CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 – GEODETIC POSITIONING

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 5 questions on 2 pages.	Ma	<u>rks</u>
<u>Q. No</u>	Time: 3 hours	Value	Earned
1.	This is an extract of an IERS bulletin:		
	DATEx (arcsec)y (arcsec)UT1-UTC (sec)201612300.08250.2639-0.40693201612310.08070.2636-0.407802017110.07900.26350.591272017120.07750.26360.59022		
1.	a) <i>x</i> , <i>y</i> stands for polar motion. Explain the phenomenon of polar motion. How are these values obtained nowadays? What are they needed for?	5	
	 b) Define UT1 and UTC. Which space-geodetic technique allows for the determination of UT1? How is UTC obtained? What happened between December 31st 2016 and January 1st 2017? 	10	
2.	GPS was designed and implemented as a military satellite navigation system in the 1980s. Its primarily application is to allow instantaneous positioning world-wide a a meter 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.)	:	
	The Canadian Height Reference System CGVD28 has been replaced by the new CGVD2013.a) How is the CGVD2013 defined and realized? What are the advantages compared to CGVD28?	7	
3.	b) You just finished a GPS survey. The output of your GPS-software are Cartesian coordinates XYZ with respect to NAD83(CSRS) of all markers. After having transformed them to UTM coordinates and to CGVD28 heights, you are asked to change to the new CGVD2013. Explain in details the impac on the calculation of the UTM coordinates and how you get the CGVD2013 heights.		

June 2020

4.	 You are in charge of checking the fitness for use of the coordinates of about 100 sites, established several years ago by terrestrial means. The requested relative accuracy between all sites is 1 cm horizontally and 2 cm vertically. You decide to measure a control sample by GPS. You select 15 sites which are well distributed over the area of 10 times 10 km and which are suited for GPS. a) Which procedure do you suggest in order to satisfy the accuracy requirements in terms of choice of type of receivers, schedule of site occupation, observation techniques, and strategy of data analysis? The old coordinates of the sites are UTM coordinates with respect to NAD83 (original) together with their orthometric heights. The new coordinates obtained by GPS are Cartesian geocentric coordinates with respect to NAD83(CSRS). b) What do NAD83 and NAD83(CSRS) stand for? What are the major differences between the realization of NAD83 and NAD83(CSRS)? c) Explain in detail the procedure you are applying in order to check the quality of the old coordinates horizontally. d) Explain in detail the procedure you are applying in order to check the quality of the old coordinates vertically. 	15 10 7 8
	Marker A :Height with respect to CGVD2013 : $H = 535.79 \text{ m}$ Height with respect to NAD83(CSRS) : $h_{ell} = 507.80 \text{ m}$ Planar coordinates with respect to NAD83(CSRS) :zone y (m) x (m) scale merid.conv.	
	UTM 19 5 190 722.517 327 586.657 0.999 965 4 -1°39'00.79" MTM 7 5 190 078.210 246 728.524 0.999 941 -0°33'19.89"	
	The central meridians are: $UTM-19 = W69^\circ$ and $MTM-07 = W70.5^\circ$	
	a) Estimate roughly the latitude and longitude of marker A.	6
5.	b) What does UTM and MTM stand for? What do they have in common? What are the differences?	6
	c) Why do the scale and the convergence of the meridian for the same marker differ between UTM and MTM?	3
	 d) Calculate the UTM coordinates of Marker B, knowing that Marker B is exactly 250 m to the north of Marker A. In other words: 250 m is the horizontal distance at the height of the terrain between both markers. (Hint: Where is the geodetic north direction on the UTM-map? A sketch might help.) A resolution of 1 mm is required. 	5
	(<i>Remark valid for all calculations</i> : just giving numerical results without commenting on how you got them will not be accepted).	
	Total Marks:	100