S26. Ans.(b)
Sol. According to IS 1905 – 1987, the strength of various grades of mortars are →

Grade	Strength (MPa)
	10
	7.5 – 6.0
	5.0-3.0
	3.0 – 2.0
	0.7
	0.5

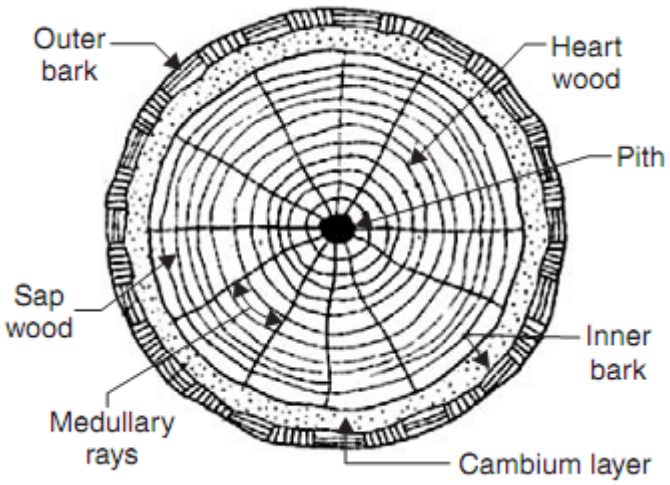
S27. Ans.(a)
Sol. The process of adding the cement in order to improve the quality of mortar is known as gauging. It results in more economical, denser and stronger lime mortar is called as gauged mortar. The proportion of cement to lime by volume is about 1:6 to 1:8.

S28. Ans.(a)
Sol. Slate is obtained from the metamorphism of mudstone. It absorbs less amount of water so it is used in high rainfall areas, flooring, roofing, D.P.C, mountainous area etc.

S29. Ans.(b)
Sol. Sub classification of sedimentary rocks
(1) made from mechanical weathering
(2) Chemical made from chemical weathering.
(3) Organic rocks.

S30. Ans.(d)
Sol. Seasoning of timber is done to remove the sap from the timber.
Kiln seasoning of timber results in-
(a) Reduce density of timber
(b) Increases the life of timber
(c) Provide dimensional stability
(d) Reduce the weight
(e) Reduce the shrinkage and warping
The moisture content in a well-seasoned timber is about 10-12%.

S31. Ans.(a)
Sol. Cambium layer is the sap being converted to sapwood. It decides the future growth of the plants. It is between inner bark & sap wood.
Structure of tree



S32. Ans.(c)
Sol.

- Deciduous trees are hard wood tress. They are also known as broad leaved trees.
  Ex. Sal, oak babul, Teak etc.
- Conifers trees are soft wood trees.
  Ex. Chir, deodar, sandal, pine etc.
- Bamboo, palm & cane are the example of endogenous tree.

S33. Ans.(a)
Sol. According to IS 10262:1982, the compressive strength for different grades of OPC are-

Grade	Compressive strength
A	31.9 – 36.8 MPa
B	36.8 – 41.7 MPa
C	41.7 – 46.6 MPa
D	46.6 – 51.5 MPa
E	51.5 – 56.4 MPa
F	56.4 – 61.3 MPa

S34. Ans.(d)
Sol.

S.N.	Shape	Shape factor
1	I-Section	1.12-1.15
2.	Rectangle	1.5
3.	Circle	1.7
4.	Diamond	2.0

S35. Ans.(a)
Sol. According to IS, when the effect of seismic load or wind load is taken in to account the permissible stresses in steel are increased by 33.33%.

S36. Ans.(d)
Sol.

S = Size of weld
'k' depends upon angle between fusion
Here, Angle of fusion given = 99°

Angle of fusion	K
60° - 90°	0.70
91° - 100°	0.65
101° - 106°	0.60
107° - 113°	0.55
114° - 120°	0.50

Hence
→ effective throat thickness should not be less than 3 mm.

