Autumn 2017 – **Main Exam**

UTS
UNIVERSITY OF TECHNOLOGY SYDNEY

SEAT NUMBER:

STUDENT NUMBER:

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.

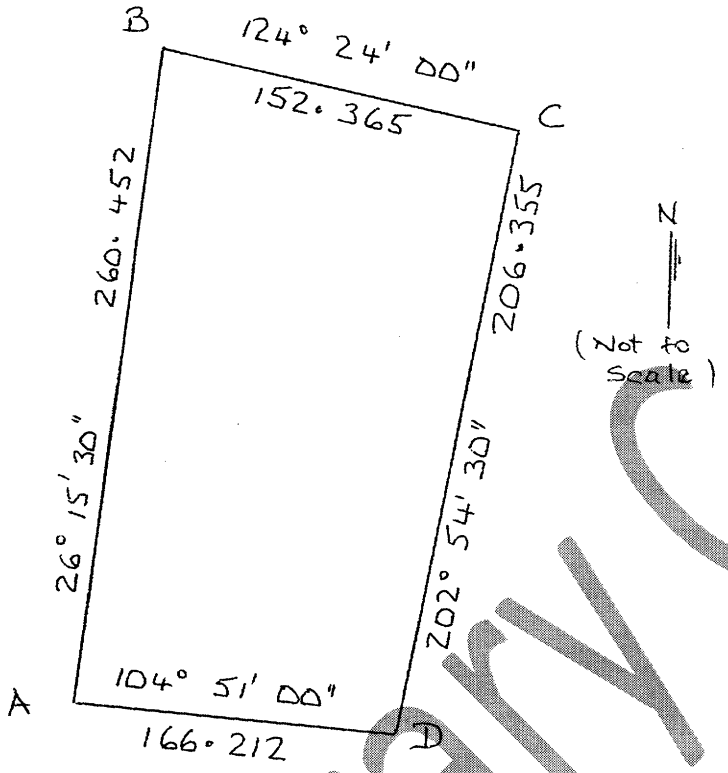
Rough work space
Do **not** write your answers on this page.

QUESTION 1 (10 Marks)

A closed traverse was run from A via B, C and D and closing to A. A sketch plan of the traverse showing adjusted bearings and horizontal distances is shown below.

Complete the traverse close using the table below. (4 Marks)

Calculate the misclose and the proportional accuracy of the traverse. (6 Marks)
Do NOT find the coordinates of the points.



LINE	Bearing	Dist	Δ E		Δ N	
			E (+)	W (-)	N (+)	S(-)
A-B						
B-C						
C-D						
D-A						

ANSWERS

Traverse Misclose .....

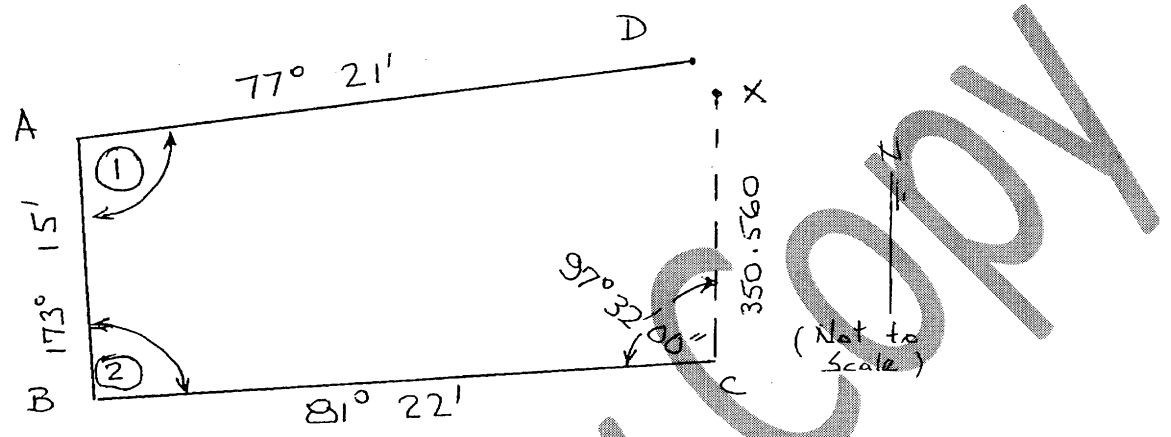
Proportional Accuracy of the traverse. .....

