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TSPSC - 2020

HMWSSB (Manager)

Hyderabad Metropolitan Water Supply and Sewerage Board

QUESTIONS WITH DETAILED SOLUTIONS

CIVIL ENGINEERING

PAPER-II

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TSPSC - HMWSSB 2020 (PAPER - II)

Civil Engineering

Questions with Detailed Solutions



01. Outlets which maintain a constant discharge irrespective of the fluctuations in the water supply channel and water course is known as

- (a) Semi modular outlet
- (b) Kennedy's gauge outlet
- (c) Rigid module
- (d) Non-modular outlet

01. Ans: (c)

Sol: In a rigid module, Q is constant irrespective of fluctuations on u/s & d/s.

02. The rate of seepage (q) through an earth dam obtained from a flow net is given by the following equation

- (a) $q = kh \left(\frac{N_f}{N_d} \right)$
- (b) $q = k \left(\frac{N_f}{N_d} \right)$
- (c) $q = kh (N_f \times N_d)$
- (d) $q = h \left(\frac{N_f}{N_d} \right)$

Where,

k = coefficient of permeability of soil,

h = total head causing the flow,

N_f = total number of flow channels,

N_d = total number of potential drops.

02. Ans: (a)

Sol: $q = kh \frac{N_f}{N_d}$

Applicable only for isotropic soils.

03. Lacey's general regime flow equation is given by the following equation

- (a) $V = 35.5 \left(\frac{R}{S} \right)^{1/2} \sqrt{RS}$
- (b) $V = 10.8 R^{2/3} S^{1/2}$
- (c) $V = \frac{1}{6} R^{2/3} S^{1/2}$
- (d) $V = 1260 R^2 S$

Where,

S = bed slope, r = hydraulic mean radius in meter.

03. Ans: (b)

Sol: $V = 10.8 R^{2/3} S^{1/2}$

The three Lacey's equations are

1. $V = \sqrt{\frac{2}{5} fR}$

2. $Af^2 = 140V^5$

3. $V = 108 fR$

04. Identify from the following which Indian code book is used for determination of evaporation from reservoirs.

- (a) 6966-1989
- (b) 6926-1973
- (c) 6939-1992
- (d) 6955-1973

04. Ans: (c)

Sol: Methods for determination of evaporation from reservoirs.

05. Water is released at the rate of 12 cumec at the head of a canal. If duty at the field is 1250 hectares/cumec and loss of water in transmit is 0.25%. Find the area of the land that can be irrigated in hectares.

- (a) 1.125×10^4
- (b) 1.125×10^2
- (c) 1.125×10^8
- (d) 1.125×10^6

05. Ans: (*)

Sol: (**Note:** A loss of water in transmit is to be mentioned 0.25 only.

$Q_{H.C} = 12 \text{ cumcs}$

$D_f = 1250 \text{ ha/cumecs}$

Losses = 0.25 = 25%

$\eta = 75\%$ (efficiency)

$Q_g = 75\% \times 12 = 9 \text{ cumc}$

$Q = \frac{A}{D}$

$A = Q \times D = 9 \times 1250 = 11250 \text{ ha}$

$= 1.1250 \times 10^4 \text{ ha}$

06. From which river the water has been lifting to Konda Pochamma reservoir?

- (a) Godavari (b) Musi
(c) Kaleswaram (d) Krishna

06. Ans: (a)

Sol: On river Godavari.

07. The total hardness value obtained from the complete analysis of a water sample is found to be 117 mg/l. The analysis further showed that the concentrations of all the three principal cations causing hardness are numerically same. Value of the carbonate hardness is 57 mg/l. Calculate the value of non-carbonate hardness is

- (a) 6 mg/l (b) 117 mg/l
(c) 50 mg/l (d) 60 mg/l

07. Ans: (d)

Sol: Total hardness = 117 mg/l

Carbonate hardness = 57 mg/l

Non-carbonate hardness = ?

TH = CH + NCH

117 = 57 + NCH

NCH = 60 mg/l

08. Units of turbidity is

- (a) Nephelometric turbidity units
(b) Threshold number
(c) Gram/l
(d) Unit less

08. Ans: (a)

09. Identify water distribution system among the following:

- (a) Reticulation system
(b) Radial system
(c) Combined gravity and pumping system
(d) Tree system

09. Ans: (b)

10. During certain period the load on the hydel power plant varies from 15000 to 35000 kW. Calculate the load factor.

- (a) 0.510 (b) 0.810
(c) 0.620 (d) 0.7143

10. Ans: (d)

Sol: Load factor = $\frac{\text{Average load}}{\text{Peak load}}$

$$= \frac{15000 + 35000}{2} = \frac{25000}{2} = 12500$$

$$= \frac{12500}{35000} = \frac{25}{70} = \frac{5}{14} = 0.3571$$

11. A gate consists of two leaves of timber or steel hinged and sealed to the spillway crest is called as _____

- (a) tainter gate
(b) rolling gate
(c) bear-trap gate
(d) drum gate

11. Ans: (a)

Sol: tainter gate or Radial gate

12. Consider the following items

- A. Intakes
B. Water treatment plant
C. Service reservoirs
D. Control valves
E. Hydrants

Choose the correct answer related to components of public water supply system:

- (a) A, B, C and D only
(b) A, B, C, D and E only
(c) A, B and C only
(d) A, C and D only

12. Ans: (b)

Sol: All of them given in the question are part & parcel of water supply system.



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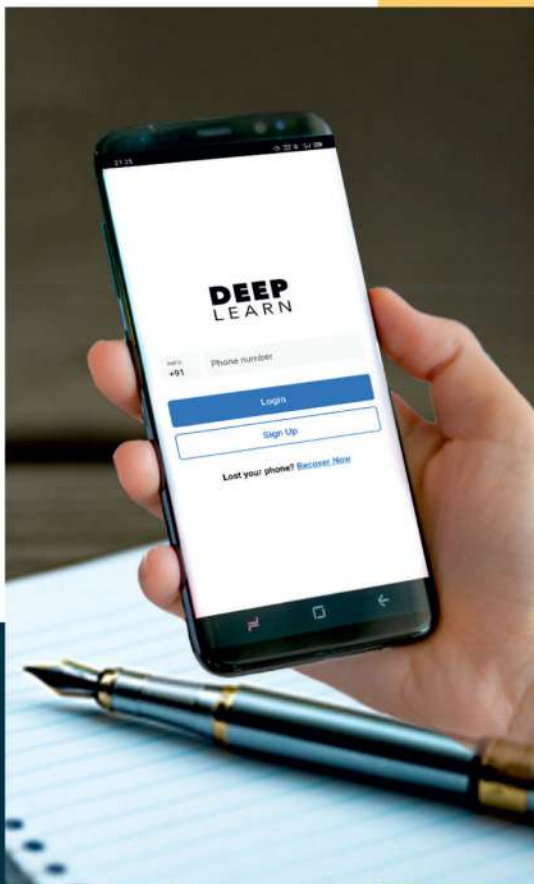
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13. The horizontal flow velocity in a sedimentation tank passing a discharge 'Q' and having length 'L', width 'B' and depth 'H' is given by

(a) $\frac{Q}{B \times L}$ (b) $\frac{Q}{L \times H}$ (c) $\frac{Q}{BH}$ (d) $\frac{Q}{BL}$

13. Ans: (c)

Sol: $V_H = \frac{Q}{c/s \text{ area}} = \frac{Q}{B \times H}$

14. Particulate matter (fly ash) carried in effluent gasses from the furnaces burning fossils fuels are better removed by

- (a) Cotton bag house filter
 (b) Electrostatic precipitator
 (c) Wet scrubber
 (d) Cyclone

14. Ans: (b)

Sol: Flyash from thermal power stations effectively removed by Electrostatic precipitator.

15. Two primary air pollutants are

- (a) Sulphur oxide and hydrocarbons
 (b) Ozone and peroxyacety nitrate
 (c) Sulphur oxide and ozone
 (d) Nitrogen oxygen and peroxyace tylnitarte

15. Ans: (a)

Sol: Among the given two primary ait pollutions are SO_x & HC.

16. The design technique adopted in design of large water supply networks as an aid to supply and separate the smaller loops is

- (a) Circle method
 (b) Hardy cross method
 (c) Electric network analyzer method
 (d) Equivalent pipe method

16. Ans: (b)

Sol: Complex pipe networks consisting the closed loops solved by Hardy cross method.

17. Which valve is placed in a pumping main so that if pump fails or stops, water is prevented from flowing back to the pump and thus pumping equipment is saved from possible damage?

- (a) reflex valve
 (b) air relief value
 (c) sluice valve
 (d) pressure relief valve

17. Ans: (a)

Sol: To prevent back blow reflux valve is provided

18. **Assertion (A):** Slow sand filters are more efficient in removal of bacteria than rapid sand filters.

Reason (R): The sand used in slow sand filters is finer than that in rapid sand filters.

Select correct answer based on the coding system given below:

- (a) A is true but R is false
 (b) A is false but R is true
 (c) Both A and R are true and R is the correct explanation of A
 (d) Both A and R are true and R is not the correct explanation of A

18. Ans: (c)

Sol: Slow sand filter media consists sand grains of very fine size could able to trap even microorganisms i.e Bacteria & higher forms of life.

19. According to Indian Roads Congress, the maximum width of road vehicles is

- (a) 2.00 m (b) 3.8 m
 (c) 2.65 m (d) 2.44 m

19. Ans: (d)

20. In which year Motor Vehicle Act was brought into effect by Government of India to regulate the road traffic in the form of traffic laws, ordinances and regulations.

- (a) 1949 (b) 1939
(c) 1959 (d) 1929

20. Ans: (b)

21. The second twenty year road development plan 1961-81 is also called as _____

- (a) Bombay Road Plan (b) Nagpur Road Plan
(c) Lucknow Road Plan (d) Delhi Road Plan

21. Ans: (a)

Sol: 1943-63 Nagpur Road Plan
1961-81 Bombay Road Plan
1981-2001 Lucknow Road Plan

22. What type of noise can be abated by providing lining on walls and ceiling with sound absorbing materials?

- (a) Reflection noise (b) Structural noise
(c) Direct air borne noise (d) Source noise

22. Ans: (a)

Sol: Reflection noise is controlled by (or) Abuted by providing ceiling as wells with noise absorbing material.

