CLASS TEST

S.No. : 01 IG_CE_B+D_030423

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SURVEYING

CIVIL ENGINEERING

Date of Test : 03/04/2023

ANSWER KEY

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

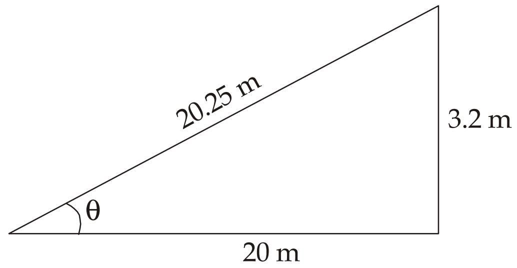
DETAILED EXPLANATIONS

1. (a)

Invar tapes are made of an alloy of nickel (36%) and steel (64%) having very low coefficient of thermal expansion.

- Invar tapes are mainly used for high degree of precision required for base measurements.
- Invar tapes is less affected by temperature changes.
- They need the greatest care to handle them to avoid bending and kining.

2. (a)



$$\text{Hypotenusal allowance} = l(\sec\theta - 1)$$

$$= 20\left(\frac{20.25}{20} - 1\right)$$

$$= 0.25\text{m}$$

$$= 25 \text{ cm}$$

3. (d)

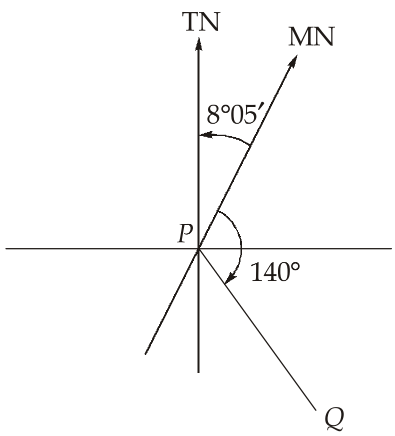
Isogonic lies: It is the line passing through points on the earth surface at which declination is same at a given point.

Agonic lines: These are special isogonic lines which pass through points having zero declination.

Isoclinic lines: The imaginary line joining the points having same dip on the surface of the earth.

Aclinic lines: The imaginary line joining the points with no dip.

4. (d)



True bearing of PQ = Magnetic bearing ± magnetic declination E/W
= 140° + 8°05′
= 148°05′

5. (d)

A theodolite is a precise instrument for measuring horizontal angels, angles of elevation and depression i.e., vertical angles, bearing and azimuth of a line.

- Theodolite is also used for prolongation of survey lines, finding difference in elevations and setting out engineering works requiring higher precision i.e., ranging the highway and railway curves, aligning tunnels etc.; measuring distances indirectly and levelling.

6. (a)

$$L \times l = L_1 \times l_1$$
$$L = 940.5 \text{ m}, \; l = 20.1 \text{ m}, \; l_1 = 20 \text{ m}$$
$$\therefore \quad L_1 = \frac{940.5 \times 20.1}{20} = 945.2 \text{ m}$$

7. (b)

For setting out right angles in chain surveying, the following instruments are generally used:
(i) Cross staffs
(ii) Optical squares
(iii) Prism squares

Cross-staffs are of following types:
(i) Open cross-staff:
It is used for
- Finding the foot of a perpendicular offset.
- Setting out a right angle at a point of the chain line

(ii) French cross-staff
It is used for setting out right angles.
- It has the advantages that the lines can also be set out at angles of 45° and 135°. In that respect, a french cross-staff is superior to an open cross-staff.

(iii) Adjustable cross-staff
It is used to take offsets and to set out any desired angle from the chain line.

8. (c)

BS is the first sight taken on a levelling staff held at a point of known elevation.

11. (c)

$$\text{Correction for sag} = \frac{W^2 l_1}{24 P^2} = \left[\frac{(30)^2 \times 100}{24 \times (200)^2}\right] = 0.09375 \text{ m}$$

Horizontal distance = 100 – 0.09375 = 99.90625 m

12. (b)

$$\alpha = \frac{S}{nD} \times 206265''$$
$$\therefore \quad S = \frac{\alpha n D}{206265} = \frac{30 \times 2 \times 150}{206265} = 0.0436 \text{ m}$$

13. (b)

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

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

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

14. (c)

$$L = (1 - P_l)\ Sl$$

$$W = (1 - P_w)\ Sw$$

$\therefore$ $$L = (1 - 0.65) \times 250 \times 20 \text{ m} = 1.75 \text{ km}$$

$$W = (1 - 0.30) \times 250 \times 20 \text{ m} = 3.5 \text{ km}$$

Area covered by one photograph

$$= LW$$

$$= 1.75 \times 3.5$$

$$= 6.125 \text{ km}^2$$

15. (b)

