GATE Environmental Science and Engineering

Sample Paper – 1

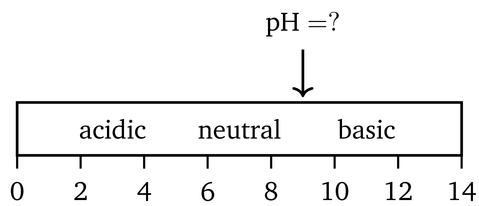
Duration: 128 Minutes **Maximum Marks: 72**

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 has a hydrogen-ion concentration $[H^+] = 1 \times 10^{-9}$ mol/L at $25°$C. On the pH scale shown, its pH is: **[1 mark]**



(A) 5

(B) 7

(C) 14

(D) 9

Q2. A water sample contains calcium ions at a concentration of 25 mg/L (atomic mass of Ca $= 40$). Expressed as an equivalent concentration of calcium carbonate, the calcium hardness is: **[1 mark]**

(A) 62.5 mg/L as $CaCO_3$

(B) 25 mg/L as $CaCO_3$

(C) 100 mg/L as $CaCO_3$

(D) 50 mg/L as $CaCO_3$

Q3. In routine bacteriological testing of drinking water, the group of organisms used as the standard indicator of recent faecal contamination is: **[1 mark]**

(A) *Salmonella typhi*

(B) *Vibrio cholerae*

(C) coliform bacteria (*Escherichia coli*)

(D) *Entamoeba histolytica*

Q4. At $25°$C a water sample has a pH of 6. Taking the ion product of water as $K_w = [H^+][OH^-] = 1 \times 10^{-14}$, the hydroxyl-ion concentration $[OH^-]$ is: **[1 mark]**

(A) 1×10^{-6} mol/L

(B) 1×10^{-8} mol/L

(C) 1×10^{-7} mol/L

(D) 1×10^{-14} mol/L

Q5. At 25°C the saturation (equilibrium) dissolved-oxygen concentration of a river is 8.2 mg/L, while the measured dissolved oxygen is 6.2 mg/L. The dissolved-oxygen deficit of the water is: **[1 mark]**

(A) 2.0 mg/L

(B) 6.2 mg/L

(C) 8.2 mg/L

(D) 14.4 mg/L

Q6. The Most Probable Number (MPN) technique applied to a water sample is used to estimate the: **[1 mark]**

(A) turbidity of the water

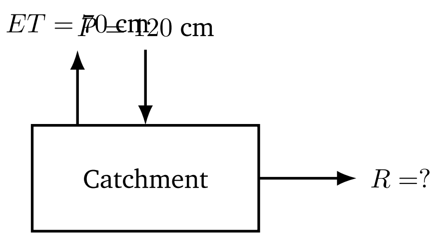
(B) dissolved-oxygen content

(C) total hardness

(D) coliform bacterial density

Water Resources and Environmental Hydraulics

Q7. For the catchment water balance shown, the annual rainfall is $P = 120$ cm and the evapotranspiration loss is $ET = 70$ cm. If the change in storage over the year is negligible, the annual runoff $R = P - ET$ is: **[1 mark]**



(A) 190 cm

(B) 70 cm

(C) 50 cm

(D) 120 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 catchment has runoff coefficient $C = 0.6$, rainfall intensity $i = 36$ mm/hr and area $A = 100$ ha. The peak runoff Q is: **[1 mark]**

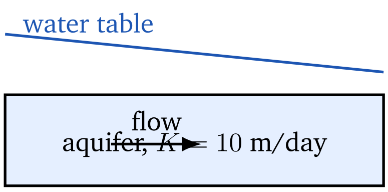
(A) 3.6 m^3/s

(B) 21.6 m^3/s

(C) 60 m^3/s

(D) 6 m^3/s

Q9. For the 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 $K = 10$ m/day and $i = 0.02$, the Darcy velocity is: **[1 mark]**



hydraulic gradient $i = 0.02$

(A) 0.2 m/day

(B) 20 m/day

(C) 0.02 m/day

(D) 2 m/day

Q10. A confined aquifer of thickness $b = 20$ m and hydraulic conductivity $K = 25$ m/day carries groundwater under a hydraulic gradient of $i = 0.001$ across a width $W = 1000$ m. The volumetric flow $Q = K\,i\,(b\,W)$ through this section is: **[1 mark]**

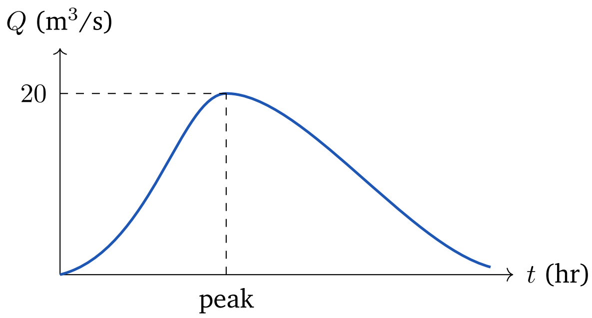
(A) 50 m^3/day

(B) 500 m^3/day

(C) 5000 m^3/day

(D) 5 m^3/day

Q11. A 2-hour unit hydrograph of a catchment has a peak ordinate of 20 m^3/s, as shown. For a rainfall excess of 4 cm occurring uniformly over the same 2-hour duration, the peak of the resulting direct-runoff hydrograph is: [1 mark]



(A) 80 m^3/s

(B) 20 m^3/s

(C) 5 m^3/s

(D) 40 m^3/s

Q12. Water flows in a wide open channel. By Manning's equation $V = \frac{1}{n} R^{2/3} S^{1/2}$, with Manning's roughness $n = 0.015$, hydraulic radius $R = 1$ m and bed slope $S = 0.0009$, the mean velocity of flow is: [1 mark]