23. Read the following statements related to road alignment:

- A. Improper alignment would result in increase in construction cost
B. Improper alignment would result in increase in maintenance cost
C. Improper alignment would result in decrease in vehicle operation cost
D. Improper alignment would result in increase in accident rate.

Identify the WRONG statement:

- (a) C only (b) D only
(c) A only (d) B only

23. Ans: (c)

Sol: Good alignment reduces vehicle operation, maintenance and construction costs.

24. The required camber of a pavement depends on

- A. the type of pavement surface
B. the amount of rainfall
C. longitudinal slope of the road
D. traffic volume

Identify the correct statement:

- (a) A and D only (b) A, B, C and D
(c) A and B only (d) A and C only

24. Ans: (c)

Sol: Camber Depends on

- i. Type of road surface ii. Rainfall

25. Indian railways is the world leader in the manufacture of which type of sleepers?

- (a) Concrete (b) Steel
(c) Cast iron (d) Wooden

25. Ans: (a)

Sol: Indian railways is the world leader in producing prestress concrete sleepers. Appropriate answer is concrete sleepers (among given options).

26. Identify the correct formula for the calculation of safe speed on transitioned curves for broad gauge and meter gauge in km/h using the following equation.

- (a) $V = 2.4 \sqrt{R - 70}$
(b) $V = 4.4 \sqrt{R - 70}$
(c) $V = 4.4 \sqrt{D - 70}$
(d) $V = 2.4 \sqrt{D - 70}$

26. Ans: (b)

Sol: Safe speed on transition curve is

For BG & MG $V = 4.4 \sqrt{R - 70}$

27. Wear on rails is more prominent at some locations. Study the following points related to this

- A. On sharp curves
- B. On steep gradients
- C. On approaches to railway stations
- D. In tunnels and coastal areas

Identify the correct statement from the following

- (a) A, B, C and D only
- (b) A, C, and D only
- (c) A, B and C only
- (d) A, B and D only

27. Ans: (a)

Sol: Wear on rails is more prominent on

- A. Curves due to super elevation.
- B. Steep gradients due to impact.
- C. On approaches to railway sections (due to braking effect)
- D. In tunnels (Pollution) and in costal areas (corrosion) effect

28. Calculate the safe stopping distance for design speed of 36 kmph for two way traffic on a two lane road. Assume coefficient of friction as 0.25 and reaction time of driver as 2.5 seconds.

Take $g = 10 \text{ m/sec}^2$

- (a) 45 m
- (b) 40 m
- (c) 20 m
- (d) 25 m

28. Ans: (a)

Sol: $V = 36 \text{ kmph} = 10 \text{ m/s}$

Two lane (T/W)

$f = 0.25$

$t = 2.5 \text{ sec}$

$g = 10 \text{ m/sec}^2$

$$\text{SSD} = vt + \frac{v^2}{2gf}$$

$$= 10 \times 2.5 + \frac{10 \times 10}{2 \times 10 \times 0.25}$$

$$= 25 + 20 = 45 \text{ m}$$

29. What is the maximum contact shear stress (F) at the contact point between the wheel and the rail is given by the empirical formula

- (a) $4.13 \left(\frac{R}{P} \right)^{1/2}$
- (b) $2.13 \left(\frac{R}{P} \right)^{1/2}$
- (c) $4.13 \left(\frac{P}{R} \right)^{1/2}$
- (d) $2.13 \left(\frac{P}{R} \right)^{1/2}$

Where R is the radius of the fully worn out wheel in mm, P is the static wheel load.

29. Ans: (c)

Sol: Maximum contact shear stress (F) at the contact point between wheel and rail is given by

$$F = 4.13 \left[\frac{P}{R} \right]^{1/2}$$

R = Radius of fully worn out wheel

P = Wheel load

30. Calculate the rate of super-elevation for a horizontal highway curve of diameter 1000, and speed 50 kmph

- (a) 0.22
- (b) 0.0022
- (c) 0.25
- (d) 0.022

30. Ans: (*)

Sol: Super elevation

$$R = \frac{D}{2} = \frac{1000}{2} = 500 \text{ m}$$

$V = 50 \text{ kmph}$

$$e = \frac{V^2}{127R} = \frac{50^2}{127(500)} = 0.04$$

31. The critical hydraulic gradient for a soil with a grain specific gravity 'G' and void ratio 'e' is given by the following equation.

- (a) $\frac{G-1}{1+e}$
- (b) $\frac{G+e}{1-e}$
- (c) $\frac{G+e}{1+e}$
- (d) $\frac{G+1}{1+e}$

31. Ans: (a)

Sol: $i_c = \frac{G-1}{1+e}$

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32. One cubic meter of wet soil weights 19.80 kN. If the specific gravity of soil particle is 2.70 and water content is 1%. Find the dry unit weight of the soil.

- (a) 1.8 kN/m³ (b) 1.8 N/m³
(c) 18 kN/m³ (d) 18 N/m³

32. Ans: (*)

Sol: (Note: In Question, water content should be 10%)

$$V = 1 \text{ m}^3 \quad W = 19.80 \text{ kN}$$

$$G = 2.7$$

$$\gamma = \frac{W}{V} = 19.80 \text{ kN/m}^3$$

$$\gamma_d = \frac{\gamma}{1 + w} = \frac{19.80}{1 + 0.1} = 18 \text{ kN/m}^3$$

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

List-I (Term)

- A. Porosity
B. Air content
C. Void ratio
D. Degree of saturation

List II (Definition)

- P. Ratio of the volume of air void to the total volume of voids
Q. Ratio of the volume of voids to the volume of solids
R. Ratio of the volume of water in the voids to the volume of voids
S. Ratio of volume of voids to the total volume of the soil mass

Identify the correct match

- | A | B | C | D |
|-------|---|---|---|
| (a) S | P | R | Q |
| (b) S | Q | P | R |
| (c) S | Q | R | P |
| (d) S | P | Q | R |

33. Ans: (d)

Sol: List -I

List-II

- | | |
|-------------------------|----------------------|
| A. Porosity | S. $\frac{V_v}{V}$ |
| B. Air content | P. $\frac{V_a}{V_v}$ |
| C. Void ratio | Q. $\frac{V_v}{V_s}$ |
| D. Degree of saturation | R. $\frac{V_w}{V_v}$ |

34. If k_x and k_z are the permeabilities in the X and Z directions respectively in a two dimensional flow situation, the effective permeability k_e is given by

- (a) $\frac{k_z}{k_x}$ (b) $k_x + k_z$
(c) $\sqrt{k_x k_z}$ (d) $\frac{k_x}{k_z}$

34. Ans: (c)

Sol: $k_e = \sqrt{k_x \cdot k_z}$

35. The stress at failure on the failure plane in cohesion less soil mass were: shear stress = 3 kN/m², Normal stress = 4 kN/m². Determine the resultant stress on the failure plane.

- (a) 4 kN/m² (b) 7 kN/m²
(c) 3 kN/m² (d) 5 kN/m²

35. Ans: (d)

Sol: $\tau_f = 3 \text{ kN/m}^2$

$$\sigma = 4 \text{ kN/m}^2$$

$$\sigma_R = \sqrt{\sigma^2 + \tau_f^2}$$

$$= \sqrt{4^2 + 3^2} = 5 \text{ kPa}$$

36. Strap footing is also called

- (a) combined foundation
(b) pile foundation
(c) pump handle foundation
(d) raft foundation

36. Ans: (a)

37. The time factor for a particular average degree of consolidation

- (a) is independent of the distribution of initial excess hydrostatic pressure
- (b) depends upon the distribution of initial excess hydrostatic pressure
- (c) depends upon the drainage path
- (d) depends upon the coefficient of consolidation

37. Ans: (*)

Sol: **Note:** The question should be like this.

The time factor for a particular degree of consolidation is,

$$\text{Time factor, } T_v = \frac{C_v \cdot t}{d^2}$$

It depend on coefficient of consolidation

It depends on drainage path.

It is independent of the distribution of excess hydrostatic pressure.

Then (a), (c), (d) are correct.

38. Read the following statements related to compaction of soil

- A. Compaction increases the dry density of soil
- B. Compaction increases its shear strength
- C. Compaction decrease the tendency for settlement of the soil
- D. Compaction brings high permeability of the soil

Identify the correct statement from the following:

- (a) A and D only
- (b) A, B, C only
- (c) A, B and D only
- (d) A, C and D only

38. Ans: (b)

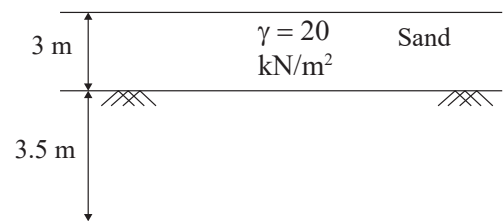
Sol: Compaction reduces permeability of soil so, option is (b).

39. A sand fill compacted to a bulk density of 20 kN/m^3 is to be placed on a compressible saturated marsh deposit 3.5 m thick. The height of the sand fill is to be 3 m . If the volume compressibility of the deposit is $7 \times 10^{-4} \text{ m}^2/\text{kN}$. Estimate the final settlement of the soil

- (a) 14.70 mm
- (b) 1.47 mm
- (c) 147 mm
- (d) 1470 mm

39. Ans: (a)

Sol:



$$m_v = 7 \times 10^{-4} \text{ m}^2/\text{kN}$$

$$\therefore \Delta \sigma' = q = r \times 3$$

$$= 20 \times 3 = 60 \text{ kPa}$$

$$S_f = m_v \cdot H \cdot \Delta \sigma'$$

$$= 7 \times 10^{-4} \times 3.5 \times 60$$

$$= 0.147 \text{ m} = 147 \text{ mm}$$

40. In a semi-infinite homogenous isotropic material, the electrical resistivity is measured using the following equation

- (a) $2\pi D \frac{I}{E}$
- (b) $\pi D \frac{I}{E}$
- (c) $2\pi D \frac{E}{I}$
- (d) $\pi D \frac{E}{I}$

Where D = distance between electrodes in m, E = potential drop between the inner electrodes (Volts) and I = current flowing between the outer electrodes (A).

