/g

(B) 25 mL/g

(C) 62.5 mL/g

(D) 100 mL/g

Q23. The activated-sludge aeration tank shown has a volume of $V = 800$ m^3 and receives $Q = 2000$ m^3/day of wastewater carrying an applied BOD of $S_0 = 240$ mg/L. The volumetric BOD (organic) loading rate $= \dfrac{Q\,S_0}{V}$ is: **[2 marks]**



$V = 800$ m^3

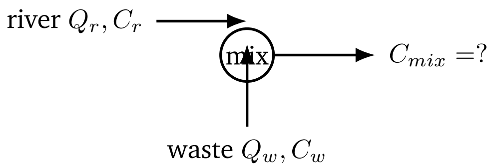
(A) 0.3 kg BOD/(m^3·day)

(B) 0.6 kg BOD/(m^3·day)

(C) 6.0 kg BOD/(m^3·day)

(D) 1.2 kg BOD/(m^3·day)

Q24. Treated wastewater is discharged into a stream, as sketched. The waste stream carries $Q_w = 0.4$ m^3/s at a BOD of 250 mg/L and the receiving river carries $Q_r = 3.6$ m^3/s at a BOD of 5 mg/L. Assuming complete mixing, the BOD just downstream of the outfall is nearest to: **[2 marks]**



(A) 255 mg/L

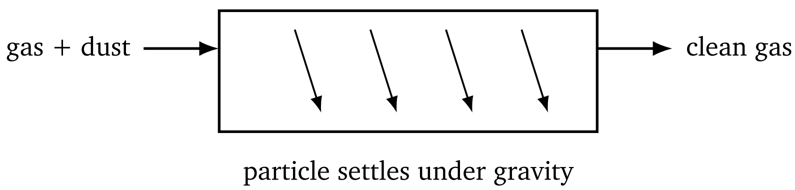
(B) 127.5 mg/L

(C) 60 mg/L

(D) 29.5 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]**



(A) 0.076 m/s

(B) 0.76 m/s

(C) 0.00076 m/s

(D) 0.0076 m/s

Q26. A fabric (bag) filter receives a gas carrying a particulate loading of 12 g/m^3 and discharges it at 0.3 g/m^3. The overall collection (removal) efficiency of the fabric filter is: **[2 marks]**

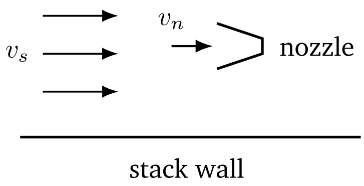
(A) 97.5%

(B) 2.5%

(C) 90%

(D) 75%

Q27. During stack (source) emission testing, a sample of the flue gas is withdrawn through a nozzle. For the sampling to be *isokinetic*, and hence for the measured particulate concentration to be representative, the velocity of the gas entering the nozzle must be: **[2 marks]**



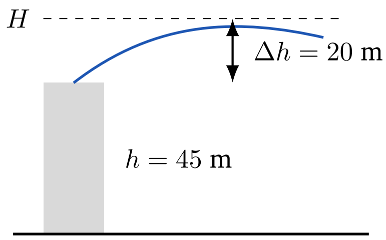
(A) twice the local stack-gas velocity

(B) equal to the local stack-gas velocity at the sampling point

(C) zero (still sampling)

(D) half the local stack-gas velocity

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) 25 m

(C) 65 m

(D) 90 m

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 $\text{mg/m}^3 = \text{ppm} \times \dfrac{M}{24.45}$, the mass concentration is nearest to: **[2 marks]**

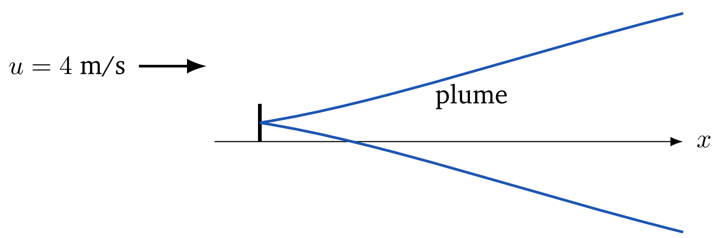
(A) 5.73 mg/m^3

(B) 28 mg/m^3

(C) 2.86 mg/m^3

(D) 11.4 mg/m^3

Q30. A continuous ground-level point source emits a pollutant at $Q = 80$ 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) 15.9 mg/m^3

(B) 7.96 mg/m^3

(C) 3.98 mg/m^3

(D) 1.59 mg/m^3

Noise Pollution and Environmental Monitoring

Q31. Two identical machines each produce a sound-pressure level of 80 dB at a receiver. When both operate together, the combined level is $L = 10\log_{10}\left(10^{L_1/10} + 10^{L_2/10}\right)$. The resulting level is nearest to: **[2 marks]**

(A) 160 dB

(B) 83 dB

(C) 80 dB

(D) 86 dB

Q32. At a receiver, one source produces 85 dB and a second produces 79 dB. The combined sound level, using $L = 10\log_{10}(10^{8.5} + 10^{7.9})$, is nearest to: **[2 marks]**

