

INDIAN INSTITUTE OF TECHNOLOGY PATNA
CE 102: Environmental Studies
Final Examination 2015-16 II: CSE + ME

Maximum Time: 120 Minutes

Maximum Marks: 40

Instructions

- Make suitable assumptions wherever necessary.
- Numbers in the parenthesis at the end of each question indicate Maximum Marks.
- Use of notes/reference materials is not permitted.
- Use of mobile phone is not permitted. Sharing of calculator is not permitted.
- Write your name and roll number on the question paper in the space below before proceeding further. *Do not forget to submit question paper along with answer book.*

Name: _____

Roll No: _____

Questions

(12)

1. Briefly answer any five of the following questions:

(5 × 02)

- (i) Differentiate qualitatively between surface water and ground water based on following characteristics: (a) turbidity, (b) hardness, (c) total dissolved solids, and (d) dissolved oxygen.
- (ii) Differentiate between conventional sanitation system and ecological sanitation (EcoSan) system in terms of: (a) fresh water requirement, (b) flow of materials including nutrients, (c) degree of pollution, and (d) sustainability.
- (iii) Why color as water quality parameter is measured on Pt-Co scale? Is Pt-Co scale applicable for color measurement of industrial effluent? Justify your answer.
- (iv) Drawing representative diagrams, differentiate between nephelometry and turbidimetry principles of turbidity measurement.
- (v) Assuming theoretical oxygen demand (ThOD) is equivalent and synonymous with chemical oxygen demand (COD), estimate COD of 100 mg/L solution of urea $[\text{CO}(\text{NH}_2)_2]$. Justify your estimate.
- (vi) Explain briefly ignitability and corrosivity properties of hazardous waste with examples.

2. (a) Briefly define/explain following terms: (i) sustainable development, (ii) eutrophication, (iii) food chain, (iv) food web, and (v) e-waste.
(b) Briefly explain how food chain and food web will be affected if e-waste is not properly managed.

(05 + 02)

3. Stating Dalton's Law of Partial Pressure and Henry's Law, estimate equilibrium dissolved oxygen concentration (in mg/L) in natural surface water free from pollution at 25°C. Assume $(K_H)_{\text{O}_2}$ in water at 25°C as 0.76 atm-m³/mol.

(03)

4. (a) Drawing schematic/block diagram, briefly describe Carbon Cycle.
(b) A sample of air analyzed at 0°C and 1 atm pressure is reported to contain 9 ppm of CO. Determine the equivalent CO concentration in micrograms per cubic meter and milligrams per cubic meter.

(03 + 02)

5. Draw a typical flow sheet of drinking water treatment plant indicating a typical sequence of unit operations as blocks that are used for the treatment of (i) surface water and (ii) ground water containing 10-20 mg/L of both iron and manganese.

(03)

6. (a) Calculate the total hardness, carbonate hardness, and non-carbonate hardness (in mg/L as CaCO_3) of water ($\text{pH} = 7$) that contains the following ion concentrations: $\text{Na}^+ = 56 \text{ mg/L}$; $\text{Ca}^{2+} = 40 \text{ mg/L}$; $\text{Mg}^{2+} = 30 \text{ mg/L}$; $\text{HCO}_3^- = 190 \text{ mg/L}$; $\text{Cl}^- = 165 \text{ mg/L}$; $\text{Al}^{3+} = 30 \text{ mg/L}$.
- (b) What are the alkalinity-causing species present in natural water? Nitrification involves biological conversion of ammonia (NH_4^+) to first nitrite (NO_2^-) and finally to nitrate (NO_3^-) as per the following complete balanced reaction: $\text{NH}_4^+ + 2\text{O}_2 \rightarrow \text{NO}_3^- + 2\text{H}^+ + \text{H}_2\text{O}$
- Justify the statement showing calculation that 'nitrification process involves consumption of alkalinity of 7.14 mg as CaCO_3 per mg of $\text{NH}_4^+\text{-N}$ '.
- (c) Assuming ThOD is equivalent and synonymous with COD, estimate COD of 100 mg/L solution of potassium hydrogen phthalate (KHP) ($\text{C}_8\text{H}_5\text{KO}_4$). (03 + 02 + 02)
7. A lake is 10 m deep, well-mixed and perfectly circular with a radius of 100 m. At the inlet 2 cubic meters of water enters every second, containing 4 mg NO_3^-/L in snowmelt from the lightning-prone slopes of mountains nearby. Every day the local fisherman remove 20 kg of nitrogen (as N) from the lake in sustainable fish catches, and according to air measurements made the lake emits 500 moles of N_2O and 1000 moles of N_2 every day. There are no other sources or sinks of N. Writing appropriate mass balance equation, calculate the concentration of NO_3^- in the water coming out of the lake. (05)

Some Useful Information:

C: 12; H: 1; O: 16; N: 14; S: 32; Na: 23; K: 39; Ca: 40; Mg: 24; Al: 27; Cl: 35.5