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Chapterwise Multichoice Objective Questions

CHAPTER -1

Q. 1. Irrigation is basically required in :

(*a*) humid regions (*b*) arid regions

(*c*) semi arid regions (*d*) all of the above.

Q. 2. Irrigation may not be needed in :

(*a*) England (*b*) Israel

(*c*) India (*d*) none of the above.

Q. 3. Pinpoint the correct statement :

(*a*) irrigation helps in adopting mixed cropping

(*b*) 'mixed cropping' means sowing of a different crop after a particular crop has been grown

(*c*) over-irrigation may lead to saving in fertilizers

(*d*) irrigation helps in avoiding mixed cropping.

Q. 4. 'Flood irrigation' method of irrigating fields, works best on :

(*a*) level or gently rolling terrain

(*b*) steeply rolling terrain

(*c*) both (*a*) and (*b*)

(*d*) none of the above.

Q. 5. In flood irrigation, the preferred method of applying irrigation water to the comparatively steeper rolling land, is :

(*a*) check flooding (*b*) boarder flooding

(*c*) wild flooding (*d*) basin flooding.

Q. 6. Fields enclosed by dikes, where rice is grown, are called :

(*a*) paddies (*b*) furrows

(*c*) basins (*d*) none of the above.

Q. 7. The method of growing crops on ridges, running on the sides of water ditches, is known as :

(*a*) flood irrigation (*b*) furrow irrigation

(*c*) check irrigation (*d*) none of them.

Q. 8. In a field under furrow irrigation, 'furrows' are referred to represent:

(*a*) ridges on which crops are grown

(*b*) narrow ditches which carry irrigation water

(*c*) both (*a*) and (*b*)

(*d*) neither (*a*) nor (*b*).

Q. 9. In a mildly water scarce area, the drip irrigation could be preferred for growing :

(*a*) wheat (*b*) fodder
(*c*) rice (*d*) fruits and vegetables.

Q. 10. The most suitable water for irrigation is :

(*a*) C 1—S 1 (*b*) C 2—S 2
(*c*) C 4—S 1 (*d*) C 1—S 4.

Q. 11. Addition of gypsum to the irrigation water is recommended to overcome difficulties posed by :

(*a*) highly saline irrigation supplies
(*b*) irrigation supplies containing high quantities of sodium
(*c*) irrigation supplies containing heavy sediment
(*d*) all of the above.

Q. 12. The electrical conductivity of medium saline water (C 2) at 25°C is of the order of :

(*a*) 50 to 100 μΩ/cm (*b*) 100—250 μΩ/cm
(*c*) 250 to 750 μΩ/cm (*d*) 750—1500 μΩ/cm.

Q. 13. The Sodium Absorption Ratio of an irrigation water is 8. This water will be called :

(*a*) low sodium water (*b*) medium sodium water
(*c*) high sodium water (*d*) none of the above.

Q. 14. High sodium content in irrigation water is :

(*a*) generally good
(*b*) generally bad
(*c*) generally good, but bad for a few crops
(*d*) generally bad, but good for a few crops.

Q. 15. Salinity in irrigation water is measured by :

(*a*) SAR value (*b*) Electrical-conductivity value
(*c*) pH-value (*d*) none of the above.

Q. 16. The time required to irrigate a strip of area 0.203 hectare by a stream discharge of 0.043 cumec, to provide an average depth of 6.35 cm to the field, is : (assume average rate of infiltration to be 5 cm/h)

(*a*) 2.75 hour (*b*) 1.35 hour
(*c*) 1.5 hour (*d*) 1.90 hour. (*Calcutta University*)

Q. 17. If the concentration of Na, Ca, and Mg in a water sample are 345, 60 and 18 mg/1, respectively, then the Sodium Absorption Ratio (SAR) of this water will be :

(*a*) 5 (*b*) 10.
(*c*) 39 (*d*) 55.

CHAPTER 2

Q. 18. With the increase in supplied irrigation water, the yield of crops:

(*a*) increases continuously
(*b*) decreases continuously
(*c*) increases up to a certain limit, and then becomes constant
(*d*) increases up to a certain limit, and then decreases.

Q. 19. The most expected crops in a hot arid district of Rajasthan State in India, in the month of September, are :
(*a*) Rice and Sugarcane (*b*) Bazra and Maize
(*c*) Wheat and Maize (*d*) Tobacco and Cotton.

Q. 20. The maximum irrigation requirement of Rice crop is exhibited by its :
(*a*) maximum delta value (*b*) maximum duty value
(*c*) minimum duty value (*d*) none of the above.

Q. 21. The crop among the following, which is expected to have the maximum duty, is
(*a*) Wheat (*b*) Rice
(*c*) Sugarcane (*d*) Cotton.

Q. 22. Kor-Watering is the irrigation water supplied to a crop :
(*a*) at the time of its sowing
(*b*) just before harvesting
(*c*) about three weeks after sowing
(*d*) about three weeks before harvesting.

Q. 23. The duty of irrigation water for a given crop is maximum :
(*a*) on the field
(*b*) at the head of the main canal
(*c*) at the head of the water-course
(*d*) none of them.

Q. 24. The important Govt. reference made to the 'duty for a crop,' is usually related to its duty :
(*a*) on the field
(*b*) at the head of the main canal
(*c*) at the head of the water course
(*d*) none of them.

Q. 25. The duty at the end point of a canal minor, where the Govt. control usually ceases, is called :
(*a*) duty on field (*b*) outlet duty
(*c*) flow duty (*d*) storage duty.

Q. 26. The first important watering of crops is usually called :
(*a*) paleo watering (*b*) kor-watering
(*c*) crop-watering (*d*) all of the above.

Q. 27. The crop sequence, which cannot serve any useful purpose in 'Crop rotation', is :
(*a*) Wheat—Juar—Gram (*b*) Rice—Gram—Rice
(*c*) Cotton—wheat—Gram (*d*) Rice—Wheat—Cotton.

Q. 28. The optimum depth of kor watering for rice is about :
(*a*) 25 cm (*b*) 19 cm
(*c*) 13.5 cm (*d*) 9 cm.

Q. 29. The kor period, within which a crop must receive its first major watering, will be :
(*a*) less for humid climates (*b*) less for dry climates
(*c*) equal for all climates (*d*) none of the above.

Q. 30. The crop, out of the following, which is not a cash crop, is :
(*a*) Jute (*b*) Tea
(*c*) Rice (*d*) Sugarcane.

Q. 31. In India, the cultivated area under Rabi season is generally x times the area under Kharif season; where x is :

(*a*) 1 (*b*) $\frac{1}{2}$

(*c*) 2 (*d*) none of them.

Q. 32. The relationship between the duty D in ha/cumecs, the water depth Δ in cm, and base period B in days, is given by :

(*a*) $D = \frac{864\,B}{\Delta}$ (*b*) $D = \frac{8.64\,B}{\Delta}$

(*c*) $D = \frac{864\,\Delta}{B}$ (*d*) $D = \frac{8.64\,\Delta}{B}$.

Q. 33. Consumptive use of water for a crop represents :

(*a*) The transpiration needs of the crop

(*b*) evaporation needs of the cropped area.

(*c*) evapotranspiration needs of the cropped area plus the minor quantity required in plant metabolism

(*d*) None of the above.

Q. 34. The amount of irrigation water required to fulfil the evapo-transpiration and minor metabolic plant needs per unit of cropped area is called :

(*a*) consumptive use

(*b*) consumptive irrigation requirement

(*c*) net irrigation requirement

(*d*) none of the above.

Q. 35. When there is no percolation loss for leaching and other such soil needs, then the Net irrigation requirement (NIR) of a cropped area, will be equal to :

(*a*) the consumptive use (C_u)

(*b*) $C_u - R_e$: where R_e is effective rainfall during cropping

(*c*) $\frac{C_u - R_e}{\eta_a}$: where η_a is water application efficiency

(*d*) none of the above.

Q. 36. The Gross Irrigation Requirement (GIR) of water is equal to :

(*a*) NIR + η_a (*b*) NIR + $\eta_a \cdot \eta_c$

(*c*) NIR + $\frac{\eta_a}{\eta_c}$ (*d*) none of above.

where η_a = water application efficiency

η_c = water conveyance efficiency.

Q. 37. The ratio of the water stored in the root zone of a crop, to the water actually delivered to the crop in the field, is known as;

(*a*) water conveyance efficiency

(*b*) water application efficiency

(*c*) water use efficiency

(*d*) none of the above.

Q. 38. The water which can be utilised by the crops from the soil is called :

(*a*) field capacity water (*b*) capillary water

(*c*) hygroscopic water (*d*) none of the above.

Q. 39. The moisture held by a well drained soil against gravity drainage, by the force of surface tension between the soil grains and water drops, is called :

(*a*) field capacity water (*b*) hygroscopic water
(*c*) capillary water (*d*) water of adhesion.

Q. 40. Permanent wilting point moisture content for a crop represents the :

(*a*) hygroscopic water (*b*) capillary water
(*c*) field capacity water (*d*) none of the above.

Q. 41. Available moisture for a crop is equal to :

(*a*) field capacity moisture content—Wilting point moisture content
(*b*) field capacity moisture content—hygroscopic moisture content.
(*c*) both (*a*) and (*b*)
(*d*) none of the above.

Q. 42. The optimum moisture content (m.c.) which is retained in the root zone of a soil, before applying irrigation water, is :

(*a*) equal to : (the field capacity m.c.—wilting point m.c.)
(*b*) less than : (the field capacity m.c.—wilting point m.c.)
(*c*) more than : (the field capacity m.c.—wilting point m.c.)
(*d*) may be more or less than : (the field capacity m.c.—wilting point m.c.) depending upon the crop grown.

Q. 43. Irrigation water is usually applied to the fields, when the available moisture in the root zone of the crop, gets depleted by :

(*a*) 0—10% (*b*) 10—25%
(*c*) 50—80% (*d*) 100%.

Q. 44. Frequency of irrigation is dependent upon the type of :

(*a*) soil and crop (*b*) soil and climate
(*c*) soil, crop, and climate (*d*) soil, crop, climate, and fertilizer.

Q. 45.* A soil has a field capacity of 25%, permanent wilting point of 15%, and specific weight of 14.7 kN/m^3. If the root zone depth of the grown crop is 90 cm, then its available moisture holding capacity is

(*a*) 10 cm (*b*) 13.5 cm
(*c*) 16.67 cm (*d*) 20 cm.

Q. 46. After how many days will you recommend supplying irrigation water to a crop having 0.8 m root zone depth, and grown in a soil having field capacity of 30%, permanent wilting = 15%, and density of soil = 1.5 gm/cc ? The consumptive use for the crop is 5 mm/day, and only 60% of available moisture is permitted to be availed.

(*a*) 9 days (*b*) 15 days
(*c*) 21 days (*d*) 40 days.

Q. 47.* If the irrigation efficiency at a 10 hectare field is 80%, and the conveyance losses from the canal outlet is 10%, then the volume of water required at the canal outlet, for supplying 10 cm water depth in the field, will be equal to;

(*a*) 10,390 kL (*b*) 7200 kL
(*c*) 13,900 kL (*d*) 1,39,000 kL.

Q. 48. The Δ (in m) for a crop, having quantity duty D (in ha/M. cum), and base period B (in days) is given by :

(*a*) $\Delta = \frac{8.64\,B}{D}$ (*b*) $\Delta = \frac{864\,B}{D}$

(*c*) $\Delta = \frac{100}{D}$ (*d*) $\Delta = \frac{10{,}000}{D}$.

*Hints are given at the end of the chapter, for solving starred questions.

Q. 49. The ratio of the water stored in the root zone during irrigation, to the water needed in the root zone prior to irrigation, is called :

(*a*) efficiency of water use
(*b*) efficiency of water storage
(*c*) efficiency of water application
(*d*) efficiency of water conveyance.

Q. 50. If the irrigation water applied to a field penetrates uniformly throughout, then the water distribution efficiency is :

(*a*) 1 (*b*) 0
(*c*) 0.5
(*d*) none of them, as more data is required to ascertain it.

Q. 51. The efficiency of water application does not depend upon :

(*a*) climatic conditions
(*b*) type of the soil
(*c*) method of application
(*d*) geometry of the conveyance system.

Q. 52. The efficiency of water conveyance does not depend upon :

(*a*) climatic conditions
(*b*) geometry of the conveyance system
(*c*) nature of the boundary of the conveyance system
(*d*) method of application of water.

Q. 53. Which of the following is not correctly matched?

(*a*) Rice—Kharif (*b*) Wheat—Rabi
(*c*) Barley—Kharif (*d*) Potatoe—Rabi.

CHAPTER 3

Q. 54. If the intensity of irrigation for Kharif is 45% and that for Rabi is 60%; then the annual intensity of irrigation, is :

(*a*) 60% (*b*) 100%
(*c*) 105% (*d*) none of them.

Q. 55.* If in a certain irrigation project, and in a given year, 72% and 56% of the culturable command remained unirrigated in Kharif and Rabi seasons, respectively; then the intensity of irrigation for that year and for that project, would be :

(*a*) 36% (*b*) 64%
(*c*) 72% (*d*) 128%.

Q. 56. The gross irrigated area cannot exceed the cultivable commanded area :

(*a*) Correct (*b*) Incorrect.

Q. 57.* The area, on which crops are grown in a particular season, is called :

(*a*) culturable commanded area (CCA)
(*b*) gross sown area (*c*) net sown area
(*d*) none of the above.

Q. 58.* The CCA for a particular State is 5 Mha; out of which, 4.5 Mha is being sown in Rabi season and 2.5 Mha in Kharif season. These areas are being irrigated to the extent of 90% and 80%, respectively. The annual intensity of irrigation for this State is :

(*a*) 80.7% (*b*) 85%
(*c*) 100% (*d*) 121%.

Q. 59. In plain areas, the irrigation canals are usually aligned along :
(*a*) ridge lines (*b*) contour lines
(*c*) valley lines (*d*) across the contours.

Q. 60. A ridge canal is also called a :
(*a*) watershed canal (*b*) contour canal
(*c*) side slope canal (*d*) none of the above.

Q. 61. The canal, which may frequently encounter cross-drainage works, will be a:
(*a*) watershed canal (*b*) contour canal
(*c*) side slope canal (*d*) none of these.

Q. 62. In a hilly district, where watershed line is very high as compared to the head-works, which type of alignment you would recommend for a proposed canal, if cross-drainage is to be avoided :
(*a*) canal along the ridge line
(*b*) canal along the contour line
(*c*) canal across the contour lines
(*d*) none of them.

Q. 63. The canal, which can irrigate only on one side, is a :
(*a*) watershed canal (*b*) contour canal
(*c*) side slope canal (*d*) none of them.

Q. 64. The capacity of an irrigation canal is usually controlled by :
(*a*) average kharif demand
(*b*) average rabi demand
(*c*) kor demand of rabi crops
(*d*) kor demand of kharif crops.

Q. 65. The optimum kor water depth for a kharif crop is 19 cm with an allowed kor water period of 3 weeks, the outlet discharge factor for this crop will be:
(*a*) 955 ha/cumec (*b*) 782 ha/cumec
(*c*) 860 ha/cumec (*d*) none of them.

Q. 66.* If the discharge required for different crops grown in a field is 0.4 cumecs, and the capacity factor and time factor are 0.8 and 0.5, the design discharge for the distributary will be :
(*a*) 0.80 cumecs (*b*) 0.16 cumecs
(*c*) 1 cumecs (*d*) 1.24 cumecs.

Q. 67.* An irrigation canal is to be designed to deliver 6.25 cumecs to meet the peak Rabi demand of a total of 5100 hectares of cropped area. The estimated canal losses are 25% of the head discharge. The duty on capacity of this canal will be :
(*a*) 816 ha/cumec (*b*) 1020 ha/cumec
(*c*) 653 ha/cumec (*d*) 612 ha/cumec.

Q. 68. 'Duty on capacity' is also called :
(*a*) outlet duty (*b*) capacity factor
(*c*) full supply coefficient (*d*) quantity duty.

Q. 69.* The 8000 hectares of gross commanded area of an irrigation project includes 20% of reserved forests, usar lands, roads, etc. The pastures and fallow lands are 10%. If the intensity of irrigation is 50%, the area to be irrigated is :
(*a*) 4000 hectares (*b*) 3200 hectares
(*c*) 2800 hectares (*d*) none of them.

Q. 70. The discharge carried by a minor distributary is usually less than :

(*a*) 0.5 cumecs (*b*) 1 cumecs
(*c*) 2.5 cumecs (*d*) none of them.

Q. 71. The discharge carried by a major distributary, is usually up to :

(*a*) 5 cumecs (*b*) 10 cumecs
(*c*) 30 cumecs (*d*) 50 cumecs.

Q. 72. Earthen irrigation canals, when aligned curvilinear in plan, must be on gentle curves. This adopted curve radius, should be :

(*a*) more for canal carrying more discharge
(*b*) less for canal carrying more discharge
(*c*) equal for all discharges.

Q. 73. The canal which is not supposed to do any irrigation is called :

(*a*) main canal (*b*) water course
(*c*) major distributary (*d*) minor distributary.

Q. 74. Unlined irrigation canals, when aligned on curvilinear routes in plan, will have to be pitched on :

(*a*) both sides (*b*) concave side only
(*c*) convex side only (*b*) none of the above.

CHAPTER 4

Q. 75. The bed of an alluvial channel along the flow will always be :

(*a*) flat (*b*) wavy
(*c*) duned and rippled (*d*) all of the above are possible.

Q. 76. The bed form, which is not expected in an alluvial channel with sediment motion, is :

(*a*) rippled (*b*) meandered
(*c*) duned (*d*) anti duned.

Q. 77. The bed of an alluvial channel carrying silted water at a high velocity is expected to be :

(*a*) rippled (*b*) duned
(*c*) flat (*d*) wavy.

Q. 78. The anti-dunes develop on beds of alluvial streams, when Froude number is:

(*a*) 0 (*b*) 0.5
(*c*) 1 (*d*) 1.2.

Q. 79.* The critical shear stress τ, at which incipient motion of sediment takes place, is proportional to :

(*a*) $\sqrt{d}$ (*b*) d
(*c*) d^2 where *d* is grain size (*UPSC Engg. Services*)

Q. 80.* In order to ensure that no scouring takes place in the bed of a channel of bed slope S, constructed in an incoherent alluvium of size 'd' cm, the flow velocity should be restricted to :

(*a*) $4.85 \cdot d^{1/2} \cdot S^{-1/6}$ (*b*) $4.85 \cdot d^{-1/2} \cdot S^{1/6}$
(*c*) $0.48\, d^{1/2} \cdot S^{1/6}$ (*d*) $0.48 \cdot d^{1/2} \cdot S^{-1/6}$.

Q. 81.* Manning's rugosity coefficient is proportional to :

(*a*) $\sqrt{d}$ (*b*) d
(*c*) $d^{1/6}$ (*d*) $d^{2/3}$
(*e*) $d^{3/2}$; where *d* is representative grain dia of bed surface.

Q. 82. The finer sediment which does not originate from the stream bed, but originates from the catchment area, is best called as the :

(*a*) bed load (*b*) suspended load

(*c*) wash load (*d*) none of these.

Q. 83. The force exerted by the flowing water on the sediment particles to cause their motion, is called :

(*a*) buoyant force (*b*) tractive force

(*c*) kinematic force (*d*) eddy force.

Q. 84. The minimum size of sediment that may remain stable in an alluvial channel, carrying discharge intensity q, with hydraulic radius R, and bottom slope S, is :

(*a*) $11\,RS$ (*b*) $1.35\left(\frac{q^2}{g}\right)^{1/2}$

(*c*) γRS (*d*) none of them.

Q. 85.* The tractive force method of designing stable channels in non-cohesive soils, is applicable only when the channels :

(*a*) carry sedimented water

(*b*) carry clear water

(*c*) carry sedimented water, but sediment concentration does not exceed 500 ppm or so

(*d*) carry any type of water.

Q. 86. In an earthen trapezoidal channel having side slopes of 1.5 H : 1 V, constructed in a non-cohesive soil, having D_{75} particle size of 'd' m, and angle $\phi = 37°$, no scouring will occur only when the hydraulic mean depth (R) of the channel is limited to :

(*a*) $\frac{d}{33\,S_0}$ (*b*) $\frac{d}{11\,S_0}$

(*c*) $\frac{d}{21\,S_0}$ (*d*) none of them.

Q. 87. If τ_c is the critical shear stress on a channel bed, then the critical shear on the side slopes (nH : IV) of this channel (τ_c') is given by :

(*a*) $\tau_c' = \tau_c \cdot \sqrt{1 - \frac{\sin^2\theta}{\sin^2\phi}}$ (*b*) $\tau_c' = \tau_c \cdot \sqrt{1 + \frac{\sin^2\theta}{\sin^2\phi}}$

(*c*) $\tau_c' = \tau_c \cdot \sqrt{1 - \frac{\sin^2\phi}{\sin^2\theta}}$ (*d*) $\tau_c' = \tau_c \cdot \sqrt{1 + \frac{\sin^2\phi}{\sin^2\theta}}$

where ϕ = angle of repose of soil

$\theta = \tan^{-1}\left(\frac{1}{n}\right)$

Q. 88. The Lacey's and Kennedy's empirical silt theories for designing irrigation channels in Indian non-cohesive alluvial soils, are meant to ensure :

(*a*) no scouring in the channel

(*b*) no silting from out of the sedimented water entering the channel from the headworks

(*c*) both (*a*) and (*b*)

(*d*) neither (*a*) nor (*b*).

Q. 89.* The critical velocity $V_0 = 0.55 \cdot m \cdot y^{0.64}$, as suggested by Kennedy for design of trapezoidal irrigation channels, is :

(*a*) the maximum permissible velocity
(*b*) the minimum permissible velocity
(*c*) both (*a*) and (*b*)
(*d*) none of the above.

Q. 90. Critical velocity Ratio for use in Kennedy's theory, is :

(*a*) less than 1 (*b*) more than 1
(*c*) equal to 1 (*d*) all of the above.

Q. 91. The Garret's diagrams are based on :

(*a*) Lacey's theory (*b*) Khosla's theory
(*c*) Bligh's theory (*d*) Kennedy's theory.

Q. 92. The critical velocity ratio was introduced in Kennedy's equation of critical velocity to take into account the effect of :

(*a*) channel cross-section (*b*) climatic conditions
(*c*) silt grade (*d*) roughness of bed.

