

Write the following text on the front cover of your homework assignment and sign it. If the text is missing, 20 points will be subtracted from your homework grade.

**Honor Pledge for Graded Assignments**

"I affirm that I have not given or received any unauthorized help on this assignment, and that this work is my own."

Signature \_\_\_\_\_

**Problem 1 (20 points)**

Find the transformation matrix that rotates a rectangular coordinate system through an angle of  $120^\circ$  about an axis making equal angles with the original three coordinate axes.

**Problem 2 (20 points)**

$\vec{X}$  is an unknown vector satisfying the following relations involving known vectors  $\vec{A}$  and  $\vec{B}$  and scalar  $\phi$ :

$$\vec{A} \times \vec{X} = \vec{B} \quad (1)$$

$$\vec{A} \cdot \vec{X} = \phi \quad (2)$$

Express  $\vec{X}$  in terms of  $\vec{A}$ ,  $\vec{B}$ ,  $\phi$ , and the magnitude of  $\vec{A}$ .

**Problem 3 (20 points)**

Find the value of  $\alpha$  needed to make the following transformation orthogonal.

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & \alpha & -\alpha \\ 0 & \alpha & \alpha \end{pmatrix} \quad (3)$$

**Problem 4 (20 points)**

Show that

$$\nabla(\ln|\vec{r}|) = \frac{1}{r^2} \vec{r} \quad (4)$$

**Problem 5 (20 points)**

Find the value of the integral

$$\int_S (\nabla \times \vec{A}) \cdot d\vec{a} \quad (5)$$

if the vector  $\vec{A}$  is equal to

$$\vec{A} = y\hat{i} + z\hat{j} + x\hat{k} \quad (6)$$

and the surface  $S$  is defined by the paraboloid

$$z = 1 - x^2 - y^2 \quad (7)$$

where  $z \geq 0$ .