(A) 0.03 m/s

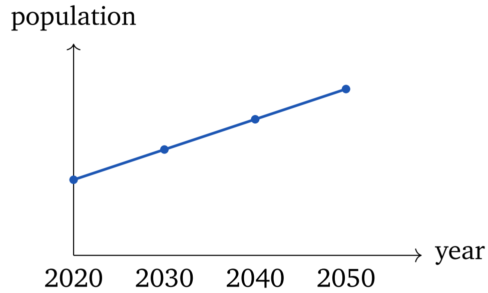
(B) 2.0 m/s

(C) 20 m/s

(D) 0.67 m/s

Water Supply and Water Treatment

Q13. A town's population in the year 2020 is 50,000 and its average decadal increase (arithmetic-increase method) is 5,000 persons, as trended below. The forecast population for the year 2050 is: [1 mark]



(A) 55,000

(B) 15,000

(C) 65,000

(D) 50,000

Q14. A city with a population of 100,000 has an average water demand of 135 litres per capita per day (lpcd). The average daily water demand of the city, expressed in million litres per day (MLD), is: **[1 mark]**

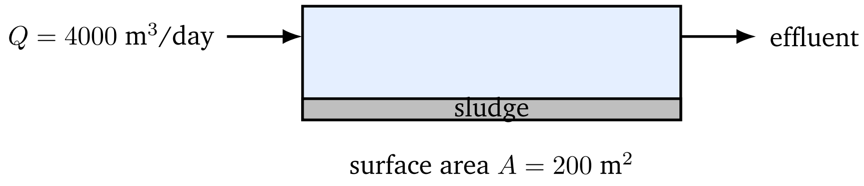
(A) 1.35 MLD

(B) 135 MLD

(C) 27 MLD

(D) 13.5 MLD

Q15. A rectangular sedimentation tank shown treats a flow of $Q = 4000$ m^3/day and has a plan (surface) area of $A = 200$ m^2. The surface overflow rate (surface loading) $SOR = Q/A$ is: **[1 mark]**



(A) 200 m/day

(B) 0.05 m/day

(C) 800 m/day

(D) 20 m/day

Q16. A discrete spherical particle of diameter $d = 0.05$ mm $= 5 \times 10^{-5}$ m and submerged density $(\rho_s - \rho) = 1650$ kg/m^3 settles in still water. By Stokes' law $v_s = \dfrac{g(\rho_s - \rho)d^2}{18\mu}$ (with $\mu = 1.0 \times 10^{-3}$ Pa·s), the settling velocity is nearest to: **[1 mark]**

(A) 2.25×10^{-2} m/s

(B) 4.5×10^{-3} m/s

(C) 2.25×10^{-3} m/s

(D) 1.1×10^{-3} m/s

Q17. A flocculation basin of volume $V = 600$ m^3 receives a flow of $Q = 200$ m^3/hr. The theoretical hydraulic detention (retention) time $t_d = V/Q$ is: **[1 mark]**

(A) 0.33 hr

(B) 1.5 hr

(C) 3 hr

(D) 6 hr

Q18. In the disinfection of water, a chlorine dose of 5.0 mg/L is applied and a free chlorine residual of 0.5 mg/L is measured after the contact period. The chlorine demand of the water is: **[1 mark]**

(A) 5.5 mg/L

(B) 4.5 mg/L

(C) 0.5 mg/L

(D) 5.0 mg/L

Wastewater Treatment and Disposal

Q19. The influent to a treatment unit has a BOD of 300 mg/L and the effluent leaving it has a BOD of 30 mg/L. The BOD-removal efficiency of the unit is: **[1 mark]**

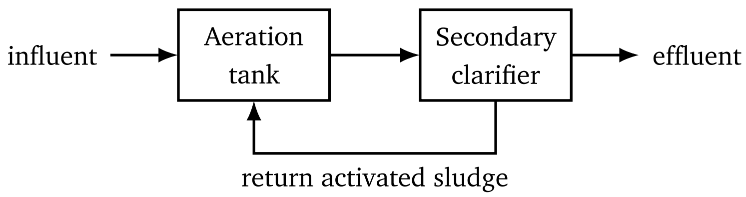
(A) 90%

(B) 10%

(C) 30%

(D) 270%

Q20. In the activated-sludge process whose flow scheme is shown, the organic matter in the aeration tank is stabilised chiefly by the metabolic action of: **[1 mark]**



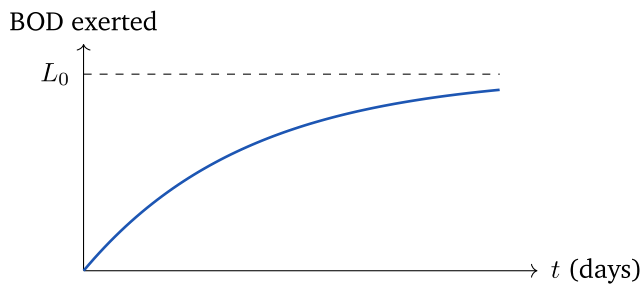
(A) anaerobic bacteria only

(B) fungi only

(C) algae

(D) aerobic bacteria

Q21. Wastewater has an ultimate (first-stage) BOD of $L_0 = 300$ mg/L and a deoxygenation rate constant $k = 0.23$ 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]**



first-order, $k = 0.23$/day

(A) 95 mg/L

(B) 300 mg/L

(C) 205 mg/L

(D) 150 mg/L

Q22. An activated-sludge aeration tank of volume $V = 500$ m^3 operates with a mixed-liquor suspended-solids concentration of $X = 2000$ mg/L. It receives $Q = 1000$ m^3/day of wastewater at an applied BOD of $S_0 = 200$ mg/L. The food-to-microorganism ratio $F/M = \dfrac{Q\,S_0}{V\,X}$ is: **[2 marks]**

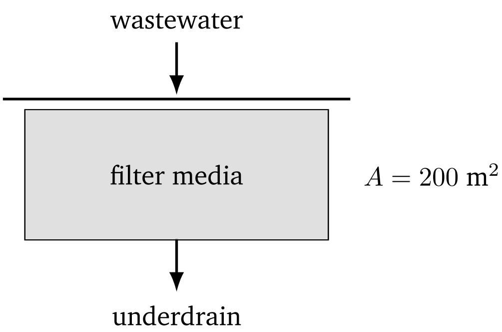
(A) 2.0 per day

(B) 0.2 per day

(C) 0.02 per day

(D) 0.4 per day

Q23. A circular trickling filter, shown in cross-section, has a surface (plan) area of $A = 200$ m^2 and receives a wastewater flow of $Q = 4 \times 10^6$ L/day. The hydraulic loading rate $HLR = Q/A$ is: **[2 marks]**