Q. 93. The most important shape parameter in sediment analysis is :

(*a*) sphericity (*b*) shape factor
(*c*) roundness (*d*) form factor.

Q. 94. Lacey's silt factor is proportional to :

(*a*) $\sqrt{d}$ (*b*) d
(*c*) d^2 ; where d is the grain size.

(*U.P.S.C.; Engg. Services*)

Q. 95. In mechanics of sediment transport, the parameter $\varepsilon = \frac{\eta}{\rho}$ (where η is eddy viscosity and ρ is density) is called :

(*a*) kinematic viscosity (*b*) absolute viscosity
(*c*) eddy kinematic viscosity (*d*) none of the above.

Q. 96. In sediment analysis, the parameter which indicates the amount of wear the grain particle has undergone during relative movement of silt and water, is

(*a*) sphericity (*b*) shape factor
(*c*) roundness (*d*) form factor.

Q. 97. The wetted perimeter P of a stable channel is proportional to :

(*a*) Q (*b*) $\sqrt{Q}$
(*c*) Q^2 ; where Q is the discharge

(*U.P.S.C.; Engg. Services*)

Q. 98. The units of Shield's Entrainment function are :

(*a*) Newton/sq m (*b*) metre
(*c*) kg/m/sec (*d*) no dimensions.

Q. 99. The cross-section of natural silt transporting channels tend to have the shape of :

(*a*) trapezium (*b*) semi-ellipse
(*c*) semi-circle (*d*) none of them.

Q. 100. In Lacey's regime theory, the flow velocity is proportional to :

(*a*) $(Qf^2)^{1/2}$ (*b*) $\frac{Q}{f^2}$
(*c*) $(Qf^2)^{1/6}$

(*U.P.S.C.; Engg. Services*)

Q. 101. For all homogeneous fluids, the value of Von-Karman Universal Constant, is:

(a) 0 (b) 1
(c) 0.4 (d) 0.8.

Q. 102. The boundary shear stress, τ_0 in an open channel is given by :

(a) $\frac{\gamma h^2}{2}$ (b) γRS
(c) $\frac{1}{n} R^{2/3} S^{1/2}$

where h = depth
R = hydraulic radius
S = Slope
γ = Specific weight of fluid
n = Manning's roughness factor

(*U.P.S.C.; Engg. Services*)

Q. 103. Lacey's regime theory is not applicable to a canal in :

(a) true regime (b) initial regime
(c) final regime (d) none of them.

Q. 104.* When a channel is protected on the bed and sides with some protective material, and there is no possibility of change in its cross-section and longitudinal slope, then the channel is said to be in :

(a) initial regime (b) final regime
(c) permanent regime (d) true regime.

Q. 105.* Hydraulic depth is the ratio of :

(a) wetted area to wetted perimeter
(b) wetted area to top width
(c) wetted area to bottom width
(d) wetted perimeter to top width.

Q. 106. The unit of Chezy's coefficient C in Chezy's formula, is :

(a) $\sqrt{m/s}$ (b) m/s
(c) m (d) Nil.

Q. 107. For a most economical trapezoidal channel section :

(a) hydraulic mean radius equals the depth of flow
(b) hydraulic mean radius equals half the depth of flow
(c) bottom width is twice the depth of flow
(d) bottom width is half the depth of flow.

Q. 108.* The channels, whose boundaries are made of easily erodible loose soils, are called :

(a) mobile boundary channels
(b) rigid boundary channels
(c) non-alluvial channels
(d) none of the above.

Q. 109.* Lacey's scour depth for a stream, carrying a discharge of 3 cumecs per metre width and having a silt factor 1.2, is :

(a) 1.32 m (b) 2.64 m
(c) 3.96 m (d) 4.32 m.

(*GATE 1992*)

Q. 110. Which one of the following is not the requirement of an ideal regime condition in Lacey's regime-theory ?

(*a*) the discharge in the channel is constant

(*b*) the channel flows through the same soil grade, as that of the sediment entering the channel from the headworks

(*c*) the sediment grade and its amount entering the channel is constant.

(*d*) the silt grade should consist of clay sized particles.

(*e*) the flow should be uniform.

Q. 111.* An irrigation canal proposed to be excavated in an incoherent alluvium of median size 0.4 mm, for carrying a discharge of 40 cumecs, should ideally have a bed slope of :

(*a*) 1 in 6000 (*b*) 1 in 5200

(*c*) 1 in 2000 (*d*) 1 in 1265.

Q. 112.* The silt factor 'f', as used by Lacey in his regime theory, was adjusted to be equal to 1 for the silt of Upper Bari-Doab alluvium. What was the median size of this alluvium ?

(*a*) 0.28 mm (*b*) 0.32 mm

(*c*) 0.40 mm (*d*) 0.5 cm.

Q. 113. Average sediment load in a regime canal of Lacey, is of the order of :

(*a*) 50 ppm (*b*) 500 ppm

(*c*) 5000 ppm (*d*) 10,000 ppm.

Q. 114.* The discharge carried by a regime canal of bed width 22 m and water depth 2.5 m, is about;

(*a*) 22 cumecs (*b*) 34 cumecs

(*c*) 84 cumecs (*d*) none of them.

Q. 115.* Two irrigation channels, A and B, are designed on Lacey's theory to carry the same discharge. The alluvium through which canal A has to pass, however, is coarser than that for canal B. In such a design, we expect :

(*a*) channel *A* to be deeper

(*b*) channel *B* to be deeper

(*c*) channel *A* to have larger wetted perimeter

(*d*) channel *B* to have larger cross-sectional area.

Q. 116. The major drawback of Laceys regime theory, as used for the design of irrigation canals, is that :

(*a*) it does not consider the quantum of sediment load, which is likely to flow into the canal

(*b*) It is applicable only to non-cohesive soils

(*c*) it is applicable only to alluvial areas of North India or Pakistan.

(*d*) none of the above.

Q. 117. "An alluvial river scours and silts its bed automatically, depending upon the variation in the flow discharge". Which theory helps us to know this important conclusion?

(*a*) Lacey's theory (*b*) Kennedy's theory

(*c*) Einstein's theory (*d*) none of them.

Q. 118. Stable channels for a given bed-load transport, can be best designed on the basis of

(*a*) Lacey's theory (*b*) Kennedy's theory

(*c*) Einstein's theory (*d*) all of the above.

Q. 119. In an irrigation canal, berms are provided at :

(*a*) NSL (*b*) FSL

(*c*) Bank level (*d*) none of the above.

Q. 120. Counter berms are provided in an irrigation canal :

(*a*) at the outer sides of the canal banks to allow movement of cattle

(*b*) at the inner sides of the canal banks at the ground level, to make bank line and bed line parallel

(*c*) at the outer sides of the canal banks to keep the saturation gradient line well within the bank section

(*d*) none of the above.

Q. 121. Berms are provided in an irrigation canal at :

(*a*) the outer edge of the canal banks to allow movement of cattle

(*b*) the inner sides of the canal bank at the ground level, to make inner bank line and bed line parallel

(*c*) the outer sides of the canal banks, to keep the phreatic line adequately covered by earth cover

(*d*) none of the above.

Q. 122.* An alluvial canal is excavated using side slopes of $n_1 : 1$ (H : V) in excavation and $n_2 : 1$ in filling. If the depth of cutting is d_1, and top of the bank is at a height of d_2 above the bed, then the berm width required to have the bed line and bank line parallel to each other, despite fluctuations in the ground level, is :

(*a*) $(n_2 - n_1)\, d_2$ (*b*) $(n_2 - n_1)\, d_1$

(*c*) $(n_2 - n_1)(d_2 - d_1)$ (*d*) $n_2 \cdot d_2$.

Q. 123.* An alluvial irrigation canal is constructed with 1 : 1 (H : V) side slopes in cutting and 2 : 1 in filling, and the water depth upto FSL is expected to be y. A berm width equal to y is left initially, which with the passage of time, and when channel attains regime conditions, is likely to become :

(*a*) $1.1\,y$ (*b*) $1.25\,y$

(*c*) $1.5\,y$ (*d*) $2y$.

CHAPTER 5

Q. 124. A lined alluvial canal is best designed on the basis of :

(*a*) Lacey's formula (*b*) Kennedy's formula

(*c*) Manning's formula (*d*) Continuity equation.

Q. 125. Lining of irrigation channels :

(*a*) increases water logging (*b*) increases channel cross section

(*c*) increases command area (*d*) increases chances of breaching.

Q. 126.* An irrigation canal is lined along its 20 m perimeter @ Rs. 40 per m^2 of lining. The lining has resulted in net water saving @ 3 cumecs per M-m^2 of lined area, whereas each cumec of water increases the annual crop yield by Rs. 4 lakh. Assuming the life of lining as 40 years, and the saving in maintenance cost to be balanced by the interest on investment, the benefit cost ratio for the project is :

(*a*) 1.2 (*b*) 1.0

(*c*) 0.83 (*d*) none of them.

Q. 127. The transmission loss of valuable water in an ordinary alluvial irrigation canal in a North Indian State, in cumecs per million sq m of wetted area, is of the order of :

(*a*) 0.5—0.6 (*b*) 2.5—3.5
(*c*) 25—35 (*d*) 250—350.

Q. 128. A triangular lined canal section with corners rounded by a radius equal to the full supply depth of 4 m, is likely to have its hydraulic radius, as :

(*a*) 4 m
(*b*) 3 m
(*c*) 2 m
(*d*) cannot be ascertained, as side slopes are not given.

Q. 129.* A standard triangular lined channel section with 1.5 H : 1 V side slopes has a capacity of 26 cumecs and full supply depth of 2.5 m. The lining material for the channel would be safe for withstanding mean velocity of :

(*a*) 1.8 m/s (*b*) 2.0 m/s
(*c*) 2.2 m/s (*d*) none of them.

Q. 130. Safety ladders are provided in large irrigation canals, to :

(*a*) enable the fish to pass from one place to another
(*b*) enable the cattle to cross the canal
(*c*) enable the swimmers to get out of the canal
(*d*) provide safe exit to avoid accidental drowning.

Q. 131. The main advantage offered by Bentonite layer lining in an irrigation canal is that :

(*a*) seepage loss is reduced
(*b*) cross-sectional area of the channel is reduced
(*c*) cost of land acquired is reduced
(*d*) earth work excavation is reduced.

Q. 132. The free-board in lined canals is measured between :

(*a*) FSL and top of lining
(*b*) FSL and top of canal bank
(*c*) top of lining and top of canal bank
(*d*) none of them.

133. The minimum recommended free-board for lined canals carrying discharge of more than 10 cumecs is

(*a*) 0.3 m (*b*) 0.6 m
(*c*) 0.75 m (*d*) 1.2 m.

Q. 134. Under-drainage arrangements in canals are necessarily required in :

(*a*) unlined canals
(*b*) lined canals
(*c*) both (*a*) and (*b*)
(*d*) lined canals constructed on sandy soils alone.

Q. 135. When elaborate under-drainage arrangements can not be provided, and the soil strata is sandy, the preferred material for canal lining, would be :

(*a*) cement concrete lining
(*b*) soil cement lining
(*c*) brick lining
(*d*) shotcrete lining.

Q. 136. Steel reinforcement in concrete lining is justified, mainly because :
(*a*) it augments the structural strength of uncracked lining
(*b*) it enables the lining to take tensile loads
(*c*) it reduces the width of shrinkage cracks
(*d*) none of the above.

Q. 137. Which among the following is not true about Asphaltic concrete lining?
(*a*) it is fairly cheap
(*b*) it is flexible and readily confirms to subgrade
(*c*) it permits certain type of weed growth
(*d*) it decreases the rugosity coefficient to increase channel efficiency.

CHAPTER 6

Q. 138. A land is said to be water-logged, when :
(*a*) the land is necessarily submerged under standing water
(*b*) there is a flowing water over the land
(*c*) the pH value of the soil becomes as high as 8.5
(*d*) the soil pores in the root zone get saturated with water, either by the actual watertable or by its capillary fringe.

Q. 139. Water-logging of cropped land leads to reduced crop yields, due to :
(*a*) ill-aeration of root zone, causing lack of oxygen to plants
(*b*) growth of water-loving plants interfering with the sown crop
(*c*) surrounding of the root zone by the resultant saline water, which extracts the good water from plant roots by osmosis
(*d*) all of the above.

Q. 140. Pick up the incorrect statement from the following :
(*a*) intensive irrigation should be avoided in areas susceptible to water-logging
(*b*) extensive irrigation should be adopted in areas susceptible to water logging
(*c*) lift irrigation can help alleviate water-logging susceptibilities.
(*d*) none of the above.

Q. 141. Which one of the followings does not contribute to water logging?
(*a*) inadequate drainage
(*b*) seepage from unlined canals
(*c*) frequent flooding
(*d*) excessive tapping of ground water.

Q. 142. Which one of the followings, is not a remedial measure for water logging?
(*a*) good drainage for irrigated land
(*b*) conjunctive use of water in the basin
(*c*) lining of canals and water courses
(*d*) contour bunding.

Q. 143. Pick up the incorrect statement :
(*a*) moderately saline lands are represented by visible whiteish deposits of salts on the top and upper layers of soil
(*b*) $Na_2\,CO_3$ is the most harmful salt for causing salinity
(*c*) Nacl is the least harmful salt for causing salinity
(*d*) a highly saline land is called an alkaline land, or a black alkali.
(*e*) none of the above.

Q. 144. Point out the incorrect statement, out of the following :
(*a*) salinity is caused by water-logging
(*b*) water logging is not caused by salinity
(*c*) salinity subsides, when once the water logging is removed
(*d*) none of the above.

Q. 145. Alkaline soils are best reclaimed by :
(*a*) leaching
(*b*) addition of gypsum to soil
(*c*) providing good drainage
(*d*) addition of gypsum to soil and leaching.

Q. 146. A recently reclaimed alkaline soil should preferably be sown with a salt resistant crop, like :
(*a*) wheat (*b*) cotton
(*c*) barseem (*d*) any of the above.

Q. 147.* A soil has an Exchangeable Sodium Percentage (ESP) of 16%, and its Electrical conductivity (EC) is 32 milli-mhos/cm. If the pH of this soil is 9.5, then the soil is classified as :
(*a*) alkaline soil (*b*) saline soil
(*c*) saline alkali soil (*d*) none of the above.

Q. 148. The soil becomes practically infertile when its pH value is about :
(*a*) 0 (*b*) 7
(*c*) 11 (*d*) none of them.

Q. 149. Which of the following crops can withstand the highest water table, which normally should be 0.7 to 2.5 m below the level of the cropped land?
(*a*) wheat (*b*) lucerine
(*c*) cotton (*d*) rice.

Q. 150. While growing crops in high water-table areas, open jointed drains, discharging into outlet drains, are sometimes laid below the cropped land to lower down the water-table and to remove the rain water effectively. These drains are called:
(*a*) tile drains (*b*) french drains
(*c*) gravity outlets (*d*) surface drains.

Q. 151. A tile drain is laid below a cropped land to remove excess irrigation water. The Drainage Coefficient of this drain, is usually expressed as;
(*a*) cm of water depth removed from the drainage area per day
(*b*) cum of water removed per second
(*c*) percentage of applied water, which is intercepted by this drain
(*d*) none of the above.

Q. 152. When a sub-surface open jointed drain is laid below a farm land to intercept excess irrigation water, then its capacity, depending upon soil type, should be of the order of :
(*a*) 5—10% of applied water
(*b*) 10—50% of applied water
(*c*) 50—80% of applied water
(*d*) none of them.

Q. 153. The method, which uses dead furrows on cropped farms for drainage of excess irrigation or rain water, is called :
(*a*) surface inlet (*b*) tile drainage
(*c*) bedding (*d*) french drain.

CHAPTER 7

250 Objective questions on this chapter are given in author's another book, titled *"Hydrology and Water Resources Engineering"*, which deals with the subject matter in greater details than given in this book. Students are advised to refer to that volume to be well versed with the subject on 'Hydrology', which in itself, is a full subject, other than from 'Irrigation'.

CHAPTER 8

Q. 154. Ghaggar river which appears and disappears in Rajasthan State of India, can be classified as a

(*a*) meandering river (*b*) deltaic river
(*c*) virgin river (*d*) none of the above.

Q. 155. The quantum of river discharge, which is large enough in magnitude as well as in frequency, so as to cause controlling effect on the river course and cross-section, is known as :

(*a*) design discharge (*b*) median discharge
(*c*) maximum flood discharge
(*d*) dominant discharge.

Q. 156. The ratio of dominant discharge for a river to the peak discharge for that river, is of the order of :

(*a*) 3/16 (*b*) 9/16
(*c*) 13/16 (*d*) 3/2.

Q. 157. The 'meander length' for an alluvial river is :

(*a*) the total channel length along its looped course
(*b*) the total channel length minus the direct straight length
(*c*) the axial length of one meander
(*d*) the looped length of one meander
(*e*) none of the above.

Q. 158. The 'meander belt' for an alluvial river is :

(*a*) the total river width between embankments
(*b*) the width between the outer edges of fully developed meander loop, measured perpendicular to river axis
(*c*) the same as meander width
(*d*) both (*b*) and (*c*).

Q. 159. For a meandering alluvial river, the ratio of its 'channel length' to 'direct axial length' is always :

(*a*) 1 (*b*) > 1
(*c*) < 1
(*d*) may be less or more than 1, depending upon the river.

Q. 160. In a meandering river, the ratio of 'arcual channel length' to 'direct axial length', is called :

(*a*) tortuosity (*b*) inverse of tortuosity
(*c*) cut off ratio (*d*) none of these.

Q. 161. Tortuosity in a meandering river, is :

(*a*) 1 (*b*) < 1
(*c*) > 1 (*d*) none of these.

Q. 162. A river reach having tortuosity of 1.2, can be said to have :
(*a*) 20% tortuosity of meander
(*b*) 80% tortuosity of meander
(*c*) 120% tortuosity of meander
(*d*) none of the above.

Q. 163. In an alluvial meandering river in flood plains, the meandering length (M_L) is x times the meandering width (M_B), where x is roughly equal to :
(*a*) 3 (*b*) $\frac{1}{3}$
(*c*) 1 (*d*) $\frac{1}{3}$ to 3.

Q. 164. For a meandering alluvial river in flood plain, the meander length is about:
(*a*) 6 W (*b*) 18 W
(*c*) 17 W (*d*) W.
where *W* is the normal river width

Q. 165. For a meandering alluvial river in flood plain, the meander width is about:
(*a*) 0.5 W (*b*) W
(*c*) 6 W (*d*) 17 W.
where *W* is the normal river width

Q. 166.* An alluvial river has a dominant discharge of 1600 m^3/s and a bed slope of 1 in 5000. The approximate value of meander belt for this river, would be :
(*a*) 0.6 km (*b*) 6 km
(*c*) 60 km (*d*) none of these.

Q. 167. An alluvial meandering river is likely to carry a peak discharge of 6000 cumecs. The extent of meandering belt in this river, estimated in km per km of meandering length, roughly equals.
(*a*) $\frac{1}{3}$ (*b*) 3
(*c*) 9 (*d*) 27.

Q. 168. Meander ratio in an alluvial meandering river is given by :
(*a*) $\frac{\text{meander length}}{\text{meander width}}$ (*b*) $\frac{\text{meander width}}{\text{meander length}}$
(*c*) $\frac{\text{meander width}}{\text{meander length}} \times 100$ (*d*) none of them.

Q. 169.* The meander belt for an alluvial stream is estimated to be 3 km. The peak discharge in this river will roughly be of the order of :
(*a*) 4000 cumecs (*b*) 700 cumecs
(*c*) 1200 cumecs (*d*) 1600 cumecs.

Q. 170. In a meandering river reach, the deepest river portions will be available at:
(*a*) the crossings
(*b*) the inner edges of meander loops
(*c*) the outer edges of meander loops
(*d*) none of them.

Q. 171. Sinuosity of a meandering river is :
(*a*) the same as tortuosity (*b*) inverse of tortuosity
(*c*) log of tortuosity (*d*) none of them.

Q. 172. Pinpoint the incorrect statement :

(*a*) guide-bunds are constructed to guide the river flow through a smaller width

(*b*) guide bunds are generally extended downstream of the hydraulic structure, in a length of about twice their upstream length

(*c*) guide banks prevent the out-flanking of the hydraulic structure by the changing river course

(*d*) aggrading rivers can be best controlled by soil conservation measures, including construction of check dams on their tributaries

(*e*) degrading rivers can be best controlled by building of cross-bars, weirs, etc., prior to other river training works.

Q. 173. Aggrading rivers are :

(*a*) silting rivers (*b*) scouring rivers

(*c*) rivers in regime (*d*) meandering rivers.

Q. 174. The river reach upstream of a newly built dam may behave, as :

(*a*) aggrading (*b*) degrading

(*c*) virgin (*d*) none of them.

Q. 175. A barrage with 600 m length is designed across an alluvial river. The U/S and D/S lengths of the proposed guide banks of this barrage, will be about:

(*a*) 750 m and 1500 m (*b*) 750 m and 750 m

(*c*) 750 m and 150 m (*d*) 750 m and 300 m

Q. 176.* A pair of guide banks are to be constructed for an alluvial river at 400 m apart at a bridge site. The design discharge of the river is 5000 cumecs at 5 m water depth of HFL above the average bed level of the river. These guide banks need to be stone pitched on water side, with apron laid from the toe in the river bed. The average estimated depth and width of this apron, respectively, will be :

(*a*) 2 m and 10 m (*b*) 1.5 m and 5 m

(*c*) 2 m and 20 m (*d*) 3 m and 20 m.

Q. 177. The repelling groynes which are largely constructed projecting from river embankments, as anti-erosion works, are :

(*a*) pointing upstream (*b*) pointing downstream

(*c*) perpendicular to the bank (*d*) none of these.

Q. 178.* If a river in an alluvial plain has a dominant discharge of 1600 cumecs, the waterway for this bridge, in the absence of model testing, can be safely adopted, as equal to :

(*a*) 190 m (*b*) 228 m

(*c*) 300 m (*d*) 480 m.

Q. 179. The upstream angle of inclination of a repelling groyne with normal to the bank line, is of the order of :

(*a*) 5 to 10° (*b*) 10 to 30°

(*c*) 30 to 50° (*d*) 70 to 90°.

