1. The radius of a horizontal curve is 100 m. The design speed is 50 kmph and the design coefficient of lateral friction is 0.15. If the full lateral friction is assumed to develop, the required superelevation is

(A) 0.917   (B) 0.524

(C) 0.234   (D) 0.047

2. The penetration test of bitumen is used to determine

(A) viscosity

(B) grade

(C) ductility

(D) softening point

3. The psychological widening of a pavement on horizontal curve of radius 230 m for a ruling speed 80 kmph is

(A) 0.255 m   (B) 0.185 m

(C) 0.55 m   (D) 0.13 m

4. While aligning a hill road with a ruling gradient of 6 percent, a horizontal curve of radius 60 m is encountered. The compensated gradient at the curve is

(A) 4.5%   (B) 4.75%

(C) 5.0%   (D) 5.25%

5. The maximum number of points of conflicts in two-way two-lane road meeting at right angle is

(A) 8   (B) 12

(C) 24   (D) 32

6. One of the following methods is not used in conducting speed and delay studies. That method is

(A) floating car method

(B) speed and delay method

(C) interview technique

(D) elevated observation

7. A vehicle of weight 2.0 tonne skids through a distance equal to 40 m before colliding with another parked vehicle of weight 1.0 tonne. After collision, both the vehicles skid through a distance equal to 12 m before stopping. If the average coefficient of friction is 0.5, both the vehicles after collision will move together with a speed of

(A) 16.3 m/s

(B) 25.6 m/s

(C) 35.4 m/s

(D) 10.8 m/s

8. Fixed delay in highway is due to

(A) road repairs

(B) pedestrian crossing the road

(C) traffic signal

(D) parked vehicle

9. The free mean speed on a roadway is found to be 80 kmph. Under stopped condition, the average spacing between vehicles is 6·9 m. The capacity flow is

(A) 3200 vehicles/hour/lane

(B) 2900 vehicles/hour/lane

(C) 2500 vehicles/hour/lane

(D) 2200 vehicles/hour/lane

10. The type of stone aggregates not suitable for pavement is

(A) round aggregates

(B) irregular aggregates

(C) angular aggregates

(D) flaky aggregates

11. The instantaneous speed of vehicles at a specified location is called

(A) spot speed

(B) time mean speed

(C) running speed

(D) constant speed

12. What is the purpose of the first general principle of working from the whole to the part?

(A) It is easy to work from the whole to the part than to work from the part to the whole

(B) To prevent accumulation of errors, if any

(C) No compensating error of any kind is possible

(D) All of the above

13. The distance between two points is measured by a 30 m long steel tape in suspension using a 15 kg pull. The cross-sectional area of the tape = 0·03 cm^2 and its total weight is 0·693 kg. The coefficient of thermal expansion, α for steel = 11×10^{-6} per °C and E for steel = $2·1 \times 10^6$ kg/cm^2. The sag correction per tape length is

(A) + 0·00238 m

(B) + 0·00267 m

(C) − 0·00238 m

(D) − 0·00267 m

14. The magnetic bearing of a line is 140° 45'. The true bearing of the line, if the magnetic declination 5° 30' W, is

(A) 146° 15'   (B) 135° 15'

(C) 39° 15' E   (D) 39° 15' W

15. When a closed compass traverse is plotted, if the closing error is within the permissible limit, it is adjusted graphically by Bowditch's rule. The permissible limit of relative closing error is

(A) $\dfrac{1}{300}$ (B) $\dfrac{1}{400}$

(C) $\dfrac{1}{500}$ (D) $\dfrac{1}{600}$

16. A 30-metre metric chain is divided into

(A) 100 links   (B) 150 links

(C) 200 links   (D) 300 links

17. A man at a position 30 m above sea level just observes the peak of a hill. The peak of the hill is 200 m above sea level. Considering combined effect of curvature and refraction, the distance between the man and the peak of the hill is

