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**UPPSC
2021**

**Assistant Engineer
Prelims Exam
Civil Engineering
Paper-II**

Detailed Solution (SET-D)

Exam Date - 29 May, 2022 Time - 02:00 PM - 04:30 PM

Office Address: F-126, Katwaria Sarai, New Delhi - 110 016
Telephone: 011-41013406, **Mobile:** 8130909220, 9711853908

Web: www.iesmaster.org

E-mail: info@iesmaster.org



SET - D

1. Which of the following are the exclusive powers of the Lok Sabha?

1. To introduce the Money Bill.
2. To ratify the declaration of emergency.
3. To pass a motion of no confidence against the Council of Ministers.
4. To impeach against the President.

Choose the correct answer from the code given below:

- (a) 1 and 3 (b) 1 and 4
(c) 3 and 4 (d) 2 and 3

Ans. (a)

Sol. Special powers of the Lok Shakhbha

- Motions of No-confidence against the government can only be introduced and passed in the Lok Sabha.
- Money bills can only be introduced in the Lok Sabha.

2. Which of the following sea is situated between Phillipines and Vietnam?

- (a) Phillipines Sea (b) Celebes Sea
(c) South China Sea (d) East China Sea

Ans. (c)

Sol. South China Sea is in South of China, East and South of Vietnam, West of the philippines and North of the Island of Borneo.

3. The provision for Anti Defection Act is mentioned in which of the following Schedules of the Constitution of India ?

- (a) 9th (b) 12th

- (c) 11th (d) 10th

Ans. (d)

4. With reference to the Vikramshila University which of the following statements is/are correct?

1. Vikramshila was one of the most important centre of learning in India during the Pala period.
2. Rakshit, Virochan, Ateesh, Deepankar and Ratnakar Shanti were very important Acharya of Vikramshila University.

Select the correct answer using the code given below:

Code:

- (a) Only 1 (b) Neither 1 nor 2
(c) Both 1 and 2 (d) Only 2

Ans. (c)

5. What was the theme of the 40th Indian International Trade Fair held in November, 2021?

- (a) Atmanirbhar Bharat
(b) Vocal for Local
(c) Is of Doing Business
(d) None of the above

Ans. (a)

Sol. 40th India international trade fair 2021 held in November (14–27) at Pragati Maidan, New Delhi. The theme was “Atmanirbhar Bharat” with a focus on economy, export potential, infrastructure supply chain demand and vibrant demography.



6. With reference to National Ayurveda Day 2021, which of the following statement is/are correct?

1. It was celebrated on 23rd October, 2021.
2. It's theme was 'Ayurveda for Poshan'.

Select the correct answer from the code given below:

- (a) 1 only (b) Neither 1 nor 2
(c) Both 1 and 2 (d) 2 only

Ans. (d)

Sol. In 2021, Ayurveda day is being observed on 2nd November 2021. The Ayurveda day celebrations are being held under the Azadi Ka Amrit Mahotsve initiative. The theme was "Ayurveda for Poshan"

7. In which of the following Puranas, the five characteristics of the Puranas are mentioned?

- (a) Vaman (b) Matsya
(c) Vayu (d) Vishnu

Ans. (b)

8. By which Constitutional Amendment 'Part IX B' was added in the Indian constitution?

- (a) 52nd Constitutional Amendment
(b) 97th Constitutional Amendment
(c) 93rd Constitutional Amendment
(d) 73rd Constitutional Amendment

Ans. (b)

9. Which one of the following States is a leading producer of diamonds in India?

- (a) Telangana (b) Karnataka
(c) Madhya Pradesh (d) Odisha

Ans. (c)

10. In India, the voting age was lowered from 21 to 18 years by which of the following Constitutional Amendment?

- (a) 56th (b) 88th
(c) 72nd (d) 61st

Ans. (d)

Sol. The 61st amendment of the constitution of India Act 1988, lowered the voting age of elections to the Lok Sabha and to the legislative Assemblies of States from 21 years to 18 years.

11. Knock-Knee syndrome results due to pollution of

- (a) Heavy metal (b) Phosphate
(c) Fluorides (d) Nitrate

Ans. (c)

Sol. Knock Knee syndrome occurs due to the pollution of fluorides. The disease is characterised by stiffness and hardness of joints and bones.

12. Baltic Republics do NOT include which of the following ?

1. Denmark 2. Estonia
3. Finland 4. Latvia

Select the correct answer using the code given below:

Code:

- (a) 1 and 2 (b) 2 and 4
(c) 2 and 3 (d) 1 and 3

Ans. (d)

Sol. The Baltic states – Estonia, Latvia and Lithuania.

13. Which French traveller called Kashi as 'Athens of India'?

- (a) Thevenot (b) Manucci
(c) Tavernier (d) Bernier

Ans. (d)



14. Which of the following App is introduced by the Election Commission of India in October, 2021 for digital mapping of all polling stations?
- (a) Arjun App (b) Chatbot App
(c) Trishul App (d) Garuda App

Ans. (d)

Sol. The Election Commission of India has launched the 'Garuda APP' for digital mapping of all polling stations, to ensure faster, smarter, transparent and timely completion of election work. Through the Garuda APP, booth level officers (BLO) will upload photos and location information of the polling station, along with data like latitude and longitude of the centre, from their registered mobile numbers. The App will also help in reducing the paper work.

15. Match List-I with List-II and select the correct answer from the code given below the lists:

List-I (Blue flag certified Beach)

- A. Ghoghla B. Kasarkod
C. Kappad D. Rushikonda

List-II (Location)

1. Andhra Pradesh 2. Kerala
3. Karnataka 4. Diu

Code:

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

Ans. (b)

Sol.

- Ghoghla beach is in U.T. of Diu.
- Kasarkod beach is in Karnataka.
- Kappad beach is in Kerala.
- Rushi Konda beach is in Andhra Pradesh.

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

List-I (Code)

- A. Code of Civil Procedure
B. Indian Penal Code
C. Criminal Procedure Code
D. Police Act

List-II (Year of Introduction)

- I. 1862 II. 1859
III. 1861 IV. 1860

Code:

- | | A | B | C | D |
|-----|-----|-----|----|-----|
| (a) | II | IV | I | III |
| (b) | III | IV | II | I |
| (c) | II | III | IV | I |
| (d) | IV | I | II | III |

Ans. (a)

17. Which of the following pairs represent units of the same physical quantity?

- (a) Kelvin and Joule
(b) Newton and Calorie
(c) Kelvin and Calorie
(d) Joule and Calorie

Ans. (d)

Sol. Joule and Calorie has same physical quantity because both are unit of energy.

18. Which of the following Article makes provision that "the law declared by the Supreme Court shall be binding on all the Courts within the territory of India"?

- (a) Article 140 (b) Article 143
(c) Article 142 (d) Article 141



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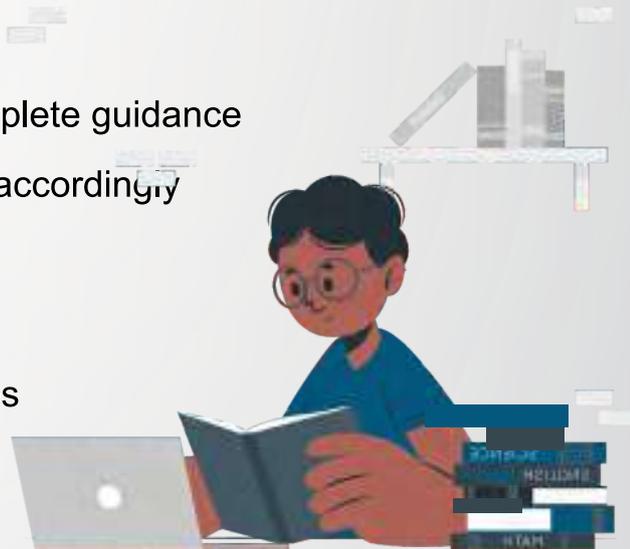
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Ans. (d)

Sol. Article 141 provides that the law declared by the supreme court shall be binding on all courts within the territory of India. The law declared has to be constructed as a principle of law that emanates from a judgement, or an interpretation of law or judgement by the supreme court, upon which, the case is decided.

