Class Test Solution (IRRIGATION) 08-09-2019
Answer key

1.	(b)	**16.**	(b)	**31.**	(c)	**46.**	(c)	**61.**	(c)
2.	(d)	**17.**	(d)	**32.**	(c)	**47.**	(c)	**62.**	(c)
3.	(d)	**18.**	(d)	**33.**	(a)	**48.**	(b)	**63.**	(c)
4.	(c)	**19.**	(a)	**34.**	(b)	**49**	(b)	**64.**	(c)
5.	(c)	**20.**	(b)	**35.**	(d)	**50.**	(c)	**65.**	(b)
6.	(a)	**21.**	(b)	**36.**	(a)	**51.**	(d)	**66.**	(c)
7.	(b)	**22.**	(c)	**37.**	(c)	**52.**	(b)	**67.**	(c)
8.	(b)	**23.**	(d)	**38.**	(c)	**53**	(d)	**68.**	(a)
9.	(d)	**24**	(c)	**39.**	(c)	**54.**	(b)	**69.**	(b)
10.	(c)	**25.**	(c)	**40.**	(c)	**55.**	(c)	**70.**	(d)
11.	(b)	**26.**	(b)	**41.**	(a)	**56.**	(c)	**71.**	(a)
12.	(a)	**27.**	(c)	**42.**	(c)	**57.**	(b)	**72.**	(a)
13.	(b)	**28.**	(d)	**43.**	(b)	**58.**	(b)	**73.**	(c)
14.	(b)	**29.**	(a)	**44.**	(b)	**59.**	(c)	**74.**	(c)
15.	(d)	**30.**	(d)	**45.**	(c)	**60.**	(a)	**75.**	(d)

CLASS TEST [IRRIGATION] SOLUTIONS

1. (b)

2. (d)

Time of irrigation of border strip (t) is

$$t = 2.303\frac{y}{f}\log_{10}\left(\frac{q}{q - fA}\right)$$

$$= 2.303 \times \frac{7.5}{2}\log_{10}\left(\frac{0.060 \times 60 \times 60}{0.060 \times 60 \times 60 - (2/100)(8 \times 250)}\right)$$

= 0.768 hr

3. (d)

4. (c)

5. (c)

Sodium adsorption ratio (SAR)

$$= \frac{Na^{+}}{\sqrt{(Ca^{++} + Mg^{++})/2}}$$

$$= \frac{20}{\sqrt{(10+5)/2}} = 7.30$$

6. (a)

7. (b)

8. (b)

$$D = \frac{8.64B}{\Delta}$$

For kor period of 25 days

$$D = \frac{8.64 \times 25}{0.15}$$

$= 1440$ ha/(m^3/s)

Discharge, $Q = \frac{2880}{1440} = 2$ m^3/s

$= 2$ m^3/s

9. (d)

10. (c)

Water percolated in root zone

$= 1200 \times 0.88 = 1056$ m^3

Area $= 1500$ m^2

depth of water applied (d_w)

$$d_w = \frac{1056}{1500}$$

$d_w = 0.704$ m

$$d_w = \frac{(F.C - M_0) \times \rho_s \times d}{\rho_w}$$

$$d_w = \frac{(F.C - 0.12) \times 1.620 \times 2.4}{1}$$

$0.704 = (F.C - 0.12) \times 1.620 \times 2.4$

$\boxed{F.C = 30.10\%}$

11. (b)

frequency of irrigation

$$= \frac{80(1 - 0.25)}{2.8}$$

= 21.43 days.

12. (a)

Soil moisture deficit

$= (0.35 - 0.20) \times 0.8 \times 1.6$

$= 0.192$ m

the amount of water wasted

$= 0.250 - 0.192$

= 58 mm

$$\% \text{ wasted} = \frac{58}{250} \times 100 = 23.2\%.$$

13. (b)

14. (b)

15. (d)

16. (b)

17. (d)

18. (d)

Net irrigation water required by wheat crop during base period

= Crop requirement of water – rainfall

= 60 – 12

= 48 cm

= 0.48 m

Volume of water required,

$$V_1 = \text{Area} \times 0.48 \text{ m}^3$$

Volume of water supplied by canal during the base period of 120 days with an irrigation efficiency of 70%

$$V_2 = 2.02\times(120\times 86400)\times 0.7$$
$$V_2 = 14660352 \text{ m}^3$$
$$V_1 = V_2$$
$$0.48 A = 14660352$$
$$\boxed{A = 3054.2 \text{ hectare}}$$

