Cover Type B

University of Technology, Sydney

TO BE RETURNED AT THE END OF THE EXAMINATION.
THIS PAPER MUST NOT BE REMOVED FROM THE EXAM CENTRE.

SURNAME: _____

FIRST NAME: _____

STUDENT NUMBER: _____

COURSE: _____

SPRING SEMESTER, 2013

SUBJECT NAME: SURVEYING

SUBJECT NO.: 48320

DAY/DATE: THURSDAY 14 NOVEMBER 2013

TIME ALLOWED: THREE Hours plus TEN Mins reading time

START/END TIME: 9:30 am - 12:40 pm

NOTES/INSTRUCTIONS TO CANDIDATES:

Attempt ALL questions.
Write the answers in the spaces provided.
The questions are NOT of equal value. Marks for each part are shown adjacent to that part of a question.
THIS IS A CLOSED BOOK EXAM.
NON Programmable Calculators ONLY and drawing instruments are allowed.
Formulae are provided at the end of the examination paper.
All of the diagrams are sketches for illustrative purposes and are not to scale.
If not enough room has been provided for calculations or written answers, please use the back of adjacent pages and note this fact, so the marker can see your complete answer or working.

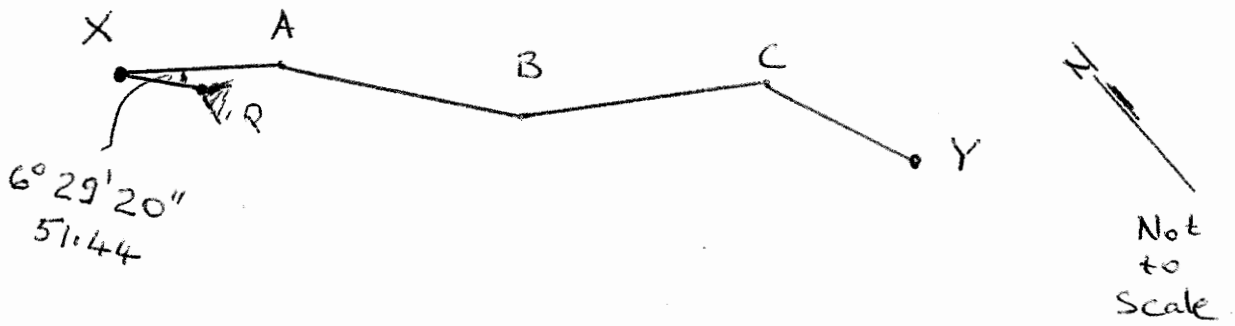
QUESTION 1 (20 Marks)

A four line traverse was run from one coordinated point X to a second coordinated point Y, as shown in the diagram below. The adjusted bearings and horizontal distances are shown in the traverse table.

The coordinates of point X are 300.000 m E, 700.000 m N
The coordinates of point Y are 663.577 m E, 321.855 m N

A radiation was made at point X and the angle from the line XA and the distance XP to the corner of a building P was made as shown in the sketch below.

a) Complete the traverse table to find the traverse misclose and its proportional accuracy. **(8 Marks)**
b) Calculate the bearing and distance of the line XY. **(4 Marks)**
c) Calculate the coordinates of P, using the traverse table below. **(4 Marks)**
d) Calculate how far point P is square off the line XY. Also state if P lies to the left or right hand side of the line XY. **(4 Marks)**



LINE	Adjusted Bearing	Horiz. Dist	Δ E		Δ N		CO-ORD INATES		PT.
			E (+)	W (-)	N (+)	S(-)	E	N	
							300.000	700.000	X
X-A	130 - 45 - 00	100.235							A
A-B	141 – 15 - 30	152.870							B
B-C	129 – 52 - 00	157.355							C
C-Y	142 – 27 - 30	116.780							Y
							300.000	700.000	X
X-P									P

Traverse Linear Misclose ..... Proportional Accuracy .....
Show coordinates of A, B, C, Y and P in the traverse table above. (Please do all calculations to three (3) decimal places)

Bearing and distance of line XY .....

