

- 1) Water emerges from an ogree spillway with velocity = 13.72 m/s and depth = 0.3m at its toe. The tail water depth required to form a hydraulic jump at the toe is
 - a) 6.48 m
 - b) 5.24 m
 - c) 3.24 m
 - d) 2.24 m
- 2) The flow of water (mass density = 1000 kg/m³ and kinematic viscosity = 10⁻⁶ m²/s) in commercial pipe, having equivalent roughness k_s , as 0.12mm, yields an average shear stress at the pipe boundary = 600 N/m². The value of k_s/δ (δ being the thickness of laminar sub-layer) for this pipe is
 - a) 0.25
 - b) 0.50
 - c) 6.0
 - d) 8.0
- 3) A river reach of 2.0 km long with maximum flood discharge of 1000 m³/s is to be physically modeled in the laboratory where maximum available discharge is 0.20 m³/s. For a geometrically similar model based on equality of Froude number, the length of the river reach (m) in the model is
 - a) 26.4
 - b) 25.0
 - c) 20.5
 - d) 18.0
- 4) An outlet irrigates an area of 20 ha. The discharge (l/s) required at this outlet to meet the evaporation transpiration requirement of 20 mm occurring uniformly in 20 days neglecting other field losses is
 - a) 2.52
 - b) 2.31
 - c) 2.01
 - d) 1.52
- 5) A wastewater sample contains 10^{-5.6} mmol/l of OH⁻ ions at 25°C. The pH of this sample is
 - a) 8.6
 - b) 8.4
 - c) 5.6
 - d) 5.4
- 6) Group I lists estimation methods of some of the water and wastewater quality parameters. Group II lists the indicators used in the estimation methods. Match the estimation methods. Match the estimation method (Group I) with the corresponding

indicator (Group II)

Group I	Group II
P Azide modified Winkler method for dissolved oxygen	1 Erichrome Black T
Q Dichromate method for chemical oxygen demand	2 Ferrion
R EDTA titrimetric method for hardness	3 Potassium chromate
S Mohr or Argentometric method for chlorides	4 Starch

- a) P-3,Q-2,R-1,S-4 c) P-4,Q-1,R-2,S-3
b) P-4,Q-2,R-1,S-3 d) P-4,Q-2,R-3,S-1

7) Determine the correctness or otherwise of the following **Assertion** [a] and the **Reason** [r]

Assertion: The crown of the outgoing larger diameter sewer is always matched with the crown of incoming smaller diameter sewer.

Reason: It eliminates backing up of sewage in the incoming smaller diameter sewer.

- a) Both [a] and [r] are true and [r] is not the correct reason for [a].
the correct reason for [a]. c) Both [a] and [r] are false
b) Both [a] and [r] are true and [r] is d) [a] is true but [r] is false

8) The 5-day BOD of a wastewater sample is obtained as 190 mg/l (with $k = 0.01 \text{ h}^{-1}$). The ultimate oxygen demand (mg/l) of the sample will be

- a) 3800 c) 271
b) 475 d) 190

9) A water treatment plant is required to process 28800 m^3/d of raw water (density = 1000 kg/m^3 , kinematic viscosity = $10^{-6} \text{ m}^2/\text{s}$). The rapid mixing tank imparts a velocity gradient of 900 s^{-1} to blend 35 35 mg/l of alum with the flow for a detention time for 2 minutes. The power input (W) required for rapid mixing is

- a) 32.4 c) 324
b) 36 d) 32400

10) Match the Group I (Terminology) with Group II (Definition/Brief Description) for wastewater treatment systems

Group I	Group II
P Primary treatment	1 Contaminant removal by physical forces
Q Secondary treatment	2 Involving biological and/or chemical reaction
R Unit operation	3 Conversion of soluble organic matter to biomass
S Unit process	4 Removal of solid materials from incoming wastewater

- a) P-4,Q-3,R-1,S-2 c) P-3,Q-4,R-2,S-1
b) P-4,Q-3,R-2,S-1 d) P-1,Q-2,R-3,S-4

maximum flow expected at this section and the speed at the maximum flow will respectively be

- a) 8000 vehicles per hour and 80 km per hour c) 2000 vehicles per hour and 80 km per hour
 b) 8000 vehicles per hour and 25 km per hour d) 2000 vehicles per hour and 40 km per hour

15) The plan of a survey plotted to a scale of 10 m to 1 cm is reduced in such a way that a line originally 10 cm long now measures 9 cm. The area of the reduced plan is measured as 81 cm^2 . The actual area (m^2) of the survey is

- a) 10000 c) 1000
 b) 6561 d) 656

16) The lengths and bearings of a closed traverse PQRSP are given below.

Line	Length (m)	Bearing (WCB)
PQ	200	0°
QR	1000	45°
RS	907	180°
SP	?	?

The missing length and bearing, respectively of the line SP are

- a) 207 m and 270° c) 707 m and 180°
 b) 707 m and 270° d) 907 m and 270°

17) The focal length of the object glass of a tachometer is 200 mm, the distance between the vertical axis of the optical centre of the object glass is 100 mm and the spacing between the upper and lower line of the diaphragm axis is 4 mm. With the line of collimation perfectly horizontal, the staff intercepts are 1 m (top), 2 m (middle), and 3 m (bottom). The horizontal distance (m) between the staff and the instrument station is

- a) 100.3 c) 150.0
 b) 103.0 d) 153.0