Class Test Solution (Surveying) 13-04-2019
Answer key

1.	(a)	16.	(c)	31.	(c)	46.	(d)	61.	(b)
2.	(a)	17.	(c)	32.	(d)	47.	(c)	62.	(b)
3.	(b)	18.	(c)	33.	(d)	48.	(a)	63.	(d)
4.	(b)	19.	(a)	34.	(a)	49.	(b)	64.	(a)
5.	(a)	20.	(b)	35.	(a)	50.	(b)	65.	(c)
6.	(d)	21.	(d)	36.	(b)	51.	(a)	66.	(a)
7.	(c)	22.	(a)	37.	(c)	52.	(c)	67.	(a)
8.	(c)	23.	(a)	38.	(a)	53.	(c)	68.	(d)
9.	(d)	24.	(d)	39.	(a)	54.	(d)	69.	(a)
10.	(c)	25.	(c)	40.	(b)	55.	(c)	70.	(a)
11.	(b)	26.	(d)	41.	(b)	56.	(b)	71.	(b)
12.	(c)	27.	(d)	42.	(d)	57.	(a)	72.	(b)
13.	(c)	28.	(c)	43.	(b)	58.	(d)	73.	(a)
14.	(c)	29.	(a)	44.	(c)	59.	(c)	74.	(a)
15.	(a)	30.	(d)	45.	(c)	60.	(d)	75.	(a)

1. (a) Topographical survey is done to determine information about man made and natural features on earth surface including their elevations.

Reconnaissance survey is a kind of preliminary survey which is performed to find out method of survey to be adopted and its rough cost.

Cadastral survey is done to establish property boundaries.

Archaeological survey is done to collect information about old and relic structures.

2. (a)

3. (b)

Errors while working from whole to part are localised where as while working from part to whole are expanded.

4. (b) $\text{Scale} = \sqrt{\frac{\text{Map area}}{\text{Ground area}}} = \sqrt{\frac{1\,\text{cm}^2}{16\times10^{10}\,\text{cm}^2}}$

$$\text{Scale} = \frac{1\,\text{cm}}{400000\,\text{cm}}$$

$$\text{Scale} = \frac{1}{400000}$$

5. (a) Actual area of survey

$$= \left(\frac{\text{Actual scale}}{\text{Reduced scale}}\right)^2 \times \text{Measured plan area} \times (\text{scale})^2$$

$$= \left(\frac{10}{9}\right)^2 \times 81 \times \left(\frac{10\,\text{m}}{1\,\text{cm}}\right)^2$$

$$= \left(\frac{10}{9}\right)^2 \times 81 \times \left(\frac{1000}{1}\right)^2$$

$$= 10^8\ \text{cm}^2$$

$$= 10^4\ \text{m}^2$$

$$= 10000\ \text{m}^2$$

Alternate solution

$$\text{Shrunk scale} = \frac{9}{10}\times\frac{1}{1000}$$

Actual area = (shrunk scale)^2 × measured area

$$= 10^4\ \text{m}^2$$

6. (d)

The main principle of surveying is to work from whole to part because by working whole to part errors are minimised or localized.

7. (c) Prism square is based on the same principle as the optical square and is used in same manner. It has an advantage over the optical square in that no adjustment is required, since the angle between the reflecting surfaces of prism is kept fixed.

8. (c)

9. (d)

Maximum length of an offset depends on:

(i) scale of plotting

(ii) nature of ground

(iii) accuracy desired

10. (c) $\text{Actual distance} = \frac{\text{Measured distance}}{\text{Nominal length of chain}} \times \text{Actual length of chain}$

Actual length of chain = 30 – 0.1 = 29.90 m

$$\therefore \quad \text{Actual distance} = \frac{300}{30}\times 29.90 = 299.0\ \text{m}$$

11. (b) $\text{Actual length} = \frac{\text{Actual tape length}}{\text{Nominal tape length}} \times$ measured length

For chaining from 0 m – 2000 m

$$\text{Average nominal tape length} = \frac{20.0+20.10}{2}$$

$$= 20.05$$

$$\therefore \text{Actual length}, L_1 = \frac{20.05}{20}\times 2000$$

$$= 2005\ \text{m}$$

For chaining from 2000 m – 4000 m

$$\text{Average nominal tape length} = \frac{20.10+20.18}{2}$$

$$= 20.14\ \text{m}$$

Actual length, $L_2 = \frac{20.14}{20} \times 2000$

$= 2014$ m

$\therefore$ True distance $= L_1 + L_2$

$= 2005 + 2014$

$= 4019$ m

12. (c) Correction for temperature per tape length

$C_T = L \times (T_m - T_0) \times \alpha$

$C_T = 50 \times (30 - 20) \times 10^{-6}$

$C_T = 0.0005$ m

13. (c)