(A) 67·5 m   (B) 72·3 m

(C) 75·6 m   (D) 80·3 m

18. In a transit theodolite, the line of sight can be reversed by revolving the telescope through

(A) 90° in horizontal plane

(B) 90° in vertical plane

(C) 180° in horizontal plane

(D) 180° in vertical plane

19. In ideal condition, in a closed traverse, the algebraic sum of latitudes and that of departures must be equal to

(A) zero   (B) 90°

(C) 180°   (D) 270°

20. The ranges for WCB and QB are respectively

(A) 0° to 90° and 0° to 180°

(B) 0° to 90° and 0° to 360°

(C) 0° to 180° and 0° to 360°

(D) 0° to 360° and 0° to 90°

21. Reverse curve should be avoided as far as possible for important tracks or highways because

(A) it is difficult to construct a reverse curve

(B) setting out a reverse curve in the field is difficult

(C) superelevation cannot be provided at the point of reverse curvature

(D) All of the above

22. The length of a transition curve is given by

(A) $\dfrac{V^2}{gR}$ (B) $\dfrac{V^3}{CR}$

(C) $\dfrac{\pi R \phi}{180°}$ (D) $\dfrac{V^2}{CR}$

where

V = Speed in m/s

R = Radius of curve in m

C = Rate of change of radial acceleration in m/s³

g = Acceleration due to gravity

ϕ = Deflection angle

23. In the geometric design of highway, a type of vertical curve used to connect two gradients forming convex curve is known as

(A) summit curve

(B) sag curve

(C) transition curve

(D) straight curve

24. If the plasticity index of a soil mass is zero, the soil is

(A) clay 　　　　(B) silt

(C) sand 　　　　(D) clayey silt

25. Diffuse double layer in soil-water system is formed because surfaces of clay particles carry a net negative charge. This results from

(A) isomorphous substitution and surface dissociation of hydroxyl ions

(B) absence of cations in the crystal lattice and adsorption of anions

(C) presence of organic matter

(D) any one combination of the factors mentioned in (A), (B) and (C) above

26. A soil with specific gravity of 2·65 has a void ratio of 0·65 in its loosest state and 0·30 in its densest state respectively. If the density index of the soil is 0·46, the dry density of the soil in its natural state is

(A) 1·65 gm/cm^3

(B) 1·78 gm/cm^3

(C) 1·91 gm/cm^3

(D) 2·14 gm/cm^3

27. If a soil is in the semi-solid state, the liquidity index, I_L is

(A) $I_L < 0$ 　　(B) $0 < I_L < 1$

(C) $I_L = 1$ 　　(D) $I_L > 1$

28. As per the IS plasticity chart, a soil is classified as CH soil. If the liquid limit of the soil is 55%, then the plastic limit of the soil is

(A) $> 29·45\%$

(B) $< 29·45\%$

(C) $> 26·55\%$

(D) $< 26·55\%$

29. For the number of columns constructed in a row, the type of foundation provided is

(A) raft 　　　　(B) strap

(C) strip 　　　　(D) footing

30. Vibratory rollers are most suited for

(A) clayey soils

(B) silty clay soils

(C) granular soils

(D) All of the above

31. A laboratory compaction test on a soil having specific gravity equal to 2·65 and at a moisture content of 12%, corresponding to 5% air voids, will have a dry density of

(A) 1·89 gm/cm^3

(B) 1·91 gm/cm^3

(C) 1·95 gm/cm^3

(D) 1·97 gm/cm^3

32. A sample of dense sand is tested in a triaxial shear with a confining pressure of $100 \, kN/m^2$. If the angle of internal friction of the sand is $38°$, the deviator stress at failure is

(A) $220 \, kN/m^2$

(B) $320 \, kN/m^2$

(C) $420 \, kN/m^2$

(D) $520 \, kN/m^2$

33. The unconfined compression test is a special type of

(A) vane shear test

(B) unconsolidated-undrained triaxial test

(C) unconsolidated-undrained direct shear test

(D) drained triaxial shear test

34. As per IS : 6403–1981, if the water table is just below the foundation level, in calculating the bearing capacity, the water table reduction factor, R_w will be

(A) $R_w = 0$

(B) $R_w = 0.5$

(C) $R_w = 1.0$

(D) $0.5 < R_w < 1.0$

35. The method of boring adopted in boundary and gravelly strata is

(A) auger boring

(B) wash boring

(C) percussion boring

(D) rotary boring

36. As per the IS codal guidelines for depth of investigation, in case rock formation is encountered prior to the termination depth, the boreholes may be extended, in rock strata, by minimum

