

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2025

Marks Scored:

Level : B.Sc.

Year : III

Exam Roll No. :

Time: 30 mins.

Course : ENVS 302

Semester : II

F. M. : 20

Date :

03 MAR 2025

Registration No.:

SECTION "A"

[16 Q. × 0.5 = 8 marks]

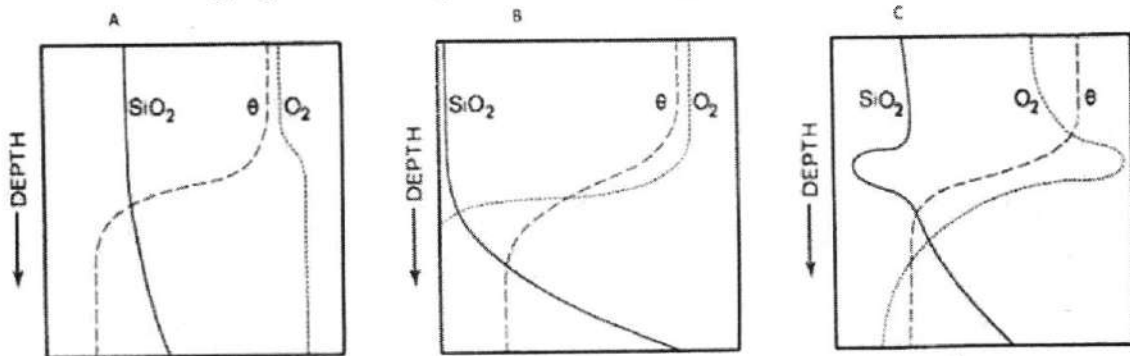
Choose and mark [X] in the most appropriate answers from the given choices.

1. Lake/ocean depth can be measured by a/an
[] Secchi disk [] Planimeter [] Luxmeter [] Echo-sounder
2. Excessive sulphate loading in aquatic ecosystems result into
[] eutrophication of water bodies [] sedimentation in water bodies
[] stratification of water bodies [] acidification of water bodies
3. Which of the following is known to undergo "cold condensation" in high latitude and high-altitude regions?
[] GHGs [] POPs [] β rays [] γ rays
4. A stream with high level of suspended material sustains
[] scraper communities [] filter-feeder communities
[] predator communities [] grazer communities.
5. Which of the following is used to collect lake bottom sediment?
[] Van Dorn sampler [] Ekman grab
[] HDPE bottles [] Surber sampler
6. Heptageniid nymphs are adapted to water bodies with high currents. Therefore, these organisms are called
[] cryophilic organisms [] halophilic organisms
[] rheophilic organisms [] barophilic organisms
7. Low Secchi depth values in glacial lakes is attributed to
[] excessive planktonic growth [] large amounts of glacial flour
[] large amounts of allochthonous inputs [] large amounts of autochthonous inputs
8. Reconstruction of past environmental conditions of watershed using sediment cores involves
[] Bioassessment [] Palaeolimnology
[] Ecotoxicology [] Limnology
9. Hydrothermal vents are characterized by
[] high temperature and high pH values [] high temperature and low pH values
[] low temperature and low pH values [] low temperature and high pH values

24. _____ is the longest distance an air mass can travel along the lake to physically move and mix water.
25. The shoreline development is calculated using the formula _____.
26. The most common form of Fe in natural waters is _____.

SECTION "C"
[7 marks]

Look at the following figures carefully and answer the questions:



27. What is θ and what information do you infer from θ ? [0.5+0.5=1]
28. Explain the DO profiles and the reasons for difference in DO profiles of each lake. [1+1+1=3]
29. Explain the SiO_2 profiles and the reason(s) for difference in SiO_2 profiles in each lake [1+1+1=3]

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SECTION "D"
[3Q. × 7 = 21 marks]

Attempt *ALL* questions.

1. Define bioindicators. Explain how bioindicators are used in stream monitoring. Add a note on the advantages and disadvantages of using bioindicators. [1+4+2=7]
2. List the major cations and anions found in freshwaters. Give an account of the importance of the major ions in water quality with appropriate examples [1+6=7]
3. Briefly describe the salient features of deep seas. Add a note on the adaptations of deep sea organisms citing appropriate examples. [3+4=7]

SECTION "E"

4. Differentiate between: [4Q × 2=8]
 - a. El Niño and La Niña
 - b. Thermocline and nutricline
 - c. Conservative and semi-conservative ions
 - d. Autotrophs and heterotrophs
5. Give an account of: [4Q × 4=16]
 - a. River damming and diversions in Nepal
 - b. Osmoregulation in fishes
 - c. High altitude limnology in Nepal
 - d. Microbial loop
6. Give reasons for the following statements: [5Q × 2=10]
 - a. Global warming has implications on coral reef survival.
 - b. Rapid drinking water quality assessments entail microbiological assessments.
 - c. H₂O₂ digestion is performed during diatom sample processing.
 - d. High mountain water bodies are naturally fishless.
 - e. Macroinvertebrate diversity is higher in water quality class II.

