The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CVX 5440 Surveying II** /CVX5530
Academic Year	: 2021/2022
Date	: 28th February 2023
Time	: 1330-1630hrs
Duration	: **03 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **SIX (06)** questions on **Six (06)** pages.
3. Answer **any FIVE (05)** questions.
4. Answer for each question should commence from a new page.
5. Necessary additional information is provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear handwriting.
8. Do not use Red colour pen.

Q1)

a) Derive an expression for Tangents AI and IB using the notations given in figure 1.1

(8 MARKS)

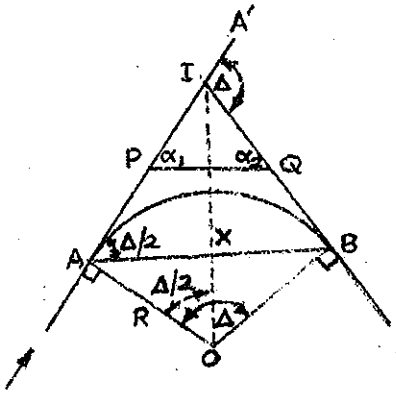


Figure 1.1

(b) Two straight lines PQ and QR on the center-line of a proposed road on a rocky headland are to be connected by a circular curve of 200 m radius. From the traverse notes, it is found that if the bearing of PQ is assumed to be N 0^0 0' E, the bearing of QR would be N 48^0 20' E. If P has been taken as the origin of coordinates, the latitude and departure of R will be + 221 m and +111 m respectively. Determine the distance of the tangent points PT_1 and RT_2.

(12 MARKS)

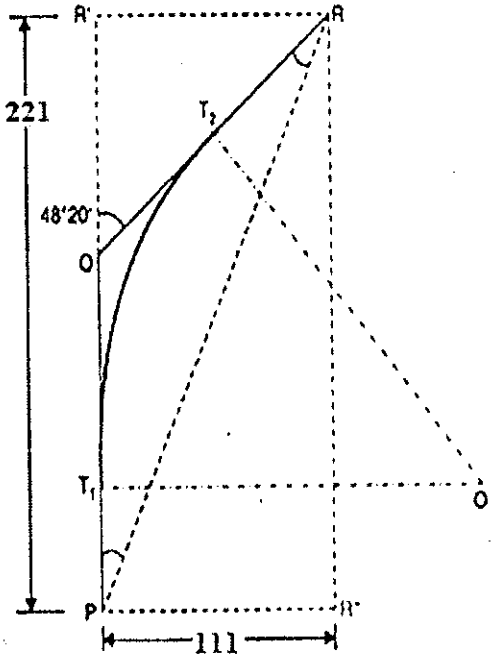


Figure 1.2

Q2)

a) Using the standard notation shown in figure 2, drive the following equation for the vertical curve assuming it to be a parabola. $y = -\{(g_1 + g_2)/ 200L\} x^2 + (g_1/100) x$

(4 MARKS)

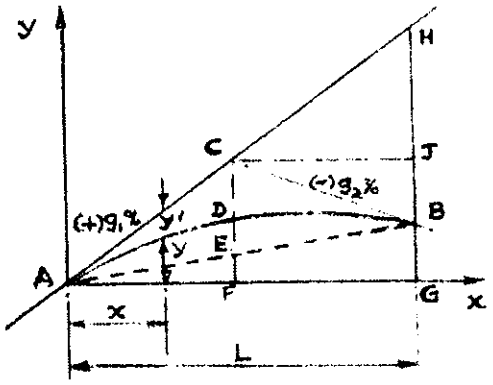


Figure 2

b) Based on the derived expression under the above question (a) for figure 2, show that the value of the mid-offset is AL /800 where A is the grade angle. (4 MARKS)

c) A parabolic vertical curve is to be set out connecting two uniforms of + 0.8% and – 0.9%. The reduced levels of the starting point and midpoints are 238.75 m and 245.75m respectively. Determine the length of the curve and the reduced level at the end point of the vertical curve.

