ACE
Engineering Academy

Hyderabad | Delhi | Bhopal |Pune | Bhubaneswar | Bengaluru |Lucknow | Patna | Chennai | Vijayawada | Visakhapatnam | Tirupati | Kukatpally| Kolkata

H.O: 204, II Floor, Rahman Plaza, Opp. Methodist School, Abids, Hyderabad-500001,
Ph: 040-23234418, 040-23234419, 040-23234420, 040 - 24750437

ESE- 2018 (Prelims) - Offline Test Series **Test-11**

CIVIL ENGINEERING

SUBJECT: HYDROLOGY AND WATER RESOURCES ENGINEERING + ENVIRONMENTAL ENGINEERING
SOLUTIONS

01. Ans: (c)

Sol: Because of coagulation,

- Permanent hardness increases
- Alkalinity of the water slightly decreases
- pH of water decreases
- percentage removal is higher when turbidity is more.

02. Ans: (b)

Sol: Sum of ammonia and organic Nitrogen is Kjeldahl's nitrogen

$\therefore$ Kjeldahl's nitrogen = 6+8 = 14 mg/L

Volume of waste water in 1 hr

$$= 0.5 \times 60 \times 60 = 1800 \text{ m}^3$$

$\therefore$ Mass of Kjedahl's nitrogen

$$= 14 \times 1800 \times 10^{-3}$$

$$= 25.2 \text{ kg}$$

03. Ans: (b)

04. Ans: (c)

Sol:

The water is always admitted through upstream valve so as to make it flow along the gravity.

Since leakage has to be detected until complete hydraulic gradient profiling is not done along the length, the place of leakage will not be known. It requires several pressure gauges along the length at specific intervals.

05. Ans: (c)

Sol: In the recarbonation process, the insoluble carbonates combine with the carbondioxide to again form the soluble bicarbonates.

$$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$$

06. Ans: (b)

Sol:

Chlorine demand to treat 1 lit of water = 0.2 mg/*l* ……(1)

Let, x mg of bleaching powder, containing 35% chlorine = (x × 0.35) mg chlorine present in water…(2)

To balance, we have

$0.2 = x \times 0.35$

$X = 0.2/0.35 = 0.571 \simeq 0.6$ mg

07. Ans: (c)

Sol:

- Copperas produces heavy floc and can therefore remove much more suspended matter than the alum.
- Time required for formation of iron flocs is lesser than that required for alum flocs.
- Copperas being good oxidising agents can remove hydrogen sulphide and its corresponding tastes and odour from water
- Copperas imparts more corrosiveness to water than that which is imparted by alum.

08. Ans: (d)

Sol: When solids are present in excessive concentration, forms a sludge blanket at the bottom of the secondary settling tank , the settling occurs only by compression, caused by the weight of the particles which are constantly added to the structure by settling. This is called Type 4 settling.

09. Ans: (d)

10. Ans: (b)

Sol: $\text{SVI} = \frac{V_{ob}}{X_{ob}} \times 1000 \left(\frac{\text{m}\ell}{\text{gm}} \right)$

V_{ob} = settled volume observed (m*l*/*l*)

X_{ob} = MLSS observed (mg/*l*)

$\text{SVI} = \frac{300}{3000} \times 1000 = 100$ m *l*/gm

11. Ans: (d)

Sol:

- Skimming tank is provided before sedimentation tank.
- Vaccuators are used to remove grease
- Flocculent settling occurs at concentration < 100 mg/*l*
- Recirculation of sewage is not done in case of Standard rate trickling filter.

12. Ans: (b)

13. Ans: (c)

Sol:

- In Bangalore method, the process of composting is Anaerobic.
- Pyrolysis is the best method for disposal of plastic and rubber waste.
- Pyrolysis means combustion of waste in the absence of air.
- When sewage is continuously applied on a piece of land, the pores or voids in the soil gets clogged and the free circulation of air will be prevented that leads to sewage sickness.

14. Ans: (b)

Sol:

- Particulates causes respiratory illness, whereas photochemical oxidants causes coughing, shortness of breadth, headache etc.
- Carbon monoxide combines with haemoglobin present in the blood to form carboxy-heamoglobin which stops the circulation of blood. This leads to unconscious or death.

15. Ans: (d)

Sol: Height of column will be more for less turbid water as longer will be the length of the path travelled by light & vice versa.

16. Ans: (a)

17. Ans: (d)

Sol:

Let the mass of waste sample be M moisture % of sample

$$= \frac{0.20M \times 60\% + 0.30 \times 8\% + 0.10M \times 5\% + 0.05M \times 5\%}{M}$$

$= 15.15\%$

18. Ans: (c)

19. Ans: (c)

Sol:

$h_{fb} = L\,(1 - n)\,(S - 1)$

$0.45 = L\,(1 - 0.54)\,(2.5 - 1)$

$$L = \frac{0.45}{0.46 \times 1.5} = \frac{0.45}{0.69} = 0.652\,m$$

20. Ans: (c)

21. Ans: (d)

Sol: All the three statements are the purpose of Aeration.

