ACE Engineering Publications

SINCE 2011

GATE | PSUs

# CIVIL ENGINEERING

## GEOMATICS ENGINEERING

**Text Book:** Theory with worked out Examples and Practice Questions

# Geomatics Engineering

**(Solutions for Text Book Practice Questions)**

## 01. Fundamental Concepts

**01. Ans: (c)**

**Sol:** Plan area = 9.5 × 11.5 cm

$= 109.25\ cm^2$

Ground area = 63500 $m^2$

$$\text{Scale} = \sqrt{\frac{\text{Map area}}{\text{Ground area}}}$$

$$= \sqrt{\frac{109.25\times10^4}{63500}} \simeq \frac{1}{2411}$$

**02. Ans: (a)**

**Sol:** Shrinkage factor = [100 – 6%]

= 94% = 0.94

L = ? B = ?

$$L = \frac{6}{0.94} \qquad B = \frac{9}{0.9}$$

L = 6.38 cm B = 9.58 cm

Dimension = 6.38 × 9.58 cm

**03. Ans: (c)**

**Sol:** Least count = $\frac{S}{n}$

$$0.01^\circ = \frac{\left(\frac{1}{5}\right)^\circ}{n}$$

Vernier dividing n = 20

Number of main scale dividing = 2n – 1

= 2 × 20 –1 = 39

**04. Ans: (1 in 555.55)**

**Sol:** Original R.F = 1 : 500

Shrunk factor = 0.9

$$\text{Revised R.F.} = \frac{1}{500}\times0.9$$

= 1 in 555.55

**05. Ans: (c)**

**Sol:** Theodolite is divided into degrees and half degrees in the length of 59 MSD, LC of direct vernier ?

$$\text{L.C.} = \frac{S}{n}$$

$$S = \frac{1}{2} = 30'$$

In direct vernier, 'n' div of V = (n – 1) div of M.S. n – 1 = 59

n = 60

$$\therefore \text{L .C} = \frac{30'}{60} = \frac{(30\times60)''}{60} = 30''$$

**06. Ans: (c)**

**Sol:** 1 cm = 100 m; O.L = 100 cm;

S.L. = 95 cm; M.A = 810 $cm^2$,

Correct Area = ?

Actual area in $km^2$ of survey

Planimetes which is a minor instrument is used for measurement of area of a map.

$$\text{C.A.} = \frac{\text{M.A.}}{(\text{S.F})^2}$$

$$\text{S.F.} = \frac{95}{100} = 0.95$$

$$\text{C.A.} = \frac{810}{(0.95)^2} = 897.501$$

$= 897.51 \text{ cm}^2$ (on map)

**Scale:**

1 cm = 100 m

C.A = 897.51 (100 × 100)

$= 8.9751 \times 10^6 \text{m}^2$

$= 8.9751 \times 10^6 \times 10^{-6} \text{ km}^2$

C.A. = 8.9751 $\text{km}^2$ (on ground)

**07. Ans: (a, b, c)**

**Sol:** Surveys based on classification upon nature of field are

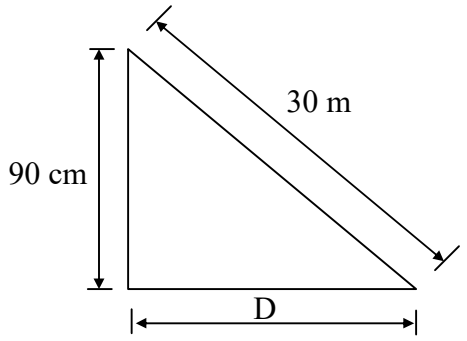
- Cadastral survey
- Hydrographic survey
- Astronomical survey

Geological survey is used for the study of rocks.

## 02. Linear Measurement Including Chain Survey

**01. Ans: (c)**

**Sol:**

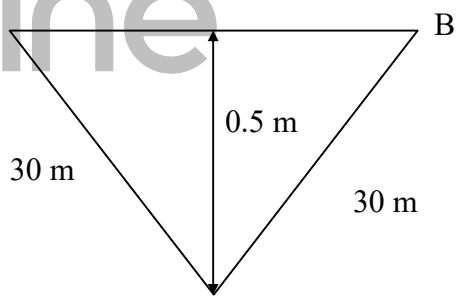



$$D = \sqrt{(30)^2 - 0.9^2}$$

$= 29.986$ cm

**02. Ans: 59.992 m**

**Sol:**




$$C_{M.A} = \frac{d^2}{L}$$

$$= \frac{(0.5)^2}{30} = 0.008\text{m} \ (-\text{ve})$$

Correct distance = 60 – 0.008

= 59.992 m

**03. Ans: (d)**

**Sol:** $C_{sag} = \frac{w^2 L}{24P^2}$

$= \frac{25^2 \times 50}{24 \times 150^2}$

$= 0.0579$ m (–)

Correct distance = 50 – 0.0579

= 49.942 m

**04. Ans: (b)**

**Sol:** $\tan 60^\circ = \frac{BD}{BC}$

$BD = 250 \tan 60^\circ$

$= 433.012$ m

$\sin 60^\circ = \frac{BD}{CD}$

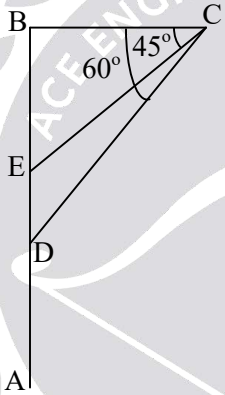
CD= 500 m

$\tan 45 = \frac{EB}{BC}$

EB = 250 m

$\sin 45 = \frac{BE}{EC}$

EC = 354 m




**05. Ans: 213 m**

**Sol:** $\sin \theta_1 = \frac{180}{300}$

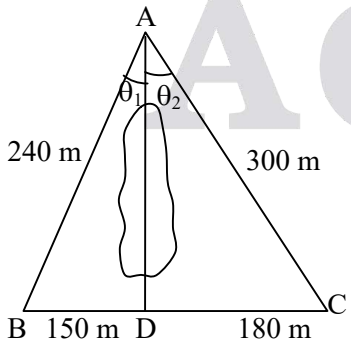
$\theta_1 = 36.86$

$\sin \theta_2 = \frac{150}{240}$

$\theta_2 = 38.68$

$\theta = \theta_1 + \theta_2 = 75.54$

150 + 180 = 330




$\tan\left(\frac{\theta}{2}\right) = \frac{330/2}{AD}$

AD = 212.9 m

$\simeq$ 213 m

**06. Ans: (d)**

**Sol:** Length of chain L = 30m

Incorrect length of chain L′ = 29.8m

Measured distance $\ell'$ = 450 m

Actual distance = $\ell'\left(\frac{L'}{L}\right)$

$= 450 \times \frac{29.8}{30} = 447$ m

**07. Ans: (a)**

**Sol:** Length of base line = 2500 m

Elevation = 200 m

Radius of the earth R = 6370 km

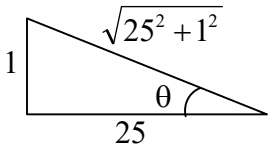
$C_{MSL} = \frac{Lh}{R}$

$= \frac{2500 \times 200}{6370 \times 10^3} = -0.0785$m

The correction is negative, if the measured distance is above MSL.

**08. Ans: (b)**

**Sol:**




Slope correction = ?