If C_P is the correction for pull, we have

$$C_P = \frac{(P - P_0)\, L}{AE}$$

where

P = Pull applied during measurement (N)

P_0 = Standard pull (N)

L = Measured length (m)

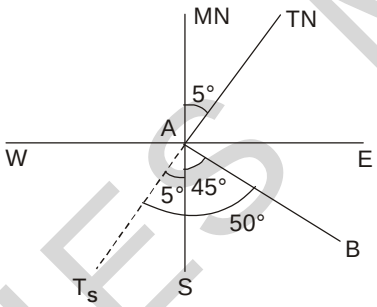
A = Cross-sectional area of the tape (cm^2)

E = Young's modulus of elasticity (N/cm^2)

Here L = 1500 m, P_0 = 100 N, P = 150 N

$$\therefore C_P = \frac{(150 - 100)\,1500}{AE} = \frac{50 \times 1500}{AE}$$

14. (c)



True bearing of line

AB = Magnetic bearing + declination

= S45° E + 5°

= S50°E

15. (a) Magnetic bearing = True bearing + δ_{west}

= 34°20′40′ + 2°0′20″

= 36°21′0″

16. (c) Magnetic Declination, $\delta = 2°E$

Magnetic F.B of AB = N 79°50′′E $\cong$ 79°50′

To find local attraction at St^n A

As St^n O is free from local attraction

Hence F.B of OA will be correct

Correct F.B of OA = N 50°20′W $\simeq$ 309°40′

$\therefore$ Correct B.B of OA= 129°40'

$\because$ Obs F.B of AO = Obs B.B of OA

= S52° 40'E = 127°20'

Error = M.V – T.V

= 127°20' – 129°40'

= – 2°20'

Correction = + 2°20'

Local attraction @ St^n A= +2°20′ $\cong$ 2°20′E

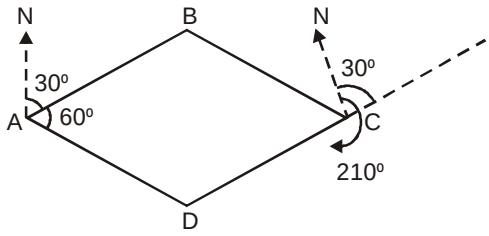
$\therefore$ Magnetic F.B of AB = N 79°50'E

$\delta = 2°E$, L.A = 2°20'E

$\therefore$ T.B of F.B of AB=N 79°50' E + 2° + 2° 20'= N84° 10'E

17. (c) In quadrantal bearing system bearing of line varies from 0° to 90°.

18. (c)



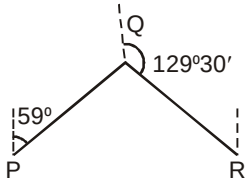
$\because$ AB||DC

$\therefore$ bearing of line DC is 30°

$\therefore$ bearing of CD = 30° + 180° = 210°

19. (a) An aluminium ring, graduated to degrees and half degrees is attached to the needle.

20. (b)



Line	FB	BB
PQ	59º0′	239º0′
QR	129º30′	309º30′

$\therefore \angle PQR = -FB \text{ of line } QR + BB \text{ of } PQ$

$= -129º30' + 239º0' = + 109º30'$

(interior included angle)

21. (d)

Included angles = Bearing of previous line – Bearing of next line

$\angle A$ = Bearing of AE – Bearing of AB

$= (300º - 180º) - 60º30' = 59º30'$

$\angle E$ = Bearing of ED – Bearing of EA

$= (205º30' - 180º) - 300° + 360°$

$\angle E = 85º30'$

22. (a)

23. (a) Contour is a imaginary line joining the points of same elevation on the earth surface.

Line of sight is the line joining optical center of objective and point of intersection of cross hair. When line of sight comes in plane of collimation it is called as line of collimation.

Tie stations are stations on main survey lines and line joining these tie stations as called as Tie line.

Magnetic meridian is the line joining magnetic north and magnetic south.

