POSTAL BOOK PACKAGE 2025

MADE EASY PUBLICATIONS

CIVIL ENGINEERING

CONVENTIONAL Practice Sets

CONTENTS

SURVEYING AND GEOLOGY

1 CHAPTER Introduction

Q.1 A surveyor measured the distance between two points marked on the plan drawn to a scale of 1 cm = 1 m (RF = 1 : 100) and found it to be 50 m later on he detected that he used a wrong scale of 1 cm = 50 cm (RF = 1 : 50) for the measurement. Determine the correct length. Also determine the correct area if the measured area is 60 m^2?

Solution:

$$\text{RF of wrong scale} = \frac{1}{50}$$

$$\text{RF of correct scale} = \frac{1}{100}$$

$$\text{Correct length} = \frac{\text{RF of wrong scale}}{\text{RF of correct scale}} \times \text{Measured length}$$

$$= \frac{1/50}{1/100} \times 50 = 100 \text{ m}$$

$$\text{Correct area} = \left(\frac{\text{RF of wrong scale}}{\text{RF of correct scale}}\right)^2 \times \text{ Measured area}$$

$$= \left(\frac{1/50}{1/100}\right)^2 \times 60 = 240 \text{ m}^2$$

Q.2 Design a vernier for a theodolite circle which is divided into degrees and half degrees to read up to 30″.

Solution:

$$\text{Least count} = \frac{s}{n}, \quad s = 30'$$

Now $$30'' = \frac{30}{60} \text{ min.}$$

$\therefore$ $$\frac{30}{60} = \frac{30}{n}$$

$\Rightarrow$ $$n = 30 \times 2 = 60$$

59 such primary division should be taken from the main scale and then divided into 60 parts the vernier.

Q.3 The circle of a theodolite is divided into degrees and $\frac{1}{4^{\text{th}}}$ of a degree. Design a suitable decimal vernier to read up to 0.005°.

Solution:

$$\text{Least Count} = \frac{s}{n}; \; s = \frac{1}{4}^{\circ}; \text{ L.C. } = 0.005^{\circ}$$

$\therefore$ $$0.005 = \frac{1}{4} \cdot \frac{1}{n}$$

$$\Rightarrow \quad n = \frac{1}{4 \times 0.005} = 50$$

Take 49 such primary divisions from the main scale and divide it into 50 parts for the vernier.

Q.4 Design an extended vernier for an Abney level to read up to 10′. The main circle is divided into degrees.

Solution:

$$\text{Least Count} = \frac{s}{n}; \; s = 1^\circ \; ; \; \text{L.C.} = 10'$$

$$\therefore \quad \frac{10}{60} = \frac{1}{n}; \quad \text{or} \quad n = 6$$

Take five spaces of the main scale and then divide it into six equal parts for the vernier.

Q.5 In a plan, a 10 cm scale drawn shrunk to 9.7 cm. If the scale of the given plan is written as 1 : 250, determine the actual length of a line which at present shows 10 cm.

Solution:

$$\text{Present representative factor (R.F.)} = \frac{1}{250} \times \frac{9.7}{10}$$

$$\text{Actual distance} \times \text{R.F.} = \text{Drawing distance}$$

$$\text{Actual distance} = \frac{10 \text{ cm}}{\frac{1}{250} \times \frac{9.7}{10}} = 2577 \text{ cm} = 25.77 \text{ m}$$

Q.6 A rectangular plot of land measures 20 cm × 30 cm on a village map drawn to a scale of 100 m to 1 cm. Calculate its area in hectares. If the plot is redrawn on a topo sheet to a scale of 1 km to 1 cm, what will be its area on the topo sheet? Also determine the R.F. of the scale of the village map as well as on the topo sheet.

