

**CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS**

**SCHEDULE II / ITEM 1  
GEODETTIC POSITIONING**

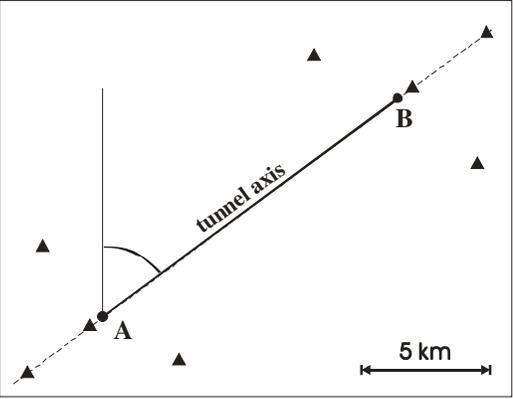
**March 2009**

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 by the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

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

**Marks**

<u>Q. No</u>	<u>Time: 3 hours</u>	<u>Value</u>	<u>Earned</u>
<b>1</b>	a) How is the International Terrestrial Reference System (ITRS) defined, realized and maintained. Enumerate the different observation techniques used and comment on the difference between a specific ITRF and the ITRS.	15	
	b) What is the difference between ITRS and NAD83(CSRS) ? Explain the transformation between ITRF2000 and NAD83(CSRS) 3D Cartesian coordinates.	11	
	c) If one looks back, an important realization of NAD was NAD27. Enumerate and explain 3 major differences in the definition and/or realization of NAD27 and NAD83(CSRS).	9	
<b>2</b>	a) What are the characteristics, the applications and attainable accuracy of: <ul style="list-style-type: none"> <li>- Dual-frequency Real Time Kinematic (RTK)?</li> <li>- Precise Point Positioning (PPP)?</li> <li>- Single frequency Differential GPS (DGPS)?</li> </ul>	12	
	b) Comment on the disturbing potential of the troposphere and the ionosphere on the above mentioned methods i.e.: RTK, PPP, DGPS.	8	
<b>3</b>	a) 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? Argue.	5	

4		<p>You are the responsible surveyor in chief involved in the construction of a tunnel. Tunneling will be done starting simultaneously at both portals and the break-through will be at midway. The civil engineer in charge wants you to guarantee an error less than 3 cm horizontally and 1 cm vertically at the break-through. He hands you out the UTM coordinates of the points A and B, corresponding to the starting and end point of the planned tunnel (see sketch).</p>	20	
	<p>a) Your first task is to establish a reference network of a total of 8 markers (2 times 4 markers at each end) using GPS. Based on the above requirements, which procedure would you suggest: choice of receivers, schedule of site occupation, observation techniques, and strategy of data analysis? What will be your final result in terms of <u>type of coordinates</u> and <u>datum they refer to</u>?</p>		10	
	<p>b) <i>Theoretical questions</i> : What is the difference between an astronomical azimuth and a geodetic azimuth? What is the difference between a geodetic azimuth and a grid bearing with respect to UTM ?</p>		10	
	<p>c) <i>Applied to the tunnel</i> : You have UTM coordinates of A and B and the GPS results for all your markers. From now on you use a theodolite for controlling the direction of the heading since GPS will not work in the tunnel. Explain in details how you proceed. Comment on the influence of the deviation of the vertical.</p>		10	
		<b>100</b>		