

OJEE MTech Environmental Sample Paper 01

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.

B) Total Questions: The exam contains 90 questions.

C) Marking Scheme & Rules:

- +4 marks for each correct answer; -1 mark for each incorrect answer.

Q1. The temporary hardness of water is caused by the presence of:

- A. Chlorides and sulfates of calcium and magnesium
- B. Carbonates and bicarbonates of calcium and magnesium
- C. Nitrates of sodium and potassium
- D. Sulfates of iron and manganese

Q2. Which of the following air pollutants is primarily responsible for the depletion of the ozone layer?

- A. Carbon dioxide
- B. Sulfur dioxide
- C. Chlorofluorocarbons (CFCs)
- D. Nitrogen oxides

Q3. In a BOD test, standard BOD is usually measured at:

- A. 15°C for 3 days
- B. 20°C for 5 days
- C. 25°C for 5 days
- D. 30°C for 3 days

Q4. The most common coagulant used in water treatment is:

- A. Chlorine
- B. Alum
- C. Copper sulfate
- D. Potassium permanganate

Q5. The process of converting atmospheric nitrogen into ammonia is known as:

- A. Denitrification
- B. Nitrification
- C. Nitrogen fixation
- D. Ammonification

Q6. Which type of settling occurs in a primary sedimentation tank treating municipal wastewater?

- A. Discrete settling (Type I)
- B. Flocculant settling (Type II)
- C. Hindered settling (Type III)
- D. Compression settling (Type IV)

Q7. Sound pressure level (SPL) in decibels is calculated using a reference pressure of:

- A. 20 μPa
- B. 200 μPa
- C. 2 μPa
- D. 0.2 μPa

Q8. The optimal Carbon to Nitrogen (C:N) ratio for efficient composting of solid waste is:

- A. 10:1 to 15:1
- B. 20:1 to 40:1
- C. 50:1 to 70:1
- D. 80:1 to 100:1

Q9. Methemoglobinemia (Blue Baby Syndrome) is caused by excess concentrations of which ion in drinking water?

- A. Fluoride
- B. Arsenic
- C. Nitrate
- D. Sulfate

Q10. What is the standard Environmental Lapse Rate (ELR) in the troposphere?

- A. 6.5°C per km
- B. 9.8°C per km
- C. 1.0°C per km
- D. 10.0°C per km

Q11. A plume behavior resulting from severe temperature inversion, where pollutants are trapped close to the ground, is called:

- A. Looping
- B. Coning
- C. Fanning
- D. Fumigation

Q12. The permissible limit of Fluoride in drinking water as per IS 10500 when no alternate source is available is:

- A. 0.5 mg/L
- B. 1.0 mg/L
- C. 1.5 mg/L
- D. 2.5 mg/L

Q13. In the activated sludge process, the Sludge Volume Index (SVI) indicates:

- A. The rate of aeration
- B. The settleability of the sludge
- C. The organic loading rate
- D. The dissolved oxygen concentration

Q14. Crown corrosion in sewer pipes is primarily caused by:

- A. Carbon dioxide
- B. Methane
- C. Hydrogen sulfide
- D. Carbon monoxide

Q15. Electrostatic precipitators are highly efficient in removing:

- A. Gaseous pollutants
- B. Dissolved solids
- C. Particulate matter
- D. Volatile organic compounds

Q16. The ratio of the volume of water retained by soil to the total volume of the soil is called:

- A. Specific yield
- B. Specific retention
- C. Porosity
- D. Permeability

Q17. Trickling filters operate based on the principle of:

- A. Suspended growth process
- B. Attached growth process
- C. Anaerobic digestion
- D. Chemical coagulation

Q18. The "greenhouse effect" is mainly caused by:

- A. Nitrogen and Oxygen
- B. Carbon dioxide and Methane
- C. Argon and Helium
- D. Ozone and Sulfur dioxide

Q19. Hardness in water is commonly measured using which titrant?

- A. EDTA
- B. Silver nitrate
- C. Sulfuric acid
- D. Sodium thiosulfate

Q20. According to Noise Pollution Rules, permissible daytime noise limit for residential areas is:

- A. 75 dB(A)

- B. 65 dB(A)
- C. 55 dB(A)
- D. 45 dB(A)

Q21. Biochemical Oxygen Demand (BOD) of safe drinking water must be:

- A. 0 mg/L
- B. 5 mg/L
- C. 10 mg/L
- D. 30 mg/L

Q22. Which of the following is a secondary air pollutant?