22. Ans: (b)

Sol:

- Tube well water is pure as water percolates and goes through natural filtration.
- For slow sand filter, uniformity coefficient varies from 1.8 to 2.5 while for rapid sand filter, it varies from 1.2 to 1.8.
- BOD of safe drinking water should be zero.

23. Ans: (No Answer)

Sol:

$$Q_D = 8640\,m^3/day$$

$$= 8640 \times \frac{1}{24 \times 60 \times 60}$$

$= 0.1\ m^3/sec$

$$BOD_{mix} = \frac{BOD_D Q_D + BOD_R Q_R}{Q_D + Q_R}$$

$$BOD_{mix} = \frac{0.1 \times 100 + 1.2 \times 0}{0.1 + 1.2}$$

$$= \frac{10}{1.3} = 7.69$$

24. Ans: (d)

Sol: Ammonia is used as a dechlorinator because it reacts with chlorine to form chloramines.

25. Ans: (d)

Sol: Volume based on BOD loading

$$= \frac{\text{Total BOD}}{\text{BOD loading}}$$

$$= \frac{4000(\text{kg})}{0.4(\text{kg}/\text{m}^3/\text{d})} = 10000\ \text{m}^3$$

Volume based on aeration period = $Q \times D_t$

$$= 20\times10^3\left(\frac{\text{m}^3}{\text{d}}\right)\times\frac{6}{24}(\text{day})$$

$$= 5000\ \text{m}^3$$

$\therefore$ Maximum of both

$\therefore$ V = 10,000 m^3

26. Ans: (a)

27. Ans: (c)

Sol:

At the end of active decomposition zone, DO level again raises to 40% of saturation.

28. Ans: (b)

Sol:

$$V = \left(V_1 - \frac{2}{3}(V_1 - V_2)\right)\times t$$

V_1 = vol. of undigested sludge

V_2 = vol. of digested sludge

$$= \left(20 - \frac{2}{3}(20-10)\right)\times 15$$

V = 200 m^3

29. Ans: (a)

Sol:

Foul gases are released in use of spray nozzle application.

30. Ans: (d)

31. Ans: (a)

Sol:

Sanitary land filling is allowed for pre-processing and post processing waste from waste processing plant.

32. Ans: (a)

Sol:

Dry air cools at the rate of 9.8°C per km and it is called dry adiabatic lapse rate

Resulting temperature of air

$$= 40 - 9.8 \times \frac{500}{1000} = 35.1°C$$

33. Ans: (b)

Sol: $\text{Lime} = \frac{56}{100} \times 250$

$\Rightarrow$ 140 mg/lit as $CaCO_3$

Quantity = 140 kg

34. Ans: (c)

35. Ans: (c)

36. Ans: (a)

Sol:.

Navigation channel with high velocity currents carrying floating debris, so for locating intake structure navigation channel should be avoided.

37. Ans: (c)

38. Ans: (d)

Sol:

F = Total infiltration water in 2 hours = 80 cm

f_o = 300 mm/hr f_c = 100 mm/hr

$$F_s = \frac{f_o - f_c}{k} + f_c t$$

$$800 = \frac{300 - 100}{k} + 100 \times 2$$

$$600 = \frac{200}{k}$$

$$k = \frac{200}{600} = \frac{1}{3}$$

39. Ans: (d)

Sol:

For a wide rectangular channel from Manning's formula

$$Q = A \times \frac{1}{n}(R)^{2/3}(S)^{1/2}$$

$A = b \times d$

$$R = \frac{bd}{b + 2d}$$

$$\therefore b >> d \Rightarrow R = \frac{bd}{b}$$

$$R = d$$

$$\therefore Q = bd.\frac{1}{n}(d)^{2/3}(S)^{1/2}$$

$$= \frac{1}{n}b(S)^{1/2}(d)^{5/3}$$

$Q = (const)\ (d)^{5/3}$

Given $Q = C_r\ (G - a)^{\beta}$ when n, b, s are constant

$$G - a = d$$

$$\therefore \beta = \frac{5}{3} = 1.67$$

40. Ans: (c)

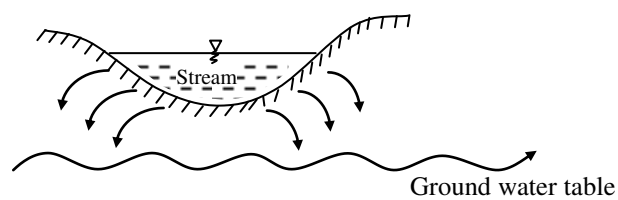
Sol:

1. Blaney-criddle equation gives potential evaporation relating it to sunshine and temperature which are taken as a measure of solar radiation.
2. Stilling well gauges an instrument used for measuring sea level by the movement of float in a well and these gauges are in contact with sea water by restricted hole or narrow pipes .Bubble gauges do not have stilling wells.
3. Gauges are used to measure water surface elevation by fixing rigidly to a structure due to different ground levels (or) change in width of stream etc. It is not possible to measure the water surface elevation at all sections by a single gauge. Hence gauges are built in sections at various locations called as sectional gauges.

