CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 - GEODETIC POSITIONING

March 2016

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 for the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of 6 questions on 2 pages.

Time: 3 hours

Q. No		Marks Value	Earned
1.	a) Give the definition of the international terrestrial reference system (ITRS). How are its origin and the orientation of its axes defined? Explain the concept of the No-Net-Rotation used in the definition of the ITRS.	10	
	b) The ITRF2014 has been recently published. Explain how the new ITRF2014 solution was obtained. Which spaceborne technics contributed to its realisation?	7	
	c) The transformation between ITRF2014 and ITRF2008 is a 14 parameter transformation. Explain ***with formulas*** the transformation.	8	
	d) Calculate the change (difference of the 3D Cartesian coordinates) at epoch 2016.0 induced by transforming from ITRF2008 to ITRF1993 at a site situated at N50º and W72º. The height may be put to zero.	10	
2.	You are in charge of digitizing and converting old cadaster plans to NAD83 (CSRS). The total area covered is about 2 x 2 km.		
	a) What does NAD83 (CSRS) stand for and how was it realized? Comment on the maintenance of NAD83 (CSRS).	10	
	b) On the old cadaster plans you find the mention NAD27 and a coordinate grid. After digitization you have a list of coordinates in NAD27 of all interesting points. Explain how you proceed to convert these coordinates to NAD83 (CSRS), knowing that you need an accuracy of 15 cm.	5	
	c) In the case where absolutely no information on the cadaster plans is given (no datum, no north orientation, no scale), how would you proceed?	5	
3.	In Canada a new vertical datum has recently been introduced, replacing the old CGVD28 one. What is this new vertical datum called? How is it defined, realized and maintained?	10	

	T1 mm	T2 mm	T3 mm	D 10-9	R1 mas	R2 mas	R3 mas
	-24.0	2.4	-38.6	3.41	-1.71	-1.48	-0.30
Rates	-2.8	-0.1	-2.4	0.09	-0.11	-0.19	0.07

*Table : Transformation parameters at epoch 2010.0 and their rates from **ITRF2008** to **ITRF1993** (source : http://itrf.ign.fr)*

4.	GPS was designed and implemented as a military satellite navigation system in the 1980's. Its primary application is to allow instantaneous positioning world-wide at a metre level. How is this solution obtained? (Explain which observations are used, which additional information is requested and where it comes from. Give the observation equation)	10	
5.	Which other GNSS (Global Navigation Satellite Systems) exist or are presently under development? What do you think will be their impact on surveying in the future?	5	
6.	a) Being involved in a large aerophotogrammetric survey using only ground based control points, you are in charge of determining the coordinates of about 100 markers, which are homogenously distributed over an area of 50 km x 50 km. The only piece of information you get from those responsible is that an accuracy better than 5 cm is required and you decide to use GPS. Which technical specifications would you suggest to satisfy this requirement, in terms of: choice of receiver type, observing technique and strategies, observables used, and data processing strategy? Which deliveries in terms of type of coordinates, datum used and accuracy indicators do you propose? b) What method do you know that would allow you to reduce the number of ground based control points?	15 5	
	Total Marks:	100	