Q. 180. Which one among the following is not the real cause of an alluvial river following a serpentine course?

(*a*) variation of discharge

(*b*) availability of steeper land gradient than what is required for equilibrium.

(*c*) availability of inadequate land gradient than what is required for equilibrium

(*d*) none of these.

Q. 181. An alluvial river increases its length by meandering due to;

(*a*) variation of discharge (*b*) variation in land topography
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 182. The factor which is not primarily responsible for meander in an alluvial river, is;

(*a*) variation of discharge (*b*) excess silt load
(*c*) deficient silt load (*d*) none of them.

Q. 183. The secondary factor, which is responsible for meandering in an alluvial river, is :

(*a*) inadequate land gradient (*b*) deficient silt load
(*c*) constant discharge (*d*) none of them.

Q. 184. Point out the incorrect statement in relation to the behaviour of a meandering alluvial river :

(*a*) Primary cause for meandering is the silting action due to excess sediment at the available discharge and surface slope
(*b*) Secondary cause for meandering is the scouring action due to deficiency of sediment at the available discharge and surface slope
(*c*) Meandering tendency is more in an alluvial river during floods, because of high variation in discharge
(*d*) if there is no variation of discharge in an alluvial river, there will be no meandering
(*e*) none of them.

Q. 185. Out of the following choices given below, choose impermeable spur(s) :

(*a*) an earthen spur protected by stone apron
(*b*) an earthen spur, unprotected by stone apron
(*c*) a balli spur (*d*) a tree groyne
(*e*) (*a*) and (*b*) both (*f*) (*c*) and (*d*) both.

Q. 186. Permeable spurs are best suitable for rivers, which :

(*a*) carry heavy suspended load
(*b*) carry large bed load, but light suspended load
(*c*) need permanent protection to dikes
(*d*) need attracting the river current, for providing deeper channel
(*e*) flow in upper hilly reaches.

Q. 187. Denehey's spur is :

(*a*) a hockey-shaped earthen spur
(*b*) a *T*-shaped stone spur, as used in Australia
(*c*) a *T*-shaped earthen spur, as used in India
(*d*) a type of a balli spur, especially developed for Indian rivers.

Q. 188. Which one of the following effects can not be attributed to have been caused by the construction of dikes along a river coarse?

(*a*) faster travel of a flood wave
(*b*) higher flood levels along the river
(*c*) increased peak discharges all along downstream points
(*d*) decrease in surface slope of the river above the leveed reach
(*e*) increased bed levels in the river
(*f*) reduction in meander belt, causing steeper hydraulic gradients.

Q. 189. Which one of the following effects produced by a Cut off in an alluvial river, is not an advantage to navigation :

(*a*) shortened route and elimination of sharp bends
(*b*) shortened travel time, particularly at low and moderate river stages
(*c*) increased water depth at low river stages
(*d*) lowering of the flood stages and flood periods.

CHAPTER 9

Q. 190. Barrages constructed across alluvial rivers help in :

(*a*) controlling floods (*b*) restoring river regime
(*c*) ensuring monsoon storage (*d*) all of them.

Q. 191. Which one among the following is a correct choice in relation to a weir?

(*a*) it is helpful in diverting excess water to a river from a canal
(*b*) it does not cause any heading up of water on its upstream side
(*c*) it stores water by raised counter-balanced gates
(*d*) it increases the chances of floods in the upstream areas
(*e*) none of them.

Q. 192. If two canals are taken off from both the flanks of a river at the site of a diversion headwork, then the number of undersluices and divide walls, will respectively, be :

(*a*) 1 and 1 (*b*) 1 and 2
(*c*) 2 and 1 (*d*) 2 and 2.

Q. 193. Pinpoint the incorrect statement :

(*a*) the old Okhla barrage near Delhi has recently been replaced by a new weir
(*b*) the cost of a barrage is usually higher than that of a weir
(*c*) a weir can pond up additional water on its upstream side, by using shutters on its top
(*d*) a barrage does not increase the susceptibility of flooding in upstream areas
(*e*) none of them.

Q. 194. In a barrage project, a divide wall is provided to :

(*a*) separate the lower crest 'undersluice side' from the higher crest 'weir side'
(*b*) separate the higher crest 'undersluice side' from the lower crest 'weir side'
(*c*) keep the cross-currents away from the barrage body
(*d*) serve none of the above purposes.

Q. 195. A canal headworks has nothing to do with a :

(*a*) weir (*b*) guide bank
(*c*) head regulator (*d*) safety ladder.

Q. 196. In a diversion headworks project, the canal head regulator is usually aligned:

(*a*) parallel to the barrage axis
(*b*) perpendicular to the divide wall
(*c*) parallel to the divide wall
(*d*) none of them.

Q. 197. The choice among the following, which does not control the discharging capacity to be provided for the undersluices, is :

(*a*) that it should be at least double the canal discharge
(*b*) that it should be about 10 to 15% of maximum flood discharge
(*c*) that it should be able to pass winter freshets and low floods.
(*d*) that it should be equal to the dominant discharge of the river
(*e*) none of them.

Q. 198. Anadromous fish often move large distances in rivers in India :

(*a*) to upstream only
(*b*) to downstream only
(*c*) to downstream in winter, and upstream in summer
(*d*) to upstream in winter, and downstream in summer.

Q. 199. A fish ladder is provided in a canal project :

(*a*) to catch the fish for commercial development
(*b*) to enable the fish to move freely in the river
(*c*) to serve the same purpose as a canal ladder.
(*d*) (*b*) and (*c*) both.

Q. 200. Head sluices are the gate controlled openings, in :

(*a*) the entire length of the barrage
(*b*) the under-sluice length of the barrage
(*c*) the regulator of the main off taking canal
(*d*) none of them.

Q. 201. Silt excluders are constructed :

(*a*) on the river bed downstream of the head regulator
(*b*) on the river bed upstream of the head regulator
(*c*) on the canal bed downstream of the canal head regulator
(*d*) none of these.

Q. 202. The silt exclusion device, constructed on the bed of the main canal, taking off from a headwork, is called :

(*a*) silt excluder (*b*) silt ejector
(*e*) both (*a*) and (*b*) (*d*) none of them.

Q. 203. The tunnel openings provided infront of a canal head regulator at a Diversion headworks :

(*a*) discharge sedimented water into the canal
(*b*) discharge sediment load into the under-sluices, from where it ejects out to the downstream river
(*c*) discharge clear water into the canal
(*d*) none of these.

Q. 204. Canal headworks in the upper rocky reaches of the rivers, are uncommon, because :

(*a*) more drops are required on the resulting canal system.
(*b*) costly head regulator is required
(*c*) more cross-drainage works are required on the resulting canal network
(*d*) all of the above.

CHAPTER 10

Q. 205. If y_1 and y_2 are water depths upstream and downstream of a hydraulic jump respectively, the loss of energy due to hydraulic jump is :

(*a*) $(y_2 - y_1)^4/4y_1 y_2$ (*b*) $(y_2 - y_1)^3/4y_1 y_2$

(*c*) $(y_2 - y_1)^2/4y_1 y_1$ (*d*) $(y_2 - y_1)/4y_1 y_2$. (*GATE 1990*)

Q. 206. A hydraulic jump involves;

(*a*) subcritical flow (*b*) super critical flow

(*c*) critical flow (*d*) all of the above.

Q. 207. A hydraulic jump ensures :

(*a*) change of subcritical flow to super critical flow

(*b*) change of super critical flow to subcritical flow

(*c*) change of subcritical flow to critical flow

(*d*) change of super critical flow to critical flow.

Q. 208. The phenomenon of hydraulic jump leads to :

(*a*) evolution of energy

(*b*) dissipation of energy

(*c*) sometimes (*a*) and sometimes (*b*)

(*d*) none of these.

Q. 209. If a vertical line is drawn on the specific energy curve, corresponding to a particular value of specific energy, then the two depth values are obtained which are known as :

(*a*) initial and sequent depths (*b*) alternate depths

(*c*) conjugate depths (*d*) all of these.

Q. 210. The sequent depth is always :

(*a*) less than the alternate subcritical depth

(*b*) more than the alternate subcritical depth

(*c*) equal to the alternate subcritical depth

(*d*) none of the above.

Q. 211. The formula connecting initial depth (y_1) with sequent depth (y_2) in a hydraulic jump, is given as :

(*a*) $y_2 = \frac{-y_1}{2} + \sqrt{\frac{y_1^2}{4} + \frac{2q^2}{gy_1}}$ (*b*) $y_2 = \frac{y_1}{2} + \sqrt{\frac{y_1^2}{4} + \frac{2q^2}{gy_1}}$

(*c*) $y_2 = \frac{-y_1}{2} + \sqrt{\frac{y_1^2}{4} + \frac{q^2}{gy_1}}$ (*d*) $y_2 = \frac{y_1}{2} + \sqrt{\frac{y_1^2}{4} + \frac{q^2}{gy_1}}$

where q is the discharge intensity in the channel at the section of the hydraulic jump.

Q. 212. The hydraulic jump that develops usually in barrages and canal head regulators, is of the type :

(*a*) strong jump (*b*) steady jump

(*c*) oscillating and weak jump (*d*) undular jump.

Q. 213. The formation of a hydraulic jump on a sloping glacis, as compared to that on a horizontal floor, is always :

(*a*) more definite and more efficient

(*b*) more definite and less efficient

(*c*) less definite and more efficient

(*d*) less definite and less efficient.

CHAPTER 11

Q. 214. The safety of a hydraulic structure founded on pervious foundation can be ensured :

(*a*) by providing sufficient length of its concrete floor
(*b*) by providing sufficient depth of its concrete floor
(*c*) by providing a downstream cutoff of some reasonable depth
(*d*) all of the above.

Q. 215. Point out the correct meaning of 'piping', as applied to the design of barrages:

(*a*) it refers to a network of pipes laid below the hydraulic structure to remove the seeping water
(*b*) it refers to the process of undermining of foundation and creation of hollows therein
(*c*) it refers to the uplift force caused by seeping water on the floor of the hydraulic structure
(*d*) none of the above.

Q. 216. While designing the downstream floor thickness of a weir, the ordinate of the uplift pressure at a point is 2.8 m. If the relative density of concrete is taken to be 2.4, then the minimum thickness of the floor to be provided for resisting uplift pressure, without accounting safety factor, is :

(*a*) 1.16 m (*b*) 2 m
(*c*) 0.8 m (*d*) none of them.

Q. 217.* While designing the floor thickness of a weir in its upstream length, the average head causing uplift is 2.8 m. The provided floor thickness here, with suitable factor of safety, could best be :

(*a*) 2 m (*b*) 2.5 m
(*c*) 0.8 m (*d*) 4.5 m.

Q. 218. The critical exit gradient suggested in Khosla's theory of design of weirs and barrages, is :

(*a*) less for more porous soils (*b*) more for more porous soils
(*c*) equal for all kinds of soils (*d*) none of them.

Q. 219.* Khosla's safe exit gradient for design of weirs will be the lowest for the soil type :

(*a*) fine sand (*b*) coarse sand
(*c*) shingle and gravels (*d*) none of them.

Q. 220. Point out the incorrect statement in relation to the design of weirs and barrages :

(*a*) Bligh's safe hydraulic gradient is the same as the Khosla's safe exit gradient
(*b*) the first streamline below a barrage section follows the bottom profile of the section
(*c*) equipotential lines are the lines joining the points of equal residual seepage head
(*d*) none of them.

Q. 221. Which one of the following factors, is not to be considered in the design of major hydraulic structures founded on an alluvial North Indian River?

(*a*) uplift caused by steady seepage
(*b*) piping caused by steady seepage
(*c*) uplift caused by high flood flow in the jump trough
(*d*) none of the above.

Q. 222. Bligh's theory, as applied to the design of weirs and barrages on permeable foundations, account for :

(*a*) hydrostatic forces only

(*b*) hydrodynamic forces only

(*c*) both (*a*) and (*b*)

(*d*) none of them.

Q. 223. Retrogression is :

(*a*) the back water effect of a weir

(*b*) the raising of the river bed upstream of the weir, during initial years of its construction

(*c*) the lowering of the river bed downstream of the weir, during initial years of its construction

(*d*) none of them.

Q. 224. According to Khosla's theory of independent variables for seepage below a hydraulic structure, the exit gradient, in the absence of a downstream sheet pile, is :

(*a*) 0 (*b*) 1

(*c*) ∞ (*d*) none of them.

Q. 225. The value of Khosla's critical exit gradient for usually met alluvial sandy soils of our country, is about :

(*a*) 0 (*b*) 1

(*c*) ∞ (*d*) $\frac{1}{4}$ to $\frac{1}{6}$.

Q. 226. The value of Khosla's safe exit gradient for usually met alluvial river soils of our country is :

(*a*) 0 (*b*) 1

(*c*) ∞ (*d*) $\frac{1}{4}$ to $\frac{1}{6}$.

Q. 227. Critical exit gradient, as enunciated in Khosla's theory of design of weirs and barrages on pervious foundations, is :

(*a*) the left out pressure in the seeping water at the downstream end point, where it emerges out on the river bed

(*b*) the rate of loss of pressure of the seeping water at the downstream emerging point, which is just enough to lift the soil grains at that point

(*c*) the actual pressure gradient of the seepage, at the down-stream emerging point

(*d*) none of the above.

Q. 228. Safe exit gradient, as enunciated by Khosla's theory of design of weirs and barrages, is :

(*a*) the actual seepage gradient available at the downstream exit point

(*b*) the seepage gradient at the downstream exit point, equalling the submerged weight of a unit volume of soil there

(*c*) about $\frac{1}{4}$ to $\frac{1}{6}$ times the gradient which is just able to lift the soil grain at the downstream exit point

(*d*) none of the above.

Q. 229. The critical exit gradient, as applicable to barrages, is expressed by :

(*a*) $w(1-n)(S_s - 1)$,

where w = unit weight of water
n = porosity of soil
S = specific gravity of soil grains

(*d*) $\frac{H}{d} \cdot \frac{1}{\pi\sqrt{\lambda}}$

where H, d, and λ have their usual meaning

(*c*) $\frac{\text{Safe exit gradient}}{\text{Factor of safety}}$

(*d*) none of the above.

Q. 230. The minimum thickness(t) of the downstream floor, as required in the design of weirs, can be expressed by the equation :

(*a*) $\frac{h}{G+1}$ (*b*) $\frac{h}{G-1}$

(*c*) $\frac{h-t}{G-1}$ (*d*) $1.33\left(\frac{h}{G-1}\right)$

where h = ordinate of hydraulic gradient line above the top of the floor
G = Specific gravity of floor material.

Q. 231. The back water effect of a weir is best called :

(*a*) retrogression (*b*) afflux

(*c*) back water curve (*d*) none of them.

Q. 232. A breast wall is usually provided :

(*a*) in the weir section
(*b*) in the under-sluice section
(*c*) in the main canal section
(*d*) in the head regulator section.

Q. 233. Just downstream of the pucca concrete floor of a barrage section, an inverted filter covered by c.c. blocks is laid in a length of about 1.5 to 2 D, where D is :

(*a*) the Lacey's normal scour depth
(*b*) 1.5 times the Lacey's normal scour depth
(*c*) 1.5 times the Lacey's scour depth minus the downstream water depth
(*d*) none of the above.

Q. 234. Just downstream of the concrete floor of a weir section, an inverted filter covered by c.c. blocks is laid. This filter should be such, as :

(*a*) to let out the residual seepage
(*b*) not to allow the soil particles to escape
(*c*) not to get clogged in itself
(*d*) all of the above.

Q. 235. The safety against any possible scour, on upstream or downstream side of the pucca floor of a hydraulic structure, is usually ensured by laying :

(*a*) inverted filter (*b*) toewall

(*c*) rock toe (*d*) stone apron.

Q. 236. For the head regulator, the most severe condition of uplift pressure on the floor occurs when :

(*a*) the flow in the river is at flood level and canal is running at full supply depth

(*b*) the canal runs dry and the river flow is at high flood level

(*c*) the canal runs at full supply depth and the river flow is at pond level

(*d*) the canal runs dry and the river flow is at pond level. (*GATE 1992*)

CHAPTER 12

Q. 237. Canal drops are required to :

(*a*) dissipate excess energy

(*b*) dissipate inadequate land slope

(*c*) dissipate excess land slope

(*d*) none of the above.

Q. 238. A trapezoidal notch fall can maintain normal water depth in the upstream channel :

(*a*) at any one given value of the design discharge

(*b*) at all the discharges

(*c*) at any two values of the design discharges

(*d*) at no discharge at all.

Q. 239. The depth-discharge relationship of the upstream canal remains practically unaffected by the introduction of a fall of the type :

(*a*) Ogee fall

(*b*) Sarda type vertical fall

(*c*) Trapezoidal notch fall

(*d*) none of the above.

Q. 240. For low to moderate discharges of the order of 10-15 cumecs and fall height of 1 to 1.5 m, cheaper Sarda type canal falls can be recommended :

(*a*) universally, without any if and buts

(*b*) if the canal runs with highly variable discharge

(*c*) when the canal fall is not to be used as a meter and discharge is fairly constant

(*d*) when the canal fall is not to be used as a meter, irrespective of variation in discharge.

Q. 241. The type of canal fall, which can be universally used without any if and buts for moderate discharges of the order of 40-60 cumecs and low fall heights of 1 to 1.5 m, is :

(*a*) vertical drop fall (*b*) ogee fall

(*c*) glacis fall (*d*) baffle fall.

Q. 242. The type of fall, which you may recommend for very high drops and very low discharges, is :

(*a*) Sarda type fall (*b*) Siphon well drop

(*c*) Straight glacis fall (*d*) Inglis fall.

Q. 243. The canal fall, involving parabolic glacis, is called :

(*a*) Straight glacis fall (*b*) Glacis fall

(*c*) Inglis fall (*d*) Montague fall.

Q. 244. An Inglis fall, also called a Baffle fall, can be recommended for all discharges, provided :

(*a*) the fall is more than 1.5 m
(*b*) the fall is undrowned
(*c*) the fall is either flumed or unflumed
(*d*) all of the above.

Q. 245. The energy dissipation in a Sarda type canal drop is caused by :

(*a*) hydraulic jump (*b*) friction blocks
(*c*) water pool (*d*) baffle wall.

Q. 246. The best energy dissipation on the down-stream side of a canal drop, is caused in :

(*a*) Sarda type fall (*b*) Glacis fall
(*c*) Ogee fall (*d*) Montague fall.

Q. 247. A baffle wall and a water pool to dissipate energy, was introduced as an improvement, in a :

(*a*) Glacis fall (*b*) Montague fall
(*c*) Inglis fall (*d*) none of the above.

Q. 248. A meter fall of 1.8 m height is to be constructed on a canal carrying a discharge of 50 cumecs. The type of fall that you may recommend will be :

(*a*) Glacis fall (*b*) Montague fall
(*c*) Inglis fall (*d*) none of the above.

Q. 249. The energy dissipation in an Inglis fall is caused by :

(*a*) a pool of water (*b*) a hydraulic jump
(*c*) neither (*a*) nor (*b*) (*d*) both (*a*) and (*b*).

Q. 250. The length of the water cistern to be provided in a Sarda type fall, is :

(*a*) $5\,(y_2 - y_1)$ (*b*) $5\sqrt{H \cdot H_L}$
(*c*) $\frac{1}{4}(H \cdot H_L)^{2/3}$ (*d*) $1.84 \cdot H^{3/2}$.

where y_1, y_2, H, H_L have their usual meaning.

Q. 251. The concrete glacis of a glacis fall, usually slopes H : V, as :

(*a*) 2 : 1 (*b*) 1 : 2
(*c*) 1 : 5 (*d*) 5 : 1.

Q. 252. In a glacis fall, the hydraulic jump forms on :

(*a*) the horizontal floor (*b*) the sloping glacis
(*c*) either (*a*) or (*b*) (*d*) none of the above.

Q. 253. Friction blocks on the downstream side of the pucca canal fall, can be used to dissipate the left out energy in the falling water, in case of :

(*a*) a glacis fall (*b*) a vertical drop fall
(*c*) a baffle fall (*d*) (*a*) and (*b*) both
(*e*) (*a*), (*b*) and (*c*) all.

Q. 254. A trapezoidal crest in a Sarda type canal fall is preferred and used in comparison to a rectangular crest, when :

(*a*) the discharge is less than 14 cumecs
(*b*) the discharge is equal to or more than 14 cumecs
(*c*) the discharge is less than 30 cumecs
(*d*) the discharge is equal to or more than 30 cumecs.

Q. 255. A cylinder fall, popularly known as syphon well drop, is suitable and economical for :
(*a*) low discharges and low drops
(*b*) low discharges and high drops
(*c*) high discharges and low drops
(*d*) high discharges and high drops.

Q. 256. In a baffle fall, the hydraulic jump forms, on :
(*a*) the sloping glacis (*b*) the horizontal baffle platform
(*c*) either (*a*) or (*b*) (*d*) none of the above.

Q. 257. A baffle wall, as a sort of a low weir, is constructed in a baffle type canal fall at the end of the baffle platform and before the water cistern, inorder to head up water to its upstream side to :
(*a*) ensure formation of hydraulic jump to dissipate energy
(*b*) withstand actual impact of the high velocity jet to dissipate energy
(*c*) both (*a*) and (*b*)
(*d*) none of the above.

CHAPTER-13

Q. 258. The canal regulator, which is constructed at a diversion headworks, is called a :
(*a*) cross regulator (*b*) distributary head regulator
(*c*) canal module (*d*) none of the above.

Q. 259. The gated regulator, which is constructed in the parent canal near the site of an offtaking canal, is called a :
(*a*) canal head regulator (*b*) distributary head regulator
(*c*) cross regulator (*d*) none of the above.

Q. 260. A cross regulator helps in
(*a*) increasing supply in the parent channel downstream
(*b*) increasing supply in the offtaking channel
(*c*) increasing water depth in the parent canal, upstream
(*d*) both (*b*) and (*c*)
(*e*) all (*a*), (*b*) and (*c*) above.

Q. 261. Point out the choice among the following, which is not a function of a distributary head regulator :
(*a*) it serves as a meter for measuring discharge in the offtaking canal
(*b*) it serves to control silt entry into the offtaking canal
(*c*) it helps in controlling and regulating supplies in the entire downstream canal network.
(*d*) it helps in controlling supplies in the offtaking canal.
(*e*) none of the above.

