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UPPSC 2020

Assistant Engineer
Prelims Exam
Civil Engineering
Paper-II

Detailed Solution (SET-B)

Exam Date - 13th December **Time - 02:00 PM - 04:30 PM**

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SET - B

1. Match **List-I** with **List-II** and choose the correct answer using the code given below.

List-I (Text)	**List-II (Writer)**
(A) Kiratarjuniyam	1. Dandi
(B) Dashakumar	2. Kalidas
(C) Buddha Charitam	3. Bharavi
(D) Vikramorvashiyam	4. Ashvaghosha

Codes:

	A	**B**	**C**	**D**
(a)	3	4	1	2
(b)	3	1	4	2
(c)	2	3	1	4
(d)	1	3	2	4

Ans. **(b)**

2. A large tank near Mahoba, temples at Ajaygarh and Mahoba and city of Rajavasini were built by a Chandella King

(a) Nannuk (b) Vakpati

(c) Rahil (d) Jayashakti

Ans. **(c)**

3. Which of the following Rights a cultivator enjoyed on his own land during the Mughal period?

(a) Right to mortgage only

(b) Right to sell and gift

(c) Right to mortgage and gift

(d) All the above rights

Ans. **(a)**

4. Match List-I with List-II and select the correct answer using the code given below.

List-I (Tribes)	**List-II (States)**
(A) Tharus	1. Madhya Pradesh
(B) Todas	2. Jharkhand
(C) Santhal	3. Uttarakhand
(D) Gond	4. Tamil Nadu

Codes:

	A	**B**	**C**	**D**
(a)	1	3	4	2
(b)	4	2	1	3
(c)	2	1	3	4
(d)	3	4	2	1

Ans. **(d)**

5. Match List-I with List-II and select the correct answer using the code given below.

List-I	**List-II**
(A) Nokrek	1. Uttarakhand
(B) Agasthyamalai	2. Arunachal Pradesh
(C) Nandadevi	3. Kerala
(D) Dehang Debang	4. Meghalaya

Codes:

	A	**B**	**C**	**D**
(a)	4	3	1	2
(b)	4	3	2	1
(c)	3	4	1	2
(d)	2	3	4	1

Ans. **(a)**

6. States get share of the revenue from

(a) Income Tax

(b) Customs Revenue

(c) Excise Tax

(d) Surcharge on Income Tax

Ans. (c)

7. Which Article of the Indian Constitution empowers Parliament to make law for implementing international agreements?

(a) Article 249 (b) Article 250

(c) Article 252 (d) Article 253

Ans. (d)

8. Who appoints the acting Chief Justice of India?

(a) Chief Justice of India

(b) Chief Justice of India with previous consent of the President

(c) President of India

(d) President in consultation with the Chief Justice of India

Ans. (c)

9. The rotation intensity of Maize-Mustard-Mung crop is

(a) 100% (b) 200%

(c) 300% (d) 400%

Ans. (c)

10. Which of the following is NOT a Kharif crop?

(a) Soyabean (b) Lentil

(c) Cotton (d) Pigeon pea

Ans. (b)

11. 'Five Star Village Scheme' started by Government of India in September 2020 relates to which one of the following?

(a) Electricity Supply

(b) Postal Service Schemes

(c) Health Services

(d) Primary Education

Ans. (b)

12. Who won the US Open 2020. Mens Tennis Singles Title on 14th September, 2020?

(a) Alex Zverev (b) Dominic Thiem

(c) D. Medvedev (d) P. C. Busta

Ans. (b)

13. Which of the following pairs is NOT correctly matched?

Ancient name of the cities		**Modern name of the Cities**
(a) Esipattan	–	Saranath
(b) Dashapur	–	Mandsor
(c) Banvasi	–	Talkad
(d) Mahoday	–	Kannauj

Ans. (c)

14. The early farming site located on the bank of lake is

(a) Mehargarh (b) Lahuradeva

(c) Chirand (d) T. Narsipur

Ans. (d)

15. Author of the 'Dastane Mazahib' which discusses about the Din-i-Ilahi of Akbar, was

(a) Mohammad Rabbani

(b) Mohsin Faani

(c) Badauni

(d) Afif

Ans. (b)

16. Match List-I with List-II and select the correct answer using the code given below.

List-I (States)	List-II (Highest Peaks)
(A) Tamil Nadu	(1) Dhoopgarh
(B) Rajasthan	(2) Saramati
(C) Nagaland	(3) Guru Shikhar
(D) Madhya Pradesh	(4) Doda Betta

Codes:

	A	B	C	D
(a)	3	4	1	2
(b)	1	2	4	3
(c)	4	3	2	1
(d)	2	1	3	4

Ans. **(c)**

17. Who was appointed the Minister of 'Ministry of Rehabilitation' set up on 06 September, 1947?

(a) S. P. Mukerji

(b) Sardar Vallabhabhai Patel

(c) J. L. Nehru

(d) K. C. Niyogi

Ans. **(d)**

18. 'Leopold Matrix' is associated with

(a) Weather Forecasting

(b) Disaster Management

(c) Environmental Impact Assessment Method

(d) Environmental Law

Ans. **(c)**

19. The Joint Sitting of the Indian Parliament for transacting a legistlative business is presided over by

(a) The President of India

(b) The senior most Member of Parliament

(c) The Chairman of the Rajya Sabha

(d) The Speaker of the Lok Sabha

Ans. **(d)**

20. The term 'Office of Profit' has been defined by the

(a) Constitution

(b) Parliament

(c) Supreme Court

(d) Union Council of Ministers

Ans. **(b)**

21. While deciding any question relating to the disqualification of a Member of Parliament, the President shall obtain the opinion of

(a) Election Commission

(b) Chief Justice of India

(c) Attorney General

(d) Speaker of the Lok Sabha

Ans. **(a)**

22. Soyabean seed contains

(a) 20% protein and 40% oil

(b) 40% protein and 10% oil

(c) 40% protein and 20% oil

(d) 20% protein and 20% oil

Ans. **(c)**

23. As per the results of 'Swachh Sarvekshan 2020', announced by Ministry of Housing and Urban Affairs on 20th August 2020, which is the Cleanest City in Uttar Pradesh?

(a) Agra (b) Gaziabad

(c) Lucknow (d) Prayagraj

Ans. **(b)**

24. How many teachers from Uttar Pradesh were selected for 'National Award' on Teachers day 5th Sept., 2020?

(a) Six (b) Five

(c) Four (d) Three

Ans. **(d)**

25. 'Poshan Maah' was celebrated by Government of India in the year 2020, in which of the following months?

