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# SURVEYING

## CIVIL ENGINEERING

**Date of Test : 29/07/2025**

## ANSWER KEY ➤

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

## DETAILED EXPLANATIONS

**1. (b)**

$$\text{Relief displacement, } d = \frac{r \,.\, h}{H} = \frac{90 \times 450}{3500} = 11.57 \text{ mm}$$

**2. (a)**

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

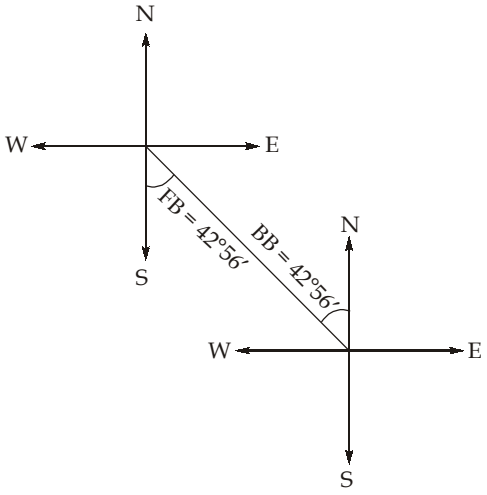
$$1 : 35000 \quad \Rightarrow \quad \text{Scale} = \frac{1}{35000}$$

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

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

$\therefore$ Largest scale is 1 cm = 75 m

**3. (c)**




**4. (c)**

For a well conditioned triangle interior angle $\geq 30°$ and $\leq 120°$

$\therefore$ Triangles 3 and 4 are not well conditioned triangles.

**5. (c)**

Folds may be defined as undulations or bends or curvatures developed in the rocks of the crust as a result of stresses to which these rocks have been subjected from time to time.

**6. (b)**

$$S = \frac{f}{H - h}$$

$$\Rightarrow \quad \frac{1}{10000} = \frac{15 \times 10^{-2}}{H - 300}$$

$$\Rightarrow \quad H = 1800 \text{ m}$$

**7. (b)**

Difference between longitude = 23°45′ – (–21°30′) = 45°15′

**8. (a)**

- Least count of main scale of theodolite is 20 sec.
- River is obstacle for chaining only.
- Line joining places of equal dip is called isoclinic line.

**9. (b)**

- Tilt is rotation of aerial camera about the line of flight.
- Tip is rotation of aerial camera about a horizontal axis normal to the line of flight. It is also known as swing.
- Isocenter is the point on an aerial photograph in which the bisector of the angle of tilt meets the photograph.
- Altitude is vertical distance of aircraft above the earth's surface.

**10. (a)**

Plane table is oriented by trough compass, backsighting or resection.

**11. (b)**

Map is the orthographic projection of the Earth's surface.

**12. (d)**

**13. (c)**

$$\text{Total area covered} = 25.75 + (15 - 1) \times 25.75 \times 0.4$$
$$= 169.95 \text{ km}^2$$

**14. (b)**

**15. (d)**

$$\text{First RL} = 51.45 \text{ m, Last RL} = 63.50 \text{ m}$$
$$\Sigma BS = 87.755 \text{ m, } \Sigma FS = 73.725 \text{ m}$$

When there is no error, then

$$\Sigma BS - \Sigma FS = \text{Last RL} - \text{First RL} \qquad \ldots(i)$$

The difference between LHS and RHS is the closing error of the work

$$\Sigma BS - \Sigma FS = 87.755 - 73.725 = 14.03 \text{ m}$$
$$\text{Last RL} - \text{First RL} = 63.50 - 51.45 = 12.05 \text{ m}$$
$$\therefore \quad \text{Closing error} = 14.03 - 12.05 = 1.98 \text{ m}$$

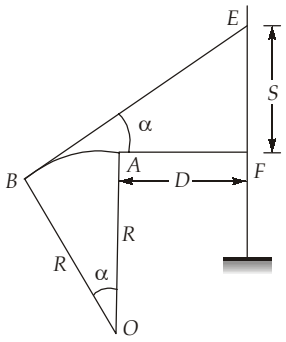
**16. (b)**

Normal equation of $A$ is

$$= \frac{2\times(2A)+3\times(4A)}{2\times2+3\times4}$$

$$\Rightarrow \quad A = \frac{160°\ 50'\ 0''}{16} = 10°\ 3'\ 8''$$

**17. (c)**




From Δ BEF (approximately), we have

$$\tan\alpha \simeq \alpha = \frac{S}{D} \qquad \text{(for small values of } \alpha, \tan\alpha \simeq \alpha) \qquad ...(i)$$