Length = 60 m

Gradient = 1 in 25

$$\cos\theta = \frac{25}{\sqrt{25^2+1^2}} = 0.99$$

$$= 60\ (1-\cos 2.29) = 48\ \text{mm}$$

**09. Ans: (d)**

**Sol:** Length of tape L = 30 m

Pull = 10 kg

3 spans of 10 m

Area of cross section A = 0.08 sq. cm

Density of tape = 7.86 g/cc

$$\text{Correction for sag} = \frac{w^2\ell}{24n^2P^2}$$

$$w = 7.86 \times 0.08 \times 30 \times 100 = 1.88\ \text{kg}$$

$$C_{sag} = \frac{(1.88)^2(30)}{24\times 3^2\times 10^2} = -0.0049\ \text{m}$$

**10. Ans: (a)**

**Sol:** 30 m chain 10 cm too long measured distance = 2500 m

15 cm too long at the end of day total distance = 4500 m

True distance =?

$$\text{For 2500 m; } L' = \frac{30+30.1}{2} = 30.05\ \text{m}$$

$$\ell_1 = 2500\times\frac{30.05}{30} = 2504.16\ \text{m}$$

$$\text{For 2000 m; } L' = \frac{30.1+30.15}{2} = 30.125$$

$$\ell_2 = 2000\times\frac{30.125}{30} = 2008.33\ \text{m}$$

Total = 2504.16 + 2008.33

= 4512.49 m

**11. Ans: (d)**

**Sol:** Length of tape = 50 m

Std. temperature = 20°C

Pull = 10 kg

Measured temperature =50°

$\alpha = 1 \times 10^{-6}/°C$

$C_{Temp} = l\alpha\Delta T$

$= 50 \times 1 \times 10^{-6}\ (50–20)$

$= 1.5 \times 10^{3}$ m

True length of a tape = 50.0015 m

**12. Ans: (a, b, c)**

**Sol:** If a chain is found to be too long it may be adjusted

- Closing the opened joints of the rings
- Removing one or more circular rings
- Replacing worn out rings

## 03. Compass Survey

**01. Ans: (a)**

**Sol:** M.B = N $5^o$ 30′ E ($5^o$ 30′)

T.B = N $10^o$ 30′ w ($349^o$ 30′)

Magnetic declination = T.B –M.B

$= 349^o.30' - 5^o\ 30'$

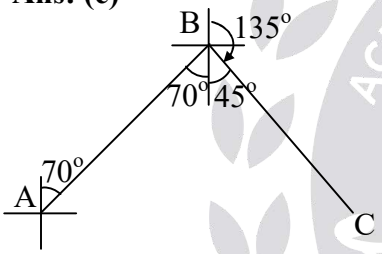
$= 344^o$

$= 16^o \ \because 360^o - 344^o$

$= N\ 16^oW$

**02. Ans: (c)**

**Sol:**




$\angle B = 70^o + 45^o = 115^o$

**03. Ans: (d)**

**Sol:** $W.C.B = \frac{6\pi}{3} \times \frac{180}{\pi} = 360^o$

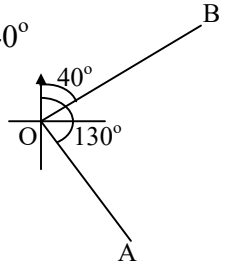
$= 0^oN$

**04. Ans: (c)**

**Sol:** Included angle

$= 130^o - 40^o$

$= 90^o$

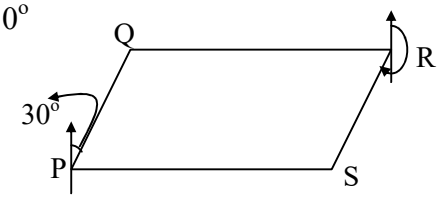



**05. Ans: (a)**

**Sol:** Bearing of RS

$= 180^o + 30^o$

$= 210^o$




**06. Ans: (b)**

**Sol:**

| Line | F.B |
|---|---|
| PQ | 50° |
| QR | 170° |
| RS | 230° |
| SP | 310° |

F.B of SP – F.B of SR

$\angle S = 310° - (230° - 180°) = 260°$

**07. Ans: (d)**

**Sol:**

| | | | Corrected | | |
|---|---|---|---|---|---|
| **Line** | **FB** | **BB** | **FB** | **BB** | **Correction** |
| AB | 126°30′ | 307°45′ | 127°15′ | 307°15′ | –0°30′@ B |
| BC | 49° | 227°15′ | **48°30′** | 228°30′ | +1°15′@ C |
| CD | 340°15′ | 161°30′ | 341°30′ | 161°30′ | |
| DE | 258°15′ | 78°15′ | 258°15′ | 78°15′ | |
| FA | 212°15′ | 31°30′ | 212°15′ | 32°15′ | +0°45′@ A |

**08. Ans: (a)**

**Sol:** D = 6°30′ W

MB = ?

TB = S32°30′E = 147°30′

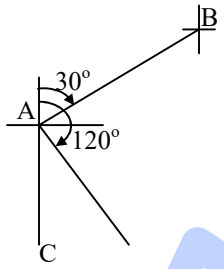
TB = MB ± D

147°30′ + 6°30′ = MB

MB = 154°

**09. Ans: (a)**

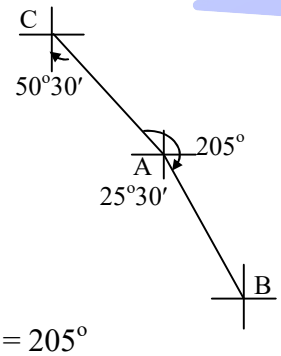
**Sol:**




∠BAC = 90°

**10. Ans: (b)**

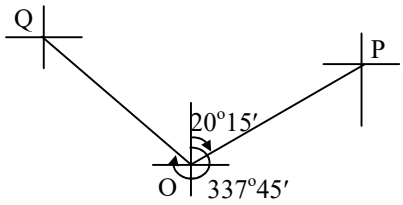
**Sol:**




∠CAB = 205°

**11. Ans: (d)**

**Sol:**




∠QOP = 42°30′

**12. Ans: (b)**

**Sol:** True bearing = magnetic bearing ± declination

= 187°30′ – 2° = 185°30′

T.B = 185°30′ – 3°30′ = 182°

**13. Ans: (b)**

**Sol:** FB of PA

= N48°45′W (360° –48°45′ – 311°15′)

BB of PA = 311°15′ – 180° = 131°15′

= FB of AP

Observed F.B of AP S50°30′E (129°30′)

∴ Correction for L.A = +1°45′ at A

Corr. M.F.B of AB = 80°50′ + 1°45′

= 82°35′

Corr T.B of AB = 82°35′ + 3° = 85°35′

= N85°35′ E

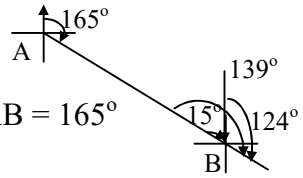
**14. Ans: (d)**

**Sol:**

| Line | F.B | B.B | |
|---|---|---|---|
| AB | 20° | 201° | 200° –1 at B |
| BC | 100° | **280°** | |
| CA | 230° | 50° | |

**15. Ans: (a)**

**Sol:**




Bearing of a line AB = 165°

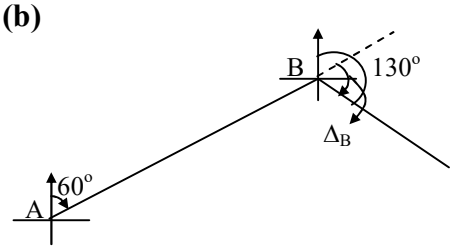
∠ABC = 139°

FB of BC = 139° –15°

= 124°

**16. Ans: (b)**

**Sol:**




$\Delta_B = 130^o - 60^o = 70^o$

**17. Ans: (a, b, c)**

**Sol:** In Centesimal System, an angle is measured in grades, minutes, and seconds.

- Dip is an angle measured in the vertical plane.
- Compass are graduated in centesimal system
- Dip is not treated as natural source of error
- Isogonic lines are lines joining points of same or equal declination angle.
- Isoclinic lines are lines joining points of same or equal dip angle

## 04. Plane Table Survey

**01. Ans: (c)**

**Sol:** $PP' = e.K$

$E = 50\text{ cm} = 500\text{ mm};$

$$K = \frac{1}{1000} = 500.\frac{1}{1000} = \frac{1}{2} = 0.5\text{ mm}$$

**02. Ans: 0.125 mm**

**Sol:** $PP' = e.K$

$$K = \frac{1}{2000}$$

$$= 250.\frac{1}{2000} = 0.125\,\text{mm}$$

**03. Ans: (c)**

**Sol:** The method of plane tabling commonly used for establishing the instrument station the method of Resection

**04. Ans: (d)**

**Sol:** For locating an inaccessible point with the help of only a plane table, we use Intersection method.

**05. Ans: (b, c)**

**Sol:**

- If the plane table lies on the great circle we do not get best fix.
- Best fix is obtained when point lies inside great triangle near the orthocenter.
- Trial point should always be at one side of the resectors.
- Lehamann's is more accurate than 2 point problem.

