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ESE- 2019 (Prelims) - Offline Test Series Test-7

CIVIL ENGINEERING

SUBJECT: HYDROLOGY, WATER RESOURCES ENGINEERING AND ENVIRONMENTAL ENGINEERING

01. Ans: (b)

Sol:

$$d_{storage} = \frac{\text{Volume}}{\text{Area}} = \frac{650-65}{1000} = 0.585 \text{ m}$$

$d_{storage} = sd\,(FC - MC)$

$$0.585 = \frac{1450}{1000} \times 1.8 \times (FC - 0.08)$$

$FC = 30.41\% \simeq 30\%$

02. Ans: (d)

03. Ans: (d)

Sol:

$$U = \frac{1}{2} bcwH \qquad P_1 = \frac{wH_1^2}{2}$$

$\therefore U > P_1$

$$x_4 = \frac{2b}{3} \qquad P_1 = \frac{H_1}{3}$$

$\therefore M_U > M_{P1}$

04. Ans: (b)

Sol:

Ozone is a highly reactive gas with unpleasant odour.

05. Ans: (c)

Sol:

100 gm of $CaCO_3$ requires 56 gm of CaO

Total $CaCO_3$ alkalinity

$$= \frac{200 \times 10^6}{10^6} = 200 \text{ kg/day}$$

Total $MgSO_4$ hardness

$$= \frac{60 \times 10^6}{10^6} = 60 \text{ kg/day}$$

$$\therefore \text{ Lime required} = \frac{200}{100} \times 56 + \frac{60}{120} \times 56$$

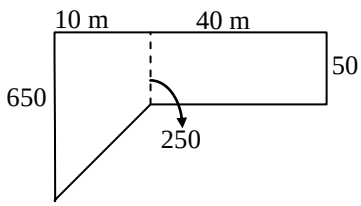
$= 140$ kg/day

06. Ans: (d)

Sol: $U_1 = \frac{1}{2} c w b (H_1 + H_2)$

$= \frac{1}{2} \times 1 \times 10 \times 50 \times (65 + 5) = 17{,}500$ kN/m

U_2 with drainage gallery



$U_2 = \left(\frac{650 + 250}{2}\right) 10 + \left(\frac{250 + 50}{2}\right) 40$

= 10,500 kN/m

Save in U = 17,500 – 10,500

= 7000 kN/m

% saving = $\frac{7000}{17500} \times 100 = 40\%$

07. Ans: (c)

Sol: Creep Length, L_c = 70 m

H = 7 m

C = 10

At mid point of 'DE'

Creep length, *l* = 45 m

Unbalanced head,

$h = H\left(1 - \frac{\ell}{L_C}\right) = 7 \times \left(1 - \frac{45}{70}\right) = 2.5$ m

$t_{min} = \frac{4}{3}\left(\frac{h}{S_C - 1}\right) = \frac{4}{3}\left(\frac{2.5}{2.5 - 1}\right) = 2.22$ m

08. Ans: (b)

Sol: Sulphur containing coal $= \frac{2}{100} \times 1800$

= 36 kg/hr

$= \frac{36 \times 10^3 \text{ g}}{60 \times 60 \text{ sec}}$

= 10 gm/sec

SO_2	$\rightarrow$	S	+	O_2
64		32		2 × 16

32 gm of S produce = 64 gm of SO_2

10 gm of S produce = $\frac{64}{32}$ × 10 gm of SO_2

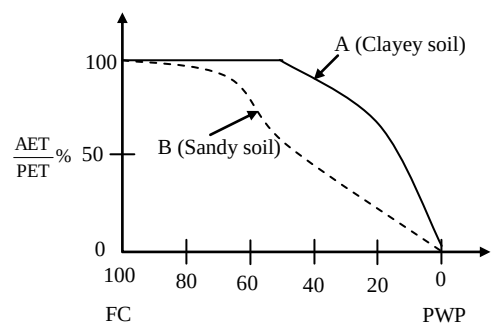
= 20 gm/sec

09. Ans: (d)

Sol: For a given frequency, increase in duration will decrease the intensity of rainfall.