(a) September (b) August

(c) July (d) June

Ans. **(a)**

26. If two triangulation signals of 6.75 m height each are to be just visible over ground mutually, what is the maximum distance between their locations on the ground surface?

(a) 10 km (b) 20 km

(c) 30 km (d) 50 km

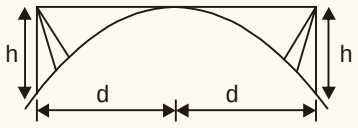
Ans. **(b)**

Sol. $d = 3.854\sqrt{h}$

$d = 3.854 \times \sqrt{6.75}$

$d = 10$ km

So, maximum distance between their location = 2d = 20 km



27. The system that uses the sun as a source of electromagnetic energy and records the naturally radiated and reflected energy from the object is called

(a) Geographical Information System (GIS)

(b) Global Positioning System (GPS)

(c) Passive Remote Sensing (PRS)

(d) Active Remote Sensing (ARS)

Ans. **(c)**

28. The ratio of curvature correction to that of refraction is

(a) 3 (b) 12

(c) 14 (d) 7

Ans. **(d)**

Sol. Curvature correction $(C_C) = -0.0785d^2$

Refraction correction $(C_R) = 0.0112d^2$

$$\left|\frac{C_C}{C_R}\right| = 7$$

29. In a vertical curve, an upgrade of 2.0% is followed by a downgrade of 2.0%. The rate of change of grade is 0.05% per 20 m chain. The length of the vertical curve will be

(a) 800 m (b) 1000 m

(c) 1200 m (d) 1600 m

Ans. **(d)**

Sol. Length of vertical curve,

$$(L) = \frac{\text{Total change of grade}}{\text{Permissible rate of change of grade}}$$

$$L = \frac{2-(-2)}{0.05} \times 20$$

$L = 1600$ m

30. Repetition of beds on a geological map may be due to

(a) Unconformity (b) Disconformity

(c) Faulting (d) Folding

Ans. **(d)**

31. The velocity distribution in turbulent flow is a function of the distance 'y' measured from the boundary surface and the friction velocity μ_* and follows a

(a) parabolic law (b) hyperbolic law

(c) logarithmic law (d) linear law

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Ans. **(c)**

Sol. For turbulent flow,

Velocity profile follows a logarithmic law

$$\frac{u(y)}{u_*} = 2.5 ln\left(\frac{y}{y'}\right)$$

where,

$u_* \rightarrow$ Shear velocity

$y \rightarrow$ Distance measured from the boundary surface

$y' \rightarrow$ It depends on smooth and rough surface

32. While conducting flow measurement using a rectangular notch, an error of 2% in head over the notch and error of 3% in the length was observed. The percentage error in the computed discharge would be

(a) +6% (b) –1%

(c) –2.5% (d) Zero

Ans. **(a)**

Sol. For rectangular notch,

$$\text{Discharge}, Q = \frac{2}{3} C_d L \sqrt{2g} H^{3/2}$$

Given :

$$\frac{\Delta L}{L} = \frac{3}{100}, \frac{\Delta H}{H} = \frac{2}{100}$$

$$\frac{\Delta Q}{Q} = \frac{\Delta L}{L} + \frac{3}{2}\frac{\Delta H}{H}$$

$$\frac{\Delta Q}{Q} = 0.03 + 1.5 \times 0.02$$

$$= 0.06$$

$$\frac{\Delta Q}{Q} = +6\%$$

33. A channel designed by Lacey's theory has a mean velocity of 1 m/s and silt factor of unity. The hydraulic mean radius will be

(a) 2.5 m (b) 2 m

(c) 1 m (d) 0.5 m

Ans. **(a)**

Sol. Hydraulic mean radius (R)

$$= \frac{5}{2}\frac{V^2}{f} = \frac{5}{2} \times \frac{1^2}{1} = 2.5 \text{ m}$$

34. A pipe is said to be equivalent to another if, in both

(a) Length and discharge are the same

(b) Velocity and diameter are the same

(c) Discharge and frictional head loss are the same

(d) Length and diameter are the same

Ans. **(c)**

Sol. A pipe is said to be equivalent to another. If, discharge and frictional head loss are the same.

35. The pressure drop per unit length of pipe $(\Delta P / L)$ in Laminar flow is dependent on the velocity, viscosity and diameter. It is equal to

(a) $\frac{d^2}{32\mu V}$ (b) $\frac{32\mu VL}{\gamma d^2}$

(c) $\frac{32\mu V}{d^2}$ (d) $\frac{8\mu V}{d^2}$

Ans. **(c)**

Sol. For laminar flow,

Pressure drop,

$$\Delta P = \gamma h_e = \left(\frac{32\mu V_{ay} l}{\gamma d^2}\right)\gamma$$

$$\Delta P = \frac{32\mu V_{avg} l}{d^2}$$

Pressure drop per unit length,

$$\frac{\Delta P}{l} = \frac{32\mu V_{avg}}{d^2}$$

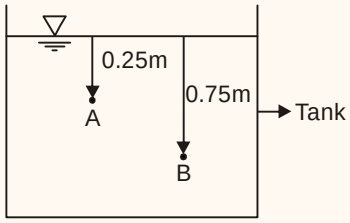
36. The ratio of pressures between the two points A and B located respectively at depth 0.25 m and 0.75 m below a constant level of water in a tank is

(a) 1 : 2 (b) 1 : 3

(c) 1 : 4 (d) 1 : 5

Ans. **(b)**

Sol.



Pressure at A, $P_A = \gamma_w \times 0.25$

Pressure at B, $P_B = \gamma_w \times 0.75$

$$\frac{P_A}{P_B} = \frac{0.25}{0.75} = \frac{1}{3}$$

$$\frac{P_A}{P_B} = \frac{1}{3}$$

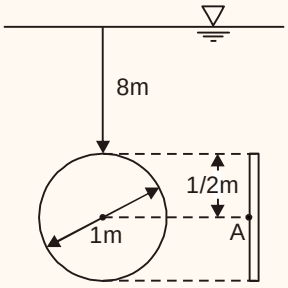
37. A circular plate 1 m in diameter is submerged vertically in water such that its upper edge is 8 m below the free surface of water. The total hydrostatic pressure force on one side of the plate is

(a) 6.7 kN (b) 65.4 kN

(c) 45.0 kN (d) 77.0 kN

Ans. **(b)**

Sol.



