MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF

INSPECTOR OF LEGAL METROLOGY

UNDER FOOD, CIVIL SUPPLIES & CONSUMER AFFAIRS, GOVT. OF MIZORAM

NOVEMBER, 2023

CIVIL ENGINEERING PAPER-III

Time Allowed : 2 hours | Full Marks : 200

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

1. The crushing strength (MPa) of a good stone used for construction of a building must not be less than _____

(a) 10 (b) 50
(c) 100 (d) 120

2. In ordinary cement, about 99% of its final strength is achieved in _____

(a) 3 days (b) 7 days
(c) 28 days (d) 1 year

3. In the process of the hydration of ordinary Portland cement (OPC), what is the water requirement (expressed as the percentage by weight of cement) to complete the chemical reactions?

(a) 15 to 25% (b) 20 to 25%
(c) 25 to 35% (d) 35 to 45%

4. What is the main reason to use lime in the cement slurry during the plastering in the topcoat?

(a) To make the surface bright. (b) To harden the cement.
(c) To make the plaster non-shrinkable. (d) To improve the workability of plaster.

5. Which one of the following metamorphic rocks has more weathering resistance characteristics?

(a) Limestone (b) Phyllite
(c) Quartzite (d) Slate

6. Which of the following types of stone is used in the rubble masonry?

(a) Hard (b) Shallow
(c) Clay (d) Smooth

7. The hydraulicity of the hydraulic lime is mainly due to _____.

(a) calcium oxide (b) clay
(c) sulphur (d) water

8. The red colour obtained by the bricks is due to the presence of:

(a) lime (b) silica
(c) manganese (d) iron oxide

9. Which constituent of the cement, upon addition of water, sets and hardens first?

(a) tri-calcium silicate (b) tri-calcium aluminate
(c) di-calcium silicate (d) free lime

10. The aggregate is called fine aggregate if it is completely retained on
    (a) 0.15 mm sieve
    (b) 0.30 mm sieve
    (c) 2.36 mm sieve
    (d) 4.75 mm sieve

11. When a brick is cut into two halves longitudinally, one part is called—
    (a) king closer
    (b) cornice brick
    (c) queen closer
    (d) voussoir

12. Calculate the year's purchase for a property of useful life of 30 years and rate of interest of 5% per annum.
    (a) 0.02
    (b) 0.2
    (c) 2
    (d) 20

13. Calculate the volume (cubic meter) of earthwork for an embankment of length 30 m and width 4 m. The mean depth of the embankment is 4 m and the side slope is 2 : 1. Using mid-sectional area method.
    (a) 480
    (b) 960
    (c) 1440
    (d) 1920

14. Plumb bob lines at two different places in geodetic surveying will _____.
    (a) intersect at the surface of the Earth
    (b) intersect at the center of the Earth
    (c) parallel to each other
    (d) perpendicular to each other

15. *Assertion A:* For identical strength, a composite cement-lime mortar is preferred over cement mortar.
    Reason R: Composite cement-lime mortar has higher drying shrinkage than cement mortar.
    Select your answer based on the codes given below:
    (a) Both A and R is true and R is the correct explanation of A
    (b) Both A and R is true but R is not a correct explanation of A
    (c) A is true but R is false
    (d) A is false but R is true

16. Consider the following statements:
    1. Masonry in rich cement mortar though having good strength with high shrinkage is much liable for surface cracks.
    2. Lime mortar possesses poor workability and poor water retentivity and suffers high shrinkage.
    3. Masonry in lime mortar has better resistance against rain penetration and is less liable to crack when compared to masonry in cement mortar.