19. With reference to Delhi Sultanate consider the following statements.

1. Sultangarhi was build by Sultan Iltutmish.
2. Located in Delhi, it is the first tomb built by Turks.

Select the correct answer using the code given below:

- (a) Only 1 (b) Neither 1 nor 2
(c) Both 1 and 2 (d) Only 2

Ans. (c)

Sol. The tomb of sultan garhi is the earliest Muslim tomb in dehi, built by Iltutmish in 1231, over the grave of his eldest son, Nasir-al-Din Mahmud.

20. In which of the following States of India 'Chitrakote waterfall' is located?

- (a) Uttar Pradesh (b) Jharkhand
(c) Chattisgarh (d) Madhya Pradesh

Ans. (c)

Sol. Chitrakote waterfall is a beautiful waterfall situated on the river indravati in Bastar district of Chhattisgarh State of India.

21. Who among the following is the Chairperson of GST Council ?

- (a) President
(b) Diputy Chairman of NITI Ayog

(c) Union Finance Minister

(d) Prime Minister

Ans. (c)

Sol. Uniform Finance minister is the chairperson of GST Council.

22. What is the rank of India in 'Global Food Security Index, 2021'?

- (a) 54 (b) 83
(c) 71 (d) 62

Ans. (c)

Sol. • India is ranked at 71st position in Global Food Security Index 2021.

- The Global Food security Index was designed and constructed by Condon, based Economist Impact and is sponsored by Corteva Agriscience.

23. In the battle of Chandawar (1194 CE) King jaichand was defeated by Muhammad Gori. Present geographical location of Chandawar is

- (a) Etawah district in U.P. at the bank of river Yamuna
(b) Varanasi, U.P. at the bank of river Ganga
(c) Kannauj, U.P. at the bank of river Yamuna
(d) Prayagraj district in U.P. at the bank of river Yamuna

Ans. (a)

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

List-I	List-II
A. Acetic acid	1. Ant's sting
B. Lactic acid	2. Spinach
C. Formic acid	3. Vinegar
D. Oxalic acid	4. Curd



A B C D

- (a) 1 2 3 4
(b) 3 4 1 2
(c) 4 3 2 1
(d) 2 4 1 3

Ans. (b)

- Sol.**
- Vinegar is a combination of acetic acid and water made by a two-step fermentation process.
 - Curd has lactic acid.
 - The acid present in ant's sting is methanoic acid (formic acid).
 - Oxalic acid found in spinach.

25. Which one of the following is NOT correctly matched ?

- (a) Shaukat Usmani - Kanpur Conspiracy Case
(b) Khudiram Bose - Assembly Bomb Case
(c) Ashfaqullah Khan - Kakori Train Robbery Case
(d) Surya Sen - Chatgaon Revolt Case

Ans. (b)

- Sol.**
- On April 18, 1929, Bhagat Singh and Batukeshwar dutt throw bombs into the central legislative assembly, while it was in motion.
 - Khudiram Bose is related to Muzaffarpur conspiracy case.

26. Calculate the capacity (vehicle per hour) of the road when reaction time of the driver is 2 seconds. The design speed is 80 kmph and average length of the vehicle is 6 m. Take coefficient of friction is 0.35.

- (a) 600 (b) 724
(c) 700 (d) 653

Ans. (d)

Sol. Capacity (C) = $\frac{1000V}{S}$ veh/h

where space headway (S) = SSD + L

$$= \left[Vt_r + \frac{V^2}{2g\mu} \right] + L$$

$$= 0.278 \times 80 \times 2 + \frac{(0.278 \times 80)^2}{2 \times 9.81 \times 0.35} + 6$$

$$= 122.5 \text{ m}$$

$$C = \frac{1000 \times 80}{122.5} = 653 \text{ veh/hr}$$

27. If the intensity of rainfall is more than the infiltration capacity of soil, then the infiltration rate will be

- (a) equal to rate of rainfall
(b) more than infiltration capacity
(c) more than the rate of rainfall
(d) equal to infiltration capacity

Ans. (d)

Sol. When intensity of rainfall is more than the infiltration capacity the rate of infiltration is equal to infiltration capacity.

The actual rate of infiltration f , at a given time can be expressed as:

$$f = f_c, \text{ when } i > f_c$$

$$f = i, \text{ when } i < f_c$$

Where, i is intensity of rainfall and f_c is the infiltration capacity at a given time; i , f and f_c are expressed in cm/hr or mm/minute. The infiltration capacity (f_c) of a soil is high at the beginning of a storm and has an exponential decay as the time elapses.

28. An approximate value of the drag coefficient of a hemispherical parachute is

- (a) 2.35 (b) 0.07
(c) 0.30 (d) 1.33

Ans. (d)

Sol.

Object in fluid	Drag coefficient (C_D)
• Submarine	0.15
• Parachute	1.33
• Air craft wing (air foil)	0.10
• Smoke stack (chimney)	1.00

29. The natural process under which the following river water gets cleaned, is known as

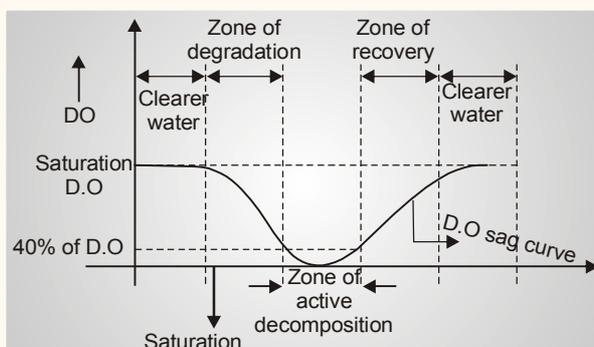
- (a) Self-purification (b) Oxidation
(c) Photo-synthesis (d) None of these

Ans. (a)

Sol. • Running water is capable of purifying itself with distance through a process known as self purification.

In a stream the natural purification process involved are :

- (i) Sedimentation of re-suspension
(ii) Dilution
(iii) Filtration
(iv) Gas transfer i.e. aeration
(v) Heat transfer
(vi) Chemical conversion i.e. oxidation, reduction and precipitation
(vii) Metabolic processes.



Zones of pollution in river stream are :

- (i) Zone of degradation.
(ii) Zone of active decomposition.
(iii) Zone of recovery.
(iv) Zone of clear water.

Zone of Degradation

- It is found upto certain distance downstream of the point at which sewage is discharged into the river.
- In this algae dies but the fish survives.
- Water becomes dark and turbid.
- DO reduces to upto 40% of saturation.

Zone of Active Decomposition

- It is a zone of heavy pollution.
- Water becomes darker than zone of degradation.
- DO may even fall to zero.
- Fish will disappear.
- At upper ends, anaerobic bacteria will replace aerobic bacteria. Hence, anaerobic conditions set in and thus gases like CH_4 , H_2S , CO_2 will be evolved and ugly scum forms on the surface.
- At the end of this zone DO concentration will reach upto 40% of the saturation DO.

Zone of Recovery

- BOD falls down.
- Organic matter will produce nitrate, sulphate, phosphate, carbonate, etc.
- D.O. content rises above 40% of the saturation value

Zone of Clear Water

- DO will rise upto its saturation value, but the pathogens may remain.

30. If in a gradually varied flow dy/dx is positive, then dE/dx



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- (a) is negative, if $Y > Y_e$
- (b) is always negative
- (c) is always positive
- (d) is positive if $Y/Y_e > 1$

Ans. (d)

Sol.

$$\frac{dy}{dx} = \frac{s_0 - s_f}{1 - F_r^2}$$

$$\frac{dE}{dx} = S_0 - S_f$$

$$\frac{dy}{dx} = \frac{(dE/dx)}{(1 - F_r^2)}$$

as $\frac{dE}{dx} > 0$ so sign of $\frac{dy}{dx}$ will be dependent on Froude number

- If $F_r > 1$ i.e. $y < y_c$

than $\frac{dy}{dx}$ will be negative.

