CLASS TEST

S.No. : 01IG_CE_C_280322

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SURVEYING

CIVIL ENGINEERING

Date of Test : 28/03/2022

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (b)
The refraction error can not be fully eliminated as there is always a possibility that the atmospheric conditions may get changed during shifting from one location to another.

3. (b)
There is no use of Intermediate sight

$$\text{Fall in elevation} = \sum \text{Foresight} - \sum \text{Backsight}$$
$$= 0.388 \text{ m}$$
$$\text{R.L. of first station} - \text{Fall in elevation} = \text{R.L. of last station}$$
$$\therefore \quad \text{R.L. of First station} = 124.238 \text{ m} = 1242.38 \text{ decimeter}$$

4. (a)
R.L. of the under side of Tee-beam = R.L. of the floor + Staff reading + Staff reading held upside down

$$\Rightarrow \quad 106.4 = 100.782 + 2.32 + \text{Staff reading held upside down}$$

$\therefore$ Staff reading held upside down = 3.3 m

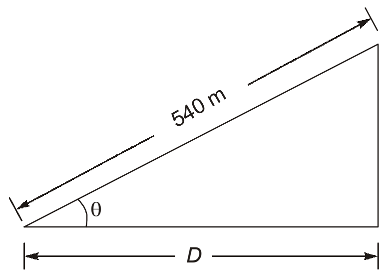
5. (a)
True difference of level between A and B

$$H = \frac{(h_b - h_a) + (h'_b - h'_a)}{2}$$

where,
h_b = reading on staff at B when instrument at A
h_a = reading on staff at A when instrument at A
h'_b = reading on staff at B when instrument at B
h'_a = reading on staff at A when instrument at B

$$\Rightarrow \quad H = 0.61 \text{ m}$$
$$\therefore \quad \text{R.L. of B} = \text{R.L. of A} - H$$
$$= 125.88 \text{ m}$$

9. (a)



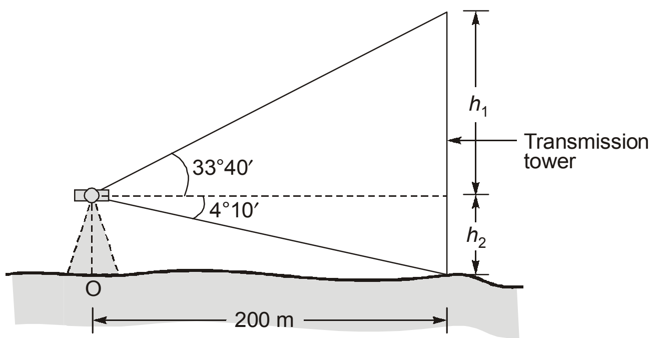
$$\text{Slope, } \tan\theta = \frac{1}{6}$$

$$\Rightarrow \quad \theta = 9.462°$$

$$\text{Horizontal distance, } D = 540\cos\theta$$

$$= 532.65 \text{ m}$$

10. (d)

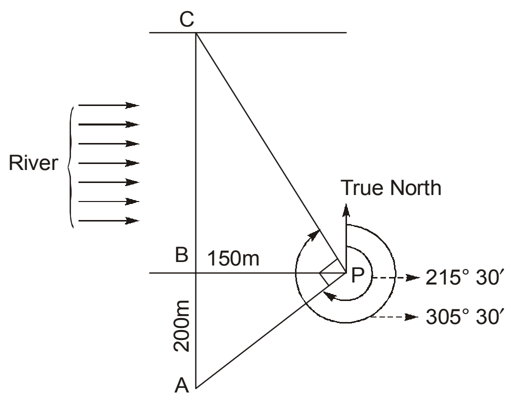


$$\text{Total height of tower, } h = h_1 + h_2$$

$$= 200\tan 33°40' + 200\tan 4°10'$$

$$= 147.8 \text{ m}$$

12. (b)



$$\tan \angle PAB = \frac{150}{200} = \frac{3}{4}$$

$$\Rightarrow \quad \angle PAB = 36.87^\circ$$

$$\angle APC = 305^\circ\,30' - 215^\circ\,30' = 90^\circ$$

$$\therefore \quad \angle ACP = 180^\circ - \angle PAB - \angle APC$$

$$= 53.13^\circ = \angle BCP$$

$$\therefore \quad BC = \frac{PB}{\tan \angle BCP} = 112.5 \text{ m}$$

13. (b)

Let the multiplying and additive constants of the tacheometer be K and C respectively.