19. (a)

20. (b)

Intensity of irrigation for kharif

$= 100 - 65 = 35\%$

Intensity of irrigation for rabi

$= 100 - 50 = 50\%$

annual intensity $= 50 + 35$

$= 85\%.$

21. (b)

Net depth of water needed

$1.6 \times 90\ (0.25 - 0.18) = 10.1$ cm

depth of water at field

$$= \frac{10.1}{0.8} = 12.6 \text{ cm}$$

Conveyance losses

$= 15\%$

depth of water at canal outlet

$$= \frac{12.6}{0.85} = 14.8 \text{ cm.}$$

22. (c)

For Wheat $A = 0.3 \times 10{,}000 = 3000$ ha

$$D = \frac{8.64B}{\Delta} = \frac{8.64\times 4\times 7}{0.135}$$

$= 1792$ ha/cumecs

$$Q = \frac{3000}{1792} = 1.674 \text{ m}^3/\text{s}$$

For Rice

$A = 0.15 \times 10{,}000 = 1500$ ha

$$D = \frac{8.64B}{\Delta} = \frac{8.64\times 3\times 7}{0.19}$$

$= 954.95$ ha/cumec

$$Q = \frac{1500}{954.95} = 1.571 \text{ m}^3/3$$

So design Q = max [Wheat, Rice] = 1.67 m^3/s.

23. (d)

Such an area may be called as a seasonal cropped area or seasonal sown area, such as Rabi or Kharif area. Net sown area is the total cropped area (which is only cropped once) in the entire year, i.e. in both the seasons.

24. (c)

Water depth required at canal

$$= \frac{\text{Water depth required in the field}}{\eta_a \times \eta_c}$$

$$= \frac{10}{0.8\times 0.9} = 13.9 \text{ cm}$$

Water required for 10 ha land

$$= \frac{13.9}{100}\times 10^5$$

$= 13900$ kL

25. (c)

26. (b)

27. (c)

$$\text{Mean depth, } D = \frac{2.0+1.9+1.8+1.6+1.5}{5}$$

$$D = 1.76 \text{ m}$$

Valves of deviations from mean are (2 – 1.76), (1.9 – 1.76), (1.8 – 1.76), (1.6 – 1.76), (1.5 – 1.76)

= 0.24, 0.14, 0.04, –0.16, –0.26

Average of absolute deviations

$$= \frac{0.24+0.14+0.04+0.16+0.26}{5}$$

= 0.168 m

Water distribution efficiency

$$= \left(1-\frac{d}{D}\right) = \left(1-\frac{0.168}{1.76}\right) = 0.9045$$

= 90.45%

28. (d)

$$NIR = 10 - 3 = 7 \text{ cm}$$

$$FIR = \frac{100}{80} \times 7 = 8.75 \text{cm}$$

$$GIR = \frac{8.75}{87.5} \times 100$$

$$GIR = 10 \text{ cm}$$

29. (a)

30. (d)

31. (c)

32. (c)

Quantity of water applied

$$= 5 \times 6 \times 3600 \text{ m}^3$$

$$= 10.8 \text{ ha} - \text{m}$$

Depth of water applied

$$= \frac{10.8}{30} = 0.36 \text{ m}$$

$$\text{Depth stored} = 0.25 \text{ m}$$

$$\text{Efficiency} = \frac{0.25}{0.36} \times 100 = 69\%$$

33. (a)

34. (b)

35. (d)

36. (a)

37. (c)

$$Q = 50 \text{ m}^3/\text{s}$$

$$f = 1.1$$

$$V = \left[\frac{Qf^2}{140}\right]^{1/6} = \left[\frac{50 \times (1.1)^2}{140}\right]^{1/6}$$

$$V = 0.869 \text{ m/s}$$

$$\text{Slope, } S = \frac{f^{5/3}}{3340\, Q^{1/6}} = \frac{(1.1)^{5/3}}{3340 \times (50)^{1/6}}$$

$$S = \frac{1}{5469}$$

38. (c)

39. (c)

$$G_E = \frac{H}{d} \times \frac{1}{\pi} \times \frac{1}{\sqrt{\lambda}}$$

$$\lambda = \frac{1 + \sqrt{1 + \alpha^2}}{2}$$

$$\alpha = b/d$$

$$\alpha = \frac{10}{1.5} = 6.67$$

$$\lambda = \frac{1 + \sqrt{1 + 6.67^2}}{2} = 3.87$$

$$G_E = \frac{4}{1.5} \times \frac{1}{\pi} \frac{1}{\sqrt{3.87}} = 0.43$$

40. (c)

$$S = \frac{f^{5/3}}{3340\, Q^{1/6}} = 2 \times 10^{-4}$$

$$f^{5/3} = (2 \times 10^{-4})\,(3340)\,(100)^{1/6}$$

$$f = 1.224$$

41. (a)

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

P increases with increase in Q.