    Which of these statements are correct?
    (a) 1, 2 and 3
    (b) 1 and 2
    (c) 2 and 3
    (d) 1 and 3

17. The service area in a building does not include the area occupied by:
    (a) Stairs
    (b) Toilets
    (c) Light and shafts
    (d) Mechanical rooms

18. The columns of conventional multi-storeyed buildings are designed NOT to withstand the forces due to
    (a) Dead loads
    (b) Live loads
    (c) Wind loads
    (d) Explosions

19. The wedge-shaped bricks forming an arch ring, are called——
    (a) Soffits
    (b) Voussoirs
    (c) Haunches
    (d) Spandrils

20. Pick up the correct statement from the following:
    (a) Plain cement concrete is equally strong in compression as well as in tension.
    (b) Slump test is performed to check concrete strength.
    (c) Curing of concrete is done for proper compaction of cement.
    (d) Fineness modulus is the index number expressing the relative sizes of both coarse and fine aggregates.

21. The maximum total settlement for isolated foundations on clayey soils should be limited to
    (a) 25 mm
    (b) 40 mm
    (c) 65 mm
    (d) 100 mm

22. Which of the following has more fire resisting characteristics?
    (a) Marble
    (b) Limestone
    (c) Compact sandstone
    (d) Granite

23. The rocks which are formed due to cooling of magma at a considerable depth from earth's surface are called—
    (a) Plutonic rocks
    (b) Hypabyssal rocks
    (c) Volcanic rocks
    (d) Metamorphic rocks

24. A mortar joint in masonry which is normal to the face of wall is known as
    (a) Bed joint
    (b) Wall joint
    (c) Cross joint
    (d) Bonded joint

25. The pressure acting on the stones in stone masonry construction should be—
    (a) Along the direction of bedding planes
    (b) At 45° to the direction of bedding planes
    (c) At 60° to the direction of bedding planes
    (d) Perpendicular to the direction of bedding planes

26. In time-cost optimization of a project, crashing is done——
    (a) On all the activities
    (b) On all the activities lying on the critical path
    (c) Only on activities lying on the original critical path and having flatter cost slopes
    (d) On original critical activities and those that become critical at any stage of crashing in the order of ascending cost slope

27. Which of the following earth moving machines has the shortest cycle time?
    (a) Drag line
    (b) Hoe
    (c) Clam shell
    (d) Dipper shovel

28. Updating a project plan may NOT result in
    (a) Change of critical path
    (b) Decrease of project completion time
    (c) Increase of project completion time
    (d) Elimination of risks

29. During the construction period, price variation clause in contracts caters to
    (a) Increase in rates of only important materials
    (b) Variation in cost in materials element, labour element and petrol-oil-lubricant element
    (c) Variation in total cost of the project on an ad hoc basis
    (d) Rate of inflation

30. For a given activity, the optimistic time, pessimistic time and the most probable estimates are 5, 17 and 8 days respectively, The expected time is
    (a) 8 days
    (b) 9 days
    (c) 10 days
    (d) 15 days

31. An excavator costs Rs. 20,00,000 and has an estimated life of 8 years. It has no salvage value at the end of 8 years. The book value of the excavator at the end of 3 years using general double declining balance method is—
    (a) Rs. 8,43,750
    (b) Rs. 8,75,000
    (c) Rs. 10,50,000
    (d) Rs. 11,56,250

32. A wheeled tractor hauling unit is working on firm earth. The total loaded weight distribution of this unit is:

    Drive wheels: 25000 kg

    Scraper wheels: 10000 kg

    If the coefficient of traction for wheeled tractor on firm earth is 0.5, the rimpull which this tractor can exert without slipping is
    (a) 10000 kg
    (b) 12500 kg
    (c) 22500 kg
    (d) 5000 kg

33. If the expected time of completion of a project is 60 weeks with a standard deviation of 5 weeks, the probability of completing the project in 50 weeks and 65 weeks respectively will be
    (a) 2.3% and 84.1%
    (b) 97.7% and 84.1%
    (c) 97.7 % and 15.9%
    (d) 15.9% and 97.7%

34. Free float is mainly used to
    (a) Identify the activities which can be delayed without affecting the total float of preceding activity
    (b) Identify the activities, which can be delayed without affecting the total float of succeeding activity
    (c) Establish priorities
    (d) Identify the activities which can be delayed without affecting the total float of either the preceding or succeeding activities