For 20 m distance, $20 = K(0.198) + C$ ...(i)

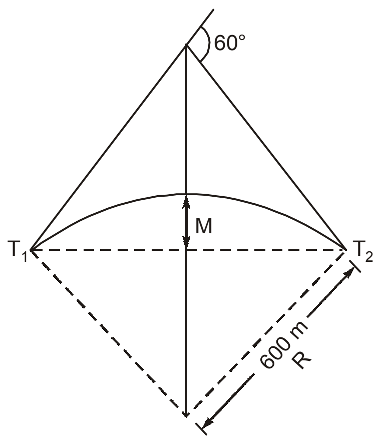
For 100 m distance, $100 = K(0.998) + C$ ...(ii)

From equation (i) and (ii),

$$K = 100 \text{ and } C = 0.2 \text{ m}$$

$$\frac{K}{C} = 500$$

14. (b)



Length of long chord, $T_1T_2 = 2R\sin(\Delta/2)$

$$= 2 \times 600 \times \sin(60/2) \qquad (\because \Delta = 60^\circ)$$

$$= 600 \text{ m}$$

Length of mid-ordinate, $M = R[1 - \cos(\Delta/2)]$

$$= 600[1 - \cos(60/2)]$$

$$= 600 \times 0.134 = 80.4 \text{ m}$$

15. (a)

$$\text{Volume} = h\left[\frac{A_1 + A_n}{2} + A_2 + A_3 + A_4\right]$$

$$= 5\left[\frac{60+1000}{2} + 180 + 330 + 650\right]$$

$$= 8450 \text{ ha-m}$$

16. (c)

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

In a closed traverse,

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

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

$\Rightarrow$ $204 \cos 87°30' + 226 \cos 20°20' + 187 \cos 280° + 192 \cos 210°3' + l \cos\theta = 0$

$\Rightarrow$ $l \cos\theta = -87.09$ m ...(i)

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

$\Rightarrow$ $204 \sin 87°30' + 226 \sin 20°20' + 187 \sin 280° + 192 \sin 210°3' + l \sin\theta = 0$

$\Rightarrow$ $l \sin\theta = -2.03$ m ...(ii)

$\Rightarrow$ $l^2 \sin^2\theta + l^2 \cos^2\theta = (2.03)^2 + (87.09)^2$

$\therefore$ $l = 87.11$ m

17. (b)

$$s = (4.86)^2 = x^2 \qquad \text{(where } x = 4.86\text{)}$$

$\Rightarrow$ $\delta s = 2x\,\delta x$

Maximum error in the individual measurement is 0.005

$\therefore$ $\delta s = 2\,(4.86)\,(0.005) = 0.0486$

18. (c)

As tape is pulled under a standard pull of 180 N, so there will be no pull (tension) correction

Only sag correction is applicable

$$\text{Sag correction} = \frac{W^2 l}{24P^2} = \frac{(30)^2 \times 100}{24 \times 180^2} = 0.116 \text{ m}$$

$\therefore$ Corrected distance between end of tapes = 100 – 0.116 = 99.884 m

19. (c)

Distance of Ship A from light house $= 3.855\sqrt{9}$ km

Distance of Ship B from Ship A $= 3.855\sqrt{9} + 3.855\sqrt{9}$ km

Distance of Ship B from light house $= 3 \times \left[3.855\sqrt{9}\right]$ km

Let the observer at Ship B can see upto 'h' m height of light house

Distance of Ship B from light house $= 3.855\sqrt{h} + 3.855\sqrt{9}$

$\Rightarrow$ $3 \times \left[3.855\sqrt{9}\right] = 3.855\sqrt{h} + 3.855\sqrt{9}$

$\Rightarrow$ $2 \times 3.855 \times 3 = 3.855\sqrt{h}$

$\Rightarrow$ $h = 36$ m

$\therefore$ The height of light house visible to observer at Ship B = (49 – 36) m

= 13 m

20. (b)

$$\text{Mean value, } \bar{x} = \frac{\Sigma \text{ observation}}{10} = 100.448\text{ m}$$

$$\text{Standard deviation of the mean} = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n(n-1)}} = 0.025\text{ m} = 2.5 \text{ centimeter}$$

21. (c)

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

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

$$\therefore \quad n = 60$$

For an extended vernier

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

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

where, s is staff intercept.

