CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2014

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

Q. No Time: 3 hours Value Earned

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1.	a) Given a simple function such as $f(x) = \sin x$, what is the slope of its tangent at $x = \pi/4$?	5	
	b) For the same function $f(x) = \sin x$, what is its curvature at $x = \pi/4$?	5	
2.	a) What is the area under the curve $f(x) = e^x$ between x = 1 and x = 2?	5	
	b) Set up the integrals for the volume under the surface $g(x,y) = e^{xy}$ within the first quadrant of a unit circle at the origin.	5	
3.	a) What are the first three terms in the expansion of $(1 + 2x)^{-1}$ as a series in x?	5	
	b) What is the general form of the n-th term in the expansion of $(1 + 2x)^{-1}$ as a series in x?	5	
4.	a) What are the two solutions of the equation $x^2 + 3x + 5 = 0$?	5	
	b) Given that x = 1 is a solution of the cubic equation $x^3 - 6x^2 + 11x - 6 = 0$, what are the other two solutions?	5	
5.	a) Given a 3 × 3 matrix A with elements $a_{ij} = i \times j$, what is its determinant?	5	
	b) For the preceding matrix A, what is A^2?	5	
6.	a) Solve the following three equations for x, y and z: $1.1x + 1.2y + 1.3z = 12$ $1.2x + 2.2y + 2.3z = 20$ $1.3x + 2.3y + 3.3z = 25$	5	
	b) Briefly describe the situation with underdetermined and overdetermined systems of linear equations. Are solution(s) possible?	5	
7.	a) Solve the ordinary differential equation: $d^2y / dx^2 = y$ for y as a function of x.	5	
	b) Solve the partial differential equation: $\partial^2 f / \partial x \, \partial y = xy$ for f as a function of x and y.	5	
8.	a) What is the gradient of the function $f(x,y,z) = e^{xyz}$ in Cartesian 'xyz' space?	5	
	b) What is the total derivative of the previous function $f(x,y,z) = e^{xyz}$?	5	
9.	a) Orthogonal matrices are used for rotations. Give an example of a rotation matrix for an angle θ of Cartesian (x,y) plane coordinates.	5	
	b) How can the orthogonality of an arbitrary matrix be easily checked?	5	
10.	Spherical triangles are defined in terms of great circles. Let two arbitrary points A and B have the same latitude φ on the spherical Earth. Considering the parallel arc AB in comparison with the spherical great circle arc AB, how can the difference be evaluated for the latitude φ and angular spacing Δλ in longitude?	10	
	Total Marks:	100	