Let $$2L = 6 \text{ m}$$

$\Rightarrow$ $$L = 3 \text{ m}$$

$$A_1 = 5 \times 4 = 20 \text{ m}^2$$

$$A_2 = 4 \times 2 = 8 \text{ m}^2$$

$$A_m = \left(\frac{5+4}{2}\right) \times \left(\frac{4+2}{2}\right) = 13.5 \text{ m}^2$$

$\therefore$ $$V = \frac{L}{3} \times (A_1 + 4A_m + A_2)$$

$$= \frac{3}{3}(20 + 4 \times 13.5 + 8) = 82 \text{ m}^3$$

16. (c)

Using reciprocal levelling,

$$h = \frac{(Q_1 - P_1) + (Q_2 - P_2)}{2}$$

$$= \frac{(2.305 - 1.575) + (2.150 - 1.540)}{2}$$

$$= 0.67 \text{ m}$$

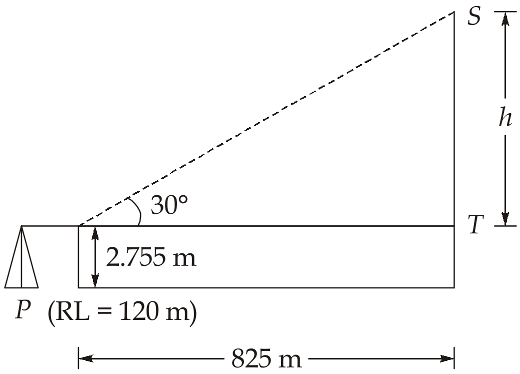
If instrument is kept at P, reading at Q will be erroneous by 'e'

$$h = (2.305 - e) - 1.575$$

$\Rightarrow$ $$0.67 = 2.305 - e - 1.575$$

$\Rightarrow$ $$e = 0.06 \text{ m}$$

17. (c)



$$\text{RL of top of tower} = \text{Height of instrument at } P + h$$
$$= (120 + 2.755) + 825 \tan 30° = 599.07 \text{ m}$$

18. (c)

19. (b)

Longitude of the place = 94°20′E

Longitude of the standard meridian = 78°30′E

∴ Difference in longitude = 94°20′ – 78°30′ = 15°50′ = 1 h 3m 20 s

The place is east of standard meridian

∴ Standard time = LMT – Difference in longitude = LMT – 1 h 3 m 20 s

⇒ LMT = 10 h 06 m 18 s + 1 h 3 m 20 s = 11 h 09 m 38 s

20. (b)

- Bowditch method also called compass rule, is used to balance a traverse where linear and angular measurements are of equal precision.
- Transit method employed where angular measurements are more precise than the linear measurements.

21. (c)

$$\text{Most probable angle} = \frac{2 \times 30 \times 00' \times 00'' + 4 \times 30°00'20''}{6}$$

$$= 30°00'23.33''$$

Hence option (c) is correct.

22. (c)

Triangulation stations are selected, keeping in view of following considerations:

1. Intervisiblity of triangulation stations.
2. Easy access to the stations with the instrument.
3. Various triangulation stations should form well conditioned triangles.

A good signal should fulfill the following requirements:

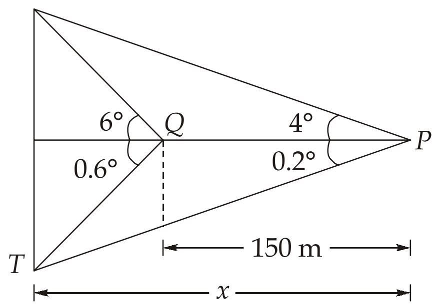
1. It should be conspicuous i.e., it should be clearly visible from a distance against any background.
2. It should be capable of being accurately centered over the station mark.

23. (b)

$$\text{RL of instrument station} = 102.680 \text{ m}$$
$$\text{Height of trunnion axis} = 1.560 \text{ m}$$
$$\text{Hence RL of line of collimation} = 120.680 + 1.560 = 104.24 \text{ m}$$
$$\text{Now, RL of staff station} = 104.24 - 1.285 = 102.955 \text{ m}$$

Hence option (b) is correct.