41. Ans: (d)

Sol:

1. When the water table intersects a land surface, ground water comes out to the surface in the form of springs or seepage.
2. The water table retained in impervious stratum is called as perched water table and the yield is very small as it is of limited extent and surrounded by material.
3. Perennial rivers are effluent streams and they get water from the surface of water table .these streams will rise or fall as the water table rises or fall.
4. Influent streams are disappearing streams because they loose water as it flow downward or infiltrate into the ground, so depression is formed.



GATE TOPPERS

GATE 2017

ESE TOPPERS

ESE 2017

CE

7 IN TOP 10 RANKS

7 All India 1st Rank in ESE.

E&T

8 IN TOP 10 RANKS

EE

7 IN TOP 10 RANKS

and many more...

ME

5 IN TOP 10 RANKS

27 Ranks in Top 10 in ESE-2017

ACE Engineering Academy
Leading Institute for ESE/GATE/PSUs

204, Rahman Plaza, Abids, Hyderabad Ph : 040-23234418/19/20

42. Ans: (b)

Sol:

1. Specific storage is volume of water released from storage from unit volume of aquifer due to unit decrease in piezometric head.

   Dimensions L^{-1} Storage coefficient or storativity is Volume of water released by a column of confined aquifer from unit c/s area under unit decrease in piezometric head and has no dimensions.
2. Intrinsic permeability (K_o) units m^2 (or) cm^2 (i.e L^2)

   $= L^2$
3. Specific capacity of well = Discharge per unit draw down

$$(K_o) = \frac{Q}{H}$$

$$= \frac{L^3T^{-1}}{L} = L^2T^{-1}$$

43. Ans: (b)

Sol:

The part of precipitation that moves over land surface to reach channels is called overland flow.

The part of precipitation that infiltrates and moves laterally through upper crests of soil and returns to surface at some other location from point of entry is called interflow.

If the interflow occurs with least time lag it is called prompt interflow and with max. time lag is called delayed interflow.

The part of precipitation that infiltrates deep into the ground water storage, and reaches the surface travelling a long path with more time lag is called ground water flow.

44. Ans: (b)

Sol:

For a channel, total storage is

$S = K[xI^n + (1 - x)Q^n]$

If n = 1, then storage is a linear relationship in terms of I, Q and is called as Muskingam equation.

45. Ans: (b)

Sol:

Time (hr)	2 hr UH ordinates	S-curve addition	S-curve ordinates
0	0	-	0
1	1	-	1
2	1	0	1
3	0	1	1
4	0	1	1
5	0	1	1

46. Ans: (c)

Sol:

Area under unit hydrograph = volume of runoff due to km eff. Rainfall

$$\Rightarrow \frac{1}{2}\times 50\times[(8+4)\times 3600] = A\times 10^6 \times \frac{1}{100}$$

$$\Rightarrow A = 108 \text{ km}^2$$

47. Ans: (d)

Sol:

Ryve's formula can be used for southern states

$$Q_p = C_R\,(a)^{2/3}$$
$$= 7\,(64)^{2/3}$$
$$= 112 \text{ m}^3/\text{sec}$$

48. Ans: (b)

Sol:

In reservoir routing storage is function of outflow only

$$S = f[Q]$$
$$S = K[x.I + (1-x)Q]$$

X=0 for linear storage or linear reservoir

$$S = k[Q]$$

So, routing storage is a function of outflow only.

49. Ans: (b)

Sol:

1. In Lacey's regime channel when depth, longitudinal slope and width attains equilibrium then the channel reaches final regime
3. According to Lacey's theory, silt is kept in suspension by eddies generated from the perimeter of the channel.

50. Ans: (b)

51. Ans: (c)

Sol:

$$\text{Duty} = 8.64\times\frac{B}{\Delta}$$

Where, B = Base period in days

= 30 days

Δ = Delta in meters

D = duty in Ha/cumecs

$$\text{Duty} = 8.64\times\frac{30}{\frac{(56-8)}{100}}$$

$$= 864\times\frac{30}{48}$$

= 540 Ha/cumecs

Losses = 100 – 25 = 75%

Duty = 540 × 0.75 = 405 Ha/cumecs

52. Ans: (c)

Sol:

Vertical acceleration reduces the unit weight of the dam material and that of water by 10%.