40. Ans: (c)

41. Who is the father of modern soil mechanics?

- (a) Newmark
- (b) Terzaghi
- (c) Rankin
- (d) Cassagrande

41. Ans: (b)

42. Working out the exact quantities of various items of work is known as

- (a) quantity surveying
- (b) valuation
- (c) estimating
- (d) mensuration

42. **Ans: (a)**

Sol: Quantity surveying is the process of finding out exact quantities of different items of work, so answer is (1) quantity surveying

After finding out exact quantities we multiply them with unit rates (found out from rate analysis or SSR) to get detailed estimate.

43. The quantity of wood for the shutters of doors and windows is measured in

- (a) m^3 (b) lumpsum
(c) m (d) m^2

43. **Ans: (d)**

Sol: Units of measurement for shutters of doors and windows is done in m^2 .

44. Newmark influence chart is applicable to the following soil mass.

- A. Semi-infinite
B. Homogenous
C. Isotropic
D. Elastic

Identify the correct statement:

- (a) A, C and D only (b) A, B, C and D
(c) A, B and C only (d) A and B only

44. **Ans: (b)**

45. Rebhann's graphical method is based on

- (a) Culmann's theory (b) Coulomb's theory
(c) Rankin's theory (d) Westergaard's theory

45. **Ans: (b)**

46. The geophone is

- (a) an electromechanical device that detects vibrations and converts them into measurable electric signals.
(b) to measure the magnitude of the velocity
(c) useful for drawing a bore well lag
(d) to measure the electrical resistivity of soil

46. **Ans: (a)**

47. To determine the whole volume formed by given sections over a given length, the Prismoidal formula can be applied

- (a) only when the number of sectional areas are even
(b) only for the three sections at a time
(c) irrespective of the number of sectional area being odd or even
(d) only when the number of sectional areas are odd

47. **Ans: (d)**

Sol: The prismoidal formula is applicable when there is an odd number of sections.

48. Read the following statements:

- A. Lead is the average horizontal distance between site of earthwork and the area of disposal
B. Lift is the average vertical distance between level of excavation to the place of spreading or heaping
C. Lift is the average horizontal distance between site of earthwork and the area of disposal
D. Lead is the average vertical distance between level of excavation to the place of spreading or heaping

Identify the correct statement:

- (a) A and C only (b) A and D only
(c) A and B only (d) C and D only

48. **Ans: (c)**

Sol: Lead is the average horizontal distance and lift is the average vertical distance.

This terminology is commonly used in movement of earth(soil), meaning transport of soil from borrow pit to embankment and also while compacting the embankment in different layers.

49. Identify the size of standard modular bricks in cms

- (a) $12 \times 6 \times 6$ (b) $12 \times 12 \times 6$
(c) $19 \times 9 \times 9$ (d) $19 \times 19 \times 9$



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49. Ans: (c)

Sol:



Standard size $(19 \times 9 \times 9) \text{ cm}^3$



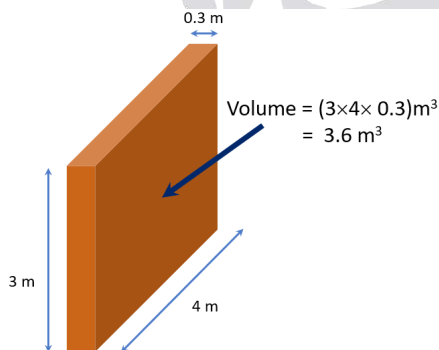
Nominal size $(20 \times 10 \times 10) \text{ cms.}$

50. Estimate the cost of brickwork for a wall 4 m long, 3 m high and 30 cm thick. The rate of brick work is Rs 320/m³.

- (a) Rs. 115.2 (b) Rs. 1,152
(c) Rs. 1, 15, 200 (d) Rs. 11,520

50. Ans: (b)

Sol:



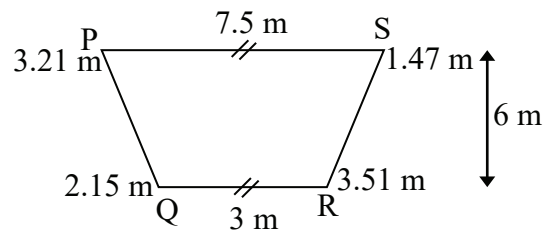
Estimate = Quantity \times Rate
= $3.6 \times 320 = 1152$ Rupees

51. P, Q, R and S are four points at the corners of an excavation. The heights of the excavation at the four points are 3.21 m, 1.47 m, 2.15 m and 3.51 m. PS and QR are parallel sides of lengths 3 m and 7.5 m respectively. The vertical distance between PS and QR is 6m. Find the volume the excavation.

- (a) 81.42 m³ (b) 814.2 m³
(c) 8142 m³ (d) 8.142 m³

51. Ans: (a)

Sol:



$$V = A \times \left(\frac{h_1 + h_2 + h_3 + h_4}{4} \right)$$

$$= (7.5 + 3) \frac{6}{2} \left(\frac{3.21 + 2.15 + 3.51 + 1.47}{4} \right)$$

$$= 81.4275 \text{ m}^3$$

52. A scale of 1 cm = 5 km is represented as a representative fraction is

- (a) 1 : 5000 (b) 1 : 500000
(c) 1 : 5000000 (d) 1 : 500

52. Ans: (B)

Sol: 1 cm = 5 KM

$$1 \text{ cm} = 5 \times 1000 \text{ m}$$

$$= 5 \times 1000 \times 100 \text{ cm}$$

$$1 : 500000$$

53. A 30 m chain was tested before a survey and found to have a length of 30.3 m. If the length of a line measured with this chain was 290 m, find the true length of the line.

- (a) 292.90 m (b) 290.30 m
(c) 290.0 m (d) 287.70 m

53. Ans: (a)

Sol: $\ell = \ell' \left(\frac{L'}{L} \right)$

$$= 290 \times \frac{30.3}{30}$$

$$= 292.90 \text{ m}$$

54. A prism square is used to
- set an enlarged view of station marks
 - Marking of survey stations
 - check the alignment of survey lines
 - set a line at right angles to a survey line

54. Ans: (d)

Sol: Instruments used to set-out right angles in chain survey

- Cross-staff
- Site – Square
- Prism – Square
- Optical square

55. Identify WRONG statement from the following:

- In Prismatic compass, reading are taken from the South end.
- In surveyors compass, readings are taken from North end.
- Prismatic compass measures whole circle bearings
- Surveyors compass measures whole circle bearing

55. Ans: (d)

Sol: Surveyor's Compass

- Measures reduced bearings
- Uses edge bar type needle
- 0° @ N & S
 90° @ E & W but E & W are interc
- Tripod is essential

56. The formwork which is used for vertical structural member such as columns, RCC walls etc known as
- formwork
 - shuttering
 - staging
 - centering

56. Ans: (b)

Sol: The formwork (shuttering) serves as mould for concrete structural components



57. The joints of the brick work shall be raked out to a depth of 20 mm and the surface of the wall washed and cleaned and kept wet for two days. This process is known as

- soiling
- plastering
- jointing
- pointing

57. Ans: (d)

Sol: For preparing the brick surface for Pointing, first all the joints in masonry are raked down to a depth of 20 mm while the still soft. The joints and surface are cleaned and then thoroughly wetted.

58. The following are related to units of measurements for various items and materials.

Identify the WRONG pair:

- Rock excavation – m^3
- Damp proof course – m^3
- Thin partition wall – m^2
- Sand filling – m^3

58. Ans: (b)

Sol: Damp proof course has a fixed thickness and it is measured in m^2 .

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

List – I (Quadratic bearing)		List – II (Whole circle bearing)	
1.	N 60°25' E	P	94° 30'
2.	S 85° 30' E	Q	277° 15'
3.	S 64° 30' W	R	244° 30'
4	N 82° 45' W	S	60° 25'

Identify the correct match:

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

59. Ans: (a)

Sol: $N 60^{\circ}25' E \Rightarrow 60^{\circ} 25'$

$S 85^{\circ} 30' E \Rightarrow 180^{\circ} - 85^{\circ}30' = 94^{\circ} 30'$

$S 64^{\circ} 30' W \Rightarrow 180^{\circ} + 64^{\circ} 30' = 244^{\circ}30'$

60. The daily variation of the position of the magnetic needle as it points to the North is called as

- (a) Diurnal variation
- (b) Annual variation
- (c) Irregular variation
- (d) Secular variation

60. Ans: (a)

Sol: Diurnal variation – 24 hours

Annual variation – 365 days

Secular variation – 250 – 300 yrs

Irregular variation – Random

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

List – I (Terms)			List – II (Definitions)
1	Telescope axis	P.	It is the line joining the intersection of the cross hairs to the optical centre of the object glass and its continuation
2	Line of Collimation	Q.	It is the operation of changing from free left to face right and vice versa
3	Face left observation	R.	It is the line joining the optical centre of the object glass to the centre of the eye piece
4	Changing face	S.	Setting the theodolite exactly over the station mark
5	Centering	T.	It is the reading taken when the instrument is in the inverted or face right position.

Identify the correct match:

	1	2	3	4	5
(a)	R	P	T	Q	S
(b)	R	P	T	S	Q
(c)	R	P	S	T	Q
(d)	R	P	S	Q	T

61. Ans: (*)

Sol: **Telescope Axis** : line joining the optical centers of eye-piece of objective.

Line of Collimation: Line joining intersection of cross hair to optical enter of objective and its continuation.

Face Left: Vertical circle towards left face of the observer.

Changing face: Changing from face left to face right of vice – versa

Centering: Settling instrument above station on ground.

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62. A total station can measure
- horizontal angles only
 - vertical angles only
 - distances electrically only
 - horizontal and vertical angles and distances

62. Ans: (d)

Sol: Basic measurement of Total station

- Horizontal angle
 - Vertical angle
 - Sloping distances
63. The number of satellites used in global positioning system operated by the US department of defence is
- 30
 - 7
 - 18
 - 24

63. Ans: (d)

Sol: GPS requires 24 active satellites in 6 fixed orbits.

64. Determine the radius of a curve if it is designated as 30 curve as 30 m arc. $\pi = 3.14$
- 583.25 m
 - 593.25 m
 - 563.25 m
 - 573.25 m

64. Ans: (*)

Sol: $D = 30^\circ$ (30 M)

$$R = \frac{1719}{D^\circ} = \frac{1719}{30^\circ} = 57.3 \text{ m}$$

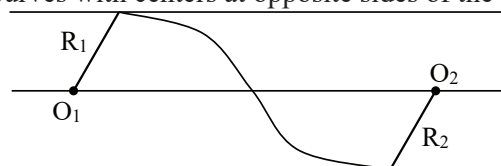
If $D = 3^\circ$ (30 m)

$$R = \frac{1719}{3^\circ} = 573 \text{ m}$$

65. A reverse curve is one
- where the simple circular curve is set from the second tangent point in the reverse direction
 - having two simple circular curves with centres in opposite directions.
 - having circular and half cubic parabola as a compound curve.
 - with a simple circular curve and a transition curve.