S37. Ans.(c)
Sol. Given, t=16mm.
Unwin's formula

S38. Ans.(a)
Sol. Given, FOS = 1.5
Shape factor (S) = 1.12
Load factor = ?
after increasing allowable stress by 20% for wind and earthquake loads.

S39. Ans.(c)
Sol. the maximum moment or shear force at a section depends on the position of the live load.

(i) For maximum positive span moment at midpoint, load span and all other alternate span.
(ii) For maximum positive support moment, unload the span on either side of the support and load the next spans.
(iii) For maximum negative span moment at midpoint, load the adjacent spans on either side of the span and all other alternate spans.

(iv) For maximum negative moment at support, load the two spans adjacent to the support and all other alternate spans.

S40. Ans.(c)
Sol. for cantilever beam

(Beam fail in shear)
Lateral stability check → distance between free end of cantilever beam shall not exceed.

→ clear distance between the lateral restraints shall be 3750 mm and the span are 4 m. so the beam fails from lateral stability.

S41. Ans.(c)
Sol. Double reinforced beam provides. –
(i) Depth of the beam restricted
(ii) Increasing moment carrying capacity.
(iii) Safety against reversal of stress.
(iv) Reduce deflection of beam.

S42. Ans.(d)
Sol. According to IS 456 : 2000
The development length =
→ For deformed bars shall be increases by 60%.
→ for bars in compression increased by 25%

S43. Ans.(c)
Sol. Spacing between lateral ties –
Maximum spacing should not be greater than.
(i) 16×minimum diameter of bar
(ii) Least lateral dimension
(iii) 300 mm.

S44. Ans.(b)
Sol. Permissible stress in steel reinforcement

Type of stress	Mild steel	Fe415	Fe500
Tension & shear	140 Mpa 130 Mpa	230 Mpa	275 Mpa
Compression	130 Mpa	190 Mpa	190 Mpa

S45. Ans.(a)
Sol. In limit state method.
Partial safety factor for RCC = 1.5

Partial safety factor for steel = 1.15
In working state method.
Partial safety factor for R.C.C. = 3
Partial safety factor for steel = 1.78

S46. Ans.(d)
Sol. size of column = 300 mm ×300 mm
Reinforced with 4-20 mm
Grade of steel = 415
M-20
Axial load (Pu)=?
= 5 Mpa (for M-20 grade concrete)
Asc = 4×

Pu =

S47. Ans.(d)
Sol. The nominal shear stress.

→ shear force
b→ breadth
d→ over all depth.

S48. Ans.(b)
Sol. Joints (J) = 4
External Reactions (=5
Members (m) = 3
Internal hinged reaction (= 1
Degree of kinematic indeterminacy = ?

S49. Ans.(c)
Sol. If a point load acting at the mid span of a fixed beam, then fixed end moment will be

Give, same load spread as UDL then fixed end moment will be –

S50. Ans.(a)
Sol. The number of plastic hinges is one more than the order of statically indeterminacy which will cause the overall total collapse of a structure.

S51. Ans.(d)
Sol. The influence line diagram is the graphical representation for reaction, shear force and bending moment due to moving load. It can be drawn for beams, arches, trusses etc.

S52. Ans.(b)
Sol. Talus → Soil transported by gravity
Till→ Soil transported by glaciers
Loess→ Soil transported by wind
Lacustrine→ Soil deposit in lake bed.

S53. Ans.(b)
Sol. Aeoline soil→ It is the soil deposit by wind. It consists primarily of sand or silt sized particle these soils have low permeability.

S54. Ans.(b)
Sol. For cohesive soil (c=o)

If water table rises to G.L

OR

→ If water table rises to ground level in sand ultimate bearing capacity is reduced approximate by 50%

S55. Ans.(b)
Sol.

