

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

FACULTY OF INDUSTRIAL TECHNOLOGY

BACHELOR OF ENGINEERING (HONOURS) DEGREE

PART II SECOND SEMESTER EXAM. JUNE -2010

ENGINEERING SURVEY II TCW 2204

INSRUCTIONS

Answer any four questions

Time : 3 hours

Total Marks : 100

QUESTION 1

The following horizontal angles were observed in a triangulation network at a construction site shown in fig. 1 .

| Angle | Observed value |
|-------|-----------------------|
| 1. | $19^{\circ} 59' 42''$ |
| 2. | $71^{\circ} 22' 53''$ |
| 3. | $87^{\circ} 35' 05''$ |
| 4. | $39^{\circ} 42' 25''$ |
| 5. | $61^{\circ} 15' 56''$ |
| 6. | $54^{\circ} 00' 28''$ |
| 7. | $43^{\circ} 04' 38''$ |
| 8. | $31^{\circ} 08' 37''$ |
| 9. | $79^{\circ} 18' 11''$ |
| 10 | $52^{\circ} 32' 25''$ |
| 11. | $88^{\circ} 36' 40''$ |

QUESTION 1 continued

- 12. $52^{\circ} 42' 36''$
- 13. $64^{\circ} 44' 10''$
- 14. $43^{\circ} 04' 38''$
- 15. $48^{\circ} 09' 33''$

Adjust the angles for geometrical consistency using any method you know. **(25 marks)**

QUESTION 2

A straight tunnel is to be driven at a constant slope on the line joining two stations P and S which are on opposite sides of a hill as shown in fig. 2 . P and S lie on the formation level of the tunnel . An initial survey is required to establish the positions of the proposed tunnel entrances and to enable this to be done , three additional points ; Q R and T are established on the hill . A closed –loop traverse P , Q , R , S , T and P is run . The observed horizontal angles and horizontal distances are as follows :

| Horizontal angles | Horizontal distances (m) |
|------------------------------|--------------------------|
| $PQR = 93^{\circ} 17' 45''$ | $PQ = 119,450$ |
| $QRS = 82^{\circ} 43' 19''$ | $QR = 588,310$ |
| $RST = 141^{\circ} 18' 47''$ | $RS = 123,280$ |
| $STP = 93^{\circ} 18' 44''$ | $ST = 391,110$ |
| $TPQ = 129^{\circ} 21' 35''$ | $TP = 405,580$ |

The coordinates (m) of P are + 450 , 000 -550,000 . and bearing P – Q = $150^{\circ} 35' 30''$

Calculate the adjusted coordinates of points Q , R , S and T , adjusted by the Bowditch method.
(25 marks)

QUESTION 3

Point C was surveyed by sighting trigonometrical beacons ; A , B and P as shown in fig 3 . The following information was obtained :

Mean observed horizontal angles

$$PCB = 142^{\circ} 01' 55''$$

$$BCA = 139^{\circ} 00' 55''$$

$$ACP = 78^{\circ} 56' 55''$$

Given

Coordinates (m)

$$P + 9\ 392,800 \qquad + 8\ 952,020$$

$$A + 9\ 844,180 \qquad + 6\ 375,000$$

$$B + 13\ 365, 170 \qquad + 8\ 536,060$$

Calculate the provisional coordinates of point C .

(25 marks)

QUESTION 4

(a) Explain the following terms associated with vertical curves : (i) stopping sight distance (SSD) **(3 marks)** , (ii) full overtaking sight distance (F. O. S. D.) (3marks) , (iii) crest curve **(2 marks)** and sag curve **(2 marks)**

(b) A parabolic vertical curve is to connect a – 2,5% gradient to a +3,5% gradient on a highway designed for a speed of 100km/hr as shown in fig. 4. The K – value for this highway is 26 and the minimum required length is to be used. The reduced level and through chainage of the intersection point of the

gradients are 1000,00m and 617,490m respectively and , in order to meet particular site conditions , the through chainage of the entry tangent point is to be 553,170m.