65. Ans: (b)

Sol: A reverse curve is a combination of 2 circular curves with centers at opposite sides of the curve.



66. Electromagnetic distance measurement measuring instruments are uses
- radiation frequencies like X rays
 - radiation frequencies from visible light to microwaves
 - radio waves
 - radiation frequencies like gamma rays

66. Ans: (b)

Sol: EDM

- Electro – optic instruments: uses modulated light waves
 - Microwave emitting instruments
 - Infra-red emitting instruments
67. Some of the minerals are listed below
- | | | |
|-----------|-----------|-------------|
| P. Talc | Q. Gypsum | R. Fluorite |
| S. Quartz | T. Diamon | U. Calcite |
- Identify correct sequence hardness of minerals from soft to hard
- P, U, Q, R, S and T
 - P, Q, R, U, S and T
 - P, Q, U, R, S and T
 - P, Q, U, S, R and T

67. Ans: (c)

Sol: The standard set of ten reference minerals used to determine the hardness of any unknown mineral is called Mohs' scale of hardness. The actual minerals of the set and their hardness are as follows:

Talc = 1;	Feldspar = 6;
Gypsum = 2;	Quartz = 7;
Calcite = 3;	Topaz = 8;
Fluorite = 4;	Corundum = 9;
Apatite = 5;	Diamond = 10;

Thus Talc is the least hard mineral and Diamond is the hardest mineral.

68. Identify the **WRONG** pair based on chemical characteristics of rock
- (a) Calcareous – principal component is lime
 - (b) Calcareous – principal component is Clay
 - (c) Argillaceous – principal constituent is clay
 - (d) Siliceous – principal component is silica

68. Ans: (b)

Sol: Chemically Calcareous rocks are mainly composed by calcium carbonate.

69. Consider the following statements of preparation of brick earth.

- | | |
|--------------|---------------|
| P. Digging | Q. Weathering |
| R. Tempering | S. Moulding |
| T. Blending | U. Un-soiling |

Identify the correct sequence of these operations for preparation of brick earth

- (a) U, Q, P, T, R and S
- (b) U, P, T, Q, R and S
- (c) U, P, Q, T, R and S
- (d) U, P, Q, T, S and R

69. Ans: (c)

Sol: In the preparation of brick earth, the correct sequence of operations are

- (a) Unsoiling
- (b) Digging
- (c) Weathering
- (d) Blending
- (e) Tempering
- (f) Moulding.

70. What is efflorescence?

- (a) Formation of white patches on the brick surface due to insoluble salts in the brick clay
- (b) Impurities in the brick clay which show after burning
- (c) Swelling of brick due to presence of carbonaceous matter and gas
- (d) Deformation of brick due to exposure to rain

70. Ans: (a)

Sol: Efflorescence is the formation of white patches on the brick surface due to insoluble salts in the brick clay.

71. What is the example for the stratified rock from the following?

- | | |
|------------|--------------|
| (a) Basalt | (b) Laterite |
| (c) Slate | (d) Granite |

71. Ans: (c)

Sol: Stratified rocks are consisting of different layers in its structure and these layers are separated by planes of stratification. These planes are also called cleavage planes or bedding planes. These rocks can easily split up along these bedding planes.

Majority of slates are formed by the dynamic metamorphism of shales. Their characteristic slaty cleavage may or may not be parallel to the bedding planes of the original shales.

72. The percentage bulking for fine aggregate is calculated using the following formula.

(a)
$$\frac{\text{Bulked volume} - \text{Dry volume}}{\text{Bulked Volume}} \times 100$$

(b)
$$\frac{\text{Dry volume}}{\text{Bulked volume}} \times 100$$

(c) $\frac{\text{Bulked volume} - \text{Dry volume}}{\text{Dry volume}} \times 100$

(d) $\frac{\text{Bulked volume}}{\text{Dry volume}} \times 100$

72. **Ans: (c)**

Sol: % Bulking =

$$\frac{\text{Bulked Volume} - \text{Dry Volume}}{\text{Dry Volume}} \times 100$$

73. The difference in 7 days compressive strength of cubes/cylinders prepared with impure and pure waters should not differ by more than

- (a) 8% (b) 15%
(c) 12% (d) 10%

73. **Ans: (d)**

Sol: The difference in 7 days compressive strength of cubes and cylinders prepared with impure and pure waters should not differ by more than 10%.

74. The upper limit of suspended particles in water for the preparation of concrete is

- (a) 2000 rpm (b) 200 rpm
(c) 2500 rpm (d) 500 rpm

74. **Ans: (a)**

Sol: The upper limit of suspended particles in water for the preparation of concrete as per IS 456:2000 is 2000 ppm.

75. The operations involved in obtaining minerals are called as

- (a) Mining
(b) Excavation
(c) Wedging
(d) Quarrying

75. **Ans: (a)**

Sol: Mining is the extraction of valuable minerals or other geological materials from the Earth, usually from an ore body, lode, vein, seam, reef or placer deposit.

76. The Ordinary Portland Cement (OPC) has been classified into the following types of cement

- (a) OPC33, OPC 43 and OPC53 only
(b) OPC33, OPC43, OPC53 and OPC63 only
(c) OPC33 only
(d) OPC33 and OPC43 only

76. **Ans: (a)**

Sol: Ordinary Portland Cement is classified into three grades i.e., 33, 44 and 53 grades.

77. Identify correct pair from the following:

Chemical

component of OPC

Function

- | | |
|-----------------------------|---------------------------------|
| (a) Fe_2O_3 | Responsible for quick setting |
| (b) SiO_2 | Imparts colour |
| (c) CaO | Controls strength and soundness |
| (d) Al_2O_3 | Gives colour |

77. **Ans: (c)**

Sol: Lime (CaO) controls the Strength and Soundness aspects of cement.

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

List – I (Admixtures)		List – II (Chemicals)	
1.	Water reducing admixture	P.	Sulphonated melanin
2.	Air entering agent	Q.	Calcium chloride
3.	Super plasticizer	R.	Lingosulphonate
4.	Accelerator	S.	Neutralised Vinsol resin

Identify the correct match:

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

78. Ans: (a)

Sol: Lignosulphonate is a plasticizer i.e., a water reducing admixture, Resins act as Air Entraining Agents, Sulphonated Melamine Formaldehyde is a Super Plasticizer and Calcium Chloride is an accelerator.

79. The maturity of concrete is defined as
- the product of time and temperature
 - the product of time and curing time
 - the summation of product of time and temperature
 - the summation of time and temperature

79. Ans: (c)

Sol: Maturity of concrete is the summation of product of Curing Period (Time) and Curing Temperature.

80. Read the following statements related to concrete:
- A round spherical or cubical shaped aggregate when computed contains less voids and higher strength than an irregular aggregate of the same nominal size.
 - High strength concrete gives lower strength as compared to lean concrete if larger size aggregate is used.
 - The larger aggregates have lower total surface area and require lower water to cement ratio resulting in higher strength
 - Large size aggregates give heterogeneous concrete causing non-uniform distribution of load when stressed.

Identify the correct statement:

- P, Q and S only
- P, Q, R, and S
- P, Q and R only
- P and Q only

80. Ans: (b)

81. What is the characteristic compressive strength of 150 mm cube at 28 days for M40 grade
- 40 N/cm²
 - 40 kN/m²
 - 40 N/mm²
 - 40 N/m²

81. Ans: (c)

Sol: The characteristic compressive strength of 150mm cube at 28 days for M40 grade is 40 N/mm².

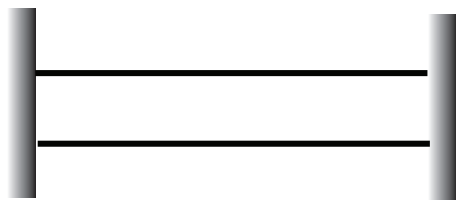
82. Identify FALSE statement from the following:
- Modulus of resilience is defined as the proof resilience of a matter per unit volume
 - Modulus of resilience is calculated using $\frac{\sigma^2}{4E}$ equation, where σ = stress induced in the body
 - The total strain energy stored in a body is commonly known as resilience
 - The maximum strain energy stored in a body is known as proof resilience

82. Ans: (b)

83. A rod is 2 m long at a temperature of 10°C and temperature is raised to 80°C. If expansion is prevented, find the stress induced in the material of the rod. Take $E = 1.0 \times 10^5$ MN/m² and $\alpha = 0.000012$ per degree centigrade.
- 96 N/mm²
 - 84 MN/mm²
 - 84 N/cm²
 - 84 N/mm²

83. Ans: (d)

Sol:



$$L = 2 \text{ m}, t_i = 10^\circ\text{C}, t_f = 80^\circ\text{C}, \Delta T = 80 - 10 = 70^\circ\text{C}$$

$$E = 1.0 \times 10^5 \frac{\text{MN}}{\text{m}^2} = 1.0 \times 10^5 \frac{\text{N}}{\text{mm}^2}$$

$$\alpha = 0.000012^\circ/\text{C}$$

$$\sigma = E\alpha\Delta T$$

$$= 1.0 \times 10^5 \times 0.000012 \times 70 = 84 \frac{\text{N}}{\text{mm}^2}$$

84. Identify the correct pair from the following?

- (a) Factor of safety: Ratio between ultimate stress to shear stress
- (b) Lateral strain: Ratio of increase in the length to the length of the body
- (c) Poisson's ratio: Ratio of lateral strain to the longitudinal strain
- (d) Pascal's law: The relationship between stress and strain for a unidirectional stress.