Total hydrostatic pressure force, $F = P_A.A$

Hydrostatic Pressure at C.G., $P_A = \rho g \bar{h}$

$$P_A = 9.81 \times 1000 \times \left(8 + \frac{1}{2}\right)$$

$$P_A = 83385 \text{N/m}^2$$

$$F = 83385 \times \frac{\pi}{4} \times (1)^2 \times 10^{-3} \text{ kN}$$

$$F = 65.49 \text{ kN}$$

38. When there is an increase in the atmospheric pressure, the water level in a well penetrating a confined aquifer

(a) decreases (b) increases

(c) does not undergo any change

(d) decrease or increase depending on the elevation of the ground

Ans. **(a)**

39. A turbine in which the total energy of water available is converted to kinetic energy is called

(a) Axial flow turbine

(b) Reaction turbine

(c) Impulse turbine

(d) Mixed flow turbine

Ans. **(c)**

Sol. **Impulse Turbine :** All hydraulic energy is converted into kinetic energy by a nozzle.

Reaction Turbine : Only some amount of energy is converted into kinetic energy before the fluid enters the runner.

40. Discharge per unit drawn down at a well is called

(a) Specific storage

(b) Specific yield

(c) Specific capacity

(d) None of the above

Ans. **(c)**

41. A stream that provides water to the water table is termed as

(a) Affluent (b) Influent

(c) Ephemeral (d) Effluent

Ans. **(d)**

42. The observed annual runoff from a basin a area 500 km^2 is 150 Mm^3 and the corresponding annual rainfall over the basin during the same year is 750 mm. What is the runoff coefficient ?

(a) 0.2 (b) 0.57

(c) 0.4 (d) 0.5

Ans. **(c)**

Sol. Annual runoff, R = 150 Mm^3

Area of basin, A = 500 km^2

$$\text{Depth of runoff} = \frac{150\times10^6}{500\times(1000)^2}\text{m}$$

= 0.3 m = 300 mm

Annual rainfall during same year, P = 750mm

$$\text{Coefficient of runoff} = \frac{R}{P} = \frac{300}{750} = 0.4$$

43. The theissen weights of 4 rain gauges A, B, C and D covering a river basin are 0.15, 0.25, 0.30 and 0.30 respectively. If the average depth of rainfall for the basin is 5 cm and rainfall recorded at B, C and D are 5 cm, 4 cm and 5 cm respectively, what is the rainfall at A ?

(a) 5 cm (b) 6 cm

(c) 7 cm (d) 8 cm

Ans. **(c)**

Sol. **Using Theissen Method**

	A	B	C	D
Weights(W)	0.15	0.25	0.3	0.3
Rainfall record P(cm)	–	5	4	5

$$\frac{P_A W_A + P_B \times W_B + P_C \times W_C + P_D \times W_D}{W_A + W_B + W_C + W_D} = P_{avg}$$

Average depth of rainfall, P_{avg} = 5 cm

$$P_{avg} = \frac{P_A \times 0.15 + 5\times0.25 + 4\times0.3 + 5\times0.3}{0.15+0.25+0.3+0.3}$$

= 5 cm

$$P_A = \frac{5-(5\times0.3+4\times0.3+5\times0.25)}{0.15}$$

$$\boxed{P_A = 7\,\text{cm}}$$

44. Water is to be lifted by a net head of 240 m. Identical pumps each with specific speed of 30 and rotational speed of 1450 rpm with design discharge 0.2 m^3/s are available. The number of pumps required will be

(a) 2 (b) 3

(c) 4 (d) 5

Ans. **(c)**

Sol.

Specific speed of each pump,

$$N_S = \frac{N\sqrt{Q}}{H_m^{3/4}}$$

$$30 = \frac{1450\sqrt{0.2}}{H_m^{3/4}}$$

Manometric head for each pump,

$$H_m = 60.211 \text{ m}$$

Number of identical pumps

$$= \frac{\text{Net head lifted}}{\text{Net head of each pump}}$$

$$= \frac{240}{60.211} = 3.985 \simeq 4$$

45. For one-dimensional flow without recharge in unconfined aquifer between two water bodies, the steady water table profiles

(a) a straight line (b) a parabola

(c) an ellipse (d) an arc of a circle

Ans. **(b)**

Sol. Water surface is a parabola in case of unconfined aquifer.

46. As per the recommendation of the Bureau of Indian Standards, the shape of the lined canal is

(a) Circular (b) Trapezoidal

(c) Parabolic (d) Elliptic

Ans. **(b)**

47. Geological strata between ground surface and water table is also termed as

(a) Piezometric zone (b) Phreatic zone

(c) Vadose zone (d) Saturated zone

Ans. **(c)**

48. The standard BOD_5 at 20°C, when compared to BOD_u is

(a) 50% (b) 68%

(c) 75% (d) 100%

Ans. **(b)**

Sol. $BOD_5 = \frac{2}{3} \times BOD_u$ or 68% BOD_u

49. Sludge bulking can be controlled by

(a) Chlorination (b) Coagulation

(c) Aeration (d) Denitrification

Ans. **(a)**

Sol. Sludge bulking can be controlled by chlorination.

50. Uniformity coefficient of filter sand is given by

(a) $\frac{D_{60}}{D_5}$ (b) $\frac{D_{50}}{D_5}$

(c) $\frac{D_{50}}{D_{10}}$ (d) $\frac{D_{60}}{D_{10}}$

Ans. **(d)**

Sol.

$$C_u = \frac{D_{60}}{D_{10}}$$

51. Which of the following causes a decrease demand of water in per capita consumption ?

(a) Use of metering system

(b) Good quality of water

(c) Better standard of living of the people

(d) Hotter climate

Ans. **(a)**

52. The following data pertain to a sewage sample :

Initial DO = 9.5 mg/L;

final DO = 2 mg/L; Dilution = 1%

The BOD of the given sample is

(a) 7.5 mg/L (b) 10 mg/L

(c) 75 mg/L (d) 750 mg/L

Ans. **(d)**

Sol.

$DO_i = 9.8 mg/L, DO_f = 2 mg/L$

Dilution ratio = 1% = 0.01

$$BOD = \frac{(DO_i - DO_f)}{\text{Dilution ratio}}$$

$$= \frac{(9.5 - 2)}{1/100}$$

$$= 750 \text{ mg/L}$$

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53. The tilt in an aerial photograph is radial from

(a) Nadir point (b) Principal point

(c) Isocentric point (d) Plumb point

Ans. **(c)**

Sol. Tilt radiates from the isocenter of the photo and cause objects to be displaced radially towards the isocentre on the upper side of the tilted photo and radially outward on the lower side.

