AE/JE Foundation

Civil Engineering

Transportation Engineering & Surveying

Top 100 Most Expected Questions

1. A hill road with ruling gradient of 1 in 20 has a horizontal curve of radius 75 m. The compensated gradient on the curve will be:

   A. 1%   B. 4%

   C. 5%   D. None of these

Ans. B

Sol. Gradient, N = 1/20 = 5%

   Grade compensation $= \frac{(30+R)}{R} \ or \ \frac{75}{R}$

   $= \frac{30 + 75}{75} = 1.4\%$

   $= \frac{75}{75} = 1\%$

   Use minimum. I.e., 1%

   Compensated gradient =5%-1% = 4%

2. If the longitudinal friction coefficient is 0.35, the resultant retardation for stopping the vehicle on the road is_____ m/s^2.

   A. 9.8   B. 5.6

   C. 3.43   D. 2.7

Ans. C

Sol. Retardation, a = fg = 0.35 x 9.81 = 3.43 m/s^2.

3. If the length of the wheel base is made thrice the initial, the mechanical widening on the horizontal curve has to be

   A. doubled   B. halved

   C. increased by 3 times   D. increased by 9 times

Ans. D

Sol. Mechanical widening, $W_m = \frac{nl^2}{2R}$

   If length (l) is made thrice, the mechanical widening increases by 9 times.

4. Which among the following factors are not considered while designing a valley curve on a highway is:

   A. comfort to passengers   B. stopping sight distance

   C. aesthetic consideration   D. drainage

Ans. B

Sol. Criteria for design of valley curve for highways:

   i) vehicle head light distance

   ii) Motorist comfort

   iii) drainage at lowest point of valley

   iv) aesthetic consideration

   ISD and SSD are not a problem on valley curves.

5. Determine the flakiness and elongation indices (total) of a 500 gm. sample if it contains 150 grams of flaky particle and 70 gm. of elongated particles.

   A. 50%   B. 30%

   C. 20%   D. 44%

Ans. A

Sol. Flakiness index $= \frac{150}{500} \times 100 = 30\%$

   Elongation index $= \frac{70}{350} \times 100 = 20\%$

   Total = 30+20 = 50%

6. In plate load test, pressure on soil is 40 kg/cm². The corresponding deflection, δ = 1.18 mm. Determine the modulus of elasticity of soil if the diameter of the plate used is 30cm.

   A. 7620   B. 6000

   C. 5750   D. 4000

Ans. B

Sol. Pressure on plate, P = 40kg/cm²

   Radius of plate, a =15 cm

   Deflection = 1.18mm = 0.118 cm

   $$E_s = \frac{1.18Pa}{\delta} = \frac{1.18 \times 40 \times 15}{1.18 \times 10^{-1}} = 6000 \text{ kg/cm}^2$$

7. The most fluid cut back bitumen is

   A. RC-0   B. RC-3

   C. SC-4   D. MC-2

Ans. A

Sol. Cutback bitumen is produced by adding petroleum distillates, such as kerosene. Viscosity of the cutback bitumen increases with the number denoted. Viscosity of RC-0, MC-0 and SC-0 are same.

8. The purpose of Marshal test is:

   A. Design of bitumen concrete mix   B. Overlay design

   C. Gradation of asphalts   D. Determination of softening point

Ans. A

Sol. The Marshall process uses a series of laboratory tests and evaluation criteria for selecting materials and to progressively narrow in on optimum bitumen concrete mix design.

9. A rigid pavement of thickness 20 cm and width 3.75m is made up of concrete with allowable tensile strength of 0.9 MPa. The spacing of contraction joints for this PCC pavement is _____.

   A. 1.2 m   B. 2 m

   C. 5 m   D. 5.6 m

Ans. C

Sol. Allowable tensile strength of concrete = σ_c = 0.9 MPa = 90 kN/m²

Coefficient of friction, f = 1.5

Density of concrete, γ_c = 24 kN/m³

For plain cement concrete road,

$$l_c = \frac{2\sigma_c}{\gamma_c f} = \frac{2 \times 90}{24 \times 1.5} = 5 \text{ m}$$

10. The maximum spacing of expansion joints in rigid pavements l_e is given by:

A. $l_e = \dfrac{\delta}{2\alpha t}$ B. $l_e = \dfrac{2\delta}{\alpha t}$

C. $l_e = \dfrac{\delta}{\alpha t}$ D. $l_e = \dfrac{\alpha}{2\delta t}$

Ans. A

Sol. The maximum spacing of expansion joint, $l_e = \dfrac{\delta}{2\alpha t}$

11. The annual average daily traffic in a proposed highway at last count is 300 CVD. The annual rate of growth of traffic is 5%. If the road is to be completed in two years, the initial traffic in the road after construction will be:

A. 300   B. 331

C. 350   D. 360

Ans. B

Sol. A = P(1+r)ⁿ = 300(1+0.05)²=330.75. Say 331 CVD

12. Fixed delays in highways is due to

A. pedestrians crossing the road   B. parked vehicles

C. traffic signals   D. road repairs

Ans. C

Sol. Fixed delay is the delay to which a vehicle is subjected regardless of the amount of traffic volume and interference present.Fixed delays occur primarily at intersections due to traffic signals and at level crossings of railways.

13. Find the effective green time of a traffic signal, where lost time due to starting delay is 2 seconds, actual green time is 19 seconds and amber time is 3 seconds.

A. 14 sec   B. 19 sec

C. 20 sec   D. 24 sec

Ans. C

Sol. Effective green time = actual green time + amber time – lost time

= 19 + 3 -2 = 20 sec.

14. If the traffic density on a highway is 100 veh/km, the average spacing /space headway (in m) is:

A. 10

B. 20

C. 50

D. 100

Ans. A

Sol. $S = \dfrac{1000}{k} = \dfrac{1000}{100} = 10 \text{ m}$

15. The design speed of a road is 50kmph. At jam conditions, the spacing between the vehicles is 10m.Find the capacity of the road in veh/km if linear speed density model is considered.