Square off distance of P from XY = ... on the ..... side of XY.

P.T.O.

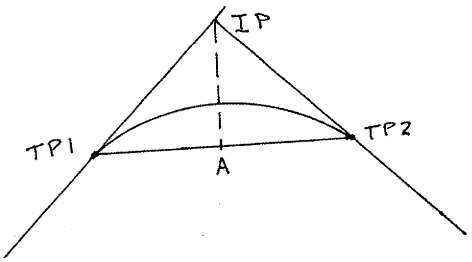
QUESTION 2 (22 Marks)

A horizontal (circular) curve had been marked ready for construction but all the pegs except for those at the I.P. and the mid point of the long chord 'A' had been lost due to bush fires.

The total deflection angle for the curve is 51° 41' 00" and the distance between the two pegs was measured as 31.6m.

Calculate:

a) **(6 Marks)** The exact radius of the curve to three (3) decimal places based on the given data. **FOR ALL FURTHER CALCULATIONS, PLEASE USE R = 150.0 m.**
b) **(2 Marks)** The distance from 'A' to the first T.P.
c) **(4 Marks)** The chainage of the second T.P., given that the chainage of the I.P is 562.355.
d) **(2 Marks)** The distance from 'A' to the crown of the curve.
e) **(6 Marks)** The deflection angles and long chords that would be needed to set out points at chainages 500 and 520, from the first T.P.
f) **(2 Marks)** The length of the short chord between 500 and 520 so that the set out could be checked.



Point to be pegged	Arc Length	δ_i	δ_T	Chord
First T.P.				
500				
520				

ANSWERS

a) Exact Radius calculated from given data .....

b) Distance from 'A' to T.P. 1 .....

c) Chainage of T.P. 2 .....

d) Distance from 'A' to the crown of the curve .....

e) Please show Deflection Angles and Long Chords in the table above.

f) Short Chord between marks placed at 500 and 520 .....

P.T.O.

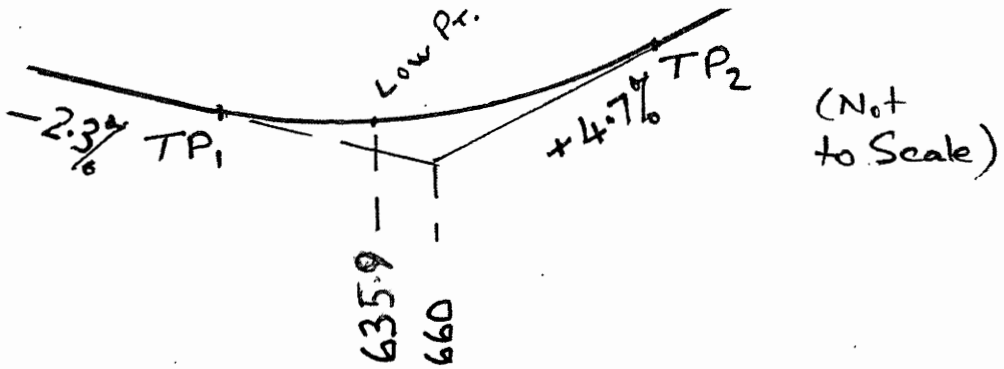
QUESTION 3 (18 Marks)
A vertical curve is to be designed on a road, to join a falling grade of 2.3 % to a rising grade of 4.7%. The Low Point on the curve MUST OCCUR at chainage 635.90 and the Intersection Point is fixed at chainage 660.0m and an R.L. of 47.250m.

a) Calculate the EXACT length of the vertical curve to meet the above requirements. **(8 Marks).** **For the rest of the calculations please adopt 140.0m and continue.**

b) Calculate the chainages and R.L.s of T.P.1 and T.P. 2 and place them into the table below. **(4 Marks)**

c) Complete the table below calculating the grade levels, ordinates and design levels at ALL the points nominated on the table, including T.P.1 and T.P. 2. **(6 Marks)**

Chainage	Grade	Grade Level	x	Ordinate	Design Level
T.P.1					
610					
I.P. 660.0		47.250			
690					
T.P. 2					



ANSWERS
a) Exact length of vertical curve .....

b) Enter chainages and R.L.s of T.P.1 and T.P. 2 into the table.

c) Complete other values in the table.

