DETAILS EXPLANATIONS

Paper-2 (Paper-1)

[PART : A]

1. It is the ability of concrete due to which it can be placed such that a strong bond is developed between concrete and steel.

2. It is the property of lime by which it sets or hardens in damp places, water or thick masonry walls.

3. Fusion takes place in presence of lime and its excess causes brick to melt.

4. Innermost central portion or core of the tree is called the pith or medulla.

5. The length of the pipe from its entrance upto the point where flow attains fully developed velocity and which remains unaltered beyond that.

6. Datum Scale

$$N = \frac{f}{H} = \frac{20\times10^{-2}\times3.28}{2000\times1} = \frac{1}{3048}$$

7. Relief Displacement

$$d = \frac{rh}{H} = \frac{r_o h}{H-h} = \frac{Rfh}{H(H-h)}$$

8. Length of error / closing line

$$l = \sqrt{(\Sigma L)^2 + (\Sigma D)^2} = \sqrt{0.4^2 + 0.3^2} = 0.5 \text{ m}$$

$$\therefore \text{ Accuracy} = \frac{0.5\text{m}}{2\text{ km}} = \frac{1}{4000}$$

9. Altitude of any star is angular distance from horizon, measures on the vertical circle passing through the body.

10. Contour Interval = $\dfrac{25\text{m}}{\text{No. of cm per km}}$

$$\text{C.I.} = \frac{25}{10} = 2.5 \text{ m}$$

Scale 100 m = 1 cm

$$1000 \text{ m} = 10 \text{ cm}$$

$$1 \text{ km} = 10 \text{ cm}$$

11. $$\frac{V_1}{V_2} = \left(\frac{H_1}{H_2}\right)^{1/7}$$

$$\Rightarrow \quad \left(\frac{V}{9}\right) = \left(\frac{120}{12}\right)^{1/7}$$

$\Rightarrow$ Velocity of wind V = 12.50 m/sec

12. Stream flow (Discharge Measurement) methods :

(i) Area Velocity method

(ii) Moving Boat method

(iii) Slope area method

(iv) Dilution method

13. Peak Discharge :

$$Q_P = C_D A^{3/4}$$

$$Q_P = 20(10)^{3/4}$$

$$Q_P = 112.47 \text{ m}^3/\text{sec}$$

$\because$ A = 1000 ha

$= 1000 \times 10^4 \text{ m}^2 = 10 \text{ km}^2$

14. Printers Ink and Inamels are thixotropic fluids.

15. Absolute pressure = Atmospheric pressure - Vaccum pressure

$= 101325 - 7200 = 94125 \text{ N/m}^2$

16. (i) The force of buoyancy always acts through the centroid of liquid displaced.

(ii) Center of buoyancy is that point through which buoyant force acts.

17. $$V_{Th} = \sqrt{2gh}$$

$$V_{Th} = \sqrt{2 \times 9.81 \times 2.5} = 7 \text{ m/sec}$$

18. Treatments such as sedimentation, screening and essentially chemical precipitation are required. The suspended-solids should not be more than 60 ppm.

19. When inversion layer exists above the emission source as well as below the source.

20. When $L > SSD$

$$L = \frac{NS^2}{(\sqrt{2H} + \sqrt{2h})^2}$$

or when $L < SSD$

$$L = 2S - \frac{(\sqrt{2H} + \sqrt{2h})^2}{N}$$

[PART : B]

21. Level difference = 3.95 – 0.435 = 3.515 m

Combined correction = $0.06735\ d^2$

$= 0.06735 \times (1.3)^2 = 0.1138$ m (negative)

$\therefore$ True difference in elevation

$= 3.515 - 0.1138 = 3.4$ m

22. (i) Shrunk-Scale = Shrinkage factor×Original-scale

$$= \frac{9.7}{10} \times \frac{1}{1000}$$

$$\text{Shrunk-Scale} = \frac{1}{1030.97}$$

(ii) Present area of 100.2 sq. cm is equivalent to

$$\left(\frac{10}{9.7}\right)^2 \times 100.2 = 106.49 \text{ sq. cm}$$

So, Area = 106.49 × 100 = 10649 sq. m

23. **Statement of Two point Problem**

"Location of the position on the plan, of the station occupied by the plane table by means of observations to two well defined points whose positions have been previously plotted on the plan".