A. 100

B. 500

C. 750

D. 1250

Ans. D

Sol. Spacing S = 10 m

$K_j = \dfrac{1000}{S} = \dfrac{1000}{10} = 100 \dfrac{\text{veh}}{\text{km}}$

Capacity, $C = \left(\dfrac{K_{max}}{2}\right)\left(\dfrac{V_m}{2}\right) = \left(\dfrac{100}{2}\right)\left(\dfrac{50}{2}\right) = 1250 \text{ veh/km}$

16. Determine the steepest gradient permissible on a 4° curve for BG line having a ruling gradient of 1 in 175.

A. 0.16%

B. 0.57%

C. 0.41%

D. None of these

Ans. C

Sol. Grade compensation = 4 x 0.04% =0.16%

Stipulated ruling gradient $= \dfrac{1}{175} \times 100 = 0.57\%$

Steepest gradient = 0.57%-0.16% =0.41%

17. A Pandrol clip is used in railways for:

A. Fixing tie bar with CI sleepers

B. Measurement of 'packing void' under the sleeper ends

C. Measurement of unevenness of rail top and rectification of alignment

D. Elastic rail fastening

Ans. D

Sol. A pandrol clip is used for elastic rail fastening. They are responsible for attaching the rail to the base plate so the rail cannot move vertically or horizontally with respect to the base plate.

18. The future to present traffic ratio in an airport is 2. Find the total requirement of future gates if 2 groups of 5 gates each are considered for traffic currently.

    A. 15   B. 25

    C. 35   D. 45

Ans. B

Sol. Present traffic = 2 x 5 = 10 gate positions
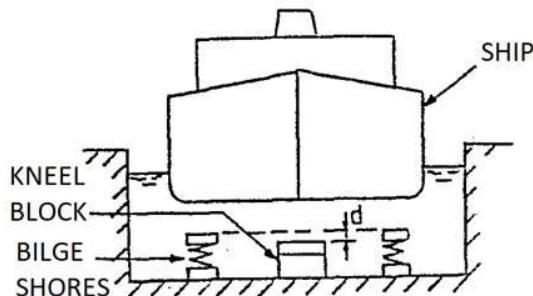
    Future traffic = present traffic x growth factor = 10 x 2 =20 numbers

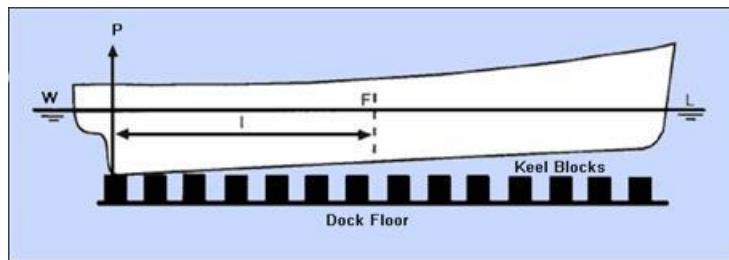   Rounded to higher number = 25 numbers

19. Keel and Bilge blocks are used as:

    A. Impact absorbers of quay walls   B. Floating indicators

    C. Support for ships in dry docks   D. Anchorage devices for ships

Ans. C

Sol. Keel and Bilge blocks are used to support the ship in dry docks.

20. Structure constructed in tunneling operations, in advance of main drivage, along its alignment, to gain information about the ground is called:

    A. shaft   B. tunnel invert

    C. tunnel soffit   D. pilot tunnel

Ans. D

Sol. A pilot tunnel is a small tunnel or shaft excavated in the center, and in advance of the main drivage, to gain information about the ground and create a free face, thus simplifying the blasting operations.

21. If aggregate size of 50-40mm is to be tested for finding out the portion of elongated aggregates using length gauge, the slot length of the gauge is

   A. 27   B. 81

   C. 45   D. 90

Ans. B

Sol. Elongated slot length = Mean X 1.8

   Flakiness slot length = Mean X 0.6

   Mean = 45

   Elongated slot length = 81

22. A 3% downgrade curve is followed by 1% upgrade curve and rate of change of grade adopted is .1% per 20m length. The length of the vertical curve in m is

   A. 80   B. 200

   C. 800   D. 400

Ans. C

Sol. $L_c = \dfrac{(3+1)20}{.1} = 800m$

23. Which of the following are the prominent characteristics of expressways?

   i.   High volume of traffic

   ii. Divided carriageways

   iii. Controlled access

   iv. Pedestrian walkways

   A. i, ii and iii   B. i, ii and iv

   C. ii, iii and iv   D. All of these

Ans. A

Sol. Pedestrian walkways are not a feature of expressways.

24. **Assertion (A):** The Bombay road plan didn't consider the length of the existing railway track while calculating the target length for highways.

   Reason (R): The rail network was thought to be competing with the road network.

   A. both A and R and true, and R is the correct explanation of A

   B. both A and R are 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

Ans. C

Sol. Reason is wrong. The Bombay road plan didn't consider the length of railways for calculation of target highway length as was done in the Nagpur plan as it was considered that the road system should be developed independent of the rail system.

25. A vehicle was travelling with a speed of 60 kmph. The driver notices an obstacle and it took 2.5 sec for the driver to respond to the situation. What will be ratio of lag to breaking distance if coefficient of longitudinal friction on the road is 0.38.

A. 1.84   B. 1.45

C. 1.12   D. 1.04

Ans. C

Sol. Here,

V = 60 kmph = 16.67 m/s

$$\frac{lag\ distance}{Breaking\ distance} = \frac{vt}{v^2/2gf} = \frac{2gft}{v} = \frac{2 \times 9.81 \times 0.38 \times 2.5}{16.67} = 1.12$$

26. The type of curve which fulfils the condition for an ideal transition curve is

A. Lemniscate   B. Cubic Parabola

C. Spiral   D. Circular Curve

Ans. C

Sol. In spiral curve the radius is inversely proportional to the length and the rate of change of centrifugal acceleration is uniform throughout the length of curve which is a required condition for an ideal transition curve.

27. What are the various factors affecting traffic characteristics?

  i. Human psychology

 ii. Origin and destination of travel

iii. Travel patterns

A. i and ii   B. ii and iii

C. i and iii   D. All of these

Ans. D

Sol. All these factors affect traffic characteristics.