QUESTION 2 (12 Marks)

The bearings of three of the boundaries of a property A, B C, D are shown in the figure below.
The coordinates of point C are 762.186m E 451.311m N
The coordinates of point D are 752.350m E 810.255m N

A theodolite was set up at point C and a horizontal angle of 97° 32' 00" was observed from B to X as shown. The horizontal distance from C to X was found to be 350.560m.

a) **Calculate the coordinates of point X and show them in the traverse table. (4 Marks)**
b) **Calculate the bearing and distance from X to D (4 Marks)**
c) **Calculate the size of the angles marked 1 and 2 on the diagram. (4 Marks)**



LINE	Bearing	Horiz. Dist	Δ E		Δ N		CO-ORD INATES		PT.
			E (+)	W (-)	N (+)	S(-)	E	N	
							762.186	451.311	C
C X									X

ANSWERS

a) Coordinates of X will be in the traverse table.

b) Bearing and Distance from X to D .....

c) Angle (1) (at A) ..... Angle at (2) (at B) .....

QUESTION 3 (20 Marks)

A road bridge which is part of a vertical curve is to be built over a wide river with a rising grade of +4.3% meeting a falling grade of – 3.7%.

The second Tangent Point of the vertical curve is fixed at Chainage 850.00 and R.L. 25.650.

The High Point of the vertical curve must be over the middle of the river which is close to chainage 619.

a) **Calculate the exact length of vertical curve that would have its highest point at chainage 619. (6 Marks)**

FOR ALL FURTHER CALCULATIONS USE L = 500.00m.

The second tangent must remain at CH 850.00.

b) **Calculate and show in the table below the chainages of TP_1 and the IP. (2 Marks)**

c) **Calculate the Design RLs for the other chainages shown in the table below. (7 Marks)**

d) **Calculate the exact chainage of the High Point on the curve. (2 Marks)**

e) **Calculate the clearance of the bridge over the water in the river at its highest point if the highest RL of the river is believed to be 21.0. (3 Marks)**

CHAINAGE	GRADE	GRADE LEVEL	ORDINATE	DESIGN R.L.
T.P.$_1$				
500				
IP				
High Pt				
800				
T.P.$_2$ 850.00		25.650		

ANSWERS

a) **Exact** length of Vertical Curve .....

b) Chainages of TP_1 and IP need to be in the table.

c) Design R.L.s need to be in the table.

d) Exact chainage of the highest point for L=500 needs to be in the table.

e) Clearance of the high point over the water. .....

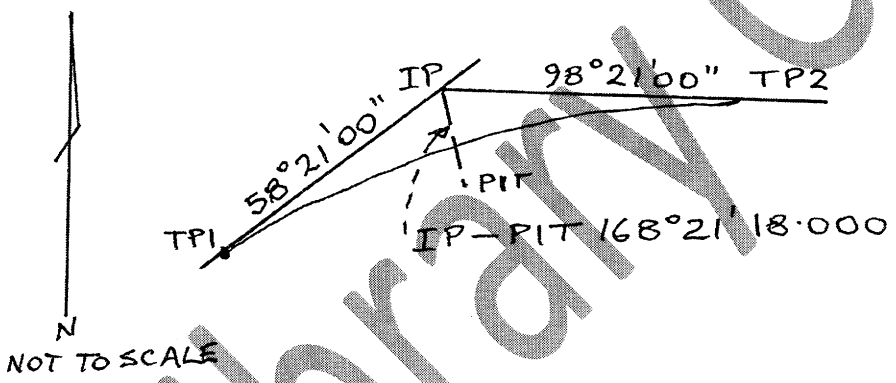
QUESTION 4 (20 Marks)

During construction of the light rail two straights are to be connected by a circular curve, as shown in the diagram below.
In order to avoid damage to a drainage pit the centreline of the road MUST be exactly 1.7 metres from the pit at the mid-point of the curve.
The bearings of the straights of the road, and the bearing and distance from the intersection of the straights to the pit are shown on the sketch below.
a) Calculate the exact length (to three decimal places of a metre) to meet this condition. (8 marks)

IT WAS THEN DECIDED TO USE A CURVE OF EXACTLY 250 RADIUS.
FOR ALL FOLLOWING CALCULATIONS USE R=250.

b) In the table below, show the bearings and distances from the first tangent point to set out points A and B which are 100 metres and 200 metres respectively from the first tangent point. (6 marks)

c) If the chainage of the intersection point is 1200, calculate the chainages of the first and second tangent points. (6 marks)