S56. Ans.(c)
Sol. water content (w) = 200%
G= 2.6
Void Ratio (e) = ?
→ soil is fully saturated (S = 1)
Se = WG
1×e = 2×2.6

S57. Ans.(c)
Sol. weight of moist (soil +tin lid) = 24 gm
Weight of tin lid = 14gm.
Oven dry weight of (soil +tin lid) = 22 gm.

Weight of water = 24-22 = 2gm.
Weight of solid = 22 – 14 = 8 gm.
Water content =
= 25%

S58. Ans.(c)
Sol.
Weld graded sand
For well graded Cc is lies between 1 to 3.

S59. Ans.(d)
Sol. discharge velocity = 6 × m/s
Void ratio (e) = 0.5
Porosity (n) =
=
=

Seepage velocity =

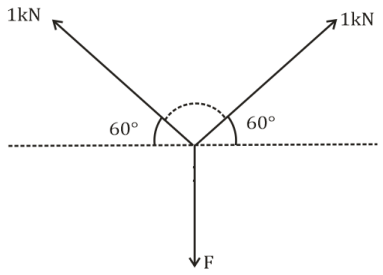
m/sec

S60. Ans.(a)
Sol.

Properties	Dry of optimum	Wet of optimum.
Structure	Flocculant	Dispersed
Permeability	More	Less
Pore water pressure	Less	More
Swelling	High	Low
Shrinkage	Less	High
Strength	More	Less

S61. Ans.(c)
Sol. Coefficient of compressibility =

S62. Ans.(a)
Fig.



Sol. from lami's theorem

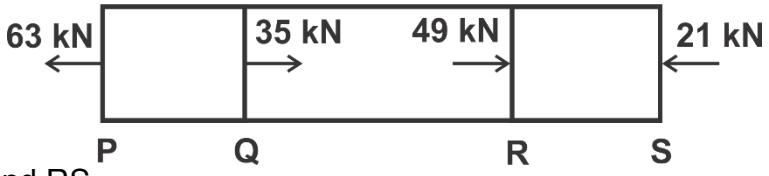
=

F =

F = N

S63. Ans.(b)

Sol.

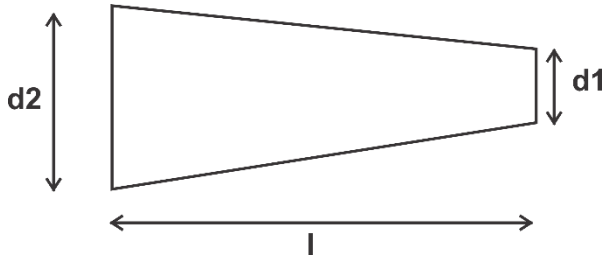


FBD of PQ, QR and RS

Stress in QR section

S64. Ans.(a)

Sol. Extension of a tapered bar



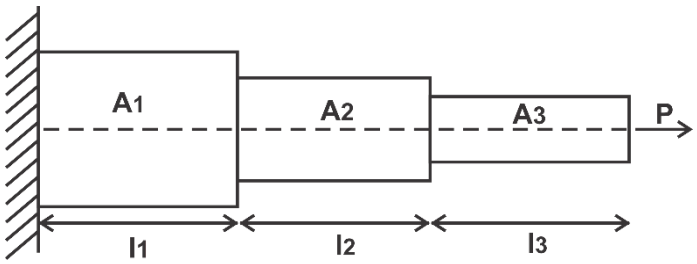
S65. Ans.(c)