54. The staff reading at a distance of 80 m from a level with bubble at its centre is 1.52 m and when it is moved 5 division out of the centre, the reading is 1.60 m. The angular value of the bubble is

(a) 20.62" (b) 41.25"

(c) 14.55" (d) 25.5"

Ans. **(b)**

Sol. $\phi = \left(\frac{S}{L \times n} \times 206265\right)\text{sec}$

$\phi = \left(\frac{(1.6-1.52)}{80 \times 5} \times 206265\right)\text{sec}$

$\phi = 41.25''$

55. In GIS, the process used for modifying map features to make them clear at a reduced scale is known as

(a) Cartographic Generalization

(b) Database generalization

(c) Topographical Encoding

(d) Data Filtering

Ans. **(a)**

Sol. Cartographic generalisation is the process of using the appropriate scale, purpose and medium of map features to make them clear at a reduced scale.

56. An Engineer measured the distance between two locations on a plan having a scale of 1 cm = 50 m as 600 m. Later, however, he found that he used a wrong scale of 1 cm = 30 m to measure the distance. The true distance between the locations is

(a) 200 m (b) 250 m

(c) 500 m (d) 1000 m

Ans. **(d)**

Sol. True distance = $\frac{\text{True scale}}{\text{Nominal scale}} \times \begin{bmatrix}\text{meausred}\\ \text{distance}\end{bmatrix}$

True distance = $\frac{50}{30} \times 600 = 1000$ m

57. Streak of a mineral is

(a) Its appearance in diffused light as obtained by rotating it.

(b) Colour of the powder of a coloured mineral as obtained by rubbing it on a porcelain plate

(c) Its appearance in thin section as seen under a polarizing microscope

(d) None of these

Ans. **(b)**

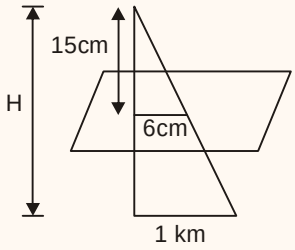
58. A road segment of length 1 km scales 6 cm on a vertical photograph. The focal length of the camera is 150 mm. If the terrain is nearly plain, then the flying height of the aircraft will be

(a) 2500 m (b) 25 km

(c) 250 km (d) 250 m

Ans. **(a)**

Sol.



$$\frac{H}{1} = \frac{15}{6}$$

$$\Rightarrow H = \frac{15}{6} \times 1\,\text{km} = 2.5\,\text{km} = 2500\,\text{m}$$

59. If the probable error in single observation is ± 0.04m and that of the mean is ± 0.01m, then the number of observations are

(a) 4 (b) 10

(c) 16 (d) 64

Ans. (c)

Sol. The relationship between the probable error of single observation (E_s) and the probable error of the mean (E_m) is given as

$$E_m = \frac{E_s}{\sqrt{n}} = 0.6745\sqrt{\frac{\Sigma V^2}{n(n-1)}}$$

$$\Rightarrow \quad 0.01 = \frac{0.04}{\sqrt{n}}$$

$$\Rightarrow \quad \boxed{n = 16}$$

60. Tangential method of tacheometry is

(a) Slower than stadia hair method

(b) Faster than stadia hair method

(c) Preferred as it involves less computations to get reduced distance

(d) Preferred as chances of operational error are less compared to stadia hair method.

Ans. (a)

61. Method adopted for measurement of horizontal angle using theodolite in case when several angles of well distributed point/objects are to be measured from the same instrument station is

(a) Repetition (b) Double angle

(c) Reiteration (d) All of the above

Ans. (c)

Sol. The reiteration method is useful when a number of angles are to be measured at one points.

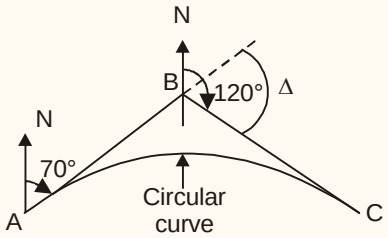
62. Two straights AB and BC have the bearing of 70° and 120° respectively. They are to be connected by a circular curve. The deflection angle will be

(a) 130° (b) 70°

(c) 50° (d) 120°

Ans. (c)

Sol.



So, deflection angle = FB of BC – FB of AB
= 120 – 70 = 50°

63. The following boundary condition exists at the wall (y = 0) in a boundary layer.

(a) u = U (b) $\frac{dP}{dX} = -ve$

(c) $\tau_0 = 0$ (d) u = 0, v = 0

Ans. (d)

Sol. Boundary condition exists at the wall,

at y = 0, u = 0

64. A hydraulic ram works on the

(a) Principle of centrifugal action

(b) Principle of water hammer

(c) Principle of reciprocating action

(d) None of the above

Ans. **(b)**

Sol. Hydraulic ram, the device uses the water hammer ejects to develop pressure.

65. Uniform flow in an open channel exists, when the flow is steady and the channel is

(a) Prismatic

(b) Non-prismatic and depth of flow is constant along the channel

(c) Prismatic and depth of flow is constant along the channel

(d) Frictionless

Ans. **(c)**

Sol. Uniform flow exists in an open channel, when flow is steady and channel is prismatic and depth of flow is constant along the channel.

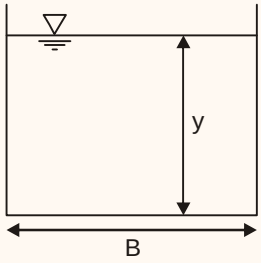
66. For a hydraulically efficient rectangular channel section, the ratio of width to normal depth is

(a) 0.5 (b) 1.0

(c) $2\sqrt{3}$ (d) 2.0

Ans. **(d)**

Sol. For efficient rectangular channel, Perimeter should be minimum



Area of flow, A = By

Wetted Perimeter of flow, P = B + 2y

$$P = \frac{A}{y} + 2y$$

$$\frac{dP}{dy} = 0, -\frac{A}{y^2} + 2 = 0$$

$$A = 2y^2$$

$$\text{Width, } B = \frac{A}{y} = 2y$$

$$\frac{B}{y} = 2$$

67. As the depth of immersion of a vertical plane surface increases, the location of centre of pressure

(a) Moves apart from the centre of gravity of the area

(b) Comes closer to the centre of gravity of the area

(c) Coincide with the centre of gravity of the area

(d) Remains unaffected

Ans. **(b)**

Sol.

$$\text{Centre of pressure, } h^* = \bar{h} + \frac{I_{CG}}{A\bar{h}}$$

$\bar{h} \rightarrow$ Centre of gravity

Depth of immersion of a vertical plane surface increases then centre of Pressure comes closer to the centre of gravity of area.

