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: _____

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# SPRING SEMESTER, 2002

**SUBJECT NAME:** SURVEYING

**SUBJECT NO.:** 48320

**DAY/DATE:** SATURDAY 16 NOVEMBER 2002

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

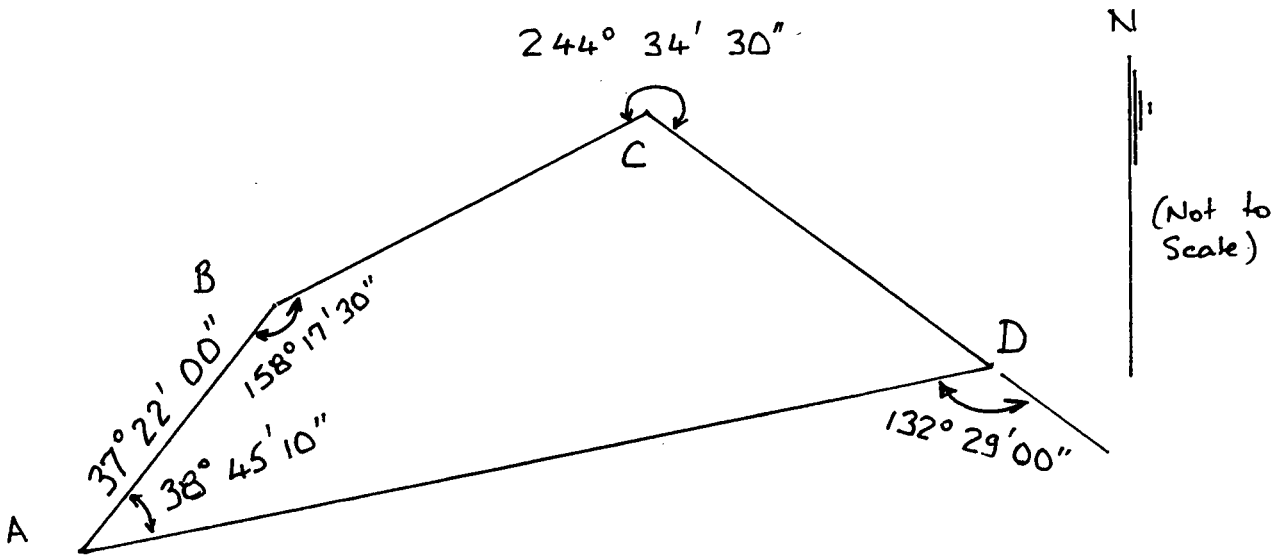
**START/END TIME:** 9:30 am - 11:40 am

## 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.**
**If not enough room for working has been provided, please use the back of adjacent pages.**

**QUESTION 1 (12 Marks)**

Using the observed angles shown on the diagram below, calculate the adjusted angles for each the traverse line.




BEARING OF AB ..... BEARING OF BC .....

BEARING OF CD ..... BEARING OF DA .....

**QUESTION 2 (14 Marks)**

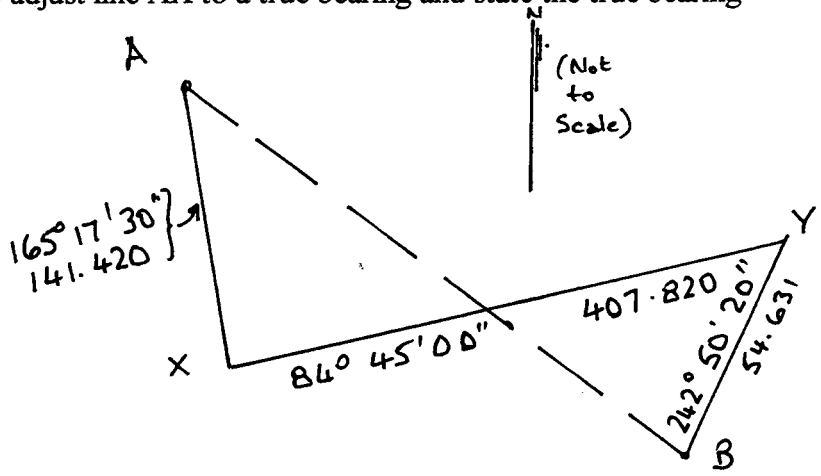
The diagram below shows a traverse, which was run between points A and B, whose coordinates are listed below.