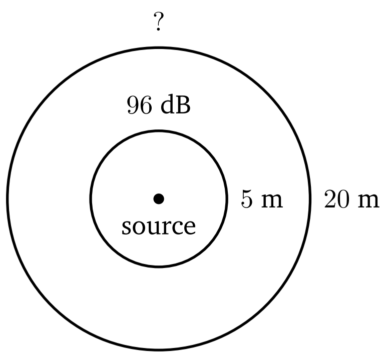
(A) 82 dB

(B) 164 dB

(C) 85 dB

(D) 86 dB

Q33. A point noise source produces 96 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) 90 dB

(B) 84 dB

(C) 96 dB

(D) 78 dB

Q34. In community-noise monitoring, the sound level that is exceeded for 10% of the measurement period, commonly used as a measure of the intrusive higher noise levels (such as passing traffic), is denoted: **[2 marks]**

(A) L_{eq}

(B) L_{90}

(C) L_{10}

(D) L_{max}

Solid and Hazardous Waste Management

Q35. A city has a population of 300,000 and a per-capita municipal solid-waste (MSW) generation rate of 0.45 kg/person/day. The total MSW generated per day, expressed in tonnes, is: **[2 marks]**

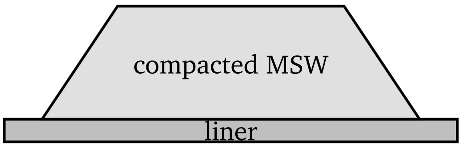
(A) 300 tonnes/day

(B) 45 tonnes/day

(C) 90 tonnes/day

(D) 135 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

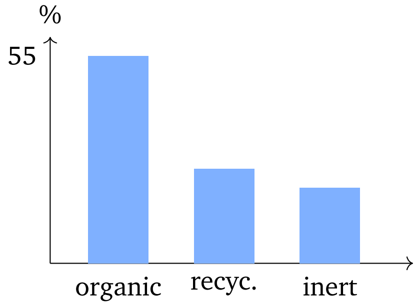
(A) 45,625 m^3

(B) 182,500 m^3

(C) 91,250 m^3

(D) 273,750 m^3

Q37. The bar chart shows the composition of a city's MSW: organic (compostable) 55%, recyclables 25% and inert/other 20%. If the total MSW is 200 tonnes/day, the mass of the compostable (organic) fraction is: **[2 marks]**



(A) 110 tonnes/day

(B) 50 tonnes/day

(C) 40 tonnes/day

(D) 200 tonnes/day

Q38. Discarded electronic (e-) waste such as cathode-ray-tube glass and printed-circuit-board solder is a hazardous waste stream chiefly because it contains a toxic heavy metal. That heavy metal of principal concern is: **[2 marks]**

(A) iron

(B) aluminium

(C) calcium

(D) lead

Q39. A mass-burn incinerator handling biomedical and municipal waste receives 40 tonnes/day of feed 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) 30 tonnes/day

(B) 10 tonnes/day

(C) 40 tonnes/day

(D) 20 tonnes/day

Q40. Under the Bio-Medical Waste Management Rules followed in India, used and discarded *sharps* such as hypodermic needles and scalpel blades are to be segregated and collected in puncture-proof containers of which colour category? **[2 marks]**

(A) yellow

(B) white (translucent)

(C) red

(D) blue

Environmental Management, Sustainability and Climate

Q41. Within the Environmental Impact Assessment (EIA) process, the stage at which the significant issues, the terms of reference and the scope of the studies to be carried out for a proposed project are identified and fixed is called: **[2 marks]**

(A) screening

(B) monitoring

(C) scoping

(D) auditing

Q42. Methane has a 100-year global-warming potential (GWP) of about 28 relative to carbon dioxide. Using this GWP, an emission of 10 tonnes of methane is equivalent to how many tonnes of CO_2 (CO_2-equivalent)? **[2 marks]**

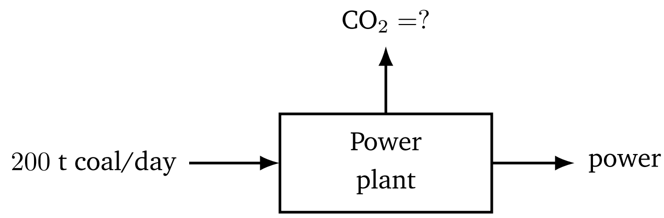
(A) 28 tonnes

(B) 10 tonnes

(C) 100 tonnes

(D) 280 tonnes

Q43. For the coal-fired power plant shown, the mass balance gives 2.5 tonnes of CO_2 released for every tonne of coal burnt, and the plant burns 200 tonnes of coal each day. The daily CO_2 emission is: **[2 marks]**



