



SEAT NUMBER:

STUDENT NUMBER:

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SURNAME:  
(FAMILY NAME)

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OTHER NAMES:

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**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

Misconduct action will be taken against you if you breach university rules.

**Declaration:** I declare that I have read the advice above on examination conduct and listened to the examination supervisor's instructions for this exam. In addition, I am aware of the university's rules regarding misconduct during examinations. I am not in possession of, nor do I have access to, any unauthorised material during this examination. I agree to be bound by the university's rules, codes of conduct, and other policies relating to examinations.

Signature:

Date:

**48320\_v3 Surveying**

**Time Allowed: 120 minutes.**

**Reading time: 10 minutes.**

Reading time is for reading only. You are not permitted to write, calculate or mark your paper in any way during reading time.

**Restricted Open Book**

**Permitted materials for this exam:**

- Drawing Instruments
- Non-programmable Calculator
- One A4 page of handwritten notes permitted

**Materials provided for this exam:**

None

**Students please note:**

- Students are permitted one single A4 page of handwritten notes.
- Questions are not of equal value
- Attempt all questions.
- A formulae sheet is provided at the end of the paper

**Do not open your exam paper until instructed.**

**Rough work space**

Do not write your answers on this page.

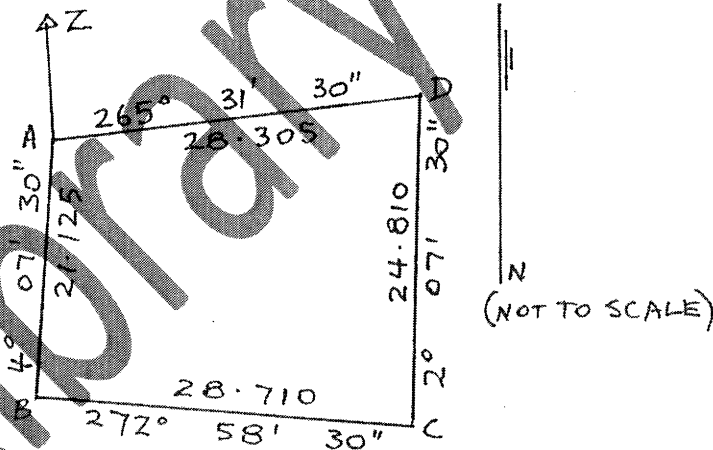
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**QUESTION 1 (18 Marks)**

A closed traverse was carried out as shown in the diagram below. The bearings shown are the adjusted bearings.

- i) (8 marks) Enter the traverse details in the table and calculate co-ordinates of the points.
- ii) (6 marks) Calculate the linear misclose and the proportional accuracy of the traverse
- iii) (4 marks) It is necessary to place a peg at point “Z” whose co-ordinates are E 398.650 N 608.275. Calculate the bearing and distance from point “A” to place a peg at “Z”.

LINE	Adjusted Bearing	Horiz. Dist	Δ E		Δ N		CO-ORD INATES		PT.
			E (+)	W (-)	N (+)	S(-)	E	N	
							400.00	600.00	A
A-B									B
B-C									C
C-D									D
D-A									A



**Answers:**

ii) Linear Misclose.....Proportional Accuracy.....

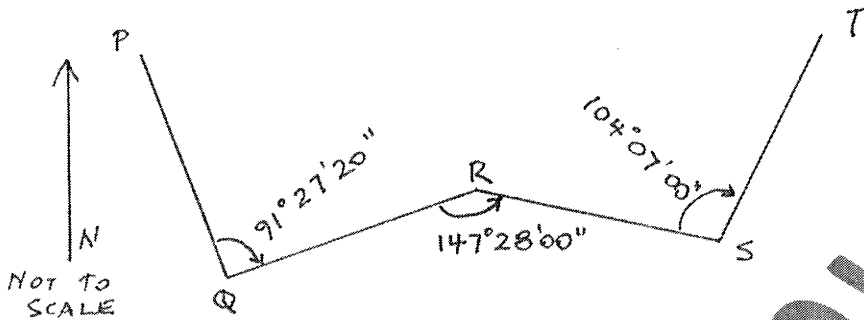
iii) Bearing A – Z ..... Distance A – Z.....

**QUESTION 2 (12 Marks)**

Angles were measured in the traverse shown below.

Given the bearing of the line P - Q is  $150^{\circ}21'30''$

- i) (6 marks) Calculate the bearings of the remaining lines
- ii) (6 marks) Calculate the angular misclose of the traverse given the bearing of the line T – S is  $198^{\circ}28'50''$ .



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**Answers:**

- i) Bearings: Q – R..... R – S .....
- S – T.....
- ii) Angular Misclose:.....