Answers:

a) Exact length of curve:_____

b) Information to set out A and B from TP1

POINT	BEARING	DISTANCE
A		
B		

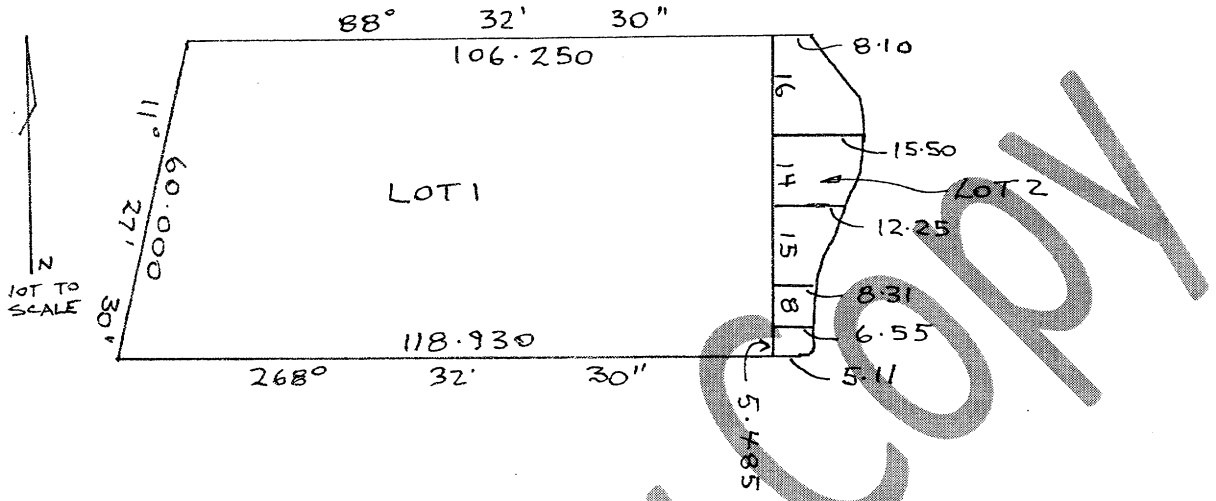
c) Chainage of TP1_____ Chainage of TP2_____

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. (8 marks)

b) Calculate the area of the new block of land. (2 marks)



Answers:

a) Area of Lot 1.....Area of Lot 2.....

b) Area of new Lot.....

QUESTION 6 (10 Marks)

An area of land was to be excavated for the construction of a swimming complex.
Natural surface levels were observed in a 10 metres grid pattern over the site as shown below in the diagram. These natural surface levels are shown in table 1 below.

The finished levels of the areas are shown in table 2 below.

The perimeter sides of each area of the site are to be vertical.

a) (3 Marks) Show in the table the excavation at each grid point.

b) (4 Marks) Calculate the nett volume of material that will have to be excavated.

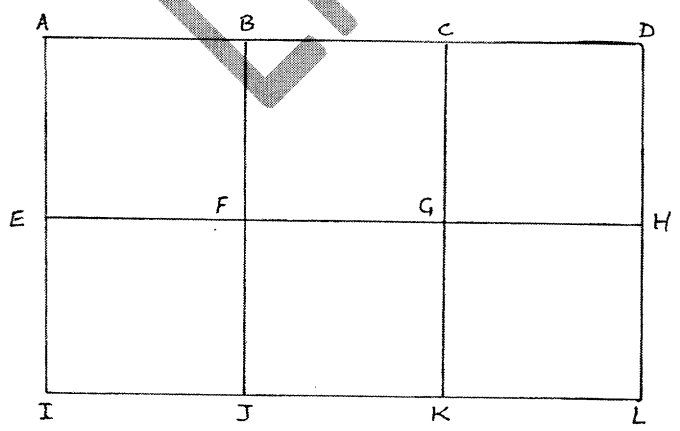
c) (3 Marks) It was later necessary to lower the base of the entire site by 0.5 metres. What is the additional volume of excavation required?

TABLE 1

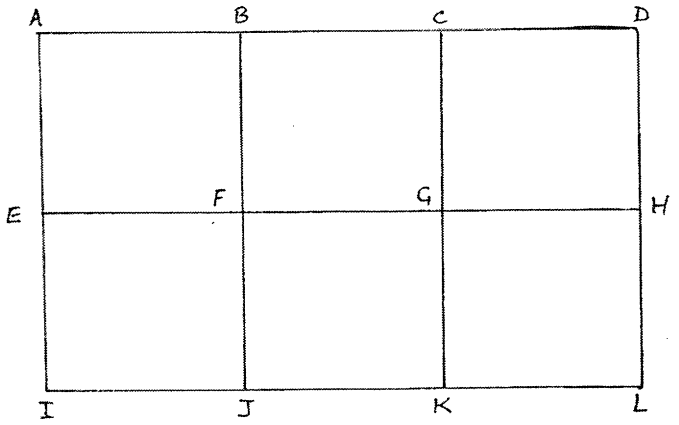
POINT	NATURAL SURFACE LEVEL	DEPTH OF EXCAVATION
A	30.2	
B	31.5	
C	32.8	
D	33.1	
E	30.5	
F	32.1	
G	33.0	
H	33.5	
I	31.2	
J	33.0	
K	33.5	
L	34.1	

