

# CLASS TEST

S.No. : 02 SK1\_CE\_B\_140819

Surveying Engineering



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# CLASS TEST 2019-2020

## CIVIL ENGINEERING

Date of Test : 14/08/2019

### ANSWER KEY > Surveying Engineering

1. (c)	7. (a)	13. (c)	19. (d)	25. (d)
2. (a)	8. (a)	14. (d)	20. (b)	26. (b)
3. (c)	9. (d)	15. (a)	21. (d)	27. (d)
4. (c)	10. (b)	16. (c)	22. (b)	28. (b)
5. (b)	11. (b)	17. (b)	23. (c)	29. (c)
6. (a)	12. (b)	18. (a)	24. (c)	30. (a)

**DETAILED EXPLANATIONS**

5. (b)

When the instrument is at A,

Apparent difference in elevation between A and B =  $2.60 - 1.30 = 1.30$  m

When the instrument is at B,

Apparent difference in elevation =  $2.40 - 0.80 = 1.60$  m

∴ True difference in elevation =  $\frac{1.30 + 1.60}{2} = 1.45$  m

6. (a)

Correction per chain =  $-(l - l') = l' - l = + 0.1$  m

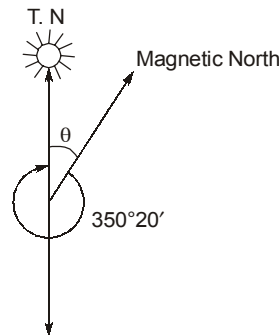
Correction per metre =  $\frac{(l - l')}{l} = \frac{+0.1}{20}$

Total correction,  $C_a = \frac{0.1}{20} \times 841.5 = +4.2$  m

Correct distance,  $L = 841.5 + 4.2 = 845.7$  m

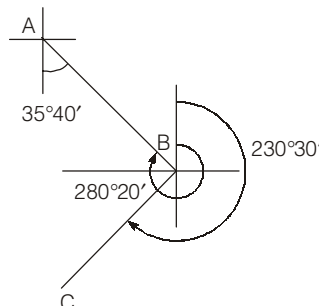
8. (a)

At noon true bearing of sun =  $180^\circ$  or  $0^\circ$



∴ Magnetic declination,  $\theta = 360^\circ - 350^\circ 20' = 9^\circ 40'$

9. (d)



Interior angle =  $280^\circ 20' - 230^\circ 30' = 49^\circ 50'$

11. (b)

Staff intercept =  $1.780 - 1.702 = 0.078$  m

Position of centre of bubble in first deviated condition =  $\frac{15 - 5}{2} = 5$  divisions towards eye-piece.

Position of centre of bubble in second deviated position =  $\frac{15-5}{2} = 5$  division towards object glass.

Total movement of the bubble =  $5 + 5 = 10$  division

$$R = \frac{n/D}{S} = \frac{10 \times 2 \times 100}{1000 \times 0.078} = 25.64 \text{ m}$$

12. (b)

$$\text{Shrinkage factor} = \frac{18}{20} = 0.9$$

Reduced plan area = (Shrinkage factor)<sup>2</sup> × Actual plan area

$$\Rightarrow 324 = (0.9)^2 \times \text{Actual plan area}$$

$$\Rightarrow \text{Actual plan area} = 400 \text{ cm}^2$$

$$\therefore \text{Actual area of survey in m}^2 = 400 \times (20)^2 = 16 \times 10^4$$

13. (c)

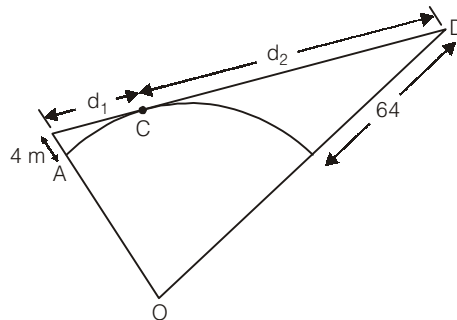
Distance of the observer from the point O where line of sight laches the surface of sea

$$d_1 = 3.8553\sqrt{4} = 7.7106 \text{ km}$$

Distance of light house  $\Rightarrow d_2 = 3.8553\sqrt{64} = 30.8424 \text{ km}$ .