10. Ans: (c)

Sol:



11. Ans: (d)

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12. Ans: (b)

Sol: Specific yield = $\frac{\text{volume of water drained}}{\text{volume of aquifer drained}}$

$$0.2 = \frac{V_w}{0.25\times100\times10^6}$$

$$V_w = 0.2\times0.25\times100\times10^6 = 5\ Mm^3$$

13. Ans: (b)

Sol: Muskingum method: Used for channel routing. It is based on hydrologic routing technique. Muskingum equation,

$$S = k\,[\,x.I + (1- x\,)Q]$$

Where,

S = storage

k = storage time constant. It is approximately equal to the time of travel of a flood wave through the channel reach. It has dimensions of time

x = weighting factor.

k and x are called routing constants, determined based on actual observation of floods through a channel reach.

14. Ans: (b)

Sol: $Q_p = \frac{kiA}{360} = \frac{0.5\times36\times200}{360}$

$= 10\ m^3/sec$

$= 10\times10^3$ lit/sec

15. Ans: (c)

Sol:

Gumbel's method: Widely used probability distribution function for prediction of flood peaks.

Gumbel's distribution has the property which gives T = 2.33yrs for the average of the annual series when record length is very large.

The value of flood with T = 2.33yrs is called the mean annual flood.

16. Ans: (d)

Sol:

Limitations of Unit Hydrograph

(i) Precipitation must be from rainfall only.

(ii) Catchments should not have unusually large storages.

(iii) The variation in peak discharge by ±10% are acceptable.

17. Ans: (a)

Sol:

$$f = f_c t + \frac{(f_o - f_c)}{k}$$

$$15 = (1.2\times8) + \frac{(6-1.2)}{k}$$

$k = 0.888/hr$

18. Ans: (b)

19. Ans: (b)

Sol:

Rainfall excess = 5.9 – 0.9 = 5 cm

Peak of flood hydrograph = 270 m^3/sec

Peak of DRH = 270 – 20 = 250 m^3/sec

$$\text{Peak of 3-hr UH} = \frac{\text{Peak of DRH}}{\text{rain fall excess}} \times 1\text{cm}$$

$$= \frac{250}{5} = 50 \text{ m}^3/\text{sec}$$

20. Ans: (c) **21. Ans: (d)**

22. Ans: (d)

Sol: Tipping bucket type gives intensity of rainfall.

Weighing bucket type and float type gives mass curve of rain fall.

23. Ans: (c)

Sol: $y = \frac{B}{2}\sin\left(\frac{6\pi x}{B}\right)$

One meander length will be completed when y again becomes zero

$\frac{6\pi x}{B} = 2\pi, 4\pi, 6\pi.....$

least $\frac{6\pi x}{B} = 2\pi$

$x = \frac{B}{3}$ $M_L = \frac{B}{3}$

Amplitude will be $\frac{M_B}{2}$

i.e $\frac{B}{2} \Rightarrow M_B = B$

$M_R = \frac{M_B}{M_L} = \frac{3B}{B} = 3$

24. Ans: (d)

25. Ans: (d)

Sol: $p = \frac{1}{10} = 0.1$

$q = 1 - p = 1 - 0.1 = 0.9$

Flood to occur at least once in the next 2 year

$= 1 - q^n = 1 - (0.9)^3$

$= 0.27 \times 100 = 27\%$

26. Ans: (c)

Sol: The intensity of heavy rain is greater than 7.5 mm/hr.

27. Ans: (c)

Sol:

$$BOD_5 = [DO_b - DO_5] \times D.F - [DO_b - DO_s]$$

$$= [8.5 - 3.5] \times \frac{100}{5} - [8.5 - 0.8]$$

$= 100 - 7.7 = 92.3$ mg/*l*

28. Ans: (d)

Sol:

$$\text{Population equivalent} = \frac{\text{Total BOD}}{\text{Per capita BOD}}$$

$Q = 1$ MLD

$y_i = 160$ mg/*l*

$$\text{Population equivalent} = \frac{Q.y_i}{\text{Per capita BOD}}$$

$$= \frac{1\times160}{80\times10^{-3}} = 2000$$

29. Ans: (d)

30. Ans: (a)

Sol: Permissible limit in drinking water for Mercury = 0.001 mg/*l*

Chromium = 0.05 mg/*l*

31. Ans: (c)

32. Ans: (c)

Sol: High salt resistant crops are fodder, Barseem, Bajra should be grown on the leached land for one or two seasons.