24.

S. No.	Chain	Length	No. of Links	Length Per Link
1.	Metric-chain	20 m 30 m	100 150	20 cm
2.	Engineering Chain	100 feet	100	1 feet
3.	Surveyor's Chain	66 feet	100	0.66 feet = 20 cm
4.	Revenue-Chain	33 feet	16	$2\frac{1}{16}$ feet

25. Properties of Good Mortar :

(i) It should be capable of developing good adhesion with the building units such as bricks, stones etc.

(ii) It should be capable of developing the designed strength.

(iii) It should be cheap

(iv) It should be durable.

(v) It should be easily workable.

(iv) It should set quickly so that speed in construction may be achieved.

26. First Class Bricks :

- These bricks are table moulded and of standard shape and they are burnt in kilns.
- The surfaces and edges of the bricks are sharp-square, smooth and straight.
- First-class bricks have all qualities of good bricks, these bricks are used for superior work of permanent nature.

27. For a rectangular weir :

$$Q = \left(\frac{2}{3}C_d L\sqrt{2g}\right)H^{3/2} = KH^{3/2}$$

$$dQ = \frac{3}{2}KH^{1/2}dH$$

$$\frac{dQ}{Q} = \frac{\frac{3}{2}KH^{1/2}dH}{KH^{3/2}} = \frac{3}{2}\frac{dH}{H}$$

$\because$ $\frac{dH}{H} = 1.5\%$

$\therefore$ Error in Discharge $= \frac{3}{2}\times 1.5 = 2.25\%$

28. Since flow is laminar and maximum velocity is required :

So, maximum Reynold's Number $R_e = 2000$

$$\Rightarrow \frac{\rho VD}{\mu} = 2000$$

$$\Rightarrow V = \frac{2000\times 0.01}{1\times 1}$$

$$\Rightarrow V = 20 \text{ cm/sec.}$$

29. By considering volumetric approach :

Water pumped = $S_y \times$ Area $\times$ Drawdown

$$S_y = \frac{\text{Water Pumpdown}}{\text{Area} \times \text{Drawdown}} = \frac{3.5 \times 10^6}{6.3 \times 10^6 \times 2.5} = 0.22$$

$S_y \simeq 22\%$

30. Total Water applied = $8 \times 3600 \times 6$

$= 172800\ m^3$

$$\text{Height of water applied} = \frac{\text{Water} - \text{Volume}}{\text{Area}}$$

$$= \frac{172800}{40 \times 10^4} = 0.432\ m = 43.2\ cm$$

$\therefore$ Field application efficiency

$$= \frac{30}{43.2} \times 100 = 70\%$$

31. **(i) Hydrolysis :** Particulate matter is converted to soluble compounds that can be hydrolysed further to simple monomers.

(ii) Fermentation (Acidogenesis) : Amino acids, sugars and some fatty acids are degraded further. Final products of fermentation (acetate, hydrogen and CO_2) are precursors of methane formation.

(iii) Methanogenesis : It is the formation of methane by microbes known as methanogens.

32. Sound pressure level (dB) = $20 \log_{10}\left(\frac{P}{P_o}\right)$

P is sound pressure in N/mm^2

P_0 is refrence pressure ($2 \times 10^{-5}\ N/m^2$)

For given sound pressure :

$P = 2000\ \mu$ bar

$= 2000 \times 10^{-6} \times 10^5\ N/m^2$

$= 200\ N/m^2$

$\therefore$ Sound pressure level

$$= \text{SPL} = 20 \log_{10}\left(\frac{200}{200 \times 10^{-5}}\right)$$

$$SPL = 20\log_{10}(10^7)$$

$$SPL = 20 \times 7 = 140 \text{ dB}$$

[PART : C]

33.