(A) 3 m

(B) 4 m

(C) 5 m

(D) 7 m

37. The depth interval between the bottom of the standard penetration test and next undisturbed sampling/ any other test shall not be less than

(A) 200 mm

(B) 300 mm

(C) 400 mm

(D) 500 mm

38. In soft cohesive soil and very loose cohesionless soil, especially below groundwater table, the undisturbed sample of soil collected is

(A) block sample

(B) thin-walled sample

(C) piston sample

(D) core sample collected in core barrel

39. For undisturbed sampling in soft sensitive clays, the preferred area ratio of the sampler should be

(A) 10 percent or less

(B) 12.5 percent or less

(C) 15 percent or less

(D) 20 percent or less

40. The angle of repose is the maximum angle which the outer face of the soil mass makes

(A) with the horizontal

(B) with the vertical

(C) with the perpendicular to the inclined plane of soil

(D) None of the above

41. A plate load test carried out on a loose sandy soil, under a pressure of $100 \, kN/m^2$, gives rise to a final equilibrium settlement of 5 mm. The plate size is 45 cm × 45 cm. If a footing of size 1 m × 1 m is loaded with a pressure of $100 \, kN/m^2$, resting on the same soil, the final equilibrium settlement will be

(A) 7·2 mm

(B) 8·2 mm

(C) 9·2 mm

(D) None of the above

42. The intensity of vertical stress, induced at a point 5 m below a point load of 200 kN, acting on the surface of a soil mass with a large lateral restraint, so that it does not undergo any lateral strain, is

(A) $3·8 \, kN/m^2$ (B) $2·5 \, kN/m^2$

(C) $0·5 \, kN/m^2$ (D) $1·5 \, kN/m^2$

43. The ultimate load capacity of a uniform shaft bored and cast-in-situ pile, 450 mm in diameter and 6·0 m long, in a cohesive soil deposit with an undrained shear strength of $30 \, kN/m^2$, is

(A) 254·5 kN (B) 297·4 kN

(C) 42·9 kN (D) 118·9 kN

44. When a pile in a group, designed for a certain safe load, is found to fall just short of the load required to be carried by it, the maximum overload, allowed above the allowable load on a single pile of the pile group, is

(A) up to 10 percent

(B) up to 15 percent

(C) up to 20 percent

(D) up to 25 percent

45. The sub-soil for a proposed 2-storeyed residential building is found to be 6 m thick black cotton soil, underlain by stiff sandy clay. The most suitable foundation for the proposed structure may be

(A) shallow isolated or combined footing

(B) shallow strip footing

(C) raft foundation

(D) under-reamed pile

46. The measurement of non-biodegradable organic content is usually carried out in terms of

(A) BOD (B) COD

(C) TOC (D) DO

47. Pick out the incorrect answer :

Automobiles, without a catalytic converter, chiefly emit

(A) carbon monoxide

(B) carbon dioxide

(C) hydrocarbons

(D) oxides of nitrogen

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7

48. A rainfall is considered as acidic if its pH value is less or equal to
    (A) 5
    (B) 5·6
    (C) 6·5
    (D) 7

49. If nitrate has crossed the limit of acceptance, which disease may cause?
    (A) Polio
    (B) Bone cancer
    (C) Lung cancer
    (D) Blue baby

50. The amount of money which can be obtained at any particular time from the open market, if the property is put for sale, is called
    (A) salvage value
    (B) market value
    (C) book value
    (D) rateable value

51. After the useful life of a building, the scrap value is considered as
    (A) 5% of cost of the building
    (B) 10% of cost of the building
    (C) 15% of cost of the building
    (D) 20% of cost of the building

52. PERT technique of network analysis is mainly useful for
    (A) deterministic activities
    (B) large and complex projects
    (C) research and development projects
    (D) small projects

53. In the network method of construction management, slack or float is defined as
    (A) difference between latest starting time and earliest starting time for an event
    (B) difference between latest finishing time and earliest finishing time for an event
    (C) difference between earliest finishing time and earliest starting time for an event
    (D) difference between latest finishing time and latest starting time for an event

54. In project crashing, rent and overheads are treated as
    (A) direct costs
    (B) indirect costs
    (C) significant costs
    (D) insignificant costs

55. Pick out the incorrect statement.
    (A) Events with zero slacks are critical.
    (B) If there is negative slack found in any activity, it may cause delay in the completion of the project.
    (C) Critical path is the line connecting the activities with zero slack.
    (D) Critical path is normally shown with thick dotted lines in the network.

