

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 - GEODETIC POSITIONING

March 2015

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.

Marks

Q. No

Time: 3 hours

Value Earned

1.	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 on weather conditions. With respect to how a standalone low-cost GPS receiver calculates its position:		
	a) Explain briefly how a pseudo-distance is measured by the receiver.	4	
	b) Which unknowns are determined?	4	
	c) Give the observation equation related to the pseudo-distance. Explain your symbols.	4	
	d) Which additional information is needed in order to obtain a solution?	4	
	e) What accuracy can be achieved?	4	
2.	a) Define geodetic latitude, geodetic longitude, and height. Add a sketch.	8	
	b) Define the deflection of the vertical. What is the typical order of magnitude of the deflection of the vertical? Explain the physical origin of this phenomenon.	4	
	c) Give a geodetic application where the deflection of the vertical is taken into account or used.	3	
3.	a) 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).	15	
	b) How were the parameters for the transformation between NAD83(CSRS) and ITRF2008 obtained?	5	
4.	What is the name of the official new vertical datum 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?	15	

5.	<p>On the official data sheet of a benchmark (situated in Alberta) you find the following information :</p> <p>Horizontal Datum : NAD83 (updated 93-09-03)</p> <p>3TMCoordinates <i>Scale Factor</i> 0.999900 <i>at Reference Meridian :</i> 114° <i>Northing :</i> 5 794 901.393 m <i>Easting :</i> 13 543.364 m <i>Convergence :</i> 00° 09' 25."32 <i>Station Ellipsoid Factor :</i> 0.999864 <i>Station Combined Factor :</i> 0.999767</p> <p>Vertical Datum : CGVD28 <i>Elevation</i> 884.423 m</p> <p>a) What are 3TM-coordinates? Why is the Northing larger than the Easting? b) What is meant by <i>Convergence</i>? What is its use? c) What is the <i>Scale Factor (at Reference Meridian)</i>, the <i>Station Ellipsoid Factor</i> and the <i>Station Combined Factor</i>? Why are they different? What is their use? d) You need the geocentric equatorial Cartesian 3D-coordinates (XYZ) with respect to NAD83 with a resolution of 1 m. Explain how you proceed to calculate them? Is there information missing? If yes which one and where can you find it?</p>	4 3 8 10	
6.	Explain how the time reference UTC is defined and realized. What is its use?	5	
Total Marks:		100	