22. (c)

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

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

$$\Rightarrow \quad \delta D = -\frac{f}{i^2}s\cos^2\delta i + 0$$

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

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

$$= -0.97s$$

23. (a)

At noon, the sun is exactly on the geographical meridian.

Hence, the true bearing of the sun at noon is zero or 180° depending upon whether it is to the North of the place or to the South of the place.

Since the magnetic bearing of the Sun is 351°20′, it is at the North of the place and hence the true bearing of the sun, which is on the meridian, will be 360°.

$\therefore$ True bearing = Magnetic bearing + Declination

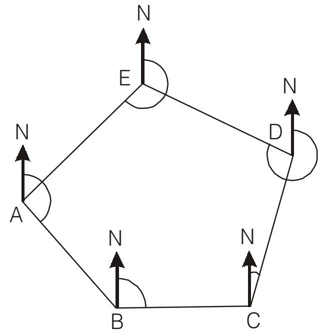
$\Rightarrow$ 360° = 351°20′ + Declination

$\therefore$ Declination = +8°40′ = 8°40′ E

24. (b)

As the Fore Bearing and Back Bearing of line EA differ exactly by 180°, stations E and A are free from local attraction. Therefore, the Fore Bearing of AB and Back Bearing of DE are also free from local attraction.

First Method:



$$\begin{aligned}
\text{Correct FB of DE} &= 134^\circ\,45' + 180^\circ = 314^\circ\,45' \\
\text{Error at D} &= 314^\circ\,15' - 314^\circ\,45' = -30' \\
\text{Correction at D} &= +30' \\
\text{Correct BB of CD} &= 222^\circ\,45' + 30' = 223^\circ\,15' \\
\text{Correct FB of CD} &= 223^\circ\,15' - 180^\circ = 43^\circ\,15' \\
\text{Error at C} &= 41^\circ\,30' - 43^\circ\,15' = -1^\circ\,45' \\
\text{Correction at C} &= +1^\circ\,45' \\
\text{Correct BB of BC} &= 256^\circ\,0' + 1^\circ\,45' = 257^\circ\,45' \\
\text{Correct FB of BC} &= 257^\circ\,45' - 180^\circ = 77^\circ\,45' \\
\text{Error at B} &= 77^\circ\,30' - 77^\circ\,45' = -15' \\
\text{Correction at B} &= +15' \\
\text{Correct BB of AB} &= 329^\circ\,45' + 15' = 330^\circ\,0' \\
\text{Correct FB of AB} &= 330^\circ\,0' - 180^\circ = 150^\circ\,0' \\
\text{Error at A} &= 150^\circ\,0' - 150^\circ\,0' = 0.0
\end{aligned}$$

Second Method:

$$\begin{aligned}
\angle A &= 150^\circ\,0' - 40^\circ\,15' && = 109^\circ\,45' \\
\angle B &= 329^\circ\,45' - 77^\circ\,30' && = 252^\circ\,15'\ (\text{exterior}) = 107^\circ\,45'\ (\text{interior}) \\
\angle C &= 256^\circ\,0' - 41^\circ\,30' && = 214^\circ\,30'\ (\text{exterior}) = 145^\circ\,30'\ (\text{interior}) \\
\angle D &= 314^\circ\,15' - 222^\circ\,45' && = 91^\circ\,30' \\
\angle E &= 220^\circ\,15' - 134^\circ\,45' && = 85^\circ\,30'
\end{aligned}$$

$$\begin{aligned}
\text{Sum of included angles} &= 109^\circ\,45' + 107^\circ\,45' + 145^\circ\,30' + 91^\circ\,30' + 85^\circ\,30' = 540' \\
(2N-4)\times 90^\circ &= (2\times 5-4)\times 90 = 540^\circ
\end{aligned}$$

