

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

March 2015

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

Marks

Q. No

Time: 3 hours

Value Earned

1.	a) What is the mathematical equation of a plane in three-dimensional Cartesian space?	5	
	b) What are the corresponding modifications to this mathematical equation for points above and below the preceding plane? Illustrate graphically the situation.	5	
2.	a) What is called a conic section in Euclidean geometry?	5	
	b) Illustrate the curves obtained in conic sections with their equations.	5	
3.	a) Give the first three terms in the series expansion of $(1 - 3x)^{-2}$ in powers of x.	5	
	b) On the real line, where does this power series converge? Where does it diverge?	5	
4.	a) Describe and illustrate Cramer's rule for solving nonhomogeneous linear algebraic equations.	5	
	b) What is the situation with homogeneous linear algebraic equations?	5	
5.	a) What is the general solution $f(t)$ for the differential equation $df / dt = f$?	5	
	b) What is the general solution $g(t)$ for the differential equation $d^2g / dt^2 = g$?	5	
6.	a) Given the function $f(x,y,z) = \sin(x) \cos(y) e^z$, what are the corresponding partial derivatives f_x , f_y and f_z ?	5	
	b) For the same function $f(x,y,z)$, what is the corresponding Laplacian?	5	
7.	a) What is a unitary matrix? Give a simple example of a unitary matrix.	5	
	b) For a skew-symmetric matrix T, show that $(I - T)(I + T)^{-1}$ is orthogonal, where I stands for the identity matrix.	5	
8.	a) Given two arbitrary vectors of order 3, what is their vector (or cross) product using the common matrix representation? Illustrate with simple numerical vectors.	5	
	b) In three-dimensional Cartesian space, what is the volume of space spanned by three arbitrary vectors at the origin? Illustrate the situation with simple numerical vectors.	5	
9.	a) Expand the complex exponential function $e^z \equiv e^{x+iy}$ into its real and imaginary parts, where i stands for the square-root of -1.	5	
	b) Using the previous result, what is the complex natural logarithm $\log z$?	5	
10.	How does the area of a spherical cap increase from zero to $2\pi R^2$ with the polar angle θ on a hemisphere of radius R? Use the surface integral for the area of such a spherical cap.	10	
Total Marks:		100	