



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
- 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.

You are **not** permitted to leave your seat (including to use the toilet):

- Until 90 mins has elapsed
- During the final 15 mins

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

- Leaving early (after 90 mins)
- Using the toilet
- Accessing your bag

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

48320 Surveying

Tuesday 11 November 2014. 9:30am – 12:40pm

Time Allowed: 3 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
- Attempt ALL questions
- Write the answers in the spaces provided on this paper

Do not open your exam paper until instructed.

Rough work space

Do not write your answers on this page.

QUESTION 1 (8 Marks)

Calculate the radiation needed to set out the corner of a house from a known point 'SSM 1'.

The coordinates of the house corner are 986.325 mE, 952.760 m N.

The coordinates of 'SSM 1' are 745.655 mE, 1124.535 mN.

The azimuth from 'SSM 1' to 'SSM 2' to do the set out is known to be $345^{\circ} 15' 30''$.

Calculate the horizontal angle needed to be turned off after sighting to SSM 2 as azimuth to mark out the corner of the house.

Radiation from SSM 1 to corner of house

Horizontal angle to be turned off

.....

QUESTION 2 (14 Marks)

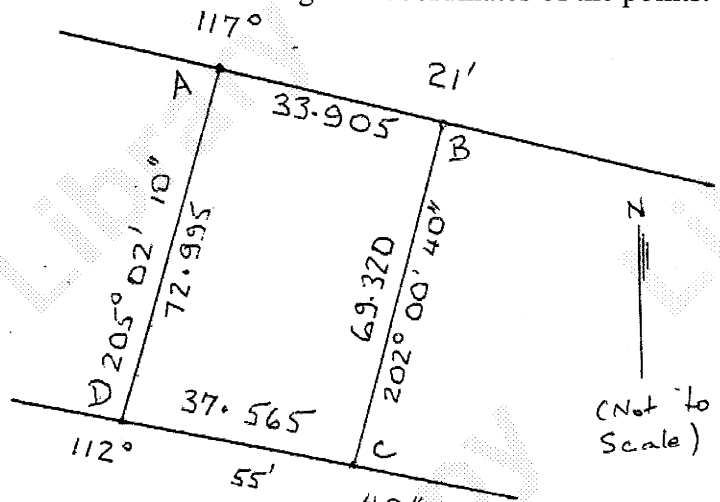
Check measurements were made by step chaining between four pegs A, B, C and D thought to be at the corners of a block of land. They are noted on the field sketch below where the bearings have been taken from the original subdivision plan.

i) Calculate the misclose and the coordinates of the points. **(6 Marks)**

LINE	Adjusted Bearing	Horiz. Dist	Δ E		Δ N		CO-ORD INATES		P T.
			E (+)	W (-)	N (+)	S(-)	E	N	
							1000.000	1000.000	A
A-B									B
B-C									C
C-D									D
D-A									A

It was then realised that a 1m error must have been made in one of the measurements. The original data was known to have a proportional accuracy that would be acceptable for subdivision (boundary) surveys.

ii) Find the line where the error was made, **(3 Marks)** the corrected distance **(1 Mark)** and the proportional accuracy of the close **(4 Marks)**. There is no need to change the coordinates of the points.



Original Traverse Misclose
 1m error made in line Corrected Distance is
 Proportional Accuracy, after the correction, is

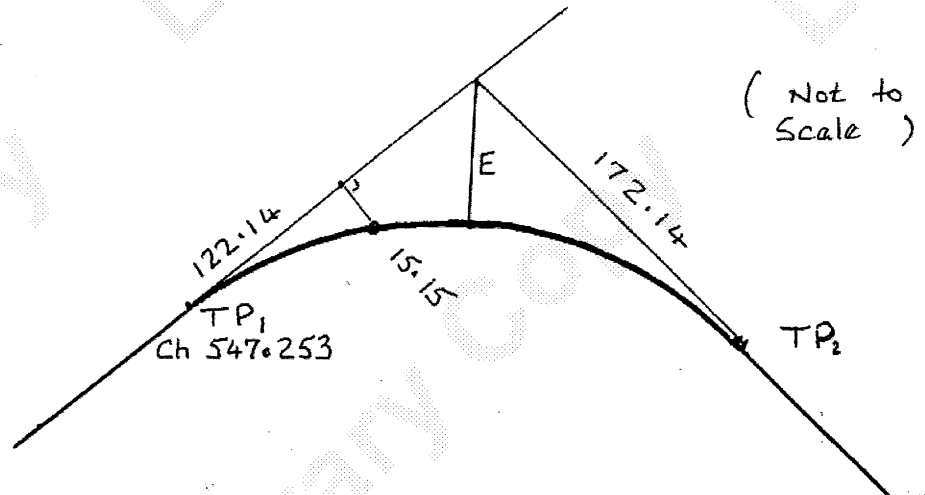
QUESTION 3 (17 Marks)

