

**CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS
ATLANTIC PROVINCES BOARD OF EXAMINERS FOR LAND SURVEYORS**

**SCHEDULE I / ITEM 1
MATHEMATICS**

March 2007

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

Marks

Q. No

Time: 3 hours

Value Earned

1. a)	Given three arbitrary points A, B and C in the plane, how can they be checked for collinearity using their Cartesian coordinates?	5	
b)	Given four arbitrary points D, E, F and G in space, how can they be checked for coplanarity using their Cartesian coordinates?	5	
2. a)	What is the general Cartesian to polar coordinate transformation in the plane?	5	
b)	What is the general Cartesian to spherical polar coordinate transformation in space?	5	
3. a)	Given two vectors $\vec{u} = (1.2 \ 2.3 \ 3.4)^T$ and $\vec{v} = (4.1 \ 5.2 \ 6.3)^T$, with the superscript T meaning transpose, what is the dot or scalar product of \vec{u} and \vec{v} ?	5	
b)	What is the cross or vector product of the preceding \vec{u} and \vec{v} ?	5	
4. a)	Given two functions $f(x) = \sin x$ and $g(x) = \cos x$, what is the smallest positive x coordinate value where $f(x) = g(x)$?	5	
b)	What is the intersection angle between $f(x)$ and $g(x)$ at their intersection point?	5	
5. a)	Given a small matrix A with elements $a_{11} = a_{22} = a_{33} = 1$, $a_{12} = a_{21} = 0.5$, $a_{13} = a_{31} = 0.3$, $a_{23} = a_{32} = 0.4$, what is its determinant?	5	
b)	What is the corresponding characteristic polynomial of A for its eigenvalues?	5	
6. a)	What is the first-order approximation of $\sqrt{x+y}$ for small x values (i.e. $x \ll y$, meaning x much smaller than y)?	5	
b)	What is the first-order approximation of $\sqrt[3]{x+y}$ for small x values (i.e. $x \ll y$)?	5	
7. a)	Given three linear equations $2x + y + z = 5$, $2x + 3y + 4z = 12$, $3x + 4y + 5z = 15$, what are x, y and z by Gaussian elimination?	5	
b)	What are the corresponding expressions for x, y and z by Cramer's rule (without necessarily evaluating them)?	5	
8. a)	Given a quadratic polynomial $x^2 + 3x + 5$, what are its roots?	5	
b)	Given a quartic polynomial $x^4 + 4x^2 + 7$, what are its roots?	5	
9. a)	Given the Cartesian coordinate transformations $X = x + 2y + 3$, $Y = -2x + y + 5$, what is the corresponding Jacobian?	5	
b)	Express the preceding transformation in terms of complex variables, i.e. $X + iY$ in terms of $x + iy$, with i denoting the square-root of -1.	5	
10.a)	What is the general solution of the differential equation $d^2y / dx^2 + k^2 y = 0$ for some constant $k \neq 0$?	5	
b)	What is the particular solution of the preceding differential equation given the boundary conditions $y(0) = 1$ and $y(\pi/2) = 3$?	5	
Total Marks:		100	