Q. 262. Khosla's theory of independent variables is used in the design of :
(*a*) weirs and barrages (*b*) cross regulators and head regulators
(*c*) modules (*d*) both (*a*) and (*b*) above
(*e*) all (*a*), (*b*) and (*c*) above.

Q. 263. The channel constructed to bypass the excess water entering a canal, is called a :
(*a*) canal module (*b*) canal siphon
(*c*) canal escape (*d*) canal regulator.

Q. 264. The crest level of a distributary head regulator is usually kept :

(*a*) the same as the upstream bed level of the parent canal
(*b*) the same as the crest level of the cross-regulator at the site.
(*c*) 0.3 to 1.0 m higher than the upstream bed level of the parent canal
(*d*) none of the above.

Q. 265. The regulator constructed on a major distributary near its junction with a minor distributary, will be called a :

(*a*) distributary head regulator
(*b*) cross-regulator
(*c*) regulating head
(*d*) none of the above.

Q. 266. The arrangement made in a canal network, which acts as its safety valve, is:

(*a*) cattle crossing (*b*) canal ladder
(*c*) canal escape (*d*) canal module.

Q. 267. The arrangement provided in a canal to help the cattle safely cross the canal, is called a :

(*a*) canal ladder (*b*) canal crossing
(*c*) cattle crossing (*d*) all of the above.

Q. 268. Point out the correct statement :

(*a*) bed bars are constructed in canals at the toe of the canal lining, to prevent slippage of lining.
(*b*) cattle crossings, besides their usual function of helping the cattle to cross the canal, also provide safety to those who are swept away by currents.
(*c*) a canal escape helps in supplying irrigation water to the downstream water courses
(*d*) none of the above.

Q. 269. Canal modules help in :

(*a*) modulating and varying the canal discharge
(*b*) releasing desired quantity of water into the water courses
(*c*) releasing desired quantity of water into the minors
(*d*) all of the above.

Q. 270. Canal outlets are also called :

(*a*) canal escapes (*b*) canal modules
(*c*) canal offtakes (*d*) canal openings.

Q. 271. The type of irrigation module, which makes equitable distribution of water more difficult, is a :

(*a*) non-modular outlet (*b*) semi-module
(*c*) rigid module (*d*) none of them.

Q. 272. A good irrigation module is the one, which :

(*a*) draws heavy silt from the canal
(*b*) draws clear water from the canal
(*c*) draws fair share of silt from the canal
(*d*) none of the above.

Q. 273. If the rate of change of discharge from an irrigation outlet is equal to the rate of change of discharge in the distributary, then the outlet is called :

(*a*) flexible (*b*) proportional
(*c*) sensitive (*d*) none of these.

Q. 274. The rate of change of discharge through an irrigation outlet becomes equal to the rate of change of water depth in the channel, when its :

(*a*) flexibility is 1 (*b*) sensitivity is 1
(*c*) setting is 1 (*d*) sensitivity is zero.

Q. 275. If the sensitivity of an irrigation module is $\frac{1}{2}$, then 50% variation in canal water depth will cause x% variation in outlet discharge, where x is :

(*a*) 100% (*b*) 50%
(*c*) 25% (*d*) 12.5%.

Q. 276. A fully modular canal outlet has its :

(*a*) sensitivity = 1, and flexibility = 1
(*b*) sensitivity = 1, and flexibility = 0
(*c*) sensitivity = 0, and flexibility = 1
(*d*) sensitivity = 0, and flexibility = 0.

Q. 277. An irrigation outlet is said to be proportional, when its :

(*a*) sensitivity = 1 (*b*) flexibility = 1
(*c*) setting = 1 (*d*) all of the above.

Q. 278. If the percentage rise/fall in the outlet discharge of a canal distributary is more than the percentage rise/fall of discharge in the distributary, then the outlet is :

(*a*) super sensitive (*b*) sub sensitive
(*c*) hyper proportional (*d*) sub proportional.

Q. 279. An irrigation, outlet fixed at a height of 0.4 y above the canal DBL, where y is the full supply depth in the canal, will have its setting equal to :

(*a*) 0.4 (*b*) 0.6
(*c*) 0.2 (*d*) none of these.

Q. 280. An irrigation outlet is said to be proportional, when its :

(*a*) setting = outlet index/channel index
(*b*) setting = channel index/outlet index
(*c*) setting = channel index × outlet index
(*d*) none of the above.

Q. 281. For a wide trapezoidal channel, the channel index is :

(*a*) 2/3 (*b*) 5/3
(*c*) 1/3 (*d*) none of them.

Q. 282. A free pipe outlet is a :

(*a*) rigid module (*b*) flexible module
(*c*) non-modular module (*d*) all of the above.

Q. 283. The type of irrigation module, which is usually considered as the best in our country, is :

(*a*) Adjustable orifice semi module
(*b*) Punjab open flume outlet
(*c*) Khanna's rigid module
(*d*) Kennedy's gauge module.

Q. 284. The only irrigation semi module, through which the discharge is not proportional to $\sqrt{H}$, where H is the head causing flow through the module, is :

(*a*) kennedy's gauge outlet (*b*) open flume outlet
(*c*) free pipe outlet (*d*) adjustable orifice semi module.

CHAPTER 14

Q. 285. The hydraulic structure which is constructed at the junction of a canal and a drain to dispose of drainage without disturbing canal supplies, is known as a;

(*a*) cattle crossing (*b*) canal module
(*c*) canal regulator (*d*) canal crossing.

Q. 286. The type of canal alignment, which involves maximum cross-drainage works, is a :

(*a*) ridge canal (*b*) contour canal
(*c*) side slope canal (*d*) all of the above.

Q. 287. The irrigation structure which is constructed at the crossing of a canal and a drain, to avoid the mixing of their respective discharges, is :

(*a*) an aqueduct (*b*) a super passage
(*c*) a level crossing (*b*) (*a*) and (*b*) both
(*e*) (*a*), (*b*) and (*c*) all.

Q. 288. When an irrigation canal is taken over a drainage channel, the crossing is called :

(*a*) an aqueduct (*b*) a super passage
(*c*) a level crossing (*d*) none of them.

Q. 289. An irrigation canal, freely flowing under a drainage channel, is specifically called a :

(*a*) canal junction (*b*) canal crossing
(*c*) canal siphon (*d*) super passage.

Q. 290. An irrigation canal flowing freely above a drainage, which in turn is flowing under pressure, is specifically, called a :

(*a*) canal siphon (*b*) canal aqueduct
(*c*) siphon aqueduct (*d*) super passage.

Q. 291. The crossing arrangement, preferably made at the junction of a huge canal and a river stream carrying short lived-high flood discharge at almost equal bed levels, is a :

(*a*) super passage (*b*) aqueduct
(*c*) level crossing (*d*) canal siphon.

Q. 292. The drainage water is sometimes allowed to join the canal water to augment canal supplies, through a hydraulic structure, called a :

(*a*) canal outlet (*b*) canal inlet
(*c*) module (*d*) level crossing.

Q. 293. The DBL of a canal and the HFL of a drain at their crossing point are, respectively, 216 m and 214 m. The adopted cross-drainage work here, will be a :

(*a*) super passage (*b*) siphon
(*c*) aqueduct (*d*) siphon aqueduct.

Q. 294. Pinpoint the correct statement in relation to the relative merits of the two cross-drainage works :

(*a*) a super passage is preferred to an aqueduct
(*b*) a canal-syphon is preferred to a super-passage
(*c*) a super passage is preferred to a canal syphon
(*d*) a siphon aqueduct is inferior to a canal siphon, and is seldom used.

Q. 295. A cross-drainage work is called a siphon, when it carries the canal water :
(*a*) below the drainage under pressure
(*b*) below the drainage at atmospheric pressure
(*c*) above the drainage at atmospheric pressure
(*d*) none of the above.

Q. 296. In a syphon aqueduct, the worst condition of uplift on the roof occurs, when:
(*a*) the canal and drainage are flowing full
(*b*) the canal is flowing full and there is no drainage discharge
(*c*) the canal is empty and drainage is flowing full
(*d*) none of the above.

Q. 297.* In an aqueduct provided with a pucca bottom floor, the uplift will occur :
(*a*) on the roof slab
(*b*) on the bottom floor
(*c*) on both the roof slab as well as the bottom floor
(*d*) no where, since the flow is free in the canal as well as in the drainage channel.

Q. 298.* In a syphon aqueduct, the worst condition of uplift on the floor occurs, when:
(*a*) the canal is full and the drainage empty, with watertable at drainage bed
(*b*) the canal is empty and the drainage full, with watertable at drainage bed
(*c*) the canal and drainage both full
(*d*) the canal is full and drainage empty, with watertable below the floor.

Q. 299. Point out the incorrect statement :
(*a*) aqueducts and super passages are usually not provided with pucca bottom floors
(*b*) aqueduct syphons and canal syphons are usually provided with pucca bottom floors
(*c*) in a level crossing, a cross regulator is provided on the canal below the crossing
(*d*) canals or drainage channels are usually flumed to affect economy at the sites of crossings, wherein the contraction transitions are not to be steeper than $22\frac{1}{2}°$ and the expansion transitions not to be steeper than 30°.
(*e*) none of the above.

Q. 300. The head loss through a siphon barrel is usually given by Unwin's formula, by neglecting velocity of approach, as :

$$H_L = \left(1 + f_1 + f_2 \cdot \frac{L}{R}\right)\frac{V^2}{2g},$$ **where f_1 and f_2 respectively represent the coefficient of head losses due to :**

(*a*) barrel friction and entry (*b*) entry and barrel friction
(*c*) barrel friction and exit (*d*) exit and barrel friction.

Q. 301. A syphon aqueduct is constructed at a canal crossing site, where drainage HFL was 212.2 m, by allowing an afflux of 0.4 m at high flood discharge. At this site, the water level, downstream of the crossing at the same high flood, will be :
(*a*) 212.2 m
(*b*) 212.6 m
(*c*) 211.8 m
(*d*) none of them, as it cannot be predicted.

Q. 302. The following data is available at the proposed site of a canal crossing :

Item	Drain	Canal
B.L. (m)	252.2	248.0
FSL/HFL (m)	253.2	253.0
Discharge (*cumecs*)	2	400

The most appropriate and economical cross-drainage work at the above site will be :

(*a*) an aqueduct (*b*) a super passage
(*c*) a syphon aqueduct (*d*) a syphon.

CHAPTER 15

Q. 303. Culverts are all those road bridges, whose spans are up to :

(*a*) 6 m (*b*) 8 m
(*c*) 10 m (*d*) 12 m.

Q. 304.* A road bridge is proposed to be constructed across an alluvial stream. The design discharge at the bridge site is estimated to be 2500 m^3/s. It is decided to adopt a total effective waterway equal to 300 m for this bridge, as against the regime width of 237.5 m, due to afflux considerations. If the HFL at the site is at RL 214.0 m, then the RL of the open foundation can be suggested at :

(*a*) 206.6 m (*b*) 207.2 m
(*c*) 208.5 m (*d*) 210.2 m.

Q. 305. The relation between Scour depth (*R*) and Regime scour depth (R_e) for an alluvial river, having regime width (W) and contracted width (B), is given by :

(*a*) $R = R_e\left(\frac{W}{B}\right)^{0.61}$ (*b*) $R = R_e\left(\frac{B}{W}\right)^{0.61}$

(*c*) $R = R_e\left(\frac{W}{B}\right)^{1/3}$ (*d*) $R = R_e\left(\frac{B}{W}\right)^{1/3}$

Q. 306. The Lacey's scour depth R, given by equation $R = 0.473\left(\frac{Q}{f}\right)^{1/3}$, is applicable, when the river width equals :

(*a*) actual river width (*b*) regime width
(*c*) any contracted width (*d*) all of the above.

Q. 307. The Lacey's scour depth R, given by the equation $R = 1.35\left(\frac{q^2}{f}\right)^{1/3}$ is applicable, when the river width equals :

(*a*) regime width (*b*) actual river width
(*c*) any contracted width (*d*) all of the above.

Q. 308. Proposed RCC road bridge, having total height of its abutments or piers from top to bottom as H, can be proposed to have economical spans, each equal to :

(*a*) $\frac{2}{3}$H (*b*) H
(*c*) 1.2 H (*d*) 1.5 H.

Q. 309. A bridge culvert is to be constructed across a proposed lined canal. The afflux at this site for a contracted canal width, can be computed by :
(*a*) Unwin's formula (*b*) Broad-crested weir formula
(*c*) Orifice formula (*d*) Molesworth formula.

Q. 310. While going to Tirupati Tirumala Devasthanam from Madras, highway road is found to be lowered at several places, over which natural drainage flow during rainy season. Such dips in the roads, are called :
(*a*) freeways (*b*) road dips
(*c*) causeways (*d*) broadways.

CHAPTER 16

Q. 311. An irrigation project is classified as a major project, when the culturable command involved in the project, is more than :
(*a*) 2,000 hectares (*b*) 5,000 hectares
(*c*) 10,000 hectares (*d*) none of the above.

Q. 312. A minor irrigation scheme, involves command area, equal to or less than :
(*a*) 100 hectares (*b*) 500 hectares
(*c*) 1000 hectares (*d*) 2000 hectares.

Q. 313. Energy is required in the utilisation of :
(*a*) ground water (*b*) surface water
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 314. In an underground profile, the zone of aeration does not include :
(*a*) soil water (*b*) capillary water
(*c*) ground water (*d*) none of them.

Q. 315. Ground water is found to occur in the geological formation, which is :
(*a*) porous (*b*) permeable
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 316. The property of a geological formation, which represents its water storage capacity, is :
(*a*) permeability (*b*) porosity
(*c*) both (*a*) and (*b*) (*d*) none of these.

Q. 317. The zone of aeration in a ground profile consists of :
(*a*) capillary fringe (*b*) soil water zone
(*c*) intermediate zone (*d*) all of them.

Q. 318. The zone of aeration in a ground profile does not include :
(*a*) capillary zone (*b*) soil water zone
(*c*) intermediate zone (*d*) saturation zone.

Q. 319. The area in our country, which is irrigated by ground water, as a fraction of the total irrigated area, is approximately equal to :
(*a*) $\frac{1}{2}$ (*b*) $\frac{2}{3}$
(*c*) $\frac{3}{4}$ (*d*) $\frac{1}{4}$.

Q. 320. The rate of flow of water through ground strata, can be estimated by :
(*a*) Manning's formula (*b*) Strickler's formula
(*c*) Dupuit's formula (*d*) Darcy's formula.

Q. 321. Darcy's law is valid, when the flow is :
(*c*) laminar (*b*) turbulent
(*c*) both (*a*) and (*b*) (*d*) none of these.

Q. 322. The relation between Transmissibility(T) and Permeability(K) for an aquifer of depth d, is :

(*a*) $K = Td$ (*b*) $T = K \cdot d$

(*c*) $T = K \cdot \log d$ (*d*) $T = \ln (Kd)$.

Q. 323.* The geological formation, which yields only insignificant quantity of ground water, is an :

(*a*) aquifer (*b*) aquifuse

(*c*) aquiclude (*d*) aquitard.

Q. 324.* The zeological formation, which may contain water, but does not yield any, is an :

(*a*) aquifer (*b*) aquifuse

(*c*) aquiclude (*d*) aquitard.

Q. 325.* The zeological formation, which contains and readily yields water to our tubewells, is an :

(*a*) aquifuse (*b*) aquitard

(*c*) aquiclude (*d*) aquifer.

Q. 326. The capillary fringe water is also called :

(*a*) suspended water (*b*) vadose water

(*c*) gravity water (*d*) all of the above.

Q. 327. The quantum of water contained in the soil pores, which cannot be extracted by gravity drainage, is called :

(*a*) pellicular water (*b*) capillary water

(*c*) hygroscopic water (*d*) none of these.

Q. 328. The cum of ground water, which can be extracted by gravity drainage from a soil stratum, when expressed as percentage fraction of the cum of the soil stratum, is called :

(*a*) pellicular water (*b*) available water

(*c*) specific yield (*d*) field capacity.

Q. 329. Field capacity of a ground aquifer, equals :

(*a*) specific yield (*b*) 100—specific yield

(*c*) $\frac{100}{\text{specific yield}}$ (*d*) none of the above.

Q. 330. Specific retention of ground water is larger in :

(*a*) coarse grained soils (*b*) fine grained soils.

Q. 331. Water wells excavated through unconfined aquifers are known as :

(*a*) gravity wells (*b*) water table wells

(*c*) non-artesian wells (*d*) all of them.

Q. 332. Water wells excavated through confined aquifers are known as :

(*a*) artesian wells (*b*) pressure wells

(*c*) both (*a*) and (*b*) (*d*) none of these.

Q. 333. In the case of a flowing well, the piezometric surface is always :

(*a*) below the ground level (*b*) above the ground level

(*c*) at the ground level (*d*) none of the above.

Q. 334. The line joining the static water levels in several wells, excavated through confined aquifer, is known as the :

(*a*) cone of depression (*b*) piezometric surface

(*c*) perched water-table (*d*) hypsometric curve.

Q. 335. If the piezometric surface along an unconfined aquifer declines to a level below the top of the aquifer, then the aquifer at this point is called :

(*a*) a perched aquifer (*b*) a leaky aquifer
(*c*) a flowing aquifer (*d*) an unconfined aquifer.

Q. 336.* The permeability of an aquifer (m/day) will :

(*a*) increase with increase in temperature of water flowing through the aquifer
(*b*) decrease with increase in temperature of water flowing through the aquifer
(*c*) not get affected by the change in temperature of water flowing through the aquifer
(*d*) increase upto 20°C and then decrease with the increase in the temperature of water flowing through the aquifer.

Q. 337.* The component of the permeability of a porous medium, which is usually expressed in units of darcy or m^2, is called :

(*a*) specific permeability (*b*) intrinsic permeability
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 338. The discharge per unit drawdown at a well is known as :

(*a*) specific yield (*b*) specific retention
(*c*) specific capacity (*d*) specific storage.

Q. 339. Storage coefficient (A) divided by aquifer depth (*d*) is known as :

(*a*) specific storage (*b*) specific capacity per unit depth of aquifer
(*c*) specific yield. (*d*) specific retention.

Q. 340.* Coefficient of storage (A) has the dimensions of :

(*a*) L^3 (*b*) L^2
(*c*) L (*d*) dimensionless.

Q. 341. The units of specific capacity of a well are :

(*a*) m^3/sec (*b*) m^2/sec
(*c*) m/sec (*d*) no units.

Q. 342. Specific capacity of a well is :

(*a*) constant over time after commissioning of the well
(*b*) increases with time after start of pumping
(*c*) decreases with time after start of pumping
(*d*) may increase or decrease, depending upon a particular aquifer.

Q. 343. Standard specific capacity of a well is the well discharge per unit of drawdown. This value of discharge should be obtained at :

(*a*) any drawdown
(*b*) a particular drawdown of 3 m
(*c*) the first 1 m of drawdown
(*d*) none of the above.

Q. 344.* The performance of a well is measured by its :

(*a*) specific capacity (*b*) specific yield
(*c*) storage coefficient (*d*) all of the above.

Q. 345. The clogging of well screens and consequent reduction in pump efficiency is indicated by :

(*a*) high value of well loss (*b*) low value of well loss
(*c*) variable value of well loss (*d*) none of the above.

Q. 346. The water level in a confined well :

(*a*) increases with increase in atmospheric pressure
(*b*) decreases with increase in atmospheric pressure
(*c*) does not undergo any change with change in the atmospheric pressure.
(*d*) all of the above are possible.

Q. 347. The water level in an unconfined well :

(*a*) increases with increase in atmospheric pressure
(*b*) decreases with increase in atmospheric pressure
(*c*) does not undergo any change with change in the atmospheric pressure
(*d*) all of the above are possible.

Q. 348.* "Specific yield" for an unconfined aquifer is :

(*a*) greater than porosity (*b*) less than porosity
(*c*) equal to porosity (*d*) unrelated to porosity. (*GATE 1989*)

Q. 349. A perched aquifer is essentially found within :

(*a*) an unconfined aquifer (*b*) a confined aquifer
(*c*) an aquiclude (*d*) none of these.

Q. 350. The most widely used type of a deep state tubewell in India is:

(*a*) cavity well (*b*) strainer tubewell
(*c*) slotted pipe gravel packed tubewell
(*d*) none of them.

Q. 351. The general average yield from standard tubewells is of the order of :

(*a*) 5 L/s (*b*) 50 L/s
(*c*) 500 L/s (*d*) 5000 L/s.

Q. 352. The types of pumps used in tubewells are :

(*a*) submergible pumps (*b*) centrifugal pumps
(*c*) turbine pumps (*d*) all of these.

Q. 353. The appropriate life of a tubewell in India is of the order of :

(*a* 1 year (*b*) 2 years
(*c*) 5 years (*d*) 15 years.

Q. 354. Corrosion of tubewell pipes may cause :

(*a*) reduced discharge from the tubewell
(*b*) excessive discharge of sand with water
(*c*) discharge of highly corrosive acidic water
(*d*) none of the above.

Q. 355. Incrustation of the tubewell pipes may lead to :

(*a*) reduced discharge from the tubewell
(*b*) excessive discharge of sand with water
(*c*) discharge of highly alkaline water
(*d*) none of the above.

Q. 356. The efficiency of the centrifugal pumps, commonly used for lifting water from wells, may be of the order of :

(*a*) 30% (*b*) 65%
(*c*) 85% (*d*) 95%.

Q. 357. Deep tubewells in soft alluviums can be best drilled by :

(*a*) rotary drilling rigs
(*b*) percussion drilling rigs
(*c*) down the hole hammer (DTH) rigs
(*d*) none of the above.

Q. 358. Deep tubewells in hard boulder-alluviums can be best drilled by :
(*a*) rotary drilling rigs
(*b*) percussion drilling rigs
(*c*) down the hole hammer (DTH) rigs
(*d*) none of the above.

Q. 359. Bored tubewells in rocky consolidated formations, as are encountered in South Indian States of our country, are usually drilled by :
(*a*) rotary drilling rigs
(*b*) percussion drilling rigs
(*c*) down the hole hammer (DTH) rigs
(*d*) none of the above.

Q. 360. Shallow tubewells upto 70 m depth in alluvial soils, are usually drilled by :
(*a*) light rigs (*b*) water jet methods
(*c*) cable tool drills (*d*) hand boring devices
(*e*) all of the above.

