1. A cylindrical can is being designed to hold a volume of 120 cm$^3$. The top and bottom of the can must be twice as thick as the sides, and so cost twice as much per area. Find the dimensions of the can that has lowest cost for material. *(Hint: Assume the radius of the can is $x$ and its height is $y$, then area of the top or bottom is $\pi x^2$, the area of the side is $2\pi xy$ and the volume of the can is $\pi x^2y$.)*

2. The diagram shows a parking lot, 20 by 60 yards. A contractor has to run a power line from $A$ to $C$; he can put it on poles around $ABC$ at $\$60$ a yard or go underground part or all the way at $\$75$ a yard. If he is honest and wants to minimize the cost, to what point $D$ (if any) should he run the underground part? If he is dishonest and wants to maximize the cost, but will run the line straight along $AD$ (because the inspector is watching), what will $D$ be?

3. Let $O$ be the tail of $\vec{B} = 2\hat{i} - \hat{j} + 3\hat{k}$ and let $\vec{A} = \hat{i} + \hat{j} - 2\hat{k}$ be a force acting at the head of $\vec{B}$. Find the torque of $\vec{A}$ about $O$; about a line though $O$ perpendicular to the plane of $\vec{A}$ and $\vec{B}$; about a line though $O$ parallel to $\vec{C} = \hat{j} - 5\hat{k}$.

4. Prove that the triple scalar product of $(\vec{A} \times \vec{B})$, $(\vec{B} \times \vec{C})$, and $(\vec{C} \times \vec{A})$, is equal to the square of the triple scalar product of $\vec{A}$, $\vec{B}$, and $\vec{C}$. *(Hint: First let $(\vec{B} \times \vec{C} = \vec{D})$, and evaluate $(\vec{A} \times \vec{B}) \times \vec{D}$).*

5. The position of a particle at time $t$ is given by $\vec{r} = \hat{i}\cos t + \hat{j}\sin t + \hat{k}t$. Show that both the speed and the magnitude of the acceleration are constant. Describe the motion.

6. In polar coordinates, the position vector of a particle is $\vec{r} = r\hat{e}_r$. Find the velocity and acceleration of the particle.