84. Ans: (c)

Sol: Poisson's ratio = $\left| \frac{\text{lateral strain}}{\text{longitudinal strain}} \right|$

85. The modulus of elasticity (E) and modulus of rigidity (C) are related by

(a) $C = \frac{3(m-2)}{mE}$

(b) $C = \frac{2(m+1)}{mE}$

(c) $C = \frac{mE}{3(m-2)}$

(d) $C = \frac{mE}{3(m+1)}$

Where $1/m = \text{Poisson's ratio}$

85. Ans: (d)

Sol: We have $E = 2G(1 + \mu)$

$$\Rightarrow E = 2C \left(1 + \frac{1}{m} \right)$$

$$E = 2C \left(\frac{m+1}{m} \right)$$

$$C = \frac{mE}{2(m+1)}$$

86. For a given material, Young's modulus is $1.5 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio is $1/4$. Calculate the Bulk modulus

- (a) $1 \times 10^5 \text{ N/mm}^2$
- (b) $0.8 \times 10^5 \text{ N/mm}^2$
- (c) $1 \times 10^5 \text{ N/cm}^2$
- (d) $0.5 \times 10^5 \text{ N/mm}^2$

86. Ans: (a)

Sol:

$$E = 1.5 \times 10^5 \frac{\text{N}}{\text{mm}^2} \quad \mu = \frac{1}{4}$$

$$E = 3K(1 - 2\mu)$$

$$1.5 \times 10^5 = 3K \left(1 - 2 \left(\frac{1}{4} \right) \right)$$

$$1.5 \times 10^5 = 3K(0.5)$$

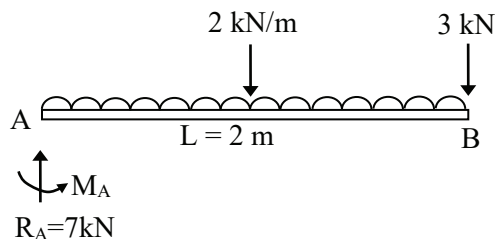
$$K = \frac{1.5 \times 10^5}{3 \times 0.5} = 1 \times 10^5 \frac{\text{N}}{\text{mm}^2}$$

87. A cantilever beam of length 2 m carries a uniformly distributed load of 2 kN/m over the whole length and a point load of 3 kN at the free end. Calculate the maximum shear force and bending moment.

- (a) 7 N and 10 N-m
- (b) 7 N and 10 kN-m
- (c) 7 kN and 10 kN-m
- (d) 7 kN and 10 N-m

87. Ans: (c)

Sol:



$$\oplus \uparrow \sum F_y = 0$$

$$-3 - (2 \times 2) + R_A = 0$$

$$R_A = 3 + 4 = 7 \text{ kN}$$

$$\therefore \text{S.F.}_A = R_A = 7 \text{ kN}$$

$$\sum M_A = 0$$

$$3 \times 2 + (2 \times 2) \times \frac{2}{2} - M_A = 0$$

$$M_A = 6 + 4 = 10 \text{ kN-m}$$

$$\text{B.M.}_A = M_A = 10 \text{ kN-m (Hog)}$$

88. Read the following statements and identify the WRONG statement from the following. These are related to theory of simple bending with assumptions

- Each layer of the beam is free to expand or contract.
- The transverse sections which were plane before bending remain plane after bending also
- The material of the beam is homogeneous and isotropic.
- The value of Young's modulus of elasticity is not equal in tension and compression.

88. Ans: (d)

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

List – I (Cross section)		List – II (Section Modulus)	
1.	Rectangular	P.	$\frac{1}{6D}(BD^3 - bd^3)$
2.	Circular	Q.	$\frac{\pi}{32D}(D^4 - d^4)$
3.	Hollow Rectangular	R.	$(BD^2/6)$
4.	Hollow Circular	S.	$(\pi D^3/32)$

Where 'D' is outer diameter and 'd' is the inner diameter.

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

89. Ans: (a)

90. Read the following:

- Polar modulus is defined as the ratio of the polar moment of inertia to radius of the shaft
- Polar modulus is also called as section modulus
- Polar modulus of a solid circular shaft is calculated using $\frac{\pi}{16}D^3$ formula
- Polar modulus of a hollow circular shaft is calculated using $\frac{\pi}{16D}(D^4 - d^4)$ Identify the correct statement from the following:
 - 2 and 3 only
 - 1 and 4 only
 - 1 and 2 only
 - 1 and 3 only

90. Ans: (b and d)

Sol: Polar section modulus $(Z_P) = \frac{J}{r_{\max}}$

$$(Z_P)_{\text{solid}} = \frac{J}{r_{\max}} = \frac{\frac{\pi}{32} D^4}{\left(\frac{D}{2}\right)} = \frac{\pi}{16} D^3$$

$$(Z_P)_{\text{Hollow}} = \frac{\frac{\pi}{32} (D^4 - d^4)}{\left(\frac{D}{2}\right)} = \frac{\pi}{16D} (D^4 - d^4)$$

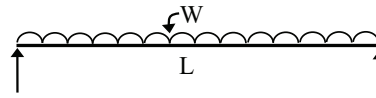
Statements 1, 3, 4 are Correct

91. Identify the correct pair from the following:

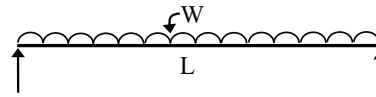
- (a) Maximum slope of a simply supported beam carrying a UDL of $W/\text{unit length}$ over the entire span $-\frac{WL^3}{34EI}$
- (b) Maximum deflection of a simply supported beam carrying a UDL of $W/\text{unit length}$ over the entire span $\frac{5WL^4}{284EI}$
- (c) Slope at the supports of a simply supported beam (length = L) carrying a point load (W) at the center $-\frac{WL^2}{64EI}$
- (d) Deflection at the center of a simply supported beam (length = L) carrying a point load (W) at the center $-\frac{WL^3}{48EI}$

91. Ans: (d)

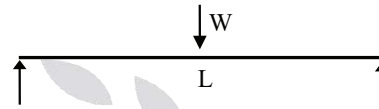
Sol:



$$\theta_{\max} = \frac{WL^3}{24EI}$$



$$y_{\max} = \frac{5WL^4}{384EI}$$



$$\theta_{\max} = \frac{WL^2}{16EI}$$



$$y_{\max} = \frac{WL^3}{48EI}$$

92. A leaf spring carries a central load of 3000 N. The leaf spring is to be made of 10 steel plates each 5 cm wide and 6 mm thick. Length of the spring is 600 mm and $E = 2 \times 10^5 \text{ N/mm}^2$. If the bearing stress is limited to 150 N/mm^2 . Determine the deflection at the center of the spring.

- (a) 11.25 mm (b) 1.25 mm
(c) 12.25 mm (d) 15.25 mm

92. Ans: (a)

Sol: $W = 3000 \text{ N}$, $n = 10$, $b = 5 \text{ cm} = 50 \text{ mm}$, $t = 6 \text{ mm}$, $L = 600 \text{ mm}$, $E = 2 \times 10^5$

$$(\sigma_b)_{\max} = 150 \frac{\text{N}}{\text{mm}^2}$$

$$\therefore \Delta_{\text{centre}} = \frac{3}{8} \frac{WL^3}{Enbt^3}$$

$$= \frac{3}{8} \times \frac{3000 \times (600)^3}{2 \times 10^5 \times 10 \times 50 \times 6^3} = 11.25 \text{ mm}$$

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93. The crippling load for a column by Euler's formula for different end conditions is given. Identify the correct pair from the following pairs

- (a) When one end is fixed and the other is free $-\frac{4\pi^2 EI}{\ell^2}$
- (b) When one end is fixed and the other is hinged
 – When both the ends are hinged $-\frac{\pi^2 EI}{2\ell^2}$
- (c) When both the ends are hinged $-\frac{\pi^2 EI}{\ell^2}$
- (d) When both the ends are fixed $-\frac{\pi^2 EI}{4\ell^2}$

93. **Ans: (c)**

Sol:

Fix - free \rightarrow	$\hat{P}_B = \frac{\pi^2 EI}{4L^2}$	$(\because L_e = 2L)$
Fix - Hinge \rightarrow	$\hat{P}_B = \frac{2\pi^2 EI}{L^2}$	$(\because L_e = \frac{L}{\sqrt{2}})$
Hinge - Hinge \rightarrow	$\hat{P}_B = \frac{\pi^2 EI}{L^2}$	$(\because L_e = L)$
Fix - Fix \rightarrow	$\hat{P}_B = \frac{4\pi^2 EI}{L^2}$	$(\because L_e = \frac{L}{2})$

94. Read the following with respect to the analysis of frames:

- (1) If the number of members in a frame is less than $(2j-3)$ then the frame is known as deficient frame.
- (2) If the number of members in a frame is more than $(2j-3)$ then the frame is known as redundant frame.
- (3) If the number of members in a frame is equal to $(2j-3)$ then the frame is known as perfect frame.

Identify the correct statement from the following:

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

94. **Ans: (c)**

Sol: If $m = 2j - 3 \rightarrow$ Perfect frame

If $m > 2j - 3 \rightarrow$ Redundant frame

If $m < 2j - 3 \rightarrow$ Deficient frame

95. Identify the expression useful for the calculation of circumferential stress for a given thin cylinder.

- (a) $\frac{pd}{2t}$ (b) $\frac{pd}{6t}$ (c) $\frac{pd}{8t}$ (d) $\frac{pd}{4t}$

Where p = internal pressure, d = internal diameter of the cylinder, t = thickness of the wall of the cylinder

95. **Ans: (a)**

96. Identify the equations for the calculations of radial pressure (P_x) and hoop stress (σ_x) at any radius 'x' in case of a thick cylinder are

$$(a) P_x = \frac{b}{x^2} - 2a \quad \sigma_x = \frac{b}{x^2} + 2a$$

$$(b) P_x = \frac{b}{x^2} - 2a \quad \sigma_x = \frac{b}{x^2} - 2a$$

$$(c) P_x = \frac{b}{x^2} - a \quad \sigma_x = \frac{b}{x^2} + a$$

$$(d) P_x = \frac{b}{x^2} + a \quad \sigma_x = \frac{b}{x^2} - a$$

96. **Ans: (c)**

97. Muller Breslau's principle for obtaining influence lines is applied to

- (1) Statically determinate beams and frames
- (2) Statically indeterminate structures
- (3) Statically indeterminate structures, the material of which is elastic and follows Hook's law.

Identify the correct statement

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

97. **Ans: (a)**

Sol: Muller Breslau's principle used to draw qualitative ILD for any structure either statically determinate and indeterminate structures, the material of which is elastic and follows Hook's law.

