CLASS TEST

Sl. No. : 02IGCE-A+C-07072023

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ENVIRONMENT ENGINEERING

CIVIL ENGINEERING

Date of Test : 07/07/2023

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (d)

2. (c)

(i) Average daily draft = $\dfrac{(250 \times 64000)}{10^6} = 16 \text{ MLD}$

Now, Maximum daily draft = 1.8 times of annual average daily draft = 1.8 × 16 = 28.8 Mld

(ii) Fire demand: Q(in lit./min) = $4637\sqrt{P}\left(1 - 0.01\sqrt{P}\right)$ (where, P = Population in thousand)

$$Q = 4637\sqrt{64}\left[1 - 0.01\sqrt{P}\right]$$

$$= 34128.32 \text{ litres/minute}$$

$$= \frac{34128.32 \times 60 \times 24}{10^6} \text{MLD} = 49.14 \text{ MLD}$$

Coincident draft: D

The maximum daily demand when added to the fire demand is known as the coincident draft.

Hence, Coincident draft = Maximum daily demand + Fire demand

= 28.8 + 49.14

= 77.94 MLD

3. (b)

Increase in population per year = $\dfrac{50000 - 30000}{20} = 1000$

Additional discharge required to reach design capacity = 6000 – 4000 = 2000 m^3/d

Present average water consumption per head per day = $\dfrac{4000}{30000} = 0.133 \text{ m}^3/\text{d}$

Increase in water consumption each year = 0.133 × 1000 = 133 m^3/day

$\therefore$ Number of years required to reach design capacity = $\dfrac{2000}{133} = 15.0375 \text{ years} \approx 15 \text{ years}$

4. (b)

Quantity of 100% pure bleaching powder required = 2 × 4000 × 10^{-3} gm = 8 gm

$\therefore$ Quantity of 25% pure bleaching powder required = $\dfrac{8}{0.25} = 32 \text{ gm}$

5. (b)

Check valve or reflux valve or non-returning valve:

- These allow the water to flow in one direction only.
- These are made of brass or gun metal.

Butterfly valve:

- Butterfly valve are used to regulate and stop the flow especially in large size conduits.
- Butterfly valve involve slightly higher head loss than sluice valves and also are not suitable for continuous throttling.

6. (d)

Electrical conductivity (in µMho/cm) at 25°C × 0.65 = Dissolved solid content (in mg/l)

7. (b)

$$\frac{F}{M} = \frac{\text{Amount of BOD}_5}{\text{Amount of VSS}}$$

$$= \frac{252 \text{ mg}/l \times 7.5 l}{1880 \text{ mg}/l \times 1.5\, l} = \frac{1890}{2820}$$

$$= 0.67$$

8. (c)

9. (d)

All of the above mentioned mechanisms describe how disinfectants inactivate and kill pathogens. The effectiveness of a specific disinfectant is primarily related to the targeted organism i.e. bacteria, virus and protozoa, dosage of disinfectant and contact time.

10. (b)

Indicator	pH range	Original colour	Final colour produced
Methyl orange	2.8 - 4.4	Red	Yellow
Phenol red	6.8 - 8.4	Yellow	Red
Methyl red	4.4 - 6.2	Red	Yellow

11. (b)

If you consider 50 decibel noise and want to add another two 50 decibel noise, it will not made up 150 decibel noise, but will make up only 54.75 decibel noise, as calculated below:

$$50 \text{ db} = 20\log_{10}\left(\frac{P_{rms}}{20}\right)$$

$$P_{\text{rms}} = 6324.55$$

∴ So, P_{rms} 3 sounds of 50 db each

$$= \sqrt{(6324.55)^2 \times 3} = 10954.44$$

Resultant sound pressure level

$$= 20\log_{10}\left(\frac{10954.44}{20}\right)$$

$$= 54.77 \simeq 54.75 \text{ db}$$

Hence option (b) is correct.

