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Surveying Engineering

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CLASS TEST 2019-2020

CIVIL ENGINEERING

Date of Test : 19/09/2019

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 = $\frac{1.30 + 1.60}{2} = 1.45\text{m}$

6. (a)

$$\text{Correction per chain} = -(l - l') = l' - l = +0.1\text{m}$$

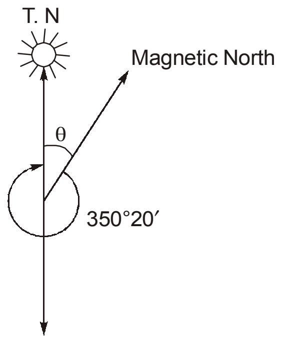
$$\text{Correction per metre} = \frac{(\ell - \ell')}{\ell} = \frac{+0.1}{20}$$

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

$$\text{Correct distance, } L = 841.5 + 4.2 = 845.7\text{ m}$$

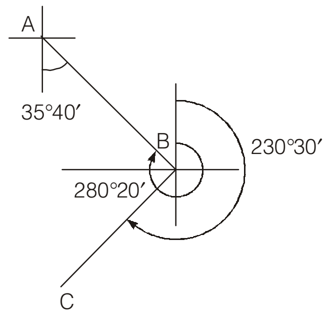
8. (a)

At noon true bearing of sun = 180° or 0°



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

9. (d)



Interior angle = 280°20′ – 230°30′ = 49°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

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

12. (b)

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

Reduced plan area = (Shrinkage factor)^2 × Actual plan area

⇒ 324 = $(0.9)^2$ × Actual plan area

⇒ Actual plan area = 400 cm^2

∴ Actual area of survey in m^2 = 400 × $(20)^2$ = 16 × 10^4

13. (c)

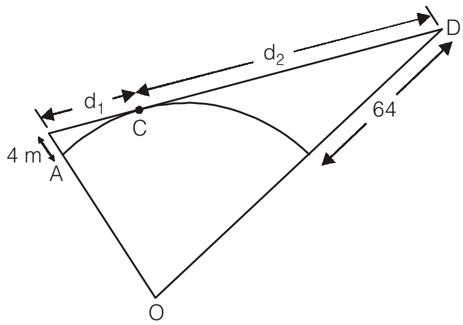
Distance of the observer from the point 0 where line of sight laches the surface of sea

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

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

Total distance from observer to light house

= $d_1 + d_2$ = 7.7106 + 30.8424 = 38.553 km



14. (d)

For a closed traverse

$$\Sigma L = 0$$

⇒ 200 cos0° + 1000 cos45° + 900 cos120° + L cosθ = 0

⇒ L cosθ = –457.107 ...(i)

$$\Sigma D = 0$$

200 sin0° + 1000 sin45° + 900 sin120° + L sinθ = 0

0 + 707.107 + 779.42 + L sinθ = 0

L sinθ = –1486.527 ...(ii)

From equation (i) and (ii),

$$\tan\theta = 3.2520$$

$$\theta = 72.91 \approx 73°$$

$$\theta = 252.91° \approx 253°$$

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

16. (c)

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

In a closed traverse,

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

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

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

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

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

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

$\Rightarrow$ $l \sin\theta = -2.03 \text{ m}$ ...(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: $\alpha = 7° 13' 40''$;

$\beta = 10° 15' 00''$;

$\gamma = 13° 12' 10''$;

$b_1 = 314.12 \text{ m}$;

In triangle AE′B

According to cosine rule

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

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

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

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 $\cos\phi$

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

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

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

21. (d)

Let the permissible error in the angular measurement be θ

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

Accuracy in linear measurement is 1 in 20

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

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

Combined error on plan $=$ Scale $\times$ 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.

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

$$\Rightarrow \quad \theta = 0°$$

$\therefore$ Angular error is not permitted.

22. (b)

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

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

To calculate maximum error, we consider δy as negative.