(A) 80 tonnes/day

(B) 250 tonnes/day

(C) 400 tonnes/day

(D) 500 tonnes/day

Q44. The long-term temperature goal of the Paris Agreement (2015) is to hold the increase in the global average temperature this century, relative to pre-industrial levels, to well below: **[2 marks]**

(A) 5°C

(B) 2°C above pre-industrial levels

(C) 10°C

(D) 0.5°C

Q45. In the framework used by the Intergovernmental Panel on Climate Change since its Fifth Assessment Report (AR5), the standardised future greenhouse-gas concentration trajectories used to drive climate projections are known as: **[2 marks]**

(A) Representative Concentration Pathways (RCPs)

(B) Montreal reduction pathways

(C) Kyoto emission baskets

(D) Ozone Depletion Potentials (ODPs)

Q46. Which international scientific body is responsible for assessing the science related to climate change and for producing the periodic Assessment Reports (AR1 to AR6) that underpin global climate policy? **[2 marks]**

(A) World Health Organization (WHO)

(B) Intergovernmental Panel on Climate Change (IPCC)

(C) United Nations Educational, Scientific and Cultural Organization (UNESCO)

(D) International Union for Conservation of Nature (IUCN)

Detailed Solutions

Q1.

Solution

Concept – pH from the hydroxyl-ion concentration: At $25°$C the pH and pOH of a water always sum to 14, because $[H^+][OH^-] = K_w = 1 \times 10^{-14}$.

Step 1 – write the given concentration: $[OH^-] = 1 \times 10^{-4}$ mol/L

Step 2 – compute the pOH: $\text{pOH} = -\log_{10}[OH^-] = -\log_{10}(10^{-4})$

Step 3 – apply the logarithm: $\text{pOH} = 4$

Step 4 – convert pOH to pH: $\text{pH} = 14 - \text{pOH} = 14 - 4$

$\text{pH} = 10$

Step 5 – interpret: A pH of 10 is well above 7, so the water is basic, consistent with the high hydroxyl-ion concentration.

Final Answer: $\text{pH} = 10 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – expressing hardness as $CaCO_3$: The hardness contributed by 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: $\text{factor} = \frac{50}{12} = 4.1667$

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

Step 4 – evaluate: $\text{Hardness} = 100$ mg/L as $CaCO_3$

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

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – forms of alkalinity versus pH: Alkalinity in water is shared among hydroxide, carbonate and bicarbonate, and which one dominates depends on the pH.

Step 1 – recall the pH ranges: Below about pH 8.3 there is essentially no carbonate or hydroxide alkalinity; above about pH 9.5 hydroxide and carbonate appear.

Step 2 – locate the given range: For the stated range of pH 4.5 to 8.3 the alkalinity is carried almost entirely by the bicarbonate ion.

Why the other options are wrong:

- A, carbonate and B, hydroxide: become significant only at higher pH (above 8.3–9.5).
- C, dissolved CO_2: is an acid, not a source of alkalinity.

Final Answer: bicarbonate ion (HCO_3^-) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept – nitrification pathway: Nitrification is the aerobic, two-step biological oxidation of ammoniacal nitrogen carried out by autotrophic bacteria.

Step 1 – first oxidation step: Ammonia is oxidised to nitrite by *Nitrosomonas*: $NH_4^+ \to NO_2^-$.

Step 2 – second oxidation step: Nitrite is then oxidised to nitrate by *Nitrobacter*: $NO_2^- \to NO_3^-$.

Step 3 – identify the final product: The end product of complete nitrification is nitrate, NO_3^-.

Why the other options are wrong:

- B, N_2: is produced by denitrification, not nitrification.
- C, ammonium: is the starting material.
- D, nitrite only: is only the intermediate, not the final product.

Final Answer: nitrate (NO_3^-) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept – biodegradability index: The ratio of BOD_5 to COD indicates how much of the oxygen demand is due to readily biodegradable matter; a higher ratio means more biodegradable waste.

Step 1 – list the data: $BOD_5 = 250$ mg/L, COD $= 500$ mg/L.

Step 2 – form the ratio: $\frac{BOD_5}{COD} = \frac{250}{500}$

Step 3 – evaluate: $\frac{BOD_5}{COD} = 0.5$

Step 4 – interpret: A ratio of 0.5 indicates a fairly biodegradable municipal wastewater, well suited to biological treatment.

Final Answer: $0.5 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept – classification of bacteria by oxygen requirement: Bacteria are grouped by how they respond to free molecular oxygen.

Step 1 – recall the definition: Organisms that grow only when free oxygen is absent, and are harmed or killed by its presence, are the obligate (strict) anaerobes.

Step 2 – match to the option: This description corresponds exactly to option C.

Why the other options are wrong:

- A, obligate aerobes: require free oxygen to grow.
- B, facultative anaerobes: grow with or without free oxygen.
- D, microaerophiles: need oxygen but only at low concentrations.

Final Answer: obligate anaerobes $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept – ϕ-index (uniform loss rate): The ϕ-index is the constant rate of abstraction (mainly infiltration) such that the rainfall depth in excess of it equals the observed direct runoff.