## 05. Levelling

**01. Ans: 1 in 24**

**Sol:** 0.750, 1.55, 2.25, 2.85, 3.55, 1.75, 2.45, 3.65, 0.950, 2.95, 3.15, 3.75

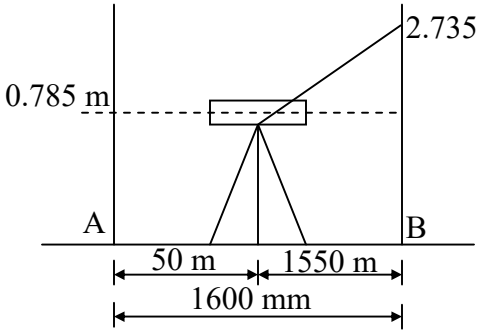
| BS | IS | FS | Rise | Fall | RL |
|---|---|---|---|---|---|
| 0.750 | | | | | 100.50 |
| | 1.550 | | | –0.80 | |
| | 2.250 | | | –0.70 | |
| | 2.850 | | | 0.60 | |
| 1.75 | | 3.550 | | –0.70 | |
| | 2.450 | | | –0.70 | |
| 0.950 | | 3.650 | | –1.20 | |
| | 2.95 | | | –2.0 | |
| | 3.15 | | | –0.2 | |
| | | 3.75 | | –0.6 | 93.00 |

$$\text{Gradient} = \frac{\text{Difference in RL's}}{9\times 20}$$

$$= \frac{7.50}{9\times 20} = 1 \text{ in } 24$$

**02. Ans: (a)**

**Sol:**




$$\text{C.S.R on B} = 2.735 - 0.06735 \times 1.55^2$$

$$= 2.573 \text{ m}$$

T.R.L difference between A & B

$$= 2.573 - 0.785$$

$$= 1.788 \text{ m} \simeq 1.8 \text{ m}$$

**03. Ans: (b)**

**Sol:** Dip of horizon, $\theta = \frac{D}{R}$ in radians

$$d = \sqrt{\frac{h}{0.06735}} = \sqrt{\frac{45}{0.06735}}$$

$$d = 25.84 \text{ m}$$

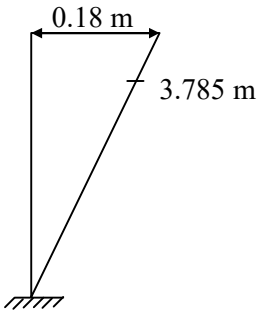
$$\theta = \frac{25.84}{6371} = 0.004\,\text{m}$$

**04. Ans: 3.781 m**

**Sol:** The correct reading

$$= \sqrt{3.785^2 - 0.18^2}$$

$$= 3.781 \text{ m}$$



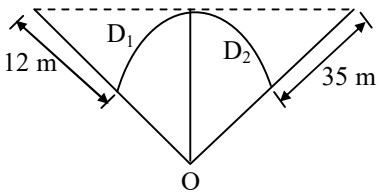

**05. Ans: (a)**

**Sol:** Radius of curvature of bubble tube $= \frac{n\ell D}{S}$

$$= \frac{5\times(2\times10^{-3})\times100}{0.05} = 20 \text{ m}$$

**06. Ans: (b)**

**Sol:**

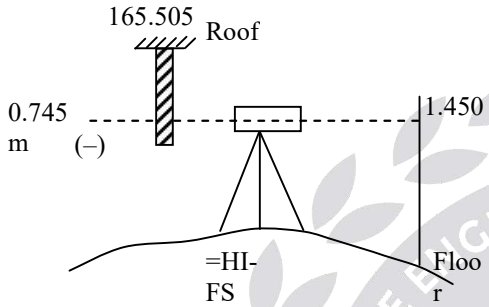


$$D = D_1 + D_2$$

$$= \sqrt{\frac{12}{0.06735}} + \sqrt{\frac{35}{0.06735}} = 36.144 \text{ km}$$

**07. Ans: (c)**

**Sol:**




R.L of floor = (165.505–0.745)–1.450

=163.310 m

**08. Ans: (a)**

**Sol:**

| Instrument | Staff reading A | Staff reading B |
|---|---|---|
| A | 1.625 | 2.545 |
| B | 0.725 | 1.405 |
| $A_1 \rightarrow A \Rightarrow h_a$ | $B_1 \rightarrow A \Rightarrow h_a'$ | |
| $A_1 \rightarrow B \Rightarrow h_b$ | $B_1 \rightarrow B \Rightarrow h_b'$ | |

**I-Instrument Set up:**

$N \rightarrow N \Rightarrow h_a$

$\rightarrow F \Rightarrow h_b$

**II-Instrument Setup:**

Near to near = $h_b'$

Near to further = $h_a'$

$$e = \frac{-1}{2}\left[(h_a - h_b) - (h_a' - h_b')\right]$$

$$= \frac{-1}{2}\left[(1.625 - 2.545) - (0.725 - 1.405)\right]$$

$$= 0.12$$

$e = e_{col} + e_c + e_R$

$0.12 = e_{col} + 0.07857(1)^2 + (-0.01122(1)^2)$

$e_{col} = 0.05265$ m

$$\theta = \tan^{-1}\left(\frac{0.05265}{1000}\right) = 10.86''$$

**09. Ans: 151.90 m**

**Sol:** $\sum$ Rise – $\sum$Fall = Last R.L. – First R.L

2.645 – (1.245) = L.R.L – 150.500

$\Rightarrow$ L.R.L = 151.90 m

**10. Ans: (d)**

**Ans:** $60^2 = \frac{h}{0.06735}$

$\Rightarrow h = 242.46$ m

**11. Ans: (a)**

**Sol:** 0.680 m, 1.455 m, 2.330 m, 2.885 m, 3.380 m 1.055 m

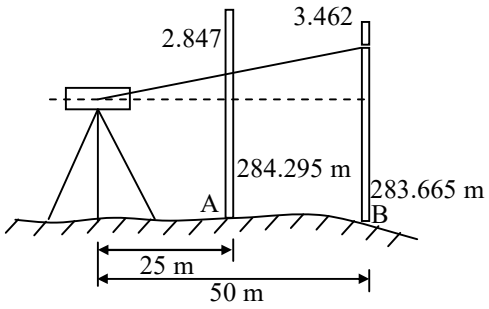
| Stn. | BS | IS | FS | Rise | Fall | RL | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | 0.680 | | | | | **81.305** | |
| 2. | | 1.455 | | | 0.775 | | |
| 3. | | 2.330 | | | 0.875 | | |
| 4. | | 2.885 | | | 0.555 | 79.100 | |
| 5 | 1.055 | 3.380 | | | | | |

81.305 – 0.775 = RL of 2

RL of 2 – 0.875 = RL of 3

**12. Ans: (d)**

**Sol:**




Difference in staff reading = 3.462 – 2.847

= 0.615 m

Difference in R.L. = 284.295 – 283.665 m

= 0.63 m

Difference of the above = 0.615 – 0.63

= 0.015 m

$e_{col}$ = 0.015 m of 25 m

$100\,m \rightarrow \frac{100}{25} \times 0.015 = 0.06$ m

**13. Ans: (a)**

**Sol:** ΣB.S – ΣFS = L.R.L – F.R.L

–6.2 – (? + 0.85) = 196.1 – 200

? = –3.150 m

**14. Ans: (a)**

**Sol:** $H = \frac{1}{2}[(1.03 - 1.630) + (0.950 - 2.740)$

= –1.195

R.L of Q = 450 – 1.195

= 448.805 m

**15. Ans: (b)**

**Sol:**

| BS | IS | FS |
|---|---|---|
| 3.425 | | |
| | 2.650 | |
| **2.150** | | **0.850** |
| 2.850 | | 1.780 |
| | 1.250 | |
| | | 0.525 |

**16. Ans: (d)**

**Sol:**

| | P | Q |
|---|---|---|
| P | 1.525 | 2.325 |
| Q | 1.545 | 2.265 |

$e = \frac{-1}{2}[(1.525 - 2.325) - (1.545 - 2.265)]$

= 0.04 m

**17. Ans: (c)**

**Sol:** $\alpha' = \frac{S}{nD}(206265)$

$= \frac{1.60 - 1.55}{4 \times 100}(206265) = 25.78$ sec

**18. Ans: (a)**

**Sol:** 74.500 + 4.685 = 79.185 m

**19. Ans: (b)**

**Sol:** Error = 0.015

$e = e_{col} + e_c + e_r$

$\Rightarrow 0.015 = e_{col} + 0.06735\,(1.5)^2$

$\Rightarrow e_{col} = -0.1365$ m

**20. Ans: (d)**

**Sol:** n = 1, R = 1.1 m

$$\alpha' = \frac{\ell}{R} = \frac{1}{1.1\times10^{3}} = \frac{1}{1100}$$

**21. Ans: (a, b, d)**

**Sol:** Levelling

- Levelling Eliminates error due to inadjustment of line of sight
- Levelling Eliminates error due to curvature
- Levelling Eliminates the combined error due to curvature and refraction completely.
- Levelling Eliminates the error due to refraction completely.

