



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, 2009**

**SUBJECT NAME: SURVEYING**

**SUBJECT NO.: 48320**

**DAY/DATE: SATURDAY 14 NOVEMBER 2009**

**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.**

**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.**

**THIS EXAM IS PRINTED ON BOTH SIDES OF EACH PAGE, THOUGH SOME (MARKED) PAGES HAVE BEEN LEFT BLANK FOR WORKING.**

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**QUESTION 1 (17 Marks)**

A rising grade of 2.7% meets a falling grade of 1.7%.

At chainage 500.0, the grade level is 68.000 and the design level (i.e. R.L. on the vertical curve is 67.731)

CALCULATE

:- the **exact length** of vertical curve needed to achieve that **(6 Marks)**;

(NOW ROUND YOUR ANSWER TO THE NEAREST METRE AND CONTINUE)

:- the chainages of T.P. 1 and I.P., (Please show these on the table below) **(2 Marks)**;

:- the R.L.s on the design surface (i.e. the R.L.s on the vertical curve) at 100m intervals of running chainage through the curve (as on the table) **(6 Marks)**;

:- the chainage and R.L. of the highest point on the curve **(3 Marks)**.

*If you can not find the length of the vertical curve, assume it is 470m and continue.*

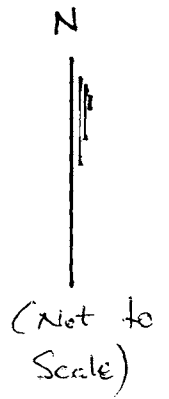
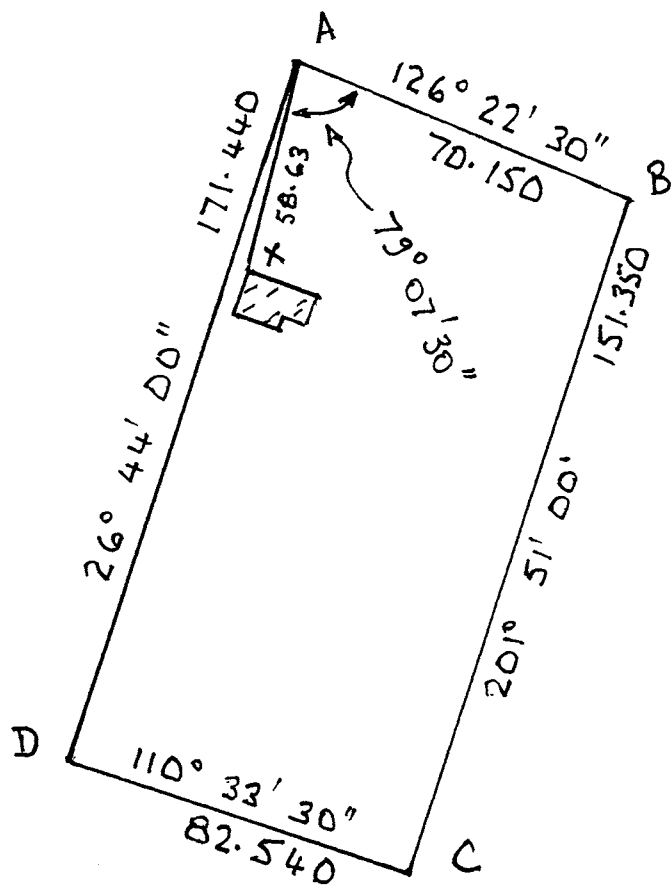
CHAINAGE	GRADE	GRADE LEVEL	ORDINATE	DESIGN R.L.
T.P.1				
200.0				
300.0				
I.P.				
400.0				
500.0		68.000		67.731
T.P.2 575.0				

**ANSWERS**

a) Precise Length of Vertical Curve .....

b) Chainages and Design Levels ---- use table for answers

c) Chainage and R.L. of highest Point on the curve ....., .....



**QUESTION 2 (18 Marks)**

A closed traverse was run from A via points B, C, and D, as indicated on the diagram on Page 2. From point A, a radiation was made to point X the corner of a house. The observed horizontal angle and the reduced horizontal distance is shown on the diagram.