Sol. linear strain components are

Shear strain components are

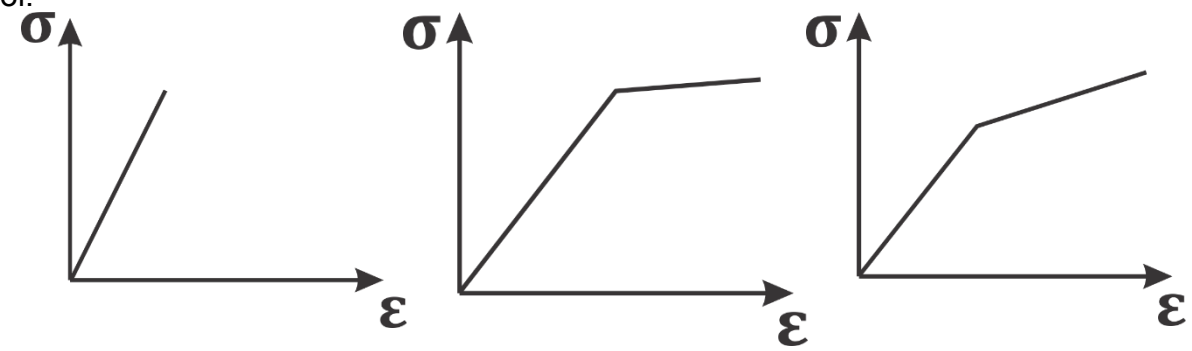
S66. Ans.(a)

Sol. Bar is composite so axial force is same throughout the bars.



Total elongation is the sum of each bar's elongation.
Total elongation

S67. Ans.(c)
Sol.



Ceramics (Brittle material)

Elasto-Plastic/Visco Plastic

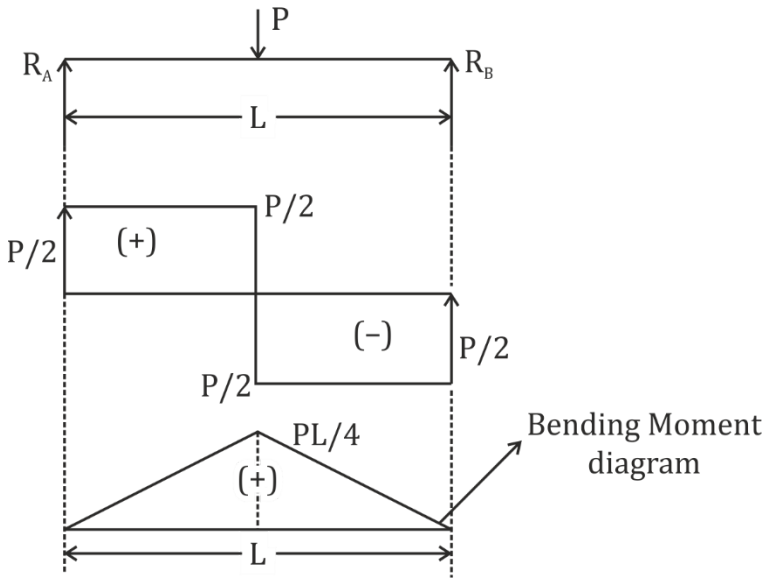
Elasto-plastic with strain hardening

S68. Ans.(b)
Sol. At θ = 45°

S69. Ans.(b)
Sol. Given that,

Radius of Mohr's circle

S70. Ans.(d)
Sol. Bending moment diagram for a simply supported beam with a load at mid-spam is a triangle.



S71. (b)

Sol. Maximum shear stress is half of the difference of the maximum and minimum principal stress which is nothing but the radius if Mohr's circle.

S72. Ans.(a)

Sol. Combined loading means there is contribution of one or more loads at a point of state of stress. It is not a complicated case of loading.

S73. Ans.(a)

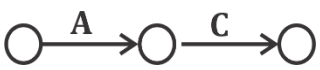
Sol. in columns,

(a) The minimum longitudinal reinforcement = 0.4 % of gross cross – sectional area.
(b) The maximum longitudinal reinforcement = 6% of gross cross-sectional area.
(c) The pitch of the transverse reinforcement shall not be more than the least of the following:
(i) The least lateral dimension of the compression members
(ii) 16 times the smallest diameter of the longitudinal reinforcement bar to be tied
(iii) 300 mm

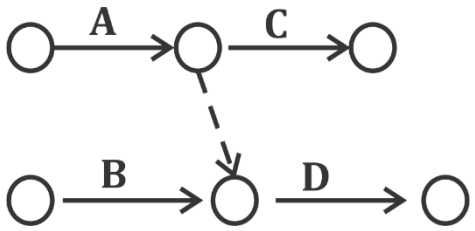
S74. Ans.(b)

Sol.