53. Ans: (b)

Sol:

1. Crop period is the time period that elaspses from the instant of its sowing to the instant of its harvesting is called crop period.
2. The time between the first watering of a crop at the time of its sowing to its last watering before harvesting is called base period
3. Watering done prior to sowing is called paleo irrigation
4. Duty of water at distributary channel is outlet factor

54. Ans: (b)

Sol:

Statement 2: classification of saline and alkaline soils depends on electrical conductivity and p^H of soil.

Statement 3: $\left(SAR = \dfrac{Na}{\sqrt{\dfrac{Ca + Mg}{2}}} \right)$

55. Ans: (d)

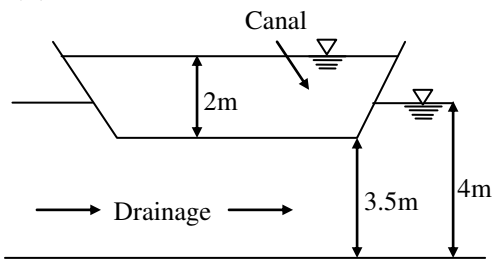
Sol:

1. Net Irrigation Requirement
$= C_u - R_e = 10 - 3 = 7$ cm
2. Field Irrigation Requirement
$$= \frac{NIR}{\eta_a} = \frac{7}{1-0.2} = 8.75\,cm$$
3. Gross Irrigation Requirement
$$= \frac{FIR}{\eta_c} = \frac{8.75}{1-0.125} = \frac{8.75}{0.875} = 10\,cm$$

56. Ans: (c)

57. Ans: (b)

Sol:



Canal will be under siphonic action because of drain water so, this type of cross drainage work is siphon acqueduct.

58. Ans: (d)

59. Ans: (b)

Sol: Limiting height, $H = \dfrac{\sigma}{\gamma_w (G+1)}$

$$H = \frac{42 \times 1000}{1(3.2+1)} = 10{,}000\,cm$$

$= 100$ m ($\gamma_w = 1 \times 10^{-3}$ kg/cc)

60. Ans: (a)

Sol:

Lacey's Regim score depth is

$$R_L = 1.35\left(\frac{q^2}{f}\right)^{1/3}$$

$f = 1$

$$= 1.35\left(\frac{8^2}{1}\right)^{1/3} = 5.4 \text{ m}$$

61. Ans: (d)

Sol:

- Irrigation canals are generally not constructed at maximum gradient since it results in high velocity and lowers FSL of the canal.
- Lower FSL cannot irrigate much area.
- Maximum grade will allow free flow of water so, more water for irrigation is available to cultivate more dry land (Arid land).

62. Ans: (a)

63. Ans: (b)

Sol:

Both the statements are correct but Reason is not correct explanation Statement (I).

Correct reason is oil and grease do not coagulate at higher temperature.

64. Ans: (d)

Sol:

Energy generation in incineration also depends upon moisture content and presence of inert in the waste.

65. Ans: (a)

Sol:

Since F/M ratio is less, BOD removal efficiency is high.

66. Ans: (b)

67. Ans: (d)

Sol:

Very high weir loading rate causes turbulence.

68. Ans: (a)

69. Ans: (c)

Sol:

ClO_2 is formed on site by combining Cl_2 and sodium chloride ClO_2 is after used as a primary disinfectant, inactivating bacteria and cysts and ClO_2 does not maintain a residual long enough to be useful as a distribution system disinfectant.

70. Ans: (c)

Sol:

Pre-chlorination does not insures residual chlorine.

71. Ans: (d)

Sol:

Sequence of treatment unit will depend not only on the qualities of the raw water available and treated water desired but also on the comparative economics of the alternative treatment steps applicable.

72. Ans: (a)

Sol:

Dilution method is based on the assumption of steady flow. If the flow is unsteady flow rate changes and storage volume changes and steady state continuity equation are not applicable.

73. Ans: (c)

Sol:

Chemicals like cetyl alcohol and steryl alcohol form thin films on water surface and they are strong flexible closes back soon if punctured by impact raindrops. Also, the water quality is not affected and is previous to oxygen and carbon dioxide.

74. Ans: (c)

Sol:

When the storm moves from upstream to downstream there will be quicker concentration of flow at basin outlet. Hence time base is less and peak is more.

More vegetation cover implies more infiltration and storage capacities of soil and delayed flow occurs. Hence the peak flow is less.

75. Ans: (d)

Sol:

Prism storage is the volume formed by an imaginary plane parallel to channel bottom at the level of water surface at outflow section. Hence it is assumed to be constant.

Wedge storage is the volume between actual water surface profile and top surface to prism storage (i.e. level of depth outflow section).

When the flood is advancing the u/s water level is more hence wedge storage is positive. When it is receding u/s water level is less resulting is negative wedge storage.