CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

October 2020

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted for the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of 10 questions on 2 pages.

Q. No   Time: 3 hours

Q. No	Question	Marks Value	Earned
1.	a) Integrate $\int \dfrac{x}{x+7}\,dx$.	5	
	b) Evaluate $\int_1^2 x\sin\left(x^2\right)\,dx$.	5	
2.	Solve the isosceles spherical triangle ABC, where $a = c = 79°17'$ and $A = C = 59°37'$. In other words, find b and B.	10	
3.	a) Find the eigenvalues of $A_2 = \begin{bmatrix} -2 & -4 & 2 \\ -2 & 1 & 2 \\ 4 & 2 & 5 \end{bmatrix}$.	5	
	b) Solve for x, y, z: $\begin{bmatrix} 3 & 4 & -2 \\ 1 & 2 & -1 \\ 3 & -1 & -3 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 20 \\ 9 \\ 6 \end{bmatrix}$	5	
4.	a) Find $\sum_{n=1}^{\infty} e^{-n}$ if it exists (five significant digits).	5	
	b) Find $\sum_{n=1}^{\infty} \dfrac{6n+3}{n^2(n+1)^2}$. Hint: use partial fractions and telescoping series.	5	
5.	a) Consider a quadratic equation $a^2x^2 + bx - c$ with real numbers a, b, c and $c > 0$. Consider the discriminant and indicate how many solutions the equation has.	5	
	b) What is the inverse B^{-1} of $B = \begin{bmatrix} -5 & 4 \\ -1 & 2 \end{bmatrix}$?	5	
6.	Find an orthonormal basis for the plane whose equation is $2x - 3y + 7z = 0$.	10	
7.	a) What is the cross product $a \times b$ for $a = \begin{pmatrix} 4 \\ -1 \\ 3 \end{pmatrix}$ and $b = \begin{pmatrix} -2 \\ 2 \\ 5 \end{pmatrix}$?	5	
	b) What is the angle between the two vectors a and b in the previous question?	5	

8.	a) Use the definition of the tangent function $\tan x$ and the quotient rule to show that $\dfrac{d}{dx}\tan x = \sec^2 x$.	5	
	b) Find the equation of the line tangent to the graph of $y = 2\ln(x)$ at $x = 3$.	5	
9.	a) Find the Taylor polynomial of order 3 generated by $f(x) = \sin x$ at $a = \dfrac{\pi}{4}$.	5	
	b) Find the Mclaurin series for $f(x) = \cosh x$. Recall that $\cosh x = \dfrac{1}{2}\left(e^x + e^{-x}\right)$.	5	
10.	a) Let $f(x) = x + 4$ and $g(x) = 2x - 5$. Find $(f \circ g)(x)$ and its inverse.	5	
	b) Find the three cube roots of 27 in the complex numbers.	5	
	Total Marks:	100	