Compute the traverse misclose and the proportional accuracy of the traverse. **(6 Marks)**

Without making any adjustments, calculate the coordinates of each traverse point. **(2 Marks)**

Calculate the coordinates of point X. **(3 Marks)**

Calculate the bearing and distance of the line XB. **(4 Marks)**

Calculate the perpendicular distance of the corner of the house (X) from the line (DA). **(3 Marks)**

LINE	Adjusted Bearing	Horiz. Dist	Δ E		Δ N		CO-ORD INATES		PT.
			E (+)	W (-)	N (+)	S (-)	E	N	
							400.000	500.000	A
A-B									B
B-C									C
C-D									D
D-A									A
							400.000	500.000	A
A-X									X

**Traverse Linear Misclose ..... Proportional Accuracy .....**

**Show coordinates of B, C, D and X in the traverse table.**

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

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

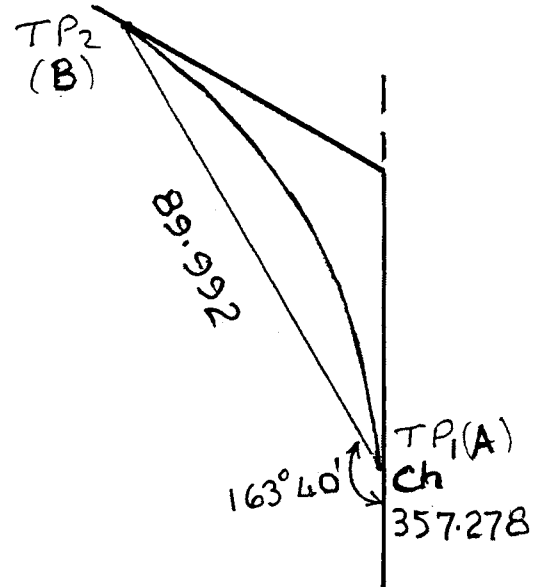
**QUESTION 3 (20 Marks)**

A horizontal (circular) curve is to be built. A theodolite was set up on point 'A' which is a tangent point and a horizontal angle and a distance were read to the second tangent point 'B', as shown. The chainage of 'A' is 357.278.

Calculate:

- a) (2 Marks) The total deflection angle
- b) (6 Marks) The radius of the curve
- c) (2 Marks) The distance from T.P.'B' to I.P.
- d) (2 Marks) The chainage of T.P. 'B'
- e) (6 Marks) The deflection angles and **long** chords that would be needed to set out points at chainages 375 and 400, **from T.P. 'A'**.
- f) (2 Marks) The length of the short chord between 375 and 400 so that the set out could be checked.

**IF YOU CAN NOT FIND THE DEFLECTION ANGLE OR THE RADIUS OF THE HORIZONTAL CURVE, ASSUME THEY ARE 28° and 170m RESPECTIVELY AND CONTINUE WITH THE QUESTION.**



Point to be pegged	Arc Length	$\delta_i$	$\delta_T$	Chord
T.P. 'A' 357.278				
375				
400				

