MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR
JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (COMBINED)
UNDER VARIOUS DEPARTMENT,
GOVERNMENT OF MIZORAM, JULY-2024

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. Determine the specific gravity of one litre (1 L) of a liquid which weighs 7 N.
    (a) 1   (b) 0.7

    (c) 1.2   (d) 0.5

2. What is the SI unit of viscosity?
    (a) Poise   (b) N.s

    (c) Pa.s   (d) dyne

3. A pipe section has water flowing through it as shown below in figure. The diameter of a pipe at section 1 and 2 are 10 cm and 15 cm respectively. The velocity of the water flowing through the pipe at section 1 is 5 m/s. Determine the velocity at section 2.
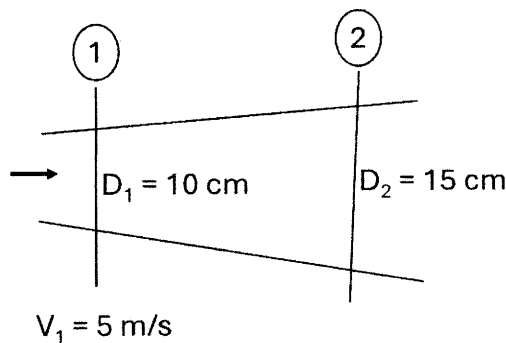

    (a) 5 m/s   (b) 3.3 m/s

    (c) 2.2 m/s   (d) 0.8 m/s

4. The rate of change of velocity due to the change of position of fluid particles in a fluid flow is known as
    (a) Conductive acceleration   (b) Convective acceleration

    (c) Local acceleration   (d) Regional acceleration

5. Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm² (gauge) and with mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross-section, which is 5 m above the datum line.

   (a) 30.0 m

   (b) 25.6 m

   (c) 20.7 m

   (d) 35.2 m

6. The head of water over an orifice of diameter 40 mm is 10 m. Find the actual velocity of the jet at vena-contracta. Take C_d = 0.6 and C_v = 0.98.

   (a) 0.010 m/s

   (b) 13.72 m/s

   (c) 4.49 m/s

   (d) 15.67 m/s

7. A direct runoff hydrograph due to an isolated storm with an effective rainfall of 2 cm was trapezoidal in shape as shown in the figure. Determine the catchment area that this hydrograph corresponds to.
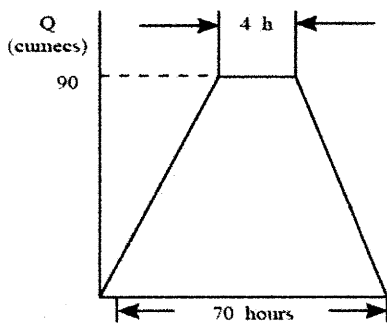
   (a) 119.8 km²

   (b) 599.4 km²

   (c) 799.5 km²

   (d) 1099.5 km²

8. The below given diagram shows the curve of a hydrograph. Which of the following would cause the peak of the curve to shift to the right?
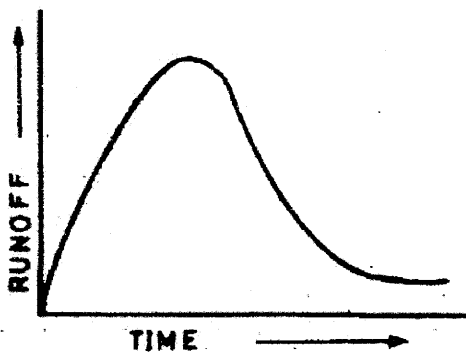

   (i)   When the length of the overland flow is more

   (ii) When the slope of the land surface is less

   (iii) When the runoff is more

   (iv) When the rainfall is moderate.