Step 1 – list the data: Total rainfall $= 5$ cm, direct runoff $= 2$ cm, storm duration $= 4$ hr.

Step 2 – find the total loss depth: Loss $=$ Rainfall $-$ Runoff $= 5 - 2 = 3$ cm

Step 3 – spread the loss over the storm duration: $\phi = \dfrac{\text{Loss}}{\text{duration}} = \dfrac{3 \text{ cm}}{4 \text{ hr}}$

Step 4 – evaluate: $\phi = 0.75$ cm/hr

Final Answer: $\phi = 0.75$ cm/hr $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept – evaporation volume from a water body: The volume lost equals the evaporation depth multiplied by the water-surface area, with consistent units.

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

Step 2 – convert the evaporation depth to metres: $d = 5 \text{ mm} = 5 \times 10^{-3}$ m $= 0.005$ m

Step 3 – multiply depth by area: $V = A\,d = 2 \times 10^6 \times 0.005$

Step 4 – evaluate: $V = 10{,}000 \text{ m}^3/\text{day}$

Final Answer: $V = 10{,}000 \text{ m}^3/\text{day} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – transmissivity of a confined aquifer: Transmissivity is the rate at which water is transmitted through the full saturated thickness under a unit hydraulic gradient, $T = K\,b$.

Step 1 – list the data: $K = 12$ m/day, $b = 25$ m.

Step 2 – substitute into $T = K\,b$: $T = 12 \times 25$

Step 3 – evaluate: $T = 300 \text{ m}^2/\text{day}$

Final Answer: $T = 300$ m^2/day $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept – Darcy velocity versus seepage velocity: The Darcy velocity is the discharge per unit gross area; because water actually moves only through the pore space, the true particle velocity is larger, $v_s = v/n$.

Step 1 – list the data: Darcy velocity $v = 0.6$ m/day, porosity $n = 0.30$.

Step 2 – write the relation: $v_s = \dfrac{v}{n}$

Step 3 – substitute: $v_s = \dfrac{0.6}{0.30}$

Step 4 – evaluate: $v_s = 2$ m/day

Final Answer: $v_s = 2$ m/day $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept – linearity (proportionality) of the unit hydrograph: A unit hydrograph corresponds to 1 cm of rainfall excess. For P cm of excess over the same duration every ordinate is scaled 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: $Q_{peak} = P \times$ (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 Q11

Q12.

Solution

Concept – continuity equation for open-channel flow: The discharge equals the cross-sectional flow area multiplied by the mean velocity, $Q = AV$.

Step 1 – compute the flow area: $A = \text{width} \times \text{depth} = 3 \times 1.2 = 3.6 \text{ m}^2$

Step 2 – write the continuity relation: $Q = AV$

Step 3 – substitute the values: $Q = 3.6 \times 1.5$

Step 4 – evaluate: $Q = 5.4 \text{ m}^3/\text{s}$

Final Answer: $Q = 5.4 \text{ m}^3/\text{s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – driving force in reverse osmosis: Natural osmosis moves water from a dilute to a concentrated solution across a semipermeable membrane. To reverse this flow (to push water *out* of the salty feed), the applied pressure must overcome the osmotic pressure.

Step 1 – recall the balance: Net water flux occurs only when the applied hydraulic pressure exceeds the osmotic pressure of the feed.

Step 2 – identify the threshold: Hence the applied pressure must be greater than the osmotic pressure of the feed solution.

Why the other options are wrong:

- B, atmospheric pressure and C, vapour pressure: are not the controlling resistances in RO.
- D, capillary pressure: governs microfiltration wetting, not the salt-rejection driving force in RO.

Final Answer: osmotic pressure of the feed solution $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept – average daily water demand: Total demand equals per-capita demand multiplied by the population.

Step 1 – list the data: Per-capita demand $=$ 150 L/person/day, population $=$ 250,000.

Step 2 – multiply: Demand $= 150 \times 250{,}000$

Step 3 – evaluate in litres per day: Demand $= 37{,}500{,}000$ L/day

Step 4 – convert to million litres per day: Demand $= \dfrac{37{,}500{,}000}{10^6} = 37.5$ MLD

Final Answer: 37.5 MLD $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept – surface overflow rate: The surface overflow rate is the flow divided by the plan area of the settling tank; it equals the settling velocity of the smallest particle that is fully removed.

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

Step 2 – write the relation: $SOR = \dfrac{Q}{A}$

Step 3 – substitute: $SOR = \dfrac{6000}{300}$

Step 4 – evaluate: $SOR = 20$ m/day (equivalently m^3/m^2·day)

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

Answer: (C) Go Back to Q15

Q16.

Solution

Concept – membrane permeate flux: The permeate flux is the volume of permeate produced per unit membrane area per unit time, $J = Q_p/A$.

Step 1 – list the data: Permeate flow $Q_p = 48$ m^3/day, membrane area $A = 20$ m^2.