56. For a first class brick, the water absorption, when immersed in cold water for 24 hours, should be

   (A) 8–11% of its dry weight
   (B) 12–15% of its dry weight
   (C) 16–20% of its dry weight
   (D) 21–25% of its dry weight

57. The process of reducing the moisture content from the timber in order to prevent the timber from possible fermentation is

   (A) seasoning of timber
   (B) sorting of timber
   (C) conservation of timber
   (D) None of the above

58. In the tensile strength test of stones, the split tensile strength, S is expressed as

   (A) $S = \dfrac{W}{\pi dL}$
   (B) $S = \dfrac{2W}{\pi dL}$

   (C) $S = \dfrac{WL}{\pi d^2}$
   (D) $S = \dfrac{2WL}{\pi d^2}$

   where

   W = Applied load
   d = Diameter of the specimen
   L = Length of the specimen

59. On the basis of modulus of elasticity in bending, for constructional purpose, timbers are classified as Group B if

   (A) the modulus of elasticity in bending is above $3 \, kN/mm^2$ and below $5 \cdot 6 \, kN/mm^2$
   (B) the modulus of elasticity in bending is above $5 \cdot 6 \, kN/mm^2$ and below $9 \cdot 8 \, kN/mm^2$

   (C) the modulus of elasticity in bending is above $9 \cdot 8 \, kN/mm^2$ and below $12 \cdot 5 \, kN/mm^2$
   (D) the modulus of elasticity in bending is above $12 \cdot 5 \, kN/mm^2$ and below $15 \, kN/mm^2$

60. Depending on the size, sand is classified as medium sand if the fineness modulus (FM) is

   (A) 3·20–3·50   (B) 2·90–3·20
   (C) 2·60–2·90   (D) 2·20–2·60

61. As per the Indian Standards, to check the dimension of bricks, the number of bricks required is

   (A) 10   (B) 15
   (C) 20   (D) 25

62. The constituent of cement which is responsible for initial setting time of cement is

   (A) dicalcium silicate
   (B) tricalcium aluminate
   (C) tricalcium silicate
   (D) tetracalcium aluminoferrite

63. The role of superplasticizer in cement concrete is to

   (A) disperse the particles
   (B) disperse the particles and remove air bubbles
   (C) disperse the particles, remove air bubbles and to retard setting
   (D) retard setting

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64. The operation of removing humps and hollows of uniform concrete surface is known as

(A) floating   (B) screeding

(C) trowelling   (D) finishing

65. Ring and ball apparatus is used for which of the following tests of bitumen?

(A) Penetration

(B) Viscosity

(C) Softening point

(D) Ductility

66. The maximum bending moment for the beam acted upon by loads as shown in the figure is
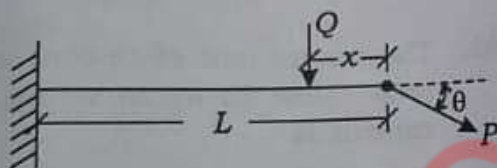
(A) $PL \sin \theta + Q(L - x)$

(B) $PL + Q(L - x)$

(C) $-PL \sin \theta + Q(x - L)$

(D) $-PL \cos \theta - Q(L - x)$

67. A cantilever beam AB of length 4.0 m, fixed at end A, carries a uniformly varying load of intensity zero at B to 2000 N/m at A. The shear force at the middle of the beam, i.e., 2.0 m from ends A and B is

(A) + 4000 N   (B) − 2000 N

(C) − 1000 N   (D) + 1000 N

68. The deflection due to UDL in a simply supported beam at midpoint is

(A) $\dfrac{WL^2}{16EI}$ (B) $\dfrac{WL^3}{48EI}$

(C) $\dfrac{WL^3}{24EI}$ (D) $\dfrac{5WL^4}{384EI}$

69. A beam of length l m carries a uniformly distributed load of w N/m and rests on two simple supports. The cantilever overhang on both sides of the beam is 1.0 m. The bending moment at the centre of the beam is

