CLASS TEST

Sl.: 03 SK_CE_S+G_290722 [E+G]

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ENVIRONMENT ENGINEERING

CIVIL ENGINEERING

Date of Test : 29/07/2022

ANSWER KEY

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

DETAILED EXPLANATIONS

7. (c)

$$\text{BOD} = (\text{Initial DO} - \text{Final DO}) \times \text{Dilution factor}$$

$$= (9.36 - 6.2) \times \frac{100}{2.5} = 126.4 \text{ mg}/l$$

8. (b)

Sound pressure, $$L = 20\log_{10}\frac{P_{rms}}{20\mu\text{Pa}} \text{ dB}$$

$$L = 20\log_{10}\frac{2000}{20}$$

$$= 20 \log_{10} 100$$

$$= 40 \text{ dB}$$

So, resultant of two sound sources = 40 dB + 40 dB = 43 dB

9. (b)

$$\text{Minimum hourly discharge} = \frac{1}{3} \text{ times average daily discharge}$$

$$\text{Minimum daily discharge} = \frac{2}{3} \text{ average daily discharge}$$

10. (a)

Detention time, $$t_d = \frac{V}{Q}$$

$$= \frac{10 \times 8 \times 1}{600} \times 60 = 8 \text{ minutes}$$

12. (a)

For Infiltration gallery,

$$Q = kL\left(\frac{H^2 - h^2}{2R}\right)$$

where, Q = 600 m^3/day

H = 6 m, k = 100 m/day

R = 100 m

h = 6 – 4 = 2 m

$$\therefore \quad 600 \text{ m}^3/\text{day} = 100 \text{ m/d} \times L \text{ (in m)} \times \left(\frac{6^2 - 2^2}{2 \times 100}\right)\frac{\text{m}^2}{\text{m}}$$

$$\Rightarrow \quad 600 = \left(100 \times L \times \frac{32}{200}\right)$$

$$\Rightarrow \quad L = 37.5 \text{ m}$$

13. (c)

The drop manholes are provided in sewerage system when there is change in elevation of ground level.

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16. (b)

$$\text{Drift Velocity}, \omega = 3 \times 10^5 \times 5.0 \times 10^{-7}\ \text{m} = 0.15\ \text{m/s}$$

For 99% efficiency

$$0.99 = 1 - \exp\left(-\frac{0.15}{Q} \times 307\right)$$

$$Q = 10\ \text{m}^3/\text{sec}$$

Now for, plate area required for 90% efficiency,

$$0.9 = 1 - \exp\left(-\frac{0.15}{10} \times A\right)$$

$\Rightarrow$ $$A = 153\ \text{m}^2$$

17. (c)

Settling velocity, $$V_S = \frac{g}{18}\frac{(G_S - 1)}{\nu} \times d^2$$

When $G_S = 2$

Let $V_{S_1} = V_S$

$$= \frac{g}{18}(2-1)\frac{d^2}{\nu}$$

$$V_S = \frac{g}{18}\frac{d^2}{\nu}$$

Now, if $G_S = 2.5$

then $$V_{S_2} = \frac{g}{18}(2.5-1)\frac{d^2}{\nu}$$

$$= 1.5 \times \frac{g}{18}\frac{d^2}{\nu} = 1.5 \times V_S$$

18. (d)

$\because$ $$S_r + S_y = n$$

$$\frac{7.5}{100} + \frac{V_w}{1.25 \times 100 \times 10^6} = \frac{30}{100}$$

$$V_w = 0.028125 \times 10^9 \times \text{m}^3$$

$$= 28.125 \times 10^6\ \text{m}^3$$

19. (a)

Sewage produced = 400000 l/day

5-day BOD of sewage = 140 mg/l ($\because$ When water is solvent, 1 ppm = 1 mg/l)

