IRRIGATION TEST 2

Number of Questions: 25 **Time: 60 min.**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. Consumptive use of water for a crop is equal to the depth of water
(A) evaporated by the crop.
(B) transpired by the crop.
(C) transpired and evaporated by the crop
(D) used by the crop in transpiration, evaporation and also the quantity of water evaporated from adjacent soil.

2. The cross-section of weir in order from upstream to downstream is _____.
(A) launching Apron → Block protection → sheet pile → impervious floor → sheet pile → filter → launching apron
(B) block protection → sheet pile → filter → sheet pile → impervious floor → launching apron
(C) impervious floor → launching apron → sheet pile → block protection → sheet pile → filter → launching apron
(D) filter → impervious floor → sheet pile → block protection → launching apron → sheet pile → launching apron

3. According to Lacey's method for design of alluvial channel, the velocity of flow
(A) increases with increase in design discharge
(B) increases with increase in diameter of silt particle
(C) increases with increase in silt factor
(D) All the above

4. Drainage gallery in a dam is used
(A) to provide drainage of the dam
(B) for post cooling of concrete
(C) Both a and b
(D) None of the above

5. Effective Precipitation for a crop may be defined as
(A) total precipitation from sowing of seeds to cutting of crop.
(B) total precipitation minus loss due to evaporation and infiltration.
(C) total precipitation minus runoff.
(D) available water stored in soil within root zone of the crop.

6. The best method of irrigation for mango trees is
(A) border strip method
(B) basin method
(C) checks or Leeves method
(D) furrow method

7. _____ are called safety valves of a dam.
(A) Diversion headwork's (B) Canal outlets
(C) Spill ways (D) Drainage Gallery

8. Non-modular outlet is the one in which discharge
(A) is independent of water levels in the distributing channel and water course.
(B) varies only with water level in the distributing channel.
(C) Varies only with water level in the water course.
(D) depends on difference in water levels in distributing channel and water course.

9. Main causes of water logging are
(A) surface runoff
(B) steep ground profile
(C) excessive irrigation
(D) All the above

10. If pH < 8.5, the soil is called
(A) acidic soil (B) saline soil
(C) basic soil (D) alkaline soil

11. Match the following.

	Group – A		Group – B
1.	Aqueduct	P.	Bed of drain well above the canal F.S.L
2.	Siphon Aqueduct	Q.	F.S.L of Canal higher than bed of drain
3.	Super passage	R.	High flood level HFL) of drain higher than canal bed
4.	Siphon	S.	Bed of canal is well above the HFL of drain

1 2 3 4 1 2 3 4
(A) *S*, *R*, *P*, *Q* (B) *P*, *Q*, *R*, *S*
(C) *Q*, *P*, *R*, *S* (D) *R*, *S*, *Q*, *P*

12. To irrigate a strip of area of size 100 m × m, the time taken is 50 minutes. Assuming average depth of water is 8 cm and average infiltration is 4 cm/hr. Find the discharge of stream flow in cumecs?
(A) 0.04 cumecs
(B) 0.0163 cumecs
(C) 0.023 cumecs
(D) 0.0368 cumecs

13. The slope of a channel in alluvium is $\frac{1}{3036}$, mean soil particle size is 0.5 mm, velocity = 0.618 m/s. Find the wetted perimeter of the regime channel in meters.
(A) 10.62 (B) 9.46
(C) 11.58 (D) 12.9

14. Find the Exchangeable Sodium Ratio (ESR) where the concentrations of all Sodium, Calcium, Magnesium and Potassium are 161, 200, 108, and 156 in ppm respectively.
(A) 83.33% (B) 43.63%
(C) 68.73% (D) 23.33%

15. An area of 1 hectare has a root zone depth of 1.2 m and available moisture holding capacity is 14 cm per meter depth. It is irrigated through a stream of 0.04 m^3/s. Water is applied to field when 60% of the available moisture is depleted. Irrigation period is 9 hours. If the water application efficiency is 70% determine the storage efficiency.
(A) 64.3% (B) 72%
(C) 58% (D) 49%

16. The moisture content of soil in the root zone of an agricultural crop at certain stage is found to be 0.06. The Field Capacity of the soil is 0.14. The root zone depth is 1.6 m. The consumption use of crop at this stage is 3mm/day and there is no precipitation during this period. Irrigation efficiency is 60%. It is intended to raise the moisture content to the field capacity in 9 days through irrigation. The necessary depth of irrigation in (mm) is _____.
(A) 250 (B) 257
(C) 300 (D) 310

