CLASS TEST

S.No. : 04IGCE_MKN_10072024

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SURVEYING

CIVIL ENGINEERING

Date of Test : 10/07/2024

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (d)

2. (a)

$$1 \text{ cm} = 75 \text{ m} \quad \Rightarrow \quad \text{Scale} = \frac{1}{7500}$$

$$1 : 35000 \quad \Rightarrow \quad \text{Scale} = \frac{1}{35000}$$

$$\text{RF} = \frac{1}{250000} \quad \Rightarrow \quad \text{Scale} = \frac{1}{250000}$$

$$1 \text{ cm} = 50 \text{ km} \quad \Rightarrow \quad \text{Scale} = \frac{1}{50 \times 10^3 \times 10^2} = \frac{1}{5000000}$$

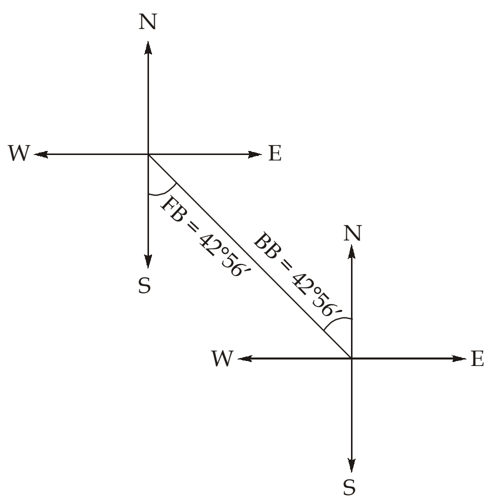
∴ Largest scale is 1 cm = 75 m

3. (c)

$$\text{True length of line} = \frac{l'}{20} \times 253$$

$$\Rightarrow \quad l' = \frac{250 \times 20}{253} = 19.76 \text{ m}$$

4. (c)



5. (a)

6. (c)

For a well conditioned triangle interior angle ≥ 30° and ≤ 120°

∴ Triangles 3 and 4 are not well conditioned triangles.

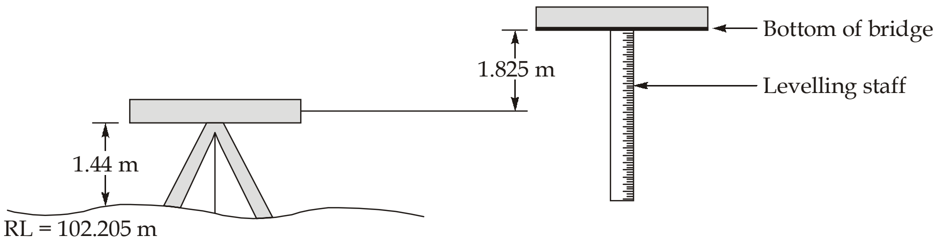
7. (a)

Let height of light house be 'H'

$$\therefore \quad H = 0.0673 \times d^2 = 0.0673 \times (50)^2 = 168.25 \text{ m}$$

8. (a)

9. (c)



$$\text{RL of bottom of bridge} = 102.205 + 1.44 + 1.825 = 105.47 \text{ m}$$

10. (d)

11. (b)

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

$$= 5\left[\frac{20+1100}{2} + 100 + 400 + 900\right] \times 10^4$$

$$= 9800 \times 10^4 \text{ m}^3$$

$$= 9800 \text{ ha-m}$$

12. (a)

$$\because \quad A = \frac{\pi D^2}{4}$$

$$\therefore \quad dA = \frac{\pi}{4} \times 2D \times dD$$

$$\Rightarrow \quad dA = \frac{\pi}{2} \times D \times 0.05 = \pm 9.42 \text{ m}^2$$

13. (a)

$$\text{Number of full chord} = \frac{1435}{20} = 71.75 \simeq 71$$

$$\text{Length of last chord} = (1435 - 71 \times 20) = 1435 - 1420 = 15 \text{ m}$$

Now, offset for last chord

$$O_n = \frac{C_n}{2R}(C_n + C_{n-1})$$

$$O_{72} = \frac{15}{2 \times 400}(15 + 20) = 0.656$$
$$\simeq 0.66 \text{ m}$$

14. (d)

$$h = \frac{(h_B - h_A) + (h'_B - h'_A)}{2}$$
$$= \frac{(1.235 - 0.845) + (2.675 - 1.425)}{2}$$
$$= 0.82 \text{ m}$$

$\because$ Staff reading at B > Staff reading at A

$\therefore$ RL of B = RL of A – h

= 100.21 – 0.82 = 99.39

$\therefore$ B is lower than A.