**22. Ans: (a, b, c)**

**Sol:** As we observe the staff readings it indicates increasing value. That means the ground is sloping down.

There is only one change in point. i.e., at 0.5 m.

## 06. Theodolite

**01. Ans: (a)**

**Sol:** Circular curve ranging is carried out by two theodolite method.

**02. Ans: (a)**

**Sol:** In a transit theodolite, any incidental error due to eccentricity of verniers is primarily counteracted by Reading both the verniers.

**03. Ans : (a)**

**Sol:** In a transit theodolite, error due to eccentricity of vernier is eliminated by reading of both verniers.

**04. Ans : (d)**

**Sol:** For minor adjustments of horizontal angles measured using a theodolite, the tangential screw is adjusted after both the plates are clamped.

**05. Ans : (a)**

**Sol:** Electronic theodolites of various ranges in which measured angle are displayed originally on display board are based on special optical technology.

**06. Ans: (a, b, c)**

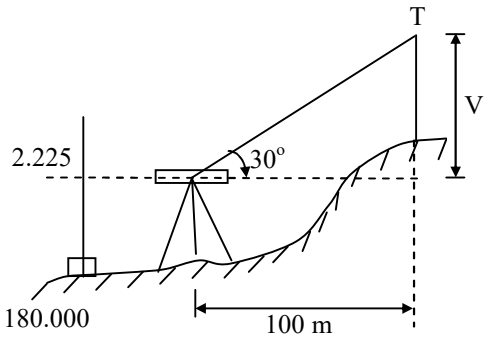
**Sol:**

- Plate level axis perpendicular to vertical axis.
- Horizontal axis perpendicular vertical axis.
- Line of sight perpendicular to vertical axis where line of sight is horizontal.
- Altitude level axis perpendicular to plate level axis

## 07. Trigonometrical Levelling

**01. Ans: (b)**

**Sol:**




$V = 1000 \tan 30^o$

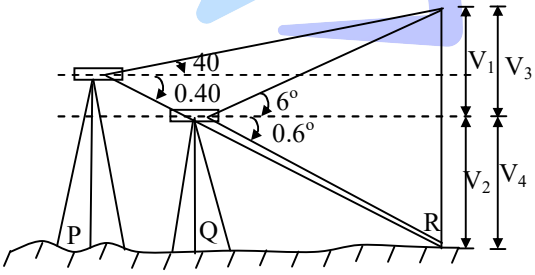
$= 577.35$ m

R.L of T = 180 + 2.225 + 577.35

= 759.575 m

**02. Ans: (c)**

**Sol:**




$V_1 + V_2 = V_3 + V_4$

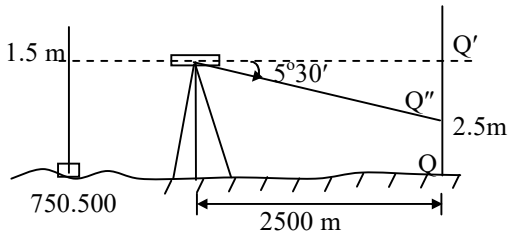
$D(\tan 6^o + \tan 0.6^o) = (D+250)(\tan 4^o + \tan 0.4^o)$

$\therefore D = 496.77$ m

Height of tower, $V_1 + V_2 = 57.4266$

**03. Ans: (509.198 m)**

**Sol:**




Corr. S.R = 2.5 – 0.06735 × 2.5 = 20.79 m

$Q'Q'' = 2500 \tan 5^o30' = 240.723$ m

R.L of Q =750.500+ 1.5–240.723 – 2.072

= 509.198 m

**04. Ans: (a)**

**Sol:** $2.650 - 0.750 = V_2 - V_1$

$= (D + 100) \tan 14^o30' - D \tan 20^o30'$

$\therefore D = 207.806$ m

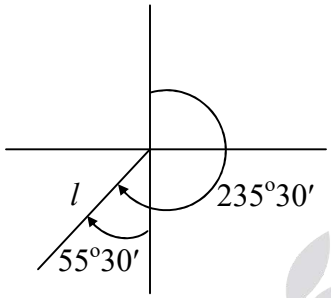
$V_1 = 207.806 \tan 20^o30' = 77.69$ m

R.L. of C = 500 + 2.65 + 77.695 = 580.345 m

## 08. Traversing & Omitted Measurements

**01. Ans: (d)**

**Sol:** Given L = - 102.65 m




$L = \ell \cos\theta$

$-102.65 = \ell \times \cos(55^\circ 30')$

$\ell = -205.82$ m

Departure (D) $= \ell \sin\theta$

$= -205.82 \sin(55^\circ 30')$

$= (-)\ 178.40$ m

**02. Ans: –124.22, 174.99**

**Sol:** T.L of B $= -34.5 - 128 \cos 45^\circ 30'$

$= -124.22$ m

T.D of B $= 83.7 + 128 \sin 45^\circ 30'$

$= 174.99$ m

B = (– 124.22, 174.99)

**03. Ans: (b)**

**Sol:** L = Latitude = 89 m (N)

D = Departure = – 49.4 [W]

$$\text{FB at PQ} \Rightarrow \theta = \tan^{-1}\left[\frac{D}{L}\right]$$

$$\theta = \tan^{-1}\left[\frac{49.4}{89}\right]$$

$$\theta = 29.03^\circ$$

FB at PQ = N 29.03° W

WCB at PQ = 360° – 29.03°

$= 330.97^\circ = 330^\circ\ 58'$

**04. Ans: (d)**

**Sol:** P = 1500 m

$$\text{Relative error} = \frac{1}{P/e} = \frac{1}{2343}$$

$$e = \sqrt{0.5^2 + 0.4^2} = 0.6403\,\text{m}$$

$$r = \frac{e}{p} = \frac{0.6403}{1500} = \frac{1}{2343}\,\text{m}$$

**05. Ans: (a)**

**Sol:** $200\cos\theta + 98\cos 178^\circ + l\cos(270^\circ) + 86.4\cos(1^\circ) = 0$

$200\sin\theta + 98\sin(178^\circ) + l\sin 270^\circ + 86.4\sin 1^\circ = 0$

$l\cos(270^\circ) + 200\cos\theta = 11.55$

$l\sin(270^\circ) + 200\sin\theta = -4.92$

$200\cos\theta = 11.55$

$$\Rightarrow \theta = \cos^{-1}\left(\frac{1.55}{200}\right) = 86.7^\circ$$

$\Rightarrow l = 204.588$ m

**06. Ans: (c)**

**Sol:**

| | A | B |
|---|---|---|
| L | 40 | 20 |
| D | –20 | 30 |

$$\text{F.B} = \tan^{-1}\frac{30+20}{20-40} = 68^\circ 11'$$

$= S68^\circ\ 11'\ E$

$$B.B = \tan^{-1}\frac{-20-30}{40-20}$$

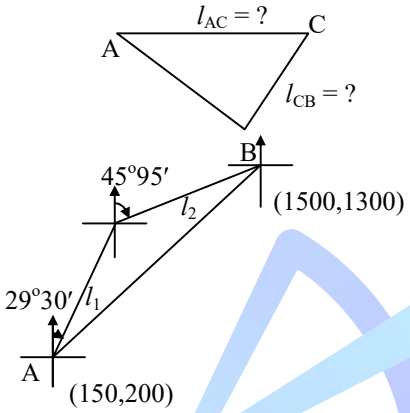
$L_2 - L_1 = 20 - 40 = -20$ (S)

$D_2 - D_1 = 30 - (-20) = 50$ (E)

$AB = \sqrt{(-20)^2 + (50)^2} = 53.85$ m

**07. Ans: (a)**

**Sol:**




FB of AC = N29°30′E

FB of BC = S 45°45′W

$\sum L = 1500 - 150 = l_1 \cos 29°30' + l_2 \cos 45° 45'$

$\sum D = 1300 - 200 = l_1 \sin 29°30' + l_2 \sin 45°45'$

$1350 = l_1 \cos 29°30' + l_2 \cos 45°45'$ …… (1)

