

**MIZORAM PUBLIC SERVICE COMMISSION**  
**COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF M.E.S.**  
**UNDER PUBLIC WORKS DEPARTMENT, AUGUST, 2018.**

**CIVIL ENGINEERING**  
**PAPER - II**

Time Allowed : 3 hours

FM : 200

**SECTION - A (Multiple Choice questions)**

**(100 Marks)**

*All questions carry equal mark of 2 each. Attempt all questions.*

*This Section should be answered only on the **OMR Response Sheet** provided.*

1. Sewage sickness relates to
  - (a) Clogging of pores in soil due to excessive application of sewage to land, obstructing aeration and leading to septic conditions
  - (b) Destruction of aquatic flora and fauna due to gross pollution of receiving bodies of water by sewage
  - (c) Reduction of waste purifying capacity of the soil
  - (d) Toxicity of sewage interfering with response to treatment
2. Sewage may be disposed of without treatment into a water body if the available dilution is
  - (a) Less than 100
  - (b) More than 100
  - (c) More than 300
  - (d) More than 500
3. Due to rise in temperature, the viscosity and unit weight of percolating fluid are reduced to 70% and 90 % respectively. Other things being constant, the change in co-efficient of permeability will be
  - (a) 18.2%
  - (b) 28.6%
  - (c) 42.3%
  - (d) 63.2%
4. An upward hydraulic gradient of certain magnitude will initiate the phenomenon of boiling in granular soils. The magnitude of the gradient will be
  - (a)  $0 \leq i \leq 0.5$
  - (b)  $0.5 \leq i \leq 1.0$
  - (c)  $i = 1.0$
  - (d)  $1.0 \leq i \leq 2.0$
5. The velocity along a circular stream line having its centre at the origin and radius 2.0m is constant at 3m/sec the radial and tangent acceleration
  - (a) 3 m/sec
  - (b) 4.5 m/sec
  - (c) 6 m/sec
  - (d) Zero
6. A grit chamber of dimensions 12.0m X 1.5 m X 0.8 m liquid depth has a flow of 720 m<sup>3</sup>/hr. Its surface loading rate and detention time are, respectively
  - (a) 40000 m<sup>3</sup>/hr/m<sup>2</sup> and 1.2 minutes
  - (b) 40000 lph/m<sup>2</sup> and 1.2 minutes
  - (c) 40000 m<sup>3</sup>/hr/m<sup>2</sup> and 40 minutes
  - (d) 40000 lph/m<sup>2</sup> and 40 minutes

7. In laminar flow, the local instability occurs first at a point where
- (a)  $u$  is maximum (b)  $du / dy$  is maximum
- (c)  $\frac{\rho u y}{\mu}$  is maximum (d)  $\frac{\rho y^2}{\mu} \frac{du}{dy}$  is maximum
8. The maximum height above the hydraulic gradient line at which a siphon can pass for a continuous flow to occur through it is
- (a) 2.0 m (b) 6.0 m
- (c) 7.75 m (d) 12.0 m
9. Steady state seepage is taking place through soil element at 'Q', 2m below the ground surface immediately downstream of the toe of an earthen dam as shown in the Fig. The water level in a piezometer installed at P, 500 mm above Q, is at the ground surface. The water level in a piezometer installed at R, 500 mm below Q is 100 mm above the ground surface. The bulk saturated unit weight of the soil is  $18 \text{ kN/m}^3$  and the unit weight of water is  $9.81 \text{ kN/m}^3$ . The vertical effective stress (in kPa) at Q is



- (a)  $14.42 \text{ kN/m}^2$  (b)  $15.89 \text{ kN/m}^2$
- (c)  $16.26 \text{ kN/m}^2$  (d)  $18.62 \text{ kN/m}^2$
10. Group I contains parameters and Group II lists methods/instruments. Match Group I with Group II.