CHAPTER 17

Q. 361. Aswan dam on Nile river in Egypt was perhaps the first modern dam of the world. Its construction was completed in the year :
(*a*) 1664 (*b*) 1798
(*c*) 1902 (*d*) 1931.

Q. 362. The only modern dam among the following, which has failed, is :
(*a*) Koyna dam in India
(*b*) Vega de Tera dam in spain
(*c*) Mauvoisin dam in Switzerland
(*d*) Trinity dam in California, USA.

Q. 363. Earthen dams are :
(*a*) rigid dams (*b*) non rigid dams
(*c*) overflow dams (*d*) diversion dams.

Q. 364. When sand and gravel foundation strata is available at a proposed dam site of moderate height, the dam may be of the type :
(*a*) earthen dam or rockfill dam
(*b*) masonry gravity dam
(*c*) double arch dam
(*d*) concrete gravity dam.

Q. 365. The prominent modern dam, which has changed its name several times, is :
(*a*) Nagarjuna sagar dam (*b*) Hoover dam
(*c*) Bhakra dam (*d*) Idduki dam.

Q. 366. The highest concrete gravity dam of the world is Grand Dixence dam is Switzerland, whose height is :
(*a*) 325 m (*b*) 317 m
(*c*) 285 m (*d*) 272 m.

Q. 367. The only arch dam of our country is Idduki dam across Periyar river in Kerala State, whose height is :
(*a*) 81 m (*b*) 143 m
(*c*) 149 m (*d*) 169 m.

Q. 368. The highest concrete gravity dam of India, which is also the 2nd highest such dam of the world, is :

(*a*) 285 m in height (*b*) 256 m in height
(*c*) 226 m in height (*d*) 206 m in height.

Q. 369. Bhakra dam of our country is located in the State of :

(*a*) Punjab (*b*) Himachal Pradesh
(*c*) Uttar Pradesh (*d*) Madhya Pradesh.

Q. 370.* The highest stone masonry gravity dam of India as well as of the world, is:

(*a*) Ramganga dam (*b*) Nagarjuna Sagar dam
(*c*) Hirakud dam (*d*) Mettur dam.

CHAPTER 18

Q. 371. A dam reservoir, not provided with gate controls on its spillway and other sluices, is called a :

(*a*) detention basin (*b*) storage reservoir
(*c*) retarding basin (*d*) all of these.

Q. 372. A dam reservoir, catering to flood control, irrigation, and water supply, although basically designed for irrigation alone, is a :

(*a*) multipurpose reservoir (*b*) single purpose reservoir
(*c*) distribution reservoir (*d*) none of the above.

Q. 373. A hydel power project has been envisaged to serve the water supply and irrigation needs of the area at its inception stage. The dam reservoir, so constructed, will be known as :

(*a*) multipurpose reservoir (*b*) single purpose reservoir
(*c*) both (*a*) and (*b*) above (*d*) none of the above.

Q. 374. The 'surcharge storage' in a dam reservoir is the volume of water stored between :

(*a*) minimum and maximum reservoir levels
(*b*) minimum and normal reservoir levels
(*c*) normal and maximum reservoir levels
(*d*) none of the above.

Q. 375. The 'useful storage' in a dam reservoir is the volume of water stored between:

(*a*) minimum and maximum reservoir levels
(*b*) minimum and normal reservoir levels
(*c*) normal and maximum reservoir levels
(*d*) none of the above.

Q. 376. The 'dead storage' in a dam reservoir, is the available volume for collection of silt and sediment, between :

(*a*) bed level of the reservoir and minimum reservoir level
(*b*) bed level of the reservoir and the silt level in the reservoir
(*c*) bed level of the reservoir and the normal pool level
(*d*) none of the above.

Q. 377. 'Bank storage' in a dam reservoir :

(*a*) increases the computed reservoir capacity
(*b*) decreases the computed reservoir capacity
(*c*) sometimes increases and sometimes decreases the computed reservoir capacity
(*d*) has no effect on computed reservoir capacity.

Q. 378. The water stored in a reservoir below the minimum pool level is called :

(*a*) valley storage (*b*) bank storage
(*c*) surcharge storage (*d*) dead storage.

Q. 379. For a flood control reservoir, the effective storage is equal to :

(*a*) useful storage + valley storage
(*b*) useful storage + surcharge storage – valley storage
(*c*) useful storage + surcharge storage + valley storage
(*d*) useful storage – valley storage.

Q. 380. The volume V of water stored in a reservoir in a depth y above a given datum, can be easily represented by an equation of the type :

(*a*) $V = [\alpha + \beta y + \gamma y^2]$ where α, β, γ are constants
(*b*) $V = [\alpha y + \beta y^2 + \gamma y^3] + K$ K is reservoir capacity up to given datum
(*c*) neither (*a*) nor (*b*).
(*d*) both (*a*) and (*b*).

Q. 381. Average yield of a storage reservoir is the arithmetic average of its :

(*a*) firm yields over a long period
(*b*) secondary yields over a long period
(*c*) firm and secondary yields over a long period
(*d*) none of the above.

Q. 382. If A_1 and A_2 are surveyed and known areas at a reservoir site at elevations of E_1 and E_2, respectively ; then the area, A, at any intermediate elevation E, is interpolated as :

(*a*) $\sqrt{A} = \sqrt{A_1} + \frac{E - E_1}{E_2 - E_1}\left(\sqrt{A_2} - \sqrt{A_1}\right)$

(*b*) $\sqrt{A} = \sqrt{A_1} + \frac{E + E_1}{E_2 + E_1}\left(\sqrt{A_2} + \sqrt{A_1}\right)$

(*c*) $A = \sqrt{A_1} + \frac{E - E_1}{E_2 - E_1}\left[\sqrt{A_2} - \sqrt{A_1}\right]^2$

(*d*) none of the above.

Q. 383. While planning a water supply reservoir, as compared to an irrigation reservoir, the design yield may be kept :

(*a*) higher (*b*) lower
(*c*) equal
(*d*) lower or higher, as per designer's discretion.

Q. 384. Yield of a reservoir represents :

(*a*) the inflow into the reservoir
(*b*) the capacity of the reservoir
(*c*) the outflow demand on the reservoir
(*d*) none of the above.

Q. 385. The capacity of a storage reservoir can be decided by using :

(*a*) the mass curve of inflow
(*b*) the mass curve of outflow
(*c*) by both (*a*) and (*b*) together
(*d*) none of the above.

Q. 386. The maximum quantity of water that is estimated to remain available in a storage reservoir for supply, even during worst dry periods, is known as its:

(*a*) firm yield (*d*) design yield

(*c*) reservoir yield (*d*) primary yield.

Q. 387. Design yield of a storage reservoir is kept :

(*a*) higher than its firm or safe yield

(*b*) lower than its firm or safe yield

(*c*) equal to its firm or safe yield

(*d*) higher or lower than the firm yield, depending upon the designer's intuition.

Q. 388. The amount of water stored in a river channel without any artificial storage, is known as :

(*a*) bank storage (*b*) river storage

(*c*) valley storage (*d*) dead storage.

Q. 389. With the reduction in reservoir capacity over the passage of time, the trap efficiency

(*a*) increases

(*b*) decreases

(*c*) remains unaffected

(*d*) may increase or decrease, depending upon the reservoir characteristics.

Q. 390. Trap efficiency of a storage reservoir is defined as :

(*a*) $\dfrac{\text{Total annual sediment inflow}}{\text{Reservoir capacity}}$

(*b*) $\dfrac{\text{Total sediment deposited in a given period}}{\text{Total sediment inflow in that period}}$

(*c*) $\dfrac{\text{Total annual sediment deposited in the reservoir}}{\text{Dead storage capacity of the reservoir}}$

(*d*) none of the above.

Q. 391. Capacity-inflow ratio for a storage reservoir is defined as :

(*a*) $\dfrac{\text{reservoir capacity}}{\text{average annual flood inflow}}$

(*b*) $\dfrac{\text{reservoir capacity}}{\text{average annual sediment inflow}}$

(*c*) $\dfrac{\text{dead storage capacity of the reservoir}}{\text{average annual sediment deposited}}$

(*d*) none of the above.

Q. 392. With the increase in its capacity-inflow ratio, the trap efficiency of a reservoir:

(*a*) increases

(*b*) decreases

(*c*) remains unchanged

(*d*) may increase or decrease depending on the reservoir characteristics.

Q. 393. The capacity-inflow ratio for a reservoir :

(*a*) is a constant factor overtime

(*b*) increases with time

(*c*) decreases with time

(*d*) may increase or decrease with time.

Q. 394. As the height of a proposed dam is increased, the cost per unit of storage :
(*a*) increases
(*b*) decreases
(*c*) initially increases and then decreases
(*d*) initially decreases and then increases.

Q. 395. "Economical height of a Dam" is that height, for which the :
(*a*) cost per unit of storage is minimum
(*b*) benefit cost ratio is maximum
(*c*) net benefits are maximum
(*d*) none of the above.

Q. 396.* If 20% of the reservoir capacity is earmarked for dead storage in a storage reservoir of 30 M cum; and the average annual silt deposition in the reservoir is 0.1 M cum, then the useful life of the reservoir will start reducing after :
(*a*) 60 years (*b*) 120 years
(*c*) 240 years (*d*) 300 years.

Q. 397. The appropriate value of the estimated average life of a dam reservoir is :
(*a*) 25 years (*b*) 50 years
(*c*) 75 years (*d*) none of these.

CHAPTER 19

Q. 398. The vertical component of the earthquake wave, which produces adverse effects on the stability of a dam, is, when it is acting in;
(*a*) upward direction (*b*) downward direction
(*c*) both (*a*) and (*b*) (*d*) none of them.

Q. 399. The horizontal component of an earthquake wave, producing instability in a dam is the one, which acts :
(*a*) towards the reservoir (*b*) towards the dam
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 400. The vertical downward earthquake acceleration, $\alpha_v = 0.1\,g$, acting on a gravity dam, will :
(*a*) increase the resisting weight of the dam by 10%
(*b*) decrease the resisting weight of the dam by 10%
(*c*) increase the uplift by 10%
(*d*) none of the above.

Q. 401. A gravity dam is subjected to hydro dynamic pressure, caused by :
(*a*) the rising waters of the reservoir when a flood wave enters into it
(*b*) the rising waves in the reservoir due to high winds
(*c*) the increase in water pressure, momentarily caused by the horizontal earthquake, acting towards the reservoir.
(*d*) the increase in water pressure, momentarily caused by the horizontal earthquake, acting towards the dam.

Q. 402. In a concrete gravity dam with a vertical upstream face, the stabilising force is provided by the :
(*a*) weight of the dam
(*b*) the water supported against the upstream slope
(*c*) both (*a*) and (*b*)
(*d*) none of the above.

Q. 403. In a concrete gravity dam, with a sloping upstream face, the resisting force is provided by the :

(*a*) weight of the dam
(*b*) weight of the water supported on the upstream slope
(*c*) both (*a*) and (*b*)
(*d*) none of these.

Q. 404. The factor among the following, which does not try to destabilise a masonry gravity dam, is :

(*a*) water seeping below the foundation of the dam
(*b*) generation of waves by high winds
(*c*) deposition of silt in dead storage zone of the reservoir
(*d*) water standing against the downstream face of the dam
(*e*) water standing against the upstream face of the dam.

Q. 405*. The horizontal destabilising force caused by the formation of waves in a storage reservoir having a fetch of 40 km, due to high wind of 160 km/h, is about :

(*a*) 30 kN (*b*) 60 kN
(*e*) 90 kN (*d*) 130 kN.

Q. 406*. According to IS 6512—1984, the wind set up in a reservoir having maximum fetch of F km, and average reservoir depth along this fetch length as D m, as caused by the wind velocity of V km/h, is given by :

(*a*) $\dfrac{V^2 F}{62000\,D}$ (*b*) $\dfrac{V^2 F}{D}$
(*c*) $\dfrac{V^2 F}{6200\,D}$ (*d*) $\dfrac{V^2 F}{620\,D}$.

Q. 407*. A reservoir, extending 20 km upstream and having a design wind velocity of 100 km/h, should be provided with a free-board of :

(*a*) 1.2 m (*b*) 1.6 m
(*c*) 2.5 m (*d*) 3 m.

Q. 408. Development of tensile stresses in a concrete or masonry gravity dam are usually not allowed, because it may lead to development of tension cracks, ultimately causing failure of the structure, by :

(*a*) excessive seepage
(*b*) excessive tensile stresses
(*c*) excessive compressive stresses
(*d*) none of the above.

Q. 409. The bottom portion of a concrete or a masonry gravity dam is usually stepped, in order to :

(*a*) increase the overturning resistance of the dam
(*b*) increase the shear strength at the base of the dam
(*c*) decrease the shear stress at the base of the dam
(*d*) none of the above.

Q. 410. The governing compressive stress in a concrete gravity dam, which should not be allowed to exceed the permissible value of about 3000 kN/m^2, while analysing full reservoir case, is :

(*a*) the vertical maximum stress at the toe
(*b*) the major principal stress at the toe
(*c*) the shear stress at the toe
(*d*) none of the above.

Q. 411. The two dimensional stability analysis of gravity dams proves better for U-shaped valleys than for *V*-shaped valleys, because the transverse joints in the dam body are generally :

(*a*) not grouted in *U*-shaped valleys, but are keyed together in *V*-shaped valleys
(*b*) not grouted in *V*-shaped valleys, but are keyed together in *U*-shaped valleys.

Q. 412. The small openings made in the huge body of a concrete gravity dam, such as sluices and inspection galleries, can be assumed to be causing only local effects without any appreciable effect on the distribution of stresses, as per the principle of :

(*a*) Laplace (*b*) St. Venant
(*c*) Reynold (*d*) St. Francis.

Q. 413. For usuall values of permissible compressive stress and specific gravity of concrete, a high concrete gravity dam is the one, whose height exceeds :

(*a*) 48 m (*b*) 70 m
(*c*) 88 m (*d*) none of these.

Q. 414*. An elementary triangular concrete gravity dam, supporting 60 m height of reservoir water and full uplift, should have a minimum base width equal to:

(*a*) 36 m (*b*) 39 m
(*c*) 51 m (*d*) 61 m.

Q. 415. Inorder to economise on the provided section of a concrete gravity dam, attempts are made to reduce the uplift, by :

(*a*) providing drainage gallery to collect seepage water
(*b*) constructing cut-off under upstream face
(*c*) pressure grouting in dam foundation
(*d*) constructing drainage channels between the dam and its foundation
(*e*) all of the above methods.

Q. 416. Transverse joints in concrete gravity dams are the :

(*a*) horizontal construction joints at each lift height
(*b*) vertical construction joints of full height and width
(*c*) diagonal construction joints for torsion
(*d*) none of the above.

Q. 417. Leakage through the transverse joints in a gravity dam is prevented by :

(*a*) shear keys (*b*) key ways
(*c*) water stops (*d*) none of these.

Q. 418. Shear key is several times provided between the bottom of a masonry or concrete gravity dam and its foundation, to increase the frictional resistance of the dam against sliding. This key is usually provided :

(*a*) near the toe (*b*) near the heel
(*c*) near the individual seams in the bed rock
(*d*) none of the above.

CHAPTER 20

Q. 419. Point out the correct statement with reference to earthen dams :

(*a*) these dams are very costly as compared to other types
(*b*) they are less susceptible to failure as compared to rigid dams
(*c*) they can be constructed almost on every type of foundation
(*d*) highly skilled labour is generally not required.

Q. 420. The most preferred type of an earthen dam section is the one, in which the:
(*a*) entire embankment is made of one type of soil
(*b*) inner embankment is made of highly porous soil, surrounded by the outer shell of highly impervious soil, both separated by transition filter material of mediocre permeability
(*c*) inner embankment is made of highly impervious soil surrounded by the outer shell of highly pervious soil, both separated by transition filter material of mediocre permeability
(*d*) none of the above.

Q. 421. When seepage takes place through the body of an earthen dam, it leads to :
(*a*) development of pore pressures in the dam body
(*b*) reduction in the shear strength of the dam
(*c*) reduction in the developed shear stresses in the dam
(*d*) (*a*) and (*b*) both
(*e*) (*a*), (*b*) and (*c*) all.

Q. 422. The most preferred soil for the central impervious core of a zoned embankment type of an earthen dam, is
(*a*) highly impervious clay (*b*) highly pervious gravel
(*c*) coarse sand (*d*) clay mixed with fine sand.

Q. 423. Pure clayey soils are generally not preferred for the central impervious cores of zoned type of earthen dams, because :
(*a*) clays are highly impervious
(*b*) clays are highly pervious
(*c*) clays are susceptible to cracking
(*d*) none of the above.

Q. 424. During the construction of an earthen dam by hydraulic fill method, development of pore pressures become important in the :
(*a*) central impervious core (*b*) pervious outer shell
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 425. The process of laying and compacting earth in layers by power rollers under Optimum Moisture Conditions (OMC) for construction of earthen dams, is known as :
(*a*) rolled fill method (*b*) hydraulic fill method
(*c*) OMC method (*d*) none of the above.

Q. 426. Coordination between field and design engineers to ensure continuous field observations and modifications in design during construction, is more importantly required in case of :
(*a*) concrete gravity dams (*b*) masonry gravity dams
(*c*) arch dams (*d*) earthen dams.

Q. 427. When the water level standing against an earthen embankment, suddenly falls down, then there is an iminent risk of sliding failure, to the :
(*a*) upstream slope (*b*) downstream slope
(*c*) both (*a*) and (*b*) (*d*) none of these.

Q. 428. When the reservoir is full, the slope which is most likely to slide, is :
(*a*) the upstream slope (*b*) the downstream slope
(*c*) both (*a*) and (*b*) (*d*) none of them.

Q. 429. Provision of horizontal berms at suitable vertical intervals may be provided in the downstream face of an earthen dam, in order to :

(*a*) allow the movement of cattle
(*b*) allow the inspection vehicles to move
(*c*) reduce the erosion caused by the flowing rain water
(*d*) none of the above.

Q. 430. The only provision among the following, which can help control the seepage through the body of an earthen dam and, thus, to keep the phreatic line well within the dam width, is :

(*a*) upstream impervious cutoff
(*b*) drain trench along the downstream toe
(*c*) relief wells
(*d*) chimney drain.

Q. 431*. During the maintenance of an earthen dam, the apparent seepage through the foundation of the dam is best taken care of, by providing :

(*a*) a chimney drain
(*b*) a rock toe
(*c*) a drain trench along the downstream toe
(*d*) an upstream impervious cutoff.

Q. 432. The base width of a rock fill dam, incomparison to that of an earthen dam, is :

(*a*) much larger
(*b*) much smaller
(*c*) sometimes larger sometimes smaller
(*d*) almost equal.

Q. 433. On moderate foundations, and particularly in seismic areas, the type of dam which can preferably be considered for construction, is :

(*a*) masonry gravity dam (*b*) earthen dam
(*c*) rock fill dam (*d*) arch dam.

CHAPTER 21

Q. 434. The 'safety valve' of a dam is its :

(*a*) drainage gallery (*b*) inspection gallery
(*c*) spillway (*d*) outlet sluices.

Q. 435. A ungated spillway starts functioning, as soon as the water level in the reservoir, crosses the :

(*a*) maximum reservoir level
(*b*) minimum reservoir level
(*c*) maximum conservation level
(*d*) none of the above.

Q. 436. The top line of an ogee spillway, which is kept at RL equal to the full reservoir level, is precisely called :

(*a*) the crest (*b*) the apex of the crest
(*c*) the corbel (*d*) the chute.

Q. 437. When the gated sluices are provided through the body of a dam spillway, then the ogee spillway structure shall normally be of :

(*a*) corbel type (*b*) non corbel type
(*c*) either (*a*) or (*b*) (*d*) none of these.

Q. 438. The effective length of an ogee spillway will be different from its actual length, in case of :

(*a*) gated spillway
(*b*) ungated spillway
(*c*) both gated as well as ungated spillway
(*d*) none of these.

Q. 439. Which one of the following spillways is least suited to earthen dams ?

(*a*) ogee spillway (*b*) side channel spillway
(*c*) chute spillway (*d*) shaft spillway.

Q. 440. The spillway, which can be adopted with ease on gravity as well as earthen dams, is :

(*a*) ogee spillway
(*b*) chute spillway
(*c*) both ogee as well as chute spillway
(*d*) none of these.

Q. 441. The famous Bhakra dam of our country has been provided with :

(*a*) trough spillway (*b*) ogee spillway
(*c*) shaft spillway (*d*) syphon spillway.

Q. 442. Hydraulic jump is widely used for dissipation of energy in :

(*a*) ogee spillways (*b*) trough spillways
(*c*) side channel spillways (*d*) all of these.

Q. 443. The surplus reservoir water, after spilling over the spillway crest, flows on the chute :

(*a*) parallel to the crest in a trough spillway
(*b*) parallel to the crest in a side channel spillway
(*c*) perpendicular to the crest in a side channel spillway
(*d*) obliquely to the crest in a chute spillway.

Q. 444. When the crest of an ogee spillway is designed to be in accordance with the lower nappe of a free falling water jet over a duly ventilated sharp crested weir, then theoretically :

(*a*) the pressure on the spillway crest will always be zero (*i.e.* atmospheric pressure)
(*b*) the pressure on the spillway crest will be zero at design head only
(*c*) the pressure on the spillway crest will always be negative
(*d*) the pressure on the spillway crest will always be positive.

Q. 445. If the operating head on an ogee spillway is more than the design head, then:

(*a*) the pressure on the crest will be zero
(*b*) the pressure on the crest will be negative, causing cavitation
(*c*) the pressure on the crest will be positive
(*d*) the discharge coefficient of the spillway will be reduced.

Q. 446. In computing the spilling capacity of high ogee spillways, the velocity head is usually :

(*a*) very small, and hence neglected
(*b*) very large, and hence cannot be neglected
(*c*) neither (*a*) nor (*b*).

Q. 447. In the functioning of an ogee spillway, the operating head :

(*a*) frequently exceeds the design head
(*b*) rarely exceeds the design head
(*c*) never exceeds the design head
(*d*) has no connection with the design head.

Q. 448. The discharge passing over an ogee spillway, per unit length of its appex line, is proportional to :

(*a*) H (*b*) H^2
(*c*) $H^{1/2}$ (*d*) $H^{3/2}$.

where H is the head over the appex of its crest.

