CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 – GEODETIC POSITIONING

October 2011

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted by the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of 4 questions on 2 pages.

Time: 3 hours

Q. No		Marks Value	Marks Earned
1.	a) What does ICRS stand for? How is this reference system defined? What does ITRS stand for? How is this reference system defined? Explain the transformation between ICRS and ITRS. Which parameters are involved? b) What does NAD83(CSRS) stands for? The transformation between NAD83(CSRS) and any realization of ITRF at any arbitrary epoch (t) can be obtained by a Helmert transformation using 14 parameters instead of 7. Explain this transformation and its parameters (with formulas). How are the parameters obtained?	10 15	
2.	GPS is a navigation system and the basic task is to provide the facility to determine instantaneously a 3D-position, worldwide and 24 hours a day independent of weather conditions. a) Explain in details how a standalone low-cost GPS receiver calculates its position. On which observations does it rely? Which unknowns are determined? Which additional information is needed and how does the receiver get this information? What accuracy can be achieved? b) What does RTK stand for? What are the differences in this approach compared to the basic solution you explained in 2a) in terms of receiver configuration, receiver type, observations, unknowns, additional information and accuracy?	15 15	
3.	a) Define geodetic latitude and longitude. Add a sketch. b) Define astronomical latitude and longitude. c) What is their relationship with the deflection of the vertical. What is the typical order of magnitude of the deflection of the vertical ? Explain the physical origin of this phenomena.	6 4 5	

4.	You are in charge of determining the coordinates of 6 markers distributed over an area of about 5 x 5 km, by RTK. You are tying the 6 markers to 2 known markers P1 and P2 situated at two opposite corners of the area. You have the following information:
	`P1: N45º34'23".54123  W75º24'13".534214   H=56.321 m  GU=–21.43 m`
	`P2: N45º36'26".65307  W75º27'45".887212   H=42.448 m  GU=–21.45 m`
	a) Give an estimate of the distance between P1 and P2 with a resolution better than 100 m. (Hint: You may use a spherical approximation)
	b) **H** stands for orthometric height and **GU** for geoid undulation. Explain the significance of these two parameters. Calculate the ellipsoidal height of P1 and P2.
	c) In order to do RTK, you install a reference receiver on P1 and have to enter the coordinates of this marker. Unfortunately your receiver only accepts 3D Cartesian coordinates ***xyz***. Explain how you obtain these coordinates (with formulas). <u>You do not have to calculate them</u>.
	d) Back at the office you realize that a new better geoid model is available giving for the geoid undulation at P1 and P2 respectively :
	`P1 : GU=–20.942 m` and `P2 : GU=–20.963 m`
	Do you have to redo the RTK survey using these new values? In other words what is the impact of changing to this new model on the determination of the latitude and longitude of the 6 markers, on the determination of their ellipsoidal heights and of their orthometric heights? Please provide arguments to support your answer.
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		10	

	Total Marks:	100	