

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2011

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

Marks

Q. No

Time: 3 hours

Value Earned

1.	a) Define continuity of a function as a limit. Illustrate with a simple diagram.	5	
	b) Define differentiability of a function as a limit. Illustrate with a simple diagram.	5	
2.	a) Given two points $P = (x_1, y_1, z_1)$ and $Q = (x_2, y_2, z_2)$ in Cartesian space, what is the vector \overline{PQ} in Cartesian coordinates?	5	
	b) What is the same vector \overline{PQ} in spherical polar coordinates? Express those vector components in terms of the Cartesian coordinates of P and Q.	5	
3.	a) What is the Taylor series expansion of $e^{\sin x}$ about $x=0$? Evaluate only the first three terms.	5	
	b) What is the inverse function of $y = e^{\sin x}$?	5	
4.	a) Complex numbers are two-dimensional quantities. Explain briefly with examples.	5	
	b) What are called the n-th roots of unity? Illustrate with $n = 1, 2, 3$.	5	
5.	a) What is the result of the dot or scalar product of two nonzero vectors in three-dimensional space? Give some simple numerical examples.	5	
	b) What is the result of the cross or vector product of two nonzero vectors in three-dimensional space? Give some simple numerical examples.	5	
6.	a) Given a small 3×3 matrix $A = (1 \ 2 \ 3 ; 4 \ 5 \ 6 ; 7 \ 8 \ 9)$, written row-wise, what are the upper triangular matrix U and lower triangular matrix L such that $A = U + L$? Are L and U unique?	5	
	b) Evaluate explicitly the characteristic polynomial of the preceding matrix A .	5	
7.	a) For variable vectors V in three-dimensional space, what does $V^T V = 1$ represent?	5	
	b) For variable vectors V in three-dimensional space, what does $V^T W V = 1$ represent for some positive diagonal matrix W ?	5	
8.	a) Given three linear equations: $x + 2y + 3z = 5$, $x + y - 2z = 8$, $x - 2y + z = 12$, evaluate x , y and z by Gaussian elimination.	5	
	b) Solve the preceding three equations for x , y and z using matrix algebra.	5	
9.	a) Given the differential equation: $du / dx + u = 3$, what is the general solution?	5	
	b) Given another differential equation $d^2v / dx^2 + 3v = 0$, what is the general solution?	5	
10.	a) At a point H on the spherical Earth, what is the direction of the normal at H?	5	
	b) At a point G on the ellipsoidal Earth, what is the direction of the normal at G? Briefly describe the general situation.	5	
Total Marks:		100	