98. The ratio of the actual length of a column to the least radius of gyration of the column is known as

- (a) Slenderness ratio (b) Section modulus
(c) Crippling stress (d) Polar modulus

98. **Ans: (a)**

Sol: Slenderness ratio = $\frac{\text{Effective length}}{\text{Least radius of gyration}}$

99. A mild steel bar of 706 mm² area and length 2.4 m is subjected to a tensile load of 90 kN. Find the strain energy stored in the bar, if the load is applied gradually.

- (a) 68.838 Nm (b) 688.3 J
(c) 68838.5 Nm (d) 6883.85 Nmm

99. **Ans: (a)**

Sol: $A = 706 \text{ mm}^2$, $L = 2.4 \text{ m} = 2400 \text{ mm}$,

$$P = 90 \times 10^3 \text{ N}$$

$$U_{\text{GAL}} = \frac{P^2 L}{2EA}$$

$$= \frac{(90 \times 10^3)^2 \times 2400}{2 \times 2 \times 10^5 \times 706} \quad (\because E_{\text{steel}} = 2 \times 10^5)$$

$$= 68838.526 \text{ N-m}$$

$$= 68.838 \text{ N-m}$$

100. Read the following statements related to continuous beams:

1. Clapeyron's theorem of three moment's method is used for the analysis of continuous beams.
2. The moment distribution method is an iterative technique and is very useful in analysing continuous beams
3. Continuous beams have to be designed for much less bending moments than those in the case of simply supported beams.

4. Maximum bending moment is generally over the supports.

Identify the correct statements

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

100 **Ans: (b)**

Sol:

- Clapeyron's theorem provides a simple method to analyse continuous beams
- Continuous beams are statically indeterminate structure and simply supported beam are statically determinate structure. Indeterminate structure has less BM compared to determinate structure.

101. A compression member may be considered as short when both slenderness ratios $\frac{l_{ex}}{D}$ and $\frac{l_{ey}}{b}$ are less than

- (a) 12 (b) 14
(c) 10 (d) 6

Where l_{ex} = effective length in respect of the major axis, l_{ey} = effective length in respect of the minor axis, D = depth in respect of the major axis, b = width of the member.

101. **Ans: (a)**

Sol: As per IS:456-2000, if it is said to be a short column then its slenderness ratio $\left(\frac{Le_x}{D} \text{ and } \frac{Le_y}{b}\right)$ shall be less than (or) equal to 12.

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

List-I		List-II	
A.	Fineness	P.	Indicates the degree or stiffness of cement
B.	Consistency	Q.	It is the stage when the paste completely loses its property
C.	Final Setting	R.	It refers to the ability of the cement paste to retain its volume after setting
D.	Soundness	S.	The overall particles size distribution of cement

Identify the correct match

A B C D

(a) S P R Q

(c) S R P Q

A B C D

(b) S R Q P

(d) S P Q R

102. Ans: (d)

Sol: Fineness indicates the overall particle size distribution of cement particles. Consistency indicates the degree of density or stiffness of cement paste, Final Setting is the stage when the cement paste completely loses its plasticity and soundness is the ability of the cement paste to retain its volume after setting.

103. Assuming that the concrete is uncracked, compute the bending stress in the extreme fibers of the beam having a size of 600 mm × 300 mm for a bending moment of 60 kNm

(a) 33.3 MPa

(b) 3.33 MPa

(c) 0.33 MPa

(d) 333 MPa

103. Ans: (b)

Sol: When the section is uncracked then the whole section is considered in the analysis

$$\frac{m}{I} = \frac{f}{y} = \frac{E}{R} \rightarrow \text{(Simply bending equation)}$$

$$\text{Bending stress, } f = \frac{m}{I} \cdot y$$

$$= \frac{m}{z} = \frac{60 \times 10^6}{\frac{1}{6} \times 300 \times 600^2}$$

$$= 3.33 \text{ MPa}$$

m: BM

$$z : \text{Section modulus} = \frac{I}{y} = \frac{\frac{bD^3}{12}}{\frac{D}{2}} = \frac{1}{6} bD^2$$

104. The maximum strain in the tension reinforcement in the section at failure shall not be less than

(a) $\frac{1.15f_y}{E_s} + 0.002$

(b) $\frac{f_y}{1.15E_s} + 0.0002$

(c) equal to 0.0035

(d) $\frac{f_y}{1.15E_s} + 0.002$

f_y = characteristic strength of steel,

E_s = Modulus of elasticity of steel

104. Ans: (d)

Sol: As per IS:456-2000, the maximum strain in the tension reinforcement shall not be less than $0.002 + \frac{f_y}{1.15E_s}$

105. Which Indian code book is used for the design of water tanks (storage of liquids)

(a) IS 456

(b) IS 13920

(c) IS 3370-2

(d) IS 1786

105. Ans: (c)

Sol: IS:456 : code of practice for plain and reinforced concrete

IS:13920: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice.

IS:3370: Concrete structures for storage of liquids - code of practice.

IS:1786 : High strength deformed steel bars and wires for concrete reinforcement.

106. Equivalent shear shall be calculated for shear and tension by using the following formula:

- (a) $V_e = V_u + 1.6 T_u/b$ (b) $V_e = 1.6 T_u/b$
(c) $V_e = V_u + T_u/b$ (d) $V_e = 1.6 V_u + T_u/b$

Where,

V_e = equivalent shear, V_u = shear,

T_u = torsional moment, b = breadth of beam.

106. Ans: (a)

Sol: Equivalent shear force can be estimated by the following formula $V_e = V_u + \frac{1.6T_u}{b}$

107. The minimum thickness of braced wall as per IS 456 is

- (a) 120 mm (b) 80 mm
(c) 250 mm (d) 100 mm

107. Ans: (d)

Sol: As per IS:456-2000, the minimum thickness of wall is 100 mm.

108. Lap splices shall not be used for bars larger than

- (a) 46 mm (b) 36 mm
(c) 38 mm (d) 40 mm

108. Ans: (b)

Sol: As per IS:456-2000, splicing should not be done if bar diameter is more than 36 mm.

109. Development length of bars can be calculated using the following formula

- (a) $\frac{\sigma_s}{4\tau_{bd}}$ (b) $\frac{\phi\sigma_s}{2\tau_{bd}}$
(c) $\frac{\phi\sigma_s}{\tau_{bd}}$ (d) $\frac{\phi\sigma_s}{4\tau_{bd}}$

where ϕ = nominal diameter of the bar,

σ_s = stress in the bar at the section considered at design load,

τ_{bd} = design bond stress.

109. Ans: (d)

Sol: The development length can be estimated by the following formula

$$L_d = \frac{\phi\sigma_{st}}{4\tau_{bd}}$$

where ϕ = bar diameter

σ_{st} ; Design stress in steel

τ_{bd} = Average bond stress

110. In case of RCC footings, the minimum cover should be

- (a) 40 mm (b) 50 mm
(c) 60 mm (d) 25 mm

110. Ans: (b)

Sol: As per IS:456-2000, the minimum cover provided for the footing is 50 mm

111. Side face reinforcement shall be provided on both sides if the depth of the beam exceeds in mm

- (a) 650 (b) 400
(c) 750 (d) 500

111. Ans: (c)

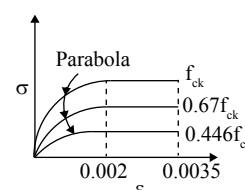
Sol: Side face reinforcement shall be provided in a beam subjected to flexure when the depth of web exceeds 750 mm.

112. The shape of the stress-strain curve of concrete up to a strain 0.002 is

- (a) parabolic (b) hyperbolic
(c) exponential (d) linear

112. Ans: (a)

Sol: The stress-strain curve for concrete is parabola upto 0.002 strain and constant till failure.



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113. Which method is used for calculating the loss of pre-stress due to creep of concrete?

- (a) Pre-stress coefficient method
- (b) Magnitude coefficient method
- (c) Creep coefficient method
- (d) Coefficient method

113. Ans: (c)

Sol: Loss of prestress due to creep of concrete can be determined from the following

1. Ultimate creep strain method
2. Creep coefficient method

114. Concrete in which pre-stress is imparted to concrete through bond between the tendons and surrounding concrete is known as

- (a) limited pre-stressing
- (b) pre-tensioning
- (c) bonded pre-stressed concrete
- (d) full-pre-stressing

114. Ans: (b)

Sol: In pretensioning method the stresses are transferred through bond.

115. What is the unit mass of steel?

- (a) 7850 kg/m³
- (b) 6850 kg/m³
- (c) 9850 kg/m³
- (d) 8850 kg/m³

115. Ans: (a)

Sol: The unit weight of steel is 7850 kg/m³

116. The minimum number of longitudinal steel bars in helically reinforced RCC columns must be

- (a) 4
- (b) 10
- (c) 6
- (d) 8

116. Ans: (c)

Sol: Helical reinforcement is provided in circular columns only.

As per IS:456-2000, minimum no of longitudinal bars in circular column are 6.

117. According to IS 456, the thickness of RCC footing on soils at its edges is kept not less than

- (a) 175 mm
- (b) 300 mm
- (c) 100 mm
- (d) 150 mm

117. Ans: (d)

Sol: As per IS:456-2000, the minimum edge thickness of footing when it is resting on soil is 150 mm.