Total distance from observer to light house

$$= d_1 + d_2 = 7.7106 + 30.8424 = 38.553 \text{ km}$$



14. (d)

For a closed traverse

$$\Sigma L = 0$$

$$\Rightarrow 200 \cos 0^\circ + 1000 \cos 45^\circ + 900 \cos 120^\circ + L \cos \theta = 0$$

$$\Rightarrow L \cos \theta = -457.107 \quad \dots(i)$$

$$\Sigma D = 0$$

$$200 \sin 0^\circ + 1000 \sin 45^\circ + 900 \sin 120^\circ + L \sin \theta = 0$$

$$0 + 707.107 + 779.42 + L \sin \theta = 0$$

$$L \sin \theta = -1486.527 \quad \dots(ii)$$

From equation (i) and (ii),

$$\tan \theta = 3.2520$$

$$\theta = 72.91 \approx 73^\circ$$

$$\theta = 252.91^\circ \approx 253^\circ$$

$$L = \frac{-1486.527}{\sin 253^\circ} = 1554.45 \approx 1555 \text{ m}$$

16. (c)

Let the length and bearing of line EA are 'l' and 'θ' respectively

In a closed traverse,

$$\sum \text{Latitudes} = 0 \text{ and } \sum \text{Departures} = 0$$

Considering,  $\sum \text{Latitudes} = 0$

$$\Rightarrow 204 \cos 87^\circ 30' + 226 \cos 20^\circ 20' + 187 \cos 280^\circ + 192 \cos 210^\circ 03' + l \cos \theta = 0$$

$$\Rightarrow l \cos \theta = -87.095 \text{ m} \quad \dots(i)$$

Considering,  $\sum \text{Departures} = 0$

$$\Rightarrow 204 \sin 87^\circ 30' + 226 \sin 20^\circ 20' + 187 \sin 280^\circ + 192 \sin 210^\circ 03' + l \sin \theta = 0$$

$$\Rightarrow l \sin \theta = -2.03 \text{ m} \quad \dots(ii)$$

$$\therefore l^2 \sin^2 \theta + l^2 \cos^2 \theta = (2.03)^2 + (87.095)^2$$

$$\therefore l = 87.12 \text{ m}$$

20. (b)

Given:  $\alpha = 7^\circ 13' 40''$  ;

$$\beta = 10^\circ 15' 00'' ;$$

$$\gamma = 13^\circ 12' 10'' ;$$

$$b_1 = 314.12 \text{ m} ;$$

In triangle AE'B

According to cosine rule

$$E'B^2 = AE'^2 + AB^2 - 2 AE' \cdot AB \cos \phi$$

$$\Rightarrow (h \cot \beta)^2 = (h \cot \alpha)^2 + b_1^2 - 2b_1 \cdot h \cot \alpha \cos \phi$$

$$\Rightarrow \cos \phi = \frac{(h \cot \alpha)^2 + b_1^2 - (h \cot \beta)^2}{2b_1 h \cot \alpha}$$

Similarly, in triangle AE'C

$$\cos \phi = \frac{(h \cot \alpha)^2 + (b_1 + b_2)^2 - (h \cot \gamma)^2}{2(b_1 + b_2) h \cot \alpha}$$

Equating both values of cos φ

$$\Rightarrow \frac{(h \cot \alpha)^2 + b_1^2 - (h \cot \beta)^2}{2b_1 h \cot \alpha} = \frac{(h \cot \alpha)^2 + (b_1 + b_2)^2 - (h \cot \gamma)^2}{2(b_1 + b_2) h \cot \alpha}$$

$$\Rightarrow h = \left[ \frac{b_1 b_2 (b_1 + b_2)}{b_1 (\cot^2 \gamma - \cot^2 \beta) + b_2 (\cot^2 \alpha - \cot^2 \beta)} \right]^{1/2}$$

Substituting the given values,  $h = 104.97 \text{ m}$

21. (d)

Let the permissible error in the angular measurement be θ

$$\therefore \text{Displacement due to angular error} = l \sin \theta = 15 \sin \theta$$

Accuracy in linear measurement is 1 in 20

$$\therefore \text{Displacement due to linear error} = \frac{15}{20} = 0.75$$

$$\text{Combined error on ground} = \sqrt{(15 \sin \theta)^2 + 0.75^2}$$

$$\text{Combined error on plan} = \text{Scale} \times \text{Combined error on ground}$$

$$= \frac{1}{30} \sqrt{(15 \sin \theta)^2 + 0.75^2}$$

and, combined error on plan should be less than 0.025 cm.

$$\therefore \frac{1}{30} \sqrt{(15 \sin \theta)^2 + 0.75^2} = 0.025$$

$$\Rightarrow \theta = 0^\circ$$

$\therefore$  Angular error is not permitted.