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SECTION "A"

[20 Q. × 1 = 20 marks]

Choose and encircle the most appropriate option from each set of choices

- Air Pollution contains _____.
a. a single type of pollution problem
b. only health problems
c. a family of related problems
d. a set of discrete problems
- We can solve our air pollution problem by _____.
a. pumping away the pollutants
b. making strict laws
c. reducing emissions
d. burning away the pollutant sources
- Industrial hygienist is mostly interested in _____.
a. primary emissions
b. secondary emissions
c. global pollutant transport
d. multimedia pollutant transport
- Dose response curve is plotted for _____.
a. individual pollutants
b. a group of homogenous pollutants
c. only primary pollutants
d. Only secondary pollutants
- Which philosophy says that there is some maximum possible degree of emission control?
a. Emission taxes
b. Air quality standard
c. Cost benefit standard
d. Emission Standard
- A square city of 35 km has emission of 0.9×10^{-5} g/m²s with mixing height is 20 m and wind speed of clean air is 1.8 m/s. The pollutant concentration, if there was no pollutant in the air initially using the fixed box model is _____.
a. 8.75 µg/m³
b. 8750 µg/m³
c. 25 µg/m³
d. 390 µg/m³
- What is the relation between the settling velocity of a particle and the drag force?
a. $3 \pi \mu r D v$
b. $2 \pi \mu r D v$
c. $3 \pi \mu D v$
d. $4/3 \pi \mu r v$
- What is the terminal settling velocity of a sphere in air with diameter 100µm if viscosity is 1.8×10^{-5} kg/m.s and density of the spherical particle is 2000 kg/m³?
a. 6.5 cm/s
b. 0.0065 cm/s
c. 0.32 cm/s
d. 0.65 cm/s
- The efficiency of a cyclone separator can be increased by:
a. Increasing the particle size
b. increasing the inlet gas velocity
c. Reducing the particle size
d. decreasing the temperature of the gas
- If the block flow efficiency of the gravity settler is 3.03×10^{-4} . The mixed flow efficiency is _____.
a. 0.999
b. 3.029×10^{-4}
c. 1
d. 0.5

11. What is the "cut diameter" in the context of air pollution control devices?
 - a. The largest particle size that cannot be collected by a device.
 - b. The smallest particle size that can be collected with 100% efficiency.
 - c. The particle size that has a 50% chance of being collected by the device.
 - d. The average particle size in the gas stream after treatment.

12. A shake deflate is a type of _____.
 - a. Surface filter
 - b. Scrubber
 - c. ESP
 - d. Bag-house

13. Which of the following statements is TRUE regarding the operation of counter flow scrubbers?
 - a. The gas and liquid move in the same direction to maximize contact time.
 - b. Counter flow scrubbers are used primarily for particulate removal.
 - c. In counter flow scrubbers, gas flows horizontally while liquid flows vertically.
 - d. Counter flow scrubbers are more efficient than cross flow scrubbers for gas absorption due to the concentration gradient.

14. The floating roof tanks are used for
 - a. fluids with high vapor pressure
 - b. fluids with low vapor pressure
 - c. corrosive fluids
 - d. toxic fluids

15. Which of the following air pollution control technologies is commonly used to reduce sulfur dioxide emissions from power plants?
 - a. ESP
 - b. Scrubbers
 - c. Catalytic converter
 - d. Wetland filtration

16. Which of the following is NOT among three plausible arrangements for SO_x removal from lean waste gas?
 - a. Bubbler
 - b. Intercoolers
 - c. Spray chamber
 - d. Packed column

17. Which of the following pollutants is found in most houses as a result of seepage from the underlying soil?
 - a. Ozone
 - b. CO
 - c. Lead
 - d. Radon

18. An ambulance siren causes a sound pressure of 200 μbar. The Sound Pressure Level (SPL) of the siren is _____ dB.
 - a. 120
 - b. 60
 - c. 74
 - d. 200

19. Masking effect of sound is observed when combination of two sounds has _____.
 - a. SPL is independent to masking effect
 - b. The difference in SPL value is zero.
 - c. The difference in SPL value ranges in between 0 to 15
 - d. The difference in SPL value is greater than 15

20. The unit of sound intensity is _____.
 - a. W/m²
 - b. decibels (dB)
 - c. Pa
 - d. Hertz (Hz)

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SECTION "B"

Attempt ALL questions. Abbreviations have usual meaning. The data and information not given in the questions should be assumed properly.

1. Provide brief answer of the following. [5×2 = 10]
- What are the key objectives of air pollution control engineering?
 - What is the use of NAAQS?
 - Explain the concept of hydraulic analogy in dose response.
 - How does air pollution affect the visibility in the atmosphere?
 - Discuss the factors that influence the efficiency of pollutant transport in the atmosphere.