15. (d)

Displacement due to angular error on ground = l sin α = 15 sin α

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

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

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.

16. (d)

Sensitivity of bubble tube is given by,

$$\alpha' = \frac{S}{nD} \times \left(\frac{360°}{2\pi} \times 60 \times 60\right)$$
$$= 24 \text{ seconds (given)}$$

S = ? (staff intercept)

n = 2 division, and

D = Distance of the staff from level = 110 m

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

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

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

17. (a)

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.

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

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

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

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

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

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

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

18. (c)

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

$= \text{RL of O} + \text{H.I.} + V - 3 + C_{co}$

$= \text{RL of instrument axis} + V - 3 + C_{co}$

$= 200 + 130.98 - 3 - 0.6057$

$= 327.37$ m

19. (b)

Let the vertical angle be θ.

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

Sloping distance, $\qquad L = kS$

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

Permissible error is 1 in 300

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

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

$\Rightarrow \quad \theta = 3°18'15''$

20. (d)

True bearing = Magnetic bearing – Declination (west)

= 320°30′ – 3°30′ = 317°0′

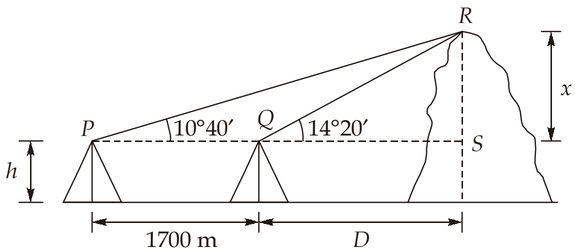
The true bearing of a line is constant,

So the present true bearing of line is also 317°0′.

∴ Present magnetic bearing = True bearing – Declination (East)

= 317°0′ – 4°15′ = 312°45′

21. (c)



In ΔPRS,

$$\tan 10°40' = \frac{x}{1700 + D}$$

$\Rightarrow \quad x - 0.188D = 320.194 \quad \quad ...(1)$

In ΔQRS, $\quad \tan 14°20' = \dfrac{x}{D}$

$\Rightarrow \quad x - 0.256\,D = 0 \quad \quad ...(2)$

From (1) and (2) $\quad x = 1205.44$ m and $D = 4708.74$ m

∴ Elevation of top of hill = $x + h$

= 1205.44 + 436.50 = 1641.94 m

22. (b)

19.5 cm on the map was originally 20 cm,

∴ 1 cm² on the map was originally $\dfrac{20^2}{19.5^2}\,\text{cm}^2$

$\Rightarrow$ 125.50 cm² was originally $\dfrac{20^2}{19.5^2} \times 125.50 = 132.0184\ \text{cm}^2$

∵ Scale of map was 1 cm = 40 m

$\Rightarrow \quad 1\ \text{cm}^2 = 1600\ \text{m}^2$

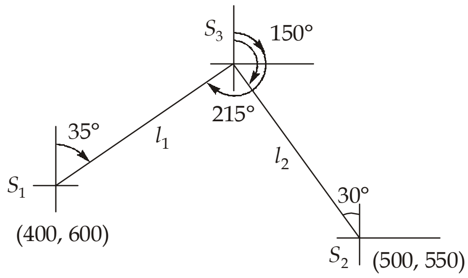
$\Rightarrow$ Area on the ground = 1600 × 132.0184

= 211,229.44 m²

Since the chain was 0.05 m too long.

$\therefore$ True area $= \dfrac{20.05^2}{20^2} \times \dfrac{211229.44}{10^4} = 21.23$ hectares

23. (d)



Let $S_1S_3 = l_1$ and $S_2S_3 = l_2$

Northing of S_3:

$$600 + l_1 \cos 35° = 550 + l_2 \cos 30°$$

$$l_1 \cos 35° - l_2 \cos 30° = -50 \quad \text{...(1)}$$

Easting of S_3:

$$400 + l_1 \sin 35° = 500 - l_2 \sin 30°$$

$$\Rightarrow \quad l_1 \sin 35° + l_2 \sin 30° = 100 \quad \text{...(2)}$$

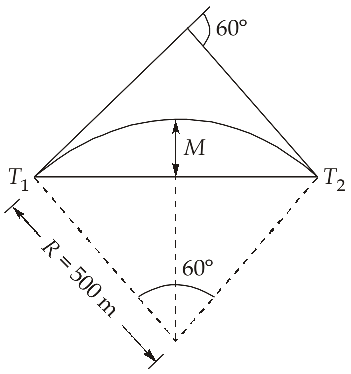
Solving (1) and (2)

$$l_1 = 67.97 \text{ m}$$

$$l_2 = 122.03 \text{ m}$$

$\therefore$ Easting of $S_3 = 400 + 67.97 \sin 35° = 438.986$ m

24. (c)