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

$$\Rightarrow \quad \delta s = 0.0077$$

23. (c)

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

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

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

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

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

$$= -0.97s$$

24. (c)

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

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

$$\therefore \quad n = 60$$

For an extended vernier

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

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

25. (d)

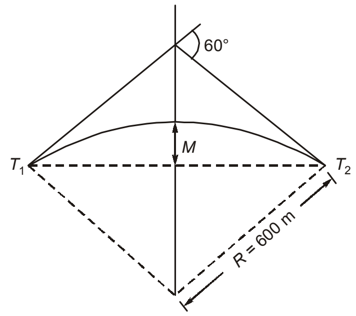
H.I = R.L + B.S

= 112.23 + 1.500 = 113.730 m

R.L = H.I + FS (as staff held inverted)

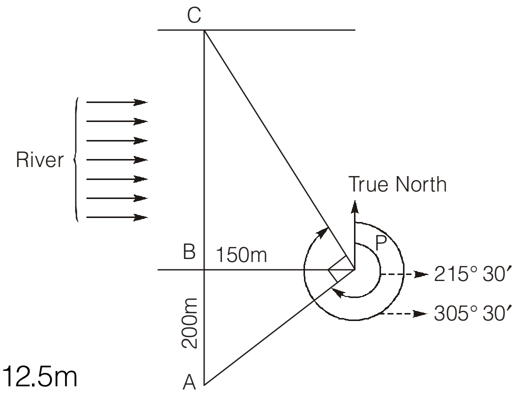
= 113.730 + 0.575 = 114.305 m

26. (b)



$$\text{Length of long chord, } T_1T_2 = 2R\sin(\Delta/2)$$
$$= 2 \times 600 \times \sin(60/2)$$
$$= 600 \text{ m} \qquad (\because \Delta = 60°)$$
$$\text{Length of mid-ordinate, } M = R[1-\cos(\Delta/2)]$$
$$= 600[1-\cos(60/2)]$$
$$= 600 \times 0.134 = 80.4 \text{ m}$$

27. (d)



$$\tan \angle PAB = \frac{150}{200} = \frac{3}{4}$$
$$\Rightarrow \quad \angle PAB = 36.87°$$
$$\angle APC = 305°\,30' - 215°\,30' = 90°$$
$$\therefore \quad \angle ACP = 180° - \angle PAB - \angle APC$$
$$= 53.13° = \angle BCP$$
$$\therefore \quad BC = \frac{PB}{\tan \angle BCP} = \frac{15°}{\tan 53.13°} = 112.5\text{m}$$

28. (b)

For the first 2000 m, average error is

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

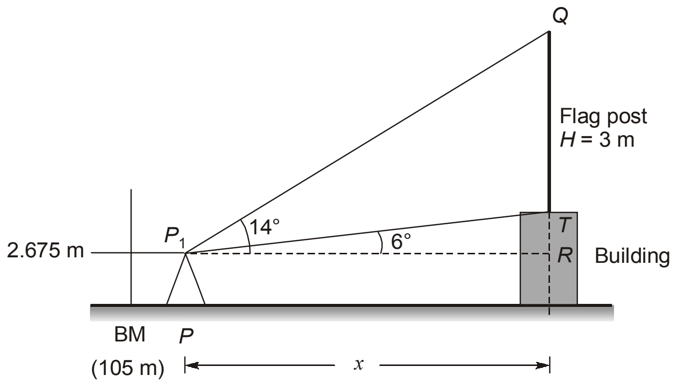
∴ Incorrect length of chain,

$$L' = 20 + 0.05 = 20.05 \text{ m}$$
$$\text{Measured length, } l' = 2000 \text{ m}$$
$$\therefore \quad \text{True length, } l_1 = \left(\frac{L'}{L}\right) \times l' = \left(\frac{20.05}{20}\right) \times 2000 = 2005 \text{ m}$$

For the next 2000 m, average error is

$$e = \frac{10+18}{2} = 14 \text{ cm} = 0.14 \text{ m}$$
$$\therefore \quad L' = 20 + 0.14 = 20.14 \text{ m}$$
$$l' = 2000 \text{ m}$$
$$\therefore \quad \text{True length, } l_2 = \left(\frac{L'}{L}\right) \times l' = \left(\frac{20.14}{20}\right) \times 2000 = 2014 \text{ m}$$
$$\text{Hence, true distance, } l = l_1 + l_2$$
$$= 2005 + 2014 = 4019 \text{ m}$$

29. (c)



From ΔP_1TR,

$$\tan 6° = \frac{TR}{x}$$

$$TR = x \tan 6° \qquad \text{...(i)}$$

From ΔP_1RQ,

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

$$\Rightarrow \qquad \tan 14° = \frac{3 + TR}{x} \qquad \text{...(ii)}$$

From (i) and (ii), we get

$$x \tan 6° = x \tan 14° - 3$$

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

$$\therefore \qquad TR = 20.80 \tan 6° = 2.186 \text{ m}$$

$\therefore$ RL of flag – post top (Q) = 105 + 2.675 + TR + 3

= 105 + 2.675 + 2.186 + 3

= 112.86 m

30. (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

■■■■