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 I / ITEM 3
ADVANCED SURVEYING

February 2001
(1990 Regulations)
(Closed Book)

This examination consists of __7__ questions on __3_ pages
Astronomical tables and formula sheets are attached.
All numerical answers must be supported with calculations.

Q. No. **Time: 3 hours** **Marks**

1.	For accurate azimuth determination by observations to stars, it is important to correct the observed horizontal directions for dislevelment of the horizontal axis. a) There are two possible reasons for the horizontal axis of a theodolite not being horizontal. Describe these two reasons and how these error sources can be accounted for. b) The following circle readings were recorded when observing Polaris: Horizontal circle reading in direct 25°23′20″ Horizontal circle reading in reverse 205°23′50″ Average vertical circle reading of 43°07′17″ Direct and reverse (face I and II) (Note: Vertical circle reading is 90° on theodolite's horizon.) The vertical axis of the theodolite is tilted by 30″ in the direction of the telescope when pointing towards Polaris, and tilted by 20″ perpendicular to the telescope when pointing towards Polaris. What is the corrected horizontal circle reading to Polaris?	15
2.	The reference manual for an electro-optical EDM gives the following equation for use in correcting distance readings for atmospheric effects: $N = \frac{108P}{273+t}$ where P is pressure in mmHg t is temperature in °C The calibration refractivity is 300. Stations A, B and C are on a straight line. The following distances are measured with an EDM when the temperature is 28°C and pressure is 750 mmHg: Distance AB = 2012.535 m Distance AC = 4021.909 m Distance BC = 2009.342 m a) What is the EDM system measurement constant? b) What is the corrected distance from A to C?	10

3. The NAD83(CSRS) position of the St. Catharines pillar determined during the Canadian Base Network (CBN) campaign is:

latitude = 43°07′17″ N
longitude = 79°13′36″ W
ellipsoidal height = 142.951 m
geoidal height = -35.742 m
orthometric height = 178.693 m

The UTM coordinates are:

N = 4 775 829.025 m
E = 644 245.656 m

The GRS80 reference ellipsoid has a = 6378137 m and 1/f = 298.257222101.

A distance of 1025.845 m was measured from the St. Catharines pillar to a control monument.

(a) What is the grid distance from the pillar to the control monument?

(b) What is the distance on the reference ellipsoid?

(c) What is the combined scale factor?

(d) What is the UTM zone width at the latitude of the pillar to the nearest kilometre?

(e) What is the UTM zone number?

15

4. Discuss the differences among geodetic azimuths derived from GPS observations, astronomic azimuth derived from observations to Polaris and a grid azimuth derived from UTM coordinates. 10

5. Discuss the differences among ellipsoidal heights derived from GPS, heights derived directly from levelling, published CGVD28 orthometric heights and geopotential height differences. 10

6. The following data was obtained from observations on Polaris:

Date: 10:00 pm EST, February 15, 2001
Latitude: 43°07′17″ N
Longitude: 79°13′36″ W

Point Sighted	D/R	HCR	Universal Time
20 RO	D	22°07′30″	
Polaris	D	96°00′20″	$3^h\ 38^m\ 39^s$
21 Polaris	R	276°00′54″	$3^h\ 41^m\ 42^s$
RO	R	202°07′42″	

(a) Determine the astronomic azimuth of the Reference Object (RO).

(b) Illustrate, on a Celestial sphere, for these observations: the Greenwich Hour Angle (GHA); Local Hour Angle (LHA) and declination (δ) of Polaris at the time of observation; the Azimuth of Polaris ($Az_{\star}$); Local Meridian of the observer; Greenwich meridian; Longitude of local meridian; Celestial equator; North Celestial Pole (NCP); Horizon; Zenith; North point and East point. 25

7.	The sun's centre reached a maximum altitude of 34°24′06.2″ (after corrections for refraction and parallax) on February 15, 2001 at $12^h\,31^m\ 00.44^s$ Eastern Standard Time. (a) Illustrate, on a Celestial sphere, the sun at culmination. Show the altitude of the sun, declination of the sun, latitude of the observer and the local meridian. (b) Determine the latitude and longitude of the observer.	15

Total Marks: 100