35. The time by which a particular activity can be delayed without affecting the preceding and succeeding activities is known as
    (a) Total float
    (b) Free float
    (c) Interfering float
    (d) Independent float

36. The difference between the time avail-to do a job and the time required to do the job, is known as
    (a) Event
    (b) Float
    (c) Duration
    (d) Constraint

37. If a is the optimistic time, b is the pessimistic time and m is most likely time of an activity, the expected time of the activity, is
    (a) $(a + m + b)/6$
    (b) $(a + 2m + b)/6$
    (c) $(a + 4m + b)/6$
    (d) $(a + 5m + b)/6$

38. Critical path lies along the activities having total float

(a) Positive (b) Negative

(c) Zero (d) Same

39. If the scheduled completion time of a project is more than the earliest expected time for completion of the project, then the probability of completion of the project within the scheduled completion time will be—

(a) 50 % (b) Less than 50 %

(c) More than 50 % (d) 100 %

40. If t is the duration of an activity, t_1 is the latest finish possible moment of its preceding activity and t_2 is the earliest start possible moment, the independent float of the activity is

(a) $(t_1 - t_2) - t$ (b) $t - (t_1 - t_2)$

(c) $(t_1 + t_2) - t$ (d) $t + (t_1 - t_2)$

41. Soil transported by wind is called

(a) Aeolian soil (b) Alluvial soil

(c) Marine soil (d) Locustrine soil

42. Rise of water table above the ground surface causes————

(a) Equal increase in pore water pressure and total stress.

(b) Equal decrease in pore water pressure and total stress.

(c) reduces both pore water pressure and total stress.

(d) Decrease in pore water pressure but increase in total stress.

43. In the following, select one that is not an assumption involved in Terzaghi's theory of one-dimensional consolidation.

(a) Soil is homogeneous and fully saturated.

(b) Water and soil particles are incompressible.

(c) Deformation of the soil is entirely due to changes in volume.

(d) Soil properties change with chemical or biological effects.

44. If the material of the base of the Casagrande liquid limit device on which the cup containing soil paste drops is softer than the standard hard rubber, then

(a) The liquid limit of soil always increases. (b) The liquid limit of soil always decreases.

(c) The liquid limit of soil may increase. (d) The liquid limit of soil may decrease.

45. The ultimate consolidation settlement of a structure resting on a soil

(a) Decreases with the increase in the initial voids ratio

(b) Decreases with the decrease in the plastic limit

(c) Increases with the increase in the initial voids ratio

(d) Increases with the decrease in the porosity of the soil

46. Skempton's pore pressure coefficient B for fully saturated soil is

(a) 1 (b) 0

(c) Between 0 and 1 (d) >1

47. The active earth pressure of a soil is proportional to (where φ is the angle of friction of the soil) __.

(a) $\tan(45° + \varphi)$ (b) $\tan(45° - \varphi)$

(c) $\tan^2(45° + \varphi/2)$ (d) $\tan^2(45° - \varphi/2)$

48. The minimum water content at which the soil just begins to crumble when rolled into threads 3 mm in diameter, is known———

(a) liquid limit
(b) plastic limit
(c) shrinkage limit
(d) permeability limit.

49. The maximum shear stress occurs on the filament which makes an angle with the horizontal plane equal to

(a) 30°
(b) 45°
(c) 60°
(d) 90°

50. For determining the moisture content of a soil sample, the following data is available; Weight of container = 260 g, Weight of soil sample and = 320 g container, Weight of soil sample (dried) and = 310 g container. The moisture content of the soil sample, is

(a) 15%
(b) 18%
(c) 20%
(d) 25%

51. For determine the specific gravity of soil solids, using a pycnometer of 500 cc., the following data is available: Weight of dry empty pycnometer = 125 g Weight of dried soil and pycnometer = 500 g Weight of dried soil and distilled = 850 g water filled in pycnometer up to top. The specific gravity of soil solids, is

(a) 2
(b) 2.25
(c) 2.50
(d) 2.75

52. Pick up the correct statement from the following:

(a) An unconfined compression test is a special case of triaxial compression test
(b) An unconfined compression test is a special case of direct shear test
(c) The confining pressure is maximum during an unconfined compression test
(d) The cylindrical specimen of a soil is subjected to major principal stress till it fails due to shearing along the plane of the failure.

