S.No. : 04 IG_CE_S+T_021119

Surveying

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CLASS TEST 2019-2020

CIVIL ENGINEERING

Date of Test : 02/11/2019

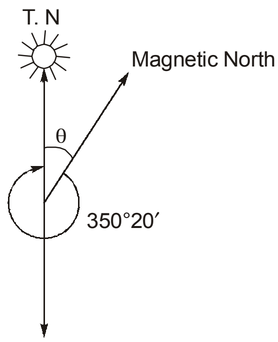
ANSWER KEY ➤ Surveying

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

Detailed Explanations

1. (a)

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



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

2. (b)

Given, elevation of tower from the bottom is 1250 m.

$$\therefore \quad d = \frac{hr}{H}$$

Here, $h = 50$ m

$H = 2500 - 1250 = 1250$ m

$$\therefore \quad d = \frac{50 \times 6.35}{1250} = 0.25 \text{ cm}$$

3. (c)

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

For 20 m distance, $20 = K(0.195) + C$ ...(i)

For 100 m distance, $100 = K(0.995) + C$ ...(ii)

From equations (i) and (ii),

$K = 100$ and $C = 0.5$ m

$$\frac{K}{C} = 200$$

4. (d)

RL of the under side of T-beam = RL of the floor + Staff reading + Staff reading held upside down

$\Rightarrow$ $107.82 = 101.56 + 2.48$ + Staff reading held upside down

$\therefore$ Staff reading held upside down = 3.78 m

5. (a)

Correction to latitude of any side

$$= \text{Total error in latitude} \times \frac{\text{Length of that side}}{\text{Perimeter of traverse}}$$

$$= 0.75 \times \frac{3}{15} \times 100 \text{ cm} = 15 \text{ cm}$$

6. (c)

$$\frac{\text{Length of long chord}}{\text{Tangent length}} = \frac{2R\sin\Delta/2}{R\tan\Delta/2} = \frac{2 \times 60 \sin 60°}{60 \tan 60°} = 1.0$$

7. (b)

$$\text{RL of } B = \text{RL of } A + \Sigma BS - \Sigma FS = 770.815 + 32.665 - 30.445 = 773.035 \text{ m}$$

$$\text{Given RL of } B = 772.935 \text{ m}$$

$$\therefore \quad \text{Closing error} = 773.035 - 772.935 = 0.100 \text{ m}$$

8. (c)

If R is the radius of the circular curve, then

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$$

$$\Rightarrow \quad \frac{300}{\sin 60^\circ} = 2R$$

$$\Rightarrow \quad R = \frac{346.41}{2} = 173.20 \text{ m}$$

10. (a)

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

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

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

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

11. (d)

We know,

$$\frac{f}{(H-h)} = \frac{x}{X}$$

here,

$x = 10.16$ cm

$X = 2.54 \text{ cm} \times 50000 = 2.54 \times 500 \text{ m} = 1270 \text{ m}$

$f = 16$ cm

$h = 200$ m

$$\therefore \quad \frac{16}{(H-200)} = \frac{10.16}{1270}$$

$$\Rightarrow \quad H - 200 = 2000 \text{ m}$$

$$\Rightarrow \quad H = 2200 \text{ m}$$

12. (b)

Since total number of observations are even so we apply Simpson's rule on first 7 observations

$$A_1 = \frac{30}{3}\left[(0+6.5) + 4(6.8+5.4+7) + 2(7.8+4.8)\right] = 1085 \text{ m}^2$$

A_2 = Applying trapezoidal rule between offsets 6.5 and 0

$$= \frac{30}{2}[6.5+0] = 97.5 \text{ m}^2$$

$$A = A_1 + A_2 = 1085 + 97.5 = 1182.5 \text{ m}^2$$

13. (d)

The difference in elevation between the vane and instrument axis

$$D \tan \alpha = 3000 \times \tan 5°36' = 294.153 \text{ m}$$

Combined correction due to curvature and refraction

$$h = 0.0673 D^2, \quad (D \text{ is in km})$$
$$= 0.0673 \times 3^2 = 0.606 \text{ m}$$