Calculate the EXACT Radius of the horizontal curve, which has a tangent length of 172.14 m and which passes through a point which is offset by 15.15m from the tangent at a distance of 122.14 m from the tangent point. (See diagram below)

FOR ALL FURTHER CALCULATIONS, PLEASE USE $R = 500.00$ m.

Calculate:

- i) the deflection angle for the curve.
- ii) the distance E shown on the diagram,
- iii) the chainage of TP_2 given that the chainage of TP_1 is 547.253
- iv) the deflection angle and chord to set out a point at chainage 780.00 from TP_1



- Exact Radius (6 Marks)
- Deflection Angle for the Curve (2 Marks)
- Distance E as shown on the diagram (2 Marks)
- Chainage of TP_2 (3 Marks)
- Set out of 780; Defln Angle (2 Marks) Chord (2 Mks)

QUESTION 4 (10 Marks)

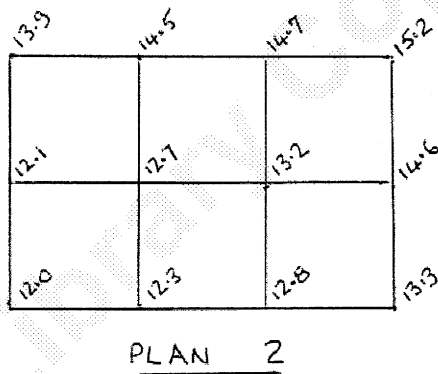
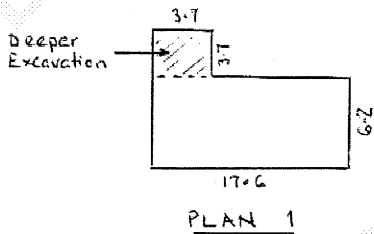
Excavation work was undertaken on the UTS site (30m x 20m) for the Library extension. (See photo below). The sides of the excavation are vertical and all parts of the base are horizontal. There is a deeper excavation consisting of two parts in the middle of the site. (Shown in lower right of photo). It is a



rectangular L shape and its dimensions are shown on sketch plan (1) below.

The R.L. of the bottom of the main excavation is 3.4m. The larger section of the deeper part is 2.7m below the base of the main excavation and the smaller part is 5.1m lower than the main excavation. Sketch plan (2) below shows a 10m x 10m grid of Reduced Levels taken at ground level before any excavation commenced.

Calculate the amount of material that had to be removed from the site.



- Volume to be removed to base of main excavation (6 Mks)
- Volume to be removed for the deeper section (both parts) (3 Mks)
- Total volume removed from site (1 Mk)

QUESTION 5 (14 Marks)