- If $F_r < 1$ i.e. $y > y_c$

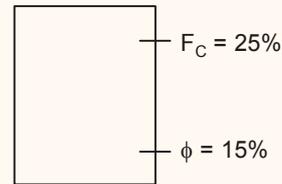
than $\frac{dy}{dx}$ will be positive

31. The field capacity of a soil is 25%, its permanent wilting point is 15% and specific dry unit weight is 1.5. If the depth of root zone of a crop is 80 cm, the storage capacity of the soil is

- (a) 8 cm
- (b) 14 cm
- (c) 12 cm
- (d) 10 cm

Ans. (c)

Sol. Root zone depth (D) = 80 cm



Depth of water stored b/w F_C & ϕ

$$= \frac{\gamma_d}{\gamma_w} \times D \times (F_C - \phi)$$

$$= \frac{G \cdot \gamma_w}{\gamma_w} \times D \times (F_C - \phi)$$

$$= 1.5 \times 80 \times (0.25 - 0.15)$$

$$= 12 \text{ cm}$$

32. In GIS, interpolation is made possible by a principle called,

- (a) Spatial auto correlation
- (b) Thematic auto-correction
- (c) Thematic auto correlation
- (d) Spatial auto-correction

Ans. (a)

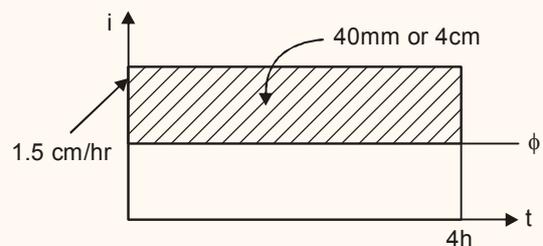
Sol. Interpolation is made possible by a principle called spatial autocorrelation.

33. A 4 hr. storm with a uniform intensity of 1.5 cm/hr produced a runoff depth of 40 mm. The average infiltration rate during this storm is

- (a) 4 mm/hr
- (b) 7 mm/hr
- (c) 6 mm/hr
- (d) 5 mm/hr

Ans. (d)

Sol.



$$(1.5 - \phi) \times 4 = 4$$

$$6 - 4\phi = 4$$

$$\phi = 0.5 \text{ cm/h}$$

$$= 5 \text{ mm/h}$$

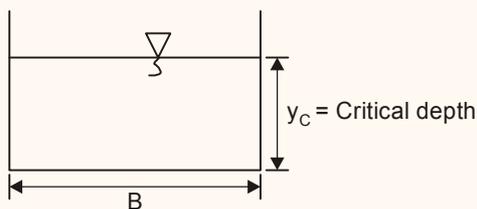
34. In a rectangular channel, if the critical depth is 2.0 m, the specific energy at critical depth is

- (a) 3.0 m (b) 2.5 m
(c) 2.0 m (d) 1.5 m

Ans. (a)

Sol. For rectangular channel
critical depth (y_c) = 2.0 m
specific energy (E) = $1.5 y_c$
= 3.0 m

Note: For rectangular channel



$$y_c = \left(\frac{q^2}{g} \right)^{1/3} \quad (\text{For critical flow})$$

A = Cross sectional area

T = Top width of flow

Q = Discharge

q = Discharge per unit width

35. The alum added as a coagulant in water treatment functions when the raw water is

- (a) Acidic with high turbidity
(b) Neutral with low turbidity
(c) Alkaline with high turbidity
(d) Acidic with low turbidity

Ans. (c)

- Sol.
- Alum requires alkalinity (Bicarbonate alkalinity) to form gelatinous precipitate of $\text{Al}(\text{OH})_3$.
 - The amount of alum required for coagulation depends on turbidity and colour of water.

Types of coagulant	Properties
(a) Alum ($\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$) (Aluminium Sulphate)	<ul style="list-style-type: none"> It is cheap and commonly used coagulant for raw water supplies. Flocs formed are stable. Normal dosage \rightarrow (10–30) mg/l. Effective in pH range of 6.5 to 8.5. It also reduces colour, taste and odour.
(b) Copperas/Ferrous ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)	<ul style="list-style-type: none"> It is commonly used for treating sewage. Flocs formed are heavy. It works in pH range of 8.5 and above. Normal dosage \rightarrow (10 – 30) mg/L.
(c) Chlorinated Copper as ($\text{Fe}_2(\text{SO}_4)_3 + \text{FeCl}_3$)	<ul style="list-style-type: none"> It is used for water which is not coloured. It is effective in removing colour also. It can work in large pH ranges. They are effective in combination with lime.
(d) Sodium Aluminate ($\text{Na}_2\text{Al}_2\text{O}_4$)	<ul style="list-style-type: none"> It is a costlier coagulant. It works in pH range between 6–8.5. It is useful for water which does not have required Alkinity. Besides coagulation, it also reduces hardness.

36. Salinity of water

- (a) Increase evaporation
(b) Does not affect evaporation

41. A liquid flows in a 30 cm diameter pipe at a Reynolds number of 10^6 . If the friction factor is 0.025, the thickness of laminar sublayer, in mm is

- (a) 0.025 (b) 0.0031
(c) 0.062 (d) 1.00

Ans. (c)

Sol. Laminar sublayer thickness

$$(\delta^l) = \frac{11.60}{u^*} \quad \dots(1)$$

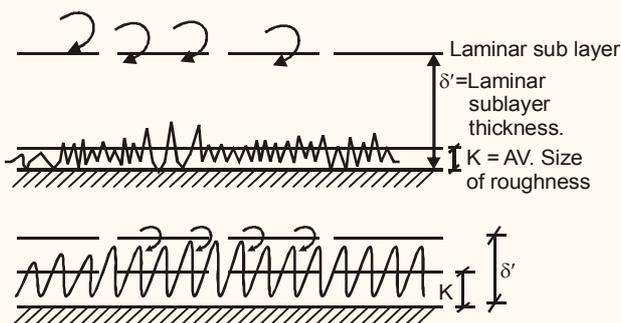
$$u^* = u_{avg} \sqrt{\frac{f}{8}} \quad \dots(2)$$

$$Re = \frac{u_{avg} \times D}{\nu} = 10^6 \Rightarrow \frac{u_{avg}}{\nu} = \frac{10^6}{D}$$

$$\delta^l = \frac{11.6\nu}{u^*} = \frac{11.6\nu}{u_{avg} \sqrt{f/8}}$$

$$= \frac{11.6}{\left(\frac{10^6}{D}\right) \times \sqrt{f/8}} = \frac{11.6}{\frac{10^6}{0.3} \times \sqrt{\frac{0.025}{8}}} = 0.06225$$

Note:



As per Nikuradse experiment

If $\frac{K}{\delta^l} < 0.25 \Rightarrow$ a hydrodynamically smooth

boundary

$\frac{K}{\delta^l} > 6 \Rightarrow$ a rough boundary

$0.25 < \frac{K}{\delta^l} < 6$ in transition

In terms of Roughness Reynolds no., $\left(\frac{u_* K}{\nu}\right)$

where $u_* = \sqrt{\frac{\tau_w}{\rho}}$; τ_w = boundary shear stress

If $\frac{u_* K}{\nu} < 3$ smooth boundary

$\frac{u_* K}{\nu} \geq 70$ rough boundary

$3 < \frac{u_* K}{\nu} < 70$ - in transition

where k = Av. Size of roughness

ν = Kinematic viscosity

ρ = density

u_* = Friction velocity

42. The following surveys are conducted before the alignment of a railway track.

1. Reconnaissance survey
2. Preliminary survey
3. Traffic survey
4. Location survey

The correct sequence in which these surveys are conducted is

- (a) 1, 3, 2, 4 (b) 3, 1, 2, 4
(c) 3, 1, 4, 2 (d) 1, 3, 4, 2

Ans. (b)

Sol. The following surveys should be carefully conducted to fix a best possible alignment:

1. Traffic survey.

2. Reconnaissance survey.
3. Preliminary survey or Survey for initial location.
4. Detailed survey or survey for final location.