(here correction will be substractive)

So, difference in elevation between the vane and instrument axis

$$\therefore \quad h = 294.153 - 0.606 = 293.547 \text{ m}$$
$$\text{RL of instrument axis} = 436.050 + 2.865 = 438.915 \text{ m}$$
$$\therefore \quad \text{RL of vane} = \text{RL of instrument axis} - h = 438.915 - 293.547 = 145.368 \text{ m}$$
$$\therefore \quad \text{RL of staff station } Q = 145.368 - 2 = 143.368 \text{ m}$$

14. (c)

Sensitivity of bubble tube is given by,

$$\alpha' = \frac{S}{nD} \times \left(\frac{360°}{2\pi} \times 60 \times 60\right) = 20 \text{ Seconds}$$
$$S = ? \text{ (staff intercept)}$$
$$n = 2 \text{ divisions (deflection) and D = distance of the staff from level = 100 m}$$
$$\therefore \quad 20 = \frac{S}{2 \times 100}\left(\frac{360}{2\pi} \times 60 \times 60\right) = \frac{S}{2 \times 100}(206265)$$
$$\Rightarrow \quad S = \frac{20 \times 2 \times 100}{206265} \simeq 19.40 \times 10^{-3} \text{m}$$

15. (a)

I is correct.

For example, an angle A with a weight of 4, will have the weight of 4A as $\frac{1}{4}$.

If a quantity is multiplied by a factor, the weight of the result is then equal to the weight of that quantity divided by the square of the factor.

In case II, Weight of 0.5 α is 2

$\Rightarrow$ Weightage of (0.33α) should be $\dfrac{2}{(0.33/0.5)^2}$

$\therefore$ Weightage of (0.33α) is 4.5.

16. (b)

20 m chain,

True length of 20 m chain, $L' = 20 + 0.1 = 20.1$ m

Actual length of survey line, $l = 1200 \times \dfrac{20.1}{20} = 1206$ m

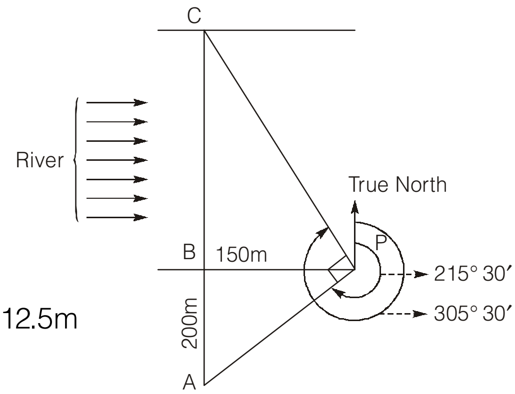
25 m length,

Actual length of survey line,

$$l = \text{Measured length} \times \frac{\text{True length of 25 m}}{\text{Considered length of 25 m}}$$
$$\Rightarrow \quad 1206 = 1212 \times \frac{L'}{25}$$
$$\Rightarrow \quad L' = 24.88 \text{ m} \qquad [\therefore \ (25 - 24.88) \times 100 = 12 \text{ cm}]$$

$\therefore$ The 25 m chain was 12 cm too short.

17. (d)



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

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

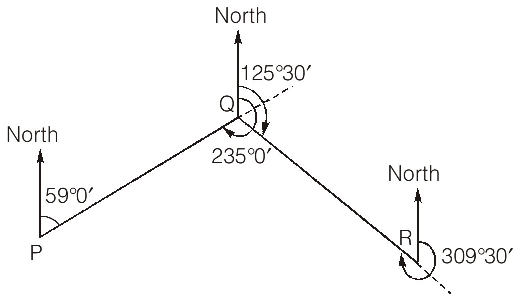
$$\angle APC = 305^\circ\,30' - 215^\circ\,30' = 90^\circ$$

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

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

$$\therefore \quad BC = \frac{PB}{\tan \angle BCP} = \frac{15^\circ}{\tan 53.13^\circ} = 112.5\text{m}$$