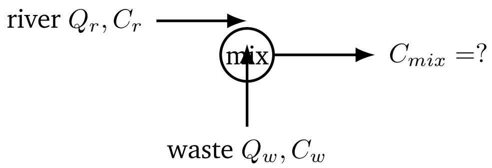
(A) 0.05 m/day

(B) 20 m/day

(C) 200 m/day

(D) 2 m/day

Q24. Treated wastewater is discharged into a stream, as sketched. The waste stream carries $Q_w = 0.5$ m^3/s at a BOD of 200 mg/L and the receiving river carries $Q_r = 4.5$ 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) 202 mg/L

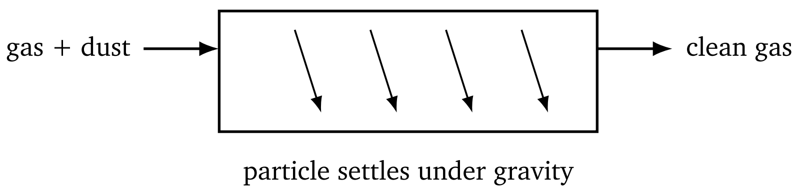
(B) 100 mg/L

(C) 40 mg/L

(D) 21.8 mg/L

Air Pollution and Control

Q25. In the gravity settling chamber shown, a spherical dust particle of diameter $d = 20\ \mu\text{m} = 2 \times 10^{-5}$ m and density $\rho_p = 2000$ 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) 0.24 m/s

(B) 2.4 m/s

(C) 0.0024 m/s

(D) 0.024 m/s

Q26. A cyclone separator receives a gas carrying a particulate loading of 10 g/m^3 and discharges it at 0.5 g/m^3. The overall collection (removal) efficiency of the cyclone is: **[2 marks]**

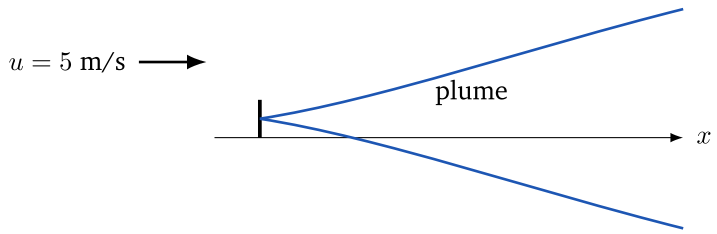
(A) 95%

(B) 5%

(C) 50%

(D) 90%

Q27. A continuous ground-level point source emits a pollutant at $Q = 100$ g/s into a wind of speed $u = 5$ 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 $\sigma_y = 30$ m and $\sigma_z = 15$ m, the concentration is nearest to: **[2 marks]**



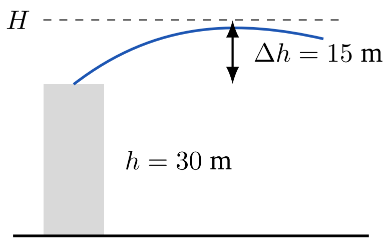
(A) 28.3 mg/m^3

(B) 14.2 mg/m^3

(C) 7.1 mg/m^3

(D) 1.42 mg/m^3

Q28. For the chimney shown, the physical stack height is $h = 30$ m and the buoyant plume rises a further $\Delta h = 15$ m above the stack top before levelling off. The effective stack height $H = h + \Delta h$ is: **[2 marks]**



(A) 30 m

(B) 15 m

(C) 45 m

(D) 60 m

Q29. In atmospheric stability analysis, the rate at which the temperature of a rising dry air parcel falls with altitude, the dry adiabatic lapse rate, is approximately: **[2 marks]**

(A) 6.5°C/km

(B) 5.0°C/km

(C) 0.98°C/km

(D) $9.8°$C/km

Q30. Ambient sulphur dioxide is measured as 0.1 ppm by volume. At $25°$C (1 atm) the molar volume of a gas is 24.45 litres and the molecular mass of SO_2 is 64. Using μg/m^3 $=$ ppm $\times \dfrac{M}{24.45} \times 1000$, the mass concentration is nearest to: **[2 marks]**

(A) 64 μg/m^3

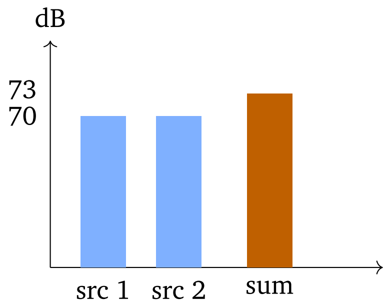
(B) 100 μg/m^3

(C) 24.45 μg/m^3

(D) 262 μg/m^3

Noise Pollution and Environmental Monitoring

Q31. Two identical machines each produce a sound-pressure level of 70 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) 73 dB

(B) 140 dB

(C) 70 dB

(D) 76 dB

Q32. At a receiver, one source produces 80 dB and a second produces 74 dB. The combined sound level, using $L = 10\log_{10}\big(10^{8.0} + 10^{7.4}\big)$, is nearest to: **[2 marks]**

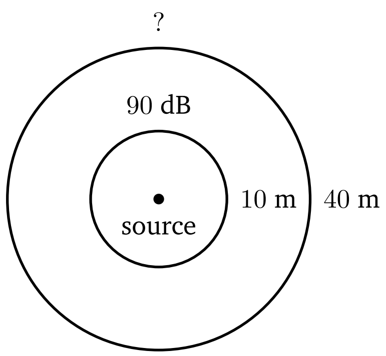
(A) 81 dB

(B) 154 dB

(C) 80 dB

(D) 86 dB

Q33. A point noise source produces 90 dB at a distance of 10 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 40 m from the source is: **[2 marks]**



(A) 84 dB

(B) 78 dB

(C) 90 dB

(D) 72 dB

Q34. In environmental noise monitoring, the single value that represents the constant sound level containing the same acoustic energy as the actual fluctuating noise measured over a stated period is denoted: **[2 marks]**