43. The velocity distribution over one half of a cross section is uniform and zero over the remaining half. The momentum correction factor for this cross section is

- (a) 2.0 (b) 3.0
(c) 1.0 (d) 4.0

Ans. (a)

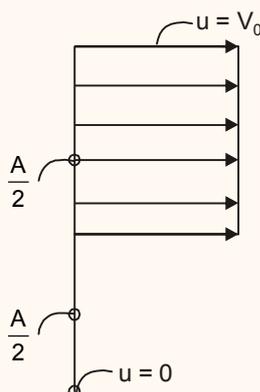
Sol.

$$\beta = \frac{\int u^2 dA}{V_{avg}^2 A}$$

β = moment correction factor

$$\beta = \frac{V_0^2 \left(\frac{A}{2}\right)}{\left(\frac{V_0}{2}\right)^2 A}$$

$$\beta = 2.0$$



$$V_{avg} = \frac{\int u dA}{A} = \frac{V_0 \left(\frac{A}{2}\right)}{A}$$

$$V_{avg} = \frac{V_0}{2}$$

44. Which of the following is NOT a method used for plane table surveying ?

- (a) Back scattering method
(b) Radiation method
(c) Traversing method
(d) Intersection method

Ans. (a)

Sol. **Setting up the Plane Table**

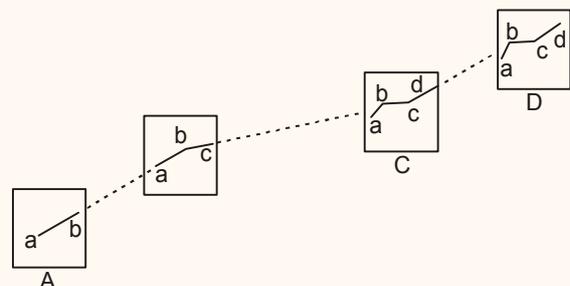
Following operations are included in setting up of the Plane Table :

1. Centering
2. Levelling
3. Orientation

Methods of Plane Table Orientation

1. By Trough Compass
2. By Back Sighting

This is the most accurate method of orientation.



Traversing with a plane table

3. Resection

45. Rheology is the study of

- (a) Newtonian fluids
(b) Non-Newtonian fluids
(c) Ideal fluids



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(d) None of these

Ans. (b)

Sol. • Fluids which obeys Newton's law of

viscosity $\left(\tau = \mu \frac{du}{dy}\right)$ are called Newtonian

Fluids and those fluids which do not obey this rule are called Non-Newtonian Fluids.

- Rheology is the study of non newtonian fluid

46. The flow velocity in a sewer does NOT depend on

- (a) its grade
- (b) its roughness
- (c) its hydraulic mean depth
- (d) its length

Ans. (d)

Sol. Flow Formula

- Manning's formula is used for open channel flow (i.e. when sewer is design to run partially full).
- Hazen Williams formula is used for closed conduit or pressure flow.
- Manning's formula

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

V = velocity of flow
R = hydraulic radius
S = slope of sewer

- Hazen William's formula

$$V = 0.849CR^{0.63}S^{0.54}$$

[C = Hazen-William coefficient,
Units are SI units]

- Velocity depends on hydraulic mean depth and slope on which the sewer is laid.

47. Errors arising from carelessness of the observer are known as

(a) mistakes

(b) systematic errors

(c) compensating errors

(d) discrepancy

Ans. (a)

Sol. Mistakes

- They are caused by the misunderstanding of the problem, carelessness or poor judgement and these can be corrected only if discovered.

Examples: (a) A reading of 5 m is booked as 15 m.

Error

This does not arise due to mistake. Rather, it is due to physical condition of instruments like temperature at the time of measurements of the length of a line & limitations of human eye etc.

$$\text{Error} = \text{Measured Value} - \text{True Value}$$

$$\text{Correction} = \text{True Value} - \text{Measured Value}$$

Hence, Measured Value + Correction = True Value

$$\text{Measured Value} - \text{error} = \text{True Value}$$

$$\text{Thus, Correction} = (-)\text{Error}$$

Errors are classified as

- (a) Systematic error
- (b) Random error

Systematic error

- Systematic error arises from the source that act in a similar manner on observations.

Random Error

- Random errors are really all those discrepancies remaining, after the mistakes and systematic errors are removed.



48. Which amongst the BOD and COD of glucose water is greater ?

- (a) BOD
- (b) COD
- (c) Both are equal
- (d) None of the above

Ans. (c)

Sol. **Chemical Oxygen Demand (COD)**

- The COD test is used to measure the content of organic matter of waste water. Both biodegradable and non biodegradable.
- The oxygen equivalent of organic matter that can be oxidised is measured by using a strong chemical oxidising agent in an acidic medium.
- Potassium dichromate has been found to be excellent for this purpose.
- This test is also sometimes called dichromate-oxygen demand test.
- $(\text{COD} - \text{BOD}_u) \equiv \text{Nonbiodegradable organics.}$

Bio-Chemical Oxygen Demand

- Bio-chemical oxygen demand is used as a measure of the quantity of oxygen required for oxidation of bio degradable organic matter present in water sample

by aerobic biochemical action.

Note: ThOD > COD > BOD > TOC

49. As per IS 10500 : 2012, the maximum desirable limits of iron and fluorides for drinking water are

- (a) 0.3 and 0.5 Mg/L, respectively
- (b) 0.5 and 1.8 Mg/L, respectively
- (c) 0.3 and 1.5 Mg/L, respectively

(d) 0.3 and 1.0 Mg/L, respectively

Ans. (*)

Sol. As per amendment no. 1 IS 10500 : 2012 the maximum desirable limits of iron and fluorides for drinking water are 1.0 mg/L for both.

50. If the base period is 100 days and the duty of the canal is 1000 hectares per cumec, the depth of water will be,

- (a) 0.864 cm
- (b) 864 cm
- (c) 86.4 cm
- (d) 8.64 cm

Ans. (c)

Sol. Base period (B) = 100 days

Duty of canal (D) = 1000 hec/cumec.

$$\text{Depth of water } (\Delta) = \frac{8.64B}{D}$$

$$= \frac{8.64 \times 100}{1000}$$

$$= 0.864 \text{ m} = 86.4 \text{ cm}$$

51. Zero hardness of water is achieved by

- (a) Using lime soda process
- (b) Using excess alum dosage
- (c) Ion exchange method
- (d) Excess lime treatment

Ans. (c)

Sol. • The water of zero hardness can be obtained from the ion exchange method only Lime soda method doesn't remove the complete hardness from the water.

52. Switch angle depends upon

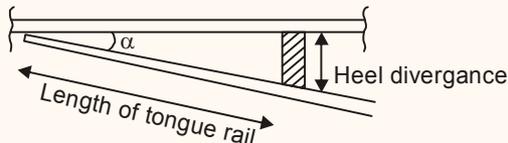
- i. Heel divergence
- ii. Length of tongue rail
- iii. Flange way clearance
- iv. Throw of switch

The correct answer is

- (a) i and ii (b) i and iv
(c) iii and iv (d) ii and iii

Ans. (a)

Sol.



$\alpha \rightarrow$ switch angle

- 53.** On a hydrograph, isolated storm is represented as
- (a) s-curve (b) complex peak
(c) multi peaks (d) single peak

Ans. (d)

Sol. • If a rainfall occurs after the end of DRH of pervious rainfall and before the start of DRH of the rainfall after it, it is called isolated storm.

- 54.** When the recirculation ratio in a high rate trickling filter is unity, then the recirculation factor is
- (a) 1 (b) Zero
(c) Less than 1 (d) More than 1

Ans. (d)

Sol. Recirculation factor (RF) = $\frac{1+R}{(1+0.1R)^2}$

Whose

R = Recirculation ration

$$= \frac{Q_R}{Q_0} = 1 \text{ (given)}$$

$$RF = \frac{1+1}{(1+0.1)^2} = 1.65$$

- 55.** The camber provided on a sloping road is 1 in 48. Which one of the following is the ruling gradient ?

- (a) 1 in 15 (b) 1 in 30
(c) 1 in 24 (d) 1 in 20

Ans. (c)

Sol. Longitudinal gradient = $2 \times$ camber

- 56.** Which one of the following methods can be employed for plastic and rubber waste disposal?

- (a) Sanitary landfill (b) Incineration
(c) Pyrolysis (d) Composting

Ans. (c)

Sol. All the four methods are commonly used methods for solid waste disposals.