(A) $+\dfrac{wl^2}{2}$ N-m   (B) $-\dfrac{wl^2}{2}$ N-m

(C) $\dfrac{wl}{2}$ N-m   (D) $\dfrac{wl}{8}(l - 4)$ N-m

70. A beam has a rectangular section of 100 mm × 200 mm. If it is subjected to a maximum moment of 40 kN-m, the maximum bending stress would be

(A) 30 N/mm^2

(B) 60 N/mm^2

(C) 120 N/mm^2

(D) 150 N/mm^2

71. A cantilever beam of flexural rigidity EI, of length l, with a concentrated load P at the free end, has a strain energy

(A) $\dfrac{P^2 l^3}{3EI}$ (B) $\dfrac{P^2 l^3}{6EI}$

(C) $\dfrac{Pl^3}{3EI}$ (D) $\dfrac{P^2 l}{2EI}$

72. For a column of length L, with both ends fixed, the Euler crippling load p is given by

(A) $P = \dfrac{\pi^2 EI}{4L^2}$

(B) $P = \dfrac{\pi^2 EI}{L^2}$

(C) $P = \dfrac{4\pi^2 EI}{L^2}$

(D) $P = \dfrac{2\pi^2 EI}{L^2}$

The flexural rigidity of the column is EI.

73. A parabolic curved beam of span l and rise h is loaded with a uniformly distributed load of intensity w per unit horizontal length. One end of the beam has a fixed support and the other end is on a horizontal roller support. The equation of the parabolic curve is given by

(A) $y = \dfrac{2h}{l^2} x(l - x)$

(B) $y = \dfrac{4l^2}{h} x(l - x)$

(C) $y = \dfrac{4h}{l} x(l - x)$

(D) $y = \dfrac{4h}{l^2} x(l - x)$

74. A uniformly distributed load of 16 kN/m covers left half of the span of a three-hinged parabolic arch of span 10·0 m and central rise 2·5 m. The horizontal thrust is

(A) 60 kN (B) 40 kN

(C) 30 kN (D) 20 kN

75. In a suspension bridge, the dominant tensile force is carried by

(A) stiffening girders

(B) suspension cables

(C) hangers

(D) towers

76. A cable is suspended between two points 20 m apart, located at the same level. It carries uniformly distributed load of 16 kN per metre of span. The sag of the cable at mid-span is 4 m. The tension in the cable at the left quarter point is

(A) 200 kN (B) 80 kN

(C) 215·4 kN (D) 297·2 kN

77. An RCC slab consists of 10 mm bars at a spacing of 10 cm. If the 10 mm bars are replaced by 12 mm bars, then the spacing between the bars should be

(A) 10 cm (B) 12 cm

(C) 12·44 cm (D) 14·40 cm

78. A beam AB of span 4 m, fixed at A and B, carries a uniformly distributed load of 1500 N/m. The support A sinks by 1 cm. $E = 2 \times 10^5$ N/mm^2, $I = 8000$ cm^4. The fixed end moment at end A is

(A) -2000 N-m

(B) $+4000$ N-m

(C) $+6000$ N-m

(D) -8000 N-m

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79. When a member is subjected to an axial tensile load, the greatest normal stress is equal to

(A) half the maximum shear stress

(B) maximum shear stress

(C) twice the maximum shear stress

(D) None of the above

80. A reinforced concrete beam 300 mm (width) × 600 mm (depth), subjected to an applied moment of 140 kN-m, is provided with 4 nos. of 25 mm diameter reinforcing bars, at an effective cover of 50 mm. Assuming M20 grade of concrete and Fe415 grade of steel, the stress in steel is

(A) 131 MPa   (B) 141 MPa

(C) 151 MPa   (D) 161 MPa

81. The neutral axis depth factor of a balanced section depends on the

(A) permissible tensile stress in steel

(B) grade of concrete

(C) modular ratio

(D) All of the above

82. The maximum spacing for shear reinforcement in a beam is

(A) greater than 300 mm

(B) greater than and equal to 300 mm

(C) less than 300 mm

(D) less than and equal to 300 mm

83. Where the depth of the web in a beam exceeds 750 mm, the side face reinforcement should not be less than

(A) 0·1 percent of the web area

(B) 0·12 percent of the web area

(C) 0·15 percent of the web area

(D) 0·85 percent of the web area

84. In limit state of collapse in flexure, the maximum strain in the tension reinforcement in the section at failure shall not be less than

