Cover Type B

U|T|S

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: _____

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# AUTUMN SEMESTER, 2006

**SUBJECT NAME:** SURVEYING

**SUBJECT NO.:** 48320

**DAY/DATE:** THURSDAY 22 JUNE 2006

**TIME ALLOWED:** TWO Hours plus TEN Mins reading time

**START/END TIME:** 2:00 pm - 4:10 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.**
**Calculators 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 closed traverse was run from A via points B, C, and D, as indicated on the traverse close form below.
From point A, a radiation was made to point X, the corner of a house.
(The traverse is shown in a diagram on the next page.)

Compute the traverse misclose and the proportional accuracy of the traverse. **(5 Marks)**
Without making any adjustments, calculate the coordinates of each traverse point. **(6 Marks)**
Calculate the coordinates of point X. **(2 Marks)**
Calculate the bearing and distance of the line XB. **(3 Marks)**
Calculate the perpendicular distance of the corner of the house (X) from the line AB **(4 Marks)**

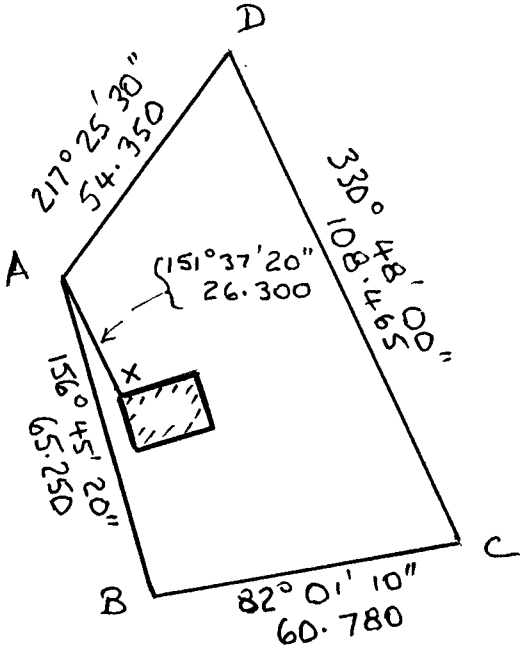
| LINE | Adjusted Bearing | Horiz. Dist | Δ E | | Δ N | | CO-ORD INATES | | PT. |
|---|---|---|---|---|---|---|---|---|---|
| | | | E (+) | W (-) | N (+) | S(-) | E | N | |
| | | | | | | | 800.000 | 400.000 | A |
| A-B | 156° 45' 20" | 65.250 | | | | | | | B |
| B-C | 82° 01' 10"" | 60.780 | | | | | | | C |
| C-D | 330° 48' 00" | 108.465 | | | | | | | D |
| D-A | 217° 25' 30" | 54.350 | | | | | | | A |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | 400.000 | 500.000 | A |
| A-X | 151° 37' 20" | 26.300 | | | | | | | X |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Traverse Linear Misclose ..... Proportional Accuracy .....**
**Show coordinates of B, C, D and X in the traverse table. (PLEASE WORK TO 3 Decimal Places)**

**Bearing and distance of line X B .....**

**Perpendicular distance of X from the line AB .....**

P.T.O.





Not to Scale

DIAGRAM FOR Q 1.

P.T.O.

**QUESTION 2 (20 Marks)**

It is proposed to upgrade a road with a horizontal circular curve. Two straights of bearings $60^{0}$ and $100^{0}$ respectively meet at an Intersection Point which is inaccessible. From point A, which must be $T.P._1$, a connection was made to the second straight at point X, as shown on the sketch below.

Point A is known to have a running chainage of 481.121

Calculate the following and show your answers to three decimal places.

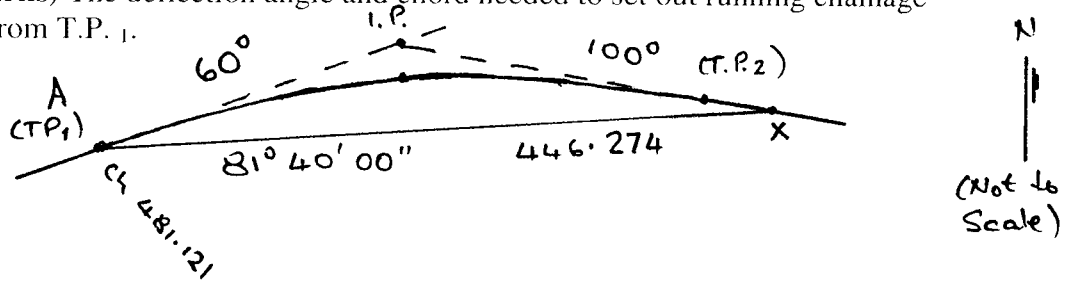
**a) (3 Marks)** the distance from X to $TP_2$