Group I		Group II	
P.	Stream-flow velocity	1.	Anemometer
Q.	Evapo-transpiration rate	2.	Penman's method
R.	Infiltration rate	3.	Horton's method
S.	Wind velocity	4.	Current meter

- (a) P-1, Q-2, R-3, S-4 (b) P-4, Q-3, R-2, S-1
- (c) P-1, Q-3, R-2, S-4 (d) P-4, Q-2, R-3, S-1
11. Wheat crop requires 55 cm of water during 120 days of base period. The total rainfall during this period is 100 mm. Assume the irrigation efficiency to be 60%. The area (in ha) of the land which can be irrigated with a canal flow of  $0.01 \text{ m}^3/\text{s}$  is
- (a) 13.82 (b) 18.65
- (c) 23.42 (d) 234.20
12. A water sample has a pH of 9.25. The concentration of hydroxyl ions in the water sample is
- (a)  $0.03 \text{ mg/L}$  (b)  $0.302 \text{ mg/L}$
- (c)  $3.020 \text{ mg/L}$  (d)  $30.208 \text{ mg/L}$

13. An institution required to treat  $4.2 \text{ m}^3/\text{min}$  of raw water for daily domestic supply. Flocculating particles are to be produced by chemical coagulation. A column analysis indicated that an overflow rate of  $0.2 \text{ mm/s}$  will produce satisfactory particle removal in a settling basin at a depth of  $3.5 \text{ m}$ . The required surface area for settling is
- (a)  $230 \text{ m}^2$  (b)  $350 \text{ m}^2$   
(c)  $1280 \text{ m}^2$  (d)  $23000 \text{ m}^2$
14. In a constant head permeameter with cross section area of  $10 \text{ cm}^2$ , when the flow was taking place under a hydraulic gradient of  $0.5$ , the amount of water collected in  $60$  seconds is  $600 \text{ cc}$ . the permeability of soil is
- (a)  $0.002 \text{ cm/s}$  (b)  $0.02 \text{ cm/s}$   
(c)  $0.20 \text{ cm/s}$  (d)  $2.0 \text{ cm/s}$
15. A sample of domestic sewage is digested with silver sulphate, sulphuric acid, potassium dichromate and mercuric sulphate in chemical oxygen demand (COD) test. The digested sample is then titrated with standard ferrous ammonium sulphate (FAS) to determine the un-reacted amount of
- (a) Mercuric sulphate (b) Potassium dichromate  
(c) Silver sulphate (d) Sulphuric acid
16. The ratio of actual evapo-transpiration to potential evapo-transpiration is in the range of
- (a)  $0.0$  to  $0.4$  (b)  $0.6$  to  $0.9$   
(c)  $0.0$  to  $1.0$  (d)  $1.0$  to  $2.0$
17. A rectangular open channel of width  $5.0 \text{ m}$  is carrying a discharge of  $100 \text{ m}^3/\text{s}$ . The Froude number of the flow is  $0.8$ . The depth of flow (in m) in the channel is
- (a)  $4$  (b)  $5$   
(c)  $16$  (d)  $25$
18. When the outflow from a storage reservoir is uncontrolled as in a freely operating spillway, the peak of outflow hydrograph occurs at
- (a) The point of inter-section of the inflow and outflow hydrographs  
(b) A point, after the inter-section of the inflow and outflow hydrographs  
(c) The tail of inflow hydrographs  
(d) A point, before the inter-section of the inflow and outflow hydrographs
19. An inert tracer is injected continuously from a point in an unsteady flow field. The locus of locations of all the tracer particles at an instance of time represents
- (a) Pathline (b) Steamtube  
(c) Strekline (d) Streamline
20. In aerobic environment, nitrosomonas convert
- (a)  $\text{NH}_3$  to  $\text{NO}_2$  (b)  $\text{NO}_2^-$  to  $\text{NO}_3^-$   
(c)  $\text{NH}_3$  to  $\text{N}_2\text{O}$  (d)  $\text{NO}_2^-$  to  $\text{HNO}_3$
21. The intensity of rainfall and time interval of typical storm are
- | Time interval (minutes) | Intensity of rainfall (mm / minute) |
|-------------------------|-------------------------------------|
| 0-10                    | 0.7                                 |
| 10-20                   | 1.1                                 |
| 20-30                   | 2.2                                 |
| 30-40                   | 1.5                                 |
| 40-50                   | 1.2                                 |
| 50-60                   | 1.3                                 |
| 60-70                   | 0.9                                 |
| 70-80                   | 0.4                                 |
- The maximum intensity of rainfall for  $20$  minutes duration of the storm is
- (a)  $1.52 \text{ mm/min}$  (b)  $1.85 \text{ mm/min}$   
(c)  $2.97 \text{ mm/min}$  (d)  $3.72 \text{ mm/min}$