P.T.O.

QUESTION 4 (10 Marks)

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

The area of the block of land has to be found.

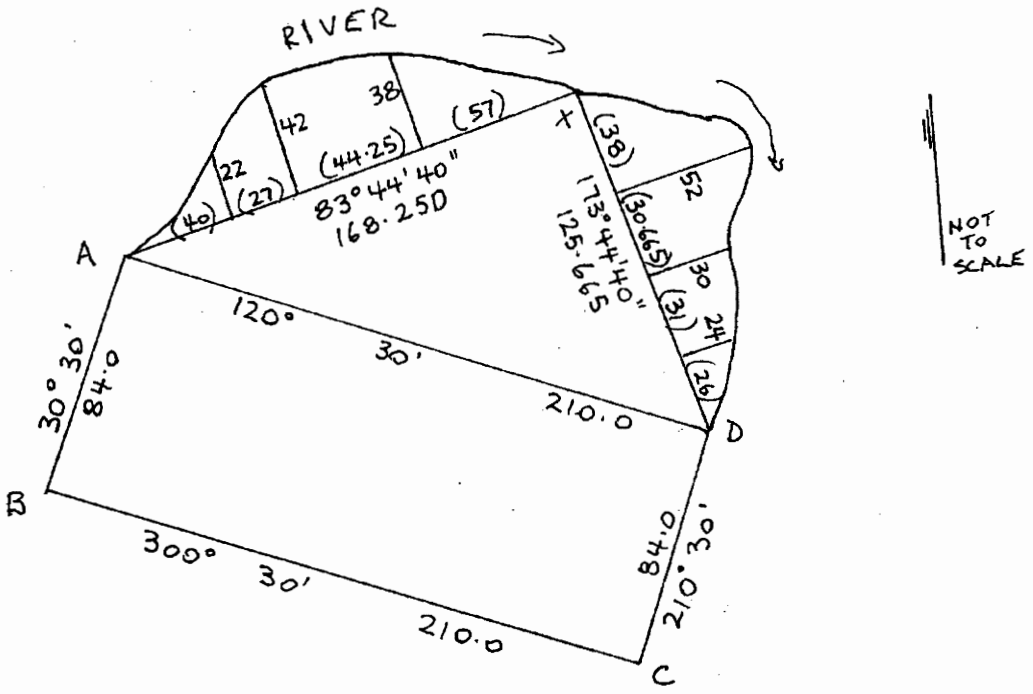
To do this, two survey lines were run from A to D via X and offsets measured from each of those lines to the river bank at appropriate points, as shown.

Determine the total area of Lot 1 **(1 Mark)** by calculating

a) **(2 Marks)** the area within the regular shape comprised of the straight lines connecting A B C and D,

b) **(2 Marks)** the area within the triangle A D X, and

c) **(5 Marks)** use the trapezoidal rule to calculate the 'offset' area between the lines AX, XD and the river bank.



ANSWERS

a) Area inside lines A B C D .....

b) Area inside A D X .....