Line	F.B.	B.B.	$\lvert B.B. - F.B. \rvert$
AB	74°	254°	$=180°$
BC	91°	271°	$=180°$
CD	166°	343°	$\neq 180°$
DE	177°	0°0'	$\neq 180°$
EA	189°	9°	$=180°$

So, point A, B, C and E are free from local attraction because the lines containing points A, B, C and E have the difference of fore and back bearing is equal to 180°.

And points D is affacted from local attraction.

To find corrected bearings :

Line	Bearing	Correction	Corrected Bearing
AB	74°0'	0° at A	74°0'
BA	254°0'	0° at B	254°0'
BC	91°0'	0° at B	91°0'
CB	271°0'	0° at C	271°0'
CD	166°0'	0° at C	166°0'
DC	343°0'	+3° at D	346°0'
DE	177°0'	+3° at D	180°0'
ED	0°0'	0° at E	0°0'
EA	189°0'	0° at E	189°0'
AE	9°0'	0° at A	9°0'

The correction at points A, B, C and E are 0° because these are free from local attraction.

34. ***Errors in Chain/Tape Surveying :***

1. Erroneous Length of Chain / Tape :

This type of errors are cumulative and can be eliminated if detected.

So the length of chain/tape is checked time to time. It may be positive or negative.

2. Bad Ranging :

If the chain/tape is streched out of the line, the measured distance will always be more and hence the error will be positive and cumulative. The error is not very serious in ordinary work if only length is required.

3. Bad straightening :

If the chain is lying ir-regular horizontal curve, the error is cumulative positive. In this error the measured distance will always be too great.

4. Non Horizontality:

This error is also cumulative and positive, since the chain/tape is laid on sloping ground.

5. Sag in chain :

If there is sag in chain/tape the error is always cumulative positive because the measured distance is greater than actual distance.

6. Variation in Temperature :

When a chain is used at temperature different from that at which it was caliberated, its length changes. So, due to fall in temperature, length decreases error is negative and vice-versa.

7. Variation in Pull (Compensating or Cumulative) :

If the pull applied in straightening the chain or tape is not equal to that of the standard pull at which it was calibrated, its length changes. If the pull applied is not measured but is ir-regular (sometimes more, sometimes less), the error tends to compensate.

8. Personal Mistakes :

Personal mistakes always produce quite ir-regular effects. The following are the most common-mistakes :

(i) Displacement of Arrows

(ii) Miscounting chain length

(iii) Mis-Reading

(iv) Erroneous Booking

35. Concrete exhibit it's properties both in plastic and hardened stages. Both are important for construction purposes.

(a) Properties in Plastic Stage :

(i) Consistency : It is a measure of the stiffness or sloppiness or fluidity of the mix. For effective handling, placing and compacting the concrete, consistency must be the same for each batch.

(ii) Workability : It is the relative ease with which concrete can placed, compacted and finished without any segregation of the individual materials. It is not the same thing as consistency.

(iii) Settlement and Bleeding : Cement and aggregate particles have densities about three times that of water.

In fresh concrete, they consequently tend to settle and displace mixing water which migrates upward and may collect on the top surface of the concrete.

(iv) Plastic Shrinkage : If water is removed from the compacted concrete before it sets, the volume of the concrete is reduced by the amount of water removed. This volume reduction is called 'Plastic Shrinkage'.

(v) Slump-loss : From the time of mixing, fresh concrete gradually losses consistency. This gives rise to the problems only if the concrete becomes too stiff to handle.

(b) Properties of Hardened Stage :

(i) Strength : When we refer to concrete strength, we generally talk about compressive strength of concrete. Because concrete is strong in compression but relatively weak in tension and bending. Compressive strength mostly depends upon amount and type of cement used in concrete mix.

