

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2019

Note: This examination consists of 10 questions on 2 pages.

<u>Q. No</u>	<u>Time: 3 hours</u>	<u>Marks</u>	
		<u>Value</u>	<u>Earned</u>
1.	a) What are the first three terms of the Taylor expansion of x^5+1 about $x=1$?	5	
	b) What is the remainder after those three terms in the previous Taylor expansion?	5	
2.	a) In Cartesian (x,y,z) space, what is the scalar or dot product of two vectors (a,b,c) and (d,e,f) ? Illustrate the situation geometrically.	5	
	b) What is the vector or cross product of these two vectors (a,b,c) and (d,e,f) ? Illustrate the situation geometrically.	5	
3.	a) Given an arbitrary square real matrix, what are its trace and its determinant?	5	
	b) What is called the singular value decomposition of an arbitrary rectangular matrix? Give a simple example with explicit dimensions.	5	
4.	a) In three-dimensional Cartesian coordinates, what is the equation of a triaxial ellipsoid with semi-axes a , b and c ?	5	
	b) In three-dimensional spherical polar coordinates, what is the equation of a unit sphere?	5	
5.	a) For the quadratic equation $x^2 + x + 1 = 0$, what are its roots explicitly?	5	
	b) The cubic equation $x^3 + x^2 + x + 1 = 0$ obviously has $x = -1$ as a root. What are the others?	5	
6.	a) On the sphere of radius R in Cartesian (x, y, z) space, what is the transformation from (spherical) latitude ϕ and longitude λ to x , y , and z ?	5	
	b) What is the inverse transformation from x , y , z to ϕ and λ on the sphere?	5	
7.	a) The harmonic series $1+1/2+1/3+\dots+1/n+\dots$ diverges. What does that mean in terms of the partial sums?	5	
	b) The series $1+1/4+1/9+\dots+1/n^2+\dots$ converges. What does that mean in terms of the partial sums?	5	
8.	a) For a simple function $f(x)$ over the real line, what is the geometrical interpretation of its first derivative $f'(x)$? Illustrate the answer graphically.	5	
	b) For the same simple function $f(x)$ over the real line, what is the geometrical interpretation of its second derivative $f''(x)$? Illustrate the answer graphically.	5	

9.	a) Given the linear equations $x + y + z = 5$, $x - y - z = 1$, $x + 2y + 3z = 8$, what are x , y and z by Gaussian elimination?	5	
	b) For the previous linear equations, verify the obtained x , y and z by Cramer's rule.	5	
10.	a) What is the difference between symmetric and skew symmetric matrices? Illustrate with small matrices.	5	
	b) What is a positive definite matrix? Give an example.	5	
Total Marks:		100	