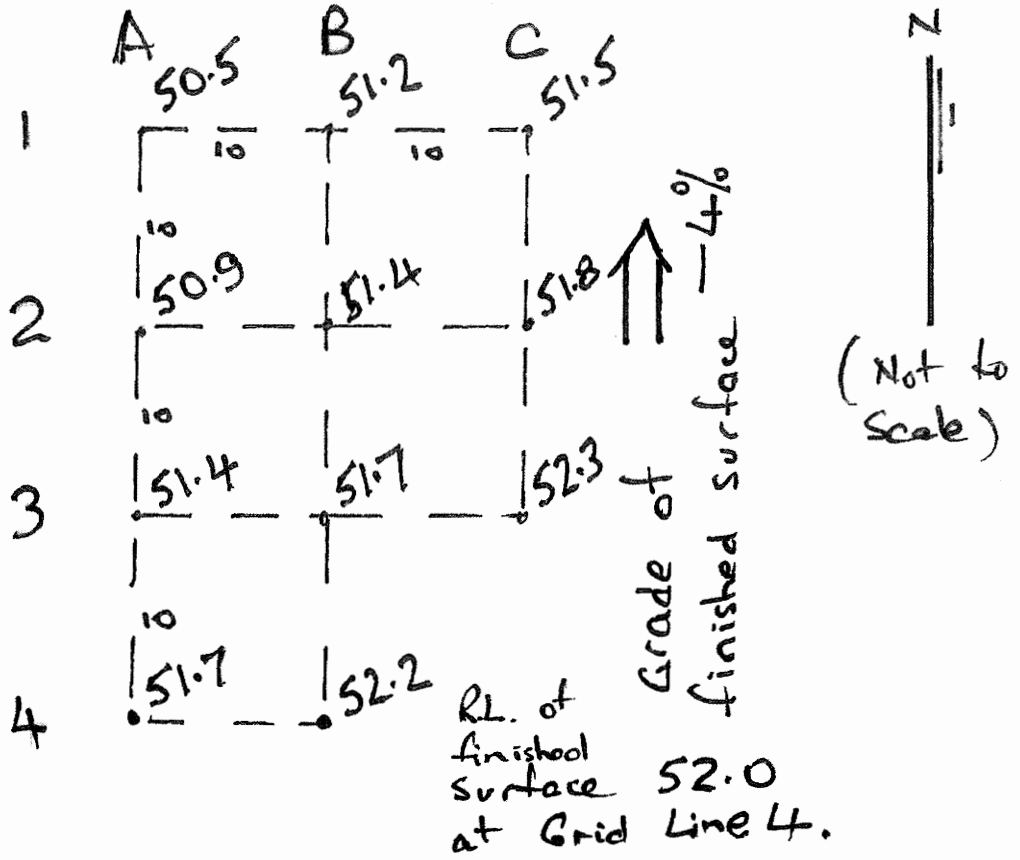
c) Offset area .....

d) Total area of land .....

P.T.O.

QUESTION 5 (10 Marks)
The grid below was levelled for a proposed car park. The perimeter sides will be vertical. The base of the excavation is to have a 4% grade falling to the north, with the finished (excavated) R.L. at Grid Line 4 being 52.0. Each grid square is 10.0m by 10.0m.

a) **(2 Marks)** Calculate the finished (excavation) level at each of the grid lines 3, 2 and 1.
b) **(2 Marks)** Show on the diagram the depth of excavation at each grid point.
c) **(6 Marks)** Calculate the NET volume of material that will have to be removed from the site after it has been graded to the required levels.



ANSWERS
a) Excavation R.L. Grid Line 3 ..... Excavation R.L. Grid Line 2 .....

Excavation R.L. Grid Line 1 .....

c) Net volume to be removed from site .....