Sanitary land fill : Simple and economical but there is continuous evolution of foul gases which may be explosive in nature. Also, it cause leachate in landfills which pollutes nearby groundwater thereby impacting the ecology of the area.

Incineration : It is a method of disposal in which the solid waste is burnt in the presence of oxygen.

Pyrolysis : It is a method of solid waste disposal in which the waste is burnt in the absence of oxygen. Although fast and requires considerable less land, but it causes air pollution and thus impacts the environment of the area.

Composting : It is a slow process whereby bacteria is used to decompose the solid waste. Used to decompose the organic materials only. It is a perfectly natural phenomenon and imposes least burden on the ecology of the area.

Fuel can be obtained through pyrolysis of plastic waste. It is considered as second best option after recycling. It also helps reduce



dependency on fossil fuel and geo-extraction. Rubber waste disposal is done through pyrolysis which can separate solids from volatile liquid and gaseous compounds that can be used as fuel.

57. The product of traffic density and traffic speed is termed as

- (a) Traffic volume
- (b) Basic capacity
- (c) Traffic capacity
- (d) None of the above

Ans. (a)

Sol. $q = K \times v$

where q is traffic volume

K is traffic density

v is traffic speed

58. A camera equipped with a 152 mm focal length lens, is used to take a vertical photograph from a flying height of 2780 m. above mean sea level. If the terrain is flat with an elevation of 500 m, the scale of the photograph will be

- (a) 1 : 15,000
- (b) 1 : 24,500
- (c) 1 : 22,000
- (d) 1 : 20,000

Ans. (a)

Sol. $f = 152 \text{ mm}$
 $H = 2780 \text{ m}$
 $h = 500$

$$\text{Scale} = \frac{f}{H-h} = \frac{152 \times 10^{-3}}{2780 - 500}$$

$$= \frac{1}{15000}$$

59. Due to which property of mercury, it does NOT stick to glass ?

- (a) Viscosity
- (b) Adhesion
- (c) Cohesion
- (d) Surface tension

Ans. (c)

Sol.

60. If the sequent depth ratio of a hydraulic jump in a rectangular channel is 16.48, the Froude number at the beginning of the jump is

- (a) 5.0
- (b) 12.0
- (c) 10.0
- (d) 8.0

Ans. (b)

Sol. Sequent depth ratio $\left(\frac{y_2}{y_1}\right) = \frac{-1 + \sqrt{1 + 8Fr_1^2}}{2}$

$$16.48 = \frac{-1 + \sqrt{1 + 8Fr_1^2}}{2}$$

$$Fr_1 = 12.0$$

61. If the impeller of a pump receives liquid on both of its sides the pump is known as

- (a) Single stage pump
- (b) Double suction pump
- (c) Single suction pump
- (d) Double stage pump

Ans. (b)

Sol. In single suction pump, fluid is admitted from the suction pipe on one side of impeller hence there is an axial thrust. However, in double suction pump liquid enters from both side of impeller and hence axial thrust is neutralised and also larger quantity of water can be pumped.

62. The minimum size of grit particles that can be removed in grit chamber is

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- (a) 0.05 mm (b) 0.50 mm
 (c) 0.20 mm (d) 0.10 mm

Ans. (c)

Sol. Grit chamber removes particles of size ≥ 0.2 mm

63. What is the relationship between the flying height (H), the focal length (f), the air base (B) and the photo base (b)?

- (a) $B = \frac{f}{b.H}$ (b) $B = \frac{H}{b.f}$
 (c) $B = \frac{b}{f.H}$ (d) $B = \frac{b.H}{f}$

Ans. (d)

Sol. Scale = $\frac{h}{B} = \frac{f}{H-h}$

For $h = 0$

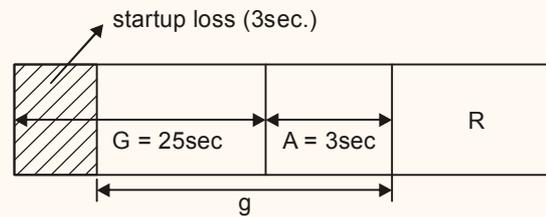
$$B = \frac{b.H}{f}$$

64. The lost time due to starting delay on a traffic signal approach is noted to be 3 seconds. The actual green time is 25 seconds and amber time is 3 seconds. How much will be the effective green time ?

- (a) 19 sec. (b) 35 sec.
 (c) 29 sec. (d) 22 sec.

Ans. (*)

Sol.



$$g = G + A - \text{startup loss}$$

$$= 25 + 3 - 3$$

$$= 25 \text{ sec.}$$

G → actual green time

A → Amber time

g → effective green time

65. An angle measured with theodolite is α with weight 2. The weight of $\frac{\alpha}{4}$ will be

- (a) $\frac{2}{4}$ (b) $\frac{4}{2}$
 (c) 2×4^2 (d) 2×4

Ans. (c)

Sol. Angle $\alpha \Rightarrow$ weight 2

$$\therefore \text{Angle } \frac{\alpha}{4} \Rightarrow 2 \times 4^2$$

66. According to recommendations of the Nagpur Conference, the formation width of an Ideal National Highway is

- (a) 12 m (b) 07.50 m
 (c) 09 m (d) 13 m

Ans. (a)

67. What will be the theoretical maximum capacity for a single lane of highway if the speed of the traffic stream is 40 kmph? (round off 10 units)

- (a) 3000 vehicles/hr.

- (b) 2010 vehicles/hr.
 (c) 2510 vehicles/hr.
 (d) 2860 vehicles/hr.

Ans. (c)

Sol.

$$C = \frac{1000V}{S}$$

$$= \frac{1000 \times 40}{0.2 \times 40 + 6}$$

$$= 2857.14$$

$$\approx 2860 \text{ veh/h}$$

68. Benkelman beam deflection method is used for design of

- (a) Rigid overlays on rigid pavements
 (b) Flexible overlays on rigid pavements
 (c) Flexible overlays on flexible pavements
 (d) Rigid overlays on flexible pavements

Ans. (c)

Sol. The Benkelman beam method is widely used for evaluation of the structural capacity of existing flexible pavements and also for estimation and design of flexible overlays for the strengthening of any weak pavement for highways.

69. The discharge through a V-notch varies as (where, H is the head)

- (a) $H^{1/2}$ (b) $H^{5/4}$
 (c) $H^{5/2}$ (d) $H^{3/2}$

Ans. (c)

Sol. Discharge through V notch (Q)

$$Q = \frac{8}{15} C_d \sqrt{2g} \tan\left(\frac{\theta}{2}\right) H^{5/2}$$

Hence $Q \propto H^{5/2}$

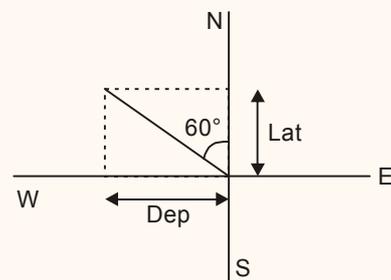
70. If the reduced bearing of a line AB is $N60^\circ W$

and length is 100 m, then the latitude and departure of the line AB will be.

- (a) + 50 m, + 86.6 m
 (b) + 70.7 m, - 50.0 m
 (c) + 50 m, - 86.6 m
 (d) + 86.6 m, - 50.0 m

Ans. (c)

Sol.



\therefore Latitude = + 100 cos 60°
 = + 50 m
 Department = - 100 sin 60°
 = - 86.6 m

71. If ' V_0 ' is the critical velocity of flow in a channel, then according to Kennedy, its silt transporting power is proportional to

- (a) $V_0^{1/2}$ (b) $V_0^{7/2}$
 (c) $V_0^{5/2}$ (d) $V_0^{3/2}$

Ans. (c)

72. The similarity between the forces of model and prototype is

- (a) Dynamic similarity
 (b) Design similarity
 (c) Kinematic similarity
 (d) Potential similarity

Ans. (a)



Sol. For dynamic similarity to exist b/w model & prototype, identical type of forces (viscous, pressure elastic etc) must be parallel and must be in same ratio at all corresponding sets of ponits.

