CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C6 – GEODETIC POSITIONING

March 2019

Note: This examination consists of 4 questions on 2 pages.

Time: 3 hours

Q. No		Marks Value	Earned
1.	a) What does the acronym ITRS stand for? Give its definition. How are its origin and the orientation of its axes defined? What is the difference between ITRS and ITRF. Which space-geodetic techniques are contributing?	10	
	b) The transformation between ITRF2014 and NAD83(CSRS) is a 14 parameter transformation Explain ***with formulas*** the transformation. Besides the values of the 14 parameters, which additional information is needed in order to perform this transformation? Why is a 7-parameter transformation not sufficient?	10	
	c) Suppose, that next year, Canada would replace NAD83(CSRS) by ITRF2014 as the official 3D-datum to be used nationwide. What would change for a surveyor? Which would be the advantages and disadvantages of such a major change? Would you personally be in favour or against such a change? Argue.	5	

2.	This is an extract of an IERS bulletin:
	
	`DATE x(arcsec) y(arcsec) UT1-UTC(sec)`
	`2016 12 30 0.0825 0.2639 -0.40693`
	`2016 12 31 0.0807 0.2636 -0.40780`
	`2017 1 1 0.0790 0.2635 0.59127`
	`2017 1 2 0.0775 0.2636 0.59022`
	
	a) *x, y* 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	

3.	Marker **A** : Altitude with respect to CGVD28 : H = 535.79 m Altitude with respect to NAD83(CSRS) : h_{ell} = 507.80 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 4 -0°33'19.89" The central meridians are : UTM-19 = W69° and MTM-07 = W70.5° a) Estimate **roughly** the geocentrical Cartesian coordinates xyz of Marker **A**. (Hint: First find latitude and longitude. You might then use a spherical approximation). b) What does UTM and MTM stand for? What do they have in common? What are the differences? c) Calculate the UTM coordinates of Marker **B**, knowing that Marker **B** is exactly 500 m to the geodetic east of Marker **A** at the same height. In other words: 500 m is the horizontal distance at the height of the terrain between both markers. (Hint: Where is the geodetic east direction on the UTM-map? A sketch might help.) A resolution of 1 mm is required. d) Since 2013 a new vertical datum is in effect in Canada. Explain how heights with respect to this new CGVD2013 can be determined directly from GPS. e) How can you obtain the height of marker **A** with respect to CGVD2013 using the given altitude information? (Short answer is sufficient) *(**Remark valid for all calculations**: just giving numerical results without commenting on how you got them will not be accepted).*	10 7 10 5 3	
4.	a) GPS is the well-known US satellite navigation system. Which other Global Navigation Satellite Systems (GNSS) are in operation or under development? Name 2 major benefits in having more than one GNSS at disposal for geodetic applications. b) What does PPP stand for? How does it work? Give a geodetic application where you would use PPP. c) What does RTK stand for? How does it work? Give a geodetic application where you would use RTK. d) What does DOP stand for? There are several DOP's (GDOP, PDOP, HDOP, VDOP). What are the differences between them? What are the use of the DOP's? e) What does WAAS stand for? How does it work? Comment on its use.	5 5 5 5 5	
	Total Marks:	100	