22. Irrigation canals are generally aligned along  
(a) ridge line (b) contour line  
(c) valley line (d) straight line
23. The difference in level between the top of a bank and supply level in a canal, is called  
(a) berm (b) free board  
(c) height of bank (d) none of these
24. Attracting groynes are built  
(a) perpendicular to the bank (b) inclined down stream  
(c) inclined up stream (d) none of these
25. Retrogression of the bed level of a river downstream a weir, occurs due to  
(a) heavy impact of water (b) increase of the bed level  
(c) less percentage of silt (d) soft soil strata
26. The crest level of a canal diversion head work, depends upon  
(a) F.S.L. of the canal (b) discharge perimeters  
(c) pond level (d) all of these
27. The saturation line is the line up to which banks get saturated after the canal runs for some time. The saturation gradient in ordinary loam soil, is generally  
(a) 2 : 1 (b) 3 : 1  
(c) 4 : 1 (d) 5 : 1
28. Economic height of a dam is the height corresponding to which  
(a) cost of the dam per unit of storage is minimum  
(b) amount of silting is less  
(c) cost of dam per unit storage is maximum  
(d) free board provided is least
29. For a given discharge in a channel, Blench curves give the relationship between the loss of head (HL) and  
(a) specific energy up-stream (b) specific energy down-stream  
(c) critical depth of water down-stream (d) depth of water down-stream
30. Pick up the incorrect statement from the following:  
(a) The full supply level of a canal should be above ground level  
(b) According to Lacey, regime conditions require a particular slope for a given discharge and silt factor  
(c) In case the ground slope is less than the required bed slope, the silt factor must be increased by permitting the entry of coarse silt  
(d) All the above
31. The percentage error in the computed discharge over a triangular notch corresponding to an error of 1% in the measurement of the head over the notch would be  
(a) 1.0 (b) 1.5  
(c) 2.0 (d) 2.5
32. A river training work is generally required when the river is  
(a) meandering (b) aggrading  
(c) degrading (d) all the above
33. For loss of head in a canal inverted syphon barrel, the factor in the Unwin formula as shown below is a coefficient for loss of head due to  $h = \left(1 + f_1 + f_2 \frac{1}{R}\right) \frac{V^2}{2g} - \frac{Va^2}{2g}$   
(a) friction (b) exit  
(c) entry (d) gradient

34. If the straight sides of a triangular section of a lined canal with circular bottom of radius  $D$ , make an angle  $\alpha$  with horizontal, the hydraulic mean depth is
- (a)  $D$  (b)  $D/2$   
(c)  $D/3$  (d)  $D/4$
35. The treatment that should be given to water from a deep tube well is
- (a) Coagulation and flocculation only (b) Disinfection only  
(c) Filtration only (d) Pre-settling only
36. In a steady state radial flow into an intake, the velocity is found to vary as  $(1/r^2)$ , where  $r$  is the radial distance. The acceleration is proportional to
- (a)  $1/r$  (b)  $1/r^3$   
(c)  $1/r^4$  (d)  $1/r^5$
37. Shear stress develops in a fluid element, if
- (a) The fluid is at least  
(b) The fluid container is subjected to uniform linear acceleration  
(c) The fluid is inviscid  
(d) The fluid is viscous and the flow is non-uniform
38. A hydraulic turbine has a discharge of 5 cubic meter per second, when operating under a head of 20m with a speed of 500rpm. If it is to operate under a head of 15m, for the same discharge, the rotational speed in rpm will approximately be
- (a) 396 (b) 413  
(c) 433 (d) 627
39. A hydraulic turbine develops a power of  $10^4$  metric horse power while running at a speed of 100 revolutions per minute, under a head of 40m. What will be the specific speed
- (a) 100 (b) 314  
(c) 523 (d) 628
40. A water treatment plant is required to process 28800  $m^3/d$  of raw water (density =  $1000kg/m^3$ , kinematic viscosity =  $10^{-6} m^2/s$ ). The rapid mixing tank imparts a velocity of  $900s^{-1}$  to blend 35 mg/l of alum with the flow for a detention time of 120 seconds. The power input (W) required for rapid mixing is
- (a) 3.24 (b) 32.4  
(c) 324 (d) 32400
41. The peak discharge of an instantaneous unit hydrograph of a basin, when compared to the peak discharge of a 4-hour unit hydrograph of that basin, would be
- (a) Greater (b) Lesser  
(c) Equal (d) Equal or lesser
42. At a rated capacity of 44 cumecs, a centrifugal pump develops 36m of head when operating at 1450 rpm. Its specific speed is
- (a) 284 (b) 326  
(c) 498 (d) 654
43. A pitot tube is used to measure
- (a) Difference in pressure (b) Pressure  
(c) Velocity of flow (d) None of the above
44. A lysimeter is used to measure
- (a) Evaporation (b) Evapotranspiration  
(c) Infiltration (d) Radiation