73. If the base period of a 6 hr. unit hydrograph of a basin is 84 hr. then, the base period of a 12 hr. unit hydrograph of the same basin will be

- (a) 90 hr.
- (b) 168 hr.
- (c) 72 hr.
- (d) 84 hr.

Ans. (a)

Sol. Base period of 12hr UH will be 6 hrs more than the base period of 6hr UH

74. The pressure in "Pascals" at a depth of 1 m below the free surface of a body of water will be equal to

- (a) 1 Pascal
- (b) 9810 Pascal
- (c) 981 Pascal
- (d) 98.1 Pascal

Ans. (b)

Sol. $P = \rho gh$
 $= (1000) \times 9.81 \times 1$
 $= 9810 \text{ N/m}^2$

75. With reference to lining of a canal which of the following statement is/are correct?

- i. It is necessary to minimise the seepage loss in canal.
- ii. It increases the discharge in canal section by increasing the velocity.

Select the correct answer using the codes given below:

- (a) only i
- (b) Neither i nor ii

- (c) Both i and ii
- (d) only ii

Ans. (c)

Sol. Lining of canal is necessary:

- (i) To minimise the seepage losses in canal.
- (ii) To increase the discharge in canal section by increasing the velocity.
- (iii) To prevent the erosion fo bed and side due to high velocities.
- (iv) To retard the growth of weed, and
- (v) To reduce maintenance of canal.

Although lining reduces the seepage losses, but it is provided on the basis of economy i.e. in terms of benifits to investment cost ratio.

Living increases the discharge carrying capacity of canels since higher velocities can be permitted.

76. In a sudden contraction, the velocity head changes from 0.5 m to 1.25 m. If the coefficient of contraction is 0.66, the head loss in this contraction is

- (a) 0.133 m
- (b) 0.648 m
- (c) 0.644 m
- (d) 0.332 m

Ans. (d)

Sol. $h_L = K \frac{V_2^2}{2g}; K = \left(\frac{1}{C_c} - 1 \right)^2$
 $K = \left(\frac{1}{0.66} - 1 \right)^2 = 0.2654$
 $h_L = 0.2654 \times 1.25$
 $= 0.332 \text{ m}$

77. A manhole is generally classified as a deep manhole, if its depth is more than

- (a) 0.6 m
- (b) 3.0 m
- (c) 1.5 m
- (d) 1.2 m

Ans. (c)

Sol. Classification of manhole based on the depth:



- shallow manholes are the one which are about 0.75 to 0.9 m in depth
- deep manholes are those which are deeper than 1.5m.

78. Bourdon gauge measures

- (a) absolute pressure
- (b) standard atmospheric pressure
- (c) local atmospheric pressure
- (d) gauge pressure

Ans. (d)

Sol. Mechanical gauges : They use flexible pipes and they are calibrated to read the gauge pressure use example : Diaphragm pressure gauge, bourdon tube pressure gauge, dead-weight pressure gauge, and bellows pressure gauge.

79. Which of the following is dimensionless?

- (a) Specific weight (b) Specific gravity
- (c) Specific viscosity (d) Specific volume

Ans. (b)

Sol.

80. Geostationary satellites have,

- (a) same distance from earth's centre
- (b) same angle with geodetic stations
- (c) same mass as global weight
- (d) same speed as earth's rotation

Ans. (d)

Sol.

- A satellite which is stationary with respect to a given position of the earth is known as geostationary satellite.
- This satellite is launched on the equatorial plane and travelling along the same angular velocity as that at which the earth rotates and in the same direction will always remain above the same point on earth at all the time.

81. Various water treatment processes are listed below

- 1. Filtration 2. Chlorination
- 3. Sedimentation 4. Coagulation
- 5. Flocculation

The correct sequence of these processes in a conventional water treatment scheme is

- (a) 5, 1, 2, 3, 4
- (b) 1, 3, 4, 2, 5
- (c) 3, 4, 5, 1, 2
- (d) 4, 5, 3, 1, 2

Ans. (d)

Sol. The correct sequence of water treatment processes are:

Coagulation → Flocculation →
Sedimentation → Filtration →
Disinfection (Chlorination)

82. According to Indian standard, the number of rain gauge stations for an area of 5200 km² in plains should be

- (a) 10 (b) 25
- (c) 20 (d) 15

Ans. (a)

Sol. BIS recommends one rain gauge station per 520km² for plain areas.

No. of rain gauge station required

$$= \left(\frac{5200}{520} \right) = 10$$

83. While testing for COD of sewage, organic matter is oxidised by K₂Cr₂O₇ in the presence of

- (a) HCl (b) HNO₃
- (c) H₂SO₄ (d) None of these

Ans. (c)



84. A rectangular block 2 m long, 1 m wide and 1 m deep floats in water. The depth of immersion is 0.5 m. If water weighs 10 kN/m³. Then the weight of the block is

- (a) 5 kN (b) 20 kN
(c) 15 kN (d) 10 kN

Ans. (d)

Sol. The block is floating on water that means buoyant force should be equal to the wt of bloc.

$$\text{buoyant force } (F_b) = (2 \times 1 \times 0.5) \times 10 = 10 \text{ kN}$$

85. The 'track modulus' is an index of measure of which of the following?

- (a) Resistance due to friction
(b) Resistance due to rolling
(c) Resistance due to deformation
(d) Resistance due to shear

Ans. (c)

86. Exit gradient is directly proportional to

- (a) Seepage load
(b) Creep length
(c) Depth of cutoff
(d) None of the above

Ans. (d)

Sol. Exit gradient (G_E) = $\frac{H}{d} \times \frac{1}{\pi\sqrt{\lambda}}$,

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

$$\text{and } \alpha = \left(\frac{b}{d}\right) = \frac{\text{length of floor}}{\text{Depth of cut off}}$$

Hence, it is directly proportional to seepage head.

87. The Bernoulli's equation is applicable only for

- (a) Irrotational flow

(b) Compressible flow

(c) Inviscid, incompressible flow

(d) Viscous flow

Ans. (c)

Sol. For Bernoulli's equation to be valid, the assumptions are

- (1) steady flow
(2) Incompressible flow
(3) frictionless flow (i.e. inviscid flow)
(4) flow is along the stream line

88. The Buckingham-Pi theorem is widely used in the dimensional analysis and expresses the resulting equation in terms of

- (a) the repeating variables
(b) n dimensionless parameters
(c) (n-m) dimensionless parameters
(d) geometric, kinematic and dynamic variables

Ans. (c)

Sol. According to Buckingham's π -theorem if there are n number of variables (both dependent and independent) in a dimensionally homogeneous eqn and these variables contain 'm' fundamental dimensions then the number of dimensionless groups, which can be formed, shall be (n-m). These dimensionless groups are called π -terms.

89. Creep is the

- (a) longitudinal movement of rail
(b) difference in level of two rails
(c) lateral movement of rail
(d) vertical movement of rail

Ans. (a)

Sol. Creep is defined as the longitudinal movement of rails with respect to sleepers in a track.

90. For non-passing sight distance, the height of

stationary object considered is

- (a) 10 cm (b) 65 cm
(c) 50 cm (d) 15 cm

Ans. (d)

Sol. For non passing sight distance (ie. stopping sight distance) the height of stationary object (obstruction) considered is 15cm

91. Muskingum method of routing satisfies the equation

- (a) $C_0 + C_1 + C_2 = 0$
(b) $C_0 \cdot C_1 \cdot C_2 = 1$
(c) $C_0 + C_1 + C_2 = 1$
(d) None of the above

Ans. (c)

Sol. As per Muskingum method of routing:

$$C_0 + C_1 + C_2 = 1$$

92. If a 2% solution of sewage sample is incubated for 5 days at 20°C and the dissolved oxygen depletion is 10 mg/L, then the BOD of the sewage would be

- (a) 50 mg/L (b) 2000 mg/L
(c) 500 mg/L (d) 200 mg/L

Ans. (c)

Sol. $BOD_5 = (\text{initial dissolved oxygen} - \text{final dissolved oxygen} \times \text{dilution factor})$

$$\text{dilution factor} = \frac{\text{final volume}}{\text{sample vol.}} = \frac{100}{2} = 50$$

$$BOD_5 = 10 \text{ mg/l} \times 50 = 500 \text{ mg/l}$$

93. The device, which can be used to control gaseous as well as particulate pollutants in the industrial emissions is known as

- (a) Spray tower
(b) Dynamic precipitator
(c) Fabric filter

(d) Cyclone

Ans. (a)

Sol. Spray towers are low cost scrubbers that can be used to remove both gaseous and particulate contaminants.