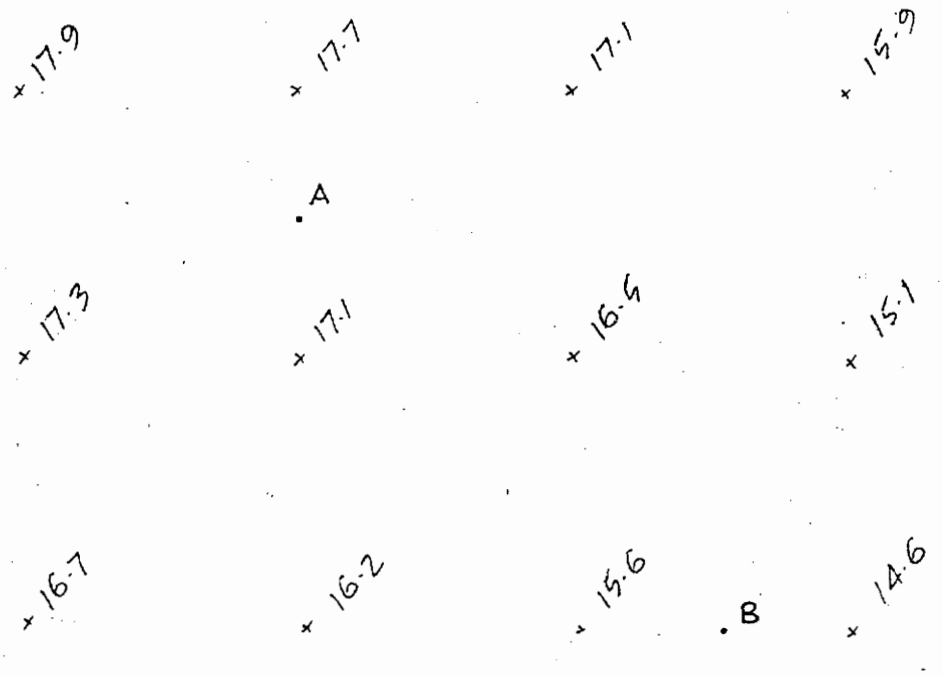
P.T.O.

QUESTION 6 (20 Marks)

a) (4 Marks)

i) (2 marks) Sketch on the plan the 16 metre contour.

ii) (2 marks) If the distance from A to B is 46 metres, calculate the grade of the line from A to B. You may scale on this plan.



Grade A –B .....%

b) (2 Marks) Who are the only people allowed, by law, to undertake cadastral surveys and what are Cadastral Surveys?

P.T.O.

c) **(2 Marks)**
List two modern developments in Electromagnetic Distance Measurement instruments.

d) (3 Marks) Briefly explain how Surveyors use GPS readings to get very accurate coordinates (centimetre precision) for control surveys when the GPS readings, by themselves have numerous errors and may only give coordinates to the nearest metre.

SURVEYING FORMULAE SHEET

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

P.T.O.

$C_{slope} = -L \times (1 - \cos\beta)$

$C_{slope} = -\left[\frac{\Delta h^2}{2L_m} + \frac{\Delta h^4}{8L_m^3}\right]$

$C_{temp} = \pm L \times \alpha \times (\Delta t)$

$\alpha_{steel} = 11.2 \times 10^{-6}/^0C$

$C_{sag} = -\frac{w^2 \times L^3}{24 \times T^2} \times \cos^2\beta$

$Grade = \frac{\Delta h}{HorDist.} \times 100$

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

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

$PQ = \left(\frac{G_2 - G_1}{200L}\right) \times x^2$

$x = \left(\frac{G_1}{G_1 - G_2}\right) \times L$

$H = 100 \times s \times \cos^2\theta$

$V = 100 \times s \times \sin\theta \times \cos\theta$

$RL_S = RL_T + HI + V - m$

$Tangent\ Dist. = R\tan\frac{\Delta}{2}$

$Secant\ Dist. = R\sec\frac{\Delta}{2}$

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

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

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

$Arc = R\theta^{rad.}$

$Arc = R\theta^{deg} \times \frac{\pi}{180}$

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

$Chord = 2R\sin\delta$

$y_0 = R - \sqrt{R^2 - \left(\frac{C}{2}\right)^2}$

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

$Area = \pi R^2$

$Sector = \frac{1}{2}R^2\theta$

$Segment = \frac{1}{2}R^2\left(\theta - \sin\theta\right)$

$Area = w\left(\frac{O_1 + O_2}{2}\right)$

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

$Volume = \frac{w}{3}\left\{A_1 + 4A_2 + 2A_3 + \cdots + A_n\right\}$

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

P.T.O.