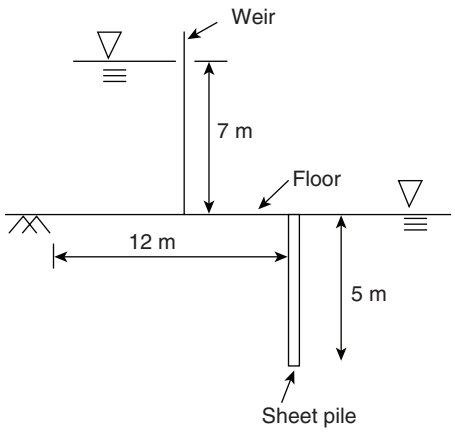
17. The transplantation of chilli crop takes 20 days and the total depth of irrigation water required by the crop is 50 cm on field. During this period, useful rainfall on field is 10 cm. Find the duty of irrigation water for this crop on the field during transplantation period. Assuming 30% losses of water in water course, find the duty at the head of water course in hectares/cumec.
(A) 208 (B) 250
(C) 302 (D) 350

18. In a gravity dam the friction coefficient is 0.8. Sum of vertical forces = 7000*t* and sum of Horizontal forces = 4000*t*. Base width is 80m and shear strength is 150 t/m^2. Find FOS against sliding and shear friction factor at base?
(A) 4.4 and 1.4 (B) 1.4 and 4.4
(C) 3.2 and 1.6 (D) 1.6 and 3.2

19. The limiting height of gravity dam with material of concrete having specific gravity of 2.5 is equal to 100m. Find crushing stress of concrete (in kg/cm^2).
(A) 20 (B) 25
(C) 30 (D) 35

20. Find the design head (H_d) of the Ogee spill way when a coordinate (– 10, 5) of the point on the D/s profile with origin at the crest of the spill way is _____.
(A) 0.56 m (B) 0.72 m
(C) 0.98 m (D) 1.1 m

21. A weir on the permeable foundation with downstream sheet pile is shown in figure below. The exit gradient as per Khosla's method is _____.



(A) 1 in 2 (B) 1 in 3
(C) 1 in 4 (D) 1 in 5

22. Match the following.

	Group – A		Group – B
1.	Bligh's theory	P.	UpperBariDoabCanal
2.	Khosla's theory	Q.	Regime Channel
3.	Lacey's theory	R.	Sheet pile is more useful at D/S end
4.	Kennedy's theory	S.	Sheet pile is more useful at U/S end

1 2 3 4 1 2 3 4
(A) Q S R P (B) R P S Q
(C) P R Q S (D) S R Q P

23. For a channel to be in regime, conditions to be established are:
(A) Channel should be flowing uniformly in unlimited coherent alluvium.
(B) Silt grade and silt charge should be constant.
(C) Both a and b
(D) None of the above

24. Calculate the bed width for an irrigation channel to carry a discharge of 6 cumecs and side slopes of the channel are $\frac{1}{2}$H : 1V. The critical velocity ratio is 0.9 and depth of flow is 0.8 m. Bed slope is 0.3 m/km.
(A) 13.75 m (B) 15.25 m
(C) 17.04 m (D) 19.21 m

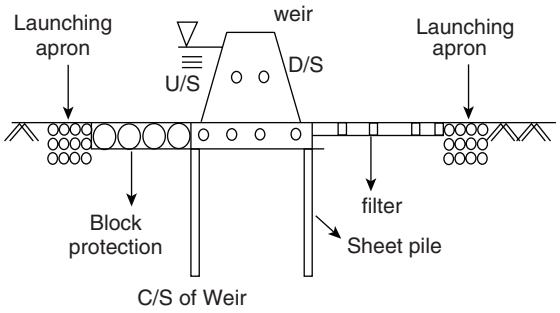
25. Find the spacing of drains in case of closed drains where the depth of impermeable layer from *GL* is 10 m and depth of drain below *GL* is 2 m. Minimum depth of drained *W.T* below *GL* is 1.5 m. Permeability of soil = 1 cm/s. Discharge through drain is 0.02 m^3/s.
(A) 14.5 m (B) 16.5 m
(C) 18.5 m (D) 20.5 m

Answer Keys

1. D	**2.** A	**3.** D	**4.** C	**5.** D	**6.** B	**7.** C	**8.** D	**9.** C	**10.** B
11. A	**12.** B	**13.** A	**14.** D	**15.** A	**16.** C	**17.** C	**18.** B	**19.** D	**20.** C
21. B	**22.** D	**23.** C	**24.** C	**25.** B					

Hints and Explanations

2.