Solution:

(i) Village map:

$$1 \text{ cm on map} = 100 \text{ m on the ground}$$

$$\therefore \quad 1 \text{ cm}^2 \text{ on map} = (100)^2 \text{ m}^2 \text{ on the ground}$$

The plot measures 20 cm × 30 cm i.e., 600 cm^2 on the map.

$$\therefore \quad \text{Area of plot} = 600 \times 10^4 = 6 \times 10^6 \text{ m}^2 = 600 \text{ hectares}$$

(ii) Topo sheet

$$1 \text{ cm on map} = 1 \text{ km on ground}$$

$$\Rightarrow \quad 1 \text{ cm}^2 \text{ on map} = 1 \text{ km}^2 \text{ on ground}$$

$$= 10^6 \text{ m}^2 \text{ on ground}$$

$$\therefore \; 6 \times 10^6 \text{ m}^2 \text{ ground area is represented by } \frac{1}{1000 \times 1000} \times 6 \times 10^6 = 6 \text{ cm}^2 \text{ map area}$$

(iii) R.F. of the scale of village map $= \dfrac{1}{100 \times 100} = \dfrac{1}{10000}$

R.F. of the scale of topo sheet $= \dfrac{1}{1 \times 1000 \times 100} = \dfrac{1}{100000}$

Q.7 A plan drawn to a scale of 1 : 3000 was measured by a mistake a scale of 1 : 4000. Determine the percentage error in the measured length and measured area.

Solution:

$$\text{Let the length on the plan} = L$$

$$\text{Actual length} = 3000\,L$$

$$\text{Percentage error} = \frac{4000L - 3000L}{3000L} = 33.33\%$$

$$\text{Percentage error in area} = \frac{\text{Measured area} - \text{Actual area}}{\text{Actual area}} \times 100$$

$$= \frac{(4000L)^2 - (3000L)^2}{(3000L)^2} \times 100 = 77.77\%$$

Q.8 The area of the plan of an old survey plotted to a scale of 10 metres to 1 cm measures now as 100.2 sq. cm as found by a planimeter. The plan is found to have shrunk so that a line originally 10 cm long now measures 9.7 cm only. Find (i) the shrunk scale, (ii) true area of the survey.

Solution:

(i) Present length of 9.7 cm is equivalent to 10 cm original length.

$$\therefore \quad \text{Shrinkage factor} = \frac{9.7}{10} = 0.97$$

$$\text{True scale R.F.} = \frac{1}{10 \times 100} = \frac{1}{1000}$$

$$\therefore \quad \text{R.F of shrunk scale} = 0.97 \times \frac{1}{1000} = \frac{1}{1030.93}$$

(ii) Present length of 9.7 cm is equivalent to 10 cm original length.

$\therefore$ Present area of 100.2 sq. cm is equivalent to

$$\left(\frac{10}{9.7}\right)^2 \times 100.2 \text{ sq. cm} = 106.49 \text{ sq. cm} = \text{Original area on plan}$$

$$\text{Scale of plan is 1 cm} = 10 \text{ m}$$

$$\therefore \quad \text{Area of the survey} = 106.49\,(10)^2 = 10649 \text{ sq. m}$$

Q.9 In 1950, plan of a rectangular field was drawn with a scale of 1 cm = 40 m. The present dimension of field read as 30 cm × 10 cm. If an original reference line of 9.4 cm now reads 10 cm then what is the actual area of field?

Solution:

$$\text{Extended factor,} \quad \text{E.F.} = \frac{\text{Extended length}}{\text{Original length}} = \frac{10}{9.4} = 1.06$$

$$\therefore \quad \text{R.F.}_{\text{[Extended scale]}} = (\text{E.F.}) \times \text{R.F.}_{\text{[original scale]}}$$

$$\text{Original scale, 1 cm} = 40 \text{ m}$$

$$\therefore \quad [\text{RF}]_{\text{Original scale}} = \frac{1}{4000}$$

$$\therefore \quad \text{RF}_{\text{[Extended scale]}} = 1.06 \times \frac{1}{4000} = \frac{1}{3760}$$

$$\Rightarrow \quad \text{Extended scale, 1 cm} = 37.6 \text{ m}$$

$$\therefore \quad \text{Actual area of field} = 30 \times 10 \times (37.60)^2 = 424128 \text{ m}^2 = 42.4128 \text{ ha}$$

■■■■

2 CHAPTER Linear Measurement

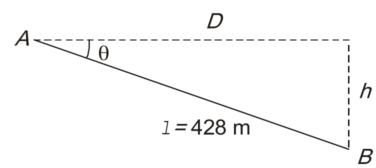
Q.1 The distance between the points measured along a slope is 428 m. Find the horizontal distance between them. if :

(a) the angle of slope between the points is 8°

(b) the difference in levels is 62 m.