$1100 = l_1 \sin 29°30' + l_2 \sin 45°45'$ ……(2)

By solving 1 & 2 $l_1 = 712.714$ m

$l_2 = 1045.7$ m

**08. Ans: (b)**

**Sol:** Length $= \sqrt{(1.39)^2 + (2.17)^2}$

$= 2.577$ m

Closing error

$$\theta = \tan^{-1}\left(\frac{2.17}{1.39}\right) = 57°21'$$

$$360° - \tan^{-1}\left(\frac{2.17}{1.39}\right) = 302°\,39'$$

**09. Ans: (c)**

**Sol:** D = 10

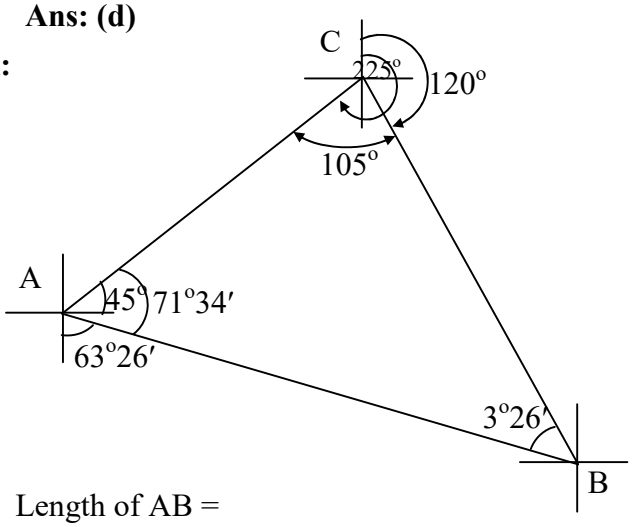
$$\theta = \tan^{-1}\left(\frac{10}{10}\right) = 45°$$

**10. Ans: (a)**

**Sol:** $\theta = \tan^{-1}\left(\frac{L}{D}\right) = \tan^{-1}\left(\frac{100}{60}\right) = 59°\,2'$

**11. Ans: (d)**

**Sol:**




Length of AB =

$\sqrt{(800-600)^2 - (600-500)^2} = 223.606$ m

$$\tan\alpha = \frac{200}{100} = 2$$

$$\alpha = 63^{o}\ 26'$$

The W.C.B of the line AB is $180^{o}$ - $63^{o}\ 26'$

$$= 116^{o}\ 34'$$

The $\Delta^{le}$ ACB,

$$\angle CAB = 116^{o}34' - 45^{o} = 71^{o}34'$$

$$\angle ACB = 225^{o} - 120^{o} - 105^{o}$$

$$\angle ABC = 180 - \left(71^{o}34' + 105^{o}\right) = 3^{o}26'$$

$$\frac{223.606}{\sin 105^{o}} = \frac{BC}{\sin\left(71^{o}34'\right)} = \frac{CA}{\sin\left(3^{o}26'\right)}$$

BC = 219.616 m

CA = 13.863 m

Latitude of CA = 13.863 cos $225^{o}$ = - 9.675

Departure CA = 13.863 sin $225^{o}$ = - 9.675

Independent coordinates of 'C'

East = 600 + 9.675 = 609.675 m

North = 600 + 9.675 = 609.675 m

**12. Ans: (a, b, c)**

**Sol:** $e = \sqrt{(-3.5)^2 + (2)^2}$

Error = 4.03

Correction = – 4.03

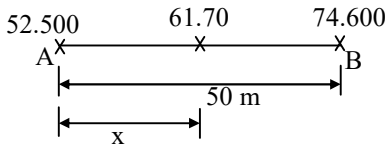
$$R.E = \frac{\text{Error of closure}}{\text{Perimeter}}$$

$$R.E = \frac{4.03}{2025} = \frac{1}{502.48}$$

## 09. Contouring

**01. Ans: (b)**

**Sol:**




$$x = \frac{61.70 - 52.500}{74.600 - 52.50} \times 50$$

x = 20.82 m

**02. Ans: (d)**

**Sol:** $H.E = \frac{20}{(1/50)} = 1000\,m$

$$R = \frac{1000}{25{,}000} = 0.04\,m$$

**03. Ans: (c)**

**Sol:** Scale : 1 : 20000

$$\text{Gradient} = \frac{4}{100}$$

Interval = 20 m

$$\text{Radius} = \frac{20}{20000} = 2.5\,cm$$

**04. Ans: (a, b, c, d)**

**Sol:**

(i) For larger area, greater contour interval is selected.

(ii) Contours always closes upon each other

(iii) Concavity of higher value contour lies towards lower value contour in case of ridges

(iv) Contours cross valley at 90°

## 10. Areas & Volumes

**01. Ans: (d)**

**Sol:** A (10, 20)

B (–30, 40)

C (50, –60)

D (70, –80)

$m_1 = \frac{20}{2} = 10$

$m_2 = 10 + \frac{10}{2} + \frac{20}{2} = 40$

$m_3 = 40 + \frac{20}{2} - \frac{30}{2} = 30$

$m_4 = 30 - 30 - 40 = -40$

$A = 10 \times 10 - 30 \times 40 + 30 \times 50 - 40 \times 70$

$= 100 - 1200 + 1500 - 2800$

$= -4000 + 1600$

$= -2400\ m^2$

**02. Ans: 2111 $m^3$**

**Sol:** b = 8.8 n = 1.5 d = 20

$A = [b + nh]\ h$

$A_1 = [8.8 + 1.5 \times 1.8]\ 1.8 = 20.7\ m^2$

$A_2 = [8.8 + 1.5 \times 2.4]\ 2.4 = 29.76\ m^2$

$A_3 = [8.8 + 1.5 \times 3]3 = 39.9\ m^2$

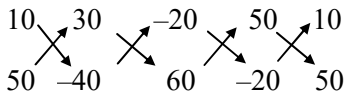
$A_4 = [8.8 + 1.5 \times 3.6]\ 3.6 = 51.12\ m^2$

$V = 20\left[\frac{20.7 + 51.12}{2} + (29.76 + 39.9)\right]$

$V = 2111\ m^3$

**03. Ans: (d)**

**Sol:**




Area of ABCDA

$= \frac{1}{2}\left|(-400 - 1500) + (1800 - 800) + (400 - 3000) + (2500 + 200)\right|$

$= 400\ m^2$

$= 0.04$ hectare's

**04. Ans: 288000 $m^3$**

**Sol:** Horizontal equivalent $= \frac{\text{Contour interval}}{\text{gradient}}$

$= \frac{330 - 210}{\frac{1}{30}} = 3600\ m$

1V – 0.5 H

4V – ? H = 8 m

$\text{Volume} = \left(\frac{28 + 12}{2}\right) \times 3600 \times 4$

$= 288000\ m^3$

**05. Ans: (b)**

**Sol:** $A_1 = 10 \times 4 = 40\ m^2$

$A_2 = 6 \times 2 = 12\ m^2$

$A_m = \left(\frac{10 + 6}{2}\right)\left(\frac{4 + 2}{2}\right)$

$= 8.2 = 24\ m^2$

$V = \frac{h}{6}[A_1 + 4A_m + A_2]$

$= \frac{8}{6}[40 + 4(24) + 12]$

$V = 197.33\ m^3$

**06. Ans: (b)**

**Sol:** $A = d\left[\frac{O_1 + O_n}{2} + O_2 + O_3 + .....O_{n-1}\right]$

$A_1 = 5\left[\frac{5+6}{2} + 4 + 5.5 + 5\right]$

$= 95$

$A_2 = 10\left[\frac{6+4.5}{2} + 4\right] = 92.5$

$A = A_1 + A_2 = 187.5 m^2$

**07. Ans: (b)**

**Sol:** $A = M [F.R – I.R \pm 10 N + C]$

$A = 10,000 [2.64 – 6.356 + 10 \times 3 + 0]$

$A = 2,62,840 mm^2$

**08. Ans: (38, 160 $m^2$)**

**Sol:** $A = M [FR – IR \pm 10 N + C]$

$= 10 [7284 – 3468 – 10 \times 2 + 20]$

$= 38,160 mm^2$ (on the plan)