TABLE 2

AREA	FINISHED SURFACE LEVEL
A-B-J-I	28.5
B-C-K-J	29.5
C-D-L-K	30.5



Continued on next page



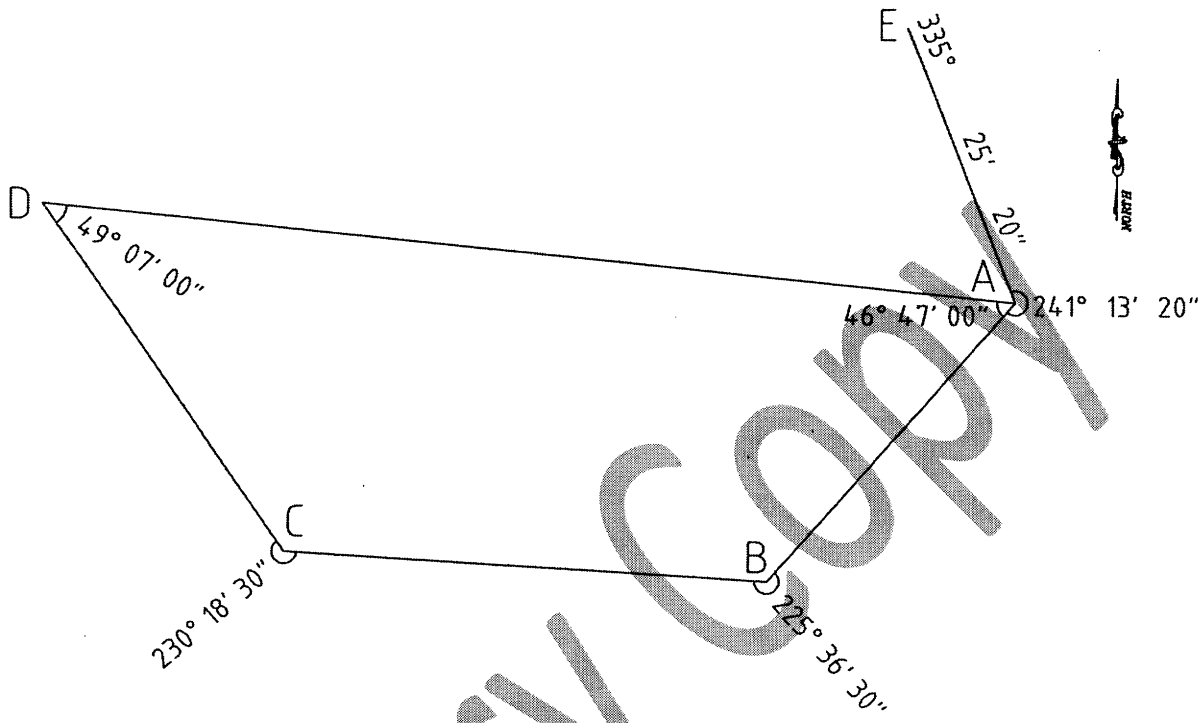
ANSWERS:

Total excavated volume :_____

Additional excavation volume: _____

QUESTION 7 (18 Marks)

A theodolite was set up at point A on the sketch below.
Zero (Azimuth) was set to point E and the angle EAB measured.
Subsequently the remaining angles shown on the sketch were measured.
The bearing of the line from A to E was determined from a previous survey to be 335^0 25' 20".



a) CALCULATE the bearing of the line A – B from the angle shown. (6 marks)

b) CALCULATE the angular misclose of the traverse. (3 marks)

b) CALCULATE the adjusted bearings of the lines in the traverse. (9 marks)

Answers:

a) Bearing of line A – B.....

b) Angular Misclose.....

c) Bearings: B – C..... C – D.....

D – A.....

SURVEYING FORMULAE SHEET

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$Area = \pi.R^2$$

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

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

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

$$Volume = \frac{w}{2}.(A_1 + 2.A_2 + 2.A_3 + ... + 2.\text{A}_{n-1} + \text{A}_n)$$

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