Q. 449*. If a flood enters a dam reservoir at F.R.L., the efficiency of its ogee spillway will :

(*a*) increase with the increasing head
(*b*) reduce with the increasing head
(*c*) remain constant with the increasing head
(*d*) vary with the increasing head.

Q. 450. The W.E.S. downstream profile of an ogee spillway can be represented by an equation :

$$\left(\frac{x}{H_d}\right)^n = K\left(\frac{y}{H_d}\right);$$

where the coefficients K and n for a vertical upstream spillway would, respectively, be :

(*a*) 2.0 and 1.85 (*b*) 0.5 and 1.85
(*c*) 2.0 and 0.85 (*d*) 0.5 and 0.85.

where (x, y) are the coordinates on the crest profile with crest appex as origin.

Q. 451. The portion of a chute spillway, which is known as its control structure, is :

(*a*) low ogee weir
(*b*) chute channel
(*c*) approach channel leading the water from the reservoir to the ogee weir.
(*d*) stilling basin at its bottom.

Q. 452. The spillway, which can be called as an 'overflow spillway', is essentially :

(*a*) an ogee spillway (*b*) shaft spillway
(*c*) chute spillway (*d*) syphon spillway.

Q. 453. The spillway, which may sometimes be called a 'waste weir', is :

(*a*) an ogee spillway (*b*) a trough spillway
(*c*) a shaft spillway (*d*) all of the above.

Q. 454. The spillways involving weir type spills, giving increased discharge with the increase in reservoir level, are :

(*a*) ogee spillways (*b*) chute spillways
(*c*) side channel spillways (*d*) all of these.

Q. 455. A shaft spillway is located :

(*a*) inside the body of a gravity dam
(*b*) inside the upstream reservoir
(*c*) inside the downstream reservoir
(*d*) on side flanks of the main dam.

Q. 456. The syphons installed within a gravity dam, to spill the surplus reservoir water, are known as :

(*a*) hooded type syphon spillway
(*b*) tilted outlet type syphon spillway
(*c*) both (*a*) and (*b*)
(*d*) none of these.

Q. 457. The syphons installed over overflow dams, constitute what are known as :

(*a*) tilted outlet type of syphon spillways
(*b*) hooded type of syphon spillways
(*c*) discharge carriers
(*d*) baby syphons.

Q. 458. Syphons installed over an overflow spillway will :

(*a*) decrease the effectiveness of the spillway
(*b*) increase the effectiveness of the spillway
(*c*) not affect the effectiveness of the spillway
(*d*) all the above are possible.

Q. 459. The only spillway among the following, through which the discharge does not increase as fast as it increases in all others, is :

(*a*) chute spillway (*b*) side channel spillway
(*c*) ogee spillway (*d*) shaft spillway.

Q. 460. The only spillway among the following, through which the discharge is almost at its capacity rate, even from the start of its functioning, is :

(*a*) chute spillway (*b*) side channel spillway
(*c*) ogee spillway (*d*) syphon spillway.

Q. 461*. An air vent is provided at F.R.L. to break the syphoning action at that level, in a :

(*a*) hooded type of syphon spillway
(*b*) tilted outlet type of syphon spillway
(*c*) saddle syphon spillway
(*d*) all of the above.

Q. 462. The energy dissipation at the toe of a spillway is affected basically by the use of hydraulic jump, in :

(*a*) a roller bucket
(*b*) a ski-jump bucket
(*c*) a sloping apron taken below the downstream river bed
(*d*) none of the above.

Q. 463. The most ideal condition for energy dissipation in the design of spillways is the one, when :

(*a*) the tail water rating curve lies above the jump rating curve at all discharges
(*b*) the tail water rating curve coincides with the jump rating curve at all discharges
(*c*) the tail water rating curve lies below the jump rating curve at all discharges
(*d*) the tail water rating curve either lies above or below the jump rating curve, depending upon the discharge.

Q. 464. When the tail water depths in the river, downstream of a spillway are quite low, such that the tail water curve, at all discharges, lies below the post jump depth curve, then the energy dissipation can be affected best by :

(*a*) a roller bucket (*b*) a ski-jump bucket
(*c*) either (*a*) or (*b*) (*d*) none of them.

Q. 465. Energy dissipation arrangements made at the bottom of an overfall spillway, usually depend upon the relative positions of tail water curve (T.W.C.) and jump height curve (J.H.C.) and also on Incoming Froude number. Such positions and suggested arrangements are given below in a haphazard manner, and you have to match them properly :

(*A*)	T.W.C. coinciding with J.H.C. at all discharges	(*i*)	ski-jump bucket at higher incoming Froude number (> 9); and sloping apron below the d/s river bed at lower froude numbers (4.5 to 9)
(*B*)	T.W.C. lying below the J.H.C. at all discharges	(*ii*)	a single horizontal apron at toe of the spillway at d/s river bed
(*C*)	T.W.C. lying above the J.H.C. at all discharges	(*iii*)	a roller bucket at higher Froude numbers, and sloping apron above the d/s river bed at lower values of *F*
(*D*)	T.W.C. lying above the J.H.C. at low discharges, and below the J.H.C. at high discharges, and *vice versa*.	(*iv*)	a sloping apron partly below and partly above the d/s river bed.

Q. 466. A troublesome and oscillating hydraulic jump is usually formed in flows, involving the incoming Froude number in the range of 2.5-4.5, which normally is met in cases of :

(*a*) weirs and barrages (*b*) overflow spillways of dams
(*c*) both (*a*) and (*b*) (*d*) none of them.

Q. 467. A very steady and stable hydraulic jump is usually formed in flows, involving the approaching Froude number in the range of 4.5-9.0, which normally is met in cases of :

(*a*) weirs and barrages (*b*) overflow spillways of dams
(*c*) both (*a*) and (*b*) (*d*) none of them.

Q. 468. In case of very high overflow spillways, the approaching Froude number of the flow at the toe of the spillway may exceed 9.0, bringing the hydraulic jump to be in the category of a 'strong jump'. In such a case, the energy dissipation arrangement preferably made at the toe of the spillway, may consists of :

(*a*) bucket type dissipator
(*b*) USBR stilling basin
(*c*) Indian standard stilling basin
(*d*) none of the above.

Q. 469. Standard USBR stilling basin II is useful for energy dissipation at the bottom of an overflow structure, if the approaching Froude number is :

(*a*) less than 4.5
(*b*) more than 4.5.

Q. 470. Standard stilling basin provided at the toe of a dam spillway for energy dissipation, is usually provided with auxiliary devices, like chute blocks and dentated sills, for the basic purpose of reducing the length of the stilling basin from about :

(*a*) $6y_2$ to $4y_2$ (*b*) $4y_2$ to $2y_2$
(*c*) $6y_2$ to $2y_2$ (*d*) $3y_2$ to y_2.

where y_2 is the post jump depth

Q. 471. The device which does not help in energy dissipation at the bottom of a hydraulic structure, over which water spills, is :

(*a*) chute block (*b*) dentated sill
(*c*) morning glory (*d*) none of them.

Q. 472. In a fixed roller of a spillway gate, the rollers are attached to the :

(*a*) gate (*b*) groove guide
(*c*) either (*a*) or (*b*) (*d*) none of them.

Q. 473. In vertical stoney spillway gate, the rollers are placed between the :

(*a*) gate and the u/s groove guide
(*b*) gate and the d/s groove guide
(*c*) either (*a*) or (*b*)
(*d*) none of them.

Q. 474. The spillway gate, which when lowered, can not be seen from a distance, is of the type :

(*a*) sliding gate (*b*) roller gate
(*c*) tainter gate (*d*) USBR drum gate.

Q. 475*. An ogee spillway of a concrete gravity dam having FRL of 325.0 m and MWL of 340.0 m, is provided with vertical gates between piers erected on the spillway. The effective length of the spillway is 60 m. The discharge through this spillway when gates are opened upto actual reservoir level of 331.0 m, will be :

(*a*) 850 cumecs (*b*) 1700 cumecs
(*c*) 2800 cumecs (*d*) none of them.

CHAPTER 22

Q. 476*. A 2 m diameter sluiceway at RL 300.0 m, is provided through a concrete overflow dam section to release water to the downstream, where tail water level is not more than 275.0 m. The discharge through this outlet, when the water level in the reservoir is at FRL of 330.0 m, is of the order of :

(*a*) 20 cumecs (*b*) 40 cumecs
(*c*) 50 cumecs (*d*) 80 cumecs.

Q. 477*. A 4 m diameter tunnel has been constructed through an earthen dam, with a bell mouth entry. The water levels on U/s and D/s sides of the dam are at RL 226 m and 210 m, respectively. The discharge through this outlet will be of the order of :

(*a*) 64 cumecs (*b*) 104 cumecs
(*c*) 170 cumecs (*d*) 216 cumecs.

Q. 478. A trash rack is not required at the entrance of a :

(*a*) syphon spillway (*b*) drum gate installation
(*c*) morning glory spillway (*d*) high head gate installation.

Q. 479. The outlet provided in a dam body, to release water for downstream water demand, is known as :

(*a*) spillway (*b*) sluiceway
(*c*) under-sluice (*d*) waterway.

Q. 480. Bar screens, used to cover dam outlets to prevent entry of debris or ice into the sluiceway conduits, are called :

(*a*) gate controlled ports (*b*) projecting collars
(*c*) trash racks (*d*) none of these.

Q. 481. Which of the following statement is false ?

(*a*) water can be withdrawn from any selected level of reservoir using dry intake towers
(*b*) Intake towers have to be designed for worst combination of hydrostatic, wind, earthquake, and wave forces
(*c*) Dry intake towers are lighter in construction as compared to wet intake towers
(*d*) none of the above.

Q. 482. A sluiceway conduit passing through an earthen dam has a length equal to L; and it has x projecting collars-each having projected length equal to x. The increased length of seepage path in this case is given by :

(*a*) $L+2nx$ (*b*) $L+nx$
(*c*) $2nx$ (*d*) none of them.

Q. 483. Projecting collars are provided on sides of a rectangular tunnel of length (L), made through an earthen dam, to increase the seepage path. Their projection length (X) and numbers (N) are decided, as to provide increased seepage path equal to 2NX, where 2NX should generally be :

(*a*) greater than $\frac{L}{4}$ (*b*) greater than $\frac{L}{2}$
(*c*) greater than L (*d*) none of the above.

CHAPTER 23

Q. 484. The flow through Penstocks and Pressure conduits is, generally :

(*a*) laminar (*b*) turbulent
(*c*) both (*a*) and (*b*) (*d*) none of these.

Q. 485. The head lost in the flow of water through a penstock pipe of given length:

(*a*) increases with the increase in flow velocity
(*b*) decreases with the increase in flow velocity
(*c*) decreases with the increase in the roughness of the pipe surface
(*d*) decreases with time.

Q. 486. Hoop's reinforcement is provided in cement concrete pressure pipes, in order to counteract the;

(*a*) water hammer pressure
(*b*) internal water pressure
(*c*) stresses caused by external backfills
(*d*) both (*a*) and (*b*)
(*e*) (*a*), (*b*) and (*c*) all.

Q. 487. When a gate valve, installed in a pressure pipe, is suddenly closed, water hammer pressure is caused on the pipe shell, in the portion :
(*a*) downstream of the valve (*b*) upstream of the valve
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 488. Which of the following types of pressure conduits is preferably used for large heads?
(*a*) P.C.C. pipes (*b*) Cast iron pipes
(*c*) Prestressed concrete pipes (*d*) Asbestos pipes.

CHAPTER 24

Q. 489. A hydropower plant, developed at the site of a drop in an irrigation canal, is of the type :
(*a*) runoff river plant (*b*) storage plant
(*c*) pumped storage plant (*d*) tidal plant.

Q. 490. A nuclear power development scheme is essentially a :
(*a*) thermal power scheme (*b*) hydropower scheme
(*c*) neither (*a*) nor (*b*) (*d*) both (*a*) as well as (*b*).

Q. 491. Fossil fuels are used in :
(*a*) a nuclear power plant (*b*) an ordinary thermal power plant
(*c*) a hydro power plant (*d*) none of them.

Q. 492. Major hydropower generation in India is from :
(*a*) runoff river plants (*b*) storage plants
(*c*) pumped storage plants (*d*) tidal plants.

Q. 493. A run off river plant for hydro power generation is essentially a :
(*a*) high head scheme (*b*) low head scheme
(*c*) medium head scheme (*d*) any of these.

Q. 494. A storage hydro plant essentially involves :
(*a*) a barrage or a weir (*b*) a dam
(*c*) either (*a*) or (*b*) (*d*) neither (*a*) nor (*b*).

Q. 495. The natural highwater falls may be used for generation of :
(*a*) hydro-power (*b*) water-power
(*c*) both (*a*) and (*b*) (*d*) neither (*a*) nor (*b*).

Q. 496. The power plant among the following, which is a storage plant, is :
(*a*) Rance power station in France, located on sea
(*b*) Ganguwal power house, located on Nangal hydel channel in India
(*c*) Sarda power house, located on Sarda Canal in U.P. in India.
(*d*) none of these.

Q. 497. The only statement, which is incorrect in regard to hydropower, is :
(*a*) the system efficiency of a hydroplant is quite high
(*b*) the installation cost of a hydroplant is very high
(*c*) the running cost of a hydro power plant is very low
(*d*) the hydraulic turbines takes a lot of time in being put off and on.

Q. 498. Identify the correct statement in regard to hydropower :
(*a*) hydropower stations are generally labour oriented
(*b*) Gestation period for hydro-power plant is usually small
(*c*) the hydro generators give high efficiency over a wide range of load
(*d*) in a hydropower scheme, the firm power is usually high, as compared to total power.

Q. 499. The minimum power, which a hydro-power plant can generate throughout the year, is called :

(*a*) power plant capacity (*b*) power plant load
(*c*) firm power (*d*) water power.

Q. 500. 400 cumecs of water is being released from a dam storage to meet the downstream demand, through the turbines of the connected hydroplant. The effective head of water acting on the turbines is 50 m. The efficiency of the hydroplant is 0.8. The electrical power generated from this plant, would be:

(*a*) 1,56,800 MW (*b*) 156.8 MkW
(*c*) 156.8 MW (*d*) none of these.

Q. 501. If the peak load for a power plant equals the plant capacity, then the ratio of the capacity factor to load factor will be :

(*a*) 1 (*b*) 0
(*c*) <1 (*d*) >1
(*e*) – 1 (*f*) none of these.

Q. 502*. If the peak load on a power plant having a capacity of 100 MW is 70 MW during a given week, and the energy produced is 58,80,000 kwh, the capacity factor for the plant for the week, will be :

(*a*) 35% (*b*) 50%
(*c*) 70% (*d*) none of these.

Q. 503*. The load factor for the data given in the above question will be :

(*a*) 0.35 (*b*) 0.50
(*c*) 0.70 (*d*) none of these.

Q. 504*. The utilisation factor for the data given in Q. 502, will be :

(*a*) 0.35 (*b*) 0.50
(*c*) 0.70 (*d*) none of these.

Q. 505. Pondage requirement in a hydropower plant includes the need :

(*a*) to balance the varying demand
(*b*) to compensate for wastage and spillage
(*c*) to balance short time fluctuations in the flow
(*d*) all of these.

Q. 506. A Pelton's turbine is a :

(*a*) velocity turbine (*b*) reaction turbine
(*c*) pressure turbine (*d*) none of these.

Q. 507. An impulse turbine, like a pelton's wheel, is used for :

(*a*) low heads and high discharges
(*b*) high heads and low discharges
(*c*) low heads and low discharges
(*d*) high heads and high discharges.

Q. 508. An impulse turbine, like a Pelton's turbine, is :

(*a*) an open body exposed to atmosphere
(*b*) a closed body not exposed to atmosphere
(*c*) a partially open and partially closed body
(*d*) none of these.

Q. 509. In a reaction turbine, like a Francis turbine or Kaplan turbine,

(*a*) the potential head of water is totally changed into kinetic head
(*b*) the potential head of water is partially changed into kinetic head
(*c*) the potential head of water is not at all changed into kinetic head
(*d*) all of the above are possible.

Q. 510. In a Francis turbine, the water
(*a*) flows out openly
(*b*) flows out through a closed draft tube
(*c*) both (*a*) and (*b*), depending upon the type
(*d*) neither (*a*) nor (*b*).

Q. 511*. You have to select turbines for a hydropower plant, having 150 m head of stored water behind the dam. The water in the reservoir is clear, and load on the power house is not likely to fluctuate much. Which type of turbines will you generally recommend?
(*a*) Pelton's turbines (*b*) Francis turbines
(*c*) Kaplan turbines (*d*) Any of them.

Q. 512. You have to select turbines for a hydropower plant, working on 150 m head. The water is sandy and load on the plant is highly variable. Which type of turbines will you generally recommend ?
(*a*) Pelton's turbines (*b*) Francis turbines
(*c*) Kaplan turbines (*d*) Any of them will do.

Q. 513. If two identical pumps, each capable to deliver a discharge Q against a head H, are connected :
(*a*) in parallel, the resulting discharge is $2Q$ against a head H
(*b*) in parallel, the resulting discharge is Q against a head of $2H$
(*c*) in series, the resulting discharge is $2Q$ against a head H
(*d*) in series, the resulting discharge is Q against a head $2H$.

CHAPTER 25

Q. 514. The minimum depth of water required for safe and economical navigation is:
(*a*) 1 m (*b*) 2.0 m
(*c*) 2.7 m (*d*) 4.2 m

Q. 515 The transit time taken by a barge tow, moving upstream in a navigable river, increases, if :
(*a*) the flow velocity is more (*b*) the flow velocity is less.

Q. 516. Inorder to improve the navigability in a river, the cutoffs are :
(*a*) encouraged (*b*) discouraged.

Q. 517. The belt conveyor forming an essential part of a ladder dredger, used for excavating river sand deposits, is used for :
(*a*) excavation of sand
(*b*) transporting excavated sand to the surface, over small distances
(*c*) transporting excavated sand to the surface, over large distances
(*d*) none of these.

Q. 518. The dredger which excavates sand deposits of a river, and discharges the excavated material with water over long distances, is called a :
(*a*) ladder dredger (*b*) suction dredger
(*c*) dipper dredger (*d*) none of these.

Q. 519. Lock and dam constructions for creation of a series of slack water pools along a river, for promoting its navigability, is adopted only when :
(*a*) the river is perennial
(*b*) the river carries heavy sediment load
(*c*) the available water in the river is quite less
(*d*) none of the above.

Q. 520. Timber is generally transported in our country through :

(*a*) rail routes (*b*) road routes
(*c*) air routes (*d*) water routes.

Q. 521. The oldest and cheapest mode of transporting cargo is by :

(*a*) rail routes (*b*) road routes
(*c*) air routes (*d*) water routes.

Q. 522. Ships or Steamers can ply to carry cargo, in Indian waterways, extending to about :

(*a*) 500 km (*b*) 2500 km
(*c*) 10,000 km (*d*) 40,000 km.

CHAPTER 26

Q. 523. The depth of water stored in an irrigation tank, rarely exceeds :

(*a*) 4 m (*b*) 8 m
(*c*) 12 m (*d*) none of them.

Q. 524. The storage created on the upstream side of a smaller stream by construction of low earthen bunds, is technically known as :

(*a*) a reservoir (*b*) a tank
(*c*) a lake (*d*) none of these.

Q. 525. The usual arrangement made in a tank-bund scheme to spill the surplus excess water, is known as a :

(*a*) tank spillway (*b*) tank sluice
(*c*) tank weir (*d*) none of these.

Q. 526. The provision of suitable breaching sections become more important in irrigation tanks, which are :

(*a*) isolated (*b*) in groups
(*c*) both (*a*) and (*b*) (*d*) none of them.

Q. 527. The cubic metres of water that can be stored in an irrigation tank between FTL (Full Tank Level) and Sill level of the lowest supply sluice, is known as:

(*a*) the gross capacity (*b*) effective capacity
(*c*) the specific capacity (*d*) none of the above.

Q. 528. If A_1 represents the area of a tank bed at bottom, and A_2 at FTL, then the storage capacity of this tank of height H, is given as :

(*a*) $H\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$ (*b*) $\frac{H}{2}\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$
(*c*) $\frac{H}{3}\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$ (*d*) none of them.

Q. 529. The top level of a tank weir in a tank bund scheme, is kept at :

(*a*) MTL (*b*) FTL
(*c*) either (*a*) or (*b*) (*d*) none of these.

Q. 530. The capacity of an irrigation tank is sometimes increased by installing a temporary stone wall over the top of the tank weir. This fixture is known is :

(*a*) saddle (*b*) dam stones
(*c*) breast wall (*d*) divide wall.

Q. 531. The discharge through the sluice of a small irrigation tank is usually controlled by a :

(*a*) dam stone (*b*) plug
(*c*) shutter gate (*d*) none of these.

Q. 532. The mostly adopted earthen section for tank bunds is of the type :

(*a*) homogeneous embankment type
(*b*) zoned embankment type
(*c*) diaphragm type
(*d*) none of the above.

Q. 533*. The discharging capacity of a masonry waste weir of 50 m length and 1 m width provided in an earthen bund, for passing a flood with 0.8 m water depth over its crest, will be :

(*a*) 12.25 cumecs (*b*) 25.4 cumecs
(*c*) 59.4 cumecs (*d*) 65.8 cumecs.

CHAPTER 27

Q. 534. An arch dam, looks like a single arch, in :

(*a*) plan (*b*) front elevation
(*c*) side elevation (*d*) none of them.

Q. 535. An arch dam behaves as :

(*a*) a cantilever vertical retaining wall, standing up from its base
(*b*) an arch, transferring loads at the two ends by horizontal arch action
(*c*) both (*a*) and (*b*)
(*d*) none of the above.

Q. 536. A non-vertical arch dam is known as a :

(*a*) buttress dam (*b*) double curvature arch dam
(*c*) shell arch dam (*d*) both (*b*) and (*c*) above.

Q. 537. Arch dams are suitable in locations where the canyon slope factor (length of arch at top/height of dam) is :

(*a*) less than 8 (*b*) greater than 16

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Q. 538. The most economical type of arch dam in general is of :

(*a*) constant radius type (*b*) variable radius type
(*c*) constant angle type (*d*) none of these.

