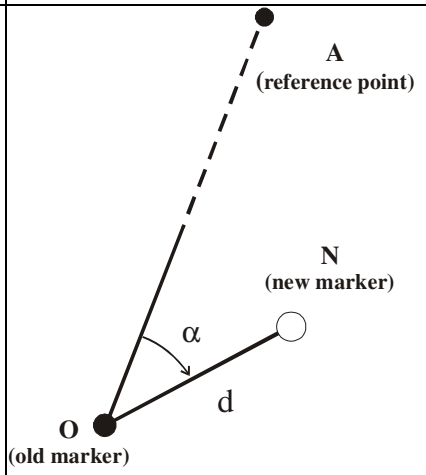
CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS
ATLANTIC PROVINCES BOARD OF EXAMINERS FOR LAND SURVEYORS

SCHEDULE II / ITEM 1 — October 2007

GEODETIC POSITIONING

Note: This examination consists of 3 questions on 2 pages — **Marks**

Q. No — Time: 3 hours — Value — Earned

Q. No		Value	Earned
	a) What is a geodetic datum? Comment on the differences between horizontal, vertical and 3D datum and their relationship.	10	
1	b) Define NAD27, NAD83, NAD83(CSRS), ITRF2000. Explain their realization and the major differences between them.	15	
	c) What are geopotential numbers, how are they obtained and what is their use?	15	
2	 You are reoccupying a GPS network installed 5 years ago for the detection of plate tectonic displacements. Unfortunately, due to the growth of the surrounding trees, the site has become unusable for GPS. You decide to install a new marker ***N*** at a distance of about 450 m and to tie it to the old one ***O*** by means of terrestrial measurements. After installing a theodolite and a distance-meter in ***O*** you measure the oblique spatial distance ***d***, the zenith angle *z*, and a horizontal angle **α** to ***N***. The reference direction for the horizontal angle is an additional marker ***A*** (See sketch). All measurements are corrected for atmospheric refraction and for instrumental height. Hence, they refer to the ground markers. Your task is to calculate the 3D difference vector from ***O*** to ***N*** with respect to ITRF. The ITRF2000 coordinates of ***O*** are known as well as UTM projection coordinates of ***O*** and ***A***.		
	a) Define a local 3D Cartesian reference frame (its origin and orientation) and give the formulas which relate the measurements to the coordinate difference within this frame. Which azimuth do you need? How do you obtain it? Explain the relationship (with formulas) between the local 3D Cartesian reference frame and ITRF2000. What is the influence of the deflection of the vertical and of the geoid undulation?	20	
.	b) The marker A is at a distance of about 5 km and you suspect that the quality of its UTM coordinates is not better than 5 cm with respect to ***O***. Give an estimation of the influence of this uncertainty on the coordinates of ***N***.	5	
	c) You decide to measure the baseline ***OA*** by GPS. You obtain the ITRF2000 coordinates of ***A***. How can you exploit this information for the calculation of the coordinates of ***N***. Do you still need the deflection of the vertical?	5	

	You are in charge of installing a GPS network on Canada Lands in a remote northern location. It consists of 6 markers spread over an area of 10 x 10 km. The nearest CBN marker is more than 1000 km away. An absolute accuracy of better than 10 cm with respect to NAD83(CSRS) and a relative accuracy better than 1 cm are requested. A field trip of 3 days with 2 GPS receivers is scheduled. The final data analysis may be done after the field trip but you are not supposed to return to the area.		
3	a) Which procedure would you suggest to satisfy the accuracy requirements and to guarantee a high level of confidence: choice of receivers, schedule of site occupation, observation techniques, and strategy of data analysis?	20	
	b) Let's now suppose that the task has been carried out successfully. You have obtainedt the geocentric Cartesian coordinates of all markers. However, you also need their orthometric heights. How can you obtain them?	10	
	Total Marks:	**100**	