Similarly, from ΔAOB,

$$\alpha = \frac{AB}{R} = \frac{nl}{R} \qquad ...(ii)$$

where $n$ = number of division deviations
$l$ = length of one division on the bubble tube
$R$ = radius of curvature of bubble

Equating ($i$) and ($ii$), we get

$$\frac{S}{D} = \frac{nl}{R}$$

$$\Rightarrow \quad R = \frac{nlD}{S} = \frac{5\times2\times10^{-3}\times100}{0.050} = 20\ \text{m}$$

**18. (a)**

$$\text{Correct volume} = \left(\frac{l'}{l}\right)^3 \times \text{Computed volume}$$

$$= \left(\frac{20.15}{20}\right)^3 \times 10000 = 10226.69\ \text{m}^3$$

**19. (c)**

$$L = T$$

$$2R\sin\frac{\Delta}{2} = R\tan\frac{\Delta}{2}$$

$$\Rightarrow \quad 2\sin\frac{\Delta}{2} = \frac{\sin\frac{\Delta}{2}}{\cos\frac{\Delta}{2}}$$

$$\Rightarrow \quad \cos\frac{\Delta}{2} = \frac{1}{2}$$

$$\Rightarrow \quad \Delta = 120°$$

**20. (c)**

The vertical circle at right angles to the celestial meridian and passing through the east and west points of the celestial horizon is called prime vertical.

**21. (a)**

- In prismatic compass box is attached with graduated ring, which rotates.
- Surveyor compass measures quadrantal circle bearing.

**22. (c)**

$$\text{Least count} = \frac{S}{n}$$

$$\Rightarrow \quad 5'' = \frac{(1/5)°}{n}$$

$$\Rightarrow \quad \frac{5}{3600} = \frac{1/5}{n}$$

$$\therefore \quad n = 144$$

For retrograde vernier $n + 1$ divisions of main scale equals to $n$ divisions of vernier scale.

$\therefore$ 145 divisions of main scale should be equal to 144 divisions of vernier scale.

**23. (b)**

As per bowditch rule, error in linear measurement is proportional to $\sqrt{l}$ and error in angular measurement is inversely proportional to $\sqrt{l}$, where $l$ is length of line.

**24. (c)**

If effect of refraction ignored, then

$$h = \frac{D^2}{2R} \qquad \left(R = \frac{12800}{2}\text{ km}\right)$$

$$\Rightarrow \quad 100 = \frac{D^2}{2\times 6400\times 1000}$$

$$\Rightarrow \quad D = \sqrt{100\times 2\times 6400\times 1000}$$

$$\Rightarrow \quad D = 35777.088\text{ m} \simeq 35.8\text{ km}$$

**25. (c)**

$$\text{Slope correction} = \frac{-h^2}{2L}$$

For 300 m length measurement, $h = \frac{1}{20} \times 300 \text{ m} = 15 \text{ m}$ (as per given slope of 1 : 20)

$$\therefore \quad \text{Slope correction} = \frac{-15^2}{2 \times 300} = -0.375 \text{ m}$$

$$\therefore \quad \text{Horizontal distance} = 300 - 0.375 = 299.625 \text{ m}$$

**26. (c)**

$$A = l \times b = 80 \text{ m}^2$$

$$\frac{\partial A}{\partial l} = b = 8 \text{ m} \qquad e_l = 0.05 \text{ m}$$

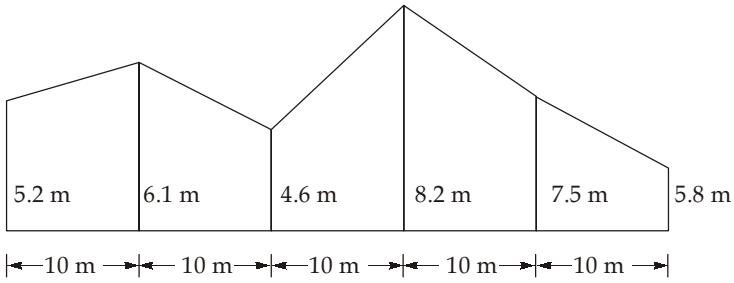
$$\frac{\partial A}{\partial b} = l = 10 \text{ m} \qquad e_b = 0.03 \text{ m}$$