68. Hydraulic jump occurs when

(a) Flow is super critical

(b) Flow is sub critical

(c) Flow is super critical and downstream depth is adequate

(d) None of the above

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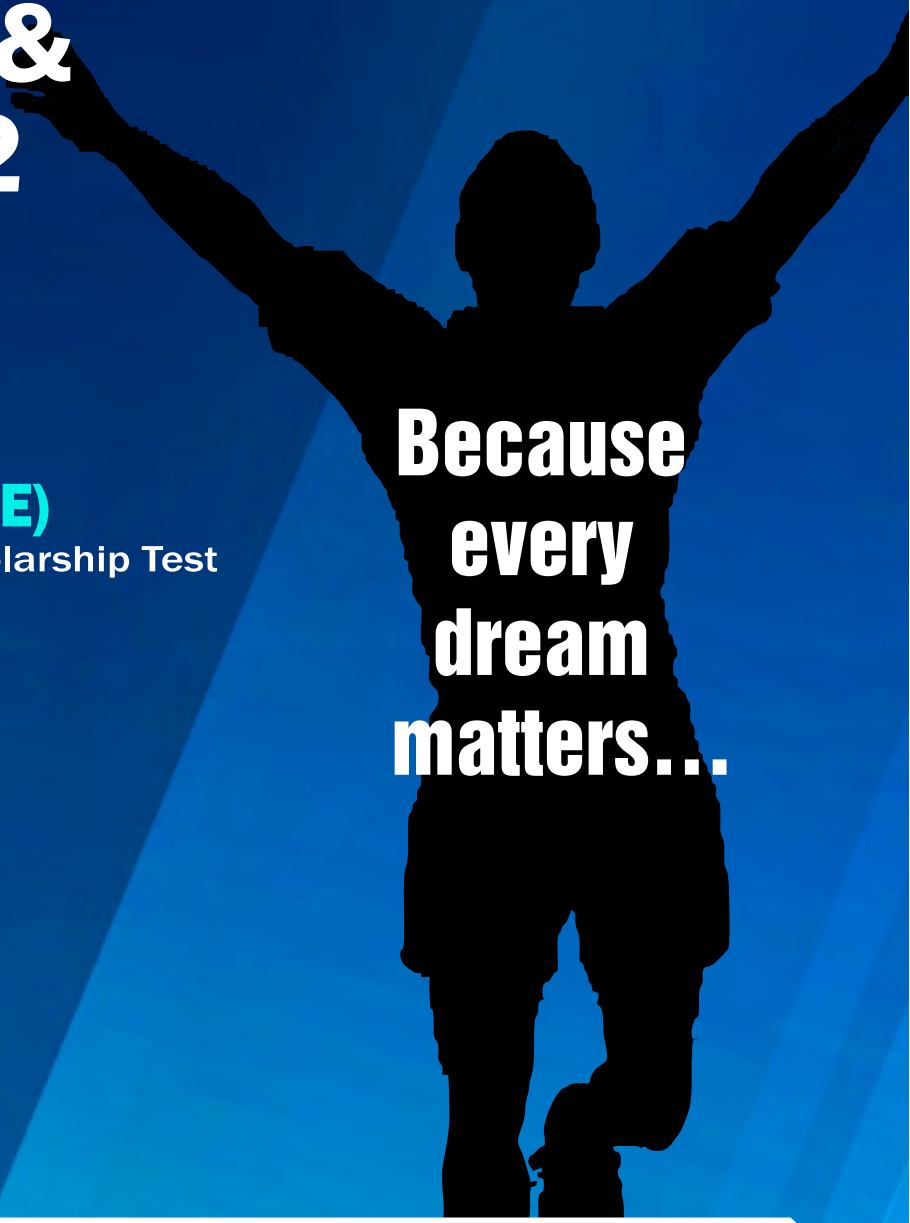

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Ans. **(c)**

Sol.

$y_1 < y_c \rightarrow$ Super Critical

$y_2 > y_c \rightarrow$ Subcritical

Hydraulic jump occurs from supercritical to subcritical.

69. In a model experiment with weir, if the dimensions of the model weir are reduced by a factor K, the flow rate through the model weir is the following fraction of the flow rate through prototype

(a) $K^{5/2}$ (b) K^2

(c) 1 (d) K^{-2}

Ans. **(a)**

Sol. According to Froude's law

$$\frac{V_r}{\sqrt{L_r}} = 1$$

$$L_m = KL_P$$

$$Q_r = A_r V_r$$

$$Q_r = L_r^2\sqrt{L_r} = L_r^{5/2}$$

$$\frac{Q_m}{Q_P} = \left(\frac{L_m}{L_P}\right)^{5/2}$$

$$Q_m = Q_P K^{5/2}$$

70. In differential manometer used in a venturimeter along a water pipeline, if an error of 2 mm has been made in observing a differential head of 10 mm, the percentage error in pressure difference is

(a) 12.6 (b) 25.2

(c) 20 (d) 10

Ans. **(c)**

Sol. Pressure difference,

$$\Delta P = \left(\frac{G_s}{G_w} - 1\right)x$$

$$\% \text{ error in pressure difference} = \frac{\Delta x}{x} \times 100$$

$$= \frac{2}{10} \times 100 = 20\%$$

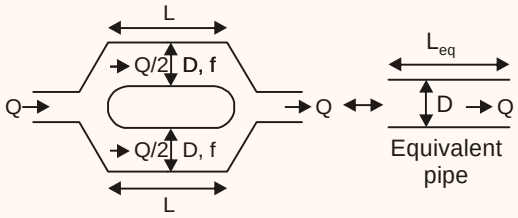
71. Two identical pipes of length L, diameter D and friction factor f, are connected in parallel between two points. The length of a single pipe of diameter D and the same friction factor f, equivalent to the above pair is

(a) $\sqrt{2}\,L$ (b) L/2

(c) $L/\sqrt{2}$ (d) L/4

Ans. **(d)**

Sol. Equivalent length for parallel connections of pipes.



$$h_l = \frac{f l \left(\frac{Q}{2}\right)^2}{12.1D^5}$$

$$h_{leq} = \frac{f l_{eq} Q^2}{12.1D^5}$$

$$h_l = h_{leq}$$

$$\frac{f\left(\frac{Q}{2}\right)^2 l}{12.1D^5} = \frac{f l_{eq}.Q^2}{12.1D^5}$$

$$l_{eq} = \frac{L}{4}$$

72. With rise in pressure, the bulk modulus of liquid

(a) Remains constant

(b) Increases

(c) Decreases

(d) None of the above

Ans. (b)

73. The highest velocity for flow of water of viscosity 0.02 Poise to be laminar in a 10 mm pipe is

(a) 100 cm/s (b) 200 cm/s

(c) 300 cm/s (d) 400 cm/s

Ans. **(*)**

Sol. Criticals Reynold's number, Re ≤ 2000

$$\frac{\rho VD}{\mu} \leq 2000$$

$$V \leq \frac{2000 \times 0.02 \times 10^{-1}}{1000 \times 10 \times 10^{-3}}$$

$V_{max} = 0.4$ m/sec

$V_{max} = 40$ cm/sec.