**a) (2 Marks)** Calculate the bearing and distance between A and B using the given (true) coordinates.

**b) (8 Marks)** Adopting the coordinates of A, calculate the coordinates of X, Y and B using the traverse information shown. (Showing your answers in the traverse table below is sufficient.)

**c) (4 Marks)** It was then realised that the azimuth adopted for the traverse was wrong. Calculate the correction needed to adjust line AX to a true bearing and state the true bearing of AX

| | **Cooordinates** | |
|---|---|---|
| **Point** | **East** | **North** |
| A | 1000.000 | 1000.000 |
| B | 1400.270 | 899.840 |




**ANSWERS**

a) Bearing and Distance of AB: ....., .....

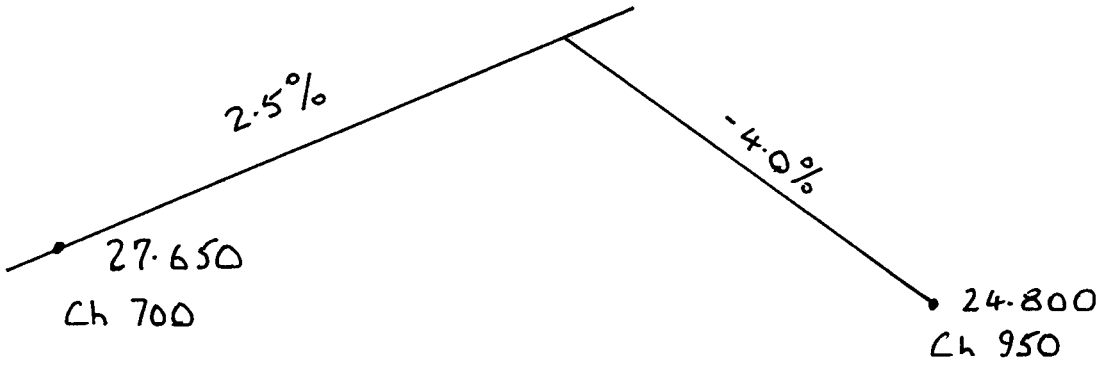
| LINE | Adjusted Bearing | Horiz. Dist | Δ E | | Δ N | | CO-ORD INATES | | PT. |
|---|---|---|---|---|---|---|---|---|---|
| | | | E (+) | W (-) | N (+) | S(-) | E | N | |
| | | | | | | | 1000.000 | 1000.000 | A |
| A-X | 165° 17' 30" | 141.420 | | | | | | | X |
| X-Y | 84° 45' 00" | 407.820 | | | | | | | Y |
| Y-B | 242° 50' 20" | 54.631 | | | | | | | B |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

c) Angular Correction needed .....

True Bearing of AX .....

**QUESTION 3 (10 Marks)**
A rising grade of 2.5% meets a falling grade of 4.0%, as shown on the diagram. At chainage 700, the grade level is 27.650 and at 950, the grade level is 24.800.

Find the chainage and R.L. of the Intersection Point.




**ANSWER**
Chainage of Intersection Point .....

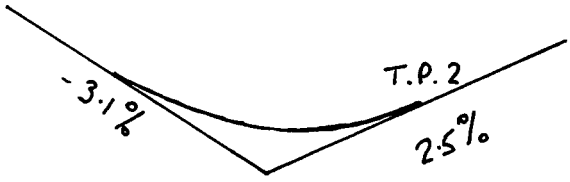
R.L. of Intersection Point .....

