CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 - GEODETIC POSITIONING   October 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 7 questions on 2 pages.   <u>Marks</u>

Q. No	Time: 3 hours	Value	Earned
1.	On the official data sheet of a benchmark (situated in Alberta) you find the following information : ***Horizontal Datum : NAD83 (updated 93-09-03)*** **3TM Coordinates** *Scale Factor 0.9999 (at Reference Meridian = 114°W)* *Northing : 5 794 901.393 m (no false northing)* *Easting : 13 543.364 m (no false easting)* *Convergence : 00° 09' 25."32* ***Vertical Datum : CGVD28*** *Elevation 884.423 m* a) 3TM-coordinates and 10TM-coordinates belong to the same type of TM coordinates. Explain briefly what TM coordinates are. What is the difference between 3TM and 10TM coordinates? What are false easting and northing in relation with TM-coordinates? b) Estimate the marker's latitude and longitude with a resolution of 0.1 degrees. c) What is meant by *Convergence*. What is its use? d) You need 10TM coordinates of this marker with respect to NAD83. Explain your procedure to convert the 3TM to 10TM coordinates.	5 6 3 6	
2.	a) Define ITRS (its origin and the orientation of its axes) and comment on its different realizations, the ITRF's. b) In Canada the official datum in use is NAD83-CSRS. How was this datum realized and how is it maintained? (brief answer) c) What type of transformation do you need to transform NAD83-CSRS to ITRF's coordinates? Explain the details (with equations). Which is the order of magnitude of the change in coordinates?	6 4 15	
3.	In Canada a new vertical datum has recently be introduced, replacing the old CGVD28 one. What is this new vertical datum called? How is it defined, realized and maintained?	10	

4.	In the last decade PPP has become a more and more powerful tool in GNSS positioning. What does PPP stand for? Explain the principles of PPP and comment on its advantages and disadvantages compared to RTK. Describe in detail one application where you would prefer a PPP solution.	15	
5.	GLONASS is the Russian Satellite Navigation System similar to the American GPS. What common features do the two systems share? What are the major differences? (in terms of constellation, satellite signals, antenna and receiver design, interoperability, ambiguity resolution strategies)	10	
6.	Australia is presently undertaking a substantial datum modernization. *From 2020, it is proposed to transition from a conventional datum to a reference frame. The national reference frame, the ATRF (Australian Terrestrial Reference Frame), will accommodate coordinate locations that change over time and be highly accurate with respect to ITRF. Given the tools and services accompanying the new reference frame, the geospatial community will be afforded the flexibility to adopt a fixed reference epoch (whether by national convention or arbitrarily chosen on a project by project basis). The ATRF will be an authoritative realisation of coordinates and velocities of continuously operating reference stations and survey control marks throughout Australia.* **(http://www.icsm.gov.au/geodesy/modern.html)** a) Describe the ***existing*** Canadian geodetic infrastructure which would allow for a similar approach as underway in Australia leading to a Canadian Terrestrial Reference Frame (CTRF).	5	
	b) In your opinion, what would be the advantages and disadvantages of such a CTRF compared to NAD83-CSRS? Would you personally be in favour to switch to such a CTRF?	5	
7.	a) Define UT1 and explain how it is obtained nowadays. Explain the role VLBI and GPS are playing in its determination.	4	
	b) What does TAI stand for? Explain how this time reference is realized. What does UTC stand for? What can be said about the differences: $\Delta_1 = UTC - TAI$ and $\Delta_2 = UTC - UT1$?	6	
	Total Marks:	100	