(A) L_{eq}

(B) L_{10}

(C) L_{90}

(D) L_{max}

Solid and Hazardous Waste Management

Q35. A city has a population of $200{,}000$ and a per-capita municipal solid-waste (MSW) generation rate of 0.5 kg/person/day. The total MSW generated per day, expressed in tonnes, is: **[2 marks]**

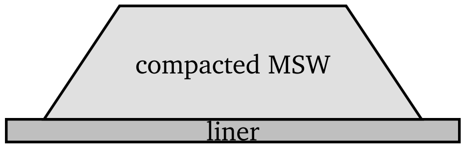
(A) 400 tonnes/day

(B) 50 tonnes/day

(C) 100 tonnes/day

(D) 200 tonnes/day

Q36. A sanitary landfill, shown in cross-section, receives 100 tonnes/day of MSW that is compacted to an in-place density of 500 kg/m^3. The landfill airspace (volume) needed for one year (365 days) of this waste is nearest to: **[2 marks]**



in-place density = 500 kg/m^3

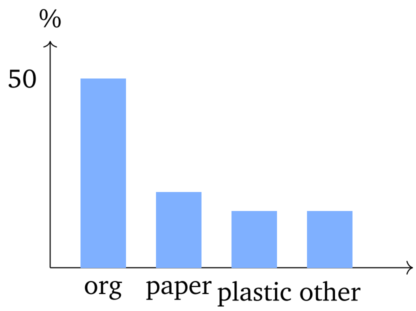
(A) 73,000 m^3

(B) 36,500 m^3

(C) 18,250 m^3

(D) 146,000 m^3

Q37. The bar chart shows the composition of a city's MSW: organic (compostable) 50%, paper 20%, plastic 15% and other 15%. If the total MSW is 100 tonnes/day, the mass of the compostable (organic) fraction is: **[2 marks]**



(A) 50 tonnes/day

(B) 20 tonnes/day

(C) 15 tonnes/day

(D) 100 tonnes/day

Q38. Under the standard framework for classifying a waste as hazardous, which one of the following is NOT one of the four defining characteristics? **[2 marks]**

(A) ignitability

(B) biodegradability

(C) corrosivity

(D) toxicity

Q39. A mass-burn incinerator receives 100 tonnes/day of MSW and leaves an ash residue equal to 20% of the input mass. The mass of ash (bottom + fly ash) produced per day is: **[2 marks]**

(A) 20 tonnes/day

(B) 80 tonnes/day

(C) 100 tonnes/day

(D) 50 tonnes/day

Q40. For efficient aerobic composting of organic solid waste, the initial carbon-to-nitrogen (C/N) ratio of the feedstock should be closest to: **[2 marks]**

(A) 1 : 1

(B) 30 : 1

(C) 100 : 1

(D) 5 : 1

Environmental Management, Sustainability and Climate

Q41. Before a major development project is cleared, a study that identifies, predicts and evaluates the likely environmental consequences of the proposal is prepared. This study is called the: **[2 marks]**

(A) Environmental Management Plan

(B) Environmental Impact Assessment

(C) Detailed Project Report

(D) Life Cycle Assessment

Q42. Among the following greenhouse gases, the one with the highest global-warming potential (GWP) per unit mass over a 100-year horizon is: **[2 marks]**

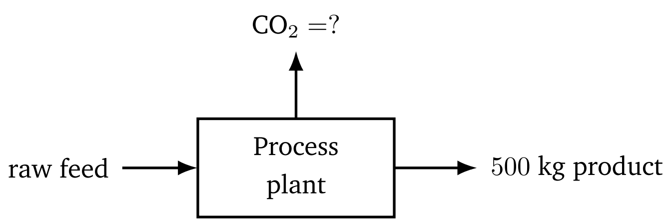
(A) carbon dioxide (CO_2)

(B) methane (CH_4)

(C) nitrous oxide (N_2O)

(D) sulphur hexafluoride (SF_6)

Q43. For the process shown, a plant emits 2 kg of CO_2 for every kilogram of product and manufactures 500 kg of product each day. The daily CO_2 emission, obtained from the mass balance, is: **[2 marks]**



(A) 250 kg/day

(B) 500 kg/day

(C) 1 tonne/day

(D) 2 tonnes/day

Q44. According to the widely accepted Brundtland definition, sustainable development is best described as development that: **[2 marks]**

(A) maximises economic growth regardless of resource use

(B) consumes all available natural resources as fast as possible

(C) meets the needs of the present without compromising the ability of future generations to meet their own needs

(D) halts all industrial and agricultural activity

Q45. The Montreal Protocol is an international agreement established primarily to phase out the emission of: **[2 marks]**

(A) carbon dioxide (CO_2)

(B) ozone-depleting substances such as chlorofluorocarbons (CFCs)

(C) sulphur dioxide (SO_2)

(D) methane (CH_4)

Q46. Of the long-lived greenhouse gases, the one contributing the largest share of the anthropogenic (human-caused) radiative forcing of the climate is: **[2 marks]**

(A) water vapour

(B) methane

(C) carbon dioxide

(D) nitrous oxide

Detailed Solutions

Q1.

Solution

Concept – definition of pH: pH is the negative base-10 logarithm of the hydrogen-ion concentration, $\text{pH} = -\log_{10}[\text{H}^+]$.

Step 1 – write the given concentration: $[\text{H}^+] = 1 \times 10^{-9}$ mol/L

Step 2 – substitute into the definition: $\text{pH} = -\log_{10}(1 \times 10^{-9})$

Step 3 – apply the logarithm: $\log_{10}(10^{-9}) = -9$

Step 4 – take the negative: $\text{pH} = -(-9)$

$\text{pH} = 9$

Step 5 – interpret: A pH of 9 is greater than 7, so the water is on the basic side, consistent with a low $[\text{H}^+]$.

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

Answer: (D) Go Back to Q1

Q2.

