

National Exams December 2018

04-Geom-B3, Networks and Precise Engineering Surveys

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.
Any Casio or Sharp approved calculator is permitted.
3. TEN (10) questions constitute a complete exam paper.
Part A: Answer ALL questions from #1 to #8;
Part B: Answer ONE of questions #9 or #10;
Part C: Answer ONE of questions #11 or #12.
4. The marks assigned to each question are shown in brackets in the left margin.
5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

PART A – PLEASE ANSWER ALL QUESTIONS FROM #1 TO #8**(10 MARKS) QUESTION ONE**

Outline the general procedure for the pre-analysis of a geodetic control network. Include i) its purpose, ii) the step-by-step procedure, iii) what types of the information to be required, and iv) what can possibly be altered in order to adjust a specific network scheme in the answer.

(14 MARKS) QUESTION TWO

Assume that you plan to conduct a field mission of horizontal angular observations from a surveying control point to multiple targets by setting up a theodolite or total station system over the surveying control point:

- (1) describe the method of “Measurement of Horizontal Directions by Reiteration Method” (also called “Measurement by Directions”) (6 MARKS), and
- (2) explain what differences derived from your readings after the method described in “(1)” can be checked against their permissible values within a half set, a full set and among multiple full sets during your field observations. (8 MARKS)

(8 MARKS) QUESTION THREE

Briefly outline the field procedure how to determine the azimuth of an unknown direction underground by using a gyrotheodolite. Include the basic calculation formulae in your answer.

(8 MARKS) QUESTION FOUR

Characterize the deformation monitoring method by using the GNSS technology.

(8 MARKS) QUESTION FIVE

Given the following expression of a measured distance by an EDM (electric distance measurement) after the principle of Phase Difference:

$$D = N \frac{c}{2nf} + \frac{\phi}{2\pi} \frac{c}{2nf} + K$$

wherein N is the integer number of the wavelength in medium, ϕ is the fractional part of the measured phase difference between the outgoing and reflected signals, c is the velocity of the EM signal in vacuum, f is the modulation frequency, n is the refractive index of the atmosphere and K is the EDM ZERO error.

By applying the law of variance propagation, analytically explain why the standard deviation of a distance measurement is represented as $\sigma = \pm(a[\text{mm}] + b[\text{ppm}])$, in which a and b are two specific constants provided by manufacturers.

(16 MARKS) QUESTION SIX

- 1) With a theodolite, the readings of the horizontal circle to a target will be affected if its horizontal axis is not perpendicular to its vertical axis. Proof that the average of the two face observations is free of this error and explain how to estimate this error (**hint**: with aid of sketches and/or math expression). (**8 marks**)
- 2) How to check whether the line of sight with a theodolite is perpendicular to its horizontal axis or not? If not, how can one adjust the theodolite? (**8 marks**)

(12 MARKS) QUESTION SEVEN

- 1) Why should a surveyor keep taking the equalized foresight and backsight distances for a level set-up? (**3 MARKS**)
- 2) Why should a surveyor ensure the height of the line of sight always higher than 0.5m above the ground in practice? (**2 MARKS**)
- 3) Why should a surveyor keep having the even number of the level set-ups while one conducts the precise leveling field observation? (**3 MARKS**)
- 4) What approach is commonly applied to significantly reduce the effect of the vertical refraction on the measured height difference in trigonometrical leveling? (**4 MARKS**)

(14 MARKS) QUESTION EIGHT

Describe the GNSS observation method: Conventional Static Positioning.

PART B – PLEASE ANSWER ONLY ONE OF QUESTIONS #9 - #10

(10 MARKS) QUESTION NINE

What is the breakthrough error in a tunnel construction? Specifically explain how to predict the horizontal breakthrough error of a tunnel project.

(10 MARKS) QUESTION TEN

Describe the shaft plumbing method in the orientation and coordinate transmission through two vertical shafts in tunnel project.

PART C – PLEASE ANSWER ONLY ONE OF QUESTIONS #11 - #12

(8 MARKS) Question ELEVEN

Characterize the geodetic deformation monitoring techniques.

(8 MARKS) Question TWELVE

What are the four important requirements for the design parameters of the deformation monitoring scheme and briefly describe them.