74. 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 the above

Ans. **(a)**

75. Lacey's scour depth for a stream, carrying a discharge of 3 cumecs per meter 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

Ans. **(b)**

Sol. Scour's depth $= 1.35\left(\frac{q^2}{f}\right)^{1/3}$

$$= 1.35 \times \left[\frac{3^2}{1.2}\right]^{1/3}$$

$= 2.64$ m

76. The discharge passing over an ogee spillway, per unit length of its apex line is proportional to (where H is head over the apex of its crest)

(a) H (b) H^2

(c) $H^{1/2}$ (d) $H^{3/2}$

Ans. **(d)**

Sol. $Q = CLH^{3/2}$

So, correct answer should be (d)

OR

Sol. For an ogee spillway

Discharge, $Q = CL_eH^{3/2}$

$Q \propto H^{3/2}$

77. Lysimeter is an instrument used to measure

(a) Evaporation (b) Infiltration

(c) Evapotranspiration (d) Transpiration

Ans. **(c)**

78. The relation between duty D in hectares/cumec, depth of water Δ in meter and base period B in days is given by

(a) $\Delta = \frac{1.98\ B}{D}$ (b) $\Delta = \frac{8.64\ B}{D}$

(c) $\Delta = \frac{5.68\ B}{D}$ (d) $\Delta = \frac{8.64\ D}{B}$

Ans. **(b)**

79. The use of unit hydrographs for estimating floods is generally limited to catchments of size less than

(a) 5000 Km^2 (b) 500 Km^2

(c) 10^6 Km^2 (d) 5000 ha

Ans. **(a)**

Sol. Unit hydrograph can't be used for catchment area greater than 5000 km^2

80. According to Khosla, to keep the structure safe against piping, exit gradient to be provided lies between

(a) 0.10 and 0.15 (b) 0.15 and 0.20

(c) 0.20 and 0.26 (d) 0.25 and 0.30

Ans. **(b)**

81. Lateral infiltration is the major drawback in the following type of infiltrometer as

(a) Simple tube (b) Double ring

(c) Sprinkling type (d) Rainfall simulator

Ans. **(a)**

82. Isolated storm is represented in a hydrograph with

(a) Single peak

(b) Multiple peak

(c) Complex peak

(d) Without single peak

Ans. **(a)**

83. The deficiency of soil moisture through the earth surface is termed as

(a) Rainfall (b) Runoff

(c) Infiltration (d) Water table

Ans. **(c)**

84. In a CBR test, the load sustained by a remoulded soil specimen at 5 mm penetration is 120 kg. The CBR value of the soil will be

(a) 9.2% (b) 7.3%

(c) 5.84% (d) 2.4%

Ans. **(c)**

Sol. CBR value of 5 mm penetration

$$= \frac{\text{load sustained by specimen at 5 mm penetration}}{\text{load sustained by standard aggregate at 5 mm penetration}}$$

$$= \frac{120}{2055} \times 100 = 5.84\%$$

85. The type of transition curve that is generally provided on hill road is

(a) Circular (b) Cubic parabola

(c) Leminiscate (d) Spiral

Ans. **(d)**

86. It is a common practice to design a highway to accommodate the traffic volume corresponding to

(a) Peak hour

(b) 15 min peak period

(c) 30^{th} hour

(d) Average Daily Traffic

Ans. **(c)**

87. The safe speed on transition curve of B.G. track can be calculated by using formula

(a) $4.35\sqrt{R-67}$

(b) $4.4\sqrt{R-70}$

(c) $3.65\sqrt{R-6}$

(d) None of the above

Ans. **(a)**

88. The maximum limit of super elevation on B.G. track in India is

(a) 76.2 mm (b) 83.2 mm

(c) 101.6 mm (d) 165.1 mm

Ans. **(d)**

Sol. Maximum value of superelvation

Gauge	Group	Limiting value of cant (mm)	
		Under normal conditions	With special permissible of CE
BG	A	165	185
BG	B and C	165	—
BG	D and E	140	—
MG	—	90	100
NG	—	65	75

89. As per Indian Road Congress (IRC) recommendation, minimum radius of horizontal curve on urban roads in plain terrain when the design speed is 60 Km/h and super elevation is limited to 7% is

(a) 120 m (b) 125 m

(c) 130 m (d) 135 m

Ans. (c)

Sol. Minimum radius $= \frac{V^2}{127(e+f)}$

$= \frac{60^2}{127(0.07+0.15)}$

$= 128.84$ m

So, provide 130 minimum radius

90. An irrigation channel designed by Lacey's theory has a mean velocity of 1.5 m/s. The silt factor is unity. The hydraulic mean radius will be

(a) 2.5 m (b) 1.5 m

(c) 5.625 m (d) 6.525 m

Ans. (c)

Sol. Hydraulic mean radius $= \frac{5}{2}\frac{V^2}{f} = \frac{5}{2}\times\frac{1.5^2}{1}$

$= 5.625$ m

91. At a hydraulic jump, the depths at the two sides are 0.4 m and 1.4 m, the head loss in the jump is

(a) 1.0 m (b) 0.9 m

(c) 0.7 m (d) 0.45 m

Ans. (d)

Sol. Given that :

$y_2 = 1.4$ m

$y_1 = 0.4$ m

Head loss in jump, $h_l = \frac{(y_2 - y_1)^3}{4y_1y_2}$

$= \frac{(1.4-0.4)^3}{4\times1.4\times0.4} = 0.446$m

$h_l \simeq 0.45$ m

92. The contact pressure P_c, typre pressure P and rigidity factor R are related by

(a) $\frac{P}{P_C} = R$ (b) $\frac{P_C}{P} = R$

(c) $P \times P_C = R$ (d) $R = \sqrt{(P\times P_C)}$

Ans. (b)

93. If modulus of elasticity of the subgrade is 25 MPa, then deflection at the surface of flexible pavement due to a wheel load of 40 kN and a tyre pressure of 0.6 MPa will be

(a) 5.24 mm (b) 6.20 mm

(c) 7.40 mm (d) 8.32 mm

Ans. (a)

Sol. Elasticity of subgrade = 25 MPa

P = 40 kN

p = 0.6 MPa

Deflection $= \frac{1.5\,pa}{E_s}$

$a = \sqrt{\frac{P}{p\times\pi}} = \sqrt{\frac{40\times1000}{0.6\times\pi}} = 145.67$mm

$\Delta = \frac{1.5\times0.6\times145.67}{25} = 5.24$ mm

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94. The design speed of a traffic lane is 70 Kmph. What is the theoretical capacity per hour taking the total reaction time to be 2 seconds and average length of vehicle as 8m?