Choice (A)

3. $V = \left(\frac{Qf^2}{140}\right)^{\frac{1}{6}} = \sqrt{\frac{2}{5} fR}$

But $f = 1.76\sqrt{d} \Rightarrow f \propto \sqrt{d}$

$\therefore \quad V \propto Q^{\frac{1}{6}}$

$\propto f^{\frac{1}{3}}$

$\propto d^{\frac{1}{6}}$. Choice (D)

4. Drainage gallery is used
1. To provide drainage of the dam.
2. For drilling and grouting of foundation
3. Post cooling of concrete
4. To lay mechanical equipment for operation of outlet gates and spill way gates. Choice (C)

5. Effective precipitation can mean rainfall and losses. But for a crop it means only available water within root zone that can be easily extracted by plants.
Choice (D)

6. A basin in created surrounding each tree and field channel supplies water to the basin used for irrigation of orchards (fruit trees) Choice (B)

9. Causes of water logging
→ Excessive rainfall irrigation
→ Seepage from canals and lands beside
→ Flat ground profile
→ Improper drainage of surface runoff Choice (C)

12. The time required to irrigate the land

$$t = \frac{y}{I}\log_e\left(\frac{Q}{Q - IA}\right)$$

$$50 \times 60 = \frac{0.8}{\frac{0.04}{60\times60}}\log_e\left(\frac{Q}{Q - \frac{0.04}{60\times60}\times 500}\right)$$

$$1.517 = \frac{Q}{Q - \frac{1}{180}}$$

$0.517Q = 8.43 \times 10^{-3}$

$Q = 0.0163\ \text{m}^3/\text{s}$. Choice (B)

13. Silt factor $f = 1.76\sqrt{d} = 1.76\sqrt{0.5} = 1.244$

Velocity $V = \left(\frac{Qf^2}{140}\right)^{\frac{1}{6}}$

$$0.618 = \left(\frac{Q\times 1.244^2}{140}\right)^{\frac{1}{6}}$$

$Q = 5\ \text{m}^3/\text{s}$

(OR)

Longitudinal slope

$$S = \frac{f^{\frac{5}{3}}}{3340\,Q^{\frac{1}{6}}}$$

$$\frac{1}{3036} = \frac{(1.244)^{\frac{5}{3}}}{3340Q^{\frac{1}{6}}}$$

$Q = 5\ \text{m}^3/\text{s}$

Perimeter $P = 4.75\sqrt{Q}$

$= 4.75\sqrt{5} = 10.62$ m Choice (A)

14. Exchangeable Sodium Ratio (ESR)

$$= \frac{\text{Na}^+}{\text{Ca}^{++} + \text{Mg}^{++} + \text{Na}^+ + \text{K}^+}$$

All concentrations are in meq/lt

$$\text{Na (meq/lt)} = \frac{161}{23} = 7$$

$$\text{Ca (meq/lt)} = \frac{\frac{200}{40}}{2} = 10$$

$$\text{Mg (meq/lt)} = \frac{\frac{108}{24}}{2} = 9$$

$$\text{K (meq/lt)} = \frac{156}{39} = 4$$

$$\therefore \quad \text{ESR} = \frac{7}{7+10+9+4}\times 100 = 23.33\%$$ Choice (D)

15. Depth of root zone = 1.2 m

Total available depth of water

$y = 14\frac{\text{cm}}{\text{m}} \times 1.2\ \text{m} = 16.8\ \text{cm}$

Water consumed = (100 – 60%) y = 6.72 cm
Water needed to raise upto Field capacity = 16.8 – 6.72 = 10.28 cm
Volume of water supplied = 0.04 × 9 × 60 × 60
= (1296 cm^3)

Application efficiency $\eta_a = 60\% = \dfrac{W_{\text{root zone depth}}}{1296}$

Water in root zone = 778 m^3

Depth of water stored $= \dfrac{778}{1.2\times10^4} = 0.06483$ m

$= 6.483$ cm

$\eta_{\text{storage}} = \dfrac{\text{water stored in root zone}}{\text{water needed to raise the w/c to } F.C}$

$\therefore \quad \eta_{\text{storage}} = \dfrac{6.483}{10.08} = 0.643 = 64.3\%.$ Choice (A)

16. d = 1.6m, OM = 0.06
FC = 0.14, C_u = 3 mm/day
Trying with S = 1
Depth of water in root zone $d_w = d.s[F.C - OM]$
= 1.6 × 1[0.14 – 0.06]
= 0.128 m = 128 mm
Total depth of water to be kept in root zone
= 128 + Cu × time
= 128 + (3 × 9)
= 155 mm