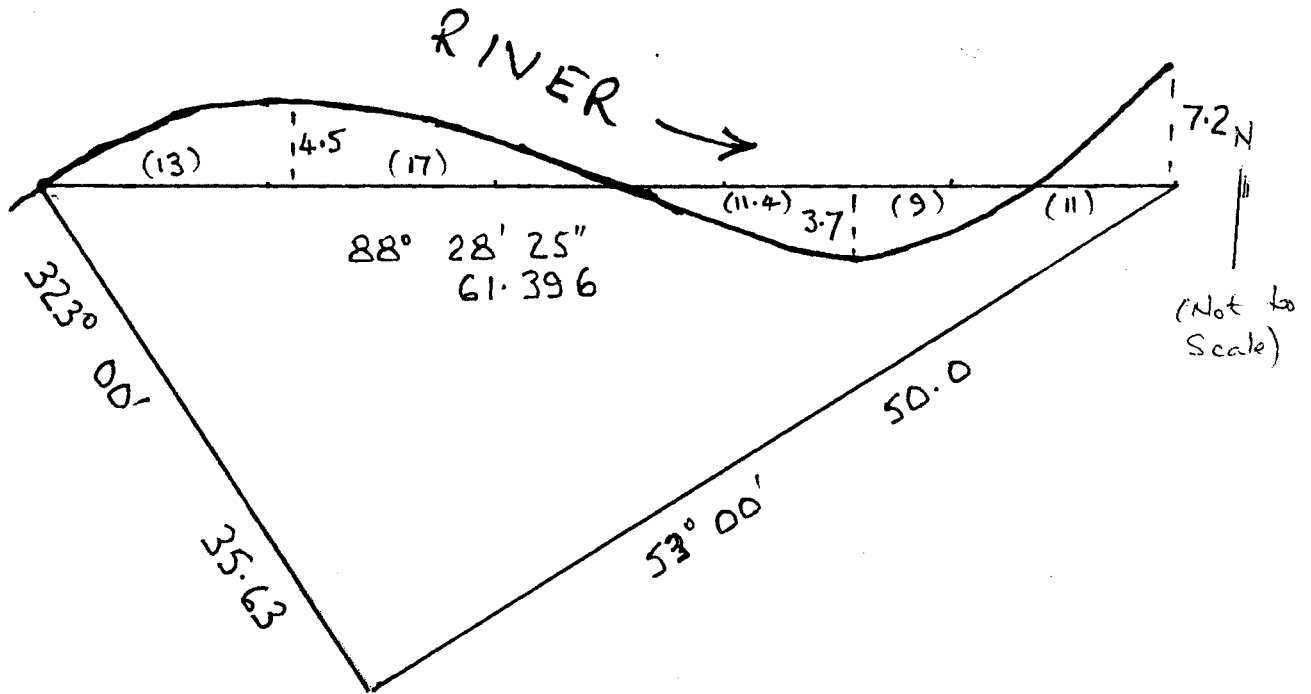
**ANSWERS**

- a) Total Deflection Angle for the curve .....
- b) Exact radius required .....
- c) The distance from T.P.'B' to I.P. ....
- d) Chainage of T.P.'B' .....
- e) Please show Deflection Angles and Long Chords in the table above.  
Short Chord between marks placed at 375 and 400 .....

**QUESTION 4 (20 Marks)**

**a) (7 Marks)**

Determine the total useable area of Lot 1 shown in the sketch plan below. The offsets shown are at right angles to the traverse line.



Areas

- inside boundaries and traverse line (i.e. the area of the regular figure) (3 Marks)

.....

- useable area of Lot 1, between the traverse line and the river bank (3 Marks) .....

Total Area of Lot 1 (1 Mark) .....

**b) (8 Marks)**

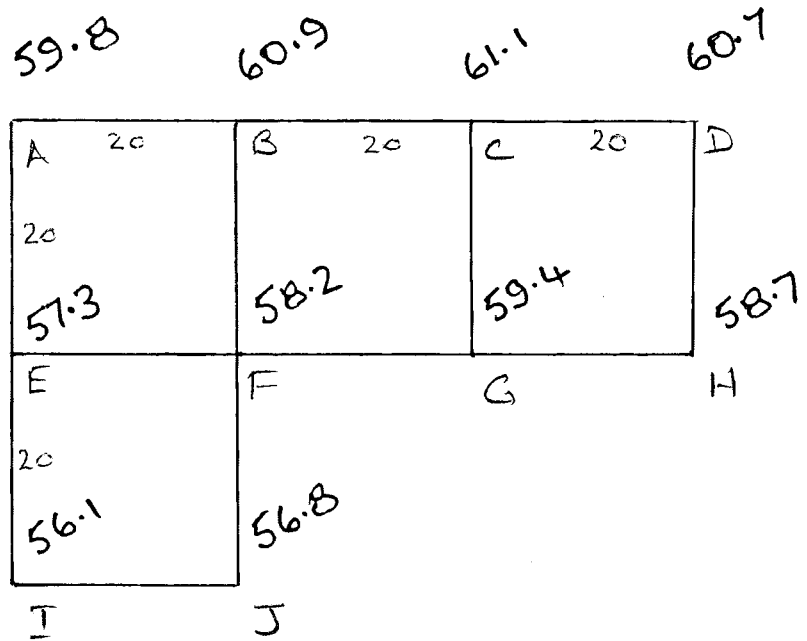
The 20m x 20m grid below was levelled for an open cut coal mine from a temporary Bench Mark. The area is to be excavated to the level of the top of the coal seam, known to be at R.L. 55.50 at the line AEI. The top of the coal seam drops downwards in the direction EH at a slope of 7%.

