

Final Exam

Name: _____

Physics 403: Mathematical Methods

Spring, 2008

Problem 1 _____ Problem 2 _____ Problem 3 _____ Problem 4 _____
Problem 5 _____ Problem 6 _____ Problem 7 _____ Problem 8 _____
Total _____

Complete this quiz showing all work.

Problem 1 Let $\vec{F} = 2xz^2\hat{x} + yx\hat{y} + y^3zx\hat{z}$. Compute $\nabla \times \vec{F}$.

Problem 2 Solve the following system of equations by computing an inverse matrix. Show all work.

$$\begin{pmatrix} 2 & 0 & 2 \\ 1 & 3 & -1 \\ 0 & 2 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 3 \\ 0 \\ -1 \end{pmatrix}$$

Problem 3 The following differential equation is not exact. Determine the integrating factor that makes the equation exact. **Do NOT solve the differential equation** – just determine the integrating factor.

$$2dx + (2x - 3y - 3)dy = 0$$

Problem 4 The differential equation for a particular oscillator is

$$\ddot{x} + 5\dot{x} + 4x = 0.$$

Determine the equation of motion if the object is displaced a distance $x_o = 5$ cm and released from rest ($\dot{x}_o = 0$) at $t = 0$ s.

Problem 5 Let $f(x)$ have a period of 2 and be defined by

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 1 & 1 < x < 2 \end{cases}$$

Graph $f(x)$. Compute a_n and b_n . (Refer to page 182.)

Problem 6 Assuming $P_0(x) = 1$ and $P_1(x) = x$ are the first two Legendre Polynomials, determine $P_2(x)$ using the recursion relation.

Problem 7 Evaluate

$$\int_0^{\infty} x^6 e^{-3x} dx$$

Problem 8 Consider a cube with one vertex at the origin and the diagonally opposed vertex at $\{2, 2, 2\}$. Let the vector field $\vec{F} = 2x\hat{y}$. Compute the flux of \vec{F} through the cube.