

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2010

Note: This examination consists of 10 questions on 1 page.

Marks

Q. No

Time: 3 hours

Value Earned

1. a)	Given the general equation of a line as $y = ax + b$ in the Cartesian (x,y) plane, what are the parameters a and b ? Illustrate their interpretation with an example.	5	
	b) Given the general equation of a plane as $z = cx + dy + e$ in the Cartesian (x,y,z) space, what are the parameters c , d and e ? Illustrate with an example.	5	
2. a)	For a general curve $y = f(x)$ in the Cartesian (x,y) plane, what is the slope of this curve at some given point x_0 ? Illustrate the situation with an example.	5	
	b) For a general curve $y = g(x)$ in the Cartesian (x,y) plane, what is the curvature of this curve at some given point x_0 ? Illustrate with an example.	5	
3. a)	For the rotation of a Cartesian (x,y) system by an angle θ around its origin, what are the corresponding coordinate transformation equations from (x,y) into (x',y') ?	5	
	b) Write the previous rotation transformation from (x,y) into (x',y') in matrix form. What is special or characteristic of the matrix in this equation?	5	
4. a)	Given a matrix M with the representation as $M = (I - A)(I + A)^{-1}$ in which I stands for the identity matrix and A is skew-symmetric. What is the inverse of M ?	5	
	b) Check the commutativity of the matrix product $(I - B)(I + B)$ for any matrix B .	5	
5. a)	Given a quadratic polynomial $ax^2 + bx + c$ for arbitrary a , b and c , when are the roots complex?	5	
	b) Given the cubic polynomial $z^3 - 1$, what are the three roots of 1 or unity?	5	
6. a)	Given three linear equations $x + y + z = 5$, $x - y + z = 3$, $x - y - z = 1$, evaluate x , y and z by Gaussian elimination.	5	
	b) Solve the preceding three equations by Cramer's rule.	5	
7. a)	Given a differential equation $du / dx + u = 1$, what is the general solution?	5	
	b) Given another differential equation $d^2v / dx^2 + 4v = 0$, what is the general solution?	5	
8. a)	What is the linear approximation to $x^{1/2} + 3$ in the neighborhood of $x = 0$?	5	
	b) What is the linear approximation to $\log_e(x^2 - 3)$ in the neighborhood of $x = 2$?	5	
9. a)	Covariance matrices are usually symmetric and positive definite. What does that imply for their eigenvalues and eigenvectors?	5	
	b) Error ellipses are representations of covariance matrices of order 2. How are they constructed from the eigenvectors and eigenvalues?	5	
10. a)	What is the sine law for spherical triangles? Give an example of its application.	5	
	b) What is the cosine law for spherical triangles? Give an example of its application.	5	
Total Marks:		100	