28. Which of the following statements are correct about the Greenshield's distribution model of traffic distribution?

i. the relation between speed and density is linear

ii. the relation between speed and volume is linear

iii. the relation between density and volume is parabolic

iv. when speed is maximum, the density is zero

A. i, ii and iii   B. ii, iii and iv

C. i, iii and iv   D. All of these

Ans. C

Sol. The relation between speed and volume is parabolic.

29. Assertion(A): The stress at the top of pavement in the interior region in winters due to wheel load is compressive.

Reason(R): The frictional stress in winters at the top of the pavement is tensile.

A. both A and R and true, and R is the correct explanation of A

B. both A and R are 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

Ans. B

Sol. Both statements are correct but are unrelated.

30. Select the incorrect statement:

A. Bitumen is obtained from destructive distillation of coal.

B. Bitumen is highly viscous at normal temperature.

C. Bitumen is soluble in carbon tetra chloride.

D. Bitumen emulsion is prepared by dispersing bitumen in form of fine globules suspended in water.

Ans. A

Sol. Bitumen is obtained from fractional distillation of petroleum while tar is obtained from destructive distillation of coal.

31. Station pointer is used for:

A. solving 3 point problem of hydrographic survey

B. determining water level and its variation

C. measuring angles

D. measuring discharge of a stream

Ans. A

Sol. The station pointer is a special type of protractor also called the three-legged protractor. It is used to plot two angles as derived with a sextant directly onto the chart using the three known points the angles were taken from. The station pointer is used in coastal piloting but found its main use in hydrographic surveying for plotting the observed angles.

32. For contouring rough countries where ordinary leveling is tedious and chaining is slow and inaccurate, the method employed is:

A. Leveling   B. Plane table surveying

C. Tacheometric surveying   D. Compass surveying

Ans. C

Sol. Tacheometric method is most suitable in hilly areas as the number of stations which can be commanded by a tacheometer is far more than those by a level and thus the number of instrument-settings is considerably reduced. And the tacheometer is used for both the vertical as well as for the horizontal measurements.

33. If the spacing of cross-hairs in a stadia diaphragm of tacheometer is 13 mm, and the focal length of the object glass is 26 cm, then the multiplying constant of the tacheometer is

A. 20   B. 100

C. 0.005   D. 200

Ans. A

Sol. Multiplying constant $= \dfrac{f}{i} = \dfrac{260}{13} = 20$ (26 cm =260 mm)

34.   The process of keeping the plane table into a fixed direction, so that a line representing a direction on the plane is parallel to its direction on the ground is called

A. Centering   B. Orientation

C. Leveling   D. Resection

Ans. B

Sol. The method of setting up plane table at each of the successive stations parallel to the position it occupied at the starting station is known as orientation. A line representing a direction on the plane is made parallel to its direction on the ground.

35.   Lehman's rules are used in solving three point problem in plane table surveying by

A. Trial and error method   B. Mechanical method

C. Tracing paper method   D. Graphical method

Ans. A

Sol. In three point problem, if the orientation of the plane table is not proper, the intersection of the resectes through the three points will not meet at a point but will form a triangle, known as triangle of error. The trial and error method of three point problem, also known as Lehman's method minimizes the triangle of error to a point iteratively.

36.   It is required to locate a route from P to Q at an upward gradient of 1 in 100. The contour map of the area is available at a contour interval of 20m at a scale of 1:10000. The radius of the arc required to obtain the route path is:

A. 0.2m   B. 0.1 m
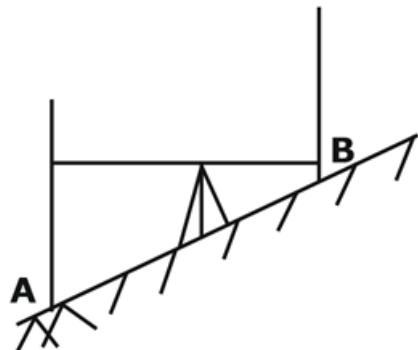
C. 0.4 m   D. 0.3 m

Ans. A

Sol. $H.E = \dfrac{CI}{CG} = \dfrac{20}{\dfrac{1}{100}} = 2000 \text{ m}$

Radius $R = \dfrac{HE}{scale} = \dfrac{2000}{10000} = 0.2 \text{ m}$

37.   If the staff reading of a succeeding point is smaller than that of preceding point and the staff being held vertical, it indicates:

A. Rise   B. Fall

C. Rise or fall   D. flat

Ans. A

Sol. From figure, if the staff intercept is less it indicates less height from the ground.

38. In a closed traverse with 4 sides, the error found from forbearing and back bearing of the last line is +2°. The correction to the second line will be:

    A. +2°   B. +0°30'

    C. 1°   D. 1°30'

Ans. C

Sol. Correction to 2nd line $= \frac{2e}{N} = \frac{2 \times 2°}{4} = 1°$

39. If the vertical circle does not read zero when the line of sight is horizontal the error is called

    A. zero error   B. residual error

    C. vernier error   D. index error

Ans. D

Sol. If the vertical circle verniers do not read zero when the line of sight is horizontal, the vertical angles measured will be incorrect. This error is known as index error and can be eliminated by applying index correction or by taking both face observations.

40. ABCD is a square of area 100m². If the bearing of AB is 30°, then the bearing of DC is:

    A. 30°   B. 150°

    C. 60°   D. 240°

Ans. A

Sol. Since bearing of side AB = 30°, the bearing of line DC will also be 30°
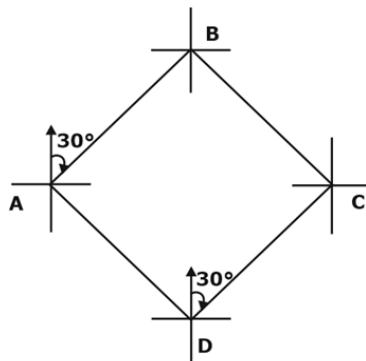
41. Temporary adjustments are those made:

    A. Periodically

    B. at every setup of instrument

    C. To restore fundamental relations between various parts

    D. Only at the first set of instrument

Ans. B

Sol. Temporary adjustments are adjustments, such as leveling or focusing, made to a surveying instrument at each setup.

