ASSOCIATION OF CANADA LANDS SURVEYORS - BOARD OF EXAMINERS
WESTERN CANADIAN BOARD OF EXAMINERS FOR LAND SURVEYORS
ATLANTIC PROVINCES BOARD OF EXAMINERS FOR LAND SURVEYORS

SCHEDULE II / ITEM 1 — March 2006

GEODETIC POSITIONING

Note: This examination consists of 4 questions on 2 pages — **Marks**

Time: 3 hours

Q. No		Marks Value	Marks Earned
1	(a) What is a vertical datum? (b) What is the difference between orthometric height and geodetic height? (c) In practice, what would you do to transform from one to another? (d) Define sea surface height. (e) Natural Resources Canada intends to adopt a geoidal model as the vertical frame in the future. What consequences, if any, would this decision bring to those who only need to use total stations for their professional practice?	25	
2	(a) What are the differences between DGPS and RTK positioning? (b) What makes "ambiguity" so important in GPS carrier phase positioning? (c) What would be the order of magnitude of errors in GPS positioning if the ionospheric delays are not modelled at all? (d) What accuracy would you associate with: (i) GPS pseudorange point positioning? (ii) GPS carrier phase relative positioning? (e) How would you classify GPS receivers in terms of observables, accuracy and applications?	25	
3	(a) The radius of curvature of the meridian section M and the radius of curvature of the prime vertical section N are given by the following equations (where a represents the semi-major axis, e the eccentricity and ϕ the latitude). Where on the Earth's surface do the values of M and N show the largest difference? Why? $N = \frac{a}{(1-e^2 \sin^2 \phi)^{1/2}}$ $M = \frac{a(1-e^2)}{(1-e^2 \sin^2 \phi)^{3/2}}$ (b) The motion of an artificial satellite can be described by six Keplerian elements: the major-semi axis of the orbital ellipse a, the eccentricity of the orbital ellipse e, the inclination of the orbital ellipse i, the argument of perigee ω, the right ascension of the ascending node Ω and the true anomaly f. Define ω, Ω and f.	25	

	(c) What is the difference between a passive and an active positioning system? (d) You are given the tropospheric delay value for two satellites: PRN01 = 3 m; PRN15 = 15 m. Which satellite is higher in the sky? Why? (e) What is the difference between a coordinate frame and a coordinate system?		
4	You are charged with writing the technical specifications for a survey using GPS. The area of the survey is surrounded by 3 Canadian Base Network (CBN) monuments, 100 km away from the survey area. You will write the specifications in two parts. In the first part, you will be establishing a number of control points in the survey area. These control points will be connected to the nearby CBN monuments. In the second part, you will determine the coordinates of several points using RTK. The latter points are close to the control points by 10 km or less. The final coordinates are required to have cm-level accuracy. GPS is the system to be used throughout the survey. What technical specifications would you suggest to satisfy the accuracy requirement, in terms of: choice of receiver types, observing techniques, observables used, error mitigation, choice of station sites, contents of a final report?	25	
	Total Marks:	**100**	