   Select the correct answer using the codes given below:

   (a) (iii) and (iv)

   (b) (ii) and (iv)

   (c) (i) and (ii)

   (d) (ii), (iii) and (iv)

9. Immediately after a rain, when all the gravity water has drained down to the water table, a certain amount of water is retained on the surface of the soil grains by molecular attraction and is not readily available to the plants, is known as
   (a) Capillary water
   (b) Gravitational water
   (c) Pellicular water
   (d) Hygroscopic water

10. In an underground profile, the zone of aeration does not include
    (a) Soil water
    (b) Capillary water
    (c) Ground water
    (d) Runoff

11. Capacity inflow ratio for a storage reservoir is defined as
    (a) $\dfrac{reservoir\ capacity}{average\ annual\ flood\ inflow}$
    (b) $\dfrac{reservoir\ capacity}{average\ annual\ sediment\ inflow}$
    (c) $\dfrac{dead\ storage\ capacity\ of\ the\ reservoir}{average\ annual\ flood\ inflow}$
    (d) $\dfrac{dead\ storage\ capacity\ of\ the\ reservoir}{average\ annual\ sediment\ deposited}$

12. Orthotolidine test is used for the determination of
    (a) Residual Chlorine
    (b) Dissolved Oxygen
    (c) Biochemical Oxygen Demand
    (d) Chloride Ion

13. If the total hardness of water is greater than its total alkalinity, the carbonate hardness will be equal to
    (a) Total Hardness
    (b) Total Alkalinity
    (c) Non-carbonate hardness
    (d) Bicarbonate hardness

14. The ratio of 5-day BOD to ultimate BOD is about
    (a) 1/3
    (b) 1/4
    (c) 2/3
    (d) 1/2

15. The settling velocity of a particle in a sedimentation tank is dependent on:
    (a) Depth of the tank
    (b) Surface area of the tank
    (c) Both the depth and surface area of the tank
    (d) None of the above

16. Calculate the Sludge Volume Index (in ml/gm) if 100 ml of sludge is collected in 30 mins on drying weighs 800 mg?
    (a) 125
    (b) 8
    (c) 0.008
    (d) 0.125

17. Which of the following wastewater treatment processes is an attached growth process?
    (a) Oxidation Pond
    (b) Imhoff tank
    (c) Rotating Biological Contactor
    (d) Activated Sludge process

18. The percentage of Chlorine in fresh bleaching powder is about _____
    (a) 10 – 15 %
    (b) 30 – 35 %
    (c) 20 – 25 %
    (d) 40 – 45 %

19. Turbines are characterized by different types of efficiency. One of the efficiencies have the equation as $\eta = \dfrac{Power\ at\ the\ shaft\ of\ the\ turbine}{Power\ delivered\ by\ water\ to\ the\ runner}$. Which among the following efficiencies is calculated using the given formula?
    (a) Hydraulic efficiency
    (b) Mechanical efficiency
    (c) Volumetric efficiency
    (d) Overall efficiency

20. On an indicator diagram of a reciprocating pump,

    (a) Pressure head is taken as abscissa and stroke length as ordinate.

    (b) Pressure head is taken as ordinate and stroke length as abscissa.

    (c) Both pressure head and stroke length are taken as abscissa.

    (d) Both pressure head and abscissa are taken as ordinate.

21. Specific speed of a turbine is defined as the speed of the turbine which

    (a) produces unit power at unit head.   (b) produces unit horsepower at unit discharge.

    (c) delivers unit discharge at unit head.   (d) delivers unit discharge at unit power.

22. The operating characteristic curves of a centrifugal pump are shown below in Figure, curve A is for
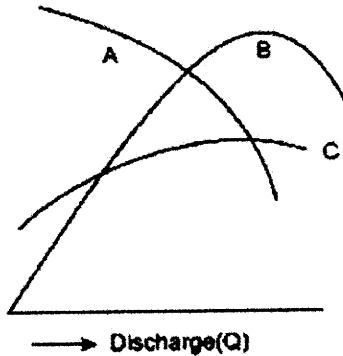
    (a) Head   (b) Efficiency

    (c) Power   (d) Time

23. The method of growing crops on ridges, running on the side of water ditches is known as

    (a) Flood irrigation.   (b) Furrow irrigation.

    (c) Check irrigation.   (d) Sprinkle irrigation.

24. If rice requires about 10 cm depth of water at an average interval of about 10 days, and the crop period for rice is 120 days, find out the delta for rice.

    (a) 100 cm   (b) 120 cm

    (c) 12 cm   (d) 1.0 cm

25. Find the delta for a crop when its duty is 864 hectares/cumec on the field, the base period of this crop is 120 days.