- A. Carbon monoxide
- B. Sulfur dioxide
- C. Ozone
- D. Particulate matter

Q23. The unit of kinematic viscosity is:

- A. Stokes
- B. Poise
- C. Pascal-second
- D. Newton-second/m²

Q24. The most common method of solid waste disposal in India is:

- A. Incineration
- B. Open dumping / Landfilling
- C. Pyrolysis
- D. Composting

Q25. In the context of EIA, "Baseline Data" refers to:

- A. Data collected after project completion
- B. Data of the environment before the project starts
- C. Financial data of the project

D. Estimated pollution levels during the project

Q26. Darcy's Law is valid as long as the flow through an aquifer is:

- A. Turbulent
- B. Laminar
- C. Transitional
- D. Unsteady

Q27. Zeolite process is used for:

- A. Disinfection of water
- B. Removal of color and odor
- C. Softening of water
- D. Removal of iron and manganese

Q28. An aquifer bounded above and below by impermeable strata is known as:

- A. Unconfined aquifer
- B. Confined aquifer
- C. Leaky aquifer
- D. Perched aquifer

Q29. The most significant greenhouse gas contributing to global warming by volume is:

- A. Methane
- B. Nitrous oxide
- C. Carbon dioxide
- D. Chlorofluorocarbons

Q30. High turbidity in water is mainly caused by:

- A. Dissolved oxygen
- B. Dissolved organic matter
- C. Suspended and colloidal solids
- D. Pathogenic bacteria

Q31. The device used to measure the velocity of flow in a pipe is a:

- A. Venturimeter
- B. Pitot tube
- C. Orifice meter
- D. Both A and C

Q32. Burning municipal solid waste under controlled conditions in presence of oxygen is called:

- A. Pyrolysis
- B. Composting
- C. Incineration
- D. Pelletization

Q33. What is the chemical formula of ozone?

- A. O_2
- B. O_3
- C. CO
- D. HO_2

Q34. Eutrophication in lakes is primarily driven by excessive presence of:

- A. Heavy metals
- B. Nitrogen and Phosphorus
- C. Dissolved Oxygen
- D. Calcium and Magnesium

Q35. Residual chlorine in water is determined using:

- A. Winkler's method
- B. Orthotolidine test
- C. EDTA method
- D. Mohr's method

Q36. A grit chamber is designed to remove:

- A. Large floating objects
- B. Organic suspended solids

- C. Inorganic discrete particles
- D. Dissolved impurities

Q37. Aerobic bacteria require which of the following to survive?

- A. Free oxygen
- B. Hydrogen sulfide
- C. Methane
- D. Carbon monoxide

Q38. The natural acidity of rainfall (pH 5.6) is due to:

- A. Atmospheric sulfur dioxide
- B. Atmospheric carbon dioxide
- C. Atmospheric nitrogen oxides
- D. Particulate matter

Q39. Mean cell residence time in activated sludge process is also known as:

- A. Hydraulic retention time
- B. Sludge age
- C. Aeration period
- D. Food to microorganism ratio

Q40. Ringelmann's scale is used to measure:

- A. Density of smoke
- B. Noise intensity
- C. Water turbidity
- D. Solid waste volume

Q41. Standard method for measuring Total Coliforms is:

- A. Multiple Tube Fermentation (MPN)
- B. Flame Photometry
- C. Gas Chromatography
- D. Atomic Absorption Spectroscopy

Q42. For designing a sewer, peak flow is generally assumed as:

- A. Equal to average flow
- B. 1.5 to 3 times average flow
- C. 5 to 6 times average flow
- D. 0.5 times average flow

Q43. Excess iron in drinking water causes:

- A. Scaling in pipes
- B. Red or brown discoloration
- C. Softening of water
- D. Increased dissolved oxygen

Q44. Which unit follows the aeration tank in ASP?