- Activity 'C' follows activity 'A'



- Activity 'D' follows activity 'A' & 'B'.



S75. Ans.(a)
Sol. Salient features about PERT analysis is→
(i) Projects are of the non-repetitive type.
(ii) Time required need not be known.
(iii) Events have been established for planning.
(iv) PERT is usually suitable for research & development type projects.
(v) It follows probabilistic or non -deterministic approach.

S76. Ans.(b)
Sol. Expected time =
Given,
Optimistic time = 5
Most likely time = 8
Pessimistic time = 17
Now,
=
= 9 days

S77. Ans.(a)
Sol. As per IRC, the super elevation to be provided in horizontal curve of radius R is given by-

S78. Ans.(d)
Sol. Given, length of wheel base (l) = 7m
Radius (R) = 490m.
No. of lanes (n) = 2
mechanical widening =
= = 0.1

S79. Ans.(c)
Sol. Given, SSD = 80 m.
Set back distance(M) = 10m.
Radius (R) = ?
Set back distance (M) = (Approx. relation)
10 =
R =
= 80 m.

S80. Ans.(c)
Sol. Given,
(R.G.) Ruling gradient = 6%
Radius(R) = 75m
(G.C) Grade compensation (%) =
=
= 1.4
Hence taken = 1% (GC)
compensate gradient (C.G.) = R.G. – G.C.
= 6% – 1%
= 5% or 1 in 20

S81. Ans.(a)
Sol. If L is the length of vehicles in m. C is the clear distance between two consecutive vehicles (SSD), V is the speed of vehicles in km/hour, then maximum number of vehicle (N) is given by-

(Vehicles/hour)

S82. Ans.(b)
Sol. Give, jam density = 75 km/h.
free mean speed = 100 vehicles/km.
Maximum capacity flow = ?

=
= 1875 veh/hr.

S83. Ans.(a)
Sol. California Bearing ratio (CBR) is a measure of arbitrary soil strength. IRC consider CBR method for designing of flexible pavement.

S84. Ans.(c)
Sol. There are some following tests are conducted on the coarse aggregates–
(i) Bitumen Adhesion test
(ii) Abrasion test
(iii) Crushing test
(iv) Impact test

S85. Ans.(b)
Sol.

S87. Ans.(a)

Sol. Number of sleepers per rail length generally varies from (M+2) to (M+7).
M = Length of a rail (in m)
for 12.8m rail length, the sleeper density is given = (M+5)
= (12.8 + 5)
= 17.8 ≃ 18
sleeper No. of sleeper required for 1280 m. long B.G. track =

= 1800 sleeper.

S88. Ans.(c)
Sol. Sugarcane has longest base period in regards to irrigation
→ depth of water is 120 cm in sugarcane
→ optimum depth of kor watering for rice is 190 mm.

S89. Ans.(c)
Sol. Intensity of irrigation is defined as the percentage of the irrigation area proposed to be irrigated annually.
<u>According to Question</u>
Intensity of irrigation for Kharif = 45%
For Rabi =60%
Annual intensity = (60+45)
=

S90. Ans.(c)
Sol. Maximum irrigation requirement means now much irrigation required for given area also called duty of this crop it's unit of measurement is hectare per cumec.
→ For rice maximum irrigation requirement of is exhibited by its minimum duty values...

S91. Ans.(a)
Sol <u>Advantage of canal lining</u>
(i) Seepage reduction
(ii) Prevention of water logging
(iii) Increase in commanded area
(iv) Increase in channel capacity
(v) less maintenance
(vi) safety against flood.