Scale 1:1000

1 mm = 1m

$= (38,160 \times 1 \times 1) m^2$

$= 38,160 m^2$

**09. Ans: (b)**

**Sol:** $V = \frac{h}{3}[first + last) + 4(even) + 2(odd)]$

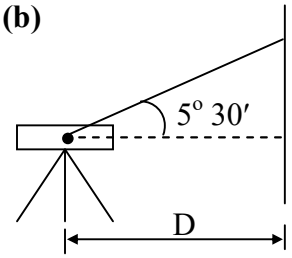
$= \frac{5}{3}[(3850 + 450) + 4(3450 + 800) + 2(2600)]$

$= 44166.66 m^3$

## 11. Tacheometry

**01. Ans: (b)**

**Sol:**




$\Rightarrow$ With an allactic lens

$k = 100 \quad C = 0$

$D_1 = ks \cos^2 \theta + C \cos \theta$

$D_1 = 100 \times 1.750 \times \cos^2 5^o 30'$

$D_1 = 173.39 m$

$\Rightarrow$ With K = 101 & C = 0.6

$D_2 = KS \cos^2 \theta + C \cos \theta$

$D_2 = 101(1.75) \cos^2(5^o 30') + 0.6 \cos (5^o 30')$

$D_2 = 175.72 m$

$\%$ age of error $= \frac{D_1 - D_2}{D_1} \times 100$

$= \frac{175.72 - 173.39}{173.39} \times 100$

$\%$ age of error = 1.35%

**02. Ans: (a)**

**Sol:** $L = KS + C$

$50 = 0.495 K + C$

$80 = 0.795 K + C$

$K = 100, C = 0.5$

**03. Ans: (d)**

**Sol:** f = 25 cm = 250 mm, i = 5 mm

$$\text{m.c} \Rightarrow K = \frac{f}{i} = \frac{250}{5} = 50$$

$$\text{A.C} \Rightarrow C = f + d = 250 + 15 \text{ cm} = 40 \text{ cm}$$

$$= 40 \times 10^{-2} \text{ m}$$

$$C = 0.40 \text{ m}$$

**04. Ans: (a)**

**Sol:** Horizontal distance, $D = Ks\cos^2\theta + C\cos\theta$

$K = 100; C = 0$

$= 100 \times (2.985 - 2.225)\cos^2(7°54')$

$= 74.564$ m

**05. Ans: (d)**

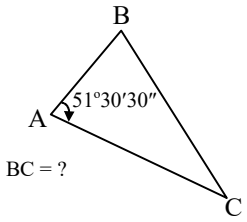
**Sol:** $D = KS + C$

$K = 95, S = 2.65 - 0.65$

$D = 95(2.65 - 0.65) + 0.5 = 190.5$ m

**06. Ans: (27.746 m)**

**Sol:**




$AB = 100 \times 0.35 + 0.2 = 35.2$ m

$AC = 100 \times 0.25 + 0.2 = 25.2$ m

$$\cos 51°30'30'' = \frac{AB^2 + AC^2 - BC^2}{2AB \times AC}$$

$BC = 27.746$ m

**07. Ans: (b)**

**Sol:** $$D = \frac{S}{\tan\alpha_1 + \tan\alpha_2} = \frac{2}{\tan(1°12') + \tan(1°30')}$$

$$= 42.43 \text{ m}$$

$V = D\tan\alpha_2 = 42.43\tan(1°30') = 1.112$

R.L of A = 100 – 1.12 – 0.5= 98.39 m

**08. Ans: (a)**

**Sol:** $$D = (206265)\frac{S}{\beta}$$

$$\beta = (30 \times 60) + 15 = 1815$$

$$D = (206265)\frac{1.25}{1815} = 142.06 \text{ m}$$

**09. Ans: (d)**

**Sol:** $$D = \frac{KS}{m}\cos^2\theta + C\cos\theta$$

$$= \frac{1000 \times 2}{m}\cos^2 6° + 0.5\cos 6°$$

$\therefore m = 19.88$

**10. Ans: (a, b, c)**

**Sol:** (i) $D = KS + C$ is applicable only if line of sight is truly horizontal and staff is vertical

(ii) When telescope is truly anallatic the additive constant becomes zero

(iii) Tacheometry has errors seldom exceeding $\frac{1}{1000}$

(iv) Tacheometric constants are $K(\text{Multiplying constant}) = \frac{f}{i}$ it is diemensionless.

But C = f+d it is having a dimension that is m or cm

## 12. Horizontal & Vertical Curves

**01. Ans: (c)**

**Sol:** $D = 2^o$

Chord length = 30 m

$\Delta = 30^o$

$$\ell = \frac{30\Delta}{2}$$

$$\ell = \frac{30 \times 30}{2}$$

$\ell = 450$ m

$$\ell = \frac{\pi R \Delta}{180}$$

$$\frac{450 \times 180}{\pi \times 30} = R$$

R = 859.44 m

Apex distance = R [sec Δ/2–1]

$$= 859.44\left[\sec\frac{30}{2} - 1\right]$$

= 30.32 m

**02. Ans: (a)**

**Sol:** $l = 2\,R \sin \Delta/2$

$$341.6 = 2 \times R \sin\left(\frac{42}{2}\right)$$

R = 476.61 m

$$\ell = \frac{\pi \times R\Delta}{180}$$

$$\ell = \frac{\pi \times 476.61 \times 42}{180}$$

$\ell = 349.4\,\text{m}$

**03. Ans: (c)**

**Sol:** Offset = $R - \sqrt{R^2 - x^2}$

$$= 500 - \sqrt{500^2 - 20^2} = 0.4 \text{ m}$$

**04. Ans: (c)**

**Sol:** $O_o = R - \sqrt{R^2 - \left(\frac{L}{2}\right)^2}$

$$= 80 - \sqrt{80^2 - \left(\frac{100}{2}\right)^2} = 17.5\,\text{m}$$

**05. Ans: (b)**

**Sol:** $L = 2R \sin\frac{\Delta}{2}$

$= 2 \times 600 \times \sin 30^o = 600$ m

Mid ordinate = $R\left(1 - \cos\frac{\Delta}{2}\right)$

= 600 (1– cos30) = 80.38 m

**06. Ans: (c)**

**Sol:** Tangent length = $R \tan\frac{\Delta}{2}$

= 200 × tan30° = 115.47 m

**07. Ans: (92.82 m)**

**Sol:** Apex distance = $R\left(\sec\frac{\Delta}{2} - 1\right) = 92.82$ m

**08. Ans: (a)**

**Sol:** Tangent length = 600 tan15°

= 160.77 m

Length of curve = $\frac{\pi R\Delta}{180} = 314.15\,\text{m}$

Change of point of curve = 1650–160.77
= 1489.23 m
Point of tangency = 1489.23+314.15
= 1803.39 m

**09. Ans: (d)**

**Sol:** $\ell = \frac{30\Delta}{D} = \frac{30\times 60}{3} = 600$ m

**10. Ans: (b)**

**Sol:** $L = \frac{g_1 - g_2}{r} = \frac{-1.5-(-3.7)}{\left(\frac{0.1}{30}\right)} = 660$ m

**11. Ans: (a)**

**Sol:** $L = \frac{0.80-(-0.70)}{\left(\frac{0.05}{1}\right)} = 30$ chains

**12. Ans: (c)**

**Sol:** L = nh
= 200 × 100
= 20000 mm
= 20 m

**13. Ans: (c)**

**Sol:** n = 40 mm
h = 100 mm
V = 20 m/sec
$L = \frac{hV}{x} = \frac{100\times 20\times 1000}{40}$
= 50000 mm
= 50 m

**14. Ans: (88.88 m)**

**Sol:** V = 20 m/sec
a = 0.3
r = 300 m
$L = \frac{v^3}{R\alpha} = \frac{20^3}{300\times 0.3} = 88.88$ m

**15. Ans: (a)**

**Sol:** $\frac{V^2}{Rg} = \frac{1}{8}$
$\Rightarrow R = 2 \times 78.67 = 157.34$ m

**16. Ans: (61.75 kmph)**

**Sol:** $h = \frac{GV^2}{Rg}$

$\Rightarrow V = \sqrt{\frac{hRg}{G}} = \sqrt{\frac{0.100\times 300\times 9.61}{}}$
= 17.155 m/s

Velocity = $17.155 \times \frac{18}{5} = 61.75$ kmph

**17. Ans: (a, b, d)**

**Sol:**

(i) Transition curve should meet the straight line and curve tangentially

(ii) The entire super elevation should be applied within the transition curve

(iii) Ideal –transition curve for highway is spiral or clothoid.