Step 2 – write the relation: $J = \dfrac{Q_p}{A}$

Step 3 – substitute: $J = \frac{48}{20}$

Step 4 – evaluate: $J = 2.4$ m^3/(m^2·day)

Final Answer: $J = 2.4$ m^3/(m^2·day) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept – empty-bed contact time (EBCT): EBCT is the time the water would take to pass through the empty bed volume of the carbon contactor, $EBCT = V/Q$.

Step 1 – list the data: Empty-bed volume $V = 20$ m^3, flow $Q = 5$ m^3/hr.

Step 2 – write the relation: $EBCT = \frac{V}{Q}$

Step 3 – substitute: $EBCT = \frac{20}{5}$

Step 4 – evaluate: $EBCT = 4$ hr

Final Answer: $EBCT = 4$ hr $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept – meaning of x/m in the Freundlich isotherm: The Freundlich isotherm relates the amount adsorbed at equilibrium to the residual concentration in solution.

Step 1 – define the symbols: x is the mass of pollutant adsorbed, m is the mass of carbon (adsorbent) and C is the equilibrium concentration left in solution.

Step 2 – interpret x/m: Therefore x/m is the mass of pollutant adsorbed per unit mass of carbon, the adsorption capacity.

Why the other options are wrong:

- A: the residual concentration is C, not x/m.
- B and C: the rate constant and surface area are properties of the carbon, not the ratio x/m.

Final Answer: mass of pollutant adsorbed per unit mass of carbon $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept – ultimate BOD from BOD_5: The first-order model $BOD_5 = L_0\left(1 - e^{-kt}\right)$ links the 5-day BOD to the ultimate BOD L_0.

Step 1 – list the data: $BOD_5 = 200$ mg/L, $k = 0.23$/day, $t = 5$ days.

Step 2 – evaluate the exponent: $kt = 0.23 \times 5 = 1.15$

Step 3 – evaluate the exponential term: $e^{-1.15} = 0.3166$

Step 4 – evaluate the bracket: $1 - e^{-1.15} = 1 - 0.3166 = 0.6834$

Step 5 – rearrange for L_0: $L_0 = \dfrac{BOD_5}{1 - e^{-kt}} = \dfrac{200}{0.6834}$

Step 6 – evaluate: $L_0 = 292.7 \approx 293$ mg/L

Final Answer: $L_0 \approx 293$ mg/L $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept – end product of denitrification: Denitrification is the anoxic biological reduction of nitrate, in which nitrate serves as the electron acceptor in place of oxygen.

Step 1 – trace the reduction sequence: $NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2$.

Step 2 – identify the main gaseous product: The nitrogen is ultimately released to the atmosphere as inert nitrogen gas, N_2.

Why the other options are wrong:

- B, ammonia: is not the product of denitrification.
- C, nitrite and D, nitrous oxide: are only intermediates, not the main end product.

Final Answer: nitrogen gas (N_2) $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept – BOD exerted in time t: The BOD exerted follows the first-order curve $y_t = L_0\left(1 - e^{-kt}\right)$, which rises from zero towards L_0.

Step 1 – list the data: $L_0 = 250$ mg/L, $k = 0.20$/day, $t = 3$ days.

Step 2 – evaluate the exponent: $kt = 0.20 \times 3 = 0.6$

Step 3 – evaluate the exponential term: $e^{-0.6} = 0.5488$

Step 4 – evaluate the bracket: $1 - e^{-0.6} = 1 - 0.5488 = 0.4512$

Step 5 – multiply by L_0: $y_3 = 250 \times 0.4512$

Step 6 – evaluate: $y_3 = 112.8 \approx 113$ mg/L

Final Answer: $y_3 \approx 113$ mg/L $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept – Sludge Volume Index (SVI): SVI is the volume in millilitres occupied by 1 gram of activated-sludge solids after 30 minutes of settling; it measures the settleability of the sludge.

Step 1 – list the data: $SV_{30} = 250$ mL/L, MLSS $= 2500$ mg/L.

Step 2 – write the formula: $SVI = \dfrac{SV_{30}\,(\text{mL/L}) \times 1000}{\text{MLSS (mg/L)}}$

Step 3 – substitute the values: $SVI = \dfrac{250 \times 1000}{2500}$

Step 4 – simplify the numerator: $250 \times 1000 = 250{,}000$

Step 5 – divide: $SVI = \dfrac{250{,}000}{2500} = 100$ mL/g

Step 6 – interpret: An SVI near 100 mL/g indicates a good, well-settling sludge.

Final Answer: $SVI = 100$ mL/g $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept – volumetric (organic) BOD loading: The volumetric loading is the mass of BOD applied to the aeration tank per unit tank volume per day, $\frac{Q\,S_0}{V}$.

Step 1 – list the data: $Q = 2000$ m^3/day, $S_0 = 240$ mg/L $= 0.240$ kg/m^3, $V = 800$ m^3.

