CLASS TEST

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SURVEYING ENGINEERING

CIVIL ENGINEERING

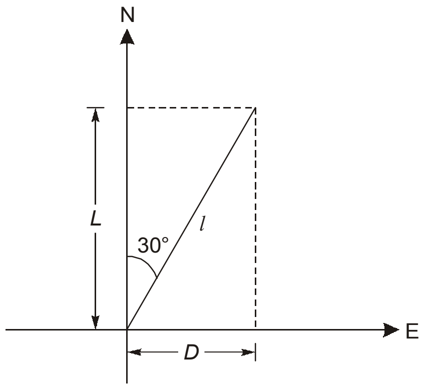
Date of Test : 20/03/2022

ANSWER KEY

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

DETAILED EXPLANATIONS

3. (a)



The departure of the line is,

$$D = l \sin 30°$$
$$= 20 \sin 30°$$
$$= 10 \text{ m}$$

4. (c)

Let the length of line measured on plan be L.

Actual area, $A = (4000\,L)^2$

Measured area, $A_m = (5000\,L)^2$

$$\text{Percentage error in area} = \frac{(5000L)^2 - (4000L)^2}{(4000L)^2} \times 100 = 56.25\%$$

5. (d)

Multiplying constant = k

Additive constant = 0, for anallactic lens

$\therefore$ $D = ks$

$\Rightarrow$ $D \,\alpha\, s$

6. (b)

The principal on which box sextant measures horizontal angle.

Angle between two points sighted by instrument = 2 × 30° = 60°.

7. (d)

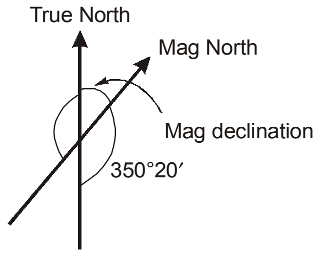
$$\text{Measured length} = 468 \text{ m}$$

$$\text{R.F. of wrong scale used} = \frac{1}{20 \times 100} = \frac{1}{2000}$$

$$\text{R.F. of correct scale} = \frac{1}{40 \times 100} = \frac{1}{4000}$$

$$\therefore \quad \text{Correct length} = \frac{(1/2000)}{(1/4000)} \times 468 = 936 \text{ m}$$

8. (d)



Since the magnetic bearing of the Sun is 350° 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°.

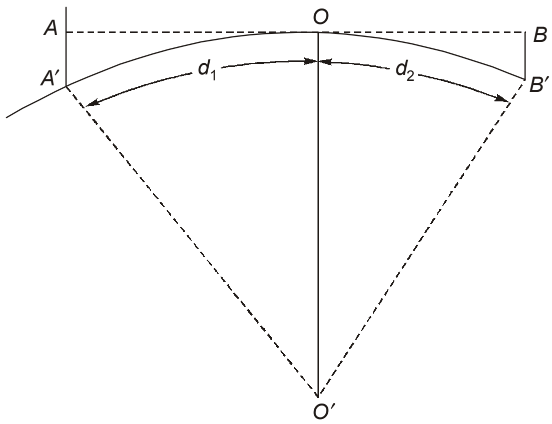
Now, True bearing = Magnetic bearing + Declination

360° = 350° 20′ + Declination

or Declination = 360° – 350° 20′

= 9° 40′ E

9. (a)



Let A and B be the two triangulation stations and let O be the point of tangency on the horizon.

Let $A'A = C_1 = 9000 \text{ m} = 9 \text{ km}$

$B'B = C_2 = 3000 \text{ m} = 3 \text{ km}$

The distance d_1 is given by

$$C = \frac{d_1^2}{2R}$$

After refraction correction,

$$C_1 = \frac{6}{7} \times \frac{d_1^2}{2R}$$

$$\Rightarrow \quad d_1 = \sqrt{2RC_1}$$

$$\Rightarrow \quad d_1 = \sqrt{2 \times 6440 \times 9 \times \frac{7}{6}} = 367.75 \text{ km}$$

$$d_2 = \sqrt{2 \times 6440 \times 3 \times \frac{7}{6}} = 212.32 \text{ km}$$

$\therefore$ Distance AB $= d_1 + d_2 = 367.75 + 212.32$

$= 580.07 \text{ km}$

10. (c)

When the instrument is at A,

Apparent difference in elevation between A and B

$$= 2.860 - 1.285$$
$$= 1.575 \text{ m} \qquad \text{(A being higher)}$$

When the instrument is at B,

Apparent difference in elevation between A and B

$$= 2.220 - 0.860$$
$$= 1.360 \text{ m} \qquad \text{(A being higher)}$$

$$\text{True difference in elevation} = \frac{1.575 + 1.360}{2} = 1.468 \text{ m}$$

11. (d)

Displacement due to angular error on ground = $l \sin \alpha = 15 \sin \alpha$

Displacement due to linear error on ground = $\frac{l}{r} = \frac{15}{20} = 0.75$

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

$$\text{Combined error in plotting on plan} = \frac{1}{30}\sqrt{(15\sin\alpha)^2 + (0.75)^2}$$

Hence,
$$\frac{1}{30}\sqrt{(15\sin\alpha)^2 + (0.75)^2} = 0.025$$

$\Rightarrow$ $\alpha = 0°$

So, no angular error can be permitted.