(12 MARKS)

Q3)

(a) Figure 3.1 shows a triangulation tower of height **h** erected at point B. Show that $h = d^2/ 2R$ for point C to clear the horizon. (8 MARKS)

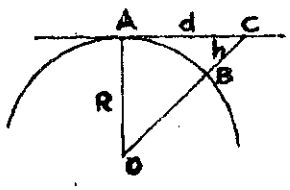


Figure 3.1

b) The altitudes of two proposed stations *A* and B, 80 km apart are respectively 225 m and 550 m. The intervening obstructions situated at *C*, 40 km from *A* have an elevation of 285 m. Ascertain if *A* and *B* are inter-visible and if necessary, find by how much *B* should be raised so that the line of sight must nowhere be less than 3 m above the obstruction at point C. You may use the equation $X= h_1 + \{(h_2 - h_1) d_1/ (d_1 + d_2)\} - 0.0676 d_1d_2$. (12 MARKS)

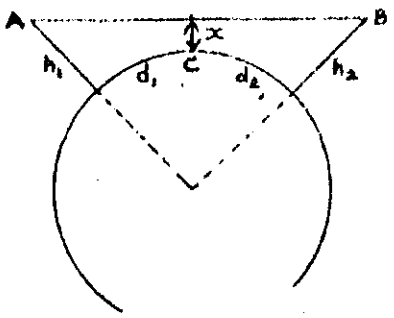


Figure 3.2

Q4)

a) Briefly describe the following terms. (6 MARKS)

- Indirect measurement
- Conditional quantity
- Most probable value

b) The following are the measured values of equal weight for two connected triangles ACD and BCD (Figure 4). *A=68^0 12'24", B=52^0 28'46", C=128^0 16'30", D=110^0 02'25", C_1=62^0 18'40", C_2=650 57'51", D_1=49^0 28'59", D_2=16^0 33'28"*. Obtain the most probable values for the above angles by answering the following questions. (14 MARKS)

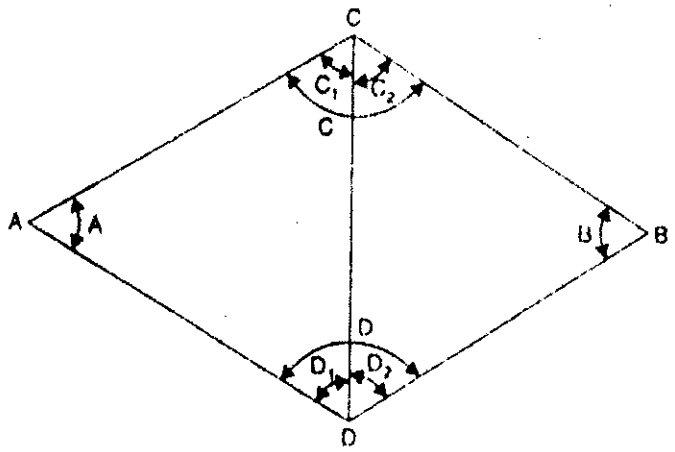


Figure: 4

i. State all the conditional equations for the angles of the polygon in Figure 4.
ii. Based on the conditional equations written under the above question (i), drive modified observed equations by eliminating A and B
iii. Develop the corresponding reduced equations for modified observed equations obtained under equation 4 (b)ii.
iv. Develop the normal equations for reduced equations obtained under question 4(b)iii and obtain the most probable values for all angles.

Q5)

a) Figure 5.1 shows an arrangement of Weisbach Triangles, which are transferring the bearing of a known line at the surface to a reference line within a tunnel. Briefly describe the process of bearing transfer with the aid of Weisbach triangles. (8 MARKS)