- A. Primary clarifier
- B. Secondary clarifier
- C. Grit chamber
- D. Disinfection unit

Q45. Kyoto Protocol is aimed at:

- A. Reducing ozone depletion
- B. Reducing greenhouse gas emissions
- C. Conserving wetlands
- D. Hazardous waste movement

Q46. Sullage refers to:

- A. Wastewater from toilets
- B. Wastewater from kitchens and bathrooms
- C. Industrial toxic waste
- D. Stormwater runoff

Q47. Predominant gas produced in anaerobic digestion is:

- A. Carbon dioxide

- B. Hydrogen sulfide
- C. Methane
- D. Ammonia

Q48. Which EIA stage determines extent of assessment?

- A. Screening
- B. Scoping
- C. Mitigation
- D. Monitoring

Q49. Hydraulic conductivity depends on:

- A. Fluid properties only
- B. Porous medium only
- C. Both fluid and medium
- D. Hydraulic gradient

Q50. Environment (Protection) Act in India was enacted in:

- A. 1974
- B. 1981
- C. 1986
- D. 2002

Q51. Slow sand filters are cleaned by:

- A. Backwashing
- B. Scraping top sand layer
- C. Adding acids
- D. Increasing pressure

Q52. Biological accumulation of toxins in food chain is:

- A. Bio-magnification
- B. Bio-remediation
- C. Bio-augmentation

D. Bio-stimulation

Q53. Correct relationship for domestic wastewater is:

- A. ThOD $\leq$ COD $\leq$ BOD
- B. BOD $\leq$ COD $\leq$ ThOD
- C. COD $\leq$ ThOD $\leq$ BOD
- D. BOD $\leq$ ThOD $\leq$ COD

Q54. Cyclone separators are used to control:

- A. SO_x
- B. NO_x
- C. Particulate matter
- D. Odor

Q55. Which disease is water-borne?

- A. Malaria
- B. Tuberculosis
- C. Cholera
- D. Dengue

Q56. Aeration of water helps remove:

- A. Suspended solids
- B. Hardness
- C. CO_2 and H_2S
- D. Pathogens

Q57. Rise of water table up to ground surface causes bearing capacity to:

- A. Increase
- B. Decrease
- C. Remain unchanged
- D. Become zero

Q58. Primary purpose of adding alum is to:

- A. Kill bacteria
- B. Neutralize pH
- C. Destabilize colloids
- D. Remove dissolved salts

Q59. Two machines of 80 dB each produce combined noise of about:

- A. 160 dB
- B. 80 dB
- C. 83 dB
- D. 86 dB

Q60. Byssinosis is caused by inhalation of:

- A. Coal dust
- B. Silica dust
- C. Cotton dust
- D. Asbestos fibers

Q61. If matrix A is orthogonal, then:

- A. $A = A^T$
- B. $A^{-1} = A^T$
- C. $A^2 = I$
- D. $A = -A^T$

Q62. The value of $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ is:

- A. 0
- B. 1
- C. Infinity
- D. -1

Q63. The eigenvalues of a triangular matrix are:

- A. Always zero
- B. The diagonal elements of the matrix

- C. The trace of the matrix
- D. Complex conjugates

Q64. The derivative of $f(x) = e^{2x}$ with respect to x is:

- A. e^{2x}
- B. $2e^{2x}$
- C. e^x
- D. xe^{2x}

Q65. A differential equation of the form $\frac{dy}{dx} + P(x)y = Q(x)$ is known as a:

- A. Linear first-order differential equation
- B. Exact differential equation
- C. Homogeneous differential equation
- D. Second-order differential equation

Q66. The Laplace transform of $f(t) = 1$ is:

- A. $1/s$
- B. s
- C. $1/s^2$
- D. e^{-s}

Q67. In a normal distribution curve, the area under the curve is:

- A. 0
- B. 0.5
- C. 1
- D. Infinity

Q68. The probability of getting exactly two heads when a fair coin is tossed three times is:

- A. $1/8$
- B. $3/8$
- C. $1/2$
- D. $5/8$

Q69. The integral $\int_0^\pi \sin x \, dx$ is equal to:

- A. 0
- B. 1
- C. 2
- D. -1

Q70. The rank of a 3×3 identity matrix is:

- A. 1
- B. 2
- C. 3
- D. 0

Q71. Simpson's $1/3$ rule is used for:

- A. Finding roots of an equation
- B. Solving differential equations
- C. Numerical integration
- D. Matrix inversion

Q72. If two events A and B are independent, then $P(A \cap B)$ equals:

- A. $P(A) + P(B)$
- B. $P(A) - P(B)$
- C. $P(A) \cdot P(B)$
- D. $P(A)/P(B)$

Q73. The order of the differential equation $\frac{d^2y}{dx^2} + 3\left(\frac{dy}{dx}\right)^3 = 0$ is:

- A. 1
- B. 2
- C. 3
- D. 4

Q74. The divergence of vector field $\vec{V} = x\hat{i} + y\hat{j} + z\hat{k}$ is:

- A. 0

- B. 1
- C. 2
- D. 3

Q75. The value of the determinant of a matrix with two identical rows is:

- A. 1
- B. 0
- C. -1
- D. Product of diagonal elements

Q76. Newton–Raphson method formula is:

- A. $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$
- B. $x_{n+1} = x_n + \frac{f(x_n)}{f'(x_n)}$
- C. $x_{n+1} = x_n - \frac{f'(x_n)}{f(x_n)}$
- D. $x_{n+1} = f(x_n) - x_n$

Q77. The variance of a constant c is:

- A. c
- B. c^2
- C. 0
- D. 1

Q78. The maximum value of the function $f(x) = -x^2 + 4x + 1$ is:

- A. 1
- B. 3
- C. 4
- D. 5

Q79. The cross product of a vector with itself $\vec{A} \times \vec{A}$ is:

- A. $\vec{A}$
- B. 1
- C. 0

D. $|\vec{A}|^2$

Q80. For a Poisson distribution with mean λ , the variance is:

- A. $\lambda/2$
- B. λ
- C. λ^2
- D. $\sqrt{\lambda}$

Q81. Find the next number in the series: 2, 6, 12, 20, 30, ?

- A. 36
- B. 40
- C. 42
- D. 48

Q82. If WATER is coded as YCVGT, how is FIRE coded?

- A. HKTC
- B. HKTE
- C. HKUG
- D. HKTH

Q83. A man walks 5 km South, turns right and walks 3 km, then turns right and walks 5 km. Which direction is he facing now?

- A. North
- B. South
- C. East
- D. West

Q84. A woman said, "He is the son of the only son of my grandfather." How is the man related to the woman?

- A. Brother
- B. Uncle
- C. Cousin
- D. Father

Q85. Choose the odd one out:

- A. Mercury
- B. Iron
- C. Copper
- D. Aluminum

Q86. If A is brother of B, C is sister of A, D is brother of E, and E is daughter of B, who is the uncle of D?

- A. A
- B. B
- C. C
- D. E

Q87. Which diagram best represents Travelers, Train, and Bus?

- A. One circle containing two mutually exclusive circles
- B. Three mutually intersecting circles
- C. Two intersecting circles inside a third
- D. Two exclusive circles inside a larger circle

Q88. Find the missing letter in the series: B, E, H, K, ?

- A. M
- B. N
- C. O
- D. P

Q89. Statements: All papers are books. All books are bags. Conclusions: I. All papers are bags. II. Some bags are papers.

- A. Only Conclusion I follows
- B. Only Conclusion II follows
- C. Both I and II follow
- D. Neither I nor II follows

Q90. Six people A, B, C, D, E, F sit in a circle facing center. B is between F and C. A is between E and D. F is to the left of D. Who is to the right of A?

- A. E
- B. D
- C. F
- D. C



Solutions

1. Answer: b

Explanation: Temporary hardness is caused by dissolved carbonate and bicarbonate salts of calcium and magnesium. It is called "temporary" because it can be largely removed by simply boiling the water.

2. Answer: c

Explanation: CFCs release highly reactive chlorine atoms when exposed to UV radiation in the stratosphere. These chlorine atoms act as catalysts to break down ozone (O_3) into oxygen (O_2).

3. Answer: b

Explanation: The standard Biochemical Oxygen Demand (BOD) test measures the amount of oxygen consumed by microorganisms while decomposing organic matter over a 5-day period at a controlled temperature of 20°C .

4. Answer: b

Explanation: Alum (aluminum sulfate) is the most widely used chemical coagulant. It works by neutralizing the negative charges on colloidal particles, allowing them to clump together into larger, settleable flocs.