12. (d)

For the theoretical oxygen demand and the organic carbon concentration [i.e. Total Organic Carbon (TOC)], consider the following oxidation reactions:

$$\underset{(180)}{C_6H_{12}O_6} + \underset{(192)}{6O_2} \longrightarrow 6CO_2 + 6H_2O$$

$$\underset{(78)}{C_6H_6} + \underset{(240)}{7.5O_2} \longrightarrow 6CO_2 + 3H_2O$$

Hence, theoretical oxygen demand is,

$$\text{ThoD} = \frac{192}{180}\times 240 + \frac{240}{78}\times 25 = 332.92 \text{ mg}/l \simeq 333 \text{ mg}/l$$

And, total organic carbon is

$$\text{TOC} = \frac{72}{180}\times 240 + \frac{72}{78}\times 25$$

$$= 119.07 \text{ mg}/l \simeq 119 \text{ mg}/l$$

13. (c)

$$\text{BOD}_5 \text{ (at 20°C)} = \frac{(D_1 - D_2) - (B_1 - B_2)(1-P)}{P}$$

$$= \frac{5.6 - 1.5\times\left(1 - \frac{15}{300}\right)}{\frac{15}{300}}$$

$$= 83.5 \text{ mg}/l$$

14. (c)

15. (b)

In saturated air, the air cools at the rate of 6°C per km rise and is known as wet adiabatic lapse rate

$$\text{Resulting temperature of air} = 43° - 6\times\frac{1500}{1000} = 34°\text{C}$$

16. (b)

Statement 2 and 3 are the properties of iron salts not alum salts.

17. (c)

$$\text{Required cloth area} = 10 \text{ m}^3/\text{s} \times \frac{60s}{\text{min}} = 600 \text{ m}^3/\text{min}$$

$$= \frac{600 \text{ m}^3/\text{min}}{1.5 \text{ m}/\text{min}} = 400 \text{ m}^2$$

$$\text{Surface area of one bag} = \pi DH = \pi \times 0.3 \times 5$$

$$= 4.712 \text{ m}^2$$

Total number of bags required = $\dfrac{400}{4.712} = 84.89 \simeq 85$

18. (c)

Total alkalinity required to be added in the form of $CaCO_3$ = 9 – 6 = 3 mg/l as $CaCO_3$

$$CaO + CO_2 \rightarrow CaCO_3$$
$$56 \text{ gm} \qquad\qquad 100 \text{ gm}$$

$\therefore$ 56 gm of CaO (quick lime) is required to produce 100 gm of $CaCO_3$.

Quantity of CaO required for 3 mg/l of $CaCO_3$ = $\dfrac{56}{100} \times 3$ mg/l

= 1.68 mg/l

Total amount of CaO required = $10 \times 10^6 \times 1.68 \times 365$

= 6132×10^6 mg per year

= 6132 kg per year

19. (b)

For tube fermentation test, 5 tubes are taken for each sample size.

Negative volume = $1 \times 1.0 + 2 \times 0.1 + 3 \times 0.01 + 4 \times 0.001$

= 1.234 ml

20. (a)

$$\text{Percentage removal} = \frac{V_s'}{V_s} \times 100$$

Where V_s' is settling velocity and V_s is surface overflow [$\because$ Efficiency of tank = 92%]

Given, $V_s' = 0.92\, V_s$

= 0.92 × Overflow rate

Using Stoke's law $V_s' = \dfrac{0.92 \times 35}{86400}$ m/s

$$\frac{(G-1)gd^2}{18\nu} = \frac{0.92 \times 35}{86400}$$

$$d = \sqrt{\frac{0.92 \times 35 \times 18\nu}{86400 \times (G-1) \times g}}$$

$$= \sqrt{\frac{0.92 \times 35 \times 18 \times 1.1 \times 10^{-6}}{86400 \times 1.7 \times 9.81}}$$