(A) $0 \cdot 85 \dfrac{f_y}{E_s}$

(B) $\dfrac{f_y}{1 \cdot 15 E_s} + 0 \cdot 002$

(C) $\dfrac{f_y}{1 \cdot 15 E_s} + 0 \cdot 0035$

(D) $0 \cdot 85 \dfrac{f_y}{E_s} + 0 \cdot 015$

85. On either side of the point of stress in a reinforcing bar, the required development length in concrete is

(A) proportional to the bar diameter

(B) proportional to stress level in steel bar at the point

(C) inversely proportional to the bond strength of the concrete

(D) All of the above

86. The effective cover of beam depends on the

   ·(A) diameter of main reinforcement

   (B) width of the beam

   (C) depth of the beam

   (D) grade of steel

87. In order that the vertical deflection limit of 10 mm of a simply supported rectangular beam of size 250 mm (width) × 400 mm (depth) and span 4 m is satisfied, the maximum uniformly distributed load, including its self-weight, is

   (A) 75 kN/m   (B) 100 kN/m

   (C) 125 kN/m (D) 150 kN/m

88. For limit state method of design, the permissible bearing stress for transfer of load at the base of column to the top of the supporting footing is

   (A) $0.25f_{ck}$ (B) $0.35f_{ck}$

   (C) $0.45f_{ck}$ (D) $0.55f_{ck}$

89. The thickness at the edge of a pile cap should not be less than

   (A) 150 mm

   (B) 300 mm

   (C) 500 mm

   (D) None of the above

90. While designing a structure under earthquake condition, effects due to vertical earthquake shaking shall be considered when

   (A) the structure is located in seismic zone IV or V

   (B) the structure has vertical or plan irregularities

   (C) the structure is rested on soft soil or the structure has large overhangs of structural members or sub-systems

   (D) any of the above conditions applies

91. By making a moment-resisting frame ductile

   (A) induced seismic force can be reduced

   (B) probability of collapse is reduced

   (C) reversible lateral displacements, after formation of plastic hinges, can be accommodated

   (D) All of the above

92. In a counterfort retaining wall

   (A) the counterforts take reactions only from the heel slab

   (B) the counterforts are subjected to compressive stresses

   (C) the counterforts act as inverted T-beam of varying rib depth

   (D) None of the above

93. As per IS : 456 standard, the average permissible bond stress for plain bars in M25 grade of concrete is

(A) 0·8 MPa   (B) 0·9 MPa

(C) 1·1 MPa   (D) 1·2 MPa

94. According to basic consideration of working stress method for reinforced concrete design, the stress-strain relationship between steel and concrete under working load is

(A) linear

(B) parabolic

(C) logarithmic

(D) quadratic

95. When Poisson's ratio is 0·2, the relation between E (Young's modulus) and K (bulk modulus) is

(A) $E = K$ (B) $E = 1·5K$

(C) $E = 1·8K$ (D) $E = 2K$

96. For a cylindrical water tank, 1·5 m in diameter and 2·0 m in height, if the efficiency of the vertical joints is 95% and the safe maximum hoop stress is 100 N/mm^2, the thickness required for the tank wall is

(A) 0·135 mm

(B) 0·155 mm

(C) 0·175 mm

(D) None of the above

97. For a sloped isolated RCC footing, the effective area resisting one-way shear is

(A) rectangular

(B) trapezoidal

(C) polygonal

(D) cylindrical

98. If the allowable shear stress in weld is 90 N/mm^2, the strength of 5 mm fillet weld per metre length would be $(k = 0·7)$

(A) 250 kN   (B) 315 kN

(C) 415 kN   (D) 520 kN

99. Los Angeles abrasion test is used for aggregates to check

(A) strength

(B) toughness

(C) hardness

(D) water absorption

100. The minimum sight distance required to avoid head-on collision of two cars approaching from the opposite directions at 90 kmph and 60 kmph, assuming a reaction time of 2·5 s, coefficient of friction of 0·7 and a brake efficiency of 50 percent in both the cases, is

(A) 169·98 m   (B) 235·8 m

(C) 153·8 m   (D) 82·2 m