**QUESTION 3 (20 Marks)**

A horizontal circular curve of radius 800 m connects two straights which intersect with a deflection angle of  $42^{\circ}00'00''$  at chainage 1000.000.

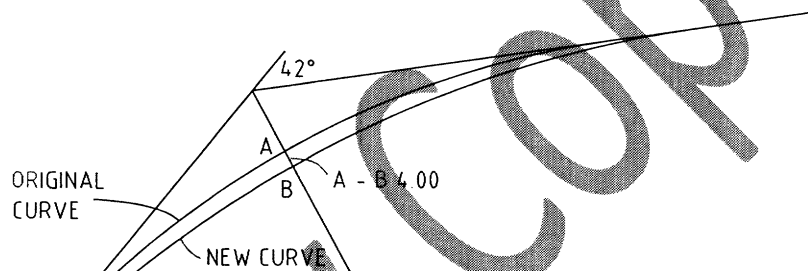
Due to historical artefacts being found on site, it was decided that the mid point of the curve must be moved 4 metres away from the current intersection point towards the centre of the curve. Point A is the existing mid point of the curve and point B is the new mid point.

The existing straights are to remain the same.

- i) (8 marks) Calculate the exact radius of the new curve.

**IT WAS THEN DECIDED TO USE AN EXACT RADUIS OF 850.00. Use a radius of 850m for all further calculations.**

- ii) (8 marks) If the chainage of the intersection point was 1000.000, calculate the chainages of the tangent points.
- iii) (4 marks) Calculate the deflection angle and distance from TP1 to place a peg at Ch800.



Answers:

Exact radius of curve .....

Chainages TP1..... TP2.....

Deflection angle and dist. for peg at CH800 Deflection angle..... Distance.....

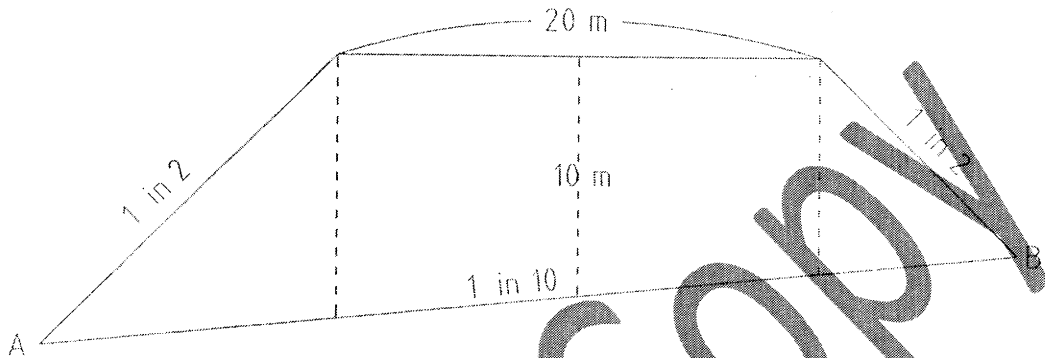
**QUESTION 4 (16 Marks)**

The cross section of an embankment is designed to have a horizontal surface and side batters at a grade of 1 in 2.

The width of the surface is 20 metres, and at the centreline the depth to the existing surface was 10 metres.

The existing ground has a crossfall of 1 in 10.

- i) (8 marks) Calculate the cross sectional area of the embankment
- ii) (8 marks) Calculate the horizontal distances from the centreline of the embankment to the point where the batter meets the natural surface on each side of the embankment.



**Answers:**

Cross sectional area .....

Horizontal distance centreline to A .....

Horizontal distance centreline to B .....

**QUESTION 5 (20 Marks)**

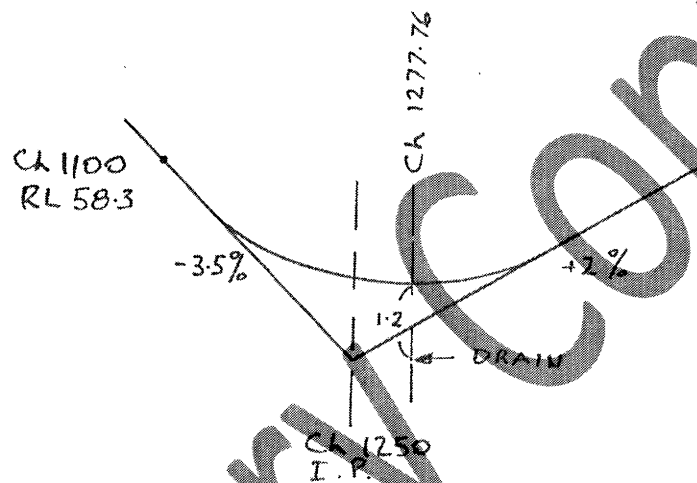
An existing road is falling at a grade of -3.5% and is to be joined to meet a rising grade of 2% at chainage 1250. The road needs to connect to an existing drainage pit at chainage 1277.76, which needs to be the low point of the curve. The road surface needs to be exactly 1.2 metres above the invert of the pit, which has a reduced level 53.145m.