12. (d)

Sensitivity of bubble tube is given by,

$$\alpha' = \frac{S}{nD} \times \left(\frac{360°}{2\pi} \times 60 \times 60\right)$$

$= 24$ seconds (given)

$S = ?$ (staff intercept)

$n = 2$ division, and

$D =$ Distance of the staff from level $= 110$ m

$$\therefore \quad 24 = \frac{S}{2 \times 110}\left(\frac{360}{2\pi} \times 60 \times 60\right) = \frac{S}{2 \times 110} \times 206265$$

$$\Rightarrow \quad S = \frac{24 \times 2 \times 110}{206265} = 25.599 \times 10^{-3} \text{m}$$

$$\simeq 25.59 \text{ mm}$$

13. (c)

In a closed traverse with no local attraction,

$$FB - BB = 180°$$

Since station 'X' is free from local attraction and therefore FB_{XY} and BB_{ZY} are correct.

$\therefore$ $FB_{XY} = 35°$ and $BB_{XY} = 216°$

But $BB_{XY} - FB_{XY} = 216 - 35° = 181° \neq 180°$

$\therefore$ A correction of $-1°$ is to be applied at station Y,

$\therefore$ $FB_{YZ} = 116° - 1° = 115°$

But $BB_{YZ} - FB_{YZ} = 293° - 115° = 178° \neq 180°$

$\therefore$ A correction of $+2°$ is to be applied at Z

$\therefore$ The correct FB of $ZY = 293° + 2° = 295°$

14. (a)

Let O be the instrument station and A be the staff station.

$$V = 3000 \tan 2° 30' = 130.98 \text{ m}$$

Since, distance of 3000 m is quite large,

$\therefore$ Combined correction for curvature and refraction,

$$C_{co} = -0.0673\, D^2 \qquad \text{(where } D \text{ is in km)}$$

$$= -0.0673\left(\frac{3000}{1000}\right)^2 = 0.6057 \text{ m}$$

Hence, RL of staff station A

$$= \text{RL of O} + \text{H.I.} + V - 3 + C_{co}$$
$$= \text{RL of instrument axis} + V - 3 + C_{co}$$
$$= 200 + 130.98 - 3 - 0.6057$$
$$= 327.37 \text{ m}$$

15. (b)

Let the vertical angle be θ.

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

Sloping distance, $L = kS$

$$\frac{\text{Sloping distance}}{\text{Horizontal distance}} = \frac{kS}{kS\cos^2\theta} = \sec^2\theta$$

Permissible error is 1 in 300

Hence, $$\frac{L}{D} = \frac{300+1}{300} = \frac{301}{300}$$

$\therefore$ $$\sec^2\theta = \frac{301}{300}$$

$\Rightarrow$ $$\theta = 3°18'15''$$

16. (a)

Normal tension is the pull which equalises correction due to pull and sag.

$$C_p = C_{sag}$$

$\Rightarrow$ $$\frac{(P-P_0)l}{AE} = \frac{W^2 l}{24P^2}$$

$\Rightarrow$ $$P = \frac{0.204W\sqrt{AE}}{\sqrt{P-P_0}}$$

17. (b)

$$\Sigma\text{Latitude} = 0$$

$\Rightarrow$ $500 \cos\theta + 245 \cos 178° + L\cos 270° + 215.84 \cos 9°45' = 0$

where θ and L are bearing of AB and length of CD respectively missing from the field book.

$\Rightarrow$ $500 \cos\theta - 244.85 + 0 + 212.72 = 0$

$\therefore$ $\theta = 86.316°$

Now, $\Sigma\text{Departure} = 0 \text{ m}$

$\Rightarrow$ $500 \sin\theta + 245 \sin 178° + L \sin 270° + 215.84 \sin 9°45 = 0$

$\Rightarrow$ $498.97 + 8.55 - L + 36.55 = 0$

$$L = 544.06 \text{ m} \simeq 544 \text{ m}$$

18. (a)

The scale expressed as R.F. is given by

$$R = \frac{f}{H-f}$$

$$\Rightarrow \quad \frac{1}{8000} = \frac{(20/100)}{(H-1500)}$$

$$H - 1500 = \frac{20 \times 8000}{100}$$

$$\Rightarrow \quad H = 1600 + 1500 = 3100 \text{ m}$$

19. (c)

The first section and the second section have odd number of ordinates, and therefore, Simpson's rule is directly applicable.