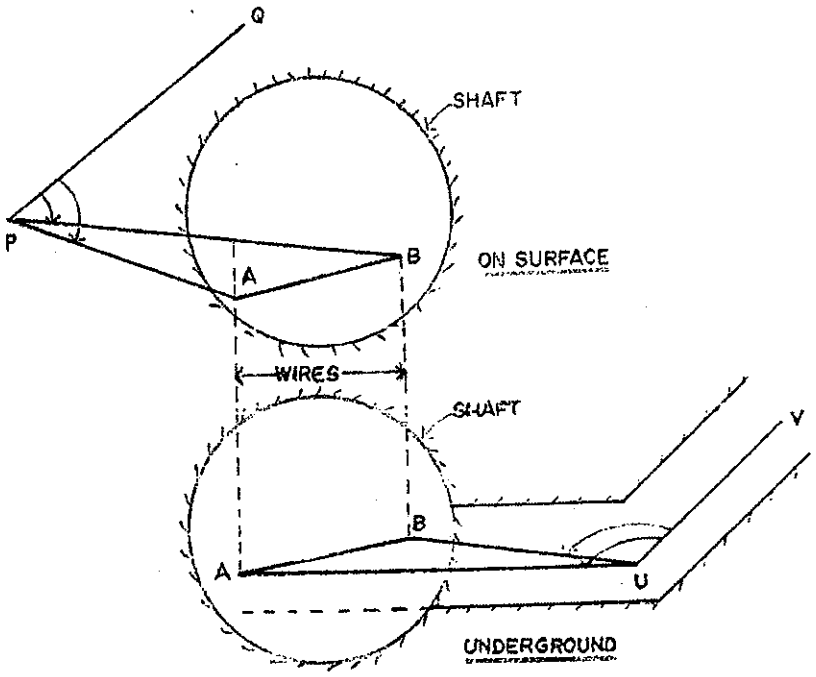


Figure 5.1

b) The center line of a tunnel is represented by two plumb lines C and D as shown in figure 5.2. C and D are 4m apart, hanging vertically in a shaft and the circle bearing of the line CD is $80^0\,40'15''$. A theodolite is set up underground at a point A, distant 3.902 m and roughly east of the nearer plumb line D, and the observed value of the angle CAD is found to be $16'12''$. Calculate the bearing of line CA and the perpendicular distance of A from the center line of the tunnel. (12 MARKS)

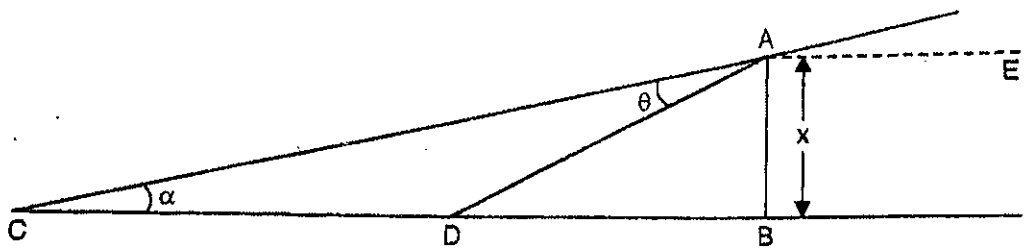
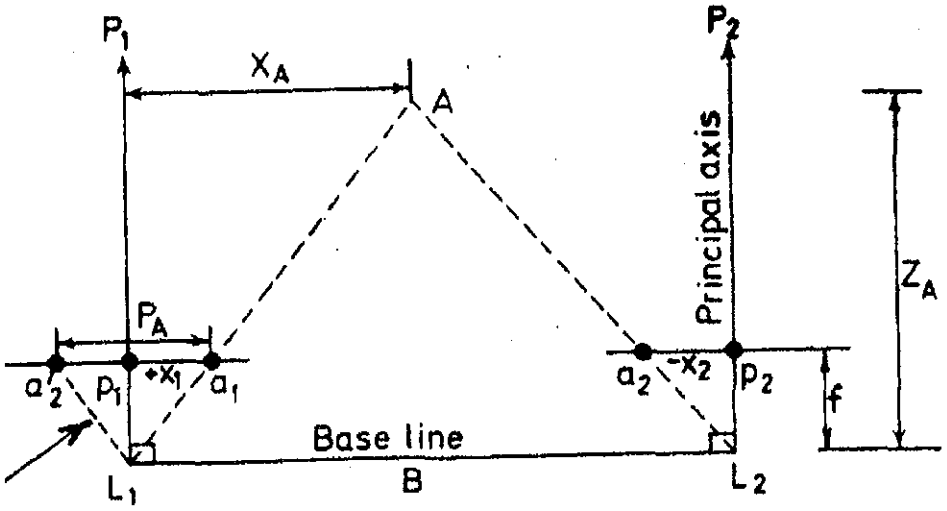