**QUESTION 4 (14 Marks)**
A vertical curve is to be designed on a road, to join a falling grade of 3.1% to a rising grade of 2.5%. The Low Point on the curve MUST OCCUR at chainage 624.00 and the second tangent point is fixed at 686.5m and an R.L. of 37.340m.

**a) (6 Marks)** Calculate the EXACT length of the vertical curve to meet the above requirements.
Round your answer to the nearest metre for further calculations. **If you can not find the length asked for in part a), you may adopt 160m and continue.**

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

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




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

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

| CHAINAGE | GRADE | GRADE LEVEL | ORDINATE | DESIGN LEVEL |
|---|---|---|---|---|
| T.P.1( ) | | | | |
| 590 | | | | |
| I.P. ( ) | | | | |
| 650 | | | | |
| T.P.2 (686.50) | | 37.34 | | |

**QUESTION 5 (20 Marks)**

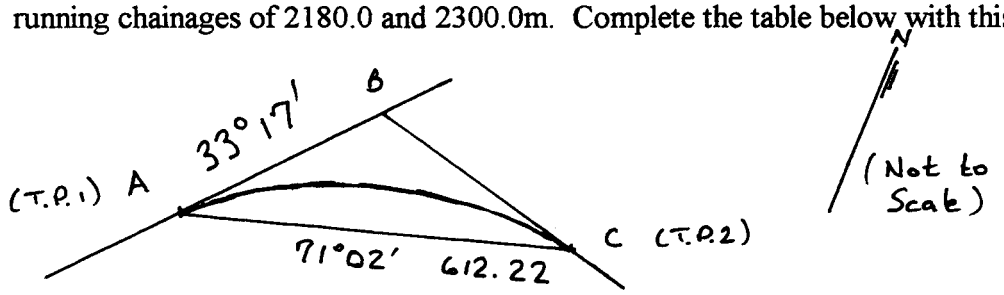
A Horizontal Curve is being designed and points A and C are tangent points.
Using the data shown on the diagram, calculate

**a) (8 Marks)** the radius of the curve. Show your answer precisely below but then round off to the nearest metre for further calculations. **If you can not find the radius assume it is 550.0m and continue.**

**b) (4 Marks)** the length and bearing of the tangent BC.

**c) (4 Marks)** If the "chainage" of the Intersection Point (B) is 2503.670, calculate the chainages of A and C; and

**d) (4 Marks)** calculate pegging data to place pegs by deflection angles and chords at the running chainages of 2180.0 and 2300.0m. Complete the table below with this data.




**ANSWERS**

a) Radius required = ..... / or adopt 550.00

b) Length of BC ..... Bearing of BC .....

c) Chainage of A ....., Chainage of B .....,

d)

| | Chainage | Arc | Defln. Angle | Total Defln. Angle | Chord |
|---|---|---|---|---|---|
| A | | | | 0° 00' 00" | |
| | 2180.00 | | | | |
| | 2300.00 | | | | |

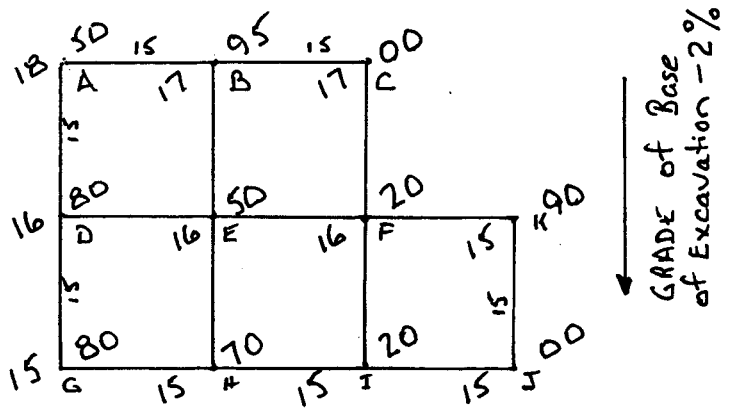
**QUESTION 6 (20 Marks)**

**a) (8 Marks)**

The 15m x 15m grid, shown below, is a plan of a proposed foundation excavation for a building. The excavation will have vertical side slopes.