Calculate ;

- (i) the reduced levels of the tangent points . **(4 marks)**
- (ii) the tangent lengths , i.e. L_1 and L_2 . **(4 marks)**
- (iii) through chainage of R . **(4 marks)and**
- (iv) gradient of BCD . **(3 marks)**

(25 marks)

QUESTION 5

AB , BC and CD are three straight lengths of piping as shown in fig. 5 . It is proposed to build to build a circular dam so that the pipes will be tangential to the dam at points E , F and G.

Given

Coordinates(m)

B – 178,760 - 79,340

C – 108,390 - 207 ,970

Bearings

B – A = $294^{\circ} 58' 00''$

C – D = $234^{\circ} 24' 00''$

Calculate the radius of the dam . **(25 marks)**

QUESTION 6

AB , CD and EF are straight portions of a railway line which are connected by curves BC and DE , the centres of which are L and P as shown in fig. 6 .

Given

Directions

and

Radii(m)

$$A-B = 163^{\circ} 10' 00''$$

$$BC = 750$$

$$E-F = 133^{\circ} 10' 00''$$

$$DE = 1200$$

Coordinates(m)

$$B - 606,710 \quad + 687,720$$

$$E + 633,100 \quad - 632,260$$

Calculate the length of the straight portion CD .

(25 marks)

List of formulae

$$\text{Sum of internal angles} = (2n - 4) \times 90^{\circ}$$

$$\text{Sum of external angles} = (2n + 4) \times 90^{\circ}$$

$$Y \text{ (or } X \text{)} = -e_y \text{ (or } -e_x \text{)} \times \underline{\text{length of traverse leg concerned}}$$

Total length of the traverse

$$A = (+m) - (-n) \quad , \quad \text{min}L_v = K \times A \quad , \quad RL_x = RL_y + \underline{(n) YX} \quad , \quad RL_z = RL_x + \underline{(m)KL}$$

100

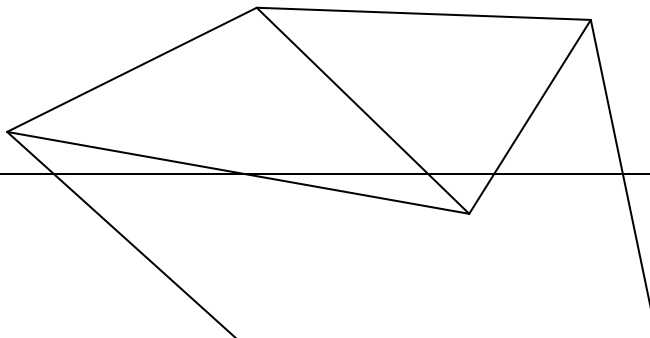
100

$$\text{Gradient} = \frac{(-n)L_1 + (+m)L_2}{L_v} \quad , \quad |V''| = \frac{a - c}{(ab + cd) \text{ Sin } 1''}$$

$$a = \sin 1 \times \sin 3 \times \sin 5 \times \sin 7 \times \sin 9 \quad , \quad b = \cot 1 + \cot 3 + \cot 5 + \cot 7 + \cot 9$$

$$c = \sin 2 \times \sin 4 \times \sin 6 \times \sin 8 \times \sin 10 \quad , \quad d = \cot 2 + \cot 4 + \cot 6 + \cot 8 + \cot 10$$