(iv) Centrifugal ratio for railways is kept as 1/8

## 13. Errors & Adjustments

**01. Ans: ($48^o$ 16′ 22.87″)**

**Sol:** $\angle A + \angle B + \angle C = 179°59'50.6''$

$d = +9.4''$

$$C_c = \left[\frac{e_c^2}{e_A^2 + e_B^2 + e_c^2}\right] d = \left[\frac{2^2}{4^2 + 6^2 + 2^2}\right] 9.4''$$

$C_c = 0.67''$

Corrected angle = [$48^o$, 16′ 22.2″] +0.67″

= $48^o$ 16′ 22.87″

**02. Ans: (a)**

**Sol:** $A \rightarrow 5$

$$\frac{\text{wt of } 3A}{\text{wt of } A/4} = \frac{5/9}{80} = \frac{5}{720}$$

**03. Ans: 22500 ± 3 $m^2$**

**Sol:** Given, side of square (a) = 150 m

Error ($e_a$) = ± 0.010 m

Area = $a^2 = (150)^2 = 22500\ m^2$

$e_A = 2a.\ e_a$

$= 2 \times 150 \times 0.010$

$= \pm 3\ m^2$

Probable value = 22500 ± $3m^2$

**04. Ans: (d)**

**Sol:** Most probable value

$$= \frac{42°12'35''+84°25'15''+168°50'23''}{7}$$

$= 42°12'36''$

**05. Ans: (d)**

**Sol:** As per laws of weights, "If a quantity of given weight is divided by a factor, the weight of the result is obtained multiplying its given weight by the square of the factor".

$3^2 \times 5 = 45$

**06. Ans: (b)**

**Sol:** MPV or WAM

$$= 40° + \frac{20\times2 + 30\times3 + 45\times9}{2+3+4}$$

$= 40°\ 34'\ 26.67''$

**07. Ans: (a)**

**Sol:** $\angle A = 47°32'30'' \pm 2'' - e_A$

$\angle B = 24°\ 16'40'' \pm 3'' - e_B$

$$E_C = \pm\sqrt{e_A^2 + e_3^2}$$

$$= \pm\sqrt{2^2 + 3^2} = \pm 3.605''$$

**08. Ans: (d)**

**Sol:** $$e_B = \pm\sqrt{e_a^2 + e_b^2 + e_c^2}$$

$$= \pm\sqrt{1^2 + 1^2 + 1^2} = \pm\sqrt{3}''$$

**09. Ans: (c)**

**Sol:** Radius, r = 12.25

$e_r = \pm 0.03$ m

$A = \pi r^2$

$e_A = 2\pi r\ e_r$

$= \pm 2.309\ m^2$

**10. Ans: 471.4352 ± 2.309 $m^2$**

**Sol:** MPV of an area

$= A \pm e_A$

$= (\pi \times 12.25^2) \pm 2.309$

$= 471.4352 \pm 2.309\ m^2$

**11. Ans: (± 1.32 m)**

**Sol:** $C = 2\pi r \qquad e_c = 2\pi e_r$

$= \pm 2 \times \pi \times 0.21$

$= \pm 1.32$ m

**12. Ans: (d)**

**Sol:** $\angle A = 20° 10' \pm 0.2$

$\angle B = 100° 40' \pm 0.1$

$\angle C = 59° 10° \pm 0.2$

$e_s = \pm\sqrt{0.2^2 + 0.1^2 + 0.2^2}$

$= \pm 0.3$

**13. Ans: 3.162 $m^2$**

**Sol:** $e_a = \pm 0.02$ m $e_b = \pm 0.01$ m

$A = ab$

$$e_A^2 = \left(\frac{\partial A}{\partial a}\right)^2 .e_a^2 + \left(\frac{\partial A}{\partial b}\right)^2 e_b^2$$

$$\frac{\partial A}{\partial a} = b = 150$$

$$\frac{\partial A}{\partial b} = a = 100$$

$$e_A^2 = 150^2(0.02)^2 + 100^2(0.01)^2$$

$\Rightarrow e_A = \pm 3.162\ m^2$

MPV = 15000± 3.162 $m^2$

**14. Ans: (d)**

**Sol:** $E\alpha\sqrt{\ell}$

$$\frac{E_1}{E_2} = \sqrt{\frac{\ell_1}{\ell_2}} \qquad \text{(or)} \qquad \frac{0.09}{E_2}$$

(or) $E_2 = \pm 0.08$ m

**15. Ans: (c)**

**Sol:** $V = ab\ c$

$e_A^2 = (4 \times 3)^2\ 0.02^2 + (3\times 3)^2\ (0.01)^2 + (3\times 4)^2\ (0.02)^2 = \pm 0.35$ m

**16. Ans: (d)**

**Sol:** $$\frac{1}{\frac{1}{3}+\frac{1}{2}} = \frac{6}{5}$$

**17. Ans: (a), (b), (c)**

**Sol:**

(i) weight is inversely proportional to varies routs

(ii) Weight of an equation remains unchanging if all the signs of the equation are change

(iii) The most probable value of observation having equal weight is the Arithmetic mean of the observations

## 14. Total Station

**01. Ans: (c)**

**Sol:** The resolution of coarse mode for distance measurement by total station is 1-2s.

**02. Ans: (d)**

**Sol:** Control Panel of total station will be consisting of Keyboard and LCD.

**03. Ans: (a)**

**Sol:** Nickel Cadmium are used as rechargeable batteries in total station

**04. Ans: (c)**

**Sol:** Communication between Instrument and prism is the use of Geotronics unicom is used in total station.

**05. Ans: (a)**

**Sol.:** Remote elevation measurement (REM) function is used to determine the heights of inaccessible points where it is not possible to located the prism.

**06. Ans: (d)**

**Sol:** Data Recorders are the devices used for transferring data from total station to the portable computer.

**07. Ans: (c)**

**Sol:** Total station is capable to store the data pertaining to maximum points of 10000.

**08. Ans: (d)**

**Sol:** The following are the advantage of total station
(i) Resection
(ii) Inversing
(iii) REM

**09. Ans: (c)**

**Sol:** The function of Electronic Note Book in total station is to store, retrieve and to calculate linear
measurements.

**10. Ans: (d)**

**Sol:** Survey station Descriptors in the total station are used for
(i) Describing the point about any datum
(ii) Identifying the station
(iii) For attributing data

**11. Ans: (b), (c) (d)**

**Sol:** The basic measurement measurements of total station are
(i) Horizontal angle
(ii) Vertical angle
(iii) Sloping distance
Horizontal distance is do not measure with total station.

## 15. Photogrammetry

**01. Ans: (d)**

**Sol:** r = 86 mm

$$d = \frac{rh}{H} = \frac{86\times10^{-3}\times600}{4500}$$

$$= 0.011466 \text{ m}$$

$$= 11.466 \text{ mm}$$

**02. Ans: (c)**

**Sol:** $S = \frac{f}{H-h}$

$$= \frac{152\times10^{-3}}{1800-300} = \frac{1}{9868}$$

**03. Ans: (a)**

**Sol:** $\frac{\text{Photo scale}}{\text{Map scale}} = \frac{\text{P.D.}}{\text{M.D.}}$

$$\Rightarrow PS = \frac{188\times10^{-3}}{120\times10^{-3}}\times\frac{1}{20,000}$$

$$= \frac{1}{12766}$$

**04. Ans: 406**

**Sol:** $N_i = \left[\frac{L_1}{L}+1\right]$

$$N_2 = \left[\frac{W_1}{W}+1\right]$$

$$L = (1-0.6)\times\frac{230\times10^{-3}}{\frac{1}{10,000}} = 0.92 \text{ km}$$

$$W = (1-0.3)\frac{230\times10^{-3}}{\frac{1}{10,000}} = 1.61 \text{km}$$

$$N_1 = \frac{L_1}{L}+1 = \frac{25}{0.92}+1 = 28.17$$

$$N_2 = \frac{W_1}{W}+1 = \frac{20}{1.61}+1 = 13.42$$

$$N = N_1 \times N_2 = 406$$

**05. Ans: (c)**

**Sol:** H = 1500 m

$h_1 = 250$ m

$d = 115.4 \times 10^{-3}$

$r = 190 \times 10^{-3}$ m

$$d = \frac{r_2 h_2}{H-h_1} = 996.05 \text{ m}$$

**06. Ans: (a)**

**Sol:** focal length = 21.5 cm

$$= 21.5 \times 10^{-2} \text{ m}$$

$$S = \frac{1}{45,000}$$

$P.D = 11 \times 10^{-2}$ m

$M.D = 3 \times 10^{-2}$ m

h = 350 m

H = ?