33. Ans: (b)

Sol: Salt concentration in mg/*l* or ppm

= 640 (EC in millimho/cm)

$$\text{Electrical Conductivity, EC} = \frac{3200}{640}$$

= 5 millimho/cm

34. Ans: (d)

Sol: $f = 1.76\sqrt{D_{50}}$

$= 1.76\sqrt{0.64} = 1.408$

$P = 4.75\sqrt{Q} = 4.75\sqrt{81}$

$= 42.25$ m

Side Slope:

$\frac{1}{2}$H to 1V or 1H – 2V

$$R = 2.5\frac{V^2}{f} \qquad \because V = \left(\frac{Qf^2}{140}\right)^{1/6}$$

$$= \frac{2.5}{f}\left(\frac{Qf^2}{140}\right)^{\frac{1}{3}} = \frac{2.5}{1.408}\left(\frac{81\times1.408^2}{140}\right)^{\frac{1}{3}}$$

= 1.85 m

35. Ans: (d)

Sol:

The interval between the two successive cleanings of slow sand filter depends mainly on the nature of the impurities and also on the size of the sand used in the filter only.

36. Ans: (b)

Sol:

Structure on a canal for disposal of surplus water – Canal escape.

37. Ans: (c)

Sol: $BOD_5 = \dfrac{(D_1 - D_2) - (B_1 - B_2)(1-P)}{P}$

D_1 = D.O of diluted, sample after dilution

D_2 = D.O of diluted, sample after 5 days

B_1 = D.O of seeded control sample before in cubation

B_2 = D.O of seeded control sample after 5 days incubation

P = Dilution ratio

D_1 = 8 mg/*l*

D_2 = 3 mg/*l*

$B_1 - B_2$ = 3 mg/*l*

$$P = \frac{20\,m\ell}{300\,m\ell} = \frac{20}{300}$$

$$BOD_5 = \frac{(8-3) - 3\left(1 - \frac{20}{300}\right)}{\frac{20}{300}} = 33\,mg/\ell$$

38. Ans: (d)

Sol:

Activated Carbon: Because of its excellent property of absorbing impurities, it is widely used for removing taste and odour.

Activated Alumina: It is excellent medium for removal of excess fluorides.

39. Ans: (b)

Sol:

Quantity of CO_2 = 0.396 × Quantity of Alum

Quantity of CO_2 = 0.396 × Q × Alum Dosage

$= 0.396 \times 12 \times 10^6 \times 16$

$= 76.032 \times 10^6$ mg

= 76 kg

40. Ans: (c)

41. Ans: (b)

Sol:

For proportional outlet

$$\frac{m}{n} = \frac{H}{D}$$

$$\frac{\frac{1}{2}}{\frac{5}{2}} = \frac{H}{1.2}$$

$$H = \frac{1.2}{5} = 0.24\ m$$

42. Ans: (d) **43. Ans: (b)**

44. Ans: (a) **45. Ans: (a)**

46. Ans: (c)

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47. Ans: (d)

Sol: The free chlorine will instantaneously kill the pathogens, while the combined chlorine will provide long term germicidal effect.

48. Ans: (d)

49. Ans: (a)

Sol: Traps may be defined as fittings, placed at the end of the soil pipes or the sullage pipes (waste pipes) to prevent the passage of foul gases from the pipes to the outside

50. Ans: (d)

Sol: $\frac{100-0}{100-t}=\frac{80-30}{80-50}$

$t = 40\ \%$

Duration $= 0.4 \times 2 \times 60 = 48$ min

51. Ans: (b) **52. Ans: (a)**

53. Ans: (d)

54. Ans: (d)

Sol:

The threshold of hearing 0.00002 N/m^2 is usually taken as the standard reference pressure.