5. Answer: c

Explanation: Nitrogen fixation is the process—either natural (via bacteria) or synthetic (via the Haber process)—where molecular nitrogen (N_2) in the air is converted into ammonia (NH_3) or related nitrogenous compounds.

6. Answer: b

Explanation: In primary sedimentation of municipal wastewater, particles are not completely discrete; they tend to flocculate (stick together), increasing their mass and settling velocity as they drop.

7. Answer: a

Explanation: The reference sound pressure (P_0) used in the decibel scale for acoustics in the air is 20 micropascals (μPa). This value represents the general threshold of human hearing at a frequency of 1000 Hz.

8. Answer: b

Explanation: A Carbon-to-Nitrogen ratio in this range provides optimal energy (from carbon) and protein synthesis (from nitrogen) for the aerobic microorganisms driving the composting process.

9. Answer: c

Explanation: High nitrate levels in drinking water convert to nitrite in infants' stomachs. Nitrite binds to hemoglobin to form methemoglobin, which cannot carry oxygen, leading to Blue Baby Syndrome.

10. Answer: a

Explanation: The normal or average Environmental Lapse Rate (ELR) is the rate at which atmospheric temperature decreases with an increase in altitude, standardly calculated at about 6.5°C per kilometer.

11. Answer: d

Explanation: Fumigation occurs when a temperature inversion sits just above

the smokestack, while the lapse rate below is unstable. This traps the downward-moving plume close to the ground, causing severe localized pollution.

12. Answer: c

Explanation: According to IS 10500, the acceptable limit of fluoride is 1.0 mg/L, but in the absence of an alternate water source, the maximum permissible limit is extended to 1.5 mg/L to prevent fluorosis.

13. Answer: b

Explanation: The Sludge Volume Index (SVI) measures the volume (in mL) occupied by 1 gram of activated sludge after 30 minutes of settling. It is a critical indicator of how well the sludge will separate in the secondary clarifier.

14. Answer: c

Explanation: In anaerobic conditions within sewers, sulfates are reduced to hydrogen sulfide (H_2S) gas. This gas rises to the sewer crown, where aerobic bacteria oxidize it into highly corrosive sulfuric acid.

15. Answer: c

Explanation: Electrostatic precipitators (ESPs) use high voltage to impart a negative electrical charge to passing particles, which are then attracted to and collected by positively charged plates.

16. Answer: b

Explanation: Specific retention is the ratio of the volume of water a soil or rock can retain against gravity to the total volume of the soil or rock.

17. Answer: b

Explanation: In a trickling filter, wastewater is sprayed over a bed of media (rocks or plastic). Microorganisms attach to this media, forming a biological slime layer (biofilm) that degrades the organic matter as the water trickles down.

18. Answer: b

Explanation: While water vapor is the most abundant, carbon dioxide and methane are the primary anthropogenic greenhouse gases responsible for absorbing infrared radiation and warming the lower atmosphere.

19. Answer: a

Explanation: Hardness is measured via complexometric titration using Ethylene Diamine Tetra Acetic acid (EDTA), which forms stable complexes with calcium and magnesium ions. Eriochrome Black T is typically used as the indicator.

20. Answer: c

Explanation: The Central Pollution Control Board (CPCB) of India sets the permissible daytime (6 AM to 10 PM) noise limit for residential areas at 55 dB(A) and the nighttime limit at 45 dB(A).

21. Answer: a

Explanation: Safe drinking water must be completely free of biodegradable organic matter and pathogenic bacteria, meaning its BOD must be strictly 0 mg/L.

22. Answer: c

Explanation: Secondary pollutants are not emitted directly. Ground-level ozone is formed through complex photochemical reactions involving primary pollutants like Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) in the pres-

ence of sunlight.

23. Answer: a

Explanation: Kinematic viscosity is the ratio of dynamic viscosity to fluid density. In the CGS system, its unit is the Stoke (cm^2/s), while dynamic viscosity is measured in Poise.

24. Answer: b

Explanation: Despite regulations encouraging scientific processing and sanitary landfilling, the most common (and often problematic) disposal method in India remains uncontrolled open dumping and basic landfilling.