118. Which code book gives guidelines for concrete mix design proportioning

- (a) IS 13920:1993
- (b) IS 1893:2002
- (c) IS 10262:2009
- (d) IS 4326:1993

118. Ans: (c)

Sol: IS:13920-1993 → Ductility detailing

IS:1893-2002 → Design of earthquake resistance structures

IS:4326-1993 → Earthquake resistant design

IS:10262 → Mix design

119. The dimensions of viscosity and surface tension are

- (a) FLT⁻¹ and FL⁻²
- (b) FL⁻¹T and FL
- (c) FLT⁻² and FL⁻¹
- (d) FL⁻¹T⁻¹ and FL⁻¹

119. Ans: (*)

Sol: Viscosity is taken as dynamic viscosity (μ)

$$\mu \text{ units: } \frac{\text{N} \cdot \text{s}}{\text{m}^2} = \text{Pa} \cdot \text{sec} = \text{kg/m} \cdot \text{sec}$$

F → Force (Newton)

L → Length (Meter)

T → Time (seconds)

$$\mu \text{ Directions} = \frac{F \cdot T}{L^2} = F \cdot L^{-2} T \text{ [No method with options]}$$

Surface Tension (σ):

$$\text{'}\sigma\text{' Units Force/length} = \frac{\text{Newton}}{\text{meter}}$$

$$\text{'}\sigma\text{' Dimensions:} = \frac{F}{L} = FL^{-1} \text{ Matching (c) \& (d)}$$

→ No option is matching for dynamic viscosity

****** No answer for this question (or) (c) & (d) award marks

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

List-I (Member)		List-II (Max. effective slenderness ratio)	
A.	A member carrying compressive loads resulting from dead loads and imposed loads	P.	400
B.	Compression flange of a beam against lateral torsional buckling	Q.	350
C.	Member always under tension	R.	300
D.	A member normally acting as a tie in a roof truss	S.	180

Identify the correct match

- | | |
|----------------|----------------|
| A B C D | A B C D |
| (a) S R Q P | (b) S Q R P |
| (c) S Q P R | (d) S R P Q |

120. Ans: (d)

Sol: The maximum effective slenderness ratio, KL/r values of a beam, strut or tension member shall not exceed those given in Table 3. of IS800:2007

121. In bolted/riveted construction, the minimum width of lacing bars shall be _____ times the diameter of the end bolt/rivet.

- | | |
|---------|-----------|
| (a) two | (b) four |
| (c) one | (d) three |

121. Ans: (d)

Sol: Minimum width of lacing bar $\nless 3 \times$ diameter of bolt/rivet.

122. Column bases are mainly subjected to and designed for

- (a) bearing and compression
- (b) bending and compression
- (c) bearing and tension
- (d) compression and tension

122. Ans: (a)

Sol: Steel columns shall be provided with column bases capable of distributing the compressive forces in the compressed steel parts of the column over a bearing area such that the bearing pressure on the foundation does not exceed the design strength of the point.

123. In case of a turbulent flow, which of the following statement is correct:

- (a) independent of the nature of the surface in contact
- (b) proportional to the square root of the velocity
- (c) proportional to the velocity of flow
- (d) independent of the pressure

123. Ans: (d)

Sol: Question is not specific

Assumptions bases like

\rightarrow Head loss \propto (velocity)²

then option (a), (b) & (c) wrong

Option (d) can be appropriate by elimination method

124. In a pressure penstock 4500 km long water is flowing at 4.0 m/sec. If the velocity of the pressure wave travelling in the pipe due to sudden complete closure of a valve at the downstream end is given as 1500 m/sec. Find the maximum pressure rise and the period of oscillation

- (a) 600 N/m² and 6 seconds
- (b) 6 MN/m² and 6 seconds
- (c) 60 MN/m² and 6 seconds
- (d) 60 N/m² and 6 seconds

124. Ans: (c)

Sol: $L = 4500 \text{ km}$

$$V = 4 \text{ m/s}$$

$$C = 1500 \text{ m/s}$$

Sudden complete closure of a valve, pressure rise (ΔP) water hammer = $\rho \cdot C \cdot V$

$$= 1000 \times 1500 \times 4 \text{ (N/m}^2\text{)}$$

$$= 6 \times 10^6 \text{ N/m}^2 = 60 \text{ MN/m}^2$$

$$\text{Period of oscillation (T)} = \frac{2L}{C}$$

$$= \frac{2 \times 4500}{1500} = 6 \text{ sec}$$

125. At a certain point in castor oil the shear stress is 0.316 N/m^2 and the velocity gradient is 0.316 sec^{-1} . Identify the correct dynamic viscosity from the following

(a) 10 Ns/m^2

(b) 0.001 Ns/m^2

(c) 0.1 Ns/m^2

(d) 1.0 Ns/m^2

125. Ans: (d)

Sol: $\tau = 0.316 \text{ N/m}^2$

$$\frac{dv}{dy} = 0.316 \text{ sec}^{-1}$$

$$\mu = ?$$

$$\text{Newton's law of viscosity } \tau = \mu \cdot \frac{dv}{dy}$$

$$0.316 = \mu \times 0.316$$

$$\therefore \mu = 1 \frac{\text{N-s}}{\text{m}^2}$$

126. The pressure at any point in a fluid at rest has the same magnitude in all directions. This law is known as

(a) Pascal's law

(b) Stoke's law

(c) Newton's law

(d) Darcy's law

126. Ans: (a)

Sol: Pascal's Law statement

127. The value of kinetic energy correction factor and momentum correction factor for laminar flow in pipes is

(a) 2.2 & 1.5

(b) 2.0 & 1.333

(c) 2.0 & 1.4

(d) 2.0 & 1.5

127. Ans: (b)

Sol: For laminar flow (pipe) kinetic energy factor (α)
 $= 2.0$

Momentum correction factor (β) = 1.333

128. According to the studies of US Bureau of Reclamation, depending upon the value of Froude Number of the incoming flow, there are various types of hydraulic jump which may occur on a horizontal flow.

Consider the following statements.

A. For Froude Number 1.0 to 1.7, the jump is called as undular jump.

B. For Froude Number 1.7 to 2.5, the jump is called as weak jump.

C. For Froude Number 2.5 to 4.5, the jump is called as oscillating jump.

D. For Froude Number 4.5 to 7.0, the jump is called as steady jump.

E. For Froude Number 9.0 and more, the jump is called strong jump.

Choose the option in which all the statements are correct

(a) A, B and D only

(b) A, B, C and E only

(c) A, B, C, D and E

(d) A, B, C and D only

128. Ans: (b)

Sol: Classification of hydraulic Jump based on Froude number of incoming flow:

Range of Froud No.	Type of Jump
$1.0 < F_{r1} < 1.7$	Undular Jump
$1.7 < F_{r1} < 2.5$	Weak jump
$2.5 < F_{r1} < 4.5$	Oscillating Jump
$4.5 < F_{r1} < 9.0$	Steady Jump
$F_{r1} < 9$	Strong or Choppy Jump

129. Match List-I (dimensionless number) with List-II (definition) and select correct answer using the codes given below the lists:

List-I (Dimensionless number)		List-II (Definition)	
A.	Reynold's number	P.	Ratio of inertia force to the viscous force
B.	Froude number	Q.	Ratio of inertia force to the surface tension force
C.	Weber number	R.	Ratio of inertia force to the elastic force
D.	Mach number	S.	Ratio of pressure force to the inertia force
E.	Euler's number	T.	Ratio of inertia force to the gravitational force

Identify the correct match

A B C D E

A B C D E

- (a) P T R Q S (b) P T Q S R
 (c) P T S Q R (d) P T Q R S

129. Ans: (d)

Sol: A. Reynold's Number $(Re) = \frac{F_{Inertia}}{F_{viscous}}$

B. Froude Number $(F_r) = \frac{F_{Inertia}}{F_{Gravity}}$

C. Weber Number $(W_b) = \frac{F_{Inertia}}{F_{surface\ tension}}$

D. Mach Number $(M) = \frac{F_{Inertia}}{F_{Elastic}}$

E. Euler's Number $(E_v) = \frac{F_{Inertia}}{F_{Pressure}}$

A → P

B → T

C → Q

D → R

E → S

130. Determine the number of the impellers required for multistage pump to lift 4200 liters/minute against a total head of 186 m, at a speed of 750 rpm. The specific speed is not to exceed 700. The manometric head available per stage is 18.6 m

- (a) 1 (b) 7 (c) 10 (d) 100

130. Ans: (c)

Sol: No. of Impellers required to lift liquid

$$= \frac{\text{Total Head}}{\text{Head/Impeller}}$$

$$= \frac{186 \text{ m}}{18.6 \text{ m/Impeller}} = 10 \text{ Impeller}$$

131. Water at 15°C flow at 4 m/sec in a 150 mm pipe. At what velocity must oil at 300°C flow in a 75 mm pipe for the two flows to be dynamically similar? Take kinematic viscosity for water at 15°C as $2.0 \times 10^{-6} \text{ m}^2/\text{sec}$ and that for oil at 30°C as $3.0 \times 10^{-6} \text{ m}^2/\text{sec}$.

- (a) 12 m/sec (b) 1.2 m/sec
 (c) 120 m/sec (d) 1200 m/sec

131. Ans:(a)

Sol: For dynamic similarity

$$(Re)_{15^\circ\text{C}} = (Re)_{230^\circ\text{C}}$$

$$\frac{V_1 \cdot D_1}{\gamma_1} = \frac{V_2 \cdot D_2}{\gamma_2}$$

$$\frac{4 \times 0.15}{2 \times 10^{-6}} = \frac{V_2 \times 0.075}{3 \times 10^{-6}}$$

$$\therefore V_2 = 12 \text{ m/s}$$

132. In the boundary layer, the flow separation depends on

- A. The curvature of the surface
 B. The Reynolds number of flow
 C. The roughness of the surface

Consider the above statements and identify the correct option from the following

- (a) A, B and C (b) A and C only
 (c) A only (d) A and B only

132. Ans: (c)

Sol:

- Flow separation depends on the curvature of the surface (A) correct
- Separation can take place in both laminar and turbulent boundary layers (B) not correct
- Roughness of surface reduces flow separation

Additional Information

Boundaries layer flow separation can take place at low Reynolds number as evidenced by experiments on sphere/cylinders etc.

In sum case, option (d) may be suitable option.

133. Von Karman momentum integral equation is applicable to

- (a) transition boundary layer only
- (b) both laminar and turbulent boundary layer
- (c) laminar boundary layer only
- (d) turbulent boundary layer only

133. Ans: (b)

Sol: Von-Karman momentum integral equation applicable to both laminar and turbulent boundary layers.

134. The concept of boundary layer was first introduced by

- (a) J. Boussinesq
- (b) Nikurade
- (c) Hagen-Poiseuille
- (d) L. Prandtl

134. Ans: (d)

Sol: Boundary layer theory was first introduced by 'L. Prandtl' [Ludwing prandtl]

135. The equation of a velocity distribution over a plate is given by $u = 2y - y^2 + 20$. Assuming $\mu = 8.00$ poise, the shear stress at the boundary and shear stress at a point 15 cm from the boundary in N/m^2 .