42. The length of a baseline measured 200 m above MSL is 637 m. The equivalent length reduced to M.S.L is (Radius of earth = 6370 km)

    A. 637.2 m   B. 637.02 m

    C. 636.8 m   D. 636.98 m

Ans. D

Sol. Correction for MSL is negative

$$C_{MSL} = \frac{Lh}{R} = \frac{200 \times 637}{6370 \times 1000} = -0.02$$

The equivalent length = 637 − 0.02 = 636.98 m

43. Shrinkage of an old map is 24/25 and the RF is 1/2500 then the corrected scale for the map is equal to:

    A. 1/2400   B. 1/2500

    C. 1/2600   D. 1/60000

Ans. C

Sol. $SF = \dfrac{24}{25}$

    Shrunk scale = original scale x S.F

    $= \dfrac{1}{2500} \times \dfrac{24}{25} = \dfrac{1}{2600}$

44. The survey carried out to fix the boundary of a building site is

    A. Engineering survey   B. Topographic survey

   C. Cadastral survey   D. EDM survey

Ans. C

Sol. Cadastral surveying is the discipline of land surveying that relates to the laws of land ownership and the definition of property boundaries. It involves interpreting and advising on boundary locations, on the status of land ownership and on the rights, restrictions and interests in property, as well as the recording of such information for use on plans, maps, etc. It also involves the physical delineation of property boundaries and determination of dimensions, areas and certain rights associated with properties, whether they are on land, water or defined by natural or artificial features.

45. The instrument used for setting gradients is:

   A. Ceylon ghat tracer

   B. Eidograph

   C. Subtense bar

   D. Altimeter

Ans. A

Sol. The Ceylon ghat tracer is extensively used for locating points on a given gradient in the preliminary survey of a hill road and also for measuring the angles of slope. This is very cheap and the work can be conducted quickly.
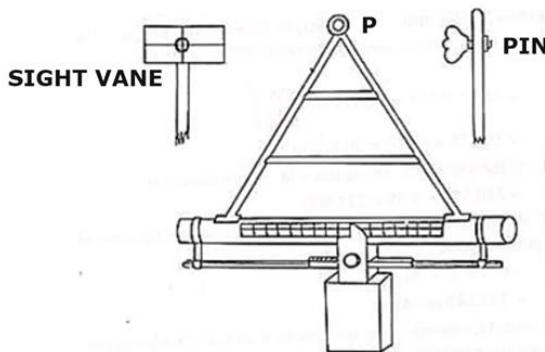

46. The vernier employed in Abney level is

   A. Retrograde vernier

   B. Double vernier

   C. Double folded vernier

   D. Extended vernier

Ans. D

Sol. The Abney Level is an engineering instrument that can be used to determine the height. Abney level can be used for the measurement of slopes, levels, tracing contours and setting grades. It consists of a fixed sighting tube, and a movable bubble level that is connected to a pointing arm, and a protractor scale. The vernier employed in an Abney level is extended vernier.
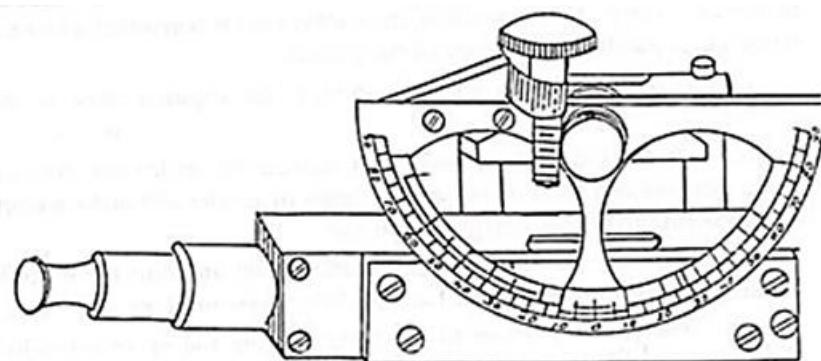
47. If i is the stadia interval, S is the staff intercept, f is the focal length of the objective, d is the distance of vertical axis of the instrument from the optic centre, then the stadia interval factor of the tacheometer is given by:

   A. f+d

   B. f/i

   C. i/f

   D. S/i

Ans. B

Sol. The stadia interval factor or Stadia multiplying constant, $$K = \frac{f}{i}$$

13

48. The process of locating the instrument station occupied by the plane table by drawing rays from the stations whose positions have already been plotted on the drawing sheet is known as _____.

A. radiation B. traversing

C. intersection D. resection

Ans. D

Sol. Resection is a method of plane table surveying in which location of plane table is unknown and it is determined by sighting it to known points or plotted points. It is also called method of orientation.

49. Two points A and B are 1000 m apart across a river. The reciprocal levels measured are:

Level at	Readings on A	Readings on B
A	2.250	3.450
B	0.635	2.225

The true level difference between A and B is:

A. 1.42 m B. 0.195 m

C. 1.345 m D. 1.395 m

Ans. D

Sol. The true level difference between A and B,

$$h = \frac{(3.450 - 2.250) + (2.225 - 0.635)}{2} = 1.395 \, m$$

50. In a surveyor's compass

A. needle is edge bar type.

B. the scale is free to float along with the magnetic needle.

C. graduations are inverted

D. sighting and reading bearings can be done simultaneously.
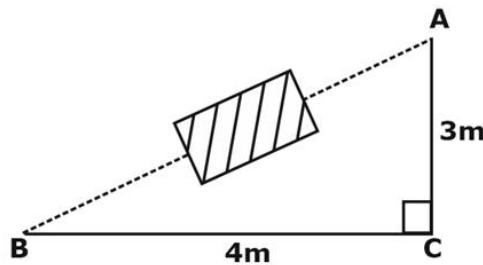
Ans. A

Sol. Surveyor's compass has an edge bar type needle. The scale is attached to the box. The graduations are not inverted but direct. The sighting has to be done first and then the surveyor has to read the northern end of the needle.