53. A compacted soil sample using 10% moisture content has a weight of 200 g and mass unit weight of 2.0 g/cm3. If the specific gravity of soil particles and water are 2.7 and 1.0, the degree of saturation of the soil is

(a) 11.1 %
(b) 55.6 %
(c) 69.6 %
(d) 72.5%

54. What is the intensity of active earth pressure at a depth of 10.0 meters in dry sand with an angle of shearing resistance of 30 degrees and a unit weight of 18 kN/m^3?

(a) 45 kN/m^2
(b) 60 kN/m^2
(c) 75 kN/m^2
(d) 90 kN/m^2

55. The vane shear test is used for the in-situ determination of the undrained strength of the intact fully saturated———

(a) sands
(b) clays
(c) gravels
(d) highly organic soils

56. The angle between the directions of the failure and the major principal plane, is equal to

(a) 90° + effective angle of shearing resistance
(b) 90° + half of the angle of shearing resistance
(c) 45° - half of the angle of shearing resistance
(d) 45° + half of the angle of shearing resistance

57. What is the expression for raw density (ρ) in terms of bulk density (ρb) and water content (w)?

(a) $\rho = \rho b + w$
(b) $\rho = \rho b - w$
(c) $\rho = (\rho b / w) + 1$
(d) $\rho = \rho b / (1 + w)$

58. Rankine's theory of earth pressure assumes that the back of the wall is

(a) Plane and smooth
(b) Plane and rough
(c) Vertical and smooth
(d) Vertical and rough

59. The equation $\tau = C + \sigma \tan \varphi$ is given by

(a) Rankine
(b) Coulomb
(c) Coleman
(d) Mohr

60. The coefficient of curvature is expressed as ———

(a) D_{60}/D_{10}
(b) D_{10}/D_{60}
(c) $D_{30}^2/(D_{60} \times D_{10})$
(d) $D_{10}^2/(D_{30} \times D_{60})$

61. If h is the difference in level between end points separated by l, then the slope correction is $(h^2/2l) + (h^4/8l^3)$.

The second term may be neglected if the value of h in a 20 m distance is less than

(a) 1/2 m
(b) 1 m
(c) 2 m
(d) 3 m

62. Which of the following methods of theodolite traversing is suitable for locating the details which are far away from transit stations?

(a) Measuring angle and distance from one transit station
(b) Measuring angles to the point from at least two stations
(c) Measuring angle at one station and distance from other
(d) Measuring distance from two points on traverse line

63. Remote sensing techniques make use of the properties of _____ emitted, reflected or diffracted by the sensed objects:

(a) Electric waves
(b) Sound waves
(c) Electromagnetic waves
(d) Wind waves

64. Which of the following methods of contouring is most suitable for a hilly terrain?

(a) Direct method
(b) Square method
(c) Cross-sections method
(d) Tachometric method

65. There are two stations A and B. Which of the following statements is incorrect?

(a) The fore bearing of AB is equal to the back bearing of BA.
(b) The fore bearing of AB is always measured clockwise from the north direction.
(c) The back bearing of AB is the opposite direction of its fore bearing.
(d) The sum of the fore bearing of AB and the back bearing of BA is 180°.

66. The Random errors tend to accumulate proportionally to

(a) Numbers of operations involved.
(b) Reciprocal of operations involved.
(c) Square root of the number of operations involved
(d) Cube root of the number of operations involved.