Reflection noise can be abated by providing lining on walls and ceiling with sound absorbing materials.

55. Ans: (d)

Sol: A = 5.4 ha

R = 3 cm/hr

= 30 mm /hr

I = 1 (Impervious surface)

$Q=\frac{AIR}{360}=\frac{5.4\times30\times1}{360}$

$= 0.45\ m^3/sec$

56. Ans: (d)

Sol: Area of the tank $=\frac{8\times10^3}{20}$

$= 400\ m^2$

$\frac{L}{B}=\frac{4}{1}$

$L = 4B$

$L \times B = 400$

$B\ (4B) = 400$

$B = 10$ m

$\therefore L = 40$ m

57. Ans: (d)

58. Ans: (c)

Sol:

$SVI=\frac{\text{Volume of sludge settled}\,(m\ell)}{MLSS(g)}$

$=\frac{400}{4}=100\ ml/g$

59. Ans: (b)

Sol:

$$\frac{V_2}{V_1} = \frac{(100 - P_1)}{(100 - P_2)}$$

$$V_2 = V_1 \frac{(100-96)}{(100-90)} = V_1 \times \frac{4}{10} = \frac{2V_1}{5}$$

$$\frac{V_2}{V_1} = \frac{2}{5} \times 100 = 40\%$$

60. Ans: (c)

Sol:

Year	Population	
1970	50000	
		6000
1980	56000	
		7000
1990	63000	
		5000
2000	68000	

$$\bar{x} = \frac{(6+7+5)}{3} 1000 = 6000$$

$P_n = P_o + n\bar{x}$

$$n = \frac{2010 - 2000}{10} = 1$$

$P_o = 68000$

$P_{2010} = P_1 = P_o + 1\ \bar{x}$

$= 68000 + 1\ (6000)$

$= 74000$

61. Ans: (b)

Sol:

Alum functions effectively only when pH value lies in between 6.5 and 8.5.

Ferrous sulphate is effective for water pH > 8.5, chlorinated copperas (Ferric sulphate and Ferric chloride) is effective for water pH < 6.5 and also pH > 8.5 Sodium Alumiante is independent of pH value of water

62. Ans: (b)

63. Ans: (c)

64. Ans: (a)

65. Ans: (d)

Sol: $$S = \frac{f^{5/3}}{3340Q^{1/6}} = \frac{1}{3340(30)^{1/6}}$$

= 1 in 5880

66. Ans: (b)

Sol: In anerobic treatment the end by products are CH_4, CO_2 and nutriend rich sludge by these are used in

In aerobic process the end products are carbon-dioxide and water.

67. Ans: (a)

Sol: Steel, however burns in dry chlorine brightly above a temperature of 90^oC. So steel can't resist high temperature, therefore it should keep in well ventilated rooms

68. Ans: (a)

69. Ans: (d)

Sol:

$$\text{Specific yield} \propto \frac{1}{\text{Area}}$$

$$\propto \frac{1}{(2d)^2}$$

$$\propto \frac{1}{4d^2}$$

70. Ans: (d)

Sol:

Clay is an example of an aquiclude.

71. Ans: (d)

Sol: $Q = kiA$ $\quad Q \propto A$

$10 = ki\,(50)$ $\quad Q = (ki)A$

$ki = \frac{10}{50}$ $\quad Q = \frac{10}{50} \times 75 = 15\,m^3/day$

Statement I is false but II is true

72. Ans: (a)

73. Ans: (c)

Sol: **Lacey** defined three regime conditions initial regime, final regime and true regime.

Initial regime: When the channel has formed its section only, but not yet secured the longitudinal slope.

74. Ans: (a)

Sol: Because of availability of Oxygen, BOD gets removed at fast rate and it is also due to settlement of organic matter.

75. Ans: (c)

Sol: Leptospirosis is due to water contaminated by the animal urine carrying the bacteria (Leptospira).

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