18. (b)



$$\text{Interior angle } PQR = \text{BB of } PQ - \text{FB of } QR$$

$$= 235^\circ\,0' - 125^\circ\,30' = 109^\circ\,30'$$

19. (a)

$$\text{Measured length} = 468 \text{ m}$$

$$\text{Scale of plan} = \frac{1}{4000}$$

$$\text{Scale used for measurement} = \frac{1}{2000}$$

$$\text{Correct length} = \frac{\text{drawn length on plan}}{\text{scale of plan}} = \frac{\left(468 \times \frac{1}{2000}\right)}{\frac{1}{4000}} = 936 \text{ m}$$

20. (b)

For the first 2000 m, average error is

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

$\therefore$ 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

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

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

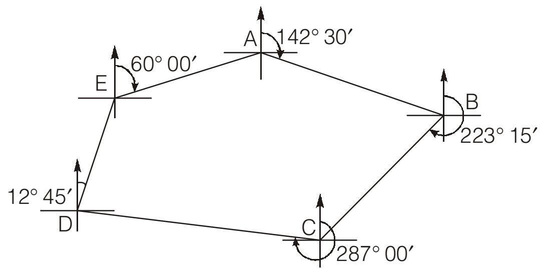
$$l' = 2000 \text{ m}$$

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

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

21. (b)

Refer to the figure shown below and convert the quadrantal bearings to whole circle bearings.



As the traversing is done in the clockwise direction, the included angles will be exterior angles.

Included angle = F.B. of next line – B.B. of previous line.

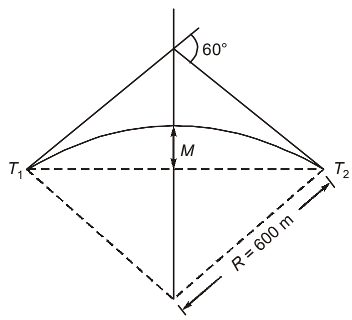
$$\angle A = \text{F.B. of AB – B.B. of EA} = 142°\,30' - 239°\,00'$$
$$= -96°\,30' = -96°\,30' + 360° = 263°\,30'$$
$$\angle B = \text{F.B. of BC – B.B. of AB} = 223°\,15' - 322°\,30' = -99°\,15'$$
$$= -99°\,15' + 360° = 260°\,45'$$
$$\angle C = \text{F.B. of CD – B.B. of BC} = 287°\,00' - 44°\,15' = 242°\,45'$$
$$\angle D = \text{F.B. of DE – B.B. of CD} = 12°\,45' - 107°\,45'$$
$$= -95°\,00' = -95° + 360° = 265°\,00'$$
$$\angle E = \text{F.B. of EA – B.B. of DE} = 60°\,00' - 193°\,15'$$
$$= -133°\,15' = -133°\,15' + 360° = 226°\,45'$$
$$\text{Sum of angles} = \angle A + \angle B + \angle C + \angle D + \angle E$$
$$= 263°\,30' + 260°\,45' + 242°\,45' + 265°\,00' + 226°\,45' = 1258°\,45'$$

Theoretical sum of external angles = $(2n + 4)90° = (2 \times 5 + 4) \times 90 = 1260°$

$$\therefore \quad \text{Error} = 1260° - 1258°\,45' = 1°\,15' = 75'$$

Correction for each angle = $75'/5 = +15'$

22. (b)



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

23. (b)

$$\text{Total volume} = d\left[\frac{A_1 + A_n}{2} + A_2 + A_3 \ldots. A_{n-1}\right]$$
$$= 7\left[\frac{3+29}{2} + 25 + 22 + 15 + 12 + 8 + 6\right]$$
$$= 7[16 + 25 + 22 + 15 + 12 + 8 + 6] = 728 \times 10^4 \text{ m}^3$$

$$60\% \text{ full volume} = 728 \times 10^4 \times 0.6 = 436.8 \times 10^4 \text{ m}^3$$

$$\text{Volume of water upto depth of 14 m} = 7\left[\frac{22+3}{2}+15+12+8+6\right] = 374.5\times10^4 \text{ m}^3$$

$$\text{Volume of water upto depth of 7 m} = 7\left[\frac{25+3}{2}+22+15+12+8+6\right] = 539\times10^4 \text{ m}^3$$

