



SEAT NUMBER:

STUDENT NUMBER:

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SURNAME:
(FAMILY NAME)

OTHER NAMES:

**This paper and all materials issued must be returned at the end of the examination.
They are not to be removed from the exam centre.**

Examination Conditions:

It is your responsibility to fill out and complete your details in the space provided on all the examination material provided to you. Use the time before your examination to do so as you will not be allowed any extra time once the exam has ended.

You are **not** permitted to have on your desk or on your person any unauthorised material. This includes but not limited to:

- Mobile phones
- Smart watches and bands
- Electronic devices
- Draft paper (unless provided)
- Textbooks (unless specified)
- Notes (unless specified)

You are **not** permitted to obtain assistance by improper means or ask for help from or give help to any other person.

If you wish to **leave and be re-admitted** (including to use the toilet), you have to wait until **90 mins** has elapsed.

If you wish to **leave the exam room permanently**, you have to wait until **60 mins** has elapsed.

You are not permitted to leave your seat (including to use the toilet) during the final 15 mins.

During the examination **you must first seek permission** (by raising your hand) from a supervisor before:

- Leaving early
- Using the toilet
- Accessing your bag

Disciplinary action will be taken against you if you infringe university rules.

48320 Surveying**Time Allowed: 2 hours and 10 mins**

Includes 10 minutes of reading time.

Reading time is for reading only. You are not permitted to write, calculate or mark your paper in any way during reading time..

This is a Closed Book exam

Please refer to the permitted materials below:

Permitted materials for this exam:

- Calculators (non-programmable only)
- Drawing instruments
i.e. Rulers, Set Squares and Compasses

Materials provided for this exam:

- This examination paper

Students please note:

- Questions are NOT of equal value.
- Answer ALL questions
- A Formulae page is provided at the end of this paper

Do not open your exam paper until instructed.

Rough work space

Do not write your answers on this page.

QUESTION 1 (20 Marks)

A closed traverse was run from A via points B, C, and D, as indicated on the traverse close form below. Radiations were made from A and D to locate points X and Y. The radiation A-X is shown in the traverse table. At D, a horizontal angle of 22° 35' 30" was observed from C to Y.

Compute the traverse misclose and the proportional accuracy of the traverse. **(7 Marks)**

Without making any adjustments, calculate the coordinates of each traverse point. **(4 Marks)**

Calculate the coordinates of points X and Y. **(5 Marks)**

Calculate the bearing and distance of the line XY. **(4 Marks)**

(Please calculate the traverse close to three decimal places)

LINE	Adjusted Bearing	Horiz. Dist	Δ E		Δ N		COORDINATES		PT
			E (+)	W (-)	N (+)	S (-)	E	N	
							400.000	600.000	A
A-B	13° 09' 10"	180.494							B
B-C	97° 16' 20"	89.469							C
C-D	187° 38' 30"	189.630							D
D-A	282° 39' 20"	107.230							A
							400.000	600.000	A
A-X	327° 56' 30"	33.250							X
									D
D-Y		54.120							Y
									X
X-Y									Y

Traverse Linear Misclose Proportional Accuracy

Show coordinates of B, C, D and X and Y in the traverse table.

Bearing and distance of line X-Y

QUESTION 2 (20 Marks)

The I.P. of a falling grade of 8.5% and a rising grade of 2.5% lies at Chainage 400.0 and an R.L. of 52.135. The point 'A' on the grade line of the existing road lies at chainage 200.0, has an R.L. of 69.135, and must not be altered when a new Vertical Curve is designed.

Due to pipes under the ground, the road surface on the new vertical curve must be designed to be very close to an R.L. of 56.25, at a chainage which is 200m further along the road from Point 'A'.

a) (6 Marks) Calculate the length of vertical curve needed to **exactly meet this R.L.**

b) (10 Marks)

Please use $L = 300\text{m}$ for all further calculations.

Complete the table below, calculating and showing the TP chainages, grade levels, ordinates and Design Levels for the nominated points, adopting $L = 300\text{m}$.

c) (4 Marks) Also calculate the chainage and R.L. of the Low Point (LP) of the Curve.