67. A level, when set up 25 m from peg A and 50 m from peg B, reads 2.853 m on a staff held on A and 4.462 m on a staff held on B, keeping the bubble at its center while reading. If the reduced levels of A and B are 283.665 m and 285.295 m, respectively, what is the collimation error per 100.0 m?

(a) 0.025
(b) 0.068
(c) 0.084
(d) 1.250

68. Hydrographic surveys deal with the mapping of

(a) Large water bodies (b) Celestial bodies

(c) Mountainous region (d) Canal system

69. The curve composed of two arcs of different radii having their centres on the opposite side of the curve, is known

(a) a simple curve (b) a compound curve

(c) a reverse curve (d) a vertical curve

70. If the length of a transition curve to be introduced between a straight and a circular curve of radius 500 m is 90 m, the maximum deflection angle to locate its junction point, is

(a) 1°43' 08" (b) 1°43' 18"

(c) 1°43' 28" (d) 1°43' 38"

71. Tilt of the staff in stadia tacheometry increases the intercept if it is

(a) away from the telescope pointing down hill (b) towards the telescope pointing up-hill

(c) away from the telescope pointing up-hill (d) towards the telescope pointing down-hill.

72. Number of links per metre length of a chain are

(a) 2 (b) 5

(c) 8 (d) 10

73. An imaginary line lying throughout on the surface of the earth and preserving a constant inclination to the horizontal, is called

(a) Contour line (b) Contour gradient

(c) Level line (d) Line of gentle scope

74. If a 30 m chain diverges through a perpendicular distance d from its correct alignment, the error in length, is———

(a) $(d^2/60)$ m (b) $(d^2/30)$ m

(c) $(d^2/40)$ m (d) $(d/30)$ m

75. The operation of resection involves the following steps:

1. Rough orientation of the plane table
2. The three lines form a triangle of error
3. Drawing lines back through the three control points
4. Select a point in the triangle of error such that each ray is equally rotated either clockwise or anti clockwise
5. The points obtained by three rays are the correct location.

The correct sequence is

(a) 1, 3, 2, 4, 5 (b) 1, 2, 3, 4, 5

(c) 1, 4, 3, 2, 5 (d) 1, 3, 4, 2, 5

76. The latitude of a traverse leg is obtained by multiplying its length by

(a) tangent of its reduced bearing (b) sign of its reduced bearing

(c) cosine of its reduced bearing (d) cosecant of its reduced bearing.

77. The height of the sink of wash basin above floor level is kept

(a) 60 cm (b) 70 cm

(c) 75 cm to 80 cm (d) 85 cm

78. For 100 sq. m cement concrete (1 : 2: 4) 4 cm thick floor, the quantity of cement required, is

(a) 0.90 m^3 (b) 0.94 m^3

(c) 0.98 m^3 (d) 1.00 m^3

79. The various stages occurring in GPS system are described below:

1. Generation of an output to the user
2. Detection of the GPS signals
3. Processing the data in the built-in-computer
4. Decoding the GPS signal.

The correct sequence of the stages is:

(a) 1, 2, 3, 4 (b) 2, 3, 4, 1

(c) 2, 4, 3, 1 (d) 3, 1, 2 , 4

80. The normal altitude of GPS satellite is about——

(a) 16,800 km (b) 20,200 km

(c) 24,400 km (d) 36,100 km

81. The reduced levels of the ends A and B of a runway are 3025 m and 3035 m and that of its mid-point is 3015 m. The reduced level of the horizontal surface, is

(a) 3070 m (b) 3060 m

(c) 3075 m (d) 3015 m

82. For night landing at airports, the thresholds are lighted in——

(a) green (b) red

(c) white (d) yellow

83. Which of the following conditions of loading imposes the greatest load on the foundation in case of dry docks?

(a) When the dock is empty

(b) When the dock is empty with the ship of maximum tonnage

(c) When the dock is full of water

(d) When the dock is dry and is under construction

84. When a ship floats at its designed water line, the vertical distance from water line to the bottom of the ship is known as