The perimeter sides of the excavation are to be vertical.

i) (2 Marks) Show on the diagram, the depth of excavation at each grid point.

ii) (4 Marks) Calculate the volume of material that will have to be removed from the site.

iii) (2 Marks) It was later realised that an error in the temporary Bench Mark had resulted in all the ground levels being 0.25m too high. Calculate the change in the volume that this error had on the original estimate.



**ANSWERS**

b) Material to be removed from the site .....

c) Change in volume due to the error .....



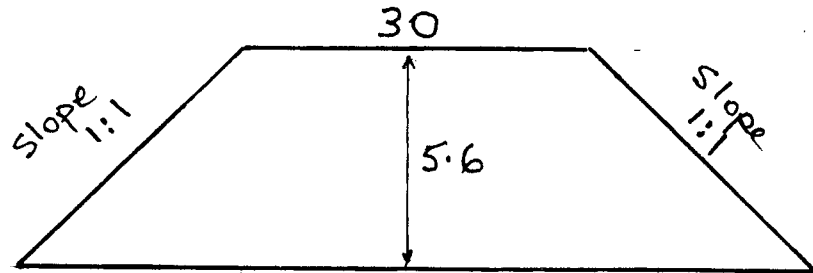
**c) (5 Marks)**

A highway embankment is to be built according to the typical cross section shown below with a formation width of 30m and side slopes of 1:1.

From chainage 100.0 onwards, the centre line of the road is falling at a grade of 3.5% while the natural surface is rising at a grade of 1.0%. Both of the slopes are uniform and continuous between chainage 100.0 and 200.0. Further, both the highway and the natural surface are horizontal at right angles to the centre line.

At chainage 100.0 the height of the highway is 5.6m above the natural surface.

Calculate the volume of fill needed between chainage 100.0 and 200.0.



Volume of fill needed .....

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**QUESTION 5 (20 Marks)**

**a) (4 Marks)**

Sketch, and LABEL, in the space below, the highest THREE (3) contour lines of an imaginary landscape, which has the following features:

The land has two conical peaks which are aligned in an east –west direction. The western peak has an R.L. of 75m; the saddle in the gap between the two peaks has an R.L. of 55m and the R.L. of the eastern peak is 65m.

The Contour Interval is to be 10m.

On the southern side of the hills, the ground fall steeply, while on the northern side, the slope is gentle.

**b) (3 Marks)**

Who are the only people allowed, by law, to undertake cadastral surveys and what are Cadastral Surveys? What is the name of the body or group who keeps the list of these approved people?

