(1) **Power Storage:**

The total distance that the wave on the transmission line travels is obviously $Tv_p$. Therefore, the total attenuation would be $\alpha_dTv_p$ if $\alpha_d$ were measured in dB/m. This total attenuation must be less than 3 dB. Thus, the following condition must hold:

$$\alpha_d < \frac{3000}{Tv_p} \text{ dB/km}$$

where the extra factor of 1000 is to convert from dB/m to dB/km.

(2) **Vector Math:**

The volume of the parallelepiped is $|\vec{A} \cdot (\vec{B} \times \vec{C})|$. Note that the three vectors could all be commuted in any combination in this expression.

(3) **Charge Distributions:**

(4) **Voltage of a Spiral Charge:**
\[ V(\vec{r}) = \iint_S \frac{\rho S