

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

March 2018

Note: NO CALCULATORS ALLOWED for this examination of ten questions on one page. Marks

Q. No

Time: 3 hours

Value Earned

1.	a) Describe differentiation as the limit of a ratio of changes for a simple function.	5	
	b) Does continuity of a function $f(x)$ imply that the preceding limit exists at some arbitrary point x_0 ? Illustrate with simple examples.	5	
2.	a) What is the gradient of a scalar function $z = g(x,y)$ in Cartesian (x,y,z) space?	5	
	b) What does a null gradient imply for the preceding function $z = g(x,y)$? Using simple examples, briefly discuss the situation.	5	
3.	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	
4.	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	
5.	a) A small matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ is known to be orthogonal. What are the implications for the elements a, b, c and d ?	5	
	b) What is the characteristic polynomial of the preceding small matrix?	5	
6.	a) Given three linear equations $x + 2y + 3z = 6$, $2x - 3y - z = 3$, $3x + y + z = 7$ what are x, y and z using Cramer's rule?	5	
	b) Using linear matrix algebra, verify the solution of the preceding equations.	5	
7.	a) What is the inverse function of $f(x) = e^{\sin x + 1}$?	5	
	b) For a complex variable z , what are the real and imaginary parts of e^{2z+3} ?	5	
8.	a) The ordinary differential equation $dx/dt = 2x + \cos t$ has a general solution $x(t)$ with initial condition $x(0) = -2/5$. Show how to solve this initial value problem.	5	
	b) The ordinary differential equation $d^2y/dt^2 - 3y = 0$ corresponds to a simple harmonic motion $y(t)$. What is a simple general solution?	5	
9.	a) For a vector function $\mathbf{g} = (\sin xy, \cos xy, \tan z)^T$ in Cartesian (x,y,z) space, what is the divergence of \mathbf{g} ?	5	
	b) For the same vector function \mathbf{g} , what is the curl of \mathbf{g} ?	5	
10.	Considering two points A and B of equal latitude on a sphere of radius R, what is the difference between the great circle arc AB and the parallel arc AB for the same longitude difference $\Delta\lambda > 0$? Where is the difference zero?	10	
Total Marks:		100	