(ii) Creep : Deformation of concrete structure and under sustained load is defined as concrete creep.

(iii) Durability : It might be defined as the ability to maintain satisfactory performance over and extended service life.

(iv) Shrinkage : It is the volume decreased of concrete caused by drying and chemical change. In another words the reduction of volume for the setting and hardening of concrete is defined as shrinkage.

(v) Modulus of Elasticity : It depends on the concrete ingredients and their mix proportions.

$$E_C = 5000\sqrt{f_{ck}}$$

(vi) Water - Tightness : Another property of concrete is water tightness. Sometime, it is called impermeability of concrete. It increases durability.

36. Groynes or spurs are the structures constructed transverse to the river flow extending from the bank into the river.

Groynes may be aligned either perpendicular to the bank line or at an angle pointing upstream or downstream.

These are also known as spur dikes or transverse dikes and constitutes the most widely used river training works.

According to function served by the groynes these may be classified as:

1. ***Attracting Groynes :*** A groyne pointing downstream tends to attract the river flow towards the bank on which it is provided and hence it is called an attracting groyne. It safeguards the opposite bank against the attack of the current as they attract the current towards the bank adjacent to them.

2. ***Repelling Groyne :*** A groyne pointing upstream tends to repell the river flow away from the bank on which it is provided and hence it is called a repelling groyne.

As compared to attracting Groynes, Repelling groynes are more effective and do not cause any trouble. As such repelling Groynes are commonly used for the purpose of river-training and bank-protection.

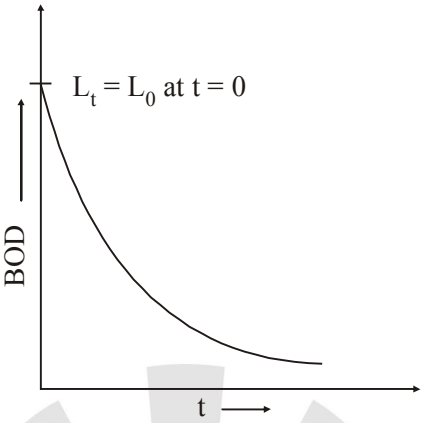
3. ***Deflecting Groynes :*** A groyne either perpendicular to the bank or pointing slightly upstream and having a relatively short length tends to only deflects the flow with repelling it and hence it is called a deflecting Groyne, it however gives only local protection.

4. ***Sedimenting Groyne :*** A groyne which dampens the velocity of flow and thus causes deposition of sediments carried by the river without repelling or deflecting the flow, is called a sedimenting Groyne.

37. $BOD_5 = 280$ mg/lt

$BOD_u = 410$ mg/lt

The relationship between ultimate BOD and BOD remains after 't' time in days is given by



$$\frac{dL_T}{dt} = -K \cdot L_t$$

K = The rate of oxidation of organic matter

L_t = BOD after t days

t = Time in days

$$\Rightarrow \int_{L_0}^{L_T} \frac{dL_T}{dt} = \int K L_T$$

$$\Rightarrow (\log_e L_T - \log_e L_0) = -Kt$$

$$\Rightarrow \log_e\left(\frac{L_T}{L_0}\right) = -Kt$$

$$\Rightarrow \frac{L_T}{L_0} = e^{-Kt}$$

$$\Rightarrow L_T = L_0 e^{-Kt}$$

$$\Rightarrow BOD = L_0 - L_T$$

$$\Rightarrow BOD = L_0 - L_0 e^{-Kt}$$

$$BOD = L_0(1 - e^{-Kt})$$

$$\Rightarrow 280 = 410(1 - e^{-Kt})$$

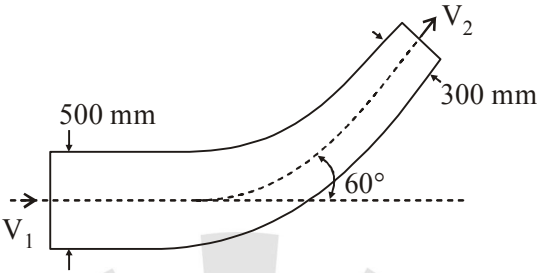
$$\Rightarrow e^{-Kt} = 1 - \frac{280}{410}$$

