EXAM I Physics 208

Name........................................Section Number.....

USEFUL INFORMATION

For two point particles

\[ \vec{F} = \frac{1}{4\pi\varepsilon_0} \frac{q_1q_2}{r^2} \hat{r} \]

\[ \int_{\vec{r}_1}^{\vec{r}_2} \vec{E} \cdot d\vec{r} = -[V(\vec{r}_2) - V(\vec{r}_1)] \]

\[ d\vec{r} = dx\vec{i}_x + dy\vec{i}_y = d\vec{r}_r + r\,d\theta\vec{i}_\theta \]

\[ E_x = -\frac{dV}{dx} \quad E_y = -\frac{dV}{dy} \]

DO NOT WASTE TIME ON COMPLICATED INTEGRALS
1. (25 points) A small block of mass $M$ is hung from a spring, spring constant $k$. It has a charge $Q$. At equilibrium the spring is stretched by an amount $\frac{Mg}{2k}$. What electric field must be present?
2. (25 points) Suppose the Coulomb Force is not the one that really exists in nature but instead was given by

\[ \vec{F} = \beta \frac{q_1 q_2}{r^5} \hat{r} \]

where \( \beta \) is a known constant. For this force find the electric potential function, \( V(x, y) \), for a charge \( Q \) located at the point \( x = a, y = b \).
3. (25 points) Suppose there were an electric field given by

\[ \vec{E} = \alpha \vec{i}_x + \beta x^2 \vec{i}_y. \]

a. What would be the electric flux through the L by W rectangle in the position shown?

b. What would be the electric flux through the shaded quarter of a circle of radius R in the position shown?

c. What would be the electric flux through the L by W rectangle in the position shown?