22. (b)

$$s = \frac{23.9}{8.34} = \frac{x}{y} \quad (\text{where } x = 23.9, y = 8.34)$$

$$\Rightarrow \delta s = \frac{y \delta x - x \delta y}{y^2}$$

To calculate maximum error, we consider  $\delta y$  as negative.

Maximum error of 'x' and 'y' are 0.05 and -0.005 respectively

$$\Rightarrow \delta s = 0.0077$$

23. (c)

$$\text{Horizontal distance, } D = Ks \cos^2 \theta + C \cos \theta$$

$$= \frac{f}{i} s \cos^2 \theta + C \cos \theta \quad \left[ \because k = \frac{f}{i} \right]$$

$$\Rightarrow \delta D = -\frac{f}{i^2} \cos^2 \theta \delta i$$

$$\Rightarrow \delta D = -\frac{K}{i} s \cos^2 \theta \delta i$$

$$= -\frac{100}{0.25} s \cos^2 10^\circ \times 0.0025 \quad \left[ i = \frac{f}{K} = 0.25 \text{ cm} \right]$$

$$= -0.97s$$

24. (c)

$$\text{Least count for an extended vernier} = \frac{\text{Smallest division of the main scale (s)}}{\text{Number of divisions of the vernier (n)}}$$

$$\Rightarrow 10'' = \frac{10'}{n}$$

$$\therefore n = 60$$

For an extended vernier

'n' division of vernier should be equal to '(2n - 1)' divisions of main scale

$$\therefore M = 2n - 1 = 119 \text{ and } N = n = 60$$

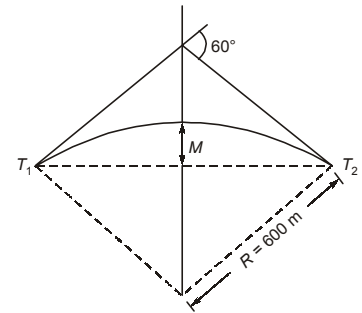
25. (d)

$$\begin{aligned} \text{H.I} &= \text{R.L} + \text{B.S} \\ &= 112.23 + 1.500 = 113.730 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{R.L} &= \text{H.I} + \text{FS} \quad (\text{as staff held inverted}) \\ &= 113.730 + 0.575 = 114.305 \text{ m} \end{aligned}$$

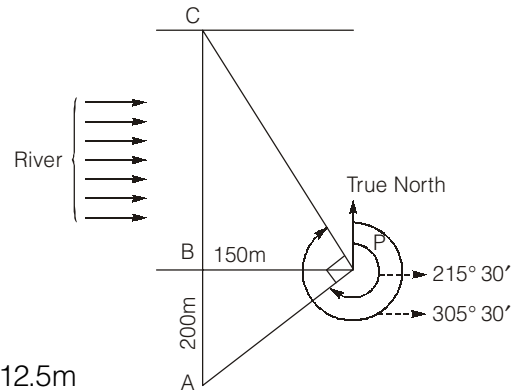
26. (b)

$$\begin{aligned} \text{Length of long chord, } T_1T_2 &= 2R \sin(\Delta/2) \\ &= 2 \times 600 \times \sin(60/2) \\ &= 600 \text{ m} \quad (\because \Delta = 60^\circ) \\ \text{Length of mid-ordinate, } M &= R[1 - \cos(\Delta/2)] \\ &= 600[1 - \cos(60/2)] \\ &= 600 \times 0.134 = 80.4 \text{ m} \end{aligned}$$