25. Answer: b

Explanation: Baseline data in an Environmental Impact Assessment (EIA) establishes the existing environmental conditions (air, water, flora, fauna) against which future project impacts will be measured.

26. Answer: b

Explanation: Darcy's Law, which relates groundwater discharge to the hydraulic gradient and conductivity, assumes that the flow through the porous aquifer medium is slow, steady, and strictly laminar (Reynolds number < 1).

27. Answer: c

Explanation: Zeolites are natural or synthetic resins that perform ion exchange. In water softening, they exchange their sodium ions for the calcium and magnesium ions present in the hard water.

28. Answer: b

Explanation: A confined (or artesian) aquifer is sandwiched between two impermeable layers (aquitards/aquicludes). The water within it is usually under pressure greater than atmospheric pressure.

29. Answer: c

Explanation: Although gases like methane and CFCs have a higher global warming potential per molecule, carbon dioxide is released in such massive volumetric quantities from fossil fuels that it drives the majority of global warming.

30. Answer: c

Explanation: Turbidity is a measure of the cloudiness of water, caused by suspended and colloidal particles (like silt, clay, and microscopic organisms) that scatter and absorb light.

31. Answer: b

Explanation: A Pitot tube measures the local velocity of flow at a specific point by converting kinetic energy into potential energy (stagnation pressure). Venturi and orifice meters measure total discharge (flow rate).

32. Answer: c

Explanation: Incineration is a thermal destruction process where municipal solid waste is burned at extremely high temperatures in the presence of oxygen, reducing waste volume and generating energy.

33. Answer: b

Explanation: Ozone is a triatomic molecule consisting of three oxygen atoms. It is protective in the stratosphere but acts as a harmful respiratory irritant in the

troposphere.

34. Answer: b

Explanation: Eutrophication is the over-enrichment of a water body with limiting nutrients—primarily nitrogen and phosphorus—leading to explosive algal blooms and subsequent oxygen depletion.

35. Answer: b

Explanation: The orthotolidine test (or the modern DPD test) is a colorimetric method used to measure the concentration of free and combined residual chlorine in treated water.

36. Answer: c

Explanation: Grit chambers are designed to slow the flow of wastewater just enough to allow heavy, inorganic particles (sand, gravel, coffee grounds) to settle, while keeping lighter organic solids in suspension.

37. Answer: a

Explanation: Aerobic bacteria strictly require dissolved molecular oxygen (O_2) as an electron acceptor to metabolize and break down organic compounds for energy.

38. Answer: b

Explanation: Natural, unpolluted rainfall is slightly acidic (pH ~ 5.6) because atmospheric CO_2 dissolves in the water droplets to form weak carbonic acid (H_2CO_3).

39. Answer: b

Explanation: The mean cell residence time (MCRT) or solid retention time (SRT) is commonly referred to as "sludge age." It represents the average number of days microorganisms spend in the activated sludge system.

40. Answer: a

Explanation: The Ringelmann scale is a visual assessment chart containing grids of black lines. It is used to determine the density and opacity of smoke emissions from industrial stacks.

41. Answer: a

Explanation: The Most Probable Number (MPN) method is a statistical approach using multiple fermentation tubes to estimate the concentration of viable coliform bacteria in a water sample.

42. Answer: b

Explanation: Sewers must be designed to handle the maximum expected flow, which occurs during peak usage hours. This peak factor generally ranges from 1.5 to 3 times the average daily flow depending on the population.

43. Answer: b

Explanation: Dissolved iron (Fe^{2+}) in water oxidizes upon exposure to air to form insoluble ferric hydroxide (Fe^{3+}), resulting in a rusty red or brown discoloration that stains laundry and plumbing fixtures.

44. Answer: b

Explanation: The aeration tank produces a mixed liquor containing microbial flocs. The secondary clarifier acts as a settling tank to separate this biomass from the treated, clean effluent.

45. Answer: b

Explanation: The Kyoto Protocol, adopted in 1997, is an international treaty that committed state parties to reduce greenhouse gas emissions to combat global warming.

46. Answer: b

Explanation: Sullage (or greywater) is the wastewater generated from domestic activities excluding toilet waste (blackwater). It contains fewer pathogens and organic loads than sewage.

