

CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C-1 MATHEMATICS

March 2026

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate value 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 3 pages.

Marks

Q. No

Time: 3 hours

Value Earned

Make sure to consult the formula collection at the end as you attempt these questions.

1.	(a) Find the general solution to the differential equation: $\frac{dy}{dx} + 3y = e^{2x}$ Hint: multiply both sides of the equation by e^{3x} and use the product rule in reverse for integration. (b) Verify that $u(x, t) = \sin(x - ct)$ is a solution to the wave equation: $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$	10	
2.	(a) Complete the square to find the vertex and axis of symmetry of the parabola: $y^2 + 6y - 4x + 1 = 0$ (b) Find the center and the lengths of the semimajor and semiminor axes of the ellipse: $9x^2 + 16y^2 - 36x + 32y - 92 = 0$	10	
3.	An electronics retailer sells three types of cables. Type A costs \$5, Type B costs \$8, and Type C costs \$13. On a particular day, they sold 50 cables total for \$360. The number of Type A cables sold was equal to the number of Type B cables plus the number of Type C cables. How many of each type were sold? Use Cramer's rule to solve this system.	10	
4.	(a) For what value(s) of k does the equation $x^2 + (k - 2)x + 9 = 0$ have exactly one real solution? (b) For the value of k you found in part (a), solve the equation for x.	10	

5.	(a) Find the gradient of the function: $f(x, y, z) = x^2y + y^2z + z^2x$ (b) Find the Laplacian of the same function.	10	
6.	(a) Find the Maclaurin series for $f(x) = \cos(2x)$ up to the fourth order term (the x^4 term). (b) Find the second-order Taylor polynomial for $f(x) = e^x$ about $a = 1$.	10	
7.	In a right spherical triangle with right angle at C , you are given the hypotenuse $c = 85^\circ 30'$ and angle $A = 68^\circ 15'$. Find the sides a and b .	10	
8.	(a) Evaluate the indefinite integral: $\int x^2 e^x dx$ Hint: use integration by parts $\int f'g = fg - \int fg'$. (b) Evaluate the definite integral: $\int_0^{\pi/4} \frac{\sin x}{1 + \cos x} dx$ Hint: substitute $u = 1 + \cos x$.	10	
9.	(a) Find the inverse of the matrix: $A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 5 & 2 \\ 1 & 1 & 2 \end{bmatrix}$ (b) Verify your answer by computing $A \cdot A^{-1}$.	10	
10.	The sum of two numbers is 12, and the sum of their squares is 74. Find the two numbers by setting up and solving a quadratic equation.	10	
	Total Marks:	100	

For the gradient of a function $f : \mathbb{R}^3 \rightarrow \mathbb{R}$:

$$\nabla f = \left(\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}, \frac{\partial f}{\partial z} \right)$$

For the Laplacian:

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$$

For Cramer's rule, if $AX = B$ is a system of linear equations, then:

$$x_i = \frac{\det(A_i)}{\det(A)}$$

where A_i is the matrix formed by replacing the i th column of A with B .

For right spherical triangles, Napier's rules state:

$$\begin{aligned}\sin a &= \sin c \sin A \\ \sin b &= \tan a \cot A\end{aligned}$$

For conic sections:

Parabola (vertex form): $(y - k)^2 = 4p(x - h)$ or $(x - h)^2 = 4p(y - k)$

Ellipse (standard form): $\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$

where (h, k) is the center (or vertex for parabola), and a, b are semimajor and semiminor axes.