24. (d) Reconnaissance is preliminary inspection of the area to be surveyed to have some idea of the terrain and the principal features of the grounds. During this, surveyor thoroughly examines the ground and then decides upon the best possible arrangement of triangles.

25. (c) A and B are free from local attraction.

Correction of station DE = 1° 15′

$\therefore$ Correct F.B of DE = 208° 1° 15′

= 209° 15′

26. (d) The graduations have 0° at N and S and 90° at E and W. Sighting and reading cannot be done simultaneously in a surveyor compass. However, it can be done simultaneously in a prismatic compass.

27. (d)

Dirunal variation: Dirunal variation is the variation of magnetic declination over a period of day. It is caused due to rotation of earth about its own axis.

Annual variation: yearly variation due to revolution of earth about sun.

Secular variation: It appears to be of periodic character and follows a sine curve pattern. Secular change from year to year is not uniform for any given locality and is different for different places. Its period is approximately 250 years for a given place, the compass needle after moving continously for a period of years in one direction with respect to the true north gradually comes to a standstill and then begins to move in opposite direction.

Irregular variation: It is due to what is known as magnetic storms, earthquakes and other solar influences. They may occur at any time and can not be predicted.

28. (c)

The size of theodolite is defined by the size of its lower graduated circle not by vertical circle.

29. (a)

30. (d)

Here the vernier has been so constructed that (n – 1) divisions on the main scale are equal in length of n divisions of the vernier.

Let s = value of one smallest division on main scale

v = Value of one smallest division on the verniers

n = Number of divisions on the vernier

Since a length of (n – 1) divisions of main scale is equal to n divisions of vernier, we have

$nv = (n - 1)\, s \Rightarrow v = \left(\frac{n-1}{n}\right) s$

$\therefore$ Least count = s – v = $s - \frac{n-1}{n}$, $s = \frac{s}{n}$

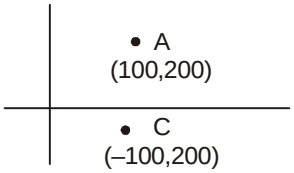
$\therefore$ $S = \frac{360}{1080} \times 3600''$

and least count (LC) = $\frac{360}{1080} \times \frac{3600}{60} = 20''$

31. (c)

The latitude is considered as negative when reckoned southward.

32. (d)



Length AC

$= \sqrt{[(100)-(-100)]^2 + (200-200)^2}$

= 200

33. (d) Methods commonly used in reconnaissance surveying for measurement of horizontal distance are Pacing, Passometer, Pedometer, Odometer, Measuring wheel, speedometer, Perambulator etc.

34. (a) Main triangulation station are control point of triangular network, they command the boundary of the area to be surveyed.

Subsidiary observations are provided to locate interior details of area to be surveyed.

Sometimes it becomes difficult to setup the instrument at the triangulation station then a satellite is selected near the main station as an instrument station. Observation are taken to other stations from this station. These are also called as false station or eccentric station.

Pivot stations are points not for observation but for continuation of triangulation network.

35. (a)

In a closed traverse, if the survey is error free.

1. $\Sigma L = 0$
2. $\Sigma D = 0$

36. (b)

Angular value of 1 div. (sensitivity) = $\frac{S}{nD} \times 206265$ *

$= \frac{0.08}{5 \times 80} \times 206265 = 41.25 \text{sec.}$

37. (c)

Radius of curvature of the bubble tube

$= R = \frac{ndL}{s}$

$= \frac{5 \times 2 \times 10^{-3} \times 100}{0.05} = 20\text{m}$

where

n = 5

d = 2 mm

L = 100 m

s = 0.05 m

38. (a)

The correction due to curvature of earth and the refraction can be combined into one composite correction.

$C = -0.0673d^2$ Where d is in km C is in m.

$\Rightarrow C = 0.0673 \times 1^2$

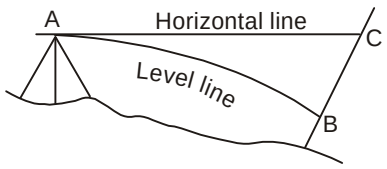
= 0.0673

39. (a) Correction for curvature is always subtractive

Curvature correction $BC = 0.0785\ D^2$

= T.V at B

– M.V at C



where D = Horizontal distance between A and B

40. (b) By balancing the distances of fore sight and back sight error due to curvature, error due to refraction and error due to inclination of line of collimation can be eliminated.