(a) Beam (b) Depth

(c) Freeboard (d) Draft

85. For Broad-Gauge single-track railway, the height of the tunnel above top of rails should be

(a) 5.5 m to 5.8 m (b) 5.8 m to 6.2 m

(c) 6.7 m to 7.3 m (d) 7.3 m to 7.5 m

86. If the coefficient of friction on the road surface is 0.15 and a maximum super-elevation 1 in 15 is provided, the maximum speed of the vehicles on a curve of 100 metre radius, is

(a) 32.44 km/hour (b) 42.44 kg/hour

(c) 52.44 km/hour (d) 62.44 km/hour

87. If degree of a road curve is defined by assuming the standard length of an arc as 30 metres, the radius of 1° curve is equal to

(a) 1875 m (b) 1719 m

(c) 1146 m (d) 1046 m

88. A district road with a bituminous pavement has a horizontal curve of 1000 m for a design speed of 75 km ph. The super-elevation is ——

(a) 1 in 40 (b) 1 in 50

(c) 1 in 60 (d) 1 in 70

89. The difference in gradients after full super-elevation and the initial alignment of a road, is known as —— ——

(a) Ruling gradient (b) Rising gradient

(c) Compensated gradient (d) Differential gradient

90. The camber for hill roads in case of bituminous surfacing is adopted as

(a) 2 % (b) 2.5 %

(c) 3.2 % (d) 4.5 %

91. The total length of a valley formed by two gradients - 3% and + 2% curve between the two tangent points to provide a rate of change of centrifugal acceleration 0.6 m/sec^2, for a design speed 100 kmph, is

(a) 16.0 m (b) 42.3 m

(c) 84.6 m (d) 96.7 m

92. If d is the thickness of a concrete pavement, the equivalent radius b of resisting section for an interior loading, is

(a) $b = \sqrt{(0.6 + d^2} + 0.675d$ (b) $b = \sqrt{(0.6 + d^2} - 0.675d$

(c) $b = \sqrt{(1.6 + d^2} + 0.675d$ (d) $b = \sqrt{(1.6 + d^2} - 0.675d$

93. If x% is the gradient of an alignment and y% is the gradient after proper superelevation along a curved portion of a highway, the differential grade along the curve, is

(a) (x + y)% (b) (x - y)%

(c) (y - x)% (d) (x × y)%

94. If D is the degree of a curve, the percentage reduction of gradient, is

(a) 0.02 D (b) 0.04 D

(c) 0.06 D (d) 0.08 D

95. The absolute minimum sight distance required for stopping a vehicle moving with a speed of 80 kmph, is

(a) 120 m (b) 200 m

(c) 640 m (d) 700 m

96. The rails get out of their original positions due to insufficient expansion gap. This phenomenon is known

(a) Hogging (b) Buckling

(c) Creeping (d) Warping

97. In a Broad-Gauge railway track, the specified ruling gradient is 1 in 250. The horizontal curve of 3° on a gradient of 1 in 250 will have the permissible gradient of

(a) 1 in 257 (b) 1 in 357

(c) 1 in 457 (d) 1 in 512

98. According to Railway Board, no diamond crossing should be flatter than

(a) 1 in $6\frac{1}{2}$

(b) 1 in $8\frac{1}{2}$

(c) 1 in $10\frac{1}{2}$

(d) 1 in $12\frac{1}{2}$

99. On a straight railway track, absolute levels at point A on two rails are 100.550 m and 100.530 m and the absolute levels at point B 100 m apart are 100.585 m and 100.515 m respectively, the value of twist of rails per metre run, is

(a) 0.4 mm

(b) 0.5 mm

(c) 0.7 mm

(d) 0.8 mm

100. _____ is a tapered movable rail made of high-carbon or manganese steel to withstand wear and at its thicker end it is attached to a running rail.

(a) Stock rail

(b) Points

(c) Turnout

(d) Tongue rail

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