$$\Rightarrow e^{-K.5} = 0.317$$

$\Rightarrow \quad -5K = -1.14$

$\Rightarrow \quad K = 0.2297 \text{ / day}$

38.



Pressure $P_1 = 180 \text{ Kg/cm}^2$

$\Rightarrow \quad P_1 = 176.58 \text{ kN/m}^2$

The flow is 900 lit./sec

By continuity equation Discharge

$$Q = A_1V_1 = A_2V_2$$

$$\Rightarrow 900 \times 10^{-3} = \frac{\pi}{4}(0.5)^2V_1 = \frac{\pi}{4}(0.3)^2V_2$$

$\Rightarrow \quad V_1 = 4.58 \text{ m/sec}$

$V_2 = 12.7324 \text{ m/sec}$

Since there is no data available hence neglecting frictional-loss and by applying bernoulli's equation

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g}$$

$$\Rightarrow \frac{176.58 \times 10^3}{9810} + \frac{(4.58)^2}{2 \times 9.81} = \frac{P_2}{9810} + \frac{(12.732)^2}{2 \times 9.81}$$

So, $P_2 = +106.04 \text{ kN/m}^2$

By applying the Impulse-momentum equation on both X and Y-direction.

For X-direction

$$176.58 \times \frac{\pi}{4} \times (0.5)^2 - 106.04 \times \frac{\pi}{4}(0.3)^2 \cos 60° - R_X = 0$$

$R_x = -6.97 \text{ kN}$

$R_x = 6.97$ kN [(–)X direction]

For Y-direction

$$R_Y - 106.04 \times \frac{\pi}{4}(0.3)^2 \sin 60° = 0$$

$R_y = 72.12$ kN [(+)X-direction]

$\Rightarrow$ Which acts to the right angle 'α' with X-axis.

$$\alpha = \tan^{-1}\left(\frac{-6.97}{72.12}\right)$$

$$\alpha = -5°31' = 174°48'$$

Resulting $R = \sqrt{R_x^2 + R_y^2}$

$$R = \sqrt{(-6.97)^2 + (72.12)^2}$$

$R = 72.45$ kN

39. Specific gravity of lubricating oil = 0.85

Dynamic-Viscosity = 0.01×9.81 N/m²

$= 0.0981$

$d = 3$ cm

Pressure Drop in pipe = 14715 N/m²

$$\Rightarrow \quad \frac{\Delta P}{\Delta L} = \frac{32\mu V}{D^2} = \frac{32 \times 0.0981 \times V}{9 \times 10^{-4}}$$

$$\Rightarrow \quad V = \frac{14715 \times 9 \times 10^{-4}}{32 \times 0.0981}$$

$$\Rightarrow \quad V = 4.2187 \text{ m/s}$$

Mass flow rate = ρaV

$= 850 \times 0.785 \times 3^2 \times 10^{-4} \times 4.2187$

$= 2.5334$ kg/sec

$$\text{Reynold's Number} = \frac{\rho V d}{\mu} = \frac{850 \times 4.2187 \times 3 \times 10^{-2}}{0.01 \times 9.81} = 1097$$

Power-required to maintain flow = $(\Delta P) = \rho Q g h_f$

$$\text{Head loss } (h_f) = \frac{\Delta P}{\rho g} = \frac{40 \times 0.15 \times 9.81 \times 10^4}{850 \times 9.81} = 70.56$$

Power Required = $\rho . a . V . g . h_f$