41. (b) Combined correction, $C = 0.0673\ d^2$

where C ⇒ meter, d ⇒ km

$C = 0.0673 \times 1.4^2$

$C = 0.132$ m

42. (d) As a check on the arithmetic involved in reducing the levels, the back-sights and foresights and the rises and falls must be summed up. The checks are then:

Σ (Backsights) – Σ (Foresights) = Σ Rises – Σ (Falls) = Last RL – first RL

This check also takes into account intermediate sight.

43. (b)

44. (c)

1. In reciprocal levelling the error which is not completely eliminated in due to parallex
2. The levelling work is best checked by close loop check.

45. (c) In case of inverted staff

RL of R = Height of instrument + FS

= (RL of benchmark+BS) + FS

= 155.305 + 1.5 + 0.575

= 157.38 m

46. (d) Reciprocal levelling eliminate following errors:

(i) Error due to earth's curvature.

(ii) Error due to refraction.

(iii) Error due to collimation.

Reciprocal levelling does not eliminate error due to parallax or error due to improper centering of instrument.

47. (c) According to principal of stadia method if line of sight is horizontal and staff is held vertical then horizontal distance between vertical axis of instrument and staff station is given by tacheometric distance equation.

$D = kS + c$

$D = 100 \times (2.830 - 1.726) + 0.4$

$D = 110.8$ m

48. (a) Additive constant lies in the range of 0.25 – 0.35m

49. (b) Actual area covered = $\frac{\text{Size of photograph}}{S^2} \times (1 - P_S)(1 - P_L)$

Actual area = $\frac{20 \times 20}{\left(\frac{1}{200}\right)^2} \times (1 - 0.60) \times (1 - 0.30)$

$= 4.48 \times 10^6\ m^2 \cong 4.48\ km^2$

50. (b)

51. (a) Scale = $\frac{F}{H - h} = \frac{20}{1500 - 500} = \frac{1}{50}$

52. (c)

53. (c) $A = \pi r^2$

$dA = 2\pi r\, dr = 2\pi \times 80 \times \pm\frac{0.05}{2}$

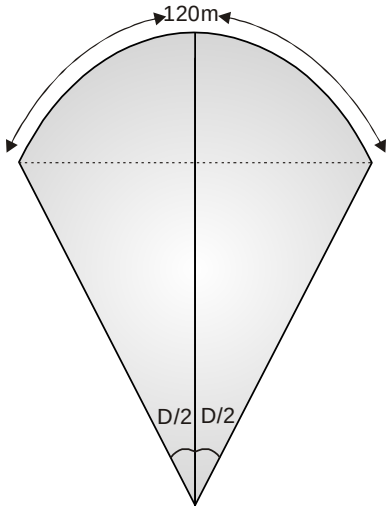
$= \pm 12.56\ m^2$.

54. (d)

For $2\Pi R$ angle at the centre is = 360^o

for 120 m arch = $\frac{360}{2\Pi R} \times (120)$

$D^o = \frac{360}{2\Pi R} \times (120)$

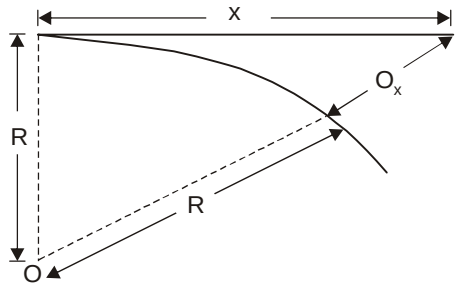


$R = \frac{6879}{D}$ m

55. (c) The length of the full chord is selected such that there is no appreciable difference between the arc length and the chord length between two consecutive pegs.

For the error to be with in the limit of 1 in 10,000 the length of the full chord should be limited to R/20

56. (b) Radial offsets from tangent requires reference of center of curve for setting out a simple circular curve by linear methods.



57. (a)

Last sub chord = 2303.39 – 2300 = 3.39 m

58. (d) Difference between longitude of local place and standard meridian

= 90°40′ E – 82°30′E = 8° 10′

As we move towards east from standard meridian there is gain in time.

We know,

$\because$ 1° = 4 min

$\therefore$ 8°10′ = 32 min 40 s

So local time,

= 6 h 30 min + 32 min 40 s

= 7 h 2 min 40 s

59. (c) The difference between mean and apparent solar time comes out to very close to zero which is called as Equation of time.