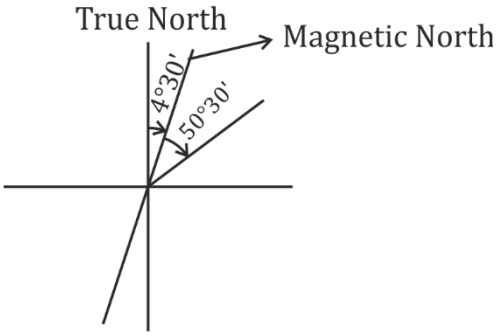
S92. Ans.(a)
Sol. Given,
Wrong length of measured line (L) = 840.5
Wrong length of chain (l) = 20.1 m
Correct length of chain (l) = 20 m
Correct length of measured line (L) = ?
L × l = L × l
L × 20 = 840.5 × 20.1

L =

S93. Ans.(b)
Sol. In case of direct Vernier, graduation increase in the same direction in which graduations of the main scale increases.

S94. Ans.(c)
Sol. Pull correction →
Sag correction →
Temperature correction →
Mean sea level correction →

S95. Ans.(d)
Sol.



True Bearing = Magnetic Bearing + Magnetic declination (East)
= 50°30' + 4°30'
= 55°

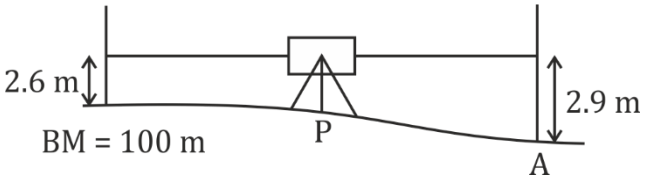
S96. Ans.(a)
Sol. Since difference of F.B and B.B of line AB differs by 180°. Hence both stations A and B are unaffected by local attraction and station C and D are affected by local attraction.

S97. Ans.(b)
Sol.

Error =

S98. Ans.(c)
Sol. Reciprocal levelling is used to determine the correct difference of elevations of two points. It eliminates the error due to curvature of earth, atmospheric refraction, and collimation error.

S99. Ans.(d)
Sol.



Height of collimation of instrument at station P
= RL of Benchmark + B.S. of Benchmark
= 100 + 2.6
= 102.6 m.
RL of A = Height of collimation at P – F.S. at A
= 102.6 – 2.9
= 99.7 m.

S100. Ans.(a)
Sol. Given,
Distance between the instrument and staff (d)= 1000 m. = 1 km
Correction due to curvature is given by
$= -0.0785\ d^2$
$= -0.0785\ (1)^2$

S101. Ans.(b)
Sol.

S102. Ans.(b)
Sol. if the flow properties, say the depth of flow, in a channel remains constant along the length of the channel it is called uniform flow. Flow in a main irrigation channel is a uniform flow.
If the change of depth in a varied flow is rapid and appreciable it is called a rapidly varied flow. In a stilling basin hydraulic jump is confined either partly or entirely for energy dissipation. Hydraulic jump is associated with rapid and significant change in depth and other flow properties.
An unsteady flow occurs when the flow properties, such as the depth or discharge at a section change with time. Sudden closure of a sluice gate creates such phenomena on the upstream of the gate.
If some flow is added to or abstracted from the varied flow it is knows as a spatially varied flow. When irrigation water spreads over a field some water spreads over a field some water percolates down into the soil creating a spatially varied flow.

S103. Ans.(c)
Sol.

S104. Ans.(b)
Sol.

For most efficient rectangular channel
Hydraulic radius = y/2

S105. Ans. (b)

Sol. The working principle of Impulse turbines is Newton's second law.

S106. Ans. (b)

Sol. Speed ratio,

S107. Ans. (a)

Sol. Pelton Turbine - Impulse Turbine

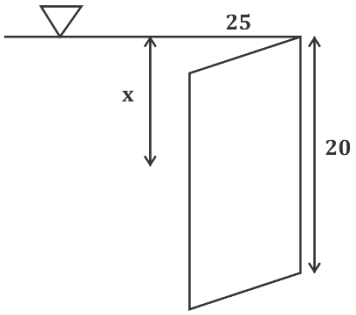
Francis Turbine - Reaction Turbine

Kaplan Turbine - Reaction Turbine

S108. Ans.(a)
Sol. H.G.L. is always above the center line of conduct.