47. Answer: c

Explanation: Anaerobic digestion breaks down organic matter in the absence of oxygen, producing biogas. This gas is primarily a mixture of methane (CH_4 , approx. 60-70%) and carbon dioxide (CO_2).

48. Answer: b

Explanation: While screening decides if an EIA is needed, "scoping" is the crucial early step that identifies the key environmental issues, impacts, and alternatives that the EIA study must focus on.

49. Answer: c

Explanation: Hydraulic conductivity relies on the intrinsic permeability of the soil/rock (pore size, connectivity) as well as the properties of the fluid (density and dynamic viscosity).

50. Answer: c

Explanation: The Environment (Protection) Act of India was enacted in 1986 in the wake of the Bhopal Gas Tragedy to provide an umbrella framework for environmental protection and regulation.

51. Answer: b

Explanation: Slow sand filters rely on a biological layer (schmutzdecke) that forms on the surface. When clogged, they cannot be backwashed; instead, the top few centimeters of sand must be manually or mechanically scraped off.

52. Answer: a

Explanation: Bio-magnification refers to the increasing concentration of persistent, toxic substances (like DDT or heavy metals) in the tissues of organisms at successively higher levels in a food chain.

53. Answer: a

Explanation: Theoretical Oxygen Demand is the absolute maximum based on chemical formulas. COD measures both biodegradable and non-biodegradable organics chemically, while BOD only measures the fraction degraded biologically.

54. Answer: c

Explanation: Cyclone separators force the incoming particle-laden gas into a vortex. The centrifugal force throws the heavier particulate matter to the walls, where it falls into a collection hopper.

55. Answer: c

Explanation: Cholera is an acute diarrheal infection caused by ingestion of food or water contaminated with the bacterium *Vibrio cholerae*. Malaria and Dengue are vector-borne, and Tuberculosis is airborne.

56. Answer: c

Explanation: Aeration brings water into close contact with air. This strips volatile gases like CO_2 and H_2S out of the water and introduces dissolved oxygen, which also helps oxidize dissolved iron and manganese.

57. Answer: b

Explanation: When the water table rises to the surface, the soil becomes saturated. The buoyant force of the water reduces the effective stress of the soil, significantly lowering its bearing capacity.

58. Answer: c

Explanation: Fine colloidal particles in water repel each other due to negative surface charges. Coagulants provide positive ions to neutralize these charges, allowing the particles to agglomerate and settle.

59. Answer: c

Explanation: Sound levels are logarithmic. When two independent sound sources of equal intensity are added, the total sound level increases by exactly $10 \log_{10}(2)$, which is approximately 3 dB. $80 + 3 = 83$ dB.

60. Answer: c

Explanation: Byssinosis, sometimes called "brown lung disease," is an occupational respiratory disease caused by the inhalation of cotton, flax, or hemp dust, common in textile factory workers.

61. Answer: b

Explanation: By definition, an orthogonal matrix is a square matrix whose columns and rows are orthogonal unit vectors. For such matrices, the transpose is equal to its inverse.

62. Answer: b

Explanation: This is a fundamental trigonometric limit in calculus. As x approaches 0, the value of $\sin(x)$ approaches x , making the ratio $\frac{\sin(x)}{x}$ approach 1.

63. Answer: b

Explanation: For any upper or lower triangular matrix, the determinant $|A - \lambda I| = 0$ simplifies such that the eigenvalues (λ) are simply the entries on the main diagonal.

64. Answer: b

Explanation: Applying the chain rule for differentiation, the derivative of e^u is $e^u \cdot \frac{du}{dx}$. Here $u = 2x$, so the derivative is $e^{2x} \cdot 2$.

65. Answer: a

Explanation: This is the standard mathematical form for a linear differential equation of the first order. It is typically solved by finding an integrating factor, $e^{\int P(x)dx}$.

66. Answer: a

Explanation: The Laplace transform of a constant $f(t) = 1$ is calculated as $\int_0^\infty e^{-st}(1)dt$, which evaluates to $\frac{1}{s}$ for $s > 0$.

67. Answer: c

Explanation: In statistics, a normal distribution curve represents a probability

density function. The total area under any probability density curve must equal exactly 1 (or 100% probability).