Length of long chord,

$$T_1T_2 = 2R\sin\left(\frac{\Delta}{2}\right) = 2 \times 500 \times \sin\left(\frac{60°}{2}\right) = 500 \text{ m}$$

Length of mid ordinate,

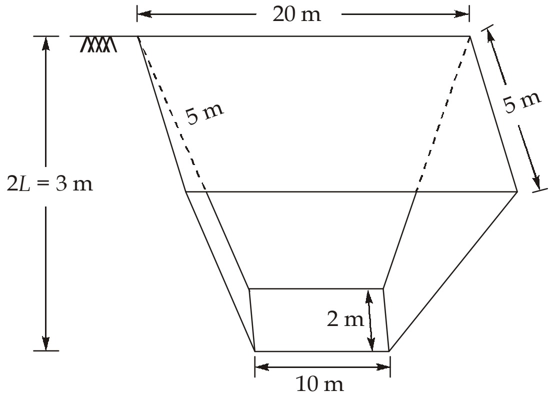
$$M = R\left[1 - \cos\frac{\Delta}{2}\right]$$

$$= 500\left[1-\cos\left(\frac{60}{2}\right)\right] = 66.987 \text{ m}$$

$\therefore \quad (T_1T_2 - M) = 500 - 66.987$

$= 433.013 \text{ m} \simeq 433.01 \text{ m}$

25. (a)



$$\text{Mean area } (A_m) = \left(\frac{20+10}{2}\right)\times\left(\frac{5+2}{2}\right)$$

$= 15 \times 3.5 = 52.5 \text{ m}^2$

Top area $(A_1) = 20 \times 5 = 100 \text{ m}^2$

Bottom area $(A_2) = 10 \times 2 = 20 \text{ m}^2$

$\therefore$ Using prismoidal formula,

$$\text{Volume, } V = \frac{L}{3}(A_1 + 4A_m + A_2)$$

$$V = \frac{1.5}{3}(100 + 4\times 52.5 + 20)$$

$= 165 \text{ m}^3$

26. (b)

$D = KS + C$

$S = 2.780 - 1.646 = 1.134 \text{ m}$

$D = 100 \times 1.134 + 0.6$

$= 114 \text{ m}$

27. (c)

$h = 1500 \text{ m}$

Scale = 1 : 8500

$f = 20 \text{ cm}$

$$\text{Scale} = \frac{f}{H-h}$$

$$\Rightarrow \quad \frac{1}{8500} = \frac{20 \times 10^{-2}}{H - 1500}$$

$$\Rightarrow \quad H = 3200 \text{ m}$$

$$\Rightarrow \quad \text{H} = 3.2 \text{ km}$$

28. (b)

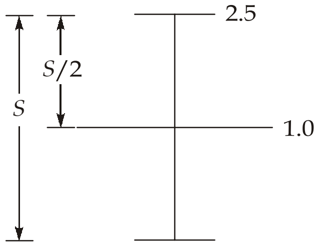
HI = RL + BS

and RL = HI – BS

Staff station	BS (m)	IS (m)	FS (m)	HI (m)	RL (m)
A	1.545	–		101.545	100
B	–0.860	–	–1.420	102.105	102.965
C	–	–	0.835	–	101.27

∴ RL of *C* = 101.27 m

29. (c)



Horizontal distance is given as

$$D = ks + C$$

Multiplying constant, $k = \frac{f}{i}$

Focal length, f = 20 cm

i = Spacing between outer lines of diaphragm axis = 4 mm

$$\therefore \quad k = \frac{20 \times 10 \text{ mm}}{4 \text{ mm}} = 50$$

Staff intercept, s = 2(2.5 – 1.0)

= 3 m

Additive constant, $C = (f + d)$

= 20 cm + 10 cm = 0.3 m

Hence, D = 50 × 3 + 0.3

= 150.3 m

30. (b)

Since subtense theodolite is used, this is a case of movable-hair stadia method of tacheometry. In this case, the distance between instrument and the staff is given as

$$D = \frac{C \times S}{n} + (f + d)$$

where, C = Theodolite constant i.e. 600

S = Staff intercept (distance between targets) = 3 m

n = Sum of the readings in the micrometer

= (3.455 + 3.405) m = 6.86 m

$(f + d)$ = 0.5

Hence, $$D = \frac{600 \times 3}{6.86} + 0.5 = 262.89 \text{ m}$$

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