94. Surface tension for an ideal fluid is

- (a) dependent on temperature
(b) zero
(c) infinite
(d) one

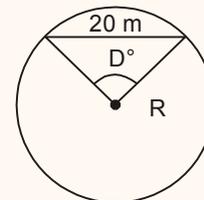
Ans. (b)

95. If the length of a chord/arc is 20 m in a curve, then the relationship between R and D in the curve will be

- (a) $R = \frac{573}{D}$ (b) $R = \frac{1718.9}{D}$
(c) $R = 1146 D$ (d) $R = \frac{1146}{D}$

Ans. (d)

Sol.



$$\therefore 2\pi R \text{ perimeter} \Rightarrow 360^\circ$$

$$\therefore 20 \text{ m perimeter} \Rightarrow \frac{360}{2\pi R} \times 20 = \frac{1146}{R}$$

$$\therefore R = \frac{1146}{D}$$

96. A check dam is a

- (a) flood control structure
(b) water storage structure



- (c) river training structure
(d) soil conservation structure

Ans. (d)

Sol. A properly designed constructed and maintained check dam will reduce scour and channel erosion by reducing flow velocity and encouraging sedimentation.

97. The unit power P_u of a turbine developing a power P under a head H is equal to

- (a) $\frac{P}{H^{5/2}}$ (b) $\frac{P}{H^{3/2}}$
(c) $PH^{3/2}$ (d) $P\sqrt{H}$

Ans. (b)

Sol. Unit power (P_u) = $\frac{P}{(H)^{3/2}}$

98. The critical condition for stability of slope of an earth dam at down stream will be

- (a) Reservoir empty with maximum seepage
(b) Reservoir full without pore water pressure
(c) Reservoir full with maximum percolation rate
(d) None of the above

Ans. (c)

Sol. The most critical for which the stability of down stream slope must be examined occurs when reservoir is full and seepage is taking place at full rate.

99. Recirculation in "Activated sludge process" is done to

- (a) Dilute the incoming sewage
(b) Supply seed to the aeration tank
(c) Operate the plant continuously
(d) Dampen the effect of the flow variation

Ans. (b)

100. Which one of the following specification for the length of base line refers to "third order Triangulation" system?

- (a) 0.5 to 3.0 km (b) 10 to 20 km
(c) 5.0 to 15 km (d) 1.5 to 5.0 km

Ans. (a)

Sol. For applying the triangulation system, certain parameters will be assumed and length of base line is one among them length of base line is between 5 – 20 km in primary, 2 – 5 km in secondary, 0.5 – 3 km in tertiary triangulation system.

101. The tower's used in triangulation are known as

- (a) Heliotropes (b) Hunter
(c) Captain McCaw (d) Bilby

Ans. (d)

102. The water balance equation for a catchment area in terms of rainfall (P), runoff (R), evaporation (E) and storage (S) is written as

- (a) $R = P - E \pm \Delta S$ (b) $P = E - R \pm \Delta S$
(c) $R = E - P \pm \Delta S$ (d) $R = P + E \pm \Delta S$

Ans. (a)

Sol. Water budget equation:

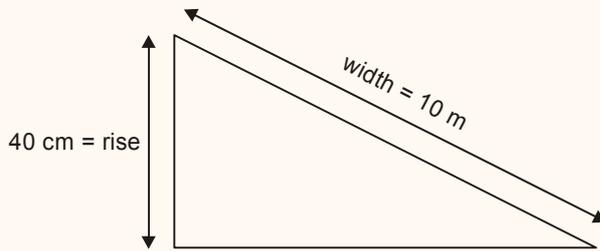
$$P - E - R - T - G = \Delta S$$

103. If the width of the highway is 10 m and its outer edge is 40 cm higher, the super elevation is 1 in

- (a) 50 (b) 20
(c) 25 (d) 40

Ans. (c)

Sol.



$$\begin{aligned} \text{Super elevation (e)} &= \frac{\text{rise}}{\text{width}} \\ &= \frac{0.4}{10} = \frac{4}{100} \\ &= \frac{1}{25} \end{aligned}$$

104. The observation of two photographs simultaneously is called

- (a) orthography (b) stereoscopy
(c) spectomy (d) spectrometry

Ans. (b)

Sol. In aerial photography, when two photographs overlaps on the same ground area is photographed from two saperate position forms a stereo-pair, used for three dimensional viewing.

105. Following errors are eliminated during reciprocal levelling

- (a) errors due to curvature only
(b) errors due to line of collimation
(c) errors due to refraction only
(d) error due to all above

Ans. (d)

Sol. Reciprocal levelling eliminates the need of applying correction due to curvature of earth, refraction and colimation error. It does not eliminates the parallax error.

106. In the centrifugal pumps, the Euler's head is independent of the following

- (a) Inlet radius of impeller
(b) Outer angular momentum
(c) Outlet velocity of triangle
(d) Outlet radius of impeller

Ans. (a)

Sol. Euler's head (H_e) = $\frac{Vw_2 u_2}{g}$

where

u_2 = tangential velocity of black at exit

Vw_2 = tangential component (whirl component) of absolute velocity at outlet

Hence it is dependent on outer angular momentum outlet velocity triangle and outlet radius of impeller.

107. Aerosol is known as

- (a) Carbon particles of microscopic size
(b) Finely divided particles of ash
(c) Diffused liquid particles
(d) Dispersion of solid or liquid particles in air

Ans. (d)

Sol. Aerosol refers to the disperson of solid or liquid particles of microscopic size in gaseous media, such as dust smoke or mist.

108. Based on '30th' hourly volume, for how much percent time during the year can the designer willingly tolerate the unfavourable oeprating conditions?

- (a) 0.33 (b) 30
(c) 5.0 (d) 2.5

Ans. (a)

Sol. 30th highest hourly volume is exceeded 29 hrs in a year is $\frac{29}{365 \times 24} \times 100\%$ of time is 0.33%

109. The ratio of the quantity of water stored in the

root zone of the crops to the quantity of water actually delivered in the field is known as

- (a) water conveyance efficiency
- (b) water use efficiency
- (c) water application efficiency
- (d) none of the above

Ans. (c)

Sol. Application efficiency

$$(\eta_a) = \frac{\text{Quantity of water stored in root zone } (W_s)}{\text{Quantity of water applied to the field}}$$

110. Which of the following is a secondary air pollutant?

- (a) Carbon monoxide
- (b) Smog
- (c) Fly ash
- (d) Carbon dioxide

Ans. (b)

Sol. • **Primary air pollutant** are those emitted directly from identifiable sources.

Example: Oxides of nitrogen, CO, CO₂, fly ash organic compound etc.

• **Secondary air pollutant** are those which are produced in the air by interaction among two or more primary pollutants or by the reaction with normal atmospheric constituents, with or without photoactivation.

Example: O₃, PAN (Peroxy acetyl nitrate) smog, H₂SO₄ etc.

111. If 5 day 20°C BOD of a waste water sample is 127 mg/L, then the 8 day 20°C BOD of the same sample is (if $K = 0.23d^{-1}$ (base e))

- (a) 146.3 mg/L
- (b) 166.3 mg/L
- (c) 162.6 mg/L
- (d) 156.3 mg/L

Ans. (d)

Sol. $BOD_5 = BOD_u (1 - e^{-kt})$

$$127 \text{ mg/l} = BOD_u (1 - e^{-5 \times 0.23})$$

$$BOD_u = 185.85 \text{ mg/l}$$

$$\text{then } BOD_8 = BOD_u (1 - e^{-8 \times 0.23})$$

$$= 156.33 \text{ mg/l}$$

112. The product of H⁺ ions and OH⁻ ions in a stronger Alkali is

- (a) 0
- (b) 10⁻¹⁴
- (c) 10⁻¹
- (d) 1

Ans. (b)

Sol. The product of molar concentration of H⁺ & OH⁻ ions in pure water or an aqueous solution at constant temperature is constant which is called the ionic product of water.