Figure 5.2

Q6)

a) Figure 6.1 shows stereoscopic photographs taken from each end of a baseline with the principal axis at 90° to the base. If the focal length is f, drive expressions for X_A, Y_A (Elevation), and Z_A. (8 MARKS)



Plan view

Figure 6.1

b) Photographs of a certain area were taken from P and Q, which were 100m apart. The focal length of the camera is 150mm. The axis of the camera makes an angle of 60^0 and 40^0 with the base at stations P and Q respectively. The image of point A appears 20.2 mm to the right and 16.4 mm above the hair lines in the photograph taken at P and 35.2 mm to the left in the photograph taken at Q [refer to (b) and (c) of figure 6.2]. Calculate the distance PA and QA and the elevation of point A, if the elevation of the instrument axis at P is 126.845 m.

(12 MARKS)

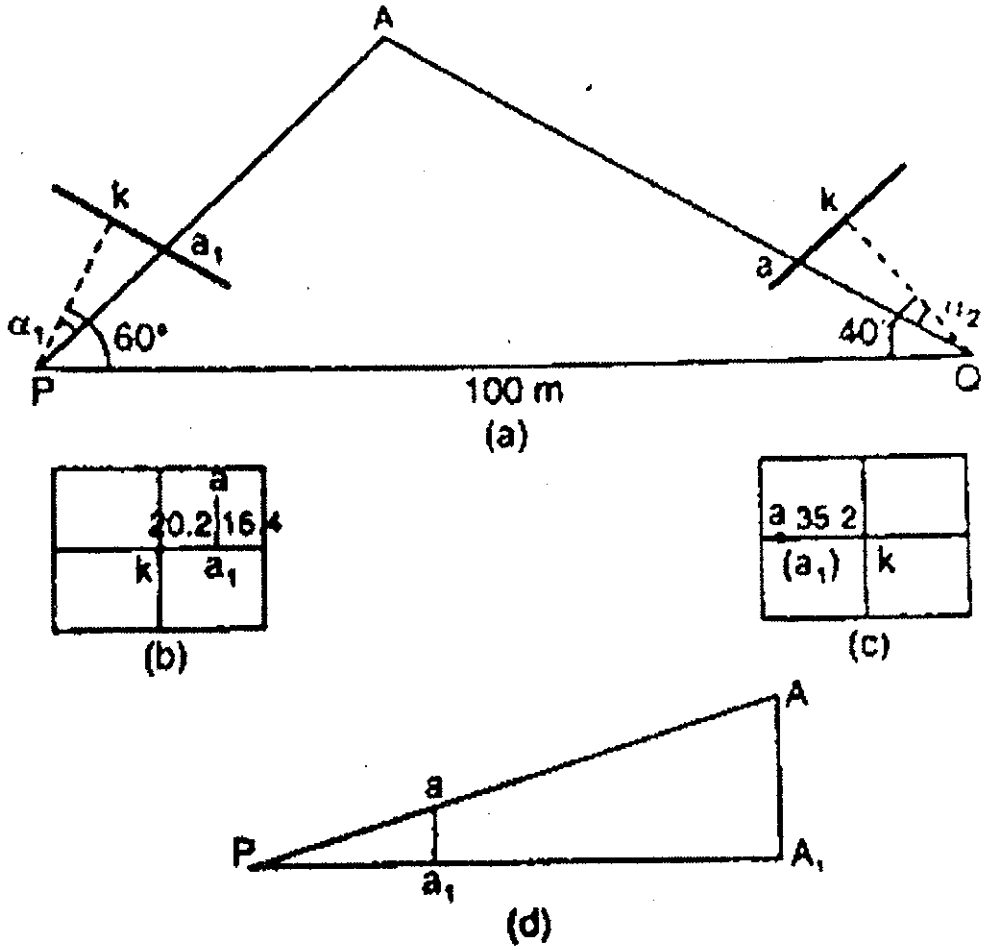


Figure 6.2