Solution

Concept – expressing hardness as $CaCO_3$: The hardness caused 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 calcium: Calcium has valency 2, so its equivalent weight is $\frac{40}{2} = 20$

Step 2 – form the conversion factor: factor $= \frac{50}{20} = 2.5$

Step 3 – multiply the calcium concentration by the factor: Hardness $= 25 \times 2.5$

Step 4 – evaluate: Hardness $= 62.5$ mg/L as $CaCO_3$

Final Answer: 62.5 mg/L as $CaCO_3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept – indicator organisms in water quality: Directly testing for every pathogen is impractical, so an easily detected, non-pathogenic organism that always accompanies faecal matter is used as an indicator.

Step 1 – recall the requirements of an indicator: It must be present whenever faecal pollution is present, be more numerous than pathogens and be easy to detect.

Step 2 – identify the organism that meets these: The coliform group, and specifically *Escherichia coli*, lives in the intestines of warm-blooded animals and satisfies all these requirements.

Why the other options are wrong:

- A, *Salmonella typhi* and B, *Vibrio cholerae*: are actual pathogens, tested for only in special cases, not routine indicators.
- D, *Entamoeba histolytica*: is a protozoan parasite, not the standard bacteriological indicator.

Final Answer: coliform bacteria (*E. coli*) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

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

Step 1 – find $[\text{H}^+]$ from the pH: $[\text{H}^+] = 10^{-\text{pH}} = 10^{-6}$ mol/L

Step 2 – rearrange for $[\text{OH}^-]$: $[\text{OH}^-] = \dfrac{K_w}{[\text{H}^+]}$

Step 3 – substitute the values: $[\text{OH}^-] = \dfrac{1 \times 10^{-14}}{1 \times 10^{-6}}$

Step 4 – subtract the exponents: $[\text{OH}^-] = 1 \times 10^{-14-(-6)}$

$[\text{OH}^-] = 1 \times 10^{-8}$ mol/L

Final Answer: $[\text{OH}^-] = 1 \times 10^{-8}$ mol/L $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – dissolved-oxygen deficit: The DO deficit is the amount by which the actual dissolved oxygen falls short of the saturation value, $D = DO_{sat} - DO_{actual}$.

Step 1 – list the data: $DO_{sat} = 8.2$ mg/L, $DO_{actual} = 6.2$ mg/L.

Step 2 – substitute into the deficit equation: $D = 8.2 - 6.2$

Step 3 – evaluate: $D = 2.0$ mg/L

Final Answer: $D = 2.0$ mg/L $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept – Most Probable Number test: The MPN method is a statistical, multiple-tube fermentation procedure that estimates the density of viable indicator organisms from the pattern of positive and negative tubes.

Step 1 – recall what the tubes detect: Each tube is scored for growth (gas/acid production) by coliform organisms.

Step 2 – translate the tube pattern into a number: The combination of positive tubes is read against standard MPN tables to give the number of coliforms per 100 mL.

Why the other options are wrong:

- A, turbidity: is measured optically with a nephelometer.
- B, dissolved oxygen: is measured by the Winkler titration or a DO probe.
- C, hardness: is measured by EDTA titration.

Final Answer: coliform bacterial density $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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 $R = P - ET$.

Step 1 – list the data: $P = 120$ cm, $ET = 70$ cm, $\Delta S \approx 0$.

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

Step 3 – substitute the values: $R = 120 - 70$

Step 4 – evaluate: $R = 50$ cm

Final Answer: $R = 50 \text{ cm} \Rightarrow \boxed{\text{C}}$

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: $C = 0.6$, $i = 36$ mm/hr, $A = 100$ ha.

Step 2 – form the numerator: $C\,i\,A = 0.6 \times 36 \times 100$

Step 3 – multiply step by step: $0.6 \times 36 = 21.6$

$21.6 \times 100 = 2160$

Step 4 – divide by 360**:** $Q = \dfrac{2160}{360}$

$Q = 6 \text{ m}^3/\text{s}$

Final Answer: $Q = 6 \text{ m}^3/\text{s} \Rightarrow \boxed{\text{D}}$

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: $K = 10$ m/day, $i = 0.02$.

Step 2 – substitute: $v = 10 \times 0.02$

Step 3 – evaluate: $v = 0.2$ m/day

Final Answer: $v = 0.2 \text{ m/day} \Rightarrow \boxed{\text{A}}$

Answer: (A) 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: $K = 25$ m/day, $i = 0.001$, $b = 20$ m, $W = 1000$ m.

Step 2 – compute the cross-sectional area: $A = b\,W = 20 \times 1000 = 20000$ m^2

Step 3 – compute the Darcy velocity: $v = K\,i = 25 \times 0.001 = 0.025$ m/day

Step 4 – multiply velocity by area: $Q = 0.025 \times 20000$

$Q = 500$ m^3/day

Final Answer: $Q = 500$ m^3/day $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept – linearity of the unit hydrograph: A unit hydrograph is defined for 1 cm of rainfall excess. For P cm of excess over the same duration, every ordinate is scaled by P (principle of proportionality).

Step 1 – list the data: Unit-hydrograph peak $= 20$ m^3/s, rainfall excess $P = 4$ cm.

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

Step 3 – substitute: $Q_{peak} = 4 \times 20$

Step 4 – evaluate: $Q_{peak} = 80$ m^3/s

Final Answer: $Q_{peak} = 80$ m^3/s $\Rightarrow \boxed{\text{A}}$

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: $n = 0.015$, $R = 1$ m, $S = 0.0009$.

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

Step 3 – evaluate $S^{1/2}$: $S^{1/2} = \sqrt{0.0009} = 0.03$

Step 4 – form the coefficient: $\frac{1}{n} = \frac{1}{0.015} = 66.667$

Step 5 – multiply the three factors: $V = 66.667 \times 1 \times 0.03$

$V = 2.0$ m/s

Final Answer: $V = 2.0$ m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) 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 2050: $n = \frac{2050 - 2020}{10} = 3$ decades

Step 2 – compute the total increase: $n\overline{x} = 3 \times 5000 = 15000$

Step 3 – add to the base population: $P = 50000 + 15000$

$P = 65000$

Final Answer: $P = 65{,}000 \Rightarrow \boxed{\text{C}}$

Answer: (C) 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 $=$ 135 L/person/day, population $=$ 100000.