27. (d)

$$\begin{aligned} \tan \angle PAB &= \frac{150}{200} = \frac{3}{4} \\ \Rightarrow \angle PAB &= 36.87^\circ \\ \angle APC &= 305^\circ 30' - 215^\circ 30' = 90^\circ \\ \therefore \angle ACP &= 180^\circ - \angle PAB - \angle APC \\ &= 53.13^\circ = \angle BCP \\ \therefore BC &= \frac{PB}{\tan \angle BCP} = \frac{150}{\tan 53.13^\circ} = 112.5 \text{ m} \end{aligned}$$



28. (b)

For the first 2000 m, average error is

$$e = \frac{0 + 10}{2} = 5 \text{ cm} = 0.05 \text{ m}$$

∴ Incorrect length of chain,

$$L' = 20 + 0.05 = 20.05 \text{ m}$$

Measured length,  $l' = 2000 \text{ m}$

$$\therefore \text{True length, } l_1 = \left(\frac{L'}{L}\right) \times l' = \left(\frac{20.05}{20}\right) \times 2000 = 2005 \text{ m}$$

For the next 2000 m, average error is

$$e = \frac{10 + 18}{2} = 14 \text{ cm} = 0.14 \text{ m}$$

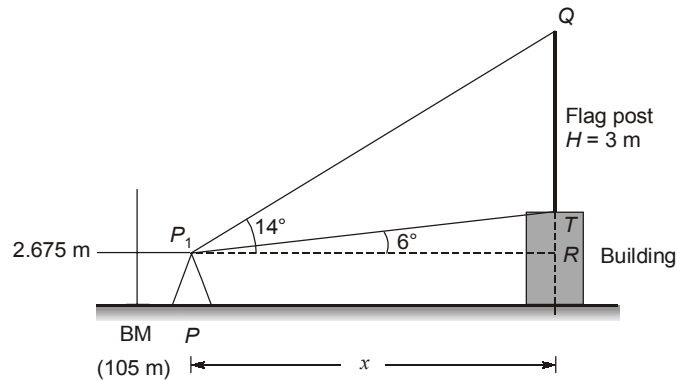
$$\therefore L' = 20 + 0.14 = 20.14 \text{ m}$$

$$l' = 2000 \text{ m}$$

$$\therefore \text{True length, } l_2 = \left(\frac{L'}{L}\right) \times l' = \left(\frac{20.14}{20}\right) \times 2000 = 2014 \text{ m}$$

$$\begin{aligned} \text{Hence, true distance, } l &= l_1 + l_2 \\ &= 2005 + 2014 = 4019 \text{ m} \end{aligned}$$

29. (c)

From  $\Delta P_1TR$ ,

$$\tan 6^\circ = \frac{TR}{x}$$

$$TR = x \tan 6^\circ \quad \dots(i)$$

From  $\Delta P_1RQ$ ,

$$\tan 14^\circ = \frac{QR}{x} = \frac{QT + TR}{x}$$

$$\Rightarrow \tan 14^\circ = \frac{3 + TR}{x} \quad \dots(ii)$$

From (i) and (ii), we get

$$x \tan 6^\circ = x \tan 14^\circ - 3$$

$$x = 20.80 \text{ m}$$

$$\therefore TR = 20.80 \tan 6^\circ = 2.186 \text{ m}$$

$$\begin{aligned} \therefore \text{RL of flag - post top (Q)} &= 105 + 2.675 + TR + 3 \\ &= 105 + 2.675 + 2.186 + 3 \\ &= 112.86 \text{ m} \end{aligned}$$

30. (a)

$$\text{H.I. at point 5} = \text{R.L. of } C + \text{Foresight at point } C = 197.82 \text{ m}$$

$$\text{R.L. of point 5} = \text{H.I. at point 5} + \text{Backsight at point 5} = 193.49 \text{ m}$$

$$\text{H.I. at point 2} = \text{R.L. of point 3} + 5.39 = 197.01 \text{ m}$$

$$\text{R.L. of point 2} = \text{H.I. at point 2} - 3.91 = 193.1$$

$$\text{R.L. of point 4} = \text{H.I. at point 2} - 4.73 = 192.28 \text{ m}$$

$$\text{R.L. of } B = \text{H.I. at point 2} - (-6.29) = 203.30 \text{ m}$$

$$\text{H.I. at } A = \text{R.L. of point 2} + 6.52 = 199.62$$

$$\text{R.L. of } A = \text{H.I. at } A - 4.39 = 195.23 \text{ m}$$