$= 2.1035 \times 10^{-5}$ m

= 21.035 μm

21. (b)

For pH = 7

Concentration of $[H^+]$ = 10^{-pH} moles/l = 10^{-7} moles/l

Now, Ionization constant, $k = \dfrac{[H^+][OCl^-]}{[HOCl]}$

$$= 2.5 \times 10^{-8} \text{ moles}/l$$

Now, $$\frac{[HOCl]}{[HOCl]+[OCl^-]} = \frac{1}{1+k\cdot 10^{pH}}$$

$$= \frac{1}{1+2.5\times10^{-8}\times10^{7}} = \frac{1}{1.25} = 0.8$$

22. (a)

Maximum hourly consumption of the maximum day i.e. peak demand $= 1.5\times1.8\times\dfrac{Q_{avg}}{24}$

$$= 1.5\times1.8\times\frac{36000}{24}\ \text{m}^3/\text{hr}$$

$$= 4050 \text{ m}^3/\text{hr}$$

23. (c)

Velocity gradient, $$G = \sqrt{\frac{P}{\mu V}}$$

So, Power input, $$P = \mu G^2 V$$

$$= 1 \times 10^{-3} \times (450)^2 \times 4$$

$$= 810 \text{ W}$$

Now, power input per unit volume $= \dfrac{P}{V} = \dfrac{810}{4} = 202.5\,\text{W/m}^3$

24. (d)

Organic matter stabilized per day $= Q\,[S_i - S_0] \times \eta$

$$= 400 \times 10^3\,[1800 - 300] \times 0.75$$

$$= 450 \text{ kg}$$

$\because$ 1 kg BOD generates 0.35 m^3 methane

$\therefore$ 450 kg BOD generates $= 0.35 \times 450 = 157.5 \text{ m}^3$

25. (d)

Sewer size	Manhole spacing
< 900 mm	Maximum 30 m
900 to 1500 mm	90 to 150 m
1500 to 2000 mm	150 to 200 m
> 2000 mm	upto 300 m

26. (b)

BOD to be removed by filter, $Y = 4 \times 10^6 \times 180 \times 10^{-6} = 720$ kg/day

$$\text{Volume of filter media, } V = \frac{720}{10000} = 0.072 \text{ ha-m}$$

$$\text{Re-circulation factor, } F = 1.69$$

$$\text{Efficiency, } \eta = \frac{100}{1 + 0.0044\sqrt{\dfrac{Y}{V.F.}}}$$

$$= \frac{100}{1 + 0.0044\sqrt{\dfrac{720}{0.072 \times 1.69}}} = 74.71\%$$

27. (d)

The maximum flow velocity in sewer occurs when depth of flow, $d = 0.81D$ and is 12.5% more than velocity at full flow condition.

28. (d)

As we know,

$$\frac{1}{\theta_C} = \frac{QY(S_0 - S)}{VX} - k_d$$

$$\frac{1}{10} = \frac{10000 \times 0.5[150 - 5]}{V \times 3000} - 0.05$$

$$V = 1611.11 \text{ m}^3 \simeq 1611 \text{ m}^3$$

29. (d)

30. (c)

Total hardness is due to multivalent cations.

$$\therefore \quad \text{Total hardness} = \left[Mg^{+2}\right] \times \frac{\text{Eq. weight of } CaCO_3}{\text{Eq. weight of } Mg^{2+}} + \left[Ca^{+2}\right] \times \frac{\text{Eq. weight of } CaCO_3}{\text{Eq. weight of } Ca^{2+}}$$

$$+ \left[Al^{3+}\right] \times \frac{\text{Eq. weight of } CaCO_3}{\text{Eq. weight of } Al^{3+}}$$

$$= 48 \times \frac{50}{12} + 45 \times \frac{50}{20} + 5 \times \frac{50}{9} = 340.28 \text{ mg}/l \text{ as } CaCO_3$$

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