45. Critical factors for the activated sludge treatment process are
- (a) Maximum hourly flow rate and maximum daily organic load
  - (b) Minimum hourly flow rate and minimum daily organic load
  - (c) Maximum and minimum flow rate
  - (d) None of the above
46. MPN index is a measure of one of the following
- (a) BOD
  - (b) Coliform bacteria
  - (c) Dissolved oxygen content
  - (d) Hardness
47. Both Reynolds and Froude numbers assume significance in one of the following examples
- (a) Motion of submarine at large depths
  - (b) Motion of ship in deep seas
  - (c) Cruising of a missile in air
  - (d) Flow over spillways
48. The ordinate of the instantaneous Unit Hydrograph (UH) of a catchment at any time  $t$  is
- (a) Difference in slope of the S-curve with effective rainfall intensity of 1cm/hr
  - (b) The slope of the direct runoff unit hydrograph at that time
  - (c) The slope of the 1-hour unit hydrograph at that time
  - (d) The slope of the S-curve with effective rainfall intensity of 1cm/hr
49. The expression for the specific speed of a pump
- (a) Does not include the diameter of the impeller
  - (b) Includes power as one of the variables
  - (c) Is necessarily non dimensional
  - (d) Yields larger values for radial pumps than for axial flow pump
50. Chlorine is sometimes used in sewage treatment to
- (a) Avoid flocculation
  - (b) Avoid bulking of activated sludge
  - (c) Helps in grease separation
  - (d) Increase biological activity of bacteria

**SECTION - B (Short answer type question)**  
**(100 Marks)**

*All questions carry equal marks of 5 each.*

*This Section should be answered only on the **Answer Sheet** provided.*

1. An average operating data for conventional activated sludge treatment plant is as follows:

Waste water flow 3500 cubic metre per day  
Volume of aeration tank 10900 cubic metre  
Influent BOD 250 mg/l  
Effluent BOD 20 mg/l  
Mixed liquor suspended solids (MLSS) 2500 mg/l  
Effluent suspended solids 30 mg/l  
Waste sludge suspended 9700 mg/l  
Quantity of waste sludge 220 cubic metre per day.

What will be the aeration period? Also find the efficiency of BOD removal.

2. A crop is grown in an area of 3000 hectare, which is fed by a system. The data pertaining to irrigation are  
 Field capacity of soil 26%  
 Optimum moisture 12%  
 Permanent wilting point 10%  
 Effective depth of root zone 80 cm  
 Apparent relative density of soil 1.4

If the frequency of irrigation is 10 days and overall irrigation efficiency is 22 %. What will be the daily consumption?

3. A rectangular channel 6.0 m wide carries a discharge of 16.0 m<sup>3</sup>/s under uniform condition with normal depth of 1.60 m. Manning's n is 0.015. Find the longitudinal slope of the channel.
4. Following chemical species were reported for water sample from a well:

Chemical	Concentration (milli equivalent/L)
Chloride (Cl <sup>-</sup> )	15
Sulphate (SO <sub>4</sub> <sup>2-</sup> )	15
Carbonate (CO <sub>3</sub> <sup>2-</sup> )	5
Bicarbonate (HCO <sub>3</sub> <sup>-</sup> )	30
Calcium (Ca <sup>2+</sup> )	12
Magnesium (Mg <sup>2+</sup> )	18
pH	8.5

Find the Alkalinity present in the water in mg/L as CaCO<sub>3</sub>.

