S.No. : 01 JP_CE_09082022

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SURVEYING

CIVIL ENGINEERING

Date of Test : 09/08/2022

ANSWER KEY ➤

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

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

$\Rightarrow$ 106.4 = 100.782 + 2.32 + 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

$\Rightarrow \quad H = 0.61\ \text{m}$

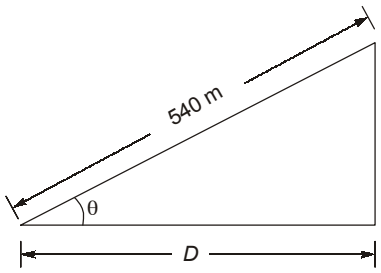
$\therefore \quad \text{R.L. of B} = \text{R.L. of A} - H$

$= 125.88\ \text{m}$

8. (c)

Temporal resolution refers to the precision of a measurement with respect to time in which, observations are made over the same area on different datas. This is useful during crop growth, deforestation, floods etc.

9. (a)



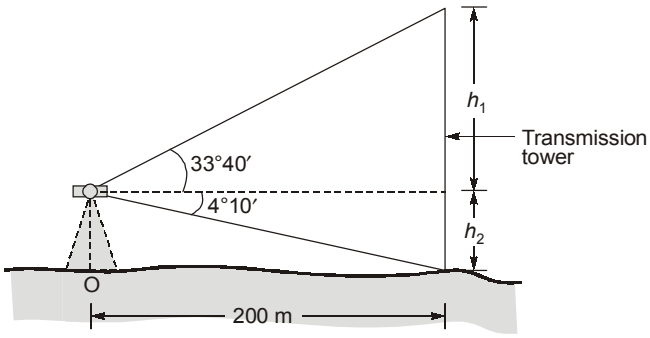
$$\text{Slope, } \tan\theta = \frac{1}{6}$$

$$\Rightarrow \quad \theta = 9.462^\circ$$

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

$$= 532.65\text{ m}$$

10. (d)

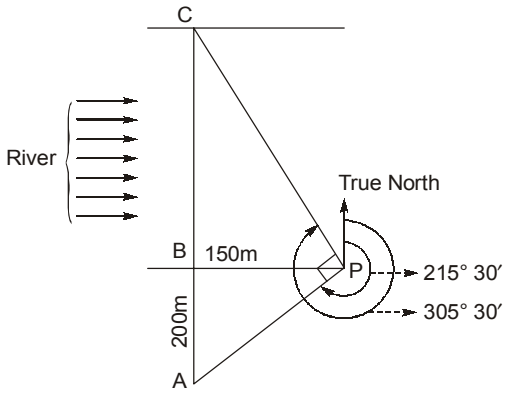


$$\text{Total height of tower, } h = h_1 + h_2$$

$$= 200\tan 33^\circ 40' + 200\tan 4^\circ 10'$$

$$= 147.8\text{ m}$$

12. (b)



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

$\Rightarrow \quad \angle PAB = 36.87°$

$\angle APC = 305° 30' - 215° 30' = 90°$

$\therefore \quad \angle ACP = 180° - \angle PAB - \angle APC$

$= 53.13° = \angle BCP$

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

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)

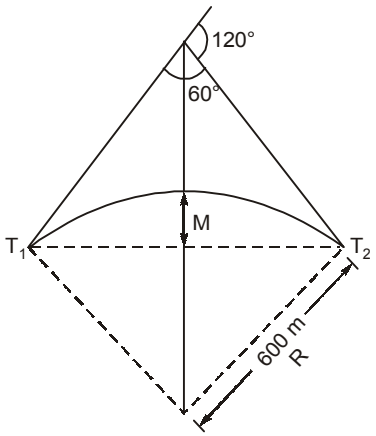
For 100 m distance, $100 = K(0.998) + C$ ...(ii)

From equation (i) and (ii),

$K = 100$ and $C = 0.2$ m

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

14. (b)



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

$= 2 \times 600 \times \sin\left(\frac{120}{2}\right)$ ($\because \Delta = 120°$)

$= 1039.2$ m

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

$= 600[1 - \cos(120/2)]$

$= 600 \times 1/2 = 300$ 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, $\sum \text{Lattitudes} = 0$

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

$$\Rightarrow l \cos\theta = -87.09 \text{ m} \quad \ldots(i)$$

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

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

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

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

$$\therefore l = 87.11 \text{ m}$$

17. (b)

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

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

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. (a)

Given: L_1 = 10 km, L_2 = 10 km

$$\text{Number of photograph in each length strip} = \frac{L_1}{(1-P_l)sl} + 1$$

$$= \frac{10000}{(1-0.6)\times 20 \times 100} + 1 = 13.5 \simeq 14$$

$$\text{Number of photograph in width strip} = \frac{L_2}{(1-P_s)sw} + 1$$

$$= \frac{10000}{(1-0.3)\times 100 \times 20} + 1 = 8.14 \simeq 9$$

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

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

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°.

$$\therefore \quad \text{True bearing} = \text{Magnetic bearing} + \text{Declination}$$

