CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

March 2016

Note: This examination consists of ten questions on one page.

Time: 3 hours

Q. No		Marks Value	Earned
1.	a) For a simple curve y = f(x) in the plane, what are continuity and differentiability at some point x_o? Illustrate the situation with simple diagrams.	5	
	b) Does continuity imply differentiability in the previous planar case? Explain.	5	
2.	a) Given two simple curves f(x) and g(x) in the plane, when do these have the same slope for some x_o?	5	
	b) When do these curves f(x) and g(x) become tangent for the same x_o?	5	
3.	a) Given three arbitrary vectors **a**, **b** and **c** in three-dimensional Cartesian space, what is $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$ in the usual matrix form? Give a numerical example.	5	
	b) With these vectors **a**, **b** and **c**, is $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$ the same as or equal to $(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{c}$?	5	
4.	a) What are the first three terms in the Taylor expansion of $f(x) = e^{\sin x}$ about x=1?	5	
	b) What can be said about the remainder term in the previous Taylor series?	5	
5.	a) Check analytically that the infinite series $1 + 1/2 + 1/3 + \ldots + 1/n + \ldots$ diverges as $n \to \infty$	5	
	b) Check analytically that the infinite series $1 + 1/4 + 1/9 + \ldots + 1/n^2 + \ldots$ converges as $n \to \infty$ (Hint: consider the partial sums)	5	
6.	a) Given an upper triangular matrix $A = [a_{ij} \mid i \& j = 1,2,3]$, what is its determinant? Give a numerical example.	5	
	b) Express a general square matrix $B = [b_{ij} \mid i \& j = 1, \ldots, N]$ as the sum of a symmetric matrix S and a skew-symmetric matrix T. Give a simple example.	5	
7.	a) The linear algebraic system $\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 6 \\ 15 \\ 24 \end{pmatrix}$ which is singular has the obvious solution x = y = z = 1. Any other possible x, y and z solution? Briefly explain the situation.	5	
	b) When the corresponding linear system of algebraic equations is homogeneous, is the situation any different from the preceding one? Explain.	5	
8.	a) Given an ellipse with semi-axes a and b at the origin, set up the integral for its circumference.	5	
	b) Given an ellipse with semi-axes a and b at the origin, set up the integral for its area.	5	
9.	a) What is the gradient of the function $f(x,y,z) = x^2y^3z^4$ in Cartesian space?	5	
	b) What is the Laplacian of the function $f(x,y,z) = x^2y^3z^4$ in Cartesian space?	5	
10.	Given two arbitrary points P and Q on the surface of the Earth, what is the spherical distance between them given their respective geocentric latitude φ and longitude λ?	10	
	Total Marks:	100	