

## DETAILED EXPLANATIONS

1. (a)
where

$$
\begin{aligned}
L \times l & =L_{1} \times l_{1} \\
L & =841.5 \mathrm{~m}, l=20.1 \mathrm{~m}, l_{1}=20 \mathrm{~m}
\end{aligned}
$$

$$
\Rightarrow \quad L_{1}=\frac{841.5 \times 20.1}{20}=845.7 \mathrm{~m}
$$

2. (b)

Chain surveying is used for securing data for exact description and marking of the boundaries of a piece of land or for preparing the maps of the area to show various details. It is generally used for plans of estates, fields, etc. on a large scale when the area is small in extent and the ground is fairly level and open.

The cross-staff survey is a special type of chain survey conducted to locate the boundaries of a field for the purpose of determining the area of the field.
3. (d)

Resection is a method of plane table surveying in which location of station occupied by plane table is unknown and it is determined by sighting any two or three known points or plotted points. It is also called method of orientation and it can be conducted by two field conditions as follows:

- The three point problem
- The two-point problem

4. (c)

$$
\text { Height of lighthouse, } \begin{aligned}
h & =0.0673 \times D^{2} \quad \text { where } D \text { is in } \mathrm{km} \\
& =0.0673 \times(40)^{2} \\
& =107.7 \mathrm{~m}
\end{aligned}
$$

5. (a)

As per Trapezoidal method,

$$
\text { Area, } A=d\left[\frac{\left(\mathrm{O}_{0}+O_{n}\right)}{2}+O_{1}+O_{2}+\ldots O_{n-1}\right]
$$

Now, since $d$ is not constant

$$
\begin{aligned}
\therefore \quad A_{1} & =5\left[\frac{4+4.7}{2}+6+7.5+6.3\right]=120.75 \mathrm{~m}^{2} \\
A_{2} & =10\left[\frac{2+4.7}{2}+3.5\right]=68.5 \mathrm{~m}^{2} \\
A & =A_{1}+A_{2} \\
& =120.75+68.5=189.25 \mathrm{~m}^{2}
\end{aligned}
$$

6. (c)
7. (d)


True bearing of $P Q=$ Magnetic bearing $\pm$ magnetic declination $\mathrm{E} / \mathrm{W}$

$$
\begin{aligned}
& =140^{\circ}+8^{\circ} 05^{\prime} \\
& =148^{\circ} 05^{\prime}
\end{aligned}
$$

8. (c)

$$
\text { Scale, } S=\frac{f}{H-h}=\frac{20 \times 10^{-2}}{2000-750}=\frac{0.20}{1250}=\frac{1}{6250}
$$

9. (d)

The deviation of staff in 3.800 m height

$$
=\frac{3.8 \mathrm{~m} \times 8 \mathrm{~cm}}{4 \mathrm{~m}}=7.6 \mathrm{~cm}
$$

$\therefore$ Correct reading of staff at point $A=\sqrt{(3.800)^{2}-\left(\frac{7.600}{100}\right)^{2}}=3.7992 \mathrm{~m}$
10. (a)

$$
\begin{aligned}
& \alpha(\text { in seconds }) & =\frac{l}{R} \times 206265^{\prime \prime} \\
\Rightarrow \quad & 25 & =\frac{2}{R} \times 206265^{\prime \prime} \\
\Rightarrow \quad & R & =16501.2 \mathrm{~mm}=16.5 \mathrm{~m}
\end{aligned}
$$

11. (a)


Using reciprocal levelling,

$$
\text { Exact difference in levels, } \begin{aligned}
H & =\frac{\left(Q_{1}-P_{1}\right)+\left(Q_{2}-P_{2}\right)}{2} \\
& =\frac{(2.205-1.475)+(2.060-1.44)}{2} \\
& =0.675 \mathrm{~m}
\end{aligned}
$$

If instrument is at $P$ then true reading at $Q$ will be

$$
Q_{1}^{T}=P_{1}+H=1.475+0.675=2.15 \mathrm{~m}
$$

So, $\quad$ Collimation error $=$ Measured value - True value

$$
=2.205-2.15=0.055 \mathrm{~m}
$$

12. (c)

We have,

$$
\Delta h=\frac{H \times \Delta p}{b+\Delta p}
$$

where,

$$
H=\text { Height of datum }
$$

$\Delta p=$ Parallax difference between two points i.e. 0.75 mm
$\Delta h=$ Elevation difference between two points i.e. 100 m
$b=$ Photograph base i.e. 94.25 mm
$\Delta h=100 \mathrm{~m}$
$H=\frac{\Delta h(b+\Delta p)}{\Delta p}=\frac{100(94.25+0.75)}{0.75}$
$=12666.67 \mathrm{~m}$
13. (b)

