

**CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS**

**C-1 MATHEMATICS**

**October 2017**

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

**Marks**

**Q. No**

Time: 3 hours

Value    Earned

1.	a) Briefly discuss the process as $x$ tends to $x_0$ as a limit for a function $f(x)$ known to be continuous at $x_0$ . What is the corresponding situation when $f(x)$ is not continuous at $x_0$ ? Illustrate with simple examples in each case.	5	
	b) What is called the curvature of a function $g(x)$ at some $x = x_0$ ? Use simple function examples with variable curvature.	5	
2.	a) Given a second-degree algebraic polynomial $x^2 + 5x + 7$ , what are its roots?	5	
	b) Given three real numbers 3.1, 5.2 and 7.3, what is a cubic polynomial with these as roots?	5	
3.	a) For a real Cartesian function $f(x,y,z) = (x+y+z) \cdot e^{xyz}$ , what is its gradient?	5	
	b) What is the divergence of the vector function $\mathbf{g}(x,y,z) = (x \cdot e^x, y \cdot e^y, z \cdot e^z)$ ?	5	
4.	a) What is the inverse of the small matrix $\begin{pmatrix} 2 & 1 \\ 1 & 3 \end{pmatrix}$ in terms of its determinant?	5	
	b) What are the eigenvalues of the previous matrix?	5	
5.	a) What are all the real and complex roots of $z^4 + 1$ ?	5	
	b) What is the exponential form of $(\cos \theta + i \sin \theta)^n$ for some $n$ with $i = \sqrt{-1}$ ?	5	
6.	a) Formally, $(1 - x)^{-1} = 1 + x + x^2 + x^3 + \dots$ , does the series converge for all $x$ ?	5	
	b) What is the $n$ -th term in the corresponding series expansion of $(1 + x^2)^{-1}$ ?	5	
7.	a) Given three equations: $x + 2y + 3z = 1$ , $x - 2y - 3z = 2$ and $x - 4y + 5z = 3$ , what are $x$ , $y$ and $z$ by Gaussian elimination?	5	
	b) Solve the preceding linear system using matrix algebra.	5	
8.	a) A simple harmonic oscillator has the differential equation $d^2x / dt^2 - k^2x = 0$ in terms of time $t$ for some constant $k$ . What is the solution $x(t)$ for arbitrary time $t > 0$ , assuming $x(0) = 0$ and given $dx/dt = v(t)$ at $t = 0$ ?	5	
	b) Solve the simple differential equation $d^2x / dt^2 + 4 dx / dt + 15x = 0$ explicitly for a complete solution with unspecified constants.	5	
9.	a) Given two vector quantities $\mathbf{u} = 1 \mathbf{i} + 2 \mathbf{j} + 3 \mathbf{k}$ and $\mathbf{v} = 4 \mathbf{i} + 5 \mathbf{j} + 6 \mathbf{k}$ , where $\mathbf{i}$ , $\mathbf{j}$ and $\mathbf{k}$ form a Cartesian triad of unit vectors, what is their vector product?	5	
	b) What is a unit vector $\mathbf{w}$ normal to $\mathbf{u}$ and $\mathbf{v}$ ?	5	
10.	On a unit sphere, given three arbitrary points in terms of their latitude and longitude, show how to compute the spherical triangle area (assuming the sides less than $\pi/2$ for simplicity). Illustrate the situation with a simple example.	10	
<b>Total Marks:</b>		100	