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

SCHEDULE II / ITEM 1 — March 2008

GEODETIC POSITIONING

Note: This examination consists of 5 questions on 2 pages

Time: 3 hours

Q. No		Marks Value	Marks Earned
1	a) What is the difference between a classical 2D datum like NAD27 and a modern 3D datum like ITRF2000? Explain briefly how both have been established.	10	
	b) A vertical datum can be established using spirit leveling and gravity measurements. Explain the role of geopotential numbers in this task. In which unit are geopotential numbers given?	10	
	c) Nowadays GPS is widely used for positioning purposes. The height obtained from GPS is basically a height above the ellipsoid. Would it not therefore be more suitable to drop the geoid as a reference surface completely and to switch to the ellipsoid as vertical datum using ellipsoidal heights only? Provide arguments.	5	
2	a) What are the characteristics, the applications and attainable accuracy of: i. Dual-frequency Real Time Kinematic (RTK), ii. Precise Point Positioning (PPP), and iii. Single-frequency Differential GPS (DGPS)?	12	
	b) Comment on the disturbing potential of the troposphere and the ionosphere on the above mentioned methods i.e.: RTK, PPP, DGPS.	8	
3	a) Define geodetic azimuth and astronomical azimuth. What information is necessary to convert an astronomical azimuth to a geodetic one? Give the typical order of magnitude of their difference. Which error amount (in cm) do you may expect over a distance of 10 km if you neglect this correction?	10	
	b) Define the meridian convergence related to a conformal projection like UTM. Explain how you convert a geodetic azimuth to a grid bearing. Where do the largest differences for UTM occur? Give their order of magnitude.	10	
4	a) Being involved in an old-fashioned large aerophotogrammetric survey using only ground based control points, you are in charge of determining the coordinates of about 200 of them by means of GPS. The points are homogenously distributed over an area of 50 km x 50 km. Unfortunately the responsible persons are not really experts and the only piece of information you get is that an accuracy better than 5 cm is required. Which technical specifications would you suggest to satisfy this requirement, in terms of: choice of receiver type, observing technique, observables used, and data processing strategy? Which deliveries in terms of coordinates and accuracy indicators do you propose?	15	
	b) Explain a method that would reduce the number of ground based control points.	5	

5	The geodetic coordinates of 2 points 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 Calculate the approximate distance (on the ellipsoid) between the 2 points with a resolution of better than 1 m. 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	
		100	