(c) Slope is 1 in 4

Solution:



(a) $D = l\cos\theta = 428\cos 8° = 423.823$ m

(b) $D = \sqrt{l^2 - h^2} = \sqrt{428^2 - 62^2} = 423.49$ m

(c) $\tan\theta = \frac{1}{4};\quad \theta = 14°\ 2.17'$

$D = l\cos\theta = 428\cos 14°\ 2.17' = 415.22$ m

Q.2 The length of a survey line measured with a 30 m chain was found to be 631.5 m. When the chain was compared with a standard chain, it was found to be 0.10 m too long. Find the true length of the survey line.

Solution:

$$\text{True length of the line} = \frac{L'}{L} \times \text{Measured length of the line}$$

Here, $L' = 30.10$ m, $L = 30$ m

Measured length of survey line $= 631.5$ m

$$\therefore \quad \text{True length of the survey line} = \frac{30.10}{30} \times 631.5 = 633.603 \text{ m}$$

Q.3 The area of a certain field was measured with a 30 m chain and found to be 5000 sq. m. It was afterwards detected that the chain used was 10 cm too short. What is the true area of the field?

Solution:

$$\text{True area} = \left(\frac{L'}{L}\right)^2 \times \text{Measured area}$$

Here, $L' = 29.9$ m, $L = 30$ m, measured area = 5000 sq.m.

$$\text{True area} = \left(\frac{29.9}{30}\right)^2 \times 5000 \text{ sq. m}$$

$$= 4966.72 \text{ sq.m.}$$

Q.4 A 20 m chain was found to be 4 cm too long after chaining 1400 m. It was 8 cm too long at the end of day's work after chaining a total distance of 2420 m. If the chain was correct before commencement of the work, find the true distance.

Solution:

The correct length of the chain at commencement = 20 m

The length of the chain after chaining 1400 m = 20.04 m

∴ The mean length of the chain while measuring

$$= \frac{20+20.04}{2} = 20.02 \text{ m}$$

True distance for the wrong chainage of 1400 m

$$= \frac{20.02}{20}\times 1400 = 1401.400 \text{ m}$$

The remaining distance = 2420 – 1400 = 1020 m

Mean length of the chain while measuring the remaining distance

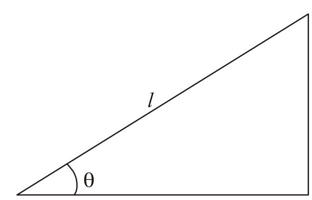
$$= \frac{20.08+20.04}{2} = 20.06 \text{ m}$$

∴ True length of remaining 1020 m $= \frac{20.06}{20}\times 1020 = 1023.06 \text{ m}$

Hence, the total true distance = 1401.40 + 1023.06 = 2424.46 m

Q.5 Determine the slope correction required for a length of 60 m, along a gradient of 1 in 20.

Solution:



$$l = 60 \text{ m}$$

$$\tan\theta = \frac{1}{20}$$

$$\Rightarrow \quad \cos\theta = 0.9988$$

Slope correction $= L(1-\cos\theta)$

Where L = Measured distance

Hence, Slope correction $= 60(1-0.9988)$

$= 7.49 \text{ cm} \simeq 7.5 \text{ cm}$

Q.6 Calculate the sag correction for a 30 m steel under a pull of 100 N in three equal spans of 10 m each. Weight of one cubic cm of steel is 0.078 N. Area of cross-section of tape is 0.08 sq. cm.

Solution:

Volume of tape per meter run = 0.08 × 100 = 8 cm^3

Weight of the tape per metre run = 8 × 0.078 = 0.624 N

∴Total weight of the tape suspended between two supports = (W) = 0.624 × 10 = 6.24 N

$$\text{Now correction of sag} = (C_s) = \frac{nl_1(wl_1)^2}{24P^2} = \frac{nl_1W^2}{24P^2} = \frac{3\times 10\times(6.24)^2}{24(100)^2} = 0.00487 \text{ m}$$

Q.7 Show that for a chain of 3 mm^2 cross-sectional area and 0.48 kg weight (material E = 2 × 10^6 kg/cm^2) standardised at 8 kg tension, the normal pull is 12 kg.

Solution:

We know that, $$P = \frac{0.204W\sqrt{AE}}{\sqrt{P-P_0}} \quad \text{...(i)}$$

where, P = Normal pull

P_0 = Pull at standardisation = 8 kg