Longitude of the place $=94^{\circ} 20^{\prime} \mathrm{E}$
Longitude of the standard meridian $=78^{\circ} 30^{\prime} \mathrm{E}$
$\therefore$ Difference in longitude $=94^{\circ} 20^{\prime}-78^{\circ} 30^{\prime}=15^{\circ} 50^{\prime}$

$$
=1 \mathrm{~h} \mathrm{3m} 20 \mathrm{~s}
$$

The place is east of standard meridian
$\therefore \quad$ Standard time $=$ LMT - Difference in longitude $=$ LMT -1 h 3 m 20 s
$\Rightarrow \quad \mathrm{LMT}=10 \mathrm{~h} 6 \mathrm{~m} 18 \mathrm{~s}+1 \mathrm{~h} 3 \mathrm{~m} 20 \mathrm{~s}=11 \mathrm{~h} 09 \mathrm{~m} 38 \mathrm{~s}$
14. (a)


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

$$
\begin{aligned}
& =20\left(\frac{20.25}{20}-1\right) \\
& =0.25 \mathrm{~m} \\
& =25 \mathrm{~cm}
\end{aligned}
$$

15. (b)


- Apex distance $(V C)=R\left(\sec \frac{\Delta}{2}-1\right)$

16. (d)

Chainage of $V=1000.5 \mathrm{~m}$
Tangent length, $V T_{1}=R \tan \frac{\Delta}{2}=600 \times \tan \frac{30^{\circ}}{2}$

$$
=600 \tan 15^{\circ}=600 \times 0.268=160.8 \mathrm{~m}
$$

Length of curve $(l)=\frac{\pi R \Delta}{180^{\circ}}=\frac{\pi \times 600 \times 30^{\circ}}{180^{\circ}}=100 \pi$
Chainage of point of tangency $\left(T_{2}\right)=$ Chainage of $T_{1}+l$


$$
\begin{aligned}
& =\text { Chainage of } V-V T_{1}+l \\
& =1000.5-160.8+100 \pi=1153.9 \mathrm{~m}
\end{aligned}
$$

17. (d)
18. (b)

Length of line $A B$,

$$
\begin{aligned}
L_{\mathrm{AB}} & =\sqrt{\left(y_{2}-y_{1}\right)^{2}+\left(x_{2}-x_{1}\right)^{2}} \\
& =\sqrt{(4-10)^{2}+(2-5)^{2}} \\
& =\sqrt{36+9} \\
& =6.71
\end{aligned}
$$



$$
\begin{aligned}
\Rightarrow & \tan \theta & =\frac{3}{6} \\
\Rightarrow & \tan \theta & =0.5 \\
\therefore & \theta & =26.56^{\circ}
\end{aligned}
$$

Bearing of line $A B$ with the north,

$$
\alpha=\theta+180^{\circ}=206.56^{\circ}
$$

Latitude of line,

$$
\begin{aligned}
A B & =\mathrm{L}_{\mathrm{AB}} \cos \alpha \\
& =6.71 \times \cos \left(206.56^{\circ}\right) \\
& =-6.00
\end{aligned}
$$

19. (a)

Scale of photograph, $\quad S=\frac{108 \times 10^{-3}}{400}=\frac{1}{3703.70}$

$$
\begin{aligned}
& \text { We know, } \\
& \therefore \quad S=\frac{f}{H} \\
& \therefore
\end{aligned} \quad H=\frac{152.4 \times 10^{-3}}{\left(\frac{1}{3703.70}\right)}=564.44 \mathrm{~m}
$$

Now, relief displacement $d=\frac{r h}{H}$

$$
\begin{aligned}
\Rightarrow & 0.07-0.06=\frac{0.07 \times h}{564.44} \\
\Rightarrow & h=80.63 \mathrm{~m}
\end{aligned}
$$

20. (a)
21. (c)


$$
\begin{array}{ll}
\because & D=L \cos 8^{\circ}-S_{2} \sin 8^{\circ} \\
\Rightarrow & D=(K s+C) \cos 8^{\circ}-S_{2} \sin 8^{\circ} \\
\Rightarrow & D=[100(2.450-1.150)+0] \cos 8^{\circ}-1.800 \sin 8^{\circ} \\
\Rightarrow & D=128.484 \mathrm{~m} \simeq 128.48 \mathrm{~m}
\end{array}
$$

22. (c)


From fig.

$$
\frac{h_{1}}{200}=\tan 30^{\circ} 45^{\prime} \text { and } \frac{h_{2}}{200}=\tan 5^{\circ} 30^{\prime}
$$

Height of building $=h_{1}+h_{2}-4.5$

$$
\begin{aligned}
& =200 \tan 30^{\circ} 45^{\prime}+200 \tan 5^{\circ} 30^{\prime}-4.5 \\
& =133.745 \mathrm{~m}
\end{aligned}
$$

23. (a)


Adding (i) and (ii),

$$
\begin{aligned}
R\left(\tan 45^{\circ}+\tan 30^{\circ}\right) & =B D+C D=220 \\
\Rightarrow \quad R & =\frac{220}{\tan 45^{\circ}+\tan 30^{\circ}}=139.47 \mathrm{~m} \simeq 140 \mathrm{~m} \text { (say) }
\end{aligned}
$$