    (a) 1.2 cm   (b) 12 cm

    (c) 120 cm   (d) 1200 cm

26. The only irrigation module, which is not an orifice type but is of weir type is

    (a) Kennedy's gauge outlet   (b) open flume outlet

    (c) pipe outlet   (d) adjustable proportional module.

27. Multiple arch dams is an example of

    (a) arch dams.   (b) buttress dams.

    (c) shell-arch dams.   (d) earth dam.

28. Presence of tail water in a gravity dam

    (a) increases the principal stress and decreases the shear stress.

    (b) increases the principal stress and increases the shear stress.

    (c) decreases the principal stress and increases the shear stress.

    (d) decreases the principal stress and decreases the shear stress.

29. When is a fluid called turbulent?

    (a) Reynolds number is zero
    (b) Reynolds number is greater than 2000

    (c) Reynolds number is greater than 100
    (d) Reynolds number is smaller than 2000

30. Open channel flow takes place

    (a) In the pump
    (b) Within a cylindrical depth

    (c) On a free surface
    (d) In the pipe

31. Which property of the fluid accounts for the major losses in pipes?

    (a) pressure
    (b) force

    (c) specific gravity
    (d) viscosity

32. When a body is totally or partially immersed in a fluid, it is buoyed up by a force equal to

    (a) weight of the body and fluild displaced by the body

    (b) difference of weights of the fluid displaced and that of the body

    (c) sum of weights of the fluid displaced and that of the body

    (d) weight of the fluid displaced by the body

33. The phenomenon occuring in an open channel when a rapidly flowing stream abruptly changes to a slowly flowing stream causing a distinct rise of liquid surface, is

    (a) hydraulic jump
    (b) critical discharge

    (c) water hammer
    (d) critical velocity

34. Which is not a form of precipitation?

    (a) Water vapour
    (b) Rain

    (c) Snow
    (d) Hail

35. Which of the following is not an example of artificial aquifer recharge?

    (a) Sprinklers
    (b) Injection wells

    (c) Percolation tanks
    (d) Subsurface dykes

36. The following figure depicts runoff hydrograph of a river. What does the line "ab" represent?
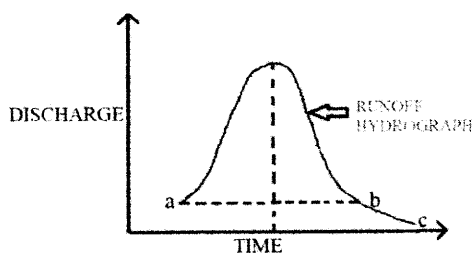
    (a) Assumed ground water inflow
    (b) Assumed surface runoff

    (c) Assumed river discharge
    (d) Assumed precipitation over river

37. If the duration of a storm is 30 minutes and the depth of rainfall is 30 cm then what will be the rainfall intensity in cm / hr?

    (a) 10
    (b) 20

    (c) 60
    (d) 100

38. What will be the probability of a storm occurring in any one year if the return period of the storm is 20 years?

    (a) 0.05
    (b) 1.05

    (c) 2.05
    (d) 3.05

39. Biochemical Oxygen Demand (B.O.D.) of safe drinking water must be
    (a) five
    (b) nil
    (c) ten
    (d) six

40. If the average daily consumption of Aizawl city is 10^5 m^3, the maximum daily consumption on peak hourly demand will be
    (a) 1.7×10^5 m^3
    (b) 9.7×10^5 m^3
    (c) 3.7×10^5 m^3
    (d) 2.7×10^5 m^3

41. Disinfection of drinking water, is done to remove
    (a) color
    (b) pH
    (c) odour
    (d) bacterias

42. Differential manometers are used to measure
    (a) atmospheric pressure
    (b) difference in pressure at two points
    (c) air temperature
    (d) atmospheric temperature

43. The fluid coming into the centrifugal pump is accelerated by
    (a) nozzle
    (b) impeller
    (c) throat
    (d) valve

44. When a canal and a drainage approach each other at the same level, the structure so provided, is
    (a) a level crossing
    (b) inlet and outlet.
    (c) a syphon
    (d) an aqueduct

45. When a canal is carried over a natural drainage, the structure provided, is known as
    (a) syphon
    (b) aqueduct
    (c) super passage
    (d) syphon-aqueduct.