Q. 539. A constant angle arch dam, when compared to constant radius arch dam, utilises concrete quantity of about :

(*a*) 43% (*b*) 130%
(*c*) 230% (*d*) none of them.

Q. 540. Amongst the following types of dam sections, the thinnest and most economical section is expected for a :

(*a*) Constant angle arch dam (*b*) shell-arch dam
(*c*) constant radius arch dam (*d*) concrete gravity dam.

Q. 541. Which of the following forces is the least important in the design of arch dams?

(*a*) reservoir water force (*b*) uplift pressure
(*c*) temperature stresses (*d*) ice load
(*e*) yield stresses.

Q. 542. A constant radius arch dam is also sometimes called a :
(*a*) constant centre arch dam (*b*) constant angle arch dam
(*c*) variable angle arch dam (*d*) none of the above.

Q. 543. The most economical central angle of the arch rings in an arch dam, is :
(*a*) 123°—34′ (*b*) 133°—34′
(*c*) 143°—34′ (*d*) 153°—34′.

Q. 544. The most economical central angle of the arch rings of an arch dam, can be adopted only at one place, preferably at mid height in an arch dam of the type :
(*a*) constant angle arch dam (*b*) constant radius arch dam
(*c*) both (*a*) and (*b*) above (*d*) none of the above.

Q. 545. In an arch dam, the 'extrodos curves' refer to the arch rings corresponding to the :
(*a*) upstream face of the dam
(*b*) downstream face of the dam
(*c*) either (*a*) or (*b*)
(*d*) none of the above.

Q. 546. A V-shaped valley with stronger foundations can suggest the choice of an arch dam of the type :
(*a*) constant radius arch dam
(*b*) variable radius arch dam
(*c*) constant angle arch dam
(*d*) none of the above.

Q. 547. The type of an arch dam, which generally requires 'overhangs at abutments', is of :
(*a*) constant radius type (*b*) variable radius type
(*c*) constant angle type (*d*) none of the above.

Q. 548. The most accurate method to design arch dams is based upon :
(*a*) the thin cylinder theory (*b*) the theory of elastic arches
(*c*) the trial load method (*d*) all of the above.

Q. 549. Which among the following is not an assumption of the 'Trial Load Analysis' method of design of arch dams ?
(*a*) plane sections normal to the axis remain plane after flexure
(*b*) any horizontal arch ring is independent of the arch rings below and above
(*c*) modulus of elasticity of concrete and rock foundation is equal for compression and tension
(*d*) stresses are proportional to strains.

Q. 550. The thin cylinder theory for designing arch dams, ignores :
(*a*) temperature stresses (*b*) ice pressures
(*c*) yield stresses (*d*) all of the above.

Q. 551. The only force considered in the design of arch dams by thin cylinder theory is :
(*a*) water pressure (*b*) yield stresses
(*c*) shrinkage stresses (*d*) none of them.

Q. 552. The temperature stresses, producing worst effects in the design of arch dams, are caused by :
(*a*) rise of temperatures (*b*) fall of temperatures
(*c*) both (*a*) and (*b*) (*d*) none of the above.

Q. 553. The stresses due to rib-shortening become quite important in the case of :
(*a*) long thin arch dams (*b*) thick arch dams of small angle
(*c*) both (*a*) and (*b*) above (*d*) none of the above.

Q. 554. While designing a freely supported deck type of a buttress dam, the chosen spacing between buttresses is usually increased to achieve economy, from about 4.5 to 15 m or so, with the :
(*a*) decrease in dam height from about 45 m to about 15 m
(*b*) increase in dam height from about 15 m to about 45 m.

Q. 555. The load from the deck of a buttress dam is transmitted to the foundations, through the :
(*a*) corbels (*b*) buttresses
(*c*) lateral braces (*d*) none of them.

Q. 556. Which of the following components in a buttress dam are responsible for transmission of load from the sloping deck slab to the buttresses?
(*a*) corbels (*b*) lateral braces
(*c*) counterforts (*d*) none of them.

Q. 557. The most suitable foundation for buttress dams is :
(*a*) pile foundation (*b*) well foundation
(*c*) mat foundation (*d*) none of them.

Q. 558. The lateral braces are provided between buttresses in a buttress dam, to :
(*a*) transfer the load from the deck to the foundation
(*b*) transfer the load from the deck to the buttresses
(*c*) provide resistance against buckling of buttresses
(*d*) none of the above.

Q. 559. No reinforcement is necessary in the :
(*a*) fixed deck buttress dam
(*b*) simple deck buttress dam
(*c*) cantilever deck buttress dam
(*d*) massive head buttress dam.

Q. 560. Which of the following dam is also known as Ambursen dam?
(*a*) multiple arch buttress dam
(*b*) mushroom head buttress dam
(*c*) massive head buttress dam
(*d*) free deck buttress dam.

Q. 561. Which of the following component of a buttress dam is also called a counterfort?
(*a*) corbel (*b*) buttress
(*c*) lateral brace (*d*) sloping deck.

Q. 562. Which of the following is incorrect about buttress dam?
(*a*) it requires less construction material than a solid gravity dam of the same height
(*b*) it is less susceptible to deliberate damage or sabotage
(*c*) Ice pressure is not significant, because ice slides over the sloping deck
(*d*) the factor of safety is usually greater than for a gravity dam.

Q. 563. Multiple dome buttress dam is a type of :
(*a*) rigid buttress dam (*b*) deck slab buttress dam
(*c*) bulk head buttress dam (*d*) none of the above.

Q. 564. In a simple deck slab buttress dam of a given height, the buttress spacing can be increased by :

(*a*) increasing the upstream slope
(*b*) decreasing the upstream slope
(*c*) either (*a*) or (*b*)
(*d*) none of these.

Q. 565. The buttresses of a free deck buttress dam are provided @ 'x' m clear spacing, and buttress thickness is proposed to be 't' m. The buttress section can then be designed like the section of a concrete gravity dam, by considering the effective unit weight of water = surcharge factor(S) × actual unit weight of water (γ_w). The value of this surcharge factor is given as :

(*a*) $S = \frac{x+t}{x}$ (*b*) $S = \frac{x+t}{t}$
(*c*) $S = \left(\frac{x+t}{1+t}\right)$ (*d*) none of these.

Q. 566. Multiple arch dams are generally used for :

(*a*) high heights (*b*) low heights
(*c*) medium heights (*d*) all of the above.

ANSWERS OF THE OBJECTIVE QUESTIONS

1. (*d*)	2. (*a*)	3. (*d*)	4. (*a*)	5. (*c*)
6. (*a*)	7. (*b*)	8. (*b*)	9. (*d*)	10. (*a*)
11. (*b*)	12. (*c*)	13. (*a*)	14. (*b*)	15. (*b*)
16. (*b*)	17. (*b*)	18. (*d*)	19. (*b*)	20. (*c*)
21. (*a*)	22. (*c*)	23. (*a*)	24. (*c*)	25. (*b*)
26. (*b*)	27. (*d*)	28. (*b*)	29. (*a*)	30. (*c*)
31. (*c*)	32. (*a*)	33. (*c*)	34. (*b*)	35. (*b*)
36. (*b*)	37. (*b*)	38. (*b*)	39. (*c*)	40. (*a*)
41. (*c*)	42. (*b*)	43. (*c*)	44. (*c*)	45. (*b*)
46. (*c*)	47. (*c*)	48. (*c*)	49. (*b*)	50. (*a*)
51. (*d*)	52. (*d*)	53. (*c*)	54. (*c*)	55. (*c*)
56. (*b*)	57. (*d*)	58. (*d*)	59. (*a*)	60. (*a*)
61. (*b*)	62. (*c*)	63. (*b*)	64. (*d*)	65. (*a*)
66. (*c*)	67. (*d*)	68. (*c*)	69. (*b*)	70. (*c*)
71. (*c*)	72. (*a*)	73. (*a*)	74. (*b*)	75. (*d*)
76. (*b*)	77. (*b*)	78. (*d*)	79. (*b*)	80. (*d*)
81. (*c*)	82. (*c*)	83. (*b*)	84. (*a*)	85. (*b*)
86. (*c*)	87. (*a*)	88. (*c*)	89. (*c*)	90. (*d*)
91. (*d*)	92. (*c*)	93. (*a*)	94. (*a*)	95. (*c*)
96. (*c*)	97. (*b*)	98. (*d*)	99. (*b*)	100. (*c*)
101. (*c*)	102. (*b*)	103. (*b*)	104. (*c*)	105. (*b*)
106. (*a*)	107. (*b*)	108. (*a*)	109. (*b*)	110. (*d*)
111. (*b*)	112. (*b*)	113. (*b*)	114. (*b*)	115. (*b*)
116. (*a*)	117. (*c*)	118. (*c*)	119. (*a*)	120. (*c*)
121. (*b*)	122. (*b*)	123. (*c*)	124. (*c*)	125. (*c*)
126. (*a*)	127. (*b*)	128. (*c*)	129. (*c*)	130. (*d*)
131. (*a*)	132. (*a*)	133. (*c*)	134. (*b*)	135. (*c*)

136. (*c*)	137. (*d*)	138. (*d*)	139. (*d*)	140. (*d*)
141. (*d*)	142. (*d*)	143. (*e*)	144. (*c*)	145. (*d*)
146. (*c*)	147. (*a*)	148. (*c*)	149. (*d*)	150. (*a*)
151. (*a*)	152. (*b*)	153. (*c*)	154. (*c*)	155. (*d*)
156. (*b*)	157. (*c*)	158. (*d*)	159. (*b*)	160. (*a*)
161. (*c*)	162. (*a*)	163. (*b*)	164. (*a*)	165. (*d*)
166. (*b*)	167. (*b*)	168. (*b*)	169. (*b*)	170. (*c*)
171. (*a*)	172. (*b*)	173. (*a*)	174. (*a*)	175. (*c*)
176. (*a*)	177. (*a*)	178. (*c*)	179. (*b*)	180. (*d*)
181. (*c*)	182. (*c*)	183. (*b*)	184. (*d*)	185. (*e*)
186. (*a*)	187. (*c*)	188. (*e*)	189. (*d*)	190. (*b*)
191. (*d*)	192. (*d*)	193. (*a*)	194. (*a*)	195. (*d*)
196. (*c*)	197. (*d*)	198. (*c*)	199. (*b*)	200. (*c*)
201. (*b*)	202. (*b*)	203. (*b*)	204. (*d*)	205. (*b*)
206. (*d*)	207. (*b*)	208. (*b*)	209. (*b*)	210. (*a*)
211. (*a*)	212. (*c*)	213. (*b*)	214. (*d*)	215. (*b*)
216. (*b*)	217. (*c*)	218. (*a*)	219. (*a*)	220. (*a*)
221. (*d*)	222. (*a*)	223. (*c*)	224. (*c*)	225. (*b*)
226. (*d*)	227. (*b*)	228. (*c*)	229. (*a*)	230. (*b*)
231. (*b*)	232. (*d*)	233. (*c*)	234. (*d*)	235. (*d*)
236. (*b*)	237. (*c*)	238. (*c*)	239. (*c*)	240. (*c*)
241. (*c*)	242. (*b*)	243. (*d*)	244. (*d*)	245. (*c*)
246. (*d*)	247. (*a*)	248. (*c*)	249. (*d*)	250. (*b*)
251. (*a*)	252. (*b*)	253. (*e*)	254. (*b*)	255. (*b*)
256. (*b*)	257. (*c*)	258. (*d*)	259. (*c*)	260. (*d*)
261. (*c*)	262. (*d*)	263. (*c*)	264. (*c*)	265. (*b*)
266. (*c*)	267. (*c*)	268. (*d*)	269. (*b*)	270. (*b*)
271. (*a*)	272. (*c*)	273. (*b*)	274. (*b*)	275. (*c*)
276. (*d*)	277. (*b*)	278. (*c*)	279. (*b*)	280. (*a*)
281. (*b*)	282. (*b*)	283. (*a*)	284. (*b*)	285. (*d*)
286. (*b*)	287. (*d*)	288. (*a*)	289. (*d*)	290. (*c*)
291. (*c*)	292. (*b*)	293. (*c*)	294. (*c*)	295. (*a*)
296. (*c*)	297. (*b*)	298. (*a*)	299. (*e*)	300. (*b*)
301. (*a*)	302. (*d*)	303. (*b*)	304. (*a*)	305. (*a*)
306. (*b*)	307. (*d*)	308. (*d*)	309. (*d*)	310. (*c*)
311. (*c*)	312. (*d*)	313. (*a*)	314. (*c*)	315. (*c*)
316. (*b*)	317. (*d*)	318. (*d*)	319. (*a*)	320. (*d*)
321. (*a*)	322. (*b*)	323. (*d*)	324. (*c*)	325. (*d*)
326. (*d*)	327. (*a*)	328. (*c*)	329. (*b*)	330. (*b*)
331. (*d*)	332. (*c*)	333. (*b*)	334. (*b*)	335. (*d*)
336. (*a*)	337. (*c*)	338. (*c*)	339. (*a*)	340. (*d*)
341. (*b*)	342. (*c*)	343. (*c*)	344. (*a*)	345. (*a*)
346. (*b*)	347. (*c*)	348. (*b*)	349. (*a*)	350. (*b*)
351. (*b*)	352. (*d*)	353. (*d*)	354. (*b*)	355. (*a*)
356. (*b*)	357. (*a*)	358. (*b*)	359. (*c*)	360. (*e*)
361. (*c*)	362. (*b*)	363. (*b*)	364. (*a*)	365. (*b*)

366. (*c*)	367. (*d*)	368. (*c*)	369. (*b*)	370. (*b*)
371. (*c*)	372. (*b*)	373. (*a*)	374. (*c*)	375. (*b*)
376. (*a*)	377. (*a*)	378. (*d*)	379. (*b*)	380. (*b*)
381. (*c*)	382. (*a*)	383. (*b*)	384. (*c*)	385. (*c*)
386. (*a*)	387. (*b*)	388. (*c*)	389. (*b*)	390. (*b*)
391. (*a*)	392. (*a*)	393. (*c*)	394. (*d*)	395. (*a*)
396. (*a*)	397. (*c*)	398. (*b*)	399. (*a*)	400. (*b*)
401. (*c*)	402. (*a*)	403. (*c*)	404. (*d*)	405. (*d*)
406. (*a*)	407. (*c*)	408. (*c*)	409. (*b*)	410. (*b*)
411. (*a*)	412. (*b*)	413. (*c*)	414. (*d*)	415. (*e*)
416. (*b*)	417. (*c*)	418. (*b*)	419. (*c*)	420. (*c*)
421. (*d*)	422. (*d*)	423. (*c*)	424. (*a*)	425. (*a*)
426. (*d*)	427. (*a*)	428. (*b*)	429. (*c*)	430. (*d*)
431. (*c*)	432. (*b*)	433. (*c*)	434. (*c*)	435. (*c*)
436. (*b*)	437. (*b*)	438. (*a*)	439. (*a*)	440. (*b*)
441. (*a*)	442. (*d*)	443. (*b*)	444. (*b*)	445. (*b*)
446. (*a*)	447. (*b*)	448. (*d*)	449. (*a*)	450. (*a*)
451. (*a*)	452. (*a*)	453. (*b*)	454. (*d*)	455. (*b*)
456. (*b*)	457. (*b*)	458. (*b*)	459. (*d*)	460. (*d*)
461. (*d*)	462. (*c*)	463. (*b*)	464. (*b*)	
465. A (*ii*) (B) (*i*) (C) (*iii*) (D) (*iv*)				
466. (*a*)	467. (*b*)	468. (*a*)	469. (*b*)	470. (*a*)
471. (*c*)	472. (*a*)	473. (*b*)	474. (*d*)	475. (*b*)
476. (*c*)	477. (*c*)	478. (*b*)	479. (*b*)	480. (*c*)
481. (*c*)	482. (*c*)	483. (*a*)	484. (*b*)	485. (*a*)
486. (*d*)	487. (*b*)	488. (*c*)	489. (*a*)	490. (*a*)
491. (*b*)	492. (*b*)	493. (*b*)	494. (*b*)	495. (*c*)
496. (*d*)	497. (*d*)	498. (*c*)	499. (*c*)	500. (*c*)
501. (*a*)	502. (*a*)	503. (*b*)	504. (*c*)	505. (*d*)
506. (*a*)	507. (*b*)	508. (*a*)	509. (*b*)	510. (*b*)
511. (*b*)	512. (*a*)	513. (*a*)	514. (*c*)	515. (*b*)
516. (*a*)	517. (*b*)	518. (*b*)	519. (*c*)	520. (*d*)
521. (*d*)	522. (*b*)	523. (*c*)	524. (*b*)	525. (*c*)
526. (*b*)	527. (*b*)	528. (*c*)	529. (*b*)	530. (*b*)
531. (*b*)	532. (*a*)	533. (*c*)	534. (*a*)	535. (*b*)
536. (*d*)	537. (*a*)	538. (*c*)	539. (*a*)	540. (*b*)
541. (*b*)	542. (*a*)	543. (*b*)	544. (*b*)	545. (*a*)
546. (*c*)	547. (*c*)	548. (*c*)	549. (*b*)	550. (*d*)
551. (*a*)	552. (*b*)	553. (*b*)	554. (*b*)	555. (*b*)
556. (*a*)	557. (*c*)	558. (*c*)	559. (*d*)	560. (*d*)
561. (*b*)	562. (*b*)	563. (*a*)	564. (*a*)	565. (*b*)
566. (*a*).				

HINTS FOR SOLVING STARRED QUESTIONS

Q. 16. *Follow example 1.1, and compute :*

From eqn (1.1)

$$T = 2.3 \cdot \frac{y}{f} \log_{10}\left(\frac{Q}{Q - f \cdot A}\right)$$

where $A = 0.203$ ha $= 2030$ m^2

$Q = 0.043$ cumecs $= 0.043 \times 60 \times 60$ m^3/h

$= 154.8$ m^3/h $= 5$ cm/hr $= 0.05$ m/h

$y = 6.35$ cm $= 0.0635$ m

$$T = 2.3 \times \frac{0.0635}{0.05} \log\left(\frac{154.8}{154.8 - 0.05 \times 2030}\right) = \mathbf{1.35\ h.}$$ **Ans.**

Q. 17. $\text{Combining wt} = \dfrac{\text{Atomic wt}}{\text{Valency}}$

$\therefore$ Combining wt of Na $= \dfrac{23}{1} = 23$

Combining wt of Ca $= \dfrac{40}{2} = 20$

Combining wt of Mg $= \dfrac{24}{2} = 12$

$$Na^+ = \frac{\text{Na in mg/l}}{23} = \frac{345}{23} = 15 \text{ milli equivalent per litre}$$

$$Ca^{++} = \frac{60}{20} = 3 \text{ milli equivalent per litre}$$

$$Mg^{++} = \frac{18}{12} = 1.5 \text{ milli equivalent per litre}$$

From eqn. (1.4) :

$$SAR = \frac{Na^+}{\sqrt{\dfrac{Ca^{++} + Mg^{++}}{2}}} = \frac{15}{\sqrt{\dfrac{3 + 1.5}{2}}} = \frac{15}{1.5} = \mathbf{10.}$$ **Ans.**

Q. 45. Specific weight means unit weight = 14.7 kN/m^3.

Also, unit wt of water = 9.8 kN/m^3:

Available moisture holding capacity of root zone

$$= \frac{\gamma d}{\gamma_w}(\text{F.C. m.c.} - \text{Wilting pt m.c.})$$

$$= \left(\frac{14.7}{9.8}\right) \times (0.9\ m)\left[25\% - 15\%\right]$$

$= 1.5 \times (0.9 \text{ m}) \times 10\% = 0.135 \text{ m} = \mathbf{13.5\ cm.}$ **Ans.**

Q.47. Water depth required at canal

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

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

∴ Volume of water required for 10 hectare (10×10^4 m^2) field

$$= \frac{13.9}{100} \text{ m} \times 10^5 \text{ m}^2 = 13{,}900 \text{ m}^3 = \mathbf{13{,}900 \text{ kl.}} \quad \textbf{Ans.}$$

Q. 48. **Storage duty** or **Quantity duty** is the crop hectares, which can be fully grown/irrigated by 1 M. cum of water.

Thus, if Δ (m) is the water depth required by the crop for its maturity, then *D* hectares of crop will evidently require ($D \times 10^4$) Δ m^3 of water, which is 1 M. cum.

$$\therefore \quad (D \times 10^4 \, \Delta \text{ m}^3 = 1 \text{ M cum} = 10^6 \text{ m}^3$$

$$\text{or} \quad D \times \Delta = 100$$

$$\text{or} \quad \Delta = \frac{100}{D}$$

where Δ is in m

D is in ha/M. cum.

Q. 55. I.I. for Kharif $= 100 - 72 = 28\%$

I.I. for Rabi $= 100 - 56 = 44\%$

Total I.I. $= 28 + 44 = \mathbf{72\%}$. **Ans.**

Q. 57. Such an area may be called as a seasonal cropped area, or seasonal sown area, such as *Rabi area 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.

Q. 58. $G.I.A = 4.5 \times 0.9 + 2.5 \times 0.8 = 6.05$ M ha

$$A.I.I = \frac{G.I.A.}{CCA} = \frac{6.05}{5} = \mathbf{1.21 \; \textit{i.e.} \; 121\%}. \quad \textbf{Ans.}$$

Q. 66. Required discharge (mean) in the field

$= 0.4$ cumecs.