(a) 828 (b) 728

(c) 628 (d) 528

Ans. **(b)**

Sol. V_{design} = 70 kmph

Average length of vehicle = 8 m

reaction time = 2 seconds

Space headway (S)

$$= 0.278 \times V \times t + \frac{V^2}{254 \times f} + \ell$$

Consider f = 0.38 for 70 kmph

$$= 0.278 \times 70 \times 2 + \frac{70^2}{254 \times 0.38} + 8$$

= 97.69 m

$$\text{Theoretical capacity} = \frac{1000 \times V}{S}$$

$$= \frac{1000 \times 70}{97.69}$$

= 716.55 veh/hr

So correct answer should be (b)

95. Calculate the stopping sight distance, given that velocity v = 100 Kmph and friction f = 0.10.

(a) 464 m (b) 563 m

(c) 860 m (d) 840 m

Ans. **(a)**

Sol. V = 100 kmph

f = 0.10

$$SSD = 0.278 V \times t + \frac{V^2}{254 \times f}$$

$$= 0.278 \times 100 \times 2.5 + \frac{100^2}{254 \times 0.10} = 463.2 m$$

So, correct answer should be (a)

96. The following items are considered for the selection of site for an airport. Mark the incorrect option.

(a) Class of airport

(b) Visibility at airport site

(c) Altitude

(d) Runway orientation

Ans. **(a)**

97. The order in which a road is built as from bottom to top

(a) subsoil, base, subgrade, subbase

(b) base, subsoil, subgrade, subbase

(c) subbase, base, subgrade, subsoil

(d) subsoil, subgrade, subbase, base

Ans. **(d)**

98. A vehicle moving at 50 Km/h speed was stopped by applying brakes and the length of the skid marks was 18 m. If the average skid resistance of the pavement is 0.75, the brake efficiency (in %) of the test vehicle will be

(a) 71.12% (b) 72.83%

(c) 73.48% (d) 74.62%

Ans. **(b)**

Sol. V = 50 kmph

ℓ = 18 m

f = 0.75

Brake efficiency = ?

$$f = \frac{V^2}{2g\ell} = \frac{(50 \times 0.278)^2}{2 \times 9.81 \times 18} = 0.547$$

$$\eta = \frac{0.547}{0.75} \times 100 = 72.9\%$$

So, correct answer should be (b)

99. For a sleeper density of (n + 5) the number of sleepers required for constructing a Broad Gauge (B.G.) railway track of length 650 m is given by

(a) 1000 (b) 900

(c) 800 (d) 700

Ans. **(b)**

Sol. Length of rail on B.G. track = 12.8 m

Sleeper density = n + 5 = 12.8 + 5 = 17.8 per rail $\simeq$ 18 per rail

$$\text{Number of rail} = \frac{650}{12.8} \simeq 51 \text{ rails.}$$

Number of sleeper = 51 × 18 = 918

So correct answer should be (b)

100. The type of the camber which is best suited for cement concrete pavement is

(a) Straight line (b) Parabolic

(c) Elliptical (d) Composite

Ans. **(a)**

101. Which one is NOT a road pattern?

(a) Block pattern

(b) Star and block pattern

(c) Hexagonal pattern

(d) Diamond pattern

Ans. **(d)**

102. If the methyl orange alkalinity of water equals or exceeds total hardness, all of the hardness is

(a) Non-carbonate hardness

(b) Carbonate hardness

(c) Pseudo hardness

(d) Negative non-carbonate hardness

Ans. **(b)**

Sol.

We know CH = min. (TH, alkalinity)

Given, Alkalinity > TH

Hence, CH = TH

103. When waste water is disposed of into a running stream, four zones are formed. In which one of the following zones, will the minimum level of dissolved oxygen be found?

(a) Zone of degradation

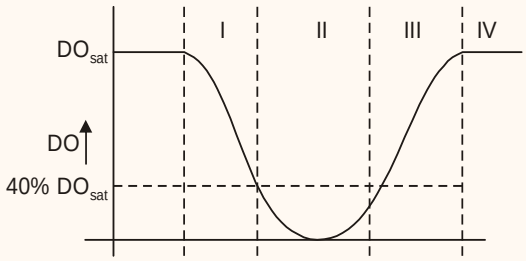
(b) Zone of active decomposition

(c) Zone of recovery

(d) Zone of clear water

Ans. **(b)**

Sol.



I = Zone of degradation

II = Zone of active decomposition

III = Zone of recovery

IV = Zone of clear water

104. Hairs of human nose can remove all the particles of size greater than

(a) 1 micron (b) 10 micron
(c) 100 micron (d) None of these

Ans. **(b)**

105. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I (Treatment Unit)	**List-II (Detention Time)**
A. Grit chamber	1. Six hours
B. Primary sedimentation	2. Two minutes
C. Activated sludge	3. Two hours
D. Sludge digestion	4. Twenty days

Codes :

	A	**B**	**C**	**D**
(a)	3	1	4	2
(b)	2	3	1	4
(c)	2	1	3	4
(d)	1	2	3	4

Ans. **(b)**

Sol. Grit chamber - Two minutes
Primary Sedimentation - Two hours
Activated sludge - Six hours
Sludge digestion - Twenty days

106. The best system for distribution of water in a randomly planned city is

(a) Dead end systems (b) Grid iron system
(c) Ring system (d) Radial system

Ans. **(a)**

Sol. For randomly planned city means city developed in haphazard manner, dead end system will be most suitable.

107. Which one of the following type of transition curves is mostly used in Indian Railways?

(a) Cubic parabola (b) Lemniscate
(c) Cubic spiral (d) Eular's spiral

Ans. **(a)**

108. The Govt. of India, appointed the National Transport Policy Committee in the year

(a) 1978 (b) 1973
(c) 1956 (d) 1943

Ans. **(a)**

109. Flexible pavement distribute the wheel load

(a) Directly to subgrade
(b) Through a set of layers to the subgrade
(c) Through structural action
(d) None of the above

Ans. **(b)**

110. The total correction for elevation temperature and gradient for a runway, should NOT be more than

(a) 35% (b) 25%
(c) 15% (d) 10%

Ans. **(a)**

111. The population of a town in three consecutive years are 5000, 7000 and 8400, respectively. The population of the town in the fourth consecutive year according to the Geometric increase method is

(a) 9500 (b) 9800
(c) 10100 (d) 10920

Ans. **(d)**

Sol.