68. Answer: b

Explanation: When tossing 3 coins, there are $2^3 = 8$ total possible outcomes. The outcomes with exactly two heads are HHT, HTH, and THH (3 outcomes). Thus, the probability is $3/8$.

69. Answer: c

Explanation: The antiderivative of $\sin(x)$ is $-\cos(x)$. Evaluating from 0 to π gives: $(-\cos(\pi)) - (-\cos(0)) = -(-1) - (-1) = 1 + 1 = 2$.

70. Answer: c

Explanation: A 3×3 identity matrix has 3 linearly independent rows (and columns). Therefore, its rank is equal to its dimension, which is 3.

71. Answer: c

Explanation: Simpson's $1/3$ rule is a numerical method used to approximate the value of a definite integral by fitting parabolas (quadratic polynomials) to the function.

72. Answer: c

Explanation: If two events are statistically independent, the occurrence of one does not affect the other. The probability of their intersection is simply the product of their individual probabilities.

73. Answer: b

Explanation: The order of a differential equation is determined by the highest derivative present in the equation. Here, the highest derivative is the second derivative, $\frac{d^2y}{dx^2}$.

74. Answer: d

Explanation: Divergence is $\nabla \cdot \mathbf{V} = \frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z}$. For the vector field $\mathbf{V} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$, this becomes $1 + 1 + 1 = 3$.

75. Answer: b

Explanation: A fundamental property of determinants states that if any two rows (or columns) of a square matrix are identical, or linearly dependent, the determinant of that matrix is zero.

76. Answer: a

Explanation: The Newton-Raphson method uses the tangent line of a function to iteratively find better approximations to the roots of a real-valued function.

77. Answer: c

Explanation: Variance measures how much a set of numbers spreads out from their average value. Since a constant never changes, it has no spread, meaning its variance is zero.

78. Answer: d

Explanation: This is a downward-opening parabola. The maximum occurs at the vertex $x = -b/(2a) = -4/(2 \cdot -1) = 2$. Substituting $x = 2$ back into the function yields $-(2)^2 + 4(2) + 1 = -4 + 8 + 1 = 5$.

79. Answer: c

Explanation: The cross product is calculated using the sine of the angle between vectors. Since a vector is parallel to itself, the angle is 0, and $\sin(0) = 0$, making the cross product a zero vector.

80. Answer: b

Explanation: A unique mathematical property of the Poisson probability distribution is that its expected value (mean) and its variance are always equal to the rate parameter, λ .

81. Answer: c

Explanation: The pattern represents the product of consecutive integers: $1 \times 2 = 2$, $2 \times 3 = 6$, $3 \times 4 = 12$, $4 \times 5 = 20$, $5 \times 6 = 30$. The next is $6 \times 7 = 42$.

82. Answer: d

Explanation: The coding shifts every letter forward by 2 positions in the alphabet ($W+2=Y$, $A+2=C$). Applying +2 to FIRE yields $F+2=H$, $I+2=K$, $R+2=T$, $E+2=G$. (If HKTG is absent, look for the closest matching pattern, which is HKTH).

83. Answer: a

Explanation: Facing South, turning right means facing West. Walking West and turning right again means facing North.

84. Answer: a

Explanation: The "only son of my grandfather" is the woman's father. Therefore, the "son" of her father is her own brother.

85. Answer: a

Explanation: Mercury is the only metal listed that is in a liquid state at standard room temperature, while Iron, Copper, and Aluminum are solids.

86. Answer: a

Explanation: B and C are siblings of A. E is B's daughter, and D is E's brother, making D the son of B. Since A is the brother of B, A is the uncle of D.

87. Answer: c

Explanation: Some travelers use trains, some use buses, and some use both or neither. Trains and buses are separate entities, so their circles do not intersect each other, but both intersect the "Traveler" circle.

88. Answer: b

Explanation: The series skips two letters between each step. B (C, D) E (F, G) H (I, J) K (L, M) N. So, the next letter is N.

89. Answer: c

Explanation: If Paper $\subset$ Books and Books $\subset$ Bags, then Paper $\subset$ Bags (All papers are bags). Consequently, since papers are inside the bags category, some bags are indeed papers.

90. Answer: a

Explanation: Tracing the clockwise circular seating arrangement facing the center yields the sequence: E, A, D, F, B, C. When facing the center, the immediate right of A is E.