

SCHEDULE I / ITEM 6

March 2010

CARTOGRAPHY AND MAP PROJECTIONS

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

Note: This examination consists of 6 questions on 2 pages.

Q. No	Time: 3 hours	Marks	
		Value	Earned
1.	Your company has just been awarded a project to create a map (using only one projection) showing the route of a pipeline in an area (latitudes 42°N to 84°N and longitudes 92°W to 141°W). Design a suitable map projection for this project if scale distortions in the area must be kept to a minimum, explaining reasons for your choices. Your design must clearly explain the aspect, distortion characteristic, developable shape, locations of standard lines, locations of central parallel and central meridian, and suggested name of projection type.	10	
2.	<p>The point scale factor (k) and the meridian convergence (C) at any given point (ϕ, λ) on a UTM projection can be approximated using the following formulas:</p> $k = k_0 \left[1 + \frac{(L \cos \phi)^2}{2} \right]; \quad \tan(C) = -(\sin \phi) \times \tan(\lambda - \lambda_{CM})$ <p>where $L = (\lambda - \lambda_{CM})$ expressed in radians; λ_{CM} is the longitude of the central meridian; k_0 is the scale factor at the central meridian; and ϕ and λ are the latitude and longitude values of the given point.</p> <p>a) At what distance (in degrees, minutes, seconds) away from the central meridian, along the equator, is the UTM scale distortion equal to zero?</p> <p>b) If a scaling accuracy ratio of 1:10,000 is to be maintained in the given zone and a Modified Transverse Mercator (MTM) projection (similar to UTM) is to be used, determine minimum and maximum scale factors and the maximum width (in degrees, minutes, seconds) of the zone, at the equator.</p> <p>c) Given the central meridian of a UTM zone 10 as 123° W; the geodetic coordinates of point B as Latitude = 50°00'0.000" N, Longitude = 124°00'10.000" W; and the corresponding UTM coordinates of point B as Northing = 5539112.50 m, Easting = 428134.53 m; answer the following:</p> <p>i. Calculate (on the UTM plane) the meridian convergence (to the nearest arc seconds) and the point scale factor (to six decimal places) for point B. Would this convergence angle change for the MTM zone if the MTM projection zone and the UTM zone have the same central meridian? Clearly explain your answers.</p> <p>ii. If the Modified Transverse Mercator (MTM) projection zone in (b) above and the UTM zone have the same central meridian, what are the MTM coordinates of point B (assuming the MTM False Easting = 4,500,000.00 m, False Northing = 0.00 m)?</p>	4 5 6 10	

3.	Given the principal scale of a map (on a UTM projection) as 1:250,000, calculate the local scale at a point P on the central meridian of the mapping zone and indicate if the scale is smaller or larger than the principal scale. If a distance of 100 km is measured along the central meridian on the reference surface of the Earth, what is the corresponding distance on the map? If you measured this distance with a millimetre scale on the map, what value would you obtain?	5	
4.	Some cartographic elements should appear on all cadastral maps in order to facilitate their functionality, while other elements may be included as optional according to local needs or resources. a) List and clearly describe the functions of those elements that should appear on all cadastral maps. b) What is GIS topology? Discuss two examples of how GIS topology can be employed in Cadastral mapping. c) Discuss two important advantages of GIS-based Cadastral mapping over the traditional one that is not based on GIS.	15 6 3	
5.	Clearly explain the essential differences between the following terms as used in cartography. Your explanations must clearly demonstrate your understanding of each of the terms. a) Map reproduction and map compilation. b) Nautical chart and a map. c) Grid and a grid reference system. d) Map layout and Map manuscript.	4 4 4 4	
6.	Answer the following as clearly and as completely as possible. a) What is Moiré pattern in color process printing? How do you avoid this problem? b) Measured field elevations of points can be considered as interval or ratio data. Explain the correctness of this statement. c) How would you recognize and resolve the need for cartographic generalization? d) What is the Canadian Geospatial Data Infrastructure (CGDI)? How will developing cartographic applications benefit from the infrastructure?	4 4 6 6	
Total Marks:		100	