Population	Increase in population	%increasein population
5000		
	2000	40
7000		
	1400	20
8400		

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$$r' = \sqrt{0.4 \times 0.2} = 0.283 \simeq 0.3$$

$$P = P_0(1+r)^n$$

$$= 84000(1 + 0.3)^1$$

$$= 10920$$

112. pH = 4 when compared to pH = 7, will be more acidic by

(a) 3 times (b) 300 times

(c) 1000 times (d) None of these

Ans. **(c)**

Sol. $(pH)_1 = 4 \Rightarrow \left[H_1^+\right] = 10^{-4}\ mol/L$

$(pH)_2 = 7 \Rightarrow \left[H_2^+\right] = 10^{-7}\ mol/L$

$$\frac{\left[H_1^+\right]}{\left[H_2^+\right]} = \frac{10^{-4}}{10^{-7}} = 10^3 = 1000$$

$\Rightarrow$ pH = 4 is 1000 more acidic than pH = 7

113. One litre of sewage when allowed to settle for 30 minutes gives a sludge volume of 30 cm^3. If the dry weight of this sludge is 3.0 gms, then the sludge volume index will be

(a) 20 (b) 30

(c) 10 (d) 40

Ans. **(c)**

Sol.

SVI

$$= \frac{(\text{Settled sludge volume mL/L})(1000\,\text{mg/g})}{\text{MLSS, mg/L}}$$

$$= \frac{30 \times 1000}{3000} = 10\,\text{mL/g}$$

114. High COD to BOD ratio of an organic pollutant represents

(a) High biodegradability of the pollutant

(b) Low biodegradability of the pollutant

(c) Presence of free oxygen for aerobic decomposition

(d) Presence of toxic material in the pollutant

Ans. **(d)**

115. Which of the following treatment process are necessary for the removing suspended solid from water?

1. Coagulation 2. Sedimentation
3. Flocculation 4. Disinfection

Select the correct answer using the codes given below :

(a) 1 and 2 (b) 1, 2 and 3

(c) 2 and 4 (d) 1 and 4

Ans. **(b)**

Sol. Removal of suspended solids occurs by sedimentation which will occur in three stages.

Coagulation - Flocculation - Sedimentation

116. If the coliform bacteria is present in a sample of water, then the coliform test to be conducted is

i. Presumptive coliform test

ii. Confirmed coliform test

iii. Completed coliform test

The correct answer is

(a) Only (i) (b) Both (i) and (ii)

(c) Both (i) and (iii) (d) All (i), (ii) and (iii)

Ans. **(d)**

Sol. All three test will be conducted.

117. The relative stability of a sewage sample whose D.O. equals the total oxygen required to satisfy its BOD is

(a) Zero (b) 1%

(c) 100% (d) Infinity

Ans. **(c)**

Sol. Relative stability of sewage

$$= \frac{\text{Amount of DO available in sewage}}{\text{Amount of oxygen required to satisfy the first stage BOD}}$$

= 1 × 100 = 100%

118. Which of the following parameters are employed in the design of Trickling filter?

1. Hydraulic loading rate
2. Organic loading rate
3. Detention time
4. Weir loading rate

(a) 1, 2, 3 and 4 (b) 1 and 2 only
(c) 2 and 3 only (d) 3 and 4 only

Ans. **(b)**

Sol. Only hydraulic loading rate and organic loading rate are employed in the design of TF.

119. The slope of a 1.0m diameter concrete sewer laid at a slope of 1 in 1000 develops a velocity of 1 m/second, when flowing full. When it is flowing half full, the velocity of flow through the sewer will be

(a) 0.5 m/sec (b) 1.0 m/sec
(c) $\sqrt{2.0}$ m/sec (d) 2.0 m/sec

Ans. **(b)**

Sol.

$$D = 1\ m,\ S = \frac{1}{1000},\quad V_{full} = 1 m/s$$

$$V = \frac{1}{n}R^{2/3}S^{1/2}$$

$$\frac{V_h}{V_f} = \left(\frac{R_h}{R_f}\right)^{2/3} = 1$$

$$V_{half\ full} = V_{full} = 1\ m/s$$

120. Self purification of running streams may be due to

(a) Sedimentation, Oxidation and Coagulation
(b) Dilution, Sedimentation and Oxidation
(c) Dilution, Sedimentation and Coagulation
(d) Dilution, Oxidation and Coagulation

Ans. **(b)**

Sol. Coagulation is not occurred during self purification of river.

121. If the height of a tower is 50m, flying height of the aircraft above the base is 5000m and the image of the top of the tower is 20 cm, from the principal point, what will be the height displacement?

(a) 2 cm (b) 1 cm
(c) 0.2 cm (d) 0.2 m

Ans. **(c)**

Sol. r = 20 cm = 0.2 m

h = 50 m

H = 5000 m

So, relief displacement $d = \frac{rh}{H}$

$$= \frac{0.2\times 50}{5000} = 2 \times 10^{-3}\ m = 0.2\ cm$$

122. The perpendicular offset from a tangent to the junction of transition curve and circular curve is equal to

(where L = Length of transition curve, R = Radius of circular curve)

(a) $\frac{L}{6R}$ (b) $\frac{L}{24R}$
(c) $\frac{L^2}{6R}$ (d) $\frac{L^2}{24R}$

Ans. **(c)**

123. In a survey, A and B are two points. Already located with respect to A and B, point C is located by taking two reading and then line CD is measured. The D point is a point on AB. The line CD is known as

(a) Base line (b) Check line
(c) Tie line (d) Additional line

Ans. **(b)**

Sol. Check line : Check line is a line provided to check accuracy of the field work.

Tie line : A chain line joining two tie stations is called tie line.

124. A tunnel should NOT be constructed along
(a) Strike direction
(b) Dip direction
(c) Oblique to the bed altitude
(d) Both along dip and strike direction

Ans. **(a)**

Sol. In strike direction case, that is, when the tunnel is driven parallel to strike of the bed. The pressure distribution to the exposed layers is unsymmetrical along the periphery of the tunnel opening.

In case of parallel to the dip direction, the layers offers a uniformly distributed load on the excavation, even relatively weaker rocks might act as self supporting in such cases.

125. Refraction error is least in case of
(a) Stadia tacheometry
(b) Tangential tacheometry
(c) Subtense bar tacheometry
(d) Omnimeters

Ans. **(c)**

***