5. One hour triangular unit hydrograph of a watershed has the peak discharge of 60 m<sup>3</sup>/sec.cm at 10 hours and time base of 30 hours. The  $\psi$  index is 0.4cm per hour and base flow is 15m<sup>3</sup>m/sec. Find the catchment area of the watershed?
6. The moisture holding capacity of the soil in a 100 hectare farm is 18 cm/m. the field is to be irrigated when 50 percent of the available moisture in the root zone is depleted. The irrigation water is to be supplied by a pump working for 10 hours a day, and water application efficiency is 75%. Details of crops planned for cultivation are as follows:

Crop	Root zone depth (m)	Peak rate of moisture use (mm/day)
A	1	5
B	0.8	4

Find the capacity of irrigation system required to irrigate crop A in 36 hectares. Also find the area of crop B that can be irrigated when the available capacity of irrigation system is 40 liters / sec.

7. A plain sedimentation tank with a length of 20m, width of 10m, and a depth of 3m is used in a water treatment plant to treat 4 million litres of water per day (4 MLD). The average temperature of water is 20°C. The dynamic viscosity of water is  $1.002 \times 10^{-3}$  N.s/m<sup>2</sup> at 20°C. Density of water is 998.2 kg/M<sup>3</sup>. Average specific gravity of particles is 2.65. What is the surface overflow rate in the sedimentation tank? What is the minimum diameter of the particle which can be removed with 100% efficiency from the sedimentation tank?
8. Determine the best hydraulic trapezoidal section to convey 85m<sup>3</sup>/s with a bottom slope of 0.001. The lining is finished concrete, n=0.012.

9. For a turbulent flow in a pipe, determine the distance from the pipe wall at which local velocity is equal to average velocity.
10. Crude oil of kinematic viscosity 2.25 strokes flows through a 20cm diameter pipe, the rate of flow being 1.5 litre per second. Find the type of flow.
11. A 50mm diameter jet of water strikes normally against a plate held in position and causes a force of 900 N on the plate. Determine the jet velocity and the discharge.
12. Find the field capacity of a soil for the following data:
  - Root zone depth=2m
  - Existing water content = 8%
  - Dry density of soil = 1.62g/cm<sup>2</sup>
  - Water applied to the soil = 500 m<sup>3</sup>
  - Water loss due to evaporation, etc. = 10%
  - Area of plot = 100sq.m
13. A crop requires a total depth of 92cm of water for a base period of 120days. Find the duty of water.
14. The slope of a channel in alluvium is  $S=1/5000$ . Lacey's silt factor=0.9. Channel side slope  $\frac{1}{2} : 1$ . Find the channel section and maximum discharge which can be allowed to flow in it.
15. A 30cm diameter well penetrates 25m below the static water table. After 24 hours of pumping at 5600 litres/minutes, the water level in a test well at 90m is lowered by 0.53m, and in a well 20m away. The drawdown is 1.11m. Find transmissibility of the aquifer, and drawdown in the main well.
16. Two primary settling basins are 26m in diameter with a 2.4m side water depth. Single effluents weirs are located on the peripheries of the tank. For a water flow of 26000m<sup>3</sup>/d, calculate the volume and detention time.
17. Chlorine usage in the treatment of 20000cubic meter per day is 18kg/day. The residual after 10 minutes contact is 0.20mg/l. Calculate the dosage in milligrams per litre and chlorine demand in water.
18. 2.2ml of raw sewage has been diluted to 220 ml and the D.O. concentration of the diluted sample at the beginning of the BOD test was 10mg/l and 6mg/l after 5 days incubation at 20°. Determine the BOD of raw sewage.
19. Calculate diameter and discharge of a circular sewer laid at a slope of 1 in 400 when it is running half full, and with a velocity of 1.9m/sec. (n in Manning's formula = 0.012).
20. Explain the various design criteria of a septic tank.

\* \* \* \* \*