Chainage	Grade	Grade Level	x	Ordinate	Design Level
'A' 200.0		69.135			69.135
TP					
300					
IP 400.0		52.135			
445					
TP					

LP					
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ANSWER

Exact length of VC needed

QUESTION 3 (20 Marks)

a) (6 Marks)

Sketch, and LABEL, in the space below, the highest THREE (3) contour lines of an imaginary landscape, which has the following features:

The land has two conical peaks which are aligned in a north-south direction.

The southern peak has an R.L. of 45m; the saddle in the gap between the two peaks has an R.L. of 25m and the R.L. of the northern peak is 35m.

The Contour Interval is to be 10m.

On the western side of the peaks, the ground fall steeply, while on the eastern side, the slope is gentle.



b) (7 Marks)

A two peg test on a level was performed as below.

The staff readings made with the level when it was in the middle of the two staffs which are 60m apart were 1.560 and 1.675.

The level was then moved to be very close to the higher staff position and the following readings noted. Close staff 1.680 and far staff 1.735.

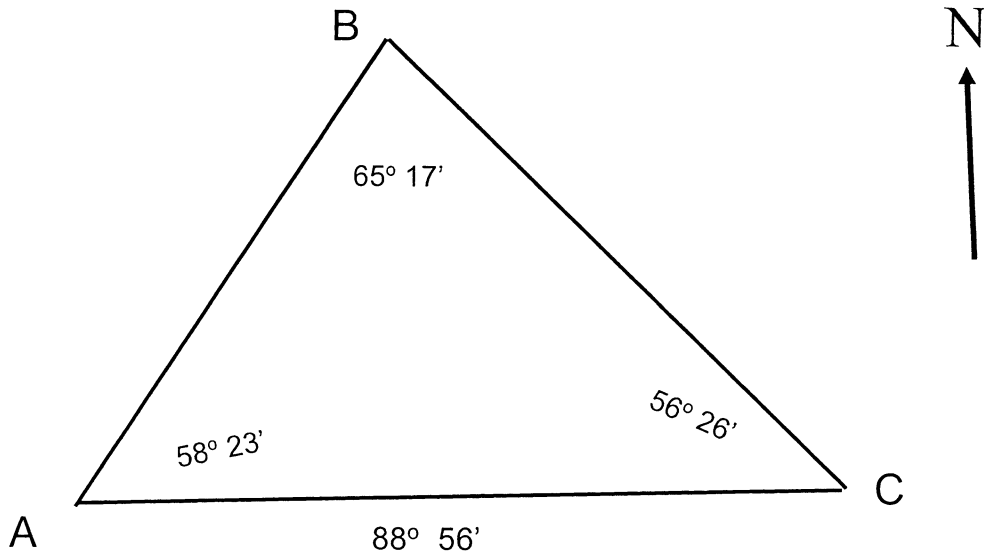
Find the true difference in height between the points and the error in the level.

True Difference in Height

Error in the level

c) (7 Marks)

Find the **adjusted** bearings for the lines AB and BC in the diagram below. The diagram is not to scale. The azimuth is line AC as shown.



Adjusted bearing of AB

Adjusted bearing of BC

QUESTION 4 (20 Marks)

Two straight rail lines intersect at point B, and are to be joined by a circular curve.

The centreline of the rails must pass through point D which is a signalling switch.

The bearing of the first line is $70^{\circ} 00' 00''$ and the bearing of the second line is $123^{\circ} 00' 00''$.

Point D is located exactly $78^{\circ} 28' 10''$ at a distance of 118.594 metres from the first tangent point.

a) (6 marks)

Calculate the exact radius for the centreline of the rails to pass through this point.

Due to construction constraints it was later decided to use a radius of 400 metres.

Use $R=400$ for all further calculations.

b) (4 marks)