S109. Ans.(b)
Sol. For equilibrium weight of the cubical block = weight of fluid displaced

S110. Ans.(c)
Sol. $f = \rho g A\bar{x}$
$= 1000 \times g \times (20 \times 25) \times 10$
$= 5gMN$



S111. Ans.(d)
Sol. Weight of body in different medium = (weight of body in air – buoyancy force due to displaced fluid)

weight of body in water = 50 gm
50= 60-

When it is submerged in oil then its buoyant force.

S112. Ans.(c)
Sol. Assume density of ice and water are same i.e.

Weight of the ice block = weight of fluid displaced

So, level of water remains constant even after the melting of ice.

S113. Ans.(a)
Sol. The flow in venturi flume takes place at atmospheric pressure.
venturi flume is used for large flow measurement Where venturi-meter measures small flow.
flow inside venturi flume takes place at atmospheric pressure.
venturi flume is critical flow open flume with constructed flow. This causes drop in hydraulic grade line which creates critical depth.
Measurement of discharge with venturi flume require two measurements viz one at upstream and other at throat.

S114. Ans.(b)
Sol. Reynold's no. =

It is below than 2000 so the flow is laminar.

S115. Ans.(d)
Sol. B = 3m.
S = 0.0002
y = 1.5m.

1.47 ≈ 1.5 N/m²

S116. Ans.(c)
Sol. Given, Population in year of 2000 () = 82200
Rate of growth (r) = 35%
Population in year of 2020 =?
No. of decades(n) = 2
As per geometrical increase method →

P = 149,809.5 ~ 149,810

S117. Ans.(a)
Sol.
Hardness - EDTA Method
D.O. - Winkler's method
Chloride - Mohr method
Chlorine - Orthotodoline test

S118. Ans.(b)
Sol. The correct sequence of processes in water treatment plant is follows as–
Coagulation → flocculation → sedimentation → filtration → Chlorination

S119. Ans.(b)
Sol. Given,
Quantity of water treated = 25000 m^3/day
Chlorine use = 9 kg/day
Chlorine dose =

= 0.36 mg/l
Chlorine demand = Chlorine dose – Residual chlorine
= 0.36 – 0.2
= 0.16 mg/l

S120. Ans.(c)
Sol. An Imhoff tank is an improvement over septic tank in which both sedimentation and digestion process of sludge takes place.

S121. Ans.(c)
Sol.

PSI Value	Level of health concern
0 – 50	Good
51 – 100	Moderate
101 – 200	Unhealthy
201 – 300	Unhealthy
301 +	Hazardous

S122. Ans.(a)
Sol. Autotrophs→ Derive both material (cell carbon) and energy from inorganic substances.
Heterotrophs→ Derive both material (cell carbon) and energy from organic substances.

S123. Ans.(d)

Sol. We know,

→ let ‘a’ cm. evaporation takes place in month of June.
Total in flow
Total outflow =
Total inflow < Total outflow, since depression takes place.
Now,
Depression in storage =
Since,

S124. Ans.(d)
Sol. Total Precipitation (P) = Σ Intensity × duration
Total precipitation (P) =
= 10.6 cm.
Run off (R) = 3 cm.

the value of - index is smaller than all the 3 successive hours rainfall intensities.
Hence,

S125. Ans.(d)
Sol.

- Simon rain gauge is a non-recording type of rain gauge and commonly used in India.
- Natural syphon rain gauge is adopted in India. It similar to weighing bucket rain gauge. It is recording type of rain gauge.
- Tipping bucket type of rain gauge is used for measuring rain in remote areas. It is recording type of rain gauge means produce continuous plot of rainfall against time.