42. (c)

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

$$= 1.35\left(\frac{10^2}{1}\right)^{1/3}$$

$$R = 6.26 \text{ m}$$

43. (b)

Assume 1 km length

$$\text{Annual benefit : } 1000 \times 20 \times \frac{3}{10^6} \times 4 \times 10^5$$

$$= \text{Rs. } 24000 \text{ per year}$$

$$\text{Annual cost} = \frac{1000 \times 20}{40} \times 40$$

$$= 20000 \text{ per year}$$

$$\text{B.C. ratio} = \frac{24000}{20000}$$

$$= 1.2$$

44. (b)

$$Q = 25 \text{ m}^3/\text{s}$$

$$f = 0.98$$

$$V_f = \left[\frac{Qf^2}{140}\right]^{1/6}$$

$$V_f = \left[\frac{25\times 0.98^2}{140}\right]^{1/6}$$

$$V_f = 0.745 \text{ m/s}$$

Area of flow, $A_f = \frac{Q}{V_f} = \frac{25}{0.745}$

$$A_f = 33.55 \text{ m}^2$$

45. (c)

for 1.5 H:1V

$$\tan\theta = \frac{y}{x} = \frac{1}{1.5}$$

$$\sin\theta = 0.554$$

$$\frac{\tau_c'}{\tau_c} = \sqrt{1-\frac{\sin^2\theta}{\sin^2\phi}} = \sqrt{1-\left(\frac{0.554}{\sin 37}\right)^2}$$

$$\frac{\tau_c'}{\tau_c} = 0.391$$

for stability on banks

$$0.75\gamma_\omega RS \le 0.391\,\tau_c$$

$$< 0.391\,(\gamma\, RS)$$

For stability on bed

$$RS = \frac{d}{11}$$

$$0.75\gamma_\omega RS \le 0.391\frac{\gamma_\omega d}{11}$$

$$RS \le \frac{0.391}{11\times 0.75}d$$

$$RS \le \frac{d}{21}$$

$$R \le \frac{d}{21S}$$

46. (c)

47. (c)

48. (b)

49. (b)

$$f = 1.76\sqrt{d_{mm}}$$

$\because \quad f_A > f_B$

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

$\therefore \quad R_A = R_B$

50. (c)

51. (d)

52. (b)

53. (d)

54. (b)

55. (c)

$$t\gamma_w G_s + 1.8\gamma_w = (9-3.4)\gamma_w$$

$$t = \frac{9-3.4-1.8}{2.6} = 1.46\text{ m}$$

56. (c)

$$\text{Thickness} = \frac{\text{Uplift pressure head}}{\text{Submerged specific gravity}}\times(\text{F.O.S.})$$

$$= \frac{4.5}{1.85}\times 1.33 = 3.23\text{m}$$

57. (b)

58. (b)

59. (c)

60. (a)

61. (c)

$$B = \frac{H}{\sqrt{S_C - C}}$$

C = 0 when uplift is ignored

$$B = \frac{H}{\sqrt{S_C}}$$

$$H = 35\times\sqrt{2.65} = 57\text{m.}$$

62. (c)

63. (c)

64. (c)

90% of initial capacity

$= 0.9 \times 4 \times 10^6$

$= 36 \times 10^5 \text{ m}^3$

Volume of sediment deposited annually till 90% of initial capacity is filled

= Annual sediment inflow × trap efficiency

$= 4 \times 10^4 \times 0.9$

$= 36 \times 10^3 \text{ m}^3$

∴ Number of years during which 90% of initial capacity shall be filled is given by

Probable life of reservoir

$$= \frac{36 \times 10^5}{36 \times 10^3} = 100 \text{ years}$$

65. (b)

$\Delta = 0.19$ m

B = 14 days

$$\text{outlet factor (D)} = \frac{8.64\,B}{\Delta}$$

$$D = \frac{8.64 \times 14}{0.19}$$

$D = 636.6 \text{ ha/m}^3\text{/s}$

66. (c)

67. (c)

68. (a)

69. (b)

70. (d)

71. (a)

72. (a)

73. (c)

74. (c)

75. (d)