51. During a chain survey, stations A and B were taken on opposite sides of an obstacle. A point C was chosen such that AC was perpendicular to BC at C. If AC = 3m and BC = 4m, the obstructed length AB is _____ m.

A. $\sqrt{7}$ B. 5

C. 7 D. 1

Ans. B

Sol. $AB = \sqrt{AC^2 + BC^2} = \sqrt{3^2 + 4^2} = 5\ m$

52. A line of 5cm has shrunk to 4.0 cm. The correct length corresponding to the measured length of 80m is _____ m.

    A. 100   B. 101
    C. 99   D. 60

Ans. A

Sol.

$\text{Shrinkage factor} = \dfrac{\text{shrunk length}}{\text{original length}} = \dfrac{4.0}{5} = 0.8$

$\text{Correct length} = \dfrac{\text{Measured length}}{\text{Shrinkage factor}} = \dfrac{80}{0.8} = 100\ m$

53. Calculate the error (mm) in the linear measurement of offset, if the length of the offset is 80 m, then the accuracy in the measurement of the length is1 cm in 60 m.

    A. 0.075   B. 1.33
    C. 7.5   D. 13.3

Ans. D

Sol. Given accuracy is 1cm in 60 m that means error of 1 cm in 60 m. Hence error in 80 m measurement= (1/60)*80 = 1.33cm=13.3mm

54. Which one is the upper limit of survey area (square kilometer) for use of plane survey?

    A. 250   B. 300
    C. 350   D. 450

Ans. A

Sol. For using the survey area for use of plane survey, upper limit is 250 km².

55. The line which is used to collect the details of the objects in an area is called ____.

    A. base line   B. check line
    C. main line   D. tie line

Ans. D

Sol. A tie line joints two fixed points on the main survey lines. It helps to checking the accuracy of surveying and to locate the interior details. The position of each tie line should be close to some features, such as paths, building etc.

56. Mean Sea Level (MSL) adopted by Survey of India for reference, is located at?

A. Delhi
B. Kolkata
C. Mumbai
D. Karachi

Ans. C

Sol. Till independence, Karachi was our reference point for mean sea level. But after independence, it is MUMBAI HIGH. Mean Sea Level (MSL) adopted by survey of India for reference, is located at Mumbai High (500–041): 0.79 +/- 0.11 mm/yr.

57. Ranging is defined as

A. measuring the distance from starting point

B. establishing intermediate points on a chain line

C. the distance between end points

D. a point on a chain line

Ans. B

Sol. establishing intermediate point on a chain line or survey line is known as Ranging.

Ranging can be done by two methods,

1- direct ranging(in this method intermediate points are visible)

2- indirect ranging(in this method intermediate points are not visible)

58. The main principle of field surveying is to work from

A. higher level to lower level
B. lower level to higher level
C. part to whole
D. whole to part

Ans. D

Sol. main fundamental principal of surveying is described as,

1) working from whole to part

2) locate the position on the point on yhe field the purpose of working from whole to part is, to localise the errors & control the accumulation of error.

59. The angle between true meridian and the magnetic meridian at the time of observations is known as

A. Orientation
B. Magnetic declination
C. Magnetic bearing
D. Dip

Ans. B

Sol. magnetic declination is defined as, the horizontal angle b/w the true meridian & magnetic meridian. If magnetic meridian is to the right side of the true meridian the declination is said to be positive & if it is to the left then it will be negative.

60. In the Prismatic Compass,

A. the graduated ring attached to the compass moves with sights

B. usage is possible without a tripod

C. the needle remains stationary when box is rotated

D. whole circle bearings are calculated

Ans. D

Sol. The compass calculates the bearings in whole circle bearing system which determines the angle which the survey line makes with the magnetic north in the clockwise direction is called Prismtic compass

61. Minimum % Bitumen content for dense bituminous macadam for nominal aggregate size 40mm is

A. < 4 %

B. ≤ 4 %

C. > 4.5 %

D. ≥ 4.5 %

Ans. B

Sol. Minimum % Bitumen content for dense bituminous macadam for nominal aggregate size 40mm minimum 4% and for nominal aggregate size 25 mm is 4.5%.

62. The absolute minimum radius of curve for safe operation, for a speed of 110 kmph is:

A. 110 m

B. 440 m

C. 220 m

D. 577 m

Ans. B

Sol. the compensate gradients is 4 degree for, so the radius will be=110*4=440m.

63. The Lucknow plan targeted to construct roads, giving a density of

A. 32 km/100 sq. km.

B. 82 km/ 100 sq. km.

C. 16 km/ 100 sq. km.

D. 48 km/ 100 sq. km.

Ans. B

Sol. The Bombay plan targeted to construct roads, giving a density of 32 km/100 sq. km.

The Nagpur plan targeted to construct roads, giving a density of 16 km/100 sq. km.

64. Calculate the number of sleepers required for 2 km railway track, if sleeper density is (n + 2) for broad gauge and the length of one rail for a broad gauge is 13 m.

A. 2200

B. 2310

C. 2430

D. 2050

Ans. B

Sol. No. of sleepers in 2 km rail = (2000 /13) ×2 = 308

No. of sleepers for 13 m rail length = n + 2 = 13 + 2 = 15

So, no. of sleepers in 308 rails = 15 ×308 /2 = 2310

65. The magnitude of super-elevation provided in Indian Railways on Broad gauge is _____ (in m)

A. $1.315\, V^2/R$

B. $0.615\, V^2/R$

C. $0.81\, V^2/R$

D. $0.415\, V^2/R$

Ans. A

Sol. The magnitude of super-elevation provided in Indian Railways on Broad gauge is 1.315 V^2/R

For meter gauge 1x V^2/R

For narrow gauge 0.676xV^2/R

66. The safe stopping sight distance as recommended by IRC for a design speed of 30 kmph in regard to hill roads is

A. 30 m
B. 35 m
C. 50 m
D. 70 m

Ans. B

Sol. Safe stopping sight distance for various speeds in hill roads as given by IRC are as follows-

Speed (kmph)	20	25	30	40	50
SSD(m)	20	30	35	50	70

Note- The SSDs for various speeds as given by IRC are different categories of roads like rural roads, hill roads etc.