Step 2 – compute the daily BOD mass applied: $Q\,S_0 = 2000 \times 0.240 = 480$ kg/day

Step 3 – divide by the tank volume: Loading $= \frac{480}{800}$

Step 4 – evaluate: Loading $= 0.6$ kg BOD/(m^3·day)

Final Answer: 0.6 kg BOD/(m^3·day) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept – complete-mixing mass balance: When two streams mix fully, the combined concentration is the flow-weighted average of the two, $C_{mix} = \frac{Q_wC_w + Q_rC_r}{Q_w + Q_r}$.

Step 1 – list the data: $Q_w = 0.4$ m^3/s, $C_w = 250$ mg/L, $Q_r = 3.6$ m^3/s, $C_r = 5$ mg/L.

Step 2 – compute the mass load of the waste stream: $Q_wC_w = 0.4 \times 250 = 100$

Step 3 – compute the mass load of the river: $Q_rC_r = 3.6 \times 5 = 18$

Step 4 – add the loads and the flows: Total load $= 100 + 18 = 118$; total flow $= 0.4 + 3.6 = 4.0$ m^3/s

Step 5 – divide: $C_{mix} = \frac{118}{4.0}$

Step 6 – evaluate: $C_{mix} = 29.5$ mg/L

Final Answer: $C_{mix} = 29.5$ mg/L $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept – terminal settling velocity (Stokes' law): For a small particle in the laminar (Stokes) regime, $v_t = \frac{g\,\rho_p\,d^2}{18\mu}$, neglecting the density of air.

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 – compute d^2: $d^2 = (1 \times 10^{-5})^2 = 1 \times 10^{-10}$ m^2

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

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

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

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

Step 6 – evaluate: $v_t = 7.57 \times 10^{-3} \approx 0.0076$ m/s

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

Answer: (D) Go Back to Q25

Q26.

Solution

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

Step 1 – list the data: $C_{in} = 12$ g/m^3, $C_{out} = 0.3$ g/m^3.

Step 2 – compute the mass removed: $C_{in} - C_{out} = 12 - 0.3 = 11.7$ g/m^3

Step 3 – divide by the inlet loading: $\eta = \frac{11.7}{12}$

Step 4 – convert to a percentage: $\eta = 0.975 \times 100 = 97.5\%$

Final Answer: $\eta = 97.5\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept – isokinetic stack sampling: For particulate sampling to be representative, the gas must enter the nozzle without being accelerated or decelerated, so that large and small particles are drawn in the same proportion as they exist in the stack.

Step 1 – state the isokinetic condition: The sampling velocity at the nozzle tip, v_n, must equal the local stack-gas velocity, v_s, at the sampling point.

Step 2 – reason about the errors of non-isokinetic sampling: If $v_n < v_s$, heavy particles overshoot the nozzle and the sample over-represents fines; if $v_n > v_s$, extra heavy particles are drawn in and the sample over-represents coarse matter. Only $v_n = v_s$ avoids both biases.

Why the other options are wrong:

- A and D: sampling at twice or half the stack velocity introduces the biases just described.
- C: zero velocity collects no representative sample at all.

Final Answer: equal to the local stack-gas velocity $\Rightarrow \boxed{\text{B}}$

$\boxed{\textbf{Answer: (B)}}$ Go Back to Q27

Q28.

Solution

Concept – effective stack height: The effective stack height is the physical chimney height plus the plume rise, $H = h + \Delta h$; it is the height at which the plume effectively behaves as the release point.

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

Step 2 – add the two contributions: $H = 45 + 20$

Step 3 – evaluate: $H = 65$ m

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

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q28

Q29.

Solution

Concept – converting a volume mixing ratio to a mass concentration: At $25°$C and 1 atm one mole of any gas occupies 24.45 litres, so mg/m^3 = ppm $\times \dfrac{M}{24.45}$.

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

Step 2 – substitute into the formula: mg/m$^3 = 5 \times \dfrac{28}{24.45}$

Step 3 – form the numerator: $5 \times 28 = 140$

Step 4 – divide by the molar volume: $\text{mg/m}^3 = \dfrac{140}{24.45}$

Step 5 – evaluate: $\text{mg/m}^3 = 5.73\ \text{mg/m}^3$

Final Answer: $5.73\ \text{mg/m}^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – Gaussian plume ground-level centre-line concentration: For a continuous ground-level point source the maximum (centre-line) ground-level concentration is $C = \dfrac{Q}{\pi\,\sigma_y\,\sigma_z\,u}$.

Step 1 – list the data: $Q = 80$ 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: $40 \times 20 = 800$; $800 \times 4 = 3200$; $\pi \times 3200 = 10053$

Step 4 – divide: $C = \dfrac{80}{10053}$

Step 5 – evaluate in g/m^3: $C = 7.96 \times 10^{-3}\ \text{g/m}^3$

Step 6 – convert to mg/m^3: $C = 7.96\ \text{mg/m}^3$

Final Answer: $C \approx 7.96\ \text{mg/m}^3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept – energy addition of equal noise sources: Sound levels add on an energy (not decibel) basis. Two equal sources double the acoustic energy, which raises the level by $10\log_{10} 2 \approx 3$ dB.