Step 2 – multiply: Demand $= 135 \times 100000$

Step 3 – evaluate in litres per day: Demand $= 13{,}500{,}000$ L/day

Step 4 – convert to million litres per day: Demand $= \frac{13{,}500{,}000}{10^6} = 13.5$ MLD

Final Answer: 13.5 MLD $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

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

Step 1 – list the data: $Q = 4000\ \text{m}^3/\text{day}$, $A = 200\ \text{m}^2$.

Step 2 – substitute: $SOR = \frac{4000}{200}$

Step 3 – evaluate: $SOR = 20\ \text{m}^3/\text{m}^2/\text{day} = 20\ \text{m/day}$

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

Answer: (D) Go Back to Q15

Q16.

Solution

Concept – Stokes' law for discrete settling: $v_s = \frac{g(\rho_s - \rho)d^2}{18\mu}$.

Step 1 – list the data: $g = 9.81\ \text{m/s}^2$, $(\rho_s - \rho) = 1650\ \text{kg/m}^3$, $d = 5 \times 10^{-5}$ m, $\mu = 1.0 \times 10^{-3}$ Pa·s.

Step 2 – square the diameter: $d^2 = (5 \times 10^{-5})^2 = 2.5 \times 10^{-9}\ \text{m}^2$

Step 3 – form the numerator: $g(\rho_s - \rho)d^2 = 9.81 \times 1650 \times 2.5 \times 10^{-9}$

$9.81 \times 1650 = 16186.5$

$16186.5 \times 2.5 \times 10^{-9} = 4.047 \times 10^{-5}$

Step 4 – form the denominator: $18\mu = 18 \times 1.0 \times 10^{-3} = 0.018$

Step 5 – divide: $v_s = \frac{4.047 \times 10^{-5}}{0.018}$

$v_s = 2.25 \times 10^{-3}$ m/s

Final Answer: $v_s \approx 2.25 \times 10^{-3}\ \text{m/s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept – hydraulic detention time: The theoretical detention time is the tank volume divided by the flow rate, $t_d = \frac{V}{Q}$.

Step 1 – list the data: $V = 600\ \text{m}^3$, $Q = 200\ \text{m}^3/\text{hr}$.

Step 2 – substitute: $t_d = \dfrac{600}{200}$

Step 3 – evaluate: $t_d = 3$ hr

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

Answer: (C) Go Back to Q17

Q18.

Solution

Concept – chlorine demand: Chlorine demand is the chlorine consumed by the water, equal to the applied dose minus the residual left over, Demand $=$ Dose $-$ Residual.

Step 1 – list the data: Dose $= 5.0$ mg/L, residual $= 0.5$ mg/L.

Step 2 – substitute: Demand $= 5.0 - 0.5$

Step 3 – evaluate: Demand $= 4.5$ mg/L

Final Answer: demand $= 4.5 \text{ mg/L} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept – treatment (removal) efficiency: $\eta = \dfrac{C_{in} - C_{out}}{C_{in}} \times 100\%$.

Step 1 – list the data: $C_{in} = 300$ mg/L, $C_{out} = 30$ mg/L.

Step 2 – form the amount removed: $C_{in} - C_{out} = 300 - 30 = 270$

Step 3 – divide by the influent value: $\dfrac{270}{300} = 0.9$

Step 4 – convert to a percentage: $\eta = 0.9 \times 100 = 90\%$

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

Answer: (A) Go Back to Q19

Q20.

Solution

Concept – biology of the activated-sludge process: The aeration tank is continuously supplied with oxygen, so the dominant organisms are those that oxidise organic matter using dissolved oxygen.

Step 1 – note the environment: Air (oxygen) is bubbled through the mixed liquor, creating an aerobic environment.

Step 2 – identify the responsible organisms: Aerobic heterotrophic bacteria consume the organic pollutants and flocculate into activated sludge.

Why the other options are wrong:

- A, anaerobic bacteria: dominate in the absence of oxygen (for example in a digester), not in an aerated tank.
- B, fungi only, and C, algae: play only minor roles and are not the principal stabilising organisms here.

Final Answer: aerobic bacteria $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept – first-order BOD exertion: The BOD exerted after time t follows $y_t = L_0\left(1 - e^{-kt}\right)$.

Step 1 – list the data: $L_0 = 300$ mg/L, $k = 0.23$ day^{-1}, $t = 5$ days.

Step 2 – form the exponent: $k\,t = 0.23 \times 5 = 1.15$

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

Step 4 – form the bracket: $1 - 0.3166 = 0.6834$

Step 5 – multiply by L_0: $y_5 = 300 \times 0.6834$

$y_5 = 205.0$ mg/L

Final Answer: $y_5 \approx 205$ mg/L $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

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

Step 1 – list the data: $Q = 1000$ m^3/day, $S_0 = 200$ mg/L, $V = 500$ m^3, $X = 2000$ mg/L.

Step 2 – form the numerator: $Q\,S_0 = 1000 \times 200 = 200000$

Step 3 – form the denominator: $V\,X = 500 \times 2000 = 1000000$

Step 4 – divide: $\dfrac{F}{M} = \dfrac{200000}{1000000}$

$\dfrac{F}{M} = 0.2$ day^{-1}

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: $HLR = \dfrac{Q}{A}$, the flow per unit plan area.

Step 1 – convert the flow to m^3/day: $Q = 4 \times 10^6$ L/day $= \dfrac{4 \times 10^6}{1000} = 4000$ m^3/day

Step 2 – list the area: $A = 200$ m^2

Step 3 – divide: $HLR = \dfrac{4000}{200}$

Step 4 – evaluate: $HLR = 20$ m^3/m^2/day $= 20$ m/day

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

Answer: (B) Go Back to Q23

Q24.

Solution

Concept – flow-weighted mixing (mass balance): When two streams mix completely, the resulting 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: $Q_w = 0.5$ m^3/s, $C_w = 200$ mg/L, $Q_r = 4.5$ m^3/s, $C_r = 2$

mg/L.