The third section has 4 ordinates (even number); the rule is applicable for the first three ordinates only

$$\Delta_1 = \frac{15}{3}\left[(7.60 + 10.6) + 4(8.5 + 12.8) + 2(10.7)\right] = 624 \text{ m}^2$$

$$\Delta_2 = \frac{10}{3}\left[(10.6 + 8.3) + 4(9.5)\right] = 189.7 \text{ m}^2$$

$$\Delta_3 = \frac{20}{3}\left[(8.3 + 6.4) + 4(7.9)\right] + \frac{20}{2}(6.4 + 4.4) = 308.6 + 108 = 416.6 \text{ m}^2$$

$$\Delta = 624 + 189.7 + 416.6 = 1230.3 \text{ m}^2$$

20. (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

$$h = 0.0673D^2, \qquad (D \text{ is in km})$$

$$= 0.0673 \times 3^2 = 0.606 \text{ m}$$

(here correction will be substractive)

So, difference in elevation between the vane and instrument axis

$\therefore$ $h = 294.153 - 0.606$

$= 293.547 \text{ m}$

RL of instrument axis $= 436.050 + 2.865 = 438.915$ m

$\therefore$ RL of vane $=$ RL of instrument axis $- h$

$= 438.915 - 293.547$

$$= 145.368 \text{ m}$$

$\therefore$ RL of staff station $Q = 145.368 - 2 = 143.368$ m

21. (b)

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

$$\frac{2 \sin 45^\circ}{\tan 45^\circ} = 1.414$$

22. (c)

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

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

$\therefore$ Correct distance between the ends of tape = 100 – 0.116 = 99.884 m

23. (a)

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

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

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

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

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

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

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

$\therefore$ $l = 87.12$ m

24. (c)

25. (a)

True difference of levels between A and B is given by,

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

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

$$\Rightarrow \quad H = \frac{(1.64 - 1.05) + (1.53 - 0.90)}{2}$$

$\Rightarrow$ $H = 0.61$ m

$\therefore$ R.L. of B = R.L. of $A - H = 126.49 - 0.61$
$= 125.88$ m

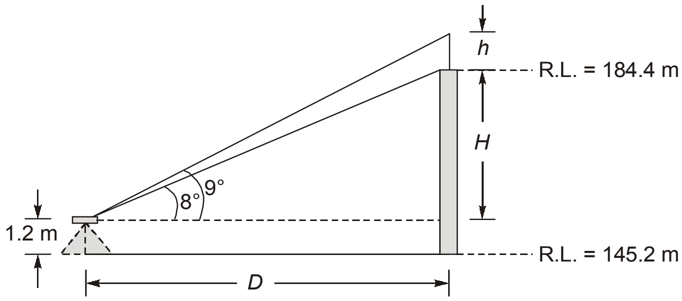
26. (c)

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

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

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

27. (b)



Height of building above instrument,

$$H = (184.4 - 145.2) - 1.2$$

$$= 38 \text{ m}$$

$$\tan 8° = \frac{H}{D}$$

$$\Rightarrow \quad D = \frac{H}{\tan 8°} \quad \text{...(i)}$$

$$\tan 9° = \frac{H+h}{D} \quad \text{...(ii)}$$

From (i) and (ii),

$$\Rightarrow \quad \tan 9° = \frac{H+h}{H}\tan 8°$$

$$\therefore \quad h = 4.825 \text{ m} = 48.25 \text{ decimeter}$$

28. (c)

Stations A and B are free from local attraction

$\therefore$ FB of BC is correct

$\therefore$ Correct BB of BC = 360° – (180° – 139°30′) = 319°30′

But BB of BC = 317°00′

$\therefore$ Correction at station C = 2°30′

$\therefore$ Correct FB of CD = 215°15′ + 2°30′

= 217°45′

$\therefore$ Correct BB of CD = 217°45′ – 180°00′

= 37°45′

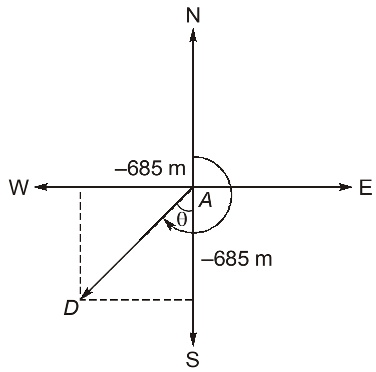
But BB of CD = 36°30′

$\therefore$ Correction at station D = 1°15′

$\therefore$ Correct FB of DE = 208°00′ + 1°15′

= 209°15′

29. (d)



$$\Sigma L = 0$$

$$-73.0 + 535.0 + 223.0 + L_{DA} = 0$$

$$L_{DA} = -685.0 \text{ m}$$

Also

$$\Sigma D = 0$$

$$440.5 + 313.0 - 68.5 + D_{DA} = 0$$

$$D_{DA} = -685.0 \text{ m}$$

$$\therefore \quad \tan\theta = \frac{-685.0}{-685.0} = 1$$

$$\therefore \quad \theta = 45°$$

$\therefore$ Reduced bearing of DA = S45°W

WCB of DA = 270° – 45° = 225°

30. (d)

$$\text{Length of vertical curve} = \frac{0.7-(-0.6)}{(0.05/20)} = 520 \text{ m}$$

$$\text{Length of curve on either side of the apex} = \frac{520}{2} = 260 \text{ m}$$

Chainage of first tangent point = 1000 – 260 = 740 m

Chainage of second tangent point = 1000 + 260 = 1260 m

■■■■