Peak discharge required

$$= \frac{\text{Mean discharge}}{\text{Capacity factor}} \qquad \left(\because \; C.F. = \frac{Q_{mean}}{Q_{peak}} \right)$$

$$= \frac{0.4}{0.8} = 0.5 \text{ cumecs}$$

Design discharge for distributary

$$= \frac{\text{Required discharge for crops}}{\text{Time factor}}$$

(Since channel runs for lesser days than the crop days, the required channel discharge should be more)

$$= \frac{0.5}{0.5} = \mathbf{1 \text{ cumecs.}} \quad \textbf{Ans.}$$

Q. 67. Discharge required at head of canal

$$= \frac{6.25 \text{ cumecs}}{0.75} = 8.33 \text{ cumecs}$$

Area irrigated $= 5100$ hectares

Duty on capacity

$$= \frac{\text{Area to be irrigated during base period}}{\text{Design full supply discharge at its head during peak demand}}$$

$$= \frac{5100}{8.33} = \mathbf{612\ ha/cumecs.} \quad \textbf{Ans.}$$

Q. 69. $G.C.A = 8000$ ha

$$CCA = GCA - \text{Reserved forests, etc.} = 8000 - 1600 = 6400 \text{ ha}$$

Pastures and fallow lands are included in CCA, and hence not to be subtracted.
Area under irrigation

$$= CCA \times \text{In. of Irr.} = 6400 \times 0.5 = 3200 \text{ hectares.} \quad \textbf{Ans.}$$

Q. 79.

$$\frac{\tau_0}{\gamma \cdot d\,(S_s - 1)} = 0.056$$

or $\tau_0 \propto d.$ **Ans.**

Q. 80. For non-scouring

$$d < 11\,RS$$

or

$$R_{max} = \frac{d}{11S} \quad ...(i)$$

$\therefore$

$$V = \frac{1}{N} \cdot R^{2/3} \cdot S^{1/2}$$

But

$$N = \frac{1}{24}\, d^{1/6}$$

$\therefore$

$$V = \frac{24}{d^{1/6}} \cdot R^{2/3} \cdot S^{1/2}$$

$$V_{max} = \frac{24}{d^{1/6}} \cdot R_{max}^{2/3} \cdot S^{1/2}$$

$$= \frac{24}{d^{1/6}} \cdot \left(\frac{d}{11S}\right)^{2/3} \cdot S^{1/2}$$

$$= \frac{24}{(11)^{2/3}} \cdot d^{2/3 - 1/6} \cdot S^{1/2 - 2/3}$$

$$= 4.85\, d^{1/2} \cdot S^{-1/6} \quad \text{where } d \text{ is in m}$$

When d is in cm *i.e.* d_{cm}, then

$$d = \frac{d_{cm}}{100}$$

$\therefore$

$$V_{max} = 4.85 \left(\frac{d\ cm}{100}\right)^{1/2} \cdot S^{-1/6}$$

$$= 0.485\, d^{1/2} \cdot S^{-1/6} \quad \text{where } d \text{ is in cm}$$

or $V_{max} \approx 0.48\, d^{1/2} \cdot S^{-1/6}.$ **Ans.**

Q. 81. N is given by Strickler's formula, as

$$N = \frac{1}{24} \cdot d^{1/6}$$

where d is representative grain dia in m.

Q. 85. Such channels are designed only for non-scouring. Hence, they must carry clear waters only. **Ans.**

Q. 86. For 1.5 H : 1 V,

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

$$\sin\theta = 0.554$$

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

$$= \sqrt{0.153} = 0.391.$$

For stability on banks

$$0.75\,\gamma RS \le 0.391\,\tau_c$$

$$\le 0.391\,(\gamma \text{RS})$$

For stability on bed,

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

$$0.75\,\gamma \cdot RS \le 0.391 \cdot \gamma \cdot \frac{d}{11}$$

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

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

or $$R \le \frac{d}{21S}.$$ **Ans.**

Q. 89. If the actual velocity in the channel exceeds the optimum velocity (V_0), then scouring may occur ; and if the actual velocity is lesser than the optimum velocity (V_0), then silting may occur. This optimum velocity, thus, represents both maximum as well as minimum velocity.

Q. 104 & Q. 108. When a canal has a *fixed configuration* (*i.e.* its bed slope and cross-section do not change with time) due to its non-erodible surface, such as in a lined canal, then the channel is called in **permanent regime.** Besides no scouring, usually, there is no silting in such channels, because higher velocities are permitted, due to their inerodible surface. Hence, the silt amount leaving the channel is almost the same as the silt amount entering the channel. Such channels, whose boundaries are fixed and rigid, are called **rigid boundary canals,** and Lacey's theory is not applicable to them. *The resistance offered to the flowing water in such a channel, is a function of the nature of the boundary surface alone.*

On the other hand, when the canals are constructed in erodible strata, their boundaries tend to change continuously with the flow of water in them. Such channels are evidently called **mobile boundary canals.** The material forming the boundaries of such channels are mostly loose soils, easily susceptible to erosion by flowing water. In such canals, higher velocities are usually not permissible, because this would lead to excessive scouring. Lower values of velocities will not be able to keep the entire silt load into suspension, which may lead to silting in them. Due to such scouring and silting of sediment, the sediment load transport at different sections along the channel, will usually be different. Silting and scouring may also result in modification of channel cross-section. *The resistance offered to the flow of water in such channels depends on two factors. viz :*

(*i*) *nature of the surface of boundaries, and*

(*ii*) *condition of the bed and banks of the channel.*

Such channels need be designed for no-nsilting and non-scouring velocity. Rivers and unlined alluvial canals are examples of mobile boundary channels.

Q. 109. Scour depth $= 1.35\left(\frac{q^2}{f}\right)^{1/3} = 1.35\left(\frac{3^2}{1.2}\right)^{1/3} = 2.64$ m. **Ans.**

Q. 111. From eqn. (4.14) :

$$f = 1.75\sqrt{d_{mm}} = 1.75\sqrt{0.4} = 1.107$$

From eqn. (4.19) :

Regime bed slope $= \frac{f^{5/3}}{3340\,Q^{1/6}} = \frac{(1.107)^{5/3}}{3340(40)^{1/6}} = \frac{1}{5200}$. **Ans.**

Q. 112.

$$1.0 = 1.75\sqrt{d_{mm}}$$

$$d_{mm} = \left(\frac{1}{1.75}\right)^2 = 0.326 \text{ mm} \approx 0.32 \text{ mm}. \quad \textbf{Ans.}$$

Q. 114.

$$P = b + \sqrt{5}\cdot y\,;$$

with $\frac{1}{2}$ H : 1 V slopes, which are generally attained in a regime canal, irrespective of Q and f

$$= 22 + \sqrt{5} \times 2.5 = 27.59 \text{ m}$$

$$P = 4.75\sqrt{Q} = 27.59$$

$\therefore$ $$Q = \left(\frac{27.59}{4.75}\right)^2 = 33.73 \text{ m}^3/\text{s} \approx 34 \text{ cumecs}. \quad \textbf{Ans.}$$

Q. 115. Given $\left[\begin{array}{l} Q_A = Q_B \\ f_A > f_B \end{array}\right.$

Now since, $$V = \left(\frac{Qf^2}{140}\right)^{1/6}$$

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

$$V_A > V_B$$

$$P_A = P_B$$

Since Q is same, $A_A < A_B$

and since $R = \frac{A}{P}$

$$R_A < R_B \quad \text{or} \quad R_B > R_A$$

i.e. channel *B* has more hydraulic radius for the same wetted perimeter, and this happens only when the channel has more depth (deeper channels are more hydraulically efficient).

$\therefore$ $y_B > y_A$.

Hence, choice (*b*) is the correct choice. **Ans.**

Q. 122. By the geometry of Fig. 29.1, it can be seen that the points, B, B', etc. will lie on the bank slope line, only when the berm equals $(n_2 - n_1)\, d_1$,

where d_1 is the depth of cutting, which will vary according to ground level.

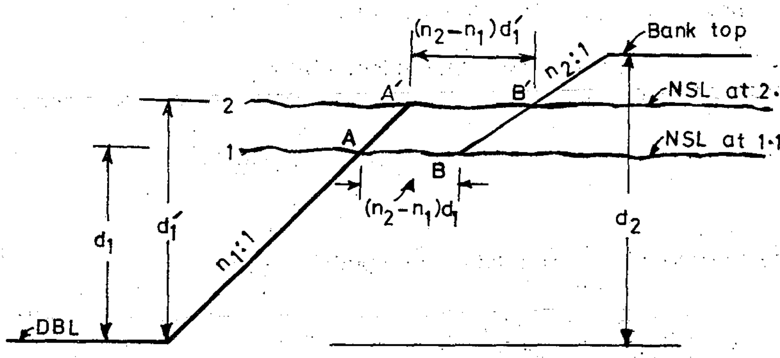

Fig. 29.1

Q. 123. It can be seen from Fig. 29.2 that when channel attains regime, $\frac{1}{2}$ H : 1 V side

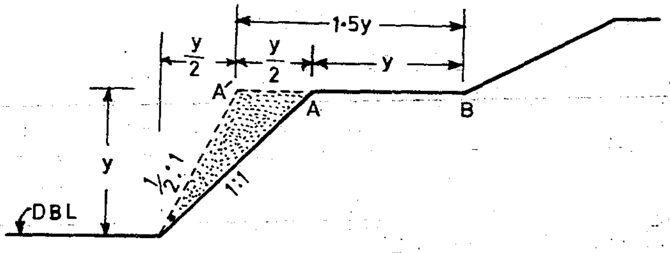

Fig. 29..2

slopes will be formed, thereby increasing the initial berm width AB to $A'B$, where

$$A'B = A'A + AB = 0.5\,y + y = 1.5\,y. \quad \textbf{Ans.}$$

Q. 126. *Assume 1 km length*

$$\text{Annual benefit} = 1000 \text{ m} \times 20 \text{ m} \times \frac{3}{10^6} \text{ cumecs} \times \text{Rs. 4 lakh/yr cumecs}$$

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

$$\text{Annual cost} = \frac{100 \text{ m} \times 20 \text{ m}}{40 \text{ yr}} \times \text{Rs. } 40/\text{m}^2 = \text{Rs. } 20{,}000 \text{ per yr.}$$

$$\text{B.C. ratio} = \frac{24000}{20000} = 1.2. \quad \textbf{Ans.}$$

Q. 129. W.r.t. Fig. 29.3 ; $\tan\theta = \frac{1}{1.5}$

$$\theta = 0.588$$

$$A = y^2(\theta + \cot\theta)$$

$$= 2.5^2(0.588 + 1.5) = 13.05\ \text{m}^2$$

$$V = \frac{26}{13.00} \cong 2\ \text{m/s.}$$ **Ans.**

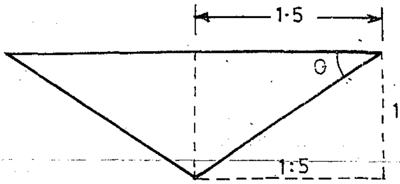

Fig. 29.3

Q. 147. The classification of saline and alkaline soils is as follows :

Sl. No.	*Classification*	*Electrical Conductivity (EC) in micro-mho/cm*	*Exchangeable Sodium Percentage (ESP)*	*pH value*
1.	**Saline soil** or *white alkali*	>4000	< 15	≤ 8.5
2.	**Alkaline soil** or *Non-saline alkali* or *sodic soil* or *black alkali*	< 4000	> 15	8.5 to 10.0
3.	**Saline-alkali soil**	> 4000	> 15	< 8.5

Q. 166. $M_B \approx 150 \cdot \sqrt{Q_a} = 150\sqrt{1600} = 6000$ m *i.e.* 6 km. **Ans.**

Q. 169. $M_B = 3\ \text{km} = 3000\ \text{m}$

Also, $M_B \approx 150 \cdot \sqrt{Q_{dominant}}$

∴ $3000 = 150\sqrt{Q_{dominant}}$

or $Q_{dominant} = 400$ cumecs

∴ $Q_{max} = \frac{16}{9} \times 400 = 711$ cumecs ≈ 700 cumecs. **Ans.**

Q. 176. Average thickness of apron

$$= T = 1.9t = 1.9 \times 0.06\,(5000)^{1/3}$$

$$= 1.95\ \text{m} ; \text{say } 2\ \text{m.}$$ **Ans.**

Average width of apron

$$= 1.5\,D$$

where $D = 1.5\,R - y$ (average), where

$$R = 0.47\left(\frac{Q}{f}\right)^{1/3}$$

$$= 0.47\,(5000)^{1/3}\ (\text{assume } f = 1) = 8.04$$

$$= 1.5 \times (1.5 \times 8.04 - 5)$$

$$= 10.6\ \text{m} \approx 10\ \text{m (say).}$$ **Ans.**

Q. 178. Waterway required

$$= 1.2 \times 4.75 \cdot \sqrt{Q_{max}}$$

where 1.2 is safety factor of Lacey's regime width

$$= 1.2 \times 4.75 \times \sqrt{1600 \times \frac{16}{9}}$$

$$\left(\text{since } Q_{max} = \frac{16}{9} \cdot Q_{dom}\right)$$

$$= 304 \text{ m} \approx 300 \text{ m.} \quad \textbf{Ans.}$$

Q. 216. Only nominal thickness is required under upstream floor.

Q. 219. ∵ Fine sand will get lifted most easily.

Q. 297. Refer and study article 14.5.6.

Q. 298. Refer and study article 14.5.6.

Q. 304.

$$R = 1.35 \left(\frac{q^2}{f}\right)^{1/3} = \left(\frac{2500}{300}\right)^{2/3} \qquad \text{(assume } f = 1\text{)}$$

$$= 5.55 \text{ m}$$

Foundation may be taken down below *HFL* by $1.33R$, or $R + 1.2$ m, whichever is more.

(*i*) $1.33\,R = 7.38$ m

(*ii*) $R + 1.2 \text{ m} = 5.55 + 1.2 = 6.75 \text{ m} < 7.38 \text{ m}$

Hence, foundation level

$$= 214 - 7.38 = 206.62 \text{ m}$$

say 206.6 m. **Ans.**

Q. 323 to Q. 325. **Aquifuge** is that geological formation, which is neither porous nor permeable ; and hence it neither contains nor yields ground water. *Granite rock is an example of aquifuge.*

Aquitard is that geological formation, which does not yield water freely to wells due to its lesser permeability, although seepage is possible through it. The yield from such a formation is, thus, insignificant. *Sandy clay is an example of aquitard.*

Aquiclude is highly porous, containing large quantities of water, but essentially impervious, as not to yield water. *A clay layer is an example of aquiclude.*

Q. 336. The permeability coefficient, *K*, is given by the eqn.

$$K = C \cdot d^2 \frac{\gamma_w}{\mu} = \frac{C \cdot d^2 \rho_w g}{\rho \cdot \nu}$$

or

$$K = \frac{C d^2 \cdot g}{\nu} \qquad \text{...(29.1)}$$

where C = constant called **shape factor**, depending on porosity, packing and grain size distribution of the porous medium

d = mean particle size of porous medium

γ_w = unit weight of water flowing through soil

μ = dynamic viscosity of water.

Thus $K \propto \frac{1}{\nu}$

ν decreases with increase in temperature (Table 1 at the end of the book), and hence *K* will increase with increase in temperature. **Ans.**

Q. 337. From Eq. (30.1)

$$K = C \cdot d^2 \frac{g}{\nu}$$

where ν represents the property of fluid passing through the porous medium
C and d represents the properties of porous medium only.

The component of permeability which represents only the properties of the porous media, is called **intrinsic or specific permeability,** and represented by K_0,

$$\text{where } K_0 = C \cdot d^2$$

Its units are m^2 or darcy,

$$\text{where 1 } \textbf{darcy} = 9.87 \times 10^{-13} \text{ m}^2.$$

The coefficient K_0 is generally used, when water/fluid temperature varies considerably or where more than one fluid is involved. However, in ground water flow, the temperature variation is small, and only water is involved as the flowing fluid, only K is considered.

Q. 340. A is defined as volume of water (m^3) released from an aquifer of 1 m^2 area and full depth d, per m fall of piezometric head. Its units will, thus, be $m^3/m^2/m$; *i.e.* dimensionless.

Q. 344. Specific yield and storage coefficient are related to a given aquifer and not to a given well.

Q. 348. Since Specific yield + Specific retention = Porosity, the specific yield, evidently, is less than porosity.

Q. 370. Ramganga dam, although 128 m high, is earthen and rockfill dam. Nagarjuna Sagar dam is 125 m high; Hirakud dam is 59 m high, and Mettur dam is 70 m high ; they are all stone masonry gravity dams.

Q. 396. Dead storage $= 0.2 \times 30 = 6$ M. cum

Time during which 6 M. cum is filled by sediment

$$@0.1 \text{ M. cum/yr} = \frac{6}{0.1} = 60 \text{ years.} \quad \textbf{Ans.}$$

Q. 405. For $F > 32$ km, the wave ht is given by eqn. (19.12) as

$$h_w = 0.032 \cdot \sqrt{V \cdot F} \text{ m}$$
$$= 0.032\sqrt{160 \times 40} = 2.56 \text{ m}$$

Force caused by waves P_w is given by eqn. (19.14) as

$$P_w = 19.62\, h_w^2 \text{ kN/m run of dam}$$
$$= 19.62 \times (2.56)^2 \text{ kN} = 128.6 \text{ kN}$$
$$\approx 130 \text{ kN. Hence, choice } (d) \text{ is correct.} \quad \textbf{Ans.}$$

Q. 406. The formula at choice (*a*) is correct. This may be remembered, as some numerical may be asked on this.

Q. 407. From eqn. (19.11),

$$\text{wave ht } (h_w) = 0.032\sqrt{V \cdot F} + 0.763 - 0.271\,(F)^{1/4} \text{ for } F < 32 \text{ km}$$

$\therefore \quad h_w = 0.032 \cdot \sqrt{100 \times 20} + 0.763 - 0.271\,(20)^{1/4}$

$= 1.431 + 0.763 - 0.573 = 1.62$ m

Free-board is generally provided equal to

$1.5\,h_w = 1.5 \times 1.62 = 2.45$ m, say 2.5 m. **Ans.**

Q. 414. From eqn. (19.22) :

$$B = \frac{H}{\sqrt{S_s - c}} = \frac{H}{\sqrt{2.4 - 1}} = \frac{60}{\sqrt{1.4}}$$

$= 50.7$ m (with full uplift = 1)

From eqn. (19.23) :

$$B = \frac{H}{\mu\,(S_s - c)} = \frac{60}{0.7\,(1.4)} = 61.22 \text{ m; say 64 m.}$$

Chosen B should be greater of the two values, *i.e.* 61 m. **Ans.**

Q. 431. Cut off can be provided only during construction. But if any seepage appears afterwards, a drain with inverted filter along toe line is provided to collect soil-free water, to check piping.

Q. 447. Since an ogee spillway is designed for maximum head, up to RL of maximum reservoir level, there are almost no chances of operating head exceeding the design head. However, under rare emergency, when extraordinary flood is being passed near the end of monsoon season, it may become necessary to allow the reservoir level to even go above the Maximum Reservoir level, by encroaching upon the freeboard, in which case, the operating head may exceed the design head.

Q. 449. The efficiency of spillway indirectly means its coefficient of discharge, which increases with the increasing head above full reservoir level (*FRL*) till it becomes about 2.2 at full design head (*i.e.* at MRL). Since the spillway starts working when water level just crosses *FRL*, the coefficient of discharge in early stages, is only about 1.7, *i.e.* about 77% of its value at full design head. Hence, the spillway efficiency can be said to be increasing from 77% to 100%, as water level in the reservoir increases from F.R.L. to M.R.L.

Q. 461. A saddle syphon is nothing but a syphon spillway, and includes both of its types. Air vent is the essential requirement of both types of syphon spillways.

Q. 475. $Q = C_d \cdot A\,\sqrt{2gH_1}$

where C_d = Coefficient of discharge through orifice

H_1 = Water head over the centre line of opening

$= RL331 - RL328 = 3$ m

A = Area of opening

$= 60 \text{ m} \times 6 \text{ m} = 360 \text{ m}^2$

$\therefore \quad Q = 0.62 \times 360\,\sqrt{2 \times 9.81 \times 3}$

$= 1712$ cumecs ≈ 1700 cumecs. **Ans.**

Q. 476. $Q = C_d A \cdot \sqrt{2gH}$

H = Water head over centre line of sluice (since it is a free overfall on downstream side)

$= RL330\,(FRL) - RL300$ m (sluice centre line level)

$= 30$ m

$$A = \frac{\pi}{4} \times 2^2 = 3.14 \text{ m}^2$$

C_d = Coefficient of discharge ≈ 0.62 for free overfall

$$\therefore \quad Q = 0.62 \times 3.14 \cdot \sqrt{2 \times 9.81 \times 30}$$

$$= 47.23 \text{ cumecs}$$

say 50 cumecs (nearest appropriate choice given). **Ans.**

Q. 477. $Q = C_d \cdot A \cdot \sqrt{2gH_L}$

$$= 0.8 \times \left(\frac{\pi}{4} \times 4^2\right) \sqrt{2 \times 9.81 \times (226 - 210)}$$

$$= 0.8 \times 4\pi \sqrt{16.62 \times 16} = 164 \text{ cumecs}$$

≈ 170 cumecs (nearest appropriate choice). **Ans.**

To countercheck, let us see the absolute maximum discharge, which computes to be 204.8 cumecs at $C_d = 1$. In any case, even if all losses are neglected, Q cannot exceed 204.8 cumecs, and hence the last choice is certainly incorrect, other choices at (*a*) and (*b*) are giving very low coefficient of discharge, such as $\frac{64}{204.8} = 0.3$ and $\frac{104}{204.8} = 0.5$, which are too low for submerged bell mouthed pipe flows.

Q. 502. From eqn. [17.6 (*a*)] :

Capacity factor (C.F.)

$$= \frac{\text{Average load}}{\text{Plant capacity}}$$

$$\text{where, average load} = \frac{\text{Energy produced}}{\text{Time in h}}$$

$$= \frac{58,80,000}{7 \times 24} \text{ kW}$$

$$= 35000 \text{ kW} = 35 \text{ MW}$$

$$\text{C.F.} = \frac{35 \text{ MW}}{100 \text{ MW}} = 0.35. \quad \textbf{Ans.}$$

Q. 503. Load factor $= \frac{\text{Average load}}{\text{Peak load}} = \frac{35 \text{ MW}}{70 \text{ MW}} = 0.5.$ **Ans.**

Q. 504. Utilisation Factor (*UF*)

$$= \frac{\text{Maximum power utilised}}{\text{Maximum power available}} = \frac{70 \text{ MW}}{100 \text{ MW}} = 0.7. \quad \textbf{Ans.}$$

Q. 511. Francis turbines are cheaper than Pelton's turbines, and there is no special need for Pelton's turbines here, because part load (variable loads) are not likely to come and water is not sandy, which may certainly need Pelton's turbines. Hence, Francis turbines will suffice to our needs. **Ans.**

Q. 533. $Q = C \cdot LH^{3/2} = 1.66 \times 50 \times (0.8)^{3/2}$

($\because$ When width of rectangular crest > 0.9 m, $C = 1.66$)

$$= 59.4 \text{ cumecs.} \quad \textbf{Ans.}$$