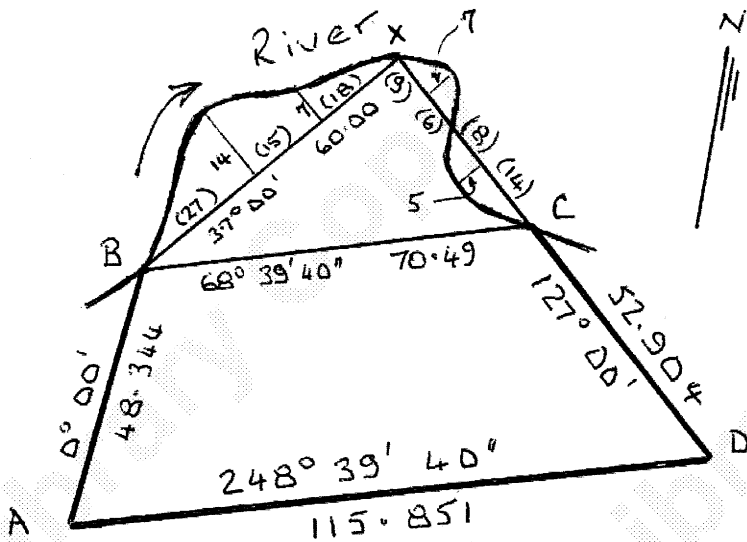
A block of land in the sketch plan below is bounded by straight lines connecting points C, D, A and B, and then the irregular river bank, as shown by the thick line.

The area of the block of land has to be found as the block is to be sold and a price per m² used.

To do this, the line DC was extended along the same bearing to point X, a distance of 37.0m. The line XB was then measured as shown. From each of those traverse lines, offsets were taken to the river bank, as shown.

Determine the total area of the block (1 Mark) by calculating:

- a) (4 Marks) the area within the regular shape comprised of the straight lines connecting A B C and D,
 - b) (3 Marks) the area within the triangle B C X, and
 - c) (6 Marks) the 'offset' area between the lines BX, XC and the river bank. Use the trapezoidal area.
- The numbers shown in brackets are the distances along each traverse line.



- Area within straight lines A B C D
- Area within straight lines B X C
- Area of 'offset' land
- Total area available for sale

QUESTION 6 (17 Marks)

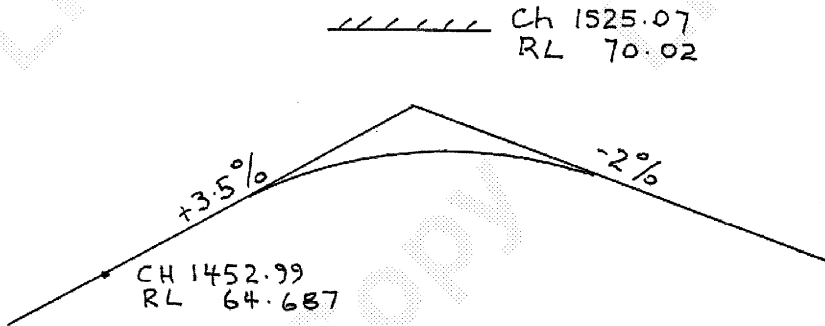
An existing road is rising at a grade of 3.5% and is to be joined to meet a falling grade of -2%. The grades need to meet at Chainage 1525.07, where there is an existing bridge. The underside of the bridge has a Reduced Level of 70.02. The new road is to have a clearance of exactly 3.5 metres below the bridge. At chainage 1452.99 the Reduced Level of the existing road is 64.687.

a) (5 Marks) Calculate the exact length of the curve to meet this clearance.

For other design reasons a curve of exactly 100 metres was decided to be used. Use this length for all further calculations.

b) (4 Marks) Calculate the position and Reduced Level of the highest point on the curve.

c) (4 Marks) Calculate the Reduced Level of the new road at chainage 1500, and chainage 1600.



Exact length of curve.....
 Chainage of High point.....Reduced Level of road at High Point.....
 Reduced level of road at chainage 1500.....
 Reduced level of road at chainage 1600.....

QUESTION 7 (20 Marks)

a) (3 marks)

List three differences between “original” total stations and the most modern instruments.

- 1.
- 2.
- 3.

b) (3 marks)

List three uses of contours which are derived from a survey plan.

- 1.
- 2.
- 3.

c) (6 marks)

A building has accidentally been built so that part of the building encroaches onto the neighbouring land. List three ways that this encroachment can be legally remedied

- 1.
.....
- 2.
.....
- 3.
.....

d) (3 marks)

Briefly list the difference between an optical level and a digital level.

-
-
-

e) (3 marks)

List three different examples of Cadastral Surveys.

- 1.
- 2.
- 3.

f) (2 marks)

On an inner city construction site at what stages would an Identification Survey be carried out?

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SURVEYING FORMULAE SHEET

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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