At chainage 1100 the reduced level of the existing road is 58.3.

- a) (8 Marks) Calculate the exact length of the curve to meet this clearance.

For other design reasons a curve of exactly 200 metres was decided to be used. Use this length for all further calculations. The intersection point is to remain the same.

- b) (6 Marks) Calculate the chainage and reduced levels at the start and finish of curve  
c) (6 Marks) Calculate the Reduced Level of the new road at chainage 1150, and chainage 1300.

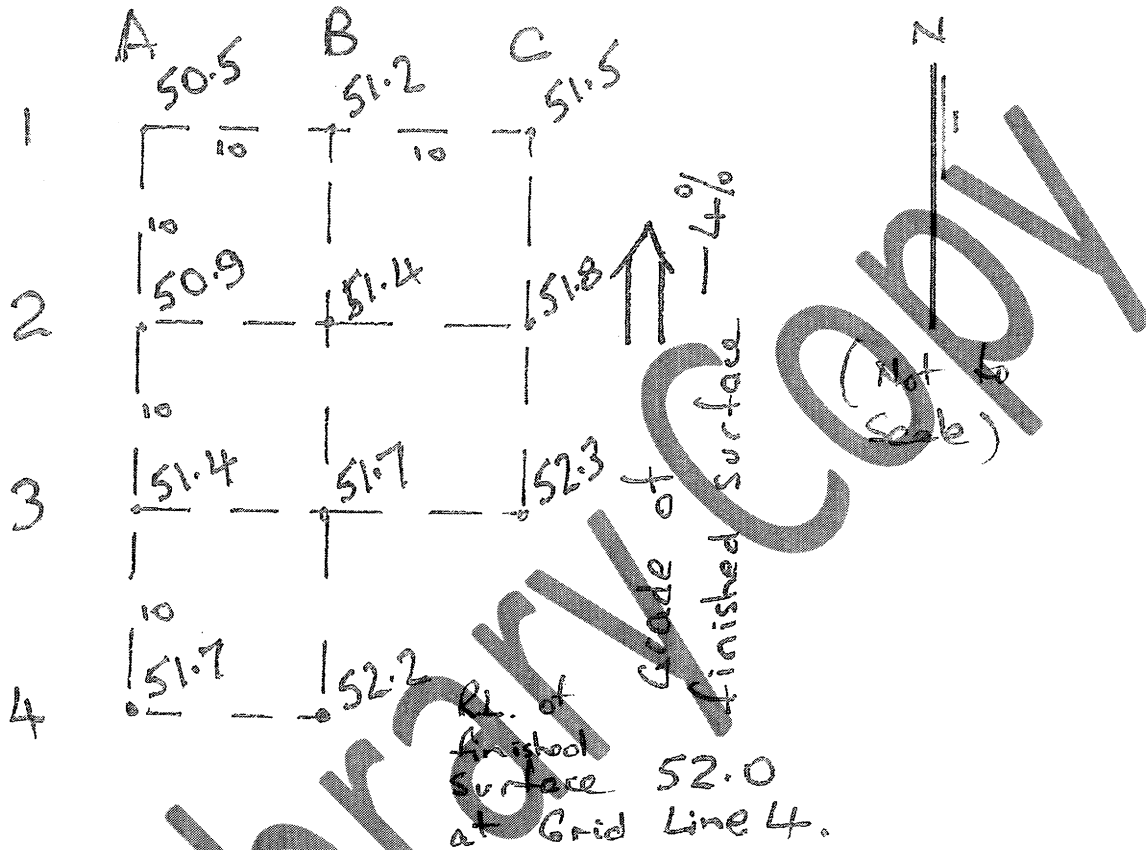
**Answers:**

- (a) Exact length of curve.....  
 (b) Chainage of start of curve.....Reduced Level at start of curve.....  
 Chainage at end of curve.....Reduced Level at end of curve.....  
 (c) RL of road at chainage 1150.....R L of road at chainage 1300.....

**QUESTION 6 (14 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) (4 Marks) Calculate the finished (excavation) level at each of the grid lines 3, 2 and 1.
- b) (4 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 .....



## SURVEYING FORMULAE SHEET

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\text{Area} = \pi . R^2$$

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

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

$$\text{Area} = (N_1.E_2 + N_2.E_3 + \dots + N_N.E_1) - (E_1.N_2 + E_2.N_3 + \dots + E_N.N_1)$$

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

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