60. (d) Sidereal year is the time required by the sun to make a complete circuit of the ecliptic, with reference to a star on the ecliptic having no proper motion. Time interval between two successive vernal equinox is tropical year.

61. (b) Simpson's one-third rule assumes that for an irregular area, the boundaries between two adjacent offsets are parabolic.

62. (b) Area between survey line and the hedge by trapezoidal method

$$A = \left(\frac{3+6}{2}+4+5.5+5\right)\times 5+\left(\frac{6+4.5}{2}+4\right)\times 10$$

$A = 187.5 m^2$

63. (d)

64. (a)

Lehmann's method or Trial and error method in the field is used to find out the position of the station of a plane table.

65. (c) For prismoidal rule we need 3 offsets so we are required to take the area at the mid section of the tank which will be calculated by taking the product of average of length and width of top and bottom of tank.

$A_1 = 6 \times 4 = 24\ m^2$

$A_2 = 4 \times 2 = 8\ m^2$

$$A_m = \left(\frac{6+4}{2}\right)\times\left(\frac{4+2}{2}\right) = 15\ m^2$$

$$V = \frac{d}{3}[A_1 + A_2 + 4(A_m)]$$

$$V = \frac{3}{3}[24+8+4\times 15] = 92\ m^3$$

66. (a) Whole circle bearing of a line is angle measured in the clockwise direction from the north end of the reference meridian.

In Quadrantal bearing system bearing of a line is measured clockwise or anticlockwise from north or south, whichever is nearer to the line.

WCB is simple to measure and its value ranges from 0° – 360°. Hence it is preferred over quadrantal bearing system.

67. (a)

The direction of survey line can either be established

(i) With relation to each other or

(ii) With relation to any median. The first

will give the angle between two lines. While the second will give the bearing of the line.

68. (d)

69. (a)

The direction of a survey line can either be established (i) with relation to each other or (ii) with relation to any median. The first will give the angle between two lines while the second will give the bearing of the line.

Bearing

Bearing of a line is its direction relative to a given median. A meridian is any direction such as (i) True meridian (ii) Magnetic meridian (iii) Arrbitrary meridian

(i) True meridian: True meridian through a point is the line in which a plane passing that point and the north and south poles, intersects with surface of the earth. It thus, passes through the true north and south. The direction of true meridian through a point can be established by astronomical observations.

True bearing: True bearing of a line is the horizontal angle which it makes with the true meridian through one of the extremities of the line. Since the direction of true meridian through a point remains fixed, the true bearing of a line in a constant quantity.

(ii) Magnetic meridian : Magnetic meridian through a point in the direction shown by a freely floating and balanced magnetic needle free from all other attractive forces. The direction of magnetic meridian can be established with the help of a magnetic compass.

(iii) Arbitary meridian : Arbitary meridian is any convenient direction towards a permanent and prominent mark or signal, such as church spire or top of a chimney such meridians are used to determine the relative positions of lines in a small area.

70. (a)

The line of collimation of a theodolite must be perpendicular to the horizontal axis at its intersection with the vertical axis if this condition exists, the line of sight will generate a vertical plane when the telescope is rotated about the horizontal axis.

If the line of sight is not perpendicular to the truunion axis of the telescope; it will not revolve in a plane when the telescope is raised or lowered but instead, it will trace out the surface of cone.

71. (b) An error will occur if the clamp screws are not properly tightened. The magnitude of error will depend upon the slip. The error can be avoided by properly tightening the screws.

The slip also occurs when the shifting head is not properly tightened or when instrument is not properly fixed to the tripod head.

72. (b) Triangulation stations to which observations are required to be taken should be intervisible and stations should form well conditioned triangles. In general no angle should be less than 30^{o} or more than 120^{o}.

To define exact position of a triangulation station so that it can be observed from other stations, signals are used. It should be conspicuous and clearly visible over ground.

It should be accurately centered over the station mark.

73. (a) For long sights curvature correction must be applied because due to curvature of earth, line of collimation differs from the level line. It is tangential to level line.

74. (a)

75. (a) The height of instrument method is more rapid less tedious and simple. However, since the check on the calculation for intermediate sights is not available the mistakes in their level pass unnoticed. The rise and fall method through more tedious, provide a full check in calculation for all sight.