**b) (6 Marks)** the radius of the curve to fit this situation. (N.B. If you can not calculate a radius; or get an answer that is no where near 550m, adopt R=550.0m and continue)

**c) (4 Marks)** The chainages of $T.P._2$, and the crown point.

**d) (2 Marks)** The length of the long chord.

**e) (5 Marks)** The deflection angle and chord needed to set out running chainage 600.00, from $T.P._1$.




**ANSWERS**

a) Distance from X to $T.P._2$ ..... .....

b) Radius required = ..... / or adopt R=550.00

c) Chainages $T.P._2$ ....., Crown Point .....

d) The Long Chord Length .....

e) Set Out data for 600.00 from $T.P._1$

Deflection Angle....., Chord .....

P.T.O.

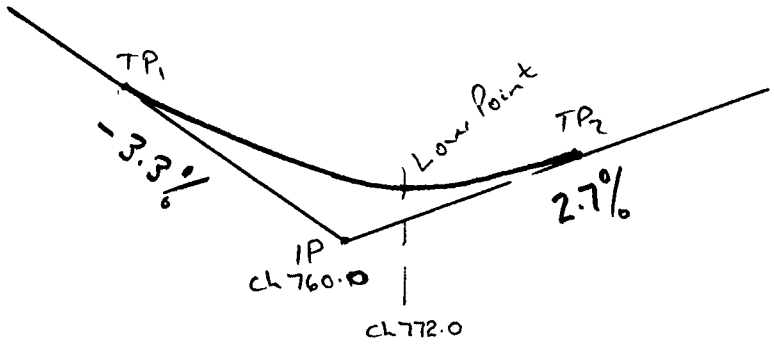
**QUESTION 3 (17 Marks)**

A vertical curve is to be designed on a road, to join a falling grade of 3.3 % to a rising grade of 2.7%. The Low Point on the curve MUST OCCUR at chainage 772.00 and the Intersection Point is fixed at chainage 760.0m and an R.L. of 43.500m.

a) Calculate the EXACT length of the vertical curve to meet the above requirements. **(7 Marks).** Round your answer to the nearest metre, for the further calculations.
**If you can not find the length asked for in part a), please adopt 260m and continue.**

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

c) Complete the table below calculating the grade levels, ordinates and design levels at ALL the points nominated on the table, including BOTH T.P.s. **(8 Marks)**




| CHAINAGE | GRADE | GRADE LEVEL | ORDINATE | DESIGN R.L. |
|---|---|---|---|---|
| T.P.1 | | | | |
| 690.0 | | | | |
| I.P. 760.0 | | 43.500 | | |
| 770.0 | | | | |
| (Low Pt) 772.0 | | | | |
| T.P.2 | | | | |

**ANSWERS**

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

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

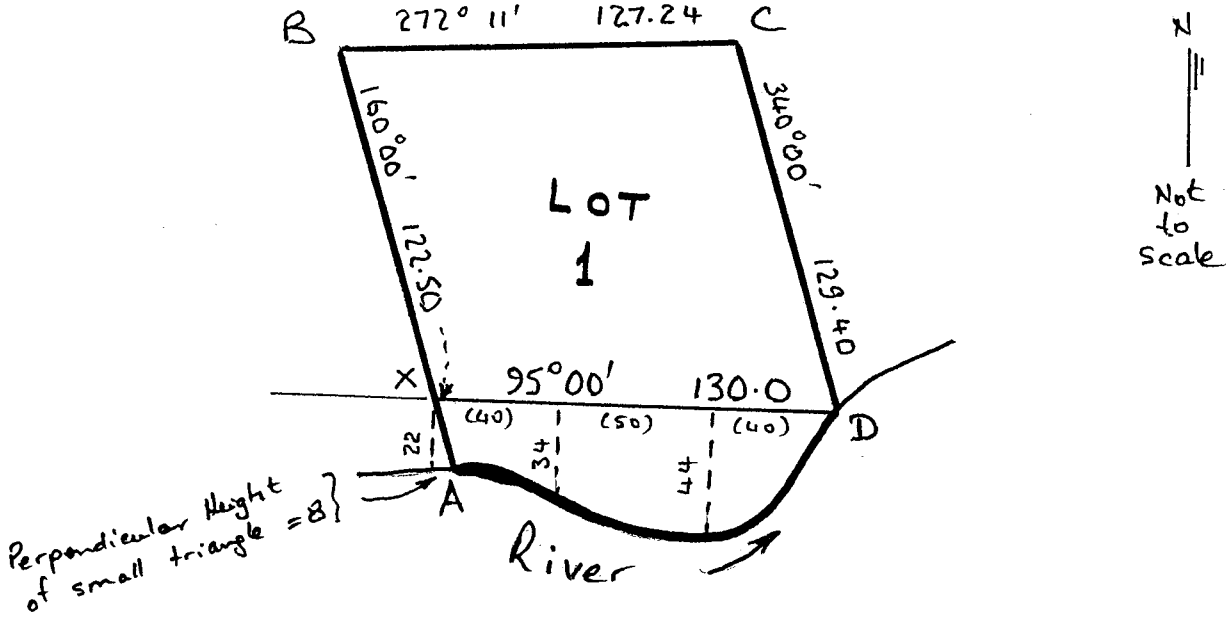
c) Complete other values in the table.

