CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS
ATLANTIC PROVINCES BOARD OF EXAMINERS FOR LAND SURVEYORS

SCHEDULE II / ITEM 1 — October 2008

GEODETIC POSITIONING

Note: This examination consists of 3 questions on 2 pages

Time: 3 hours

Q. No		Marks Value	Marks Earned
1	Traditionally a vertical datum is established by using spirit leveling and gravity measurements. a) Explain briefly the basic functional principle of a relative gravimeter and comment on the design of a gravimetric survey using this type of instrument. b) What are geopotential numbers and how are they obtained from spirit leveling and gravity measurements? *(give formulas)* c) What is the reference surface used in such a vertical datum? Why does it differ from an ellipsoid and by how much with respect to an ITRF-GRS80 ellipsoid? d) In Canada this traditional approach will be replaced in the future by a new modern one. How will the vertical datum then be defined, realized and maintained?	10 15 5 5	
2	You accepted a new job as head of the National Geodetic Surveying Department in Tongabundu, an island somewhere in the Pacific. The island measures about 200 km x 80 km. The dense population is quite homogenously distributed. All parts of the island are easily accessible by a well developed road network. Your task consists in establishing a new modern national datum for this island. You have a special budget of 150 k$Can for the infrastructure (GPS-receivers, antennas, installations, etc.) and 6 months time. The salaries of your team consisting of 5 technicians as well as the expenses for field trips are paid from a different source. You decide to install an active and a passive network. a) Explain your strategy based on your budget and the manpower to solve this task within the allocated time period. Give the technical specifications for the active network: number of stations, the installation criteria, the type of receivers and antennas, the measuring rate, the data flow, and the online data accessibility. Give the technical specifications for the installation and surveying of the passive network: the number of points, the type of receivers used, the occupation strategy, the measuring rate, the data analysis. Add a coarse time schedule for the 6 months. b) How do you define the national datum in terms of 3D Cartesian coordinates? Comment on their link to ITRS and the way plate tectonic movement is handled. Which ellipsoid parameters do you suggest? c) Which projection do you use as national projection? Argue.	20 10 5	

3	The geodetic coordinates of point A and B with respect to the GRS80 ellipsoid are: Point-A N45º 57' 02."3453 W71º43' 21."3478 Point-B N45º 55' 54."4557 W71º43' 43."6788 a) Calculate an approximate value for the geodetic azimuth from A to B with a resolution of 1'. b) Explain the difference between an astronomical and a geodetic azimuth. c) Explain the difference between a geodetic azimuth and a grid bearing with respect to a cartographic projection. d) What is the maximum difference between a geodetic azimuth and a grid bearing in the UTM projection at a mid-latitude and its influence on the coordinates over a distance of 1 km? For question 3a): Some formulae which may be helpful or not depending on the approach you opt for: $$ds^2 = R_M^2 d\varphi^2 + R_N^2 \cos^2\varphi \, d\lambda^2$$ $R_N = \frac{a}{\left(1 - e^2 \sin^2 \varphi\right)^{1/2}}$ and $R_M = \frac{a\left(1-e^2\right)}{\left(1 - e^2 \sin^2 \varphi\right)^{3/2}}$ GRS80-values : a = 6378137 m f = 1/298.257222101 ($e^2 = 2f - f^2$)	15 5 5 5	
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