67. Pick up the correct option related to transition curve:

A. Deflection angle = 3 x spiral angle

B. Deflection angle = 2 x spiral angle

C. Deflection angle = $\frac{1}{3}$ x spiral angle

D. Deflection angle = $\frac{1}{2}$ x spiral angle

Ans. C

Sol. Spiral angle = $\frac{x^2}{2RL}$

Deflection = $\frac{x^2}{6RL}$

So, deflection angle = $\frac{1}{3}$ x spiral angle

68. Choose the correct statement(s) with respect to the Lag distance in computing the absolute minimum sight distance of the vehicle.

i. The reaction time is taken as 0.15sec

ii. The distance is dependent only on the coefficient of friction, reaction time and gradient

iii. It is depended on reaction time and velocity.

iv. The reaction time is the time required to observe the obstruction.

A. i and ii
B. ii and iii
C. iii only
D. iii and iv

Ans. C

Sol. The lag distance is given by the simple equation.

Lag distance = Velocity x Reaction Time

Reaction time as per IRC recommendation is 2.5sec

Lag distance is dependent mainly on Velocity of the moving vehicle and the reaction time

and independent on coefficient of longitudinal friction, gradient and efficient of brake.

The reaction time of the driver is the time required to apply the brake after observing the obstruction

69. If the absolute minimum sight distance is 70 meters, then the stopping sight distance for the Single lane road with one- way traffic and two lane road with two- way traffic is

A. 140m, 70m

B. 70m, 140m

C. 140m, 140m

D. 70m, 70m

Ans. D

Sol. The minimum stopping sight distance should be equal to the stopping distance in case one- way traffic lanes and also in case of two- way traffic roads with two or more traffic lanes.

70. If R is the radius of a circular curve, then the versine on a chord of length L is given by

A. $\dfrac{L}{4R}$

B. $\dfrac{L^2}{4R}$

C. $\dfrac{L^2}{8R}$

D. $\dfrac{L}{8R}$

Ans. C

Sol. For any chord 'ab' of length L, the value of 'cd' is called versine (V) of curve.
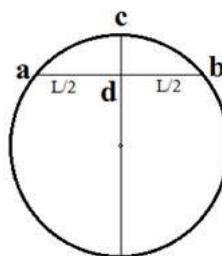
If the radius of curve is R than using property of circle,

$\dfrac{L}{2} \times \dfrac{L}{2}$ = V (2R − V)

(2R − V) $\cong$ 2R

Hence, V = $\dfrac{L^2}{8R}$

71. As per IRC:37-2012, in order to control subgrade rutting in flexible pavements, the parameter to be considered is

A. horizontal tensile strain at the bottom of bituminous layer

B. vertical compressive strain on top of subgrade

C. vertical compressive stress on top of granular layer

D. vertical deflection at the surface of the pavement

Ans. B

Sol. As per IRC : 37-2012
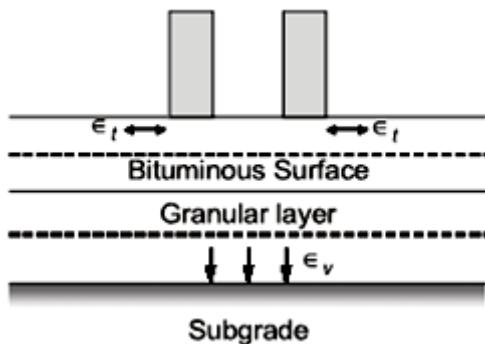
$$N = 4.1656 \times 10^{-0.08} \left[\frac{1}{\epsilon_v} \right]^{4.5337}$$

$$N = 1.41 \times 10^{-8} \left[\frac{1}{\epsilon_v} \right]^{4.5337}$$

Where

$N =$ Number of cumulative standard axle

$\epsilon_v =$ Vertical strain in the subgrade

72. A vehicle moving at 60 kmph speed was stopped by applying brake and the length of the skid marks was 30m. If the average skid resistance of the pavement is 0.70, the brake efficiency of the test vehicle nearly

A. 80%   B. 74%

C. 68%   D. 62%

Ans. C

Sol. M braking test = v^2 /2gl = $(60 \times 0.278)^2$ /2 $\times$9.81 $\times$30 = 0.4726

η braking = (0.4726 /0.7) $\times$100 = 67.5% (nearly 68%)

73. Structural failures considered in the mechanistic method of bituminous pavement design are

A. Shear and slippage   B. Fatique and Rutting

C. Fatique and shear   D. Rutting and shear

Ans. B

Sol. According to IRC66:2012

74. Consider the following statements:

A transition curve is provided on a circular curve on a highway to provide

1. gradual introduction of centrifugal force

2. minimum stopping sight distance

3. gradual introduction of super elevation

4. comfort and security to passengers

Which of these statements are correct?

A. 1, 2 and 3   B. 1, 3 and 4

C. 2, 3 and 4   D. 1, 2 and 4

Ans. B

Sol. A transition curve is provided on a circular curve on a highway to provide

- gradual introduction of centrifugal force

- gradual introduction of super elevation

- comfort and security to passengers

75. Calculate the equivalent radius of the resisting section of 20 cm thick slab, if the ratio of the radius of wheel load distribution to the thickness of the slab is 0.5

A. 8   B. 10.16

C. 20   D. 23.66

Ans. B

Sol. Equivalent radius of resisting section,

$b = \sqrt{(1.6a^2 + h^2)} - 0.675h$

Given, h = 20 cm

And a /h = 0.5 » a = 10 cm

» $b = \sqrt{(1.6 \times 10^2 - 20^2)} - 0.675 \times 20$

= 10.16 cm.

76. Which of the following conditions is not correct with respect to the transition curve?

A. It should be tangential to the straight approaches at the two ends

B. It should meet the circular curve tangentially

C. Its curvature will necessarily be non-zero at the point of take-off from the straight approaches

D. The rate of increase of curvature along the transition reach should match with the increases of cant.

Ans. C

Sol. Radius of transition curve should be infinite when taking off from straight line or meeting the straight line.