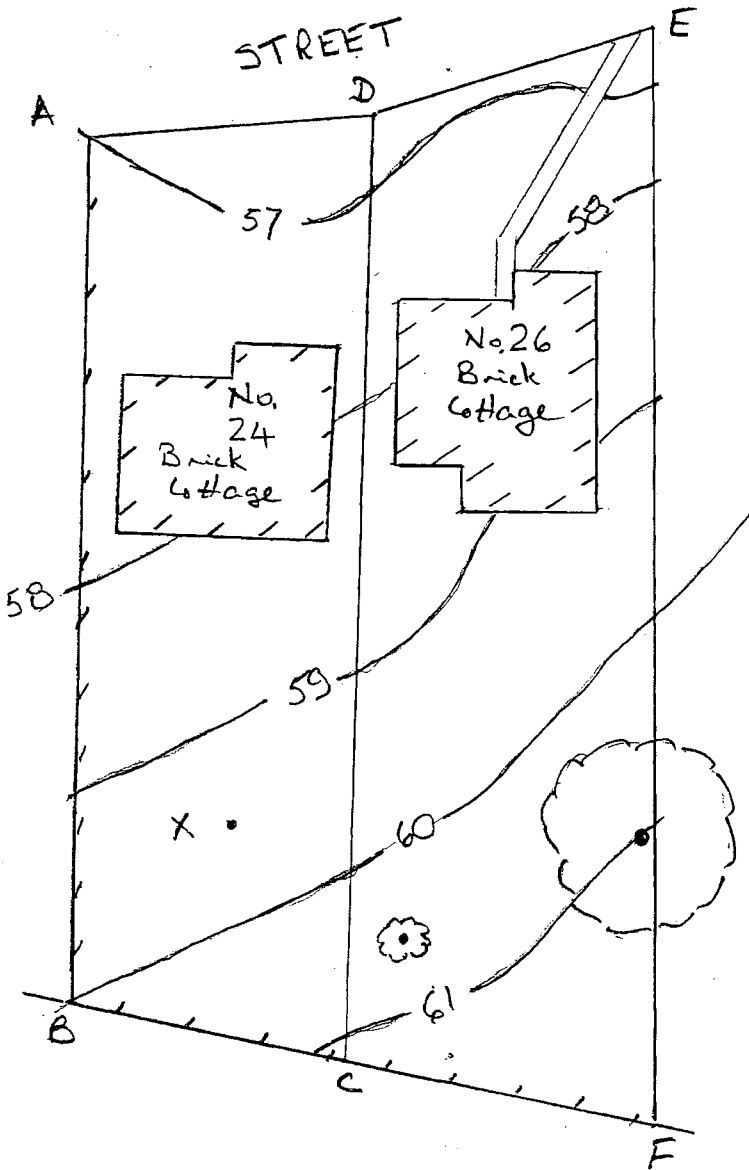
**c) (4 Marks)**

Briefly explain what a “Total Station” is. What benefits does it offer a Surveyor undertaking a detail and contour survey compared to the traditional methods?

**d) (4 Marks)**

Now that the U.S. Department of Defense has removed selective availability from its GPS satellites it is possible to get very accurate absolute coordinates from a single GPS receiver. Explain why Surveyors still prefer to make their observations using TWO receivers.

f) (5 Marks) Answer these questions referring to the detail and contour plan below. The plan shows two blocks of land with a house on each. The boundaries are the solid lines between the lettered points e.g. A-B.



Which boundaries are fenced?  
 .....

What does the plan show as being in back yard of No. 26.  
 .....

Is there a problem with the 60 m contour? If so, what is the problem .....

.....

.....

.....

.....

If the distance from A to B is 24.0m, what is the average grade along that boundary?  
 .....

Based on the contours as shown, what is the R.L. of point X in the backyard of No. 24?  
 .....

### QUESTION 6 (5 Marks)

For each of the questions below, mark clearly **all** the correct statements.

**1. Which three of the following questions may be best answered using a Geographic Information System (GIS)?**

- How does a process operate?
- Where is a particular feature found?
- What is the relationship between two variables?
- Where do certain conditions apply?
- What geographical patterns exist?

**2. Which one of the following statements best describes a Geographic Information System (GIS)?**

- GIS is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment.
- GIS refers to the use of a computer and specialised software to produce and manipulate pictorial images for purposes of animation, business presentations, and scientific research.
- GIS refers to a (generally IT based) system for managing knowledge in organisations for supporting creation, capture, storage and dissemination of information.
- GIS is a computer-based, dynamic mapping system with spatial data processing and querying capabilities.
- A GIS is the underlying structure supporting communications between spatial web-services.

**3. Which one of the following is not a type of map projection?**

- Conic.
- Geographic.
- Azimuthal.
- Cylindrical.
- Orthographic.

**4. How does a vector GIS represent a circular shape or oval, such as a circular lake or a 400m Olympic running track?**

- Both a circular and an oval shape is represented by a polygon, which is a closed set of lines.
- The circular shape is represented by one continuous line drawn at the distance of the radius from the centroid; the oval shape is defined by joining together arcs of different radii such that the centres of the arcs lie on a line passing through the join point.
- Both the circular and the oval shape are represented by one continuous line drawn at the distance of the radius from the centroid.
- The circular shape is represented by a closed set of lines and the oval shape by an open set of lines.
- Both circular and oval shapes are represented by a set of adjacent island polygons.

**5. Do raster maps have feature attribute tables? Why or why not?**

- Yes, raster maps have feature attribute tables, because they are divided into rows and columns, which form a regular grid structure with each cell being of rectangular shape. Every one of these cells is a feature that is described in more detail in the associated attribute table.
- No, raster maps do not have attribute feature tables, because they are divided into rows and columns, which form a regular grid structure with each cell being of rectangular shape. Cells are not features and therefore have no attribute table associated with them.
- No, raster maps do not have feature attribute tables, because raster is not a GIS format.
- Yes, raster maps have feature attribute tables, because these maps have no graphical representation and only consist of attribute tables.
- None of the above.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$Area = \pi R^2$$

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

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

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

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

$$Volume = \frac{w}{3} \left\{ A_1 + 4A_2 + 2A_3 + \dots + 2A_{n-1} + A_n \right\}$$

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