46. A channel designed by Lacey's theory has a mean velocity of 1 m/s. The silt factor is unity. The hydraulic mean radius will be
    (a) 1.5 cm
    (b) 0.5 cm
    (c) 2.5 cm
    (d) 3.5 cm

47. For the design of major hydraulic structures on the canals, the method generally preferred to, is based on
    (a) The relaxation method
    (b) Electrical analogy method
    (c) Power design method
    (d) Khosla's method of independent variables.

48. The intensity of irrigation means
    (a) percentage of culturable commanded area to be irrigated annually
    (b) percentage of gross commanded area to be irrigated annually
    (c) percentage of the mean of culturable commanded area and the gross commanded area to be irrigated annually
    (d) total depth of water supplied by the number of waterings.

49. If the irrigation efficiency is 80%, conveyance losses are 20% and the actual depth of watering is 16 cm, the depth of water required at the canal outlet, is
    (a) 5 cm
    (b) 15 cm
    (c) 25 cm
    (d) 35 cm

50. Buckets and blades used in a turbine are used to
    (a) Switch off the turbine
    (b) To regulate the wind speed
    (c) Alter the direction of water
    (d) To regulate the temperature

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. The capillary rise in the glass tube is not to exceed 0.2 mm of water. Determine its minimum size. Given that the surface tension for water in contact with air = 0.0725 N/m.

2. What is a manometer? Describe at least two types of manometers with necessary sketches.

3. Make a neat sketch of a flood hydrograph and mark the following elements: (i) Rising limb, (ii) peak flow, (iii) falling limb, (iv) base flow, (v) lag time and peak time.

4. Explain the concept of Breakpoint chlorination with a neat sketch.

5. Briefly explain the four different types of particle settling. Explain them with relevant examples from water/wastewater treatment.

6. Five pipes, AB, BC, CD, DE, and EF of respective lengths, 20m, 25m, 20m, 25m, and 30m are connected in series. Find the equivalent diameter of a single pipe replacing these pipes using the equivalent pipe method. (Diameters of AB = 20 cm; BC = 25 cm; CD = 30 cm; DE = 20 cm; EF = 15 cm).

7. A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 L/s under a head of 30 m. The buckets deflect the jet through an angle of 160°. Calculate the power given by water to the runner and the hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98.

8. Explain the following terms in regard to centrifugal pump with necessary mathematical expressions wherever necessary: (i) suction head, (ii) static head, (iii) delivery head, (iv) Manometric head, (v) efficiencies of a centrifugal pump.

9. Explain at least two types of Surge tanks in detail. What are the factors influencing the choice of surge tank?

10. What are the two major crop seasons in India? Explain in detail. Give at least FIVE examples of crops for each season.

11. The discharge in a rectangular channel of width 6 m with Manning's $n = 0.012$ m$^{-1/3}$, S is 24 m^3 s^{-1}. If the streamwise slope is 1 in 200 find:
    (a) the normal depth;
    (b) the Froude number at the normal depth;
    (c) the critical depth.
    State whether the normal flow is subcritical or supercritical.

12. Explain the Characteristic Curves of Centrifugal Pump with suitable diagram.

13. Explain the working principle of a Reciprocating Pump and its classification with suitable diagram.

14. Following information regarding isohytes was obtained from the analysis of a storm. Determine the mean precipitation.

Isohyets interval (mm)	50-60	60-70	70-80	80-90	90-100	100-110
Area (km^2)	15	65	110	95	125	55

15. A flood of a certain magnitude has a return period of 40 years.

Determine:

    (a) the probability of exceedance,

    (b) probability of the flood of magnitude equal to or greater than the given magnitude occurring.

        (i) at least once in 10 successive years

        (ii) two times in 10 successive years, and

        (iii) once in 10 successive years.

16. Write a short note on water treatment process and various methods of waste water treatment.

17. Write short note on Net Irrigation Requirement and Irrigation Scheduling.

18. Explain the objectives and methods of River Training Works with suitable diagram.

19. A lined canal (n = 0.015) laid at a slope of 1 in 1600 is required to carry a discharge of 25 m³/s. The side slopes of the canal are to be kept at 1.25 H : 1 V. Determine the depth of flow.

20. Explain Stratification of a lake or reservoir based on temperature with suitable diagram.

* * * * * * *