- (a) 36 at the boundary and 24.6 at 15 cm from the boundary
- (b) 18 at the boundary and 14.6 at 15 cm from the boundary
- (c) 16 at the boundary and 13.6 at 15 cm from the boundary
- (d) 26 at the boundary and 20.6 at 15 cm from the boundary

135. Ans: (c)

Sol: Newton's law of viscosity; $\tau_y = \mu \left(\frac{du}{dy} \right)_y$

$$\tau_{y=0.15 \text{ m}} = (8 \times 0.1) \cdot \frac{d}{dy} (2y - y^2 + 20)$$

$$= (0.8) (2 - 2y)$$

$$y = 0.15 \text{ m}$$

$$= (0.8) (2 - 2 \times 0.15)$$

$$= 1.36 \text{ N/m}^2$$

At boundary i.e. $y = 0$

$$\tau_{y=0} = (0.8) (2 - 2 \times 0)$$

$$= 0.8 \times 2$$

$$= 1.6 \text{ N/m}^2$$

Numerical values are not matched

Suitable answer will be (c)

136. Consider the following statements:

- A. Pelton wheel is a tangential flow impulse turbine.
- B. Francis turbine is an axial flow reaction turbine.
- C. Kaplan turbine is radial flow reaction turbine.
- D. Draft tube is used in a reaction turbine to convert residual kinetic energy into pressure energy.

Which of the above statements are NOT correct?

- (a) B and D only
- (b) A and C only
- (c) A and D only
- (d) B and C only

136. Ans: (c)

Sol: (a) and (d) are correct statement

(b) and (c) are wrong

Francis turbine is radial flow reaction turbine

Kaplan turbine is axial flow reaction turbine

137. The correct sequence of the centrifugal pump components through which the fluid flow is

- (a) Foot valve & strainer, impeller, suction pipe and delivery pipe
- (b) Strainer & foot valve, suction pipe, impeller and delivery pipe
- (c) Suction pipe, delivery pipe, impeller and foot valve & strainer
- (d) Suction pipe, foot valve & strainer, impeller and delivery pipe

137. Ans: (b)

Sol: Correct sequence of the C.P: strainer & foot valve, suction pipe, impeller and delivery pipe.

138. A Pelton wheel has to be designed for the following data. Power to be developed is 6000 kW, net head available is 300 m, speed is 550 rpm, discharge is 3 m³/sec, ratio of jet diameter to wheel diameter is 1/10. Find the overall efficiency of the turbine. Take specific weight of water as 10000 N/m³.

- (a) 56.67%
- (b) 50%
- (c) 66.67%
- (d) 60%

138. Ans: (c)

Sol: $P_o = 6000 \text{ kw}$, $H = 300 \text{ m}$, $Q = 3 \text{ m}^3/\text{sec}$

$$\frac{d}{D} = \frac{1}{10}, \gamma = 10 \text{ kN/m}^3$$

$$\eta_o = \frac{\text{output power}}{\text{water power}} = \frac{6000 \text{ kw}}{r.Q.H}$$

$$\eta_o = \frac{6000 \text{ kw}}{10 \times 3 \times 300(\text{kw})}$$

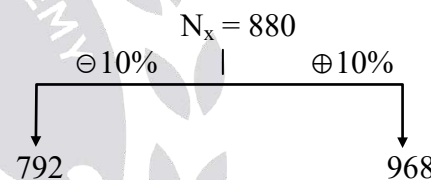
$$= \frac{6000}{9000} = 0.667 = 66.7\%$$

139. Raingauge station 'X' did not function for a part of a month during which a storm occurred. The storm produced rainfalls of 80, 90 and 100 mm at three surrounding stations A, B and C respectively. The normal annual rainfalls at the stations X, A, B and C are respectively 880, 800, 880 and 1000 mm. Estimate the missing storm rainfall at station X.

- (a) 86.67 mm
- (b) 86.87 mm
- (c) 98.67 mm
- (d) 88.87 mm

139. Ans: (d)

Sol: Stations	A	B	C	X
N (mm)	800	880	1000	880
P (mm)	80	90	100	$P_x = ?$



$N_c = 1000 \#$ Not within 10% of N_x

Use Normal Ratio Method

$$\frac{P_x}{N_x} = \frac{1}{m} \left[\frac{P_1}{N_1} + \frac{P_2}{N_2} + \frac{P_3}{N_3} \right]$$

$$\frac{P_x}{880} = \frac{1}{3} \left[\frac{80}{800} + \frac{90}{880} + \frac{100}{1000} \right]$$

$$P_x = 88.67 \text{ mm}$$

140. Identify standard non-recording raingauge among the following raingauge used for measuring rainfall which was prescribed by IMD

- (a) Symons raingauge
- (b) Floating type with siphon arrangement
- (c) Tipping bucket type
- (d) Weighing bucket type

140. Ans: (a)

Sol: Non-recording raingauge

(1) Symons raingauge

141. The observed annual runoff from a basin of area 100 km² is 600 mm³ and the corresponding annual rainfall over the basin during the same year is 1500 mm. What is the runoff coefficient?

- (a) 0.45 (b) 0.40
(c) 0.50 (d) 0.60

141. Ans: (b)

Sol: C.A = 1000 km²

R.V = 600 mm³-Runoff volume [Typo error]

P = 1500 mm [R.V = 600 mm³]

K = ?

$$\text{Runoff depth} = \frac{R.V}{C.A} = \frac{600 \times 10^6}{1000 \times 10^6}$$

$$= 0.6 \text{ m} = 600 \text{ mm} = R$$

$$k = \frac{R}{P} = \frac{600}{1500} = 0.4$$

142. Laminar sublayer exits in

- (a) turbulent boundary layer region
(b) between laminar boundary layer region and transition boundary layer region
(c) laminar boundary layer region
(d) transition boundary layer region

142. Ans: (a)

Sol: Laminar sub-layer exit in entire turbulent boundary layer region.

143. A control volume refers to

- (a) a reversible process only
(b) a specified mass
(c) a fixed region in space
(d) a closed system

143. Ans: (c)

Sol: Control volume refer to a fixed region in space.

144. Navier-Stokes equation is useful in the analysis of

- (a) viscous flow
(b) both non-viscous and turbulent flows
(c) non viscous flows
(d) turbulent flows

144. Ans: (a)

Sol: Navier-Stokes equation is used for viscous fluid flows analysis.

145. The whole circle bearing of the lines of a closed traverse are given below:

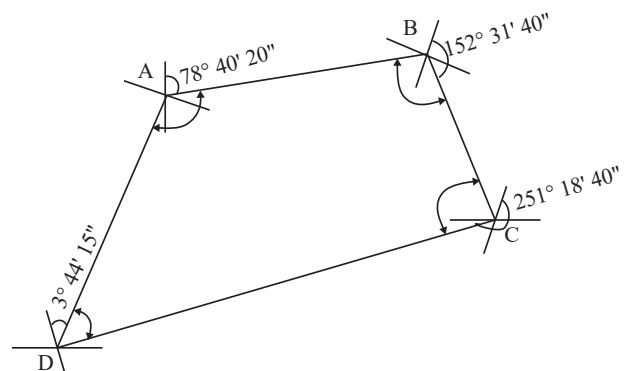
Line	AB	BC	CD	DA
Bearing	78°40'20"	152°31'40"	251°18'40"	3°44'15"

Find the included angles of the traverse:

- (a) 78°40'20", 152°31'40", 251°18'40" and 3°44'15"
(b) 105°03'55", 106°08'40", 91°13'10" and 67°34'25"
(c) 105°03'55", 106°08'40", 61°13'10" and 67°34'25"
(d) 105°03'55", 106°08'40", 81°13'10" and 67°34'25"

145. Ans: (d)

Sol:



Including angles

$$\angle A = 90^\circ - 78^\circ 40' 20'' + 90^\circ + 3^\circ 44' 15''$$

$$\angle A = 183^\circ 44' 15'' - 78^\circ 40' 20''$$

$$\angle A = 105^\circ 3' 55''$$

$$\angle B = 78^\circ 40' 20'' + (180^\circ - 152^\circ 31' 40'')$$

$$= 258^\circ 40' 20'' - 152^\circ 31' 40''$$

$$\angle B = 106^\circ 08' 40''$$

$$\angle C = (152^\circ 31' 40'' - 90^\circ) + 270^\circ - 251^\circ 18' 40''$$

$$= 62^\circ 31' 40'' + (270^\circ - 251^\circ 18' 40'')$$

$$\angle C = 81^\circ 13' 00''$$

$$\angle D = (251^\circ 18' 40'' - 180^\circ) - 3^\circ 44' 15''$$

$$= (71^\circ 18' 40'' - 3^\circ 44' 15'')$$

$$\angle D = 67^\circ 34' 25''$$

146. Which of the following formations doesn't contain any groundwater?

- (a) Aquifer
- (b) Aquitard
- (c) Aquifuge
- (d) Aquiclude

146. Ans: (c)

Sol: A rock neither containing water nor transmitting water

Eg: Solid granite

147. Darcy's law for groundwater movement states that the velocity is proportional to

- (a) the reciprocal of the hydraulic gradient
- (b) the square of the hydraulic gradient
- (c) the logarithm of hydraulic gradient
- (d) the hydraulic gradient

147. Ans: (d)

Sol: $V \propto I$

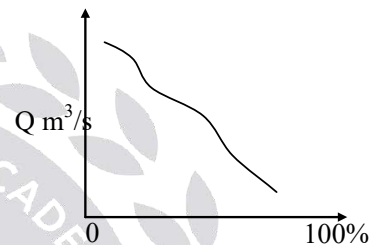
Velocity of flow is proportional to the hydraulic gradient

148. Flow duration curve is the graph drawn between

- (a) the accumulated discharge and time
- (b) the discharge and the percent of the time such discharge is equaled or exceeded
- (c) cumulative volume of flow and time
- (d) the discharge in the stream and time

148. Ans: (b)

Sol: From duration curve



% of time the flow has equaled or exceeded

149. Isohyets are defined as

- (a) line joining points of equal relative humidity
- (b) line joining points of equal amount rainfall
- (c) line joining points of equal rainfall intensity
- (d) line joining points of equal storm duration

149. Ans: (b)

Sol: Isohyets: A line on a map connecting points having the same amount of rainfall [equal rainfall depth] in a given duration.

150. The basic principles of unit hydrograph are based on

- (a) linearity and time variance
- (b) linearity and time invariance
- (c) non linear time variance and linearity
- (d) non-linearity and time invariance

150. Ans: (b)

Sol: Basic principle of UH theory

- (i) Linear response
- (ii) Time invariance

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