Curvature = 1/R and R = infinity

So, curvature = 0

77. Calculate the capacity (vehicle per hour) of the road when reaction time of the driver is 2 seconds. The design speed is 60 kmph and average length of the vehicle is 6.5 m. Take coefficient of friction as 0.30

A. 600   B. 653

C. 688   D. 724

Ans. C

Sol. SSD = 0.278 v. t + v^2 /254f = 0.278 ×60 ×2 + 60^2 /254 ×0.30

SSD = 80.6 m, S = 80.6 + 6.5 = 87.1 m

Capacity, C = 1000 V /S = 1000 ×60 /87.1 = 688.16

78. Lane capacity of a road having saturation head way as 2.7 sec and the cycle time as 60 sec is (green time = 27 sec, amber time = 5 sec, startup lost time = 4 sec, clearance lost time = 1 sec)

A. 480 veh/hr   B. 600 veh/hr

C. 540 veh/hr   D. 584 veh/hr

Ans. B

Sol. Traffic capacity of lane,

$$S = \frac{3600}{2.7(Time\ Headway\ in\ sec)} = 1333.33\ veh/hr$$

Green Ratio,

$$\frac{Effective\ Green\ Time}{Cycle\ Time} = \frac{27 + 5 - 4 - 1}{60} = \frac{27}{60}$$

Lane Capacity,

$$\frac{27}{60} \times 1333.333 = 600$$

79. The rear driving wheels of a car are providing a tractive force of 400 N. The vehicle is negotiating a curve such that the turning angle stands at 8°. The curve resistance due to turning of vehicle will be

A. 396.11 N   B. 3.89 N

C. 55.67 N   D. 344.33 N

Ans. B

Sol. Curve resistance = T – Tcosα

Here T = 400 N ; α = 8°

∴ curve resistance = T (1 – cosα) = 400 × (1 – cos 8°) = 3.89 N

80. Which of the following is a part of speed and delay studies?

1) Floating car method

2) Interview technique

3) License number method

A. 1, 2 and 3   B. 2 and 3 only

C. 1 and 3 only   D. 1 and 2 only

Ans. A

Sol. Various methods of speed and delay studies are:

1. Floating car method

2. License plate method or vehicle number method

3. Interview technique

4. Elevated observation

5. Photographic technique

81. A plate load test is carried out on a subgrade soil using a 300 mm radius rigid plate. A load of 8 tonnes resulted in a deflection of 1.5 mm. The elastic modulus (in MPa) of the soil, if the poisson's ratio is 0.5, is

A. 98.24   B. 84.71

C. 75.39   D. 66.79

Ans. D

Sol. The pressure applied $= \dfrac{8 \times 10^4}{\pi \times 300^2} = 0.283 \, N/mm^2$
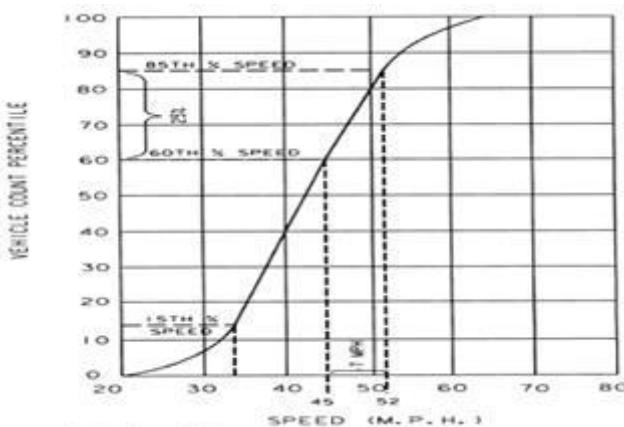
Now, $\delta = 1.18 \times \dfrac{pa}{E}$

$\Rightarrow \quad 1.5 = \dfrac{1.18 \times 0.283 \times 300}{E}$

$\therefore \quad E = 66.79 \, MPa$

82. The commutative speed distribution curve is usually adopted for geometric design of highway. The percentile speed adopted for geometric design is _____.

    A. 85th percentile speed   B. 90th percentile speed

    C. 98th percentile speed   D. 99.9th percentile speed

Ans. C

Sol. we design the highway for approximate 60kmph speed & as shown in figure for this speed the percentile speed will be 98th.

83. 10 cm bituminous concrete having cohesion meter value 60 is equivalent to 7.0 cm of cement treated base. The cohesion meter value of cement treated base will be _____.

    A. 10   B. 100

    C. 357   D. 257

Ans. C

Sol.

$$\dfrac{t_1}{t_2} = \left(\dfrac{C_2}{C_1}\right)^{1/5}$$

$$\Rightarrow \quad C_2 = \left(\dfrac{t_1}{t_2}\right)^5 \times C_1$$

$$= \left(\dfrac{10}{7}\right)^5 \times 60 = 357$$

84. Structural failures considered in mechanistic method of bituminous pavement design

    A. Fatigue and shear   B. Shear and slippage

    C. Rutting and shear   D. Fatigue and Rutting

Ans. D

Sol. Fatigue, Rutting and low temperature cracking are generally considered as the important modes of failure of a bituminous pavement structure. Thermal fatigue and top down cracking also include into the design process.

85. A curve whose radius varies from infinity to a certain value is called _____.

    A. compo und curve   B. circular curve

    C. reverse curve   D. transition curve

Ans. D

Sol. Transition curve is a curve in plan which is provided to change the horizontal alignment from straight to circular curve gradually.

    The radius of transition curve varies between infinity to R or R to infinity.

86. The speed and vehicular density relationship for a particular road was found to be u = (46 -0.23 k) where 'u' is the speed in km/hr and 'k' is the density of vehicle per km. The jam density will be _____ veh/km.

