

CLASS TEST

S.No. : 01KS_A_CE_10022020

Environmental Engineering



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CLASS TEST 2020-2021

CIVIL ENGINEERING

Date of Test: 10/02/2020

ANSWER KEY > Environmental Engineering

1. (c)	7. (c)	13. (a)	19. (a)	25. (c)
2. (c)	8. (b)	14. (a)	20. (a)	26. (b)
3. (c)	9. (a)	15. (a)	21. (d)	27. (b)
4. (d)	10. (a)	16. (c)	22. (b)	28. (b)
5. (b)	11. (d)	17. (a)	23. (a)	29. (a)
6. (d)	12. (a)	18. (c)	24. (a)	30. (c)

DETAILED EXPLANATIONS

1. (c)

$$\begin{aligned}
 [\text{CaCl}_2] \text{ as CaCO}_3 &= \frac{[\text{CaCl}_2] \text{ in mg/l}}{\text{equivalent wt of CaCl}_2} \times \text{equivalent wt of CaCO}_3 \\
 &= \frac{165}{55} \times 50 = 150 \text{ mg/l}
 \end{aligned}$$

8. (b)

The presence of nitrogen in sewage indicates the presence of organic matter and may occur in the form of free ammonia, albuminoid nitrogen, nitrites and nitrates. The free ammonia indicates the very first stage of decomposition of organic matter (thrust indicating recently staled sewage); albuminoid nitrogen indicates quantity of nitrogen present in sewage before the decomposition of organic matter is started; the nitrites indicate the presence of partly decomposed (not fully oxidized) organic matter; and nitrates indicate the presence of fully oxidized matter.

9. (a)

Rate of filtration depends on filter area i.e. length \times width. So, the new filter area becomes $(4l \times 3b)$ i.e. 12 times more than original area. So, amount of filtered water would become 12 times.

12. (a)

During water supply, temperature should be maintained between 10 to 25°C.

13. (a)

In this disinfection process, we have the relationship,

$$tC^n = k$$

where,

t = time required to kill all pathogenic organisms

C = concentration of disinfectant

n = dilution coefficient

k = constant

$$\therefore t_1 C_1^n = t_2 C_2^n \quad \dots(i)$$

In our case,

$$n = 1$$

$$t = \frac{L}{V}$$

L = length of pipe, V = velocity of flow

$$\therefore t = \frac{L}{Q/A} = \frac{L \times A}{Q}$$

$$C = \frac{W}{Q}$$

where,

W = weight of disinfectant per day

Q = discharge per day

Substituting C and t in equation (i),

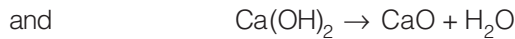
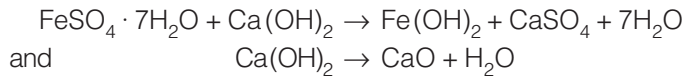
$$\frac{L \times A}{Q_1} \times \frac{W_1}{Q_1} = \frac{L \times A}{Q_2} \times \frac{W_2}{Q_2}$$

$$\Rightarrow W_2 = \frac{Q_2^2}{Q_1^2} \times W_1 = \left(\frac{28}{22}\right)^2 \times 40 \text{ kg/d} = 64.79 \text{ kg/day}$$

14. (a)

$$\text{Quantity of ferrous sulphate} = \frac{12 \times 16 \times 10^6}{10^6} = 192 \text{ kg}$$

Chemical reaction:

(Molecular weight of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O} = 278$, Molecular weight of $\text{CaO} = 56$) \therefore 278 kg of ferrous sulphate will react with 56 kg of lime.

$$\text{Hence quantity of lime corresponding to 192 kg of ferrous sulphate} = \frac{56}{278} \times 192 = 38.68 \text{ kg}$$

15. (a)

$$\begin{aligned} \text{Total hardness} &= [\text{Mg}^{2+}] \times \frac{\text{Eq. wt of CaCO}_3}{\text{Eq. wt of Mg}^{2+}} + [\text{Ca}^{2+}] \times \frac{\text{Eq. wt of CaCO}_3}{\text{Eq. wt of Ca}^{2+}} \\ &= \left(24 \times \frac{50}{12}\right) + \left(80 \times \frac{50}{20}\right) = 100 + 200 = 300 \text{ mg/l} \end{aligned}$$

17. (a)

The computation of increase in population per decade and incremental increase is shown below in table.