The excavation is to be made to R.L. 15.5m on line AB. The base of the excavation is to slope downwards at 2% towards line GJ.

Calculate the total volume of material to be removed from the site.

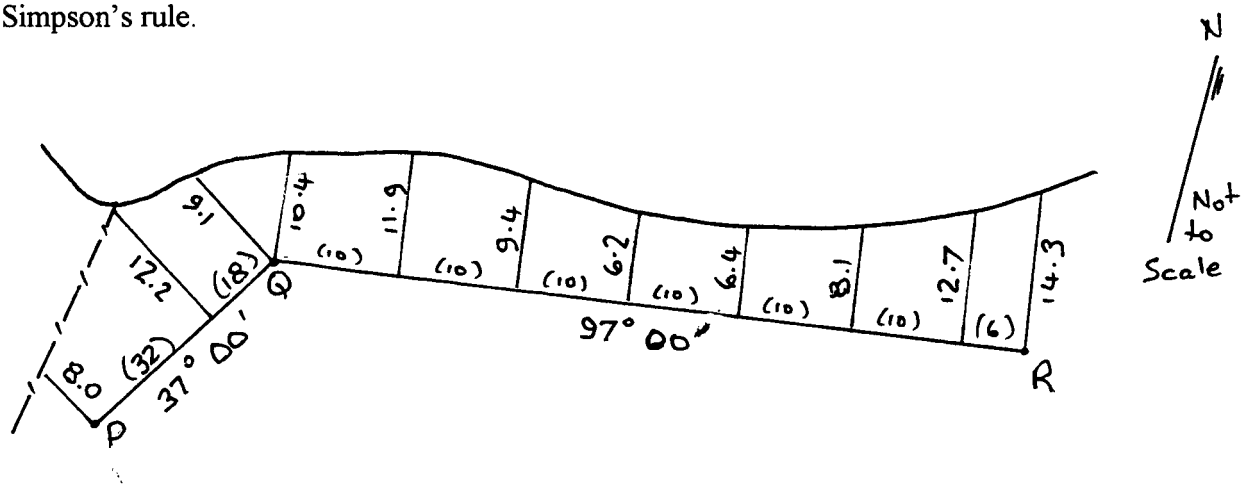



Volume to be removed from the site .....

**b) (12 Marks)**

The plan below shows a part of a block of land, whose boundaries are the fence and river as shown. Traverse lines PQ and QR were run as shown on the diagram and offsets read from the lines as shown.

Calculate the area between the traverse lines and the fence and river boundaries. Do not use Simpson's rule.




Offset area .....

**QUESTION 7 (10 Marks)**

**a) (3 Marks)**

Explain what is meant by a "Cyrax point cloud". What advantages does this give in surveying complicated areas.

**b) (3 Marks)**

Explain how it is possible for a single person to do a detail and contour survey. Briefly describe the modern equipment which allows this to occur.

**c) (2 Marks)**
Surveyors use G.P.S. to locate the positions of control points for highway surveys. Briefly explain how they typically undertake such surveys to make sure they avoid errors that might be introduced into the system deliberately or that result from the signals travelling through the atmosphere to reach the receiver/s.

**d) (2 Marks)**
Modern distance measuring instruments can run in "reflectorless" mode or using a reflector. Give an example of a situation where using the "reflectorless" mode would be an advantage to a Surveyor. What restrictions are there when using the instrument in "reflectorless" mode?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$Area = \pi R^2$$

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

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

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

$$V = \frac{w}{3}\left\{A_1 + A_n + 4(\Sigma A_{even}) + 2(\Sigma A_{odd})\right\}$$

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