CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 - GEODETIC POSITIONING

October 2019

Note:	This examination consists of 5 questions on 2 pages.	Mar	· <u>ks</u>
<u>Q. No</u>	Time: 3 hours	Value	Earned
1.	<i>A quotation from a publication by David B. Zilkoski (NOAA)</i> : There are several different height systems used by the surveying and mapping community. Two of these height systems are relevant to the International Great Lakes Datum of 1985 (IGLD 85): <i>orthometric heights</i> and <i>dynamic heights</i> . <i>Geopotential numbers</i> relate these two systems to each other.		
	a) Define geopotential numbers and give their SI-units.b) Spirit leveling allows for measuring height differences. Which additional measurements are needed to convert these height differences to geopotential	3	
	differences? How do you obtain the geopotential numbers subsequently? Explain your approach <i>with formulas</i> .	7	
	c) How do you transform dynamic heights to orthometric heights? Explain your approach <i>with formulas</i> .	5	
2.	 Among the Earth rotation parameters (EOP) published by the International Earth rotation service (IERS) are : TAI – UTC UT1 – UTC UT1 – UTC The pole position (x, y) a) Explain briefly TAI, UTC and UT1. How is the difference TAI – UTC obtained? How is the difference UT1 – UTC obtained? Which space geodetic techniques are involved in the determination of these EOPs? b) Explain what is meant by polar position or polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. Which space geodetic techniques allow for the determination of polar motion. 	10	
	 c) Two important modern space geodetic techniques are VLBI and SLR. Choose one of them and explain the acronym, its functional principle, and comment on its contribution to the determination of the various Earth rotation parameters. <i>Start your answer by identifying your choice</i>. 	10	
3.	In 2013 a new vertical datum was introduced in Canada. How has it been realized and how is it maintained? What are the advantages of changing to this new approach? Do you see any disadvantages?	10	

4.	 On the official data sheet of a benchmark (situated in Alberta) you find the following information : Horizontal Datum : NAD83 (updated 93-09-03) 3TMCoordinates Scale Factor 0.999900 at Reference Meridian : 114° Northing : 5 794 901.393 m Easting : 13 543.364 m Convergence : 00° 09' 25."32 Station Ellipsoid Factor : 0.999864 Station Combined Factor : 0.999767 a) What are 3TM-coordinates? For a site situated in Canada is the Northing always larger than the Easting? If yes, why? b) What is meant by Convergence. What is its use? c) What is the Scale Factor (at Reference Meridian), the Station Ellipsoid Factor and the Station Combined Factor? Why are they different? What is their use? d) Make a rough estimation of the latitude of this benchmark. Give your result with a resolution of 1'. e) Make a rough estimation of the longitude of this benchmark. Give your result with a resolution of 1'. (just giving numerical results without commenting on how you got it will not be accepted). 	3 4 8 5 5	
5.	 RTK is a broadly used GPS-technique allowing for a rapid determination of coordinates. a) Explain the acronym of RTK. Comment briefly on how it works. What type of GPS observations are used? Which accuracy can be achieved? b) Why are dual frequency measurements mandatory or at least of an enormous benefit compared to single frequency measurements (in RTK)? c) What does PDOP stand for? How is it obtained? What is its use? d) There have been several enhancements and improvements of the traditional RTK approach, like e.g. the use of a virtual reference station. Explain briefly this concept and comment on the infrastructure needed. 	8 7 5 5	
	Total Marks:	100	