Total depth to be released at head canal $= \dfrac{155}{\eta_a} = \dfrac{155}{0.6}$

= 258 mm

Answer must be > 258 mm (assumed S = 1)
$\therefore$ depth of irrigation = 300 mm (>258 mm)
Choice (C)

17. Irrigation depth of water
Δ = 50 – 10 = 40 cm = 0.4 m
Base period, B = 20 days

D_F, duty at field $= \dfrac{8.64\,B}{\Delta} = \dfrac{8.64\times20}{0.4}$

= 432 hectares/cumec
Duty at head of canal = $D_F \times \eta_C$
= 432 × [1 – 0.3] [$\because$ losses = 30%]
= 302.4 hectares/cumec. Choice (C)

18. Sliding $FOS = \dfrac{\mu\Sigma V}{\Sigma H} = \dfrac{0.8(7000)}{4000} = 1.4$

Shear Friction Factor (SFF) $= \dfrac{\mu\Sigma V + (b\times1\times q)}{\Sigma H}$

$= \dfrac{0.8(7000)+(80\times150)}{4000}$

= 4.4. Choice (B)

19. Critical Height of dam

$H_C = \dfrac{f_C}{w[S+1]}$

$100 = \dfrac{f_C}{1000[2.5+1]}$

$f_c = 3.5 \times 10^5$ kg/m^2
Crushing stress f_c = 35 kg/cm^2 Choice (D)

20. Equation of Ogee spill way

$\dfrac{y}{H_d} = -0.5\left(\dfrac{x}{H_d}\right)^{1.85}$

$(x, y) = (5, -10)$

$\dfrac{-10}{H_d} = -0.5\left(\dfrac{5}{H_d}\right)^{1.85}$

$\dfrac{H_d^{1.85}}{H_d} = 0.982$

$H_d^{0.85} = 0.982$

H_d = 0.978 m. Choice (C)

21. Exit Gradient $G_E = \dfrac{H}{d\pi\sqrt{\lambda}}$

$\propto = \dfrac{b}{d} = \dfrac{12}{5} = 2.4$

$\lambda = \dfrac{1+\sqrt{1+\propto^2}}{2} = \dfrac{1+\sqrt{1+2.4^2}}{2} = 1.8$

$G_E = \dfrac{7}{5\pi\sqrt{1.8}} = 0.332$

$\Rightarrow$ 1 in 3.01. Choice (B)

22. Bligh's Theory:

$t_{\min} = \dfrac{h}{(G_C - 1)}$

To minimize floor thickness sheetpile is more useful at U/S end
Khosla's theory:
Exit Gradient, $G_E = \dfrac{H}{d\pi\sqrt{\lambda}}$

H = head causing flow
To avoid piping Khosla's proposed sheet pile @ D/s end.
Kennedy made his observations on Upper Basi Drab Canal
Lacey's equations are applicable for regime channel.
Choice (D)

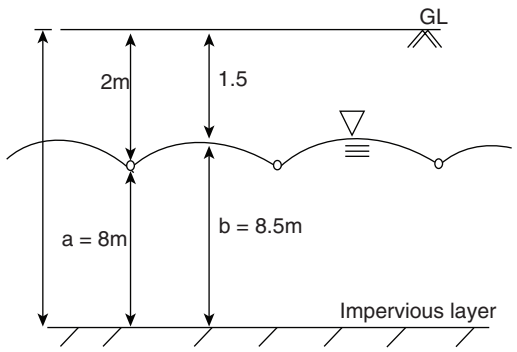
23. For a channel in regime conditions
1. Channel should be flowing uniformly.
2. Silt grade and silt charge should be constant
3. Discharge should be constant Choice (C)

24. $Q = 6$ cumecs
Critical velocity ratio. $M = 0.9$
$D = 0.8$ m
$V_K = 0.55 \text{ m } D^{0.64}$
$= 0.55\ (0.9)\ (0.8)^{0.64} = 0.43$
$A = (B + 0.5D)D = 0.8\ B + 0.32$
$Q = A.V_K$
$6 = (0.8\ B + 0.32)\ 0.43$
$B = 17.04$ m Choice (C)

25. Spacing of drains

$$L = \frac{4k\left(b^2 - a^2\right)}{Q_o}$$

$b = 10 - 1.5 = 8.5$
$a = 10 - 2 = 8$



$$L = \frac{4 \times 0.01\left(8.5^2 - 8^2\right)}{0.02} = 16.5 \text{ m}$$

$\therefore$ Spacing of drains = 16.5 m Choice (B)