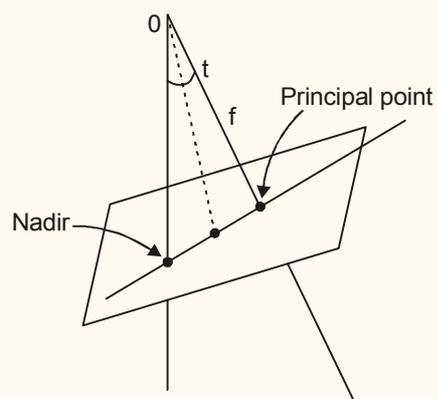
$$[H^+] [OH^-] = 10^{-14}$$

113. If 'f' is the focal length of camera and 't' is the tilt angle, distance of the photo nadir from the principal point will be

- (a) $t \sin \theta$
- (b) $t \cot \theta$
- (c) $t \tan \theta$
- (d) $t \cos \theta$

Ans. (c)

Sol.



Consider $\Delta ON \Delta$



$$\tan t = \frac{NP}{f}$$

$$\therefore NP = f \tan (t)$$

114. For analysis of direct runoff from a hydrograph, the relation $N = 0.827A^{0.2}$ is used. In this, the value of area 'A' is taken in units as

- (a) Cm^2 (b) ha^2
 (c) Km^2 (d) m^2

Ans. (c)

Sol. • In base flow separation, one of the hypothesis assumes the end of runoff to occur N days after the peak of hydrograph and N is given as

$$N = 0.827 A^{0.2}$$

where A is catchment area in km^2

115. Sludge bulking can be controlled by

- (a) Chlorination
 (b) Denitrification
 (c) Aeration
 (d) Coagulation

Ans. (a)

Sol. • Sludge with poor settling characteristics is termed bulking sludge.
 • Sludge bulking results in poor influent due to presence of excessive suspended solid and also in rapid loss of MLSS from tank.

Sludge bulking can be reduced by

- (i) Reducing sludge age
 (ii) Chlorination of returned activated sludge
 (iii) Addition of nutrient if it is less.

116. A hyetograph is a graphical representation of

- (a) Rainfall intensity and time
 (b) Commulative rainfall and time
 (c) Discharge and time
 (d) Rainfall depth and time

Ans. (a)

Sol. • Hyetograph is a histogram representing the variation of intensity of rainfall Vs time.

Note:

- Plot of commulative reainfall and time-mass curve
- Plot of discharge and time - Hydrograph

117. The maximum value of centrifugal ratio on roads and railways, respectively are taken as

(a) $\frac{1}{4}$ and $\frac{1}{6}$

(b) $\frac{1}{4}$ and $\frac{1}{8}$

(c) $\frac{1}{6}$ and $\frac{1}{8}$

(d) None of the above

Ans. (b)

Sol. The ratio of centrifugal force and weight is called centrifugal ratio

$$\text{Centrifugal ratio} = \frac{P}{w} = \frac{U^2}{gR}$$

Mode of transportation	Maximum centrifugal ratio
Road	$\frac{1}{4}$
Railway	$\frac{1}{8}$

118. An unconformity is

- (a) A surface of erosion or non-deposition as detected in a sequence of rocks
 (b) A type of joints especially associated with folded and faulted rocks
 (c) A layer of clay or shale in an igneous mass
 (d) A layer of boulders and pabbles in a sequence of rocks

Ans. (a)

Sol.

- An unconformity is a buried erosional or non-depositional surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous.

119. The zero graduation in a prismatic compass is marked in the,

- North end of the circle
- In the West end of the circle
- In the South end of the circle
- In the East end of the circle

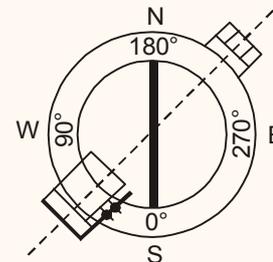
Ans. (c)

Sol. Prismatic Compass

The prismatic compass is a magnetic compass in which there is a prism for taking observations.

- The prismatic compass is generally smaller in size than a surveyor's compass.
- The prismatic compass consists of a circular box, about 85 to 100 mm diameter.
- The magnetic needle used in a prismatic compass is of broad in shape.
- An aluminum ring graduated in degrees and half degrees is directly attached with the needle.
- The graduations on the aluminium ring increase clockwise from 0° to 360°, with the zero of the graduations coinciding with the south end of the needle, 90° graduation is at the west, 180° graduation at the north and 270° graduation at the east as show below in the figure.
- The prismatic compass is used for the determination of the whole circle bearings (W.C.B.) of the lines.

- Readings are taken through a prism attached to the box.



- When the line of sight is exactly towards the north, the reading observed is 0°.
- When it points exactly to the east, the reading observed is 90°.
- It may be noted that in a prismatic compass, the sighting of the object and the reading of the bearing are done simultaneously, whereas in a surveyor's compass, first the object is sighted, and then reading of the bearing is taken by moving around the looking down from the glass cover.

120. The mechanical extra widening required for 10.5 m wide pavement on a horizontal curve of radius R meter is given by

- $\frac{\ell^2}{2R}$
- $\frac{3\ell^2}{2R}$
- $\frac{\ell^2}{R}$
- $\frac{2\ell^2}{3R}$

where, ℓ is the length of wheel base of the vehicle in meters

Ans. (b)

Sol. Mechanical widening = $\frac{n\ell^2}{2R}$

For width = 10.5 m

$n = 3$

Hence mechanical widening = $\frac{3\ell^2}{2R}$



121. The permissible error in chaining for measurement with chain on hilly terrain is

- (a) 1 in 100
- (b) 1 in 1000
- (c) 1 in 500
- (d) 1 in 250

Ans. (d)

Sol.

Chaining	Permissible error
Rough or hilly ground	1 in 250
Ordinary chain survey	1 in 1000
Steel tape	1 in 2000

122. Hypsometry is a method of

- (a) surveying of water bodies
- (b) determining elevation based on the boiling point of liquids
- (c) finding temperature at different height
- (d) measuring distance

Ans. (b)

Sol. **Hypsometry:** It is a method in which elevations are determined based on boiling point of liquid.

Note:

Method of levelling

Direct Levelling

- This is the most common method of levelling.
- In this method, a spirit level fixed to the telescope of a levelling instrument is used to make the line of sight horizontal. Then all the vertical distances are measured with respect to this horizontal line of sight. These vertical distances are used to determine the difference in elevations of various points. The direct levelling is also called as Spirit levelling.

Trigonometric Levelling.

- This is the method of levelling in which the difference of elevations is determined indirectly from the horizontal distance and the vertical angle. As the trigonometric relations are used to determine the elevations, the method is called as trigonometric levelling.

Barometric Levelling

- Barometric levelling is another type of indirect levelling in which the elevations of various points are determined indirectly from the changes in the atmospheric pressure. The atmospheric pressure decreases with an increase in elevation.

123. Which of the following is one of the factor influencing the provision of camber?

- (a) Topography
- (b) Drainage
- (c) Sub-grade characteristics
- (d) Amount of rainfall

Ans. (d)

Sol. • Camber is provided to drain off rain water from road surface.
• Greater is the rainfall greater is the slope of camber

124. Calculate the super elevation to be provided on the horizontal curve of radius 100 m. Design speed is 50 km/h and the design coefficient of lateral friction of 0.15 is fully developed.

- (a) 1.0
- (b) 0.047
- (c) 0.337
- (d) 0.917

Ans. (b)

Sol.
$$\frac{v^2}{gR} = \mu + e$$



$$\Rightarrow \frac{(0.278 \times 50)^2}{9.81 \times 100} = 0.15 + e$$

$$\Rightarrow e = 0.047$$

125. Indian Road Congress was formed in the following year

- (a) 1929 (b) 1943
(c) 1939 (d) 1934

Ans. (d)

Sol. • Indian Roads Congress (IRC) was set up by the Government of India in December, 1934 on the recommendations of Jayakar Committee with the objective of promoting and encouraging the science for building and maintenance of roads.