Step 2 – form the load from the waste: $Q_w C_w = 0.5 \times 200 = 100$

Step 3 – form the load from the river: $Q_r C_r = 4.5 \times 2 = 9$

Step 4 – add the loads: $100 + 9 = 109$

Step 5 – add the flows: $Q_w + Q_r = 0.5 + 4.5 = 5.0$

Step 6 – divide: $C_{mix} = \dfrac{109}{5.0}$

$C_{mix} = 21.8$ mg/L

Final Answer: $C_{mix} = 21.8$ mg/L $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

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

Step 1 – list the data: $g = 9.81$ m/s^2, $\rho_p = 2000$ kg/m^3, $d = 2 \times 10^{-5}$ m, $\mu = 1.8 \times 10^{-5}$ Pa·s.

Step 2 – square the diameter: $d^2 = (2 \times 10^{-5})^2 = 4 \times 10^{-10}$ m^2

Step 3 – form the numerator: $g\,\rho_p\,d^2 = 9.81 \times 2000 \times 4 \times 10^{-10}$

$9.81 \times 2000 = 19620$

$19620 \times 4 \times 10^{-10} = 7.848 \times 10^{-6}$

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

Step 5 – divide: $v_t = \dfrac{7.848 \times 10^{-6}}{3.24 \times 10^{-4}}$

$v_t = 0.0242$ m/s ≈ 0.024 m/s

Final Answer: $v_t \approx 0.024$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept – collection efficiency: $\eta = \dfrac{C_{in} - C_{out}}{C_{in}} \times 100\%$.

Step 1 – list the data: $C_{in} = 10$ g/m^3, $C_{out} = 0.5$ g/m^3.

Step 2 – form the amount collected: $C_{in} - C_{out} = 10 - 0.5 = 9.5$

Step 3 – divide by the inlet loading: $\frac{9.5}{10} = 0.95$

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 source: For a continuous ground-level point source the centre-line concentration is $C = \frac{Q}{\pi\,\sigma_y\,\sigma_z\,u}$.

Step 1 – list the data: $Q = 100$ g/s, $\sigma_y = 30$ m, $\sigma_z = 15$ m, $u = 5$ m/s.

Step 2 – build the denominator step by step: $\pi \times 30 = 94.248$

$94.248 \times 15 = 1413.7$

$1413.7 \times 5 = 7068.6$

Step 3 – divide: $C = \frac{100}{7068.6}$

$C = 0.01415$ g/m^3

Step 4 – convert to mg/m^3: $C = 0.01415 \times 1000 = 14.15$ mg/m$^3 \approx 14.2$ mg/m^3

Final Answer: $C \approx 14.2$ mg/m$^3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

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

Step 1 – list the data: $h = 30$ m, $\Delta h = 15$ m.

Step 2 – add: $H = 30 + 15$

Step 3 – evaluate: $H = 45$ m

Final Answer: $H = 45$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q28

Q29.

Solution

Concept – dry adiabatic lapse rate: A dry air parcel rising without heat exchange cools at a fixed rate set by gravity and the specific heat of air, close to $1°\text{C}$ per 100 m.

Step 1 – recall the standard value: The dry adiabatic lapse rate is about $9.8°\text{C}$ per kilometre.

Step 2 – check the per-100-m equivalent: $\frac{9.8°\text{C}}{1000\text{ m}} = 0.98°\text{C}$ per 100 m, which matches the familiar figure.

Why the other options are wrong:

- A, $6.5°\text{C/km}$: is the average *environmental* lapse rate, not the dry adiabatic one.
- C, $0.98°\text{C/km}$: mistakenly uses the per-100-m number as a per-km value.

Final Answer: $\approx 9.8°\text{C/km} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

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

Step 1 – list the data: $\text{ppm} = 0.1$, $M = 64$, molar volume $= 24.45$ L.

Step 2 – form the mass ratio: $\frac{M}{24.45} = \frac{64}{24.45} = 2.6176$

Step 3 – multiply by the ppm value: $0.1 \times 2.6176 = 0.26176$

Step 4 – multiply by 1000: $0.26176 \times 1000 = 261.8\ \mu\text{g/m}^3 \approx 262\ \mu\text{g/m}^3$

Final Answer: $\approx 262\ \mu\text{g/m}^3 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept – addition of two equal sound levels: Sound levels add on an energy basis, $L = 10\log_{10}\left(10^{L_1/10} + 10^{L_2/10}\right)$. Two equal sources double the energy.

Step 1 – note the doubling of energy: Two equal sources give total energy $= 2 \times 10^{L_1/10}$, so $L = L_1 + 10\log_{10} 2$.

Step 2 – evaluate the correction term: $10\log_{10} 2 = 10 \times 0.301 = 3.01$ dB

Step 3 – add to the single-source level: $L = 70 + 3.01$

$L \approx 73$ dB

Note: sound levels are logarithmic, so they never add arithmetically to 140 dB.

Final Answer: $L \approx 73$ dB $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q31

Q32.

Solution

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

Step 1 – convert each level to relative energy: $10^{80/10} = 10^{8.0} = 1.000 \times 10^8$

$10^{74/10} = 10^{7.4} = 0.2512 \times 10^8$

Step 2 – add the energies: $10^{8.0} + 10^{7.4} = 1.2512 \times 10^8$

Step 3 – take the logarithm: $\log_{10}(1.2512 \times 10^8) = 8.0973$

Step 4 – multiply by 10**:** $L = 10 \times 8.0973 = 80.97$ dB ≈ 81 dB

Final Answer: $L \approx 81$ dB $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q32

Q33.

Solution

Concept – inverse-square spreading of a point source: In a free field the level drops 6 dB for each doubling of distance from a point source.

Step 1 – count the doublings from 10 **m to** 40 **m:** $10 \to 20$ m is one doubling; $20 \to 40$ m is a second. So there are 2 doublings.

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

Step 3 – subtract from the near level: $L = 90 - 12$

$L = 78$ dB

Final Answer: $L = 78$ dB $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept – equivalent continuous sound level: Fluctuating noise is described by a single steady level that carries the same total acoustic energy over the measurement period.

Step 1 – recall the definition: That energy-equivalent steady level is the equivalent continuous level, written L_{eq}.

Why the other options are wrong:

- B, L_{10}: the level exceeded 10% of the time (a near-peak descriptor).
- C, L_{90}: the level exceeded 90% of the time (the background level).
- D, L_{max}: the single highest instantaneous level, not an energy average.