$$e_A = \pm\sqrt{\left(e_l \frac{\partial A}{\partial l}\right)^2 + \left(e_b \frac{\partial A}{\partial b}\right)^2}$$

$$\Rightarrow \quad e_A = \pm\sqrt{(0.05 \times 8)^2 + (0.03 \times 10)^2}$$

$$\Rightarrow \quad e_A = \pm 0.5 \text{ m}^2$$

**27. (b)**



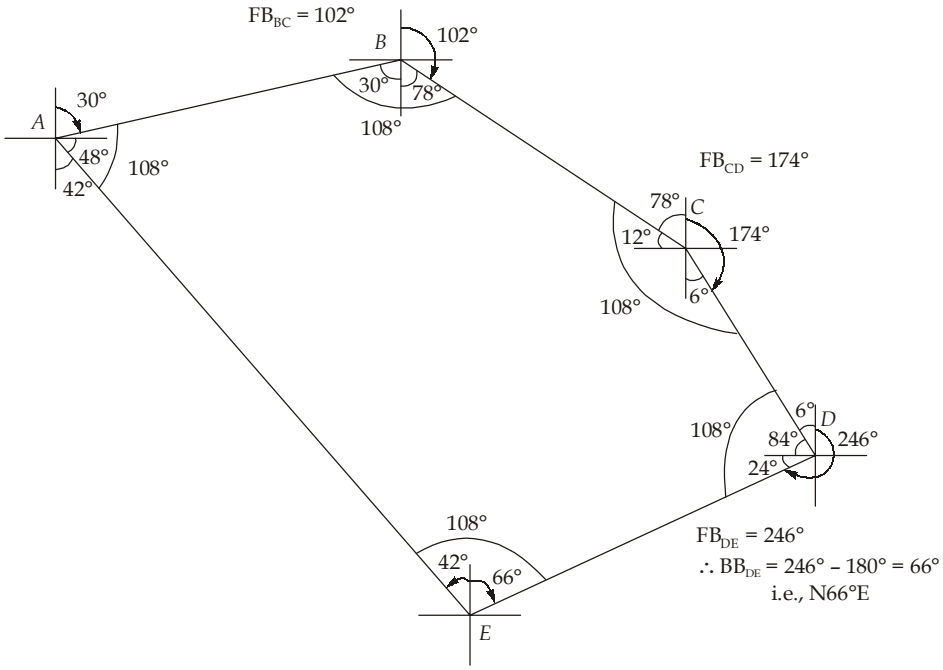

$$A = \frac{(5.2 + 6.1 + 4.6 + 8.2 + 7.5 + 5.8)}{6} \times 50$$

$$A = 311.67 \text{ m}^2$$

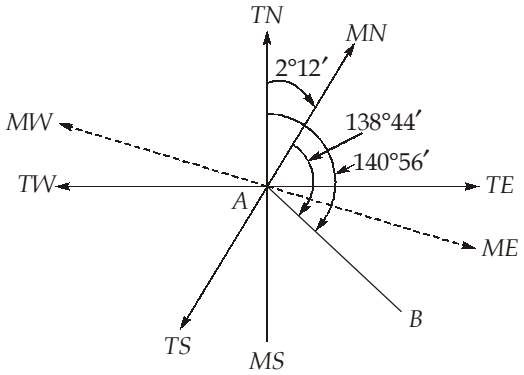
**28. (b)**

$FB_{AB}$ = N30°E

Internal angle of pentagon = 108°




**29. (d)**




$TB = MB + \delta_E = 138°\ 44' + 2°12' = 140°\ 56'$

**30. (d)**

$a_1$ = Staff reading at $A$ when instrument is at $A$ = 1.800 m

$b_1$ = Staff reading at $B$ when instrument is at $A$ = 3.300 m

$a_2$ = Staff reading at $A$ when instrument is at $B$ = 0.500 m

$b_2$ = Staff reading at $B$ when instrument is at $B$ = 2.080 m

$$\Delta h = \frac{(a_1 - b_1) + (a_2 - b_2)}{2} = -1.540 \text{ m (Fall from } A \text{ to } B)$$

∴ True reading at $A$ when instrument is at $B$ = 2.080 – 1.540(Rise from $B$ to $A$)

= 0.540 m

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