There is no error in the sum of the included angles. As there is no local attraction at A, the F.B. of AB is correct.

$$\begin{aligned}
\text{Correct B.B. of AB} &= 150^\circ + 180^\circ = 330^\circ \\
\text{Correct F.B. of BC} &= 330^\circ + \angle B = 330^\circ + 107^\circ\,45' = 437^\circ\,45' - 360^\circ = 77^\circ\,45' \\
\text{Correct B.B. of BC} &= 77^\circ\,45' + 180^\circ = 257^\circ\,45' \\
\text{Correct F.B. of CD} &= 257^\circ\,45' + 145^\circ\,30' = 403^\circ\,15' = 43^\circ\,15' \\
\text{Correct B.B. of CD} &= 43^\circ\,15' + 180^\circ = 223^\circ\,15'
\end{aligned}$$

Correct F.B. of DE = 223° 15′ + 91° 30′ = 314° 45′

Correct B.B. of DE = 314° 45′ – 180° = 134° 45′

As there is no local attraction at E, the computed B.B. of DE is equal to the observed bearing.

25. (a)

H.I. at point 5 = R.L. of C + Foresight at point C = 197.82 m

R.L. of point 5 = H.I. at point 5 + Backsight at point 5 = 193.49 m

H.I. at point 2 = R.L. of point 3 + 5.39 = 197.01 m

R.L. of point 2 = H.I. at point 2 – 3.91 = 193.1

R.L. of point 4 = H.I. at point 2 – 4.73 = 192.28 m

R.L. of B = H.I. at point 2 – (–6.29) = 203.30 m

H.I. at A = R.L. of point 2 + 6.52 = 199.62

R.L. of A = H.I. at A – 4.39 = 195.23 m

26. (a)

Let the length of line BC and DE be l_1 and l_2

ΣLattitude = 0 (for a closed traverse)

$\Rightarrow$ $500 \cos 98°30' + l_1 \cos 30°20' + 468 \cos 298°\ 30' + l_2 \cos 230° + 274 \cos 150° = 0$

$\Rightarrow$ $0.863\ l_1 - 0.643\ l_2 = 87.88$ ...(i)

ΣDeparture = 0 (for a closed traverse)

$\Rightarrow$ $500 \sin 98°30' + l_1 \sin 30°20' + 468 \sin 298°\ 30' + l_2 \sin 230° + 274 \sin 150° = 0$

$\Rightarrow$ $0.505\ l_1 - 0.766\ l_2 = -220.22$ ...(ii)

Solving equation (i) and (ii)

$\therefore$ $l_1 = 621.14$ m, $l_2 = 697.0$ m

27. (c)

A normal tension of 101.76 N is applied, so, there will be no pull and sag correction.

Corrections required are slope, pull, temperature and standardisation.

Slope correction $= -L(1-\cos\theta)$

$= -29.786\,(1-\cos 4°30')$

$= -0.09182$ m

Standardisation correction $= L\left(\dfrac{l'-l}{l}\right) = +0.00397$ m

Temperature correction $= \alpha(T-20) \times L$

$= 1.12 \times 10^{-5}(10-20) \times 29.786$

$= -0.003336$ m

Total correction $= -0.09182 + 0.00397 - 0.003336$

$= -0.09113$ m

Correct horizontal distance $= 29.786 - 0.09113$

$= 29.695 \text{ m} \simeq 29.70$ m

28. (b)

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

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

To calculate maximum error, we consider δy as negative.
Maximum error of 'x' and 'y' are 0.05 and –0.005 respectively

$$\Rightarrow \qquad \delta s = 0.0077$$

29. (d)

Let the permissible error in the angular measurement be θ

$\therefore$ 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.

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

$$\Rightarrow \qquad \theta = 0°$$

$\therefore$ Angular error is not permitted.

30. (c)

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

In a closed traverse,

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

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

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

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

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

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

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

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

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

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