Final Answer: $L_{eq} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

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

Step 1 – list the data: Population $= 200000$, generation rate $= 0.5$ kg/person/day.

Step 2 – multiply: MSW $= 200000 \times 0.5 = 100000$ kg/day

Step 3 – convert to tonnes: MSW $= \dfrac{100000}{1000} = 100$ tonnes/day

Final Answer: 100 tonnes/day $\Rightarrow \boxed{\text{C}}$

Answer: (C) 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 – compute the annual mass: $M = 100 \text{ t/day} \times 365 \text{ days} = 36500 \text{ tonnes}$

Step 2 – convert the mass to kilograms: $M = 36500 \times 1000 = 3.65 \times 10^7 \text{ kg}$

Step 3 – divide by the density: $V = \dfrac{3.65 \times 10^7}{500}$

Step 4 – evaluate: $V = 73000 \text{ m}^3$

Final Answer: $V = 73{,}000 \text{ m}^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept – component mass from a composition fraction: The mass of a component equals its percentage fraction times the total mass.

Step 1 – read the organic fraction from the chart: Organic (compostable) $= 50\% = 0.50$.

Step 2 – multiply by the total: $M_{org} = 0.50 \times 100$

Step 3 – evaluate: $M_{org} = 50$ tonnes/day

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

Answer: (A) Go Back to Q37

Q38.

Solution

Concept – characteristics that define a hazardous waste: A waste is deemed hazardous if it shows any of four characteristics: ignitability, corrosivity, reactivity or toxicity.

Step 1 – list the four recognised characteristics: Ignitability, corrosivity, reactivity, toxicity.

Step 2 – test each option against this list: Ignitability, corrosivity and toxicity are all on the list; biodegradability is not.

Step 3 – note why biodegradability does not belong: Biodegradability describes how readily a substance breaks down; it is a desirable, not a hazardous, trait.

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

Answer: (B) Go Back to Q38

Q39.

Solution

Concept – ash residue from incineration: The ash mass equals the input mass times the residue fraction.

Step 1 – list the data: Input $= 100$ tonnes/day, residue fraction $= 20\% = 0.20$.

Step 2 – multiply: $M_{ash} = 100 \times 0.20$

Step 3 – evaluate: $M_{ash} = 20$ tonnes/day

Final Answer: 20 tonnes/day $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept – optimum C/N ratio for composting: Micro-organisms need carbon for energy and nitrogen for protein; a balanced feedstock keeps the C/N ratio in a narrow band.

Step 1 – recall the optimum band: The ideal starting C/N ratio for aerobic composting is roughly 25 to 30 to 1.

Step 2 – pick the closest option: $30 : 1$ falls squarely in that band.

Why the other options are wrong:

- C, $100 : 1$: too much carbon, nitrogen becomes limiting and composting slows.
- A, $1 : 1$ and D, $5 : 1$: far too much nitrogen, causing ammonia loss and odour.

Final Answer: $30 : 1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – purpose of an environmental study before a project: The tool that anticipates and evaluates the environmental effects of a proposed project before approval is the Environmental Impact Assessment (EIA).

Step 1 – match the description to the tool: Identifying, predicting and evaluating likely consequences of a proposal is exactly the scope of an EIA.

Why the other options are wrong:

- A, Environmental Management Plan: is the set of mitigation and monitoring measures that *follows* from the EIA.
- C, Detailed Project Report: is an engineering/financial document, not an environmental prediction.
- D, Life Cycle Assessment: evaluates a product's impacts across its whole life, a different scope.

Final Answer: Environmental Impact Assessment $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – global-warming potential (GWP): GWP measures how much heat a mass of a gas traps relative to the same mass of CO_2 over a chosen horizon (CO_2 is the reference, GWP $= 1$).

Step 1 – recall the approximate 100-year GWP values: $CO_2 = 1$, $CH_4 \approx 28$, $N_2O \approx 265$, $SF_6 \approx 23{,}500$.

Step 2 – pick the largest: Sulphur hexafluoride, SF_6, has by far the highest GWP of the four.

Final Answer: sulphur hexafluoride (SF_6) $\Rightarrow \boxed{\text{D}}$

Answer: (D) 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 $= 2$ kg CO_2/kg product, production $= 500$ kg/day.

Step 2 – multiply: $CO_2 = 2 \times 500$

Step 3 – evaluate in kilograms: $CO_2 = 1000$ kg/day

Step 4 – convert to tonnes: $CO_2 = \frac{1000}{1000} = 1$ tonne/day

Final Answer: 1 tonne/day $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q43

Q44.

Solution

Concept – Brundtland definition of sustainable development: The Brundtland Commission (1987) framed sustainability around meeting present needs without foreclosing the future.

Step 1 – recall the exact idea: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

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

Why the other options are wrong:

- A and B: emphasise growth or resource consumption with no regard for the future, the opposite of sustainability.
- D: halting all activity is neither the definition nor a workable goal.

Final Answer: meets present needs without compromising future generations $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept – purpose of the Montreal Protocol: The Montreal Protocol (1987) is the treaty aimed at protecting the stratospheric ozone layer.

Step 1 – recall the target substances: It phases out ozone-depleting substances, chiefly chlorofluorocarbons (CFCs), halons and related compounds.

Why the other options are wrong:

- A, CO_2 and D, CH_4: are greenhouse gases addressed by the Kyoto Protocol and Paris Agreement, not Montreal.
- C, SO_2: is an acid-rain and local air-quality pollutant, controlled by other regulations.

Final Answer: ozone-depleting substances (CFCs) $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q45

Q46.

Solution

Concept – share of anthropogenic radiative forcing: Radiative forcing measures the net change in energy balance a gas causes; the leading human-caused contributor is the one emitted in the greatest climate-effective quantity.

Step 1 – rank the long-lived greenhouse gases by forcing: Carbon dioxide accounts for the largest single share of the anthropogenic forcing, well ahead of methane and nitrous oxide.

Step 2 – set aside water vapour: Water vapour is the dominant *natural* greenhouse gas but acts as a feedback, not a directly controlled anthropogenic emission.

Final Answer: carbon dioxide $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q46

Answer Key

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