P.T.O.

**QUESTION 4 (10 Marks)**

Lot 1 in the sketch plan below is bounded by straight lines AB, BC and CD and then the river bank, see the thick line. A survey to determine the area of the lot was undertaken and a traverse line run from D to X and offsets read from line XD to the river bank.
The offsets were taken at right angles to the traverse line XD.

Determine the total area of Lot 1 by calculating
a) the area within the regular shape XBCD, and then
b) use the trapezoidal rule for the offset area between the line XD and the river bank.




Area inside Shape XBCD .....

Area with Lot 1 between the traverse line XD and the river bank .....

Total Area of Lot 1 .....

P.T.O.

**QUESTION 5 (8 Marks)**

A sewer trench with vertical sides and 0.9m wide is to be dug. The natural surface levels along the long section as shown below. The existing ground is flat so there is no cross fall across the top of the trench.

The sewer pipe is to rise at a constant rate of 3.0% from the invert level shown at 00.

| Chainage | 00 | 10 | 16 | 25 |
|---|---|---|---|---|
| Natural Surface Level | 25.31 | 25.82 | 26.01 | 26.03 |
| Invert level | 24.51 | | | |
| Depth of Excavation | | | | |

a) Calculate the invert levels at each of the nominated points and enter the value to the table above.

b) To allow for the wall thickness of the pipe and the bedding to be laid in the bottom of the trench, the excavation must be made to a depth of 0.20m below invert level. For each point above, calculate the depth of excavation and enter it into the table.

c) Calculate the volume of material to be removed from the trench, using the End Areas method.

**Volume to be excavated from trench .....**

**QUESTION 7 (12 Marks)**
A horizontal curve has a deflection angle of 80° and a radius of 250.0m

For this horizontal curve, calculate:-
a) (2 Marks) the distance from the TP to the IP .....

b) (3 Marks) the distance from the IP to the Crown Point (i.e. the centre of the curve)

.....

c) (2 Marks) the length of the long arc .....

d) (3 Marks) the length of the chord from the TP to the Crown Point

.....

e) (2 Marks) the length from the middle of the long chord to the Crown Point

.....

P.T.O.

**QUESTION 8 (13 Marks)**

**a) (4 Marks)** What advantages are there in getting an Identification Survey performed at the time of purchasing a property?

**b) (3 Marks)** Who is able to undertake an "Identification Survey".

P.T.O.

c) Traditionally a detail and contour survey was performed in the field by a stadia survey using a theodolite and staff, then followed by office work involving hand calculations and plotting. Nowadays, modern electronic total stations and prisms are use in the field and computers look after the office work.

**(2 Marks)** Despite the changes in methods, there are still major similarities in the survey work. Briefly describe some of the similarities.

**(4 Marks)** Discuss the differences between the two techniques and briefly discuss the advantages that the modern techniques offer.

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

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

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

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

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

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

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

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

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

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

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

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

$$RL_S = RL_T + HI + V - m$$

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

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

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

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

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

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

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

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

$$Chord = 2R\sin\delta$$

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

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

$$Area = \pi R^2$$

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

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

$$2 \times Area = \left(N_1E_2 + N_2E_3 + \cdots N_NE_1\right) - \left(E_1N_2 + E_2N_3 + \cdots E_NN_1\right)$$

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

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