24. (b)



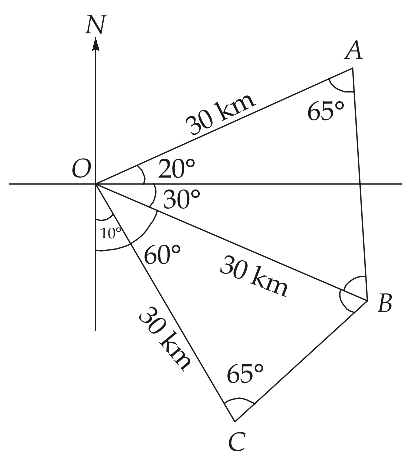
$$x(\tan 4° + \tan 0.2°) = (x - 150)(\tan 6° + \tan 0.6°)$$
$$\Rightarrow \quad 0.0734\,x = (x - 150)(0.11558)$$
$$\Rightarrow \quad 0.04218\,x = 17.337$$
$$\Rightarrow \quad x = 411.024 \text{ m}$$
$$\therefore \quad \text{Height of tower} = 411.024(\tan 4° + \tan 0.2°)$$
$$= 30.176 \text{ m}$$

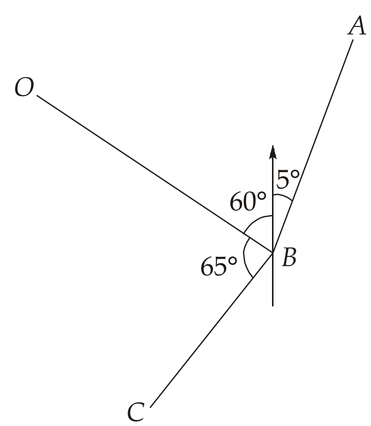
25. (d)

Height of instrument, HI = RL of floor + Staff reading from floor
= 45.65 + 0.60
= 46.250 m

RL of bottom of beam, = HI + Inverted staff reading taken from bottom of beam
= 46.250 + 3.242
= 49.492 m

26. (d)





Since speed of ships is same, the distance travelled by them will be same after an hour.

$$\text{Distance travelled} = 30 \text{ km}$$
$$\angle AOB = 50°$$
$$\angle BOC = 50°$$

Using cosine formula,
$$AB = \sqrt{OA^2 + OB^2 - 2OA \times OB\cos(\angle AOB)}$$
$$= \sqrt{30^2 + 30^2 - 2 \times 30 \times 30 \times \cos 50°}$$
$$= 25.36 \text{ km}$$

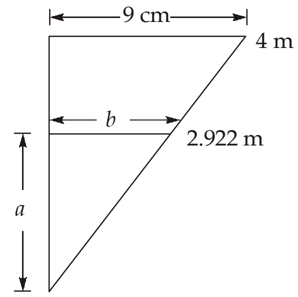
Since ΔAOB and ΔBOC are congruent,
$$AB = BC = 25.36 \text{ km}$$
$$FB \text{ of } BA = 65° - 60° = 5°$$

So, Bearing of A = N 5°E

Bearing of C = S 55°W

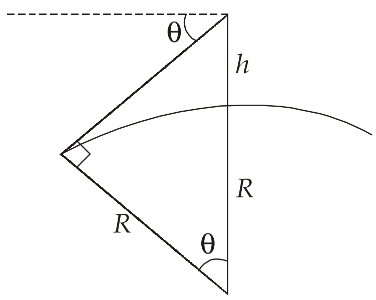
So, (a), (b) and (c) are correct.

27. (b)



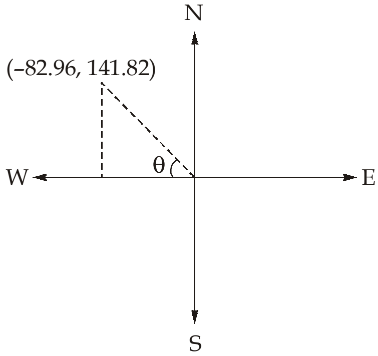
$$\frac{b}{9} = \frac{2.922}{4}$$
$$\Rightarrow \quad b = 6.5745 \text{ cm}$$
$$\therefore \quad \text{Correct reading } (a) = \sqrt{2.922^2 - (0.065745)^2}$$
$$= 2.92126 \text{ m} \simeq 2.9213 \text{ m}$$

28. (c)



$$\text{Dip} = \theta = \cos^{-1}\left(\frac{R}{R+h}\right)$$
$$\Rightarrow \quad \theta = \cos^{-1}\left(\frac{6370}{6370 + 0.082}\right)$$
$$\Rightarrow \quad \theta = 0.2907° = 17.44 \text{ minutes}$$

29. (a)



$$\tan\theta = \frac{141.82}{82.96} = 1.7095°$$

$$\therefore \quad \theta = \tan^{-1}(1.7095) = 59.674°$$

$$\text{WCB} = 270 + \theta = 270 + 59.674 = 329.674°$$

$$= 329.674 \times \pi \text{ rad} = 5.75 \text{ rad}$$

30. (c)

Average scale of photograph

$$= \frac{f}{H - h_{avg}}$$

$$h_{\text{avg}} = \frac{1}{4}(1250 + 1650 + 1486 + 1501) = 1471.75 \text{ m}$$

$$\text{Average scale} = \frac{0.160}{3200 - 1471.75} = \frac{0.16}{1728.25}$$

$$= \frac{1}{10801.56} \simeq \frac{1}{10802}$$

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