2. In the source testing, the stack was divided in four sectors and the following measurements were observed.

Sector	Velocity, v (m/s)	Concentration, c (mg/m ³)	Area, A (m ²)
1	10	500	1
2	12	600	1
3	14	650	2
4	15	675	2

Estimate the average pollutants concentration of the gas flowing in stack. [4]

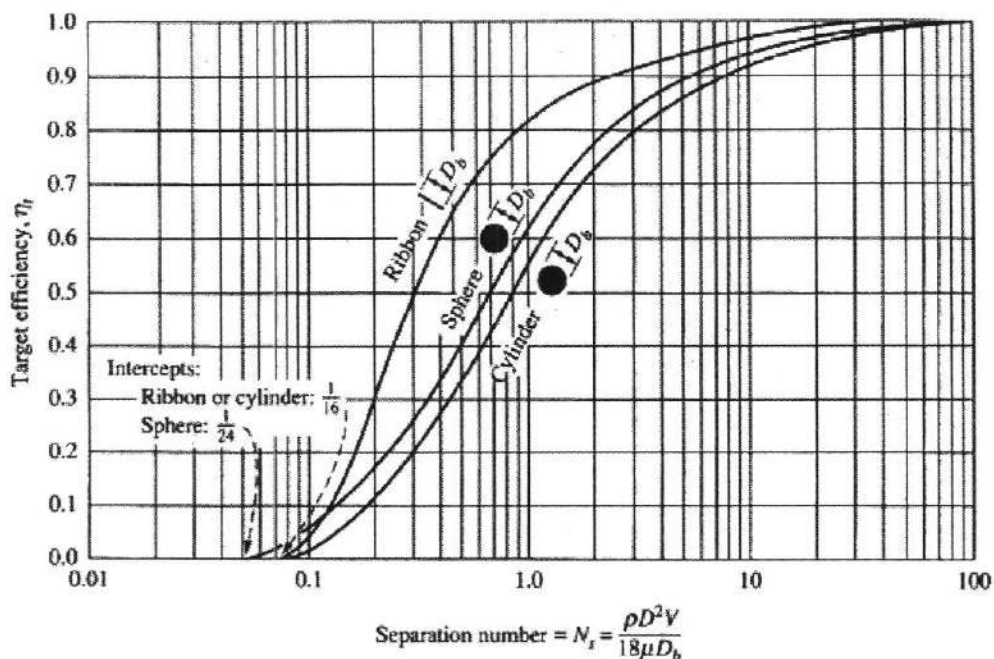
3. What are the meanings of the "cleanest possible" air philosophy and the "best technology" approach to air pollution control? Explain with real world examples. [4]
4. Explain the way to obtain suitable and representative air sample using any air quality monitoring device. Why isokinetic sampling is important for particulates? [4]
5. For the condition $y = 0$ and $z = 0$, Gaussian plume equation is modified to ground level conditions as following.

$$C_{\max} = \frac{Q}{\pi \sigma_z \sigma_y u} e^{-1/2 \frac{H^2}{\sigma_z^2}}$$

Compute the concentration C_{\max} when Q is 200 g/s at wind velocity 6 m/s and effective stack height of 50 m and distance downwind is 0.5 km for C stability. (use the curve provided with the question for missing data) [3]

P.T.O.

6. A polluted gas stream contains particles of four sizes (A, B, C, and D) in equal weight proportions. The first collector used for treatment has the following collection efficiencies: 90% for particle size A, 80% for particle size B, 60% for particle size C, 40% for particle size D. [4]
- Calculate the overall collection efficiency of the first collector.
 - If a second identical collector is added in series, determine the overall efficiency of the two collectors combined for the gas stream.
7. In an experiment, a spherical particle with diameter $0.3\mu\text{m}$ is falling in air. [6]
- How fast would it be falling if stoke's law were correct for this particle?
 - How fast would it be falling if Cunningham correction factor is applicable for this particle? (Take $A=1.728$, $\lambda=0.07\mu\text{m}$ and Viscosity of fluid $1.8\times 10^{-5}\text{ kg/m.s}$)
8. A single, cylindrical fiber having diameter of $10\mu\text{m}$ is placed perpendicular to a gas stream that is moving 1 m/s . The gas stream contains particles that are $1\mu\text{m}$ in diameter and the particle concentration is 1 mg/m^3 . What is the rate of collection of particles on the fiber? [5]



9. What are displacement and breathing losses for gasoline? How VOCs are recovered while loading and unloading truck containing gasoline? [5]
10. Smelting of metal sulfide ores generally releases SO_2 . Describe the method to convert them to sulfuric acid in a typical processing plant. [4]

11. What are thermal, prompt and Fuel NO_x . Describe the process of combustion modification to control Nitrogen Oxides. [6]