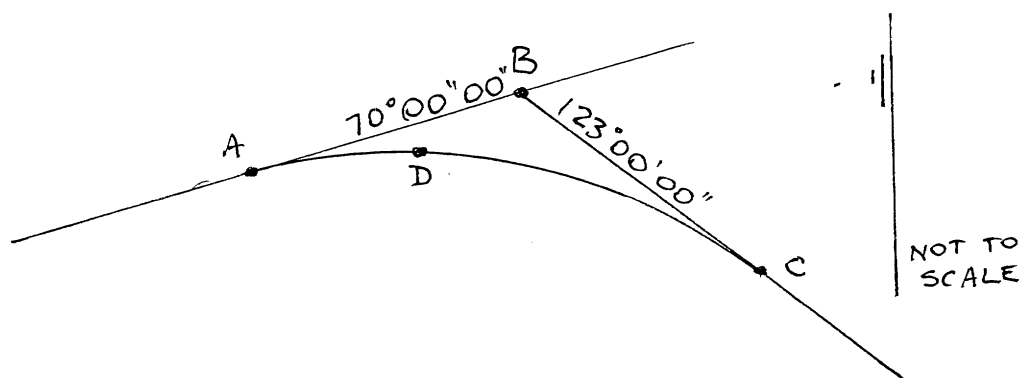
Given the chainage of the intersection point (B) is 1000 calculate the chainages of the two tangent points.

c) (5 marks)

Calculate the bearing and distance from the intersection point (B) to the mid point of the curve.

d) (5 marks)

Calculate the bearing and distance from the second tangent point to set out a point at chainage 1100.



Please put answers in the space provided on the next page

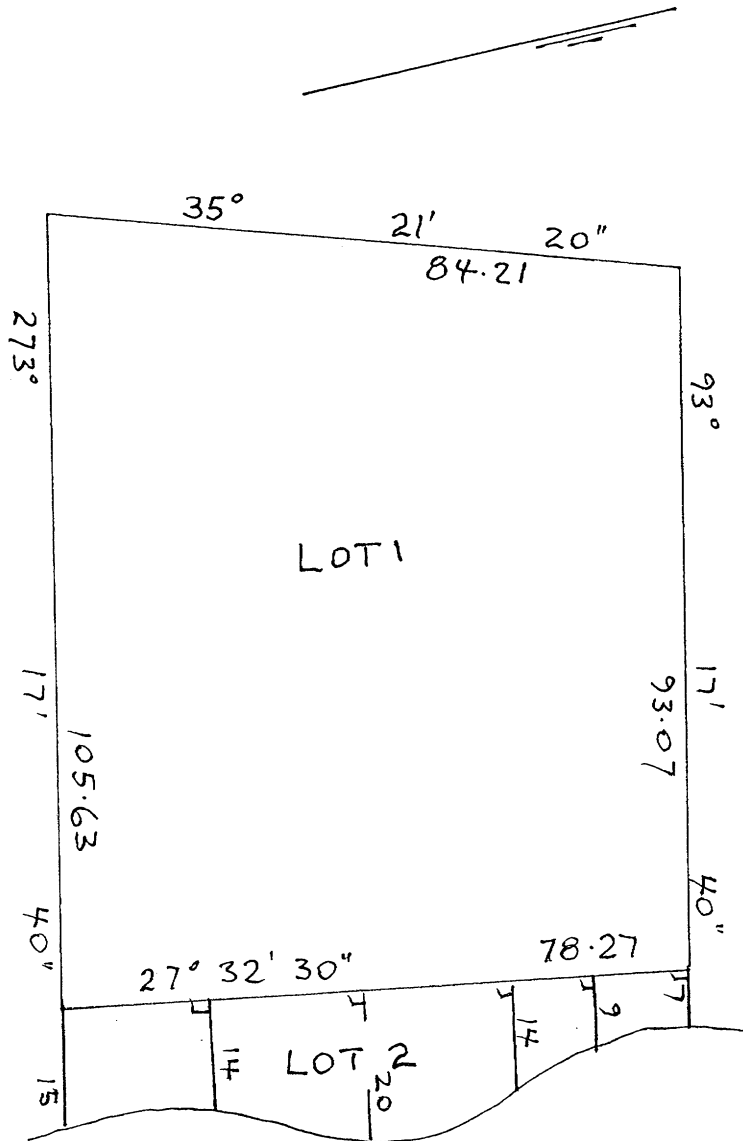
Answers:

- a) Exact radius.....
- b) Chainage of TP1..... Chainage of TP2.....
- c) Bearing and distance from B to mid point of curve.....
- d) Bearing and distance from TP 2 to Ch 1100.....

QUESTION 5 (10 Marks)

The sketch below shows a block of land which is to be consolidated (joined) with the adjoining block as shown.