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

$$\frac{\text{Photo scale}}{\text{Map scale}} = \frac{11\times10^{-2}}{3\times10^{-2}}$$

$$\Rightarrow \frac{21.5\times10^{-2}}{\frac{4-350}{45,000}} = \frac{11\times10^{-2}}{3\times10^{-2}} \Rightarrow H = 2988.637 \text{ m}$$

**07. Ans: (a)**

**Sol:** $V = \frac{L}{t} \times 3600 = 216 \text{ kmph}$

**08. Ans: 620**

**Sol:** R =?

$h_a = 650$ m, $h_b = 250$ m

$f = 250 \times 10^{-3}$

$H = 2700$

$X_A = 299.3$ m

$Y_B = 547.82$

$Y_A = +208.28$ m

$X_B = -220.5$ m

$\sqrt{(X_A - X_B)^2 + (Y_A - Y_B)^2} = 620$ m

**09. Ans: (a)**

**Sol:** $S_d = \frac{f}{H} \Rightarrow \frac{1}{8000} = \frac{25 \times 10^{-3}}{H}$

$\therefore H = 2000$ m

$d = \frac{r_1 h_1}{(H - h_1)}$

$= \frac{7.50 \times 10^{-2} \times 350}{2000 - 350}$

$= 0.015$ m $= 15.9$ mm

**10. Ans: (d)**

**Sol:** $d = r_2 - r_o$

$= 112.5 - 82.40 = 30.1$ mm

$h_2 = \frac{d(H - h_1)}{r_2}$

$= \frac{30.1}{112.5} \times (700 - 250)$

$= 120.4$ m

**11. Ans: 88.68**

**Sol:** $\Delta h = \frac{\Delta P H'}{b}$

$= \frac{3.5 \times (3000 - 200)}{110.5} = 88.68$ m

**12. Ans: (a), (c), (d)**

**Sol:**

(i) The scale of a photograph is not constant

(ii) Relief displacement decreases as flying height increases. Because relief displacement is inversely proportional to the height of flying.

(iii) Parallax decreases with higher flying height

(iv) Overlap is necessary for stereoscopic vision

Identify the correct statements

## 16. Triangulation

**01. Ans: (c)**

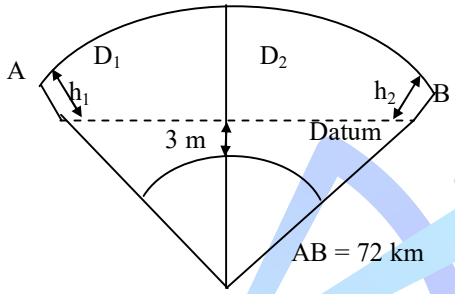
**Sol:** $\alpha = \dfrac{r\cos^2\theta/2}{D}$

$= 206265 \times \dfrac{7.5\times10^{-2}\times\cos^2 60/2}{10\times10^3}$

$= 1.16''$

**02. Ans: 63.85**

**Sol:**




Minimum elevation of line of light

$= 328 + 3 = 331$ m

(Take as a reference)

Height of A = 372 – 331 = 41 m

If line of right from A strike the ground at $D_1$

$D_1 = \sqrt{\dfrac{h_1}{0.06735}} = 24.673$ km

$\therefore D_2 = 47.327$ km

$h_2 = 0.06735\ D_2^2 = 150.85$ m

Elevation of signal at B

331 + 150.85 = 481.85 m

$\therefore$ Signal @ B to be required to elevate

= 481.85 m – 418 = 63.85

**03. Ans: (b)**

**Sol:** D = 8560 m

$r = \dfrac{140}{2} = 70$mm

$\theta = 50^o$

$\propto = \dfrac{206265\times70\times10^{-3}\times\cos^2\left(\dfrac{50}{2}\right)}{8560}$

$= 1.53''$

**04. Ans: (a), (b), (c), (d)**

**Sol:**

(i) Stations selected closer main triangulation stations to avoid obstructions are called satellite station.

(ii) Station selected for continuity of work and not for observation are pivot stations.

(iii) Laplace stations are triangulation stations at which astronomical azimuths are taken

(iv) Main stations are used to carry forward the network

## 17. Remote Sensing

**02. Ans: (c)**

**Sol:** IRS series of satellites are

1. Low orbiting satellites
2. Geostationary satellites
4. Resource survey satellites

**03. Ans: (a)**

**Sol:** A passive sensor uses sun as the source of energy.

**04. Ans: (b)**

**Sol:** For interpolation of satellite data used for monitoring dynamic changes that occure on the earth surface, the most suitable orbit for the satellite is sun-synchronous orbit

**05. Ans: (d)**

**Sol:** Stereoscopy is not strictly method of remote sensing?

**06. Ans: (c)**

**Sol:** Remote sensing techniques makes use of the properties of electromagnetic waves emitted, reflected or diffracted by the sensed objects

**07. Ans: (a)**

**Sol:** Scanning in Remote sensing systems employs only one detector.

**08. Ans: (c)**

**Sol:** The system that uses the sun as a source of electromagnetic energy and records the naturally radiated and reflected energy from the object is called Passive Remote sensing.

**09. Ans: (c)**

**Sol:** The interaction of the electromagnetic radiation produced with a specific wave length to illuminate a target on the terrain for studying its scattered radiance, is called active remote sensing

**10. Ans: (d)**

**Sol:** (i) The changing electric fields induce the changing magnetic fields in the surrounding medium
(ii) These are produced by the motion of electric charge
(iii) The oscillation of charged particles sets up changing electric fields

**11. Ans: (c)**

**Sol:** Evelyn L. Pruitt, a geographer are coined the term, 'Remote sensing'.

**12. Ans: (d)**

**Sol:** The object of photo-intepretation are
(i) Identification
(ii) Recognition of objects
(iii) Judging the significance of objects

**13. Ans: (b), (c) and (d)**

**Sol:** The components of remote sensing are
(i) Non interfering atmosphere
(ii) Energy matter interactions
(ii) End user

## 18. Geographic Information

**01. Ans: (c)**

**Sol:** To reduce the productivity is NOT a benefit of using GIS in business applications.

**02. Ans: (b)**

**Sol:** ESRI is the leading company for GIS business applications.

**03. Ans: (d)**

**Sol:** You work for the corporate office of a popular retail company that has recently begun using a GIS system. Which of the following would NOT be a good reason to use this system is to track store credit card customers who have since closed their accounts

**04. Ans: (a)**

**Sol:** Aspects of a GIS system do NOT include Legal representation of a physical location.

**05. Ans: (b)**

**Sol:** Tables can GIS NOT be used to visualize

## 19. Global Positioning System

**01. Ans: (c)**

**Sol:** Three minimum number of satellites required from which signals can be recorded to enable a global positioning system receiver to determine latitude, longitude and altitude.

**02. Ans: (c)**

**Sol:** The most widely used antenna in GPS is Microstrip antenna

**03. Ans: (b)**

**Sol:** Positional accuracies~1 – 2m if rover is less than 1-2 km from the reference station parameters is accurate for DGPS

**04. Ans: (a)**

**Sol:** For air borne application and materialization of GPS receiver and easy construction, Microstrip is the most frequency used antenna?

**05. Ans: (d)**

**Sol:** To uniquely determine the position of the user using GPS, one needs to receive signals from atleast 4 satellites.

**06. Ans: (c)**

**Sol:** In GPS, receivers are used quartz clocks

**07. Ans: (a)**

**Sol:** A passive sensor uses sun as the source of energy.

**08. Ans: (d)**

**Sol:** The code based GPS receivers are generally used for
(i) Land navigation(ii) Vehicle tracking
(iii) Trans movement

**09. Ans: (c)**

**Sol:** The GPS space segment consists of Navigation Satellite Timing and Ranging whose number is 24

**10. Ans: (a), (b) and (c)**

**Sol:** (i) GPS require 24 active satellites
(ii) A minimum of 4 satellite connects are required for accurate positioning
(iii) It works on the principle of trilateration
(iv) quartz clocks are installed in user equipments to minimise the errors.