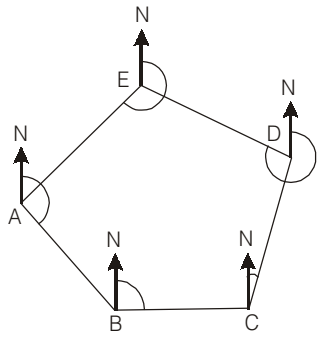
$$\Rightarrow \quad 360° = 351°20' + \text{Declination}$$

$$\therefore \quad \text{Declination} = +8°40' = 8°40'\,\text{E}$$

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:



Correct FB of DE = 134° 45′ + 180° = 314° 45′
Error at D = 314° 15′ – 314° 45′ = – 30′
Correction at D = + 30′
Correct BB of CD = 222° 45′ + 30′ = 223° 15′
Correct FB of CD = 223° 15′ – 180° = 43° 15′
Error at C = 41° 30′ – 43° 15′ = – 1° 45′
Correction at C = +1° 45′
Correct BB of BC = 256° 0′ + 1° 45′ = 257° 45′
Correct FB of BC = 257° 45′ – 180° = 77° 45′
Error at B = 77° 30′ – 77° 45′ = – 15′
Correction at B = +15′
Correct BB of AB = 329° 45′ + 15′ = 330° 0′
Correct FB of AB = 330° 0′ – 180° = 150° 0′
Error at A = 150° 0′ – 150° 0′ = 0.0

Second Method:

$\angle A$ = 150° 0′ – 40° 15′ = 109° 45′
$\angle B$ = 329° 45′ – 77° 30′ = 252° 15′ (exterior) = 107° 45′ (interior)
$\angle C$ = 256° 0′ – 41° 30′ = 214° 30′ (exterior) = 145° 30′ (interior)
$\angle D$ = 314° 15′ – 222° 45′ = 91° 30′
$\angle E$ = 220° 15′ – 134° 45′ = 85° 30′
Sum of included angles = 109° 45′ + 107° 45′ + 145° 30′ + 91° 30′ + 85° 30′ = 540′
$(2N - 4) \times 90°$ = $(2 \times 5 - 4) \times 90 = 540°$

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.

Correct B.B. of AB = 150° + 180° = 330°
Correct F.B. of BC = 330° + $\angle B$ = 330° + 107° 45′ = 437° 45′ – 360° = 77° 45′
Correct B.B. of BC = 77° 45′ + 180° = 257° 45′
Correct F.B. of CD = 257° 45′ + 145° 30′ = 403° 15′ = 43° 15′
Correct B.B. of CD = 43° 15′ + 180° = 223° 15′
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. (b)

$n = 10$

Change in staff intercept, $S = 0.05$ m

Distance between staff and instrument,

$D = 100$ m

$$\alpha = \frac{S}{nD} = \frac{0.05}{10 \times 100} = 5 \times 10^{-5} \text{ radian}$$

$$\alpha = 5 \times 10^{-5} \times \frac{180}{\pi} = 2.8647 \times 10^{-3} \text{ degree}$$

$= 0°0'\ 10.31''$

$= 10.31$ sec of arc

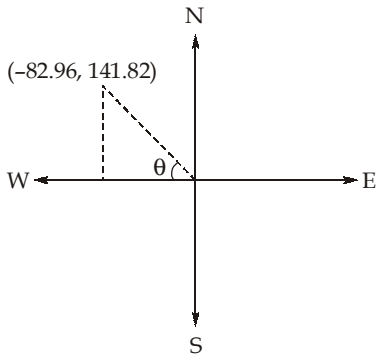
28. (b)

$$\tan\theta = \frac{141.82}{82.96} = 1.7095°$$

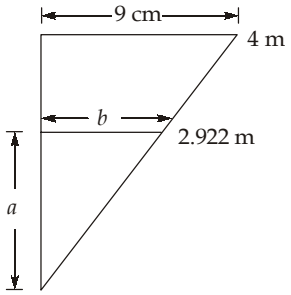
$\therefore$ $\theta = \tan^{-1}(1.7095) = 59.674°$

WCB = $270 + \theta = 270 + 59.674 = 329.674°$

$= 329.674 \times \pi$ rad $= 5.75$ rad



29. (b)



$$\frac{b}{9} = \frac{2.922}{4}$$

$$\Rightarrow \quad b = 6.5745 \text{ cm}$$

$$\therefore \quad \text{Correct reading } (a) = \sqrt{2.922^2 - (0.065745)^2}$$

$$= 2.92126 \text{ m} \simeq 2.9213 \text{ m}$$

30. (a)

Average scale of photograph

$$= \frac{f}{H - h_{avg}}$$

$$h_{avg} = \frac{1}{4}(1250 + 1650 + 1486 + 1501) = 1471.75 \text{ m}$$

$$\text{Average scale} = \frac{0.160}{3200 - 1471.75} = \frac{0.16}{1728.25}$$

$$= \frac{1}{10801.56} \simeq \frac{1}{10802}$$

■■■■