Year	Population	Increment per decade	Incremental Increase
1940	200000		
1950	380500	180500	- 65800
1960	495500	115000	- 44800
1970	565700	70200	14400
1980	650300	84600	
Total		450300	(-) 96200
Average		$\frac{450300}{4} = 112575$	$-\frac{96200}{3} = -32067$

We know that population after n decade by incremental increase method will be,

$$P_n = P + nI + \frac{n(n+1)}{2} \times r$$

Here,

$$I = 112575, r = -32067 \text{ and } n = 2$$

Expected population in the year 2000 AD (i.e. after 2 decades) is

$$\begin{aligned} P_{2000} &= 650300 + 2(112575) + \frac{2(2+1)}{2} \times (-32067) \\ &= 779249 \end{aligned}$$

Hence water requirement in 2000 AD @ 225 litres/head/day

$$\begin{aligned} &= 779249 \times 225 \\ &= 175.33 \times 10^6 \text{ litres/day} \\ &\simeq 175.3 \text{ MLD} \end{aligned}$$

18. (c)

A sedimentation tank will be more efficient when smaller particles are removed which requires low overflow rate and hence large surface area of tank.

19. (a)

Bacterial growth is logarithmic and is described by the equation,

$$N_t = N_0 e^{\mu t}$$

$$\Rightarrow 10^8 = 20 e^{0.02 \times t}$$

$$\Rightarrow t = 771.247 \text{ minute} = \frac{771.247}{60} \text{ hrs} = 12.85 \text{ hrs}$$

21. (d)

$$\text{Surface loading rate} = \frac{720}{12 \times 1.5} = 40 \text{ m}^3/\text{hr}/\text{m}^2$$

$$\text{Detention time} = \frac{V}{Q} = \frac{12 \times 1.5 \times 0.8}{720} \times 60 = 1.2 \text{ minutes}$$

22. (b)

Sewage produced = 1200000 litres/day

5 day BOD of sewage = 210 ppm = 210 mg/litre

BOD of effluent = 22 mg/litre

∴ BOD removed by pond = (210 – 22) = 188 mg/litre

∴ BOD removed per day = 1200000 × 188 = 225.6 × 10⁶ mg = 225.6 kg

It is given that organic loading = 60 kg/ha/day

$$\therefore \text{Required area} = \frac{\text{Sewage consumed}}{\text{Organic loading}} = \frac{225.6}{60} = 3.76 \text{ ha}$$

23. (a)

Stoke's law states that denser and larger particles have a higher settling velocity, thus a higher overflow rate. Hence size and density of particle affects the overflow rate.

When the temperature decreases, the rate of settling becomes slower. When the water is colder, the flow in the plant is at its lowest and the detention time in the plant is increased so the floc has time to settle out in the sedimentation basins.

26. (b)

Sludge solid removal in sedimentation tank = 0.7 × 300 = 210 mg/l

$$\therefore \text{Mass of total solids removed per 8 million litres} = \frac{210 \times 8 \times 10^6}{1000} = 1.68 \times 10^6 \text{ gm}$$

$$\begin{aligned} \therefore \text{Sludge volume} &= \frac{28 \times 10^6}{1} = 28 \times 10^6 \text{ cc} \\ &= 28 \times 10^6 \text{ ml} \\ &= \frac{28 \times 10^6}{1000} \text{ litres} = 28000 \text{ litres} \end{aligned}$$

27. (b)

$$\text{Intensity level} = 10 \log \left(\frac{I}{I_0} \right)$$

$$\text{In first source, } \frac{I}{I_0} = 4$$

$$\therefore \text{Thus increased intensity level} = 10 \log \left(\frac{I}{I_0} \right) = 10 \log(4) = 6 \text{ dB}$$

$$\text{and in second source, } \frac{I}{I_0} = 8$$

$$\therefore \text{Thus increased intensity level} = 10 \log \left(\frac{I}{I_0} \right) = 10 \log(8) = 9 \text{ dB}$$

29. (a)

$$Q = 4230 \text{ m}^3/\text{d}$$

$$N_t = N_0 e^{-0.156t}$$

Let x be the no. of microorganisms present initially.

97% kill of micro-organisms implies that at time ' t ' 3% of micro-organisms are still surviving.

$$\therefore \text{Micro-organisms surviving at time 't'} = \frac{3}{100}x$$

$$\therefore \frac{3}{100}x = x \cdot e^{-0.156t}$$

$$\therefore t = 22.48 \text{ min}$$

$$t = 0.0156 \text{ days}$$

$$\begin{aligned} \therefore \text{Volume} &= Q \cdot t \\ &= 4230 \times 0.0156 \\ &= 65.99 \text{ m}^3 \end{aligned}$$

30. (c)

$$Q = \frac{2\pi T(s_1 - s_2)}{\ln\left(\frac{r_2}{r_1}\right)}$$

$$T = \frac{55 \times 10^{-3} \times 24 \times 60 \times 60 \times \ln\left(\frac{120}{12}\right)}{2 \times \pi \times (3.5 - 0.75)}$$

$$= 633.25 \text{ m}^2/\text{day}$$

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