Fig. 1



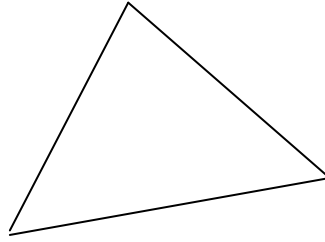


Fig.2

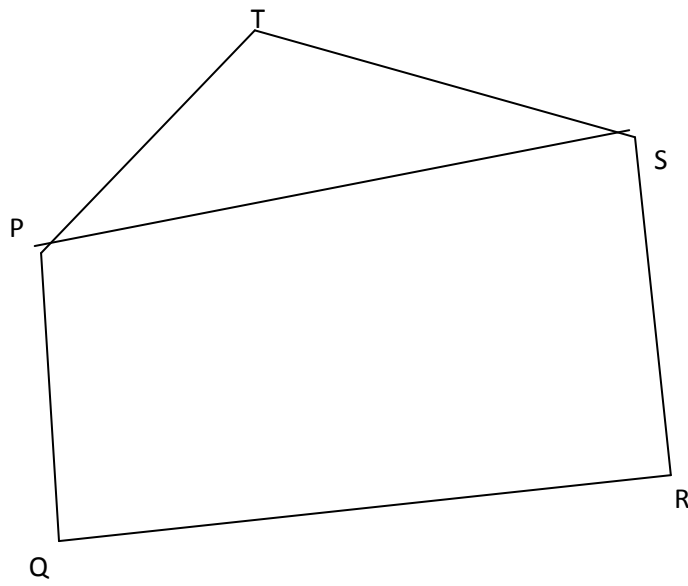


Fig. 3

B



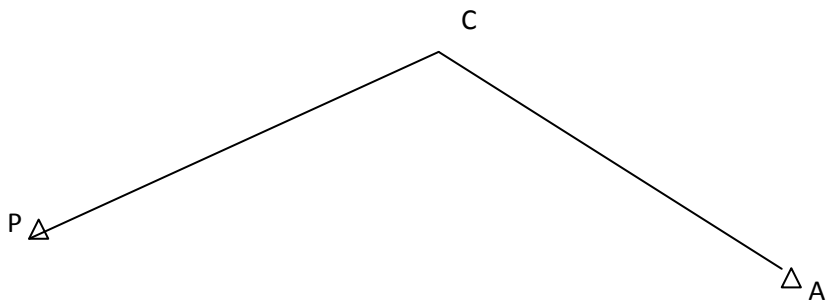


Fig.4

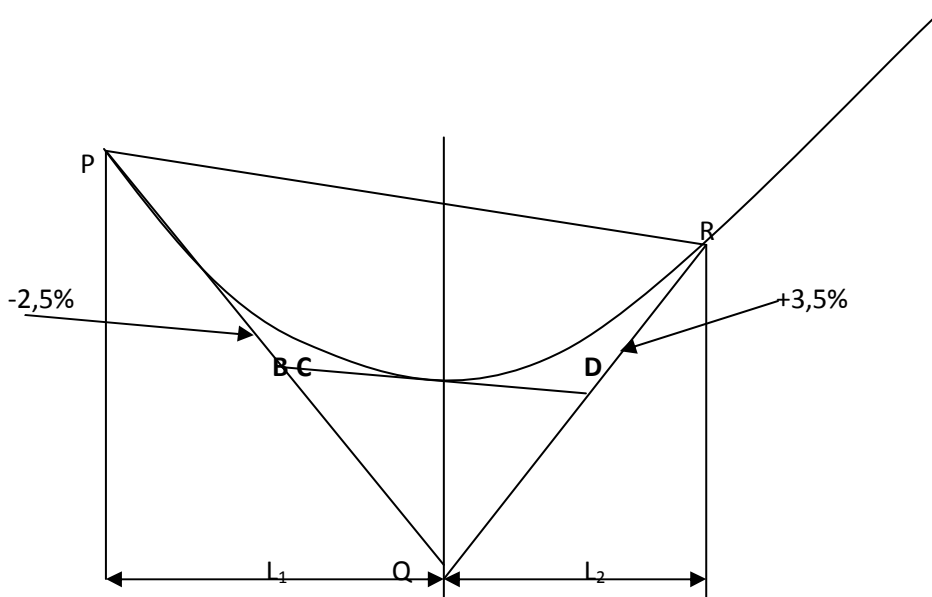
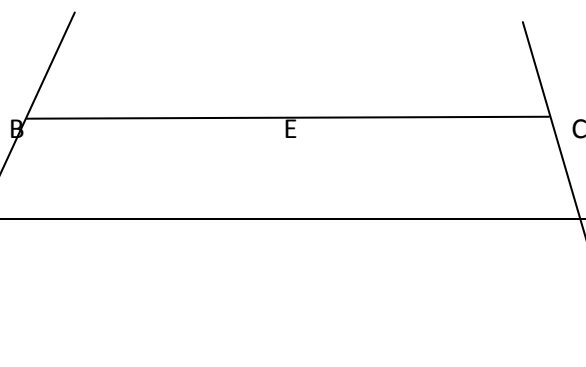


Fig.5



F

G

A



D