BOD of effluent = 15 ppm = 15 mg/l

$\therefore$ BOD removed by pond = (140 – 15) = 125 ppm = 125 mg/l

$\therefore$ Sewage produced per day

= 400000 × 125

= 50 × 10^6 mg = 50 kg

Organic loading rate = 25 kg/ha/day

$\therefore$ $$\text{Required area} = \frac{\text{Sewage produced}}{\text{Organic loading rate}}$$

$$= \frac{50}{25} = 2\ \text{ha}$$

20. (b)

Detention period of stabilisation pond, $t_d = \frac{1}{K_D}\log_{10}\left(\frac{L}{L-Y}\right)$

$$= \frac{1}{0.1}\log_{10}\left(\frac{150}{150-0.85\times150}\right) = 8.24 \text{ days}$$

21. (a)

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$
$$16\,g \qquad\qquad 44\,g$$

⇒ 16 g of CH_4 when completely oxidized leads to 44 g of CO_2.

Given x kg of CH_4 when completely oxidized leads to 3.24 kg.

$$\Rightarrow \quad 44 \text{ kg } CO_2 = 16 \text{ kg } CH_4$$

$$\Rightarrow \quad 3.24 \text{ kg } CO_2 = \frac{16}{44}\times 3.24 = x$$

$$x = 1.178 \text{ kg} \simeq 1.18 \text{ kg}$$

22. (a)

$$(100 - P_1)\, V_1 = (100 - P_2)\, V_2$$

$$\Rightarrow \quad \frac{V_2}{V_1} = \frac{100 - P_1}{100 - P_2}$$

$$\frac{V_2}{V_1} = \frac{100-97}{100-95} = \frac{3}{5} = 0.6$$

$$V_2 = 0.6\, V_1$$

$$\% \text{ decrease} = \frac{V_1 - V_2}{V_1}\times 100 = \frac{V_1 - 0.6V_1}{V_1}\times 100 = 40\%$$

23. (b)

Organic strengths of waste water cannot be determined using fixed solids, or dissolved oxygen only.

24. (a)

Unit operations	Unit process
ASP	Screening
Oxidation pond	Sedimentation
Anaerobic digestor	Grit removal

25. (c)

$$\text{Daily BOD contributed by waste} = 162 \times \frac{1000\times1000}{10^3} = 162{,}000 \text{ g/day}$$

$$\text{Population equivalent} = \frac{162{,}000}{80} = 2025$$

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26. (a)

$$\text{Ambient lapse rate} = \frac{21.25 - 15.70}{(444 - 4)} \times 1000$$

$$= 12.6\ °\text{C/km} > 9.8°\text{C/km}$$

When the ambient lapse rate exceeds the adiabatic lapse rate, the ambient lapse rate is said to be super adiabatic.

27. (c)

$$Q = 432\ \text{m}^3/\text{hr}$$

$$V_s = 0.12\ \text{cm/s} = 0.0012\ \text{m/s}$$

$$\text{To remove 100\% particle area} = \frac{432/3600}{0.0012} = 100\ \text{m}^2$$

∴ To remove 90% of particles

$$\text{Area} = 100 \times 0.9$$

$$= 90\ \text{m}^2$$

28. (c)

$$\text{Equivalent weight of bicarbonate} = 61$$

$$\text{Milli equivalents of bicarbonate} = \frac{122}{61} = 2$$

∴ $\text{Alkalinity of water in terms of } CaCO_3 = (\text{Milli equivalents of bicarbonates}) \times \text{Equivalent weight of } CaCO_3$

$$= 2 \times 50 = 100\ \text{mg}/l$$

29. (a)

$$\text{Velocity gradient } (G) = 600\ \text{s}^{-1}$$

$$\text{Volume of mixer } (V) = 2.0\ \text{m}^3$$

$$\text{Absolute viscosity of fluid } (\mu) = 1 \times 10^{-3}\ \text{N-s/m}^2$$

We know, $P = G^2 \mu V$

∴ $\text{Power input per unit volume } \left(\frac{P}{V}\right) = \mu G^2$

$$= 10^{-3} \times (600)^2 = 360\ \text{W}$$

30. (b)

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