Step 1 – list the data: $L_1 = L_2 = 80$ dB.

Step 2 – write the addition formula: $L = 10\log_{10}\left(10^{L_1/10} + 10^{L_2/10}\right)$

Step 3 – substitute equal levels: $L = 10\log_{10}(10^{8.0} + 10^{8.0}) = 10\log_{10}(2 \times 10^{8.0})$

Step 4 – split the logarithm: $L = 10\,[\log_{10} 2 + 8.0] = 10\,[0.301 + 8.0]$

Step 5 – evaluate: $L = 10 \times 8.301 = 83.0$ dB

Final Answer: $L \approx 83\ \text{dB} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – energy addition of unequal noise sources: Two levels are combined on an energy basis using $L = 10\log_{10}\left(10^{L_1/10} + 10^{L_2/10}\right)$.

Step 1 – list the data: $L_1 = 85$ dB, $L_2 = 79$ dB.

Step 2 – evaluate each energy term: $10^{8.5} = 3.162 \times 10^8$

$10^{7.9} = 7.943 \times 10^7$

Step 3 – add the energies: $3.162 \times 10^8 + 0.7943 \times 10^8 = 3.956 \times 10^8$

Step 4 – take the logarithm: $\log_{10}(3.956 \times 10^8) = 8.597$

Step 5 – multiply by 10**:** $L = 10 \times 8.597 = 85.97 \approx 86$ dB

Final Answer: $L \approx 86$ dB $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q32**

Q33.

Solution

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

Step 1 – list the data: $L_1 = 96$ dB at $r_1 = 5$ m; required level at $r_2 = 20$ m.

Step 2 – count the doublings: $\dfrac{r_2}{r_1} = \dfrac{20}{5} = 4 = 2^2$, so the distance has doubled twice.

Step 3 – compute the total attenuation: Attenuation $= 2 \times 6 = 12$ dB

Step 4 – subtract from the near level: $L_2 = 96 - 12$

Step 5 – evaluate: $L_2 = 84$ dB

Final Answer: $L_2 = 84$ dB $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q33**

Q34.

Solution

Concept – statistical (percentile) noise descriptors: Percentile levels L_N give the sound level exceeded for $N\%$ of the measurement time.

Step 1 – interpret the requirement: A level exceeded for 10% of the time is, by definition, L_{10}.

Step 2 – note its usual role: L_{10} represents the higher, intrusive noise (for example, peaks from passing traffic).

Why the other options are wrong:

- A, L_{eq}: is the equivalent continuous (energy-average) level, not a percentile.
- B, L_{90}: is exceeded 90% of the time and represents the background level.
- D, L_{max}: is the single highest instantaneous level.

Final Answer: $L_{10} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept – total MSW generation: The total daily waste equals the per-capita generation rate multiplied by the population.

Step 1 – list the data: Population $= 300{,}000$, generation rate $= 0.45$ kg/person/day.

Step 2 – multiply: MSW $= 300{,}000 \times 0.45$

Step 3 – evaluate in kilograms: MSW $= 135{,}000$ kg/day

Step 4 – convert to tonnes (1 tonne $= 1000$ kg): MSW $= \dfrac{135{,}000}{1000} = 135$ tonnes/day

Final Answer: 135 tonnes/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept – landfill airspace from mass and compacted density: The volume occupied is the mass of waste divided by its in-place (compacted) density, accumulated over the period.

Step 1 – list the data: Daily waste $= 150$ tonnes/day $= 150{,}000$ kg/day, density $= 600$ kg/m^3, period $= 365$ days.

Step 2 – compute the annual mass: $M = 150{,}000 \times 365 = 54{,}750{,}000$ kg/year

Step 3 – divide by the compacted density: $V = \dfrac{54{,}750{,}000}{600}$

Step 4 – evaluate: $V = 91{,}250 \text{ m}^3$

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

Answer: (C) Go Back to Q36

Q37.

Solution

Concept – mass of a waste fraction from its percentage: The mass of any component equals its percentage share multiplied by the total waste mass.

Step 1 – list the data: Organic fraction $= 55\%$, total MSW $= 200$ tonnes/day.

Step 2 – convert the percentage to a fraction: $55\% = 0.55$

Step 3 – multiply by the total: Organic $= 0.55 \times 200$

Step 4 – evaluate: Organic $= 110$ tonnes/day

Final Answer: 110 tonnes/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q37

Q38.

Solution

Concept – hazardous constituents of e-waste: Electronic waste is classed as hazardous largely because of the toxic heavy metals in its components.

Step 1 – identify the sources: Cathode-ray-tube funnel glass and the solder on printed circuit boards are rich in lead.

Step 2 – recognise the hazard: Lead is a well-known neurotoxin that can leach from dumped e-waste into soil and groundwater, so it is the heavy metal of principal concern.

