KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

28 JAN 2024

Marks Scored:

Level : B.E.
Year : II

Course : CHEG 210
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"
[20Q. × 0.5 = 10 marks]

Encircle the most appropriate answer

1. Which of the following is a commonly used coagulant in water treatment?
   a. Sodium hypochlorite
   b. Sodium chloride
   c. Aluminum sulfate
   d. Sodium bicarbonate

2. Which process is employed to remove dissolved salts and minerals from water?
   a. Sedimentation b. Filtration c. Reverse osmosis d. Coagulation

3. What is the primary purpose of primary treatment in wastewater treatment plants?
   a. Removing dissolved minerals
   b. Removing coarse solids and sediments
   c. Killing harmful bacteria
   d. Adjusting the pH level

4. Which type of glass is known for its ability to break into small granular chunks upon impact?
   a. Toughened b. Laminated c. Float d. Safety

5. Which of the following is an example of a secondary treatment process in wastewater treatment?
   a. Filtration
   b. Chlorination
   c. Activated sludge process
   d. Grit removal

6. If the sewage contains grease and fatty oils, these are removed in
   a. Grit chamber b. Detritus tanks c. Skimming tanks d. Sedimentation tanks

7. Which of the following is an ore of iron?
   a. Bauxite b. Hematite c. Chalcopyrite d. Galena

8. Sulphur removal by heating of pyrite ore in presence of air is called its
   a. Smelting b. Calcinations c. Roasting d. Reduction

9. Lime and soda ash are added to water to remove
   a. Its corrosiveness
   b. bacteria
   c. undesirable taste and odor
   d. bicarbonates and sulphates of calcium and magnesium

10. Trinitrotoluene (TNT) is
    a. Used in dye manufactures
    b. Used in glycerin manufacture
    c. An explosive
    d. Used in iron ore purification

11. Enamels
    a. Do not contain pigment
    b. Are prepared from non-drying oil
    c. Are same as varnish
    d. Give good glossy finish

12. Gypsum is
    a. Calcium sulphate
    b. Calcium chloride
    c. Potassium sulphate
    d. Sodium sulphate

13. What element is commonly added to glass to give it a green tint?
    a. Iron oxide  b. Cobalt oxide  c. Chromium oxide  d. Copper oxide

14. Which method is commonly used for disinfection in wastewater treatment plants?
    a. Filtration  b. Reverse osmosis  c. UV irradiation  d. Sedimentation

15. Main constituents of Portland cement are calcium aluminate and
    a. Carbonates  b. Sodium silicate  c. Silicates  d. Gypsum

16. Phosphoric acid is prepared from
    a. Rock phosphate  b. Cryolite  c. Chalcopyrite  d. Bauxite

17. What property allows some types of glass to conduct electricity?
    a. Transparency  b. Insulation  c. Ion exchange  d. Doping

18. Common salt is generally not produced by _____ method from brine.
    a. Freeze drying  b. Electrolytic  c. Solar evaporation  d. Vacuum evaporation

19. Production of one ton of cement requires about _____ tons of limestone.
    a. 0.6  b. 1.2  c. 2.2  d. 3.8

20. Which of the following statements are **INCORRECT**?
    a. Conversion of $SO_2$ to $SO_3$ in Monsanto-4 pass converter is about 98%
    b. The chemical formula of oleum is $H_2S_2O_7$, which is formed by saturating sulphuric acid with sulphur trioxide
    c. Vitriol oil is nothing but technical sulphuric acid
    d. Decomposition of sulphuric acid on heating does not start before its boiling

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Level : B.E.
Year : II
Time : 2 hrs. 30 mins.

Course : CHEG 210
Semester : II
F.M. : 40

SECTION "B"
[5Q. × 8 = 40 marks]

Attempt *ALL* questions.

1.

a. Determine the ultimate BOD of a wastewater sample which was subjected to the BOD test in which 6 ml of wastewater sample containing no dissolved oxygen was mixed with 294 ml of water containing 8.6 mg/L of dissolved oxygen. After incubation at 20 °C for 5 days, the dissolved oxygen of the mix was 5.4 mg/L. The BOD rate constant to the base e $k_{20°C}$ = 0.25 per day. [3]

b. Draw box flow diagram for urea production. [3]

c. Define glass. What are the characteristics of glass? [2]

2.

a. Compute the theoretical NBOD of a wastewater containing 30 mg/L of ammonia as nitrogen. (We often say "ammonia nitrogen" and write the expression as $NH_3$-N.) If the wastewater analysis was reported as 30 mg/L of ammonia ($NH_3$), what would the theoretical NBOD be? [2]

b. Explain briefly the production process for $CO_2$ assuming raw material source from fermenter of brewery with box flow diagram? What are the other two raw material sources of $CO_2$? [4]

c. What must be considered while manufacturing wall paint? Explain briefly with ingredients used. [2]

3.

a. A wastewater contains 13 % by mass of biomass ($C_5H_7NO_2$). Calculate the percent by mass of nitrogen in the biomass. Also calculate the percent of nitrogen by mass in the wastewater. [3]

b. Write short notes on manufacuring of cement. [5]

4.

a. One mole of water can dissolve one mole of sulfuric acid, and this process releases 90 kJ. 0.5 moles of pure sulfuric acid (49 g) are poured into 300 g of water initially at 25 °C. If the water absorbs all of the heat, will it boil? If not, find its final temperature. Heat specific capacity of water is 4.18 J $g^{-1}$ $K^{-1}$. 54 g of water, initially at 25 °C, are poured into 300 g of sulfuric acid. If the water absorbs all of the heat, will it boil? If not, find its final temperature. [2+2]

b. A 25 ml wastewater sample in placed in a dish that weigh 50 g, after evaporation and drying at 103 °C, and cooling in desiccator, the dish weighs 50.02 g. Then the dish is fired at 550 °C for 1 hour, after which the dish weighs 50.005 g. Estimate total solids (TS), volatile solids (VS) and fixed solids (FS) of the water sample.? [4]

5.

a. One of the largest copper smelters in the United States (Kennecott, at Salt Lake City) produces 320 000 tons of copper per year. The copper ore smelted is principally chalcopyrite. If all the sulfur were emitted to the atmosphere as $SO_2$, how much would be emitted? If all the sulfur in the ore were converted to sulfuric acid, how much sulfuric acid per year would the smelter produce? [2]
$CuFeS_2 + 2.5O_2 \rightarrow Cu + FeO + 2SO_2$

b. A power plant produces exhaust gas (43.3 mol/s) with 0.1 percent $SO_2$ and wishes to remove 90 percent of the $SO_2$ by scrubbing the exhaust gas with a dilute solution of sodium hydroxide, NaOH. How much sodium hydroxide will they need per year? [2]
The overall reaction will be $2NaOH + SO_2 + 0.5O_2 \rightarrow Na_2SO_4 + H_2O$

c. Draw box diagram for refractory manufacturing process. Show five distinct processes. [4]