

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

March 2025

Note: This examination consists of 10 questions on 2 pages. There is a formula sheet included.

Make sure to show all your steps. Only use fancy calculator functions (e.g. eigenvalues) for checking your work.

Marks

Q. No

Time: 3 hours

Value Earned

1.	(a) Find the eigenvalues and eigenvectors of the matrix $A = \begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}$ (b) Use the eigenvalues and eigenvectors to decompose A as $A = PDP^{-1}$ where D is diagonal.	10	
2.	Find the limit $\lim_{x \rightarrow 0} \frac{\cos(2x) - 1 + x \sin x}{6x^2}$ Show all steps in your solution.	10	
3.	A cylindrical water tank has height h meters and radius r meters. The volume must be 1000 cubic meters. Find the dimensions that minimize the surface area (including top and bottom). Note that the surface area is $2\pi r^2 + 2\pi rh$	10	
4.	Calculate the great circle distance between Montreal ($45^\circ 30'N, 73^\circ 34'W$) and Shanghai ($31^\circ 13'N, 121^\circ 28'E$). Use 6371 km for the Earth's radius.	10	
5.	Find a particular solution to the differential equation: $y'' - 2y = xe^{2x}$ by trying a solution of the form $y_p = (ax + b)e^{2x}$ and finding the values of a and b.	10	
6.	(a) Find the curl of the vector field $\mathbf{F}(x, y, z) = (yz^2)\mathbf{i} + (xyz)\mathbf{j} + (x^2y)\mathbf{k}$ (b) Evaluate the curl at the point $(1, 2, -1)$.	10	

7.	Find the three cube roots of $-8 + 8i$ in rectangular form.	10	
8.	A company sells three types of products. The first product costs \$30 to make and sells for \$50. The second costs \$45 to make and sells for \$75. The third costs \$60 to make and sells for \$90. If they sold 100 items total and made a profit of \$2500, and the number of type 1 items was twice the number of type 2 items, how many of each type did they sell? Use Cramer's rule to solve this system.	10	
9.	Find the Taylor series expansion of $f(x) = \ln(1 + x)$ about $a = 0$ up to the third order term. Show all steps in finding the derivatives and evaluating them at $a = 0$.	10	
10.	Given a right spherical triangle with hypotenuse $c = 75^\circ 20'$ and angle $B = 42^\circ 15'$, find the remaining sides a and b and angle A . (Note that $C = 90^\circ$ since this is a right spherical triangle).	10	
	Total Marks:	100	