    A. 200   B. 260

    C. 250   D. 150

Ans. A

Sol. Traffic volume = (Traffic density x Speed)

$$\Rightarrow q = ku = k(46 - 0.23k) = (46k - 0.23k^2)$$
$$If \quad q = 0$$
$$\Rightarrow \quad k(46 - 0.23k) = 0$$
$$\Rightarrow \quad k = 0, or \cdot k = \left(\frac{46}{0.23}\right) = 200 \, veh/km$$

87. If n is the length of a rail in meters, the number of sleepers per rail length generally varies from _____.

    A. n to (n+2)   B. (n+2) to (n+4)

    C. (n+3) to (n+6)   D. (n+4) tp (n+5)

Ans. C

Sol. Number of sleepers provided for one rail length of track is called sleeper density. If "N" is the length of one rail in meters,

    Sleeper Density = N+ X, (X –> 3 to 6)

    For a Broad Gauge track, total number of sleepers required for 1km length of railway track if sleeper density = N+5

    Length of one rail = 12.8m =13m

88. The shape of vertical curve used in Indian Railways is

    A. Cubic parabola   B. Circular curve

    C. Spiral   D. Lemniscates of Bernoulli

Ans. B

Sol. Shape of transition curve used in Indian Railways is cubic parabola.

Shape of vertical curve used in Indian Railways is circular curve.

89. Which instrument is used for the measurement of the longitudinal coefficient of friction?

A. Bump integrator

B. Both bump integrator and roughometer

C. Roughometer

D. Speedometer

Ans. B

Sol. The values for the coefficient of friction for different pairs of materials are tabulated from experimental results. The range of values is about 10^{-2} for smooth surfaces to 1 for the roughest surfaces. Both bump integrator and roughometer are used to measure the coefficient of longitudinal friction.

90. What is the extra widening required for a pavement of 6m width on a horizontal curve of radius 220m, if the longest wheel of vehicle expected on the road is 6m and design speed is 70 kmph?

A. 0.3m   B. 0.66m

C. 0.7m   D. 0.9m

Ans. B

Sol. Extra widening, $W_e = n\, l^2 /2R + v /9.5\, \sqrt{R}$

$= 2 \times 6^2 /2 \times 220 + 70 /9.5 \times \sqrt{220}$

$= 0.66$ m

91. In a closed traverse _____.

A. difference between fore-bearing and back-bearing should be 90°

B. sum of included angles should be (2N-4) times right angle, where N represents the number of sides

C. sum of included angles should be (2N-1) times right angle, where N is the number of sides

D. None of these

Ans. B

Sol. For a closed traverse it should be sum of included angles (2N-4) times right angle, where N represents the number of sides

$[(2N-4) \times 90^0]$

92. The sum of the interior angles of a closed traverse is equal to:

A. (2n-4)180°   B. (3n-4)180°

C. (3n-4)90°   D. (2n-4)90°

Ans. D

Sol. The sum of the interior angles of a closed traverse is equal to (2n-4)90

The sum of the exterior angles of a closed traverse is equal to (2n+4)90

93. Compute the angle between the lines AB and AC, if their respective bearings are $52°30'$ and $328°45'$.

   A. $276°15'$ B. $6°15'$

   C. $111°15'$ D. $83°45'$

Ans. D

Sol. Angle between north meridian and AB = $52°30'$ (clockwise) = $N52°30'E$

   Angle between north meridian and AC = $360° - 328°45'$

   = $31°15'$ (Anticlock-wise)= $N31°15'W$

   So, angle between AB & AC = $52°30' + 31°15' = 83°45'$ (Included Angle)

94. Relative error of the closer is the ratio of _____.

   A. closing error to sum of departure

   B. closing error to sum of latitude

   C. closing error to perimeter of travers.

   D. latitude to departure

Ans. C

Sol. Relative error is the ratio of absolute error of a measurement to the measurement being taken. In other words, this type of error is relative to the size of item being measured. It is expressed as a percentage and has no units.

   In case of traverse, it is also written as ratio of closing error to perimeter of traverse.

95. The data from a closed traverse survey PQRS are given:

Line	Include angle (in degrees)
PQ	85
QR	95
RS	97
SP	86

   The closing error of the traverse PQRS is

   A. $87°$ B. $3°$

   C. $93°$ D. $103°$

Ans. B

Sol. Sum of interior angle for a closed traverse = (2n - 4) * 90 = (2*4 - 4) * 90 = $360°$

   Given sum of interior angle = 85 + 95 + 97 + 86 = $363°$

   Then error in interior angle = $363° - 360° = 3°$

96. If the sum of northings of a traverse exceeds the sum of southings by 1 m and sum of eastings exceeds the sum of westings by 1 m, the resultant closing error and its true bearing are respectively,

   A. $\sqrt{2}$ m, N $45°$ E   B. 1 m, N $45°$ E

   C. 2 m, N $45°$ W   D. 2 m, N $45°$ E

Ans. A

Sol. as given in question northing of a traverse exceeds by southing & eastings exceeds by westings, so it is lie in first quadrant or in N-E quadrant.

Closing error = $\sqrt{[(C.L)^2 + (C.D)^2]}$

$= \sqrt{(1^2 + 1^2)} = \sqrt{2}$

97. Which of the following are among the fundamental lines of a theodolite?

1) The vertical and horizontal axes

2) The lines of collimation and axis of the plate levels.

3) The bubble line of the altitude level

A. 1 and 2 only   B. 1 and 3 only

C. 2 and 3 only   D. 1, 2 and 3

Ans. D

Sol. Fundamental lines of theodolite are:

(1) Vertical axis

(2) Horizontal axis

(3) Line of collimation

(4) Axis of plate levels

(5) Axis of telescope level

98. For minor adjustments of horizontal angles measured using a theodolite, the tangential screw is adjusted after

A. Both the plates are unclamped

B. The lower plate is clamped and the upper plate is unclamped

C. The upper plate is clamped and the lower plate is unclamped

D. Both the plates are clamped

Ans. D

Sol. The tangent screw in a theodolite is used for minor adjustments when both the plates are clamped.

99. An electronic theodolite combined with EDM is popularly known as

A. GPS   B. Total station

C. Auto Level   D. Compass

Ans. B

Sol. Total station uses the principle of EDM with electronic theodolite.

100. The process of turning the telescope about the vertical axis in horizontal plane is known as

A. transiting   B. reversing

C. plunging   D. swinging

Ans. D

Sol. The process of turning the telescope about the vertical axis in horizontal plane is known as swinging.

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