24. (c)

The sag correction $C_{s}$ is given by

$$
C_{s}=\frac{l(w l)^{2}}{24 P^{2}}
$$

where $l=$ the length of the tape (in metres) suspended between the supports
$P=$ pull applied in kg or $N$
$w=$ weight of the tape in kg or $N$ per metre run
$C_{s}=$ sag correction in metres for length $l$
$w l=$ total weight of tape suspended between the supports.
25. (d)
$\therefore$ Accuracy of linear measurement is $\frac{1}{15}$.
$\therefore$ For 15 m length, accuracy of linear measurement is $\frac{15}{15}$ i.e. 1 m
Now, displacement due to angular error on ground $=l \sin \alpha=20 \sin \alpha$

$$
\begin{aligned}
\therefore & \frac{\sqrt{(l \sin \alpha)^{2}+x^{2}}}{S} & =0.025 \\
\Rightarrow & \frac{\sqrt{(15 \sin \alpha)^{2}+1^{2}}}{50} & =0.025 \\
\Rightarrow & (15 \sin \alpha)^{2}+1^{2} & =1.5625 \\
\Rightarrow & \sin \alpha & =0.05 \\
\therefore & \alpha & =\sin ^{-1}(0.05)=2.87^{\circ} \\
\therefore & \alpha & =2.87^{\circ}
\end{aligned}
$$

26. (d)

$$
\text { First RL }=51.45 \mathrm{~m}, \text { Last } \mathrm{RL}=63.50 \mathrm{~m}
$$

$$
\Sigma \mathrm{BS}=87.755 \mathrm{~m}, \Sigma \mathrm{FS}=73.725 \mathrm{~m}
$$

When there is no error, then

$$
\begin{equation*}
\Sigma \text { BS }-\Sigma \text { FS }=\text { Last RL }- \text { First RL } \tag{i}
\end{equation*}
$$

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

$$
\begin{array}{rlrl}
\Sigma \mathrm{BS}-\Sigma \mathrm{FS}=87.755-73.725 & =14.03 \mathrm{~m} \\
& & \text { Last RL }- \text { First RL } & =63.50-51.45=12.05 \mathrm{~m} \\
\therefore \quad \text { Closing error } & =14.03-12.05=1.98 \mathrm{~m}
\end{array}
$$

27. (a)

Height of instrument, $\quad \mathrm{HI}=$ RL of floor + Staff reading from floor

$$
\begin{aligned}
& =45.65+0.60 \\
& =46.250 \mathrm{~m}
\end{aligned}
$$

RL of bottom of beam, = HI + Inverted staff reading taken from bottom of beam

$$
=46.250+3.242
$$

$$
=49.492 \mathrm{~m}
$$

28. (d)

The spacing between contour lines depends upon the slope of the ground. In steep slopes, the spacing is small, but for gentle slopes, the spacing is large. If the contour lines are equally spaced, they indicate a uniform slope.
29. (a)

Combined correction due to curvature and refraction

$$
\begin{aligned}
C & \left.=-0.0673 d^{2} \quad \text { (where } d \text { is in } \mathrm{km}\right) \\
& =-0.0673(0.425)^{2} \\
& =-0.012156 \mathrm{~m}
\end{aligned}
$$

$\therefore$ Corrected staff reading at $B=1.950-0.012156=1.938 \mathrm{~m}$

$$
\begin{aligned}
{[\mathrm{RL}] \text { of } B } & =[\mathrm{RL}] \text { of } A+\mathrm{HI}-\text { Staff reading at } B \\
& =160+1.2-1.938=159.262 \mathrm{~m}
\end{aligned}
$$

$\therefore \quad$ Level difference $=(R L)_{A}-(R L)_{B}=160-159.262=0.738 \mathrm{~m}$
30. (d)

| Line | Length (m) | Bearing | Latitude(m) | Departure(m) |
| :---: | :---: | :---: | :---: | :---: |
| $A B$ | 30 | $60.5^{\circ}$ | 14.77 | 26.11 |
| $B C$ | 120 | $300^{\circ}$ | 60 | $-60 \sqrt{3}$ |
| $C D$ | $l$ | $270^{\circ}$ | 0 | $-l$ |
| $D A$ | 300 | $\theta$ | $300 \cos \theta$ | $300 \sin \theta$ |

$\because \quad \Sigma L=0$
And $\quad \Sigma D=0$

$$
\begin{align*}
\therefore & \Sigma L & =0 \\
& &  \tag{i}\\
\text { Similarly, } & 300 \cos \theta & =-74.77 \\
\Rightarrow & \Sigma D & =0  \tag{ii}\\
\Rightarrow & 300 \sin \theta & =77.813+l
\end{align*}
$$

Squaring and adding eq. (i) and (ii)

$$
\begin{aligned}
& (300)^{2} & =(-74.77)^{2}+(77.813+l)^{2} \\
\Rightarrow & l & =212.72 \mathrm{~m}
\end{aligned}
$$