Depth of water, when the reservoir is 60% full

$$= 14+\frac{7-14}{539\times10^4-374.5\times10^4}\left(436.8\times10^4-374.5\times10^4\right)$$

$$= 14-\frac{7}{164.5}\times62.3 = 11.3489 \text{ m} \simeq 11.4 \text{ m}$$

24. (a)

$$\text{Additive constant, } C = (f+d) = 0.20+0.10 = 0.30 \text{ m}$$

$$D = ks\cos^2\theta + C\cos\theta$$

$$\Rightarrow \quad 50 = k\times0.500\cos^2 3°\,48' + 0.30\cos 3°\,48'$$

$$\Rightarrow \quad \text{Multiplying constant, } k = 99.84$$

25. (b)

If 'h' is the difference in level, then

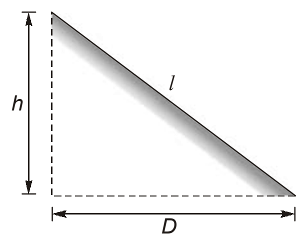
$$D^2 = l^2 - h^2$$

Here $l = 20$ m, $h = 80$ cm $= 0.8$ m

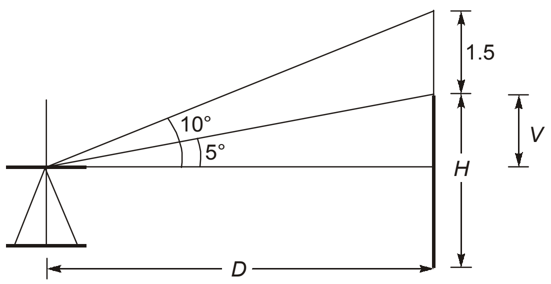
$$\Rightarrow \quad D^2 = (20)^2-(0.8)^2$$

$$\Rightarrow \quad D = \sqrt{399.36}$$

$$\therefore \quad D = 19.984 \text{ m}$$



27. (d)



$$\tan5° = \frac{V}{D},\quad \tan10° = \frac{V+1.5}{D}$$

$$\Rightarrow \quad D = \frac{1.5}{\tan10°-\tan5°} = 16.88 \text{ m}$$

$$V = D\tan5° = 1.477 \text{ m}$$

$$\text{R.L. of top of flag post} = \text{R.L. of building at the base} + H + 1.5$$

H is not known and cannot be computed.

28. (d)

$$\Sigma BS - \Sigma FS = \text{Last } RL - \text{First } RL$$

$$\Rightarrow \quad 16.26 - \Sigma FS = 23.50 - 23.47$$

$$\Rightarrow \quad \Sigma FS = 16.23 \text{ m}$$

29. (b)

The horizontal distance is given by $D = \frac{f}{i}s + C$

$$\text{Error in distance, } \delta D = -s\frac{f}{i^2}\cdot\delta i \qquad \text{(Where, } \delta i \text{ is error in the stadia interval)} \qquad ...(i)$$

Now, $\frac{f}{i} = 100$

$$\Rightarrow \quad i = \frac{f}{100} = \frac{25}{100} = 0.25 \text{ cm}$$

Substituting the values of $\frac{f}{i}$, i and δi in equation (i),

$$\Rightarrow \quad \delta D = -s \times \frac{f}{i}\cdot\frac{1}{i}\cdot\delta i = -s(100)\left(\frac{1}{0.25}\right)(0.0025) = -s.$$

30. (d)

Let the vertical angle is θ

True horizontal distance, $D = ks\cos^2\theta$

Sloping distance, $L = ks$

$$\Rightarrow \quad \frac{\text{Sloping distance}}{\text{Horizontal distance}} = \frac{ks}{ks\cos^2\theta} = \sec^2\theta$$

Permissible error is 2 in 500

$$\Rightarrow \quad \frac{L}{D} = \frac{500+2}{500} = \frac{502}{500}$$

$$\Rightarrow \quad \sec^2\theta = \frac{502}{500}$$

$$\therefore \quad \theta = 3.62°$$

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