Why the other options are wrong:

- A, iron and B, aluminium: are common but not the toxic heavy metals that make e-waste hazardous.
- C, calcium: is a benign, non-toxic element.

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

Answer: (D) Go Back to Q38

Q39.

Solution

Concept – ash residue from incineration: The ash produced is the stated fraction of the input mass fed to the incinerator.

Step 1 – list the data: Feed $= 40$ tonnes/day, ash fraction $= 25\% = 0.25$.

Step 2 – multiply the feed by the fraction: Ash $= 0.25 \times 40$

Step 3 – evaluate: Ash $= 10$ tonnes/day

Final Answer: 10 tonnes/day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept – colour coding of biomedical waste: The Bio-Medical Waste Management Rules assign each waste category a colour-coded container to ensure correct treatment and disposal.

Step 1 – recall the category for sharps: Used needles, syringes with fixed needles, scalpel blades and other metallic sharps go into puncture-proof, leak-proof white (translucent) containers.

Step 2 – match to the option: This corresponds to option B.

Why the other options are wrong:

- A, yellow: is for anatomical, soiled and expired-medicine waste sent for incineration.
- C, red: is for contaminated recyclable plastic (tubing, bottles).
- D, blue: is for glassware and metallic body implants.

Final Answer: white (translucent) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – stages of the EIA process: The EIA process runs through screening, scoping, impact prediction, mitigation, public consultation, appraisal and monitoring.

Step 1 – define scoping: Scoping is the stage at which the key issues, the terms of reference and the extent (scope) of the detailed studies are identified and fixed.

Step 2 – match to the option: This is option C.

Why the other options are wrong:

- A, screening: only decides whether a full EIA is required at all.
- B, monitoring: is the post-clearance follow-up of actual impacts.
- D, auditing: checks compliance after the project is operating.

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

Answer: (C) Go Back to Q41

Q42.

Solution

Concept – CO_2-equivalent using global-warming potential: The CO_2-equivalent of an emission equals the mass of the gas multiplied by its GWP.

Step 1 – list the data: Methane emission $= 10$ tonnes, GWP of $CH_4 = 28$.

Step 2 – write the relation: $CO_2\text{-eq} = \text{mass} \times \text{GWP}$

Step 3 – substitute: $CO_2\text{-eq} = 10 \times 28$

Step 4 – evaluate: $CO_2\text{-eq} = 280$ tonnes

Final Answer: 280 tonnes CO_2-equivalent $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q42

Q43.

Solution

Concept – CO_2 emission from a mass balance: The daily CO_2 released equals the emission factor (per unit fuel) multiplied by the quantity of fuel burnt.

Step 1 – list the data: Emission factor $= 2.5$ t CO_2 per t coal, coal burnt $= 200$ t/day.

Step 2 – multiply: $CO_2 = 2.5 \times 200$

Step 3 – evaluate: $CO_2 = 500$ tonnes/day

Final Answer: 500 tonnes/day $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q43

Q44.

Solution

Concept – temperature goal of the Paris Agreement: The 2015 Paris Agreement sets a global temperature target relative to pre-industrial levels.

Step 1 – recall the headline goal: Parties agreed to hold the rise in global average temperature to well below $2°C$ above pre-industrial levels, while pursuing efforts to limit it to $1.5°C$.

Step 2 – match to the option: The stated "well below" threshold is $2°C$, which is option B.

Why the other options are wrong:

- A, $5°C$ and C, $10°C$: are far above any agreed limit and would be catastrophic.
- D, $0.5°C$: is below the warming already observed and is not the target.

Final Answer: $2°C$ above pre-industrial levels $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept – IPCC emission/concentration scenarios: The IPCC uses standardised scenarios to drive its climate-model projections of future warming.

Step 1 – recall the AR5 scenarios: Since the Fifth Assessment Report the scenarios have been the Representative Concentration Pathways (for example RCP2.6, RCP4.5, RCP8.5), each labelled by the radiative forcing it reaches by 2100.

Step 2 – match to the option: This is option A.

Why the other options are wrong:

- B, "Montreal reduction pathways": not a real IPCC scenario family.
- C, "Kyoto baskets": the Kyoto Protocol grouped gases, but this is not the IPCC scenario set.
- D, Ozone Depletion Potentials: measure ozone-layer harm, not climate scenarios.

Final Answer: Representative Concentration Pathways (RCPs) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q45

Q46.

Solution

Concept – the global climate-assessment body: One international scientific body is charged with reviewing the published climate science and summarising it for policymakers.

Step 1 – identify the body: The Intergovernmental Panel on Climate Change (IPCC), set up in 1988 by the WMO and UNEP, produces the periodic Assessment Reports (AR1 through AR6).

Step 2 – match to the option: This is option B.

Why the other options are wrong:

- A, WHO: deals with global public health.
- C, UNESCO: covers education, science and culture broadly, not climate assessment.
- D, IUCN: focuses on nature conservation and species status.

Final Answer: Intergovernmental Panel on Climate Change (IPCC) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q46

Answer Key

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