- a) Calculate the area of the original blocks of land.
- b) Calculate the area of the new block of land.



Answers:

Area of Lot 1.....Area of Lot 2.....

Area of new Lot.....

QUESTION 6 (10 Marks)

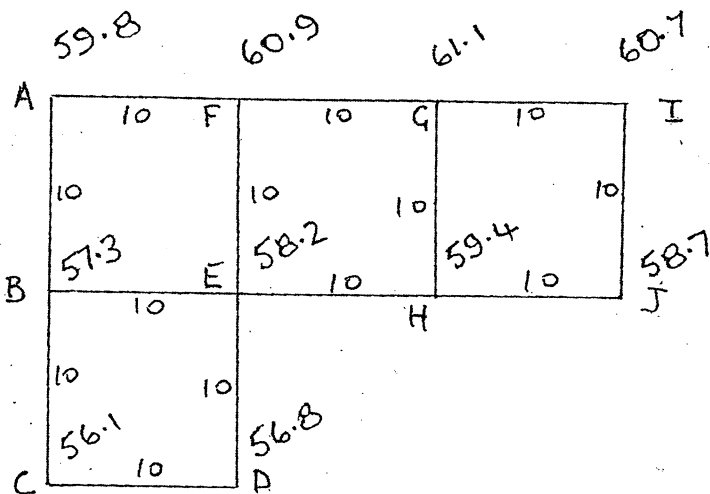
An area of land was to be filled for the construction of a villa complex. A grid was levelled over the site as shown below in the diagram.

The finished level of the line A - I is to be at RL 60.0 and then rise at a grade of 4% to the lines EJ and CD.

Any material cut from the site will be re-used as fill.

The perimeter sides of the site are to be vertical.

- a) (3 Marks) Show on the diagram, the excavation/fill at each grid point. (Show cut as –ve).
- b) (4 Marks) Calculate the nett volume of material that will have to be brought to the site.
- c) (3 Marks) It was later realised that the RL of the line A - I had to be raised by 1 metre due to drainage problems on the site. The grade from that line remained unchanged. Calculate the change in the volume that this had on the original estimate.



Answers:

Nett Volume.....

Change in Volume.....

SURVEYING FORMULAE SHEET

$$OM = \frac{L.(G_2 - G_1)}{800}$$

$$PQ = \frac{4.x^2.OM}{L^2}$$

$$d = \left(\frac{G_1}{G_1 - G_2} \right) . L$$

$$\text{Tangent Distance} = R . \tan \left(\frac{\Delta}{2} \right)$$

$$\text{Secant Distance} = R . \sec \left(\frac{\Delta}{2} \right)$$

$$\text{External Distance} = R \left(\sec \frac{\Delta}{2} - 1 \right)$$

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

$$\text{Chord} = 2 . R . \sin \frac{\Delta}{2}$$

$$\text{Arc} = R . \Theta^{\text{rad}}$$

$$\text{Arc} = R . \Theta^{\text{deg}} . \frac{\pi}{180}$$

$$\delta = \frac{\text{arc}}{2.R} \times \frac{180}{\pi}$$

$$\text{Chord} = 2 . R . \sin \delta$$

$$y_0 = R - \sqrt{R^2 - (c/2)^2}$$

$$y_1 = y_0 - \left[R - \sqrt{R^2 - x^2} \right]$$

$$\text{Grade} = \frac{\Delta h}{\text{Hor. Dist.}} \times \frac{100}{1}$$

$$\text{Area} = \pi . R^2$$

$$\text{Sector} = \frac{1}{2} . R^2 . \Theta$$

$$\text{Segment} = \frac{1}{2} . R^2 (\Theta - \sin \Theta)$$

$$\text{Area} = \frac{1}{2} . (N_1 . E_2 + N_2 . E_3 + \dots + N_N . E_1) - (E_1 . N_2 + E_2 . N_3 + \dots + E_N . N_1)$$

$$\text{Volume} = \frac{w}{2} . (A_1 + 2 . A_2 + 2 . A_3 + \dots + 2 . A_{n-1} + A_n)$$

$$\text{Volume} = \frac{\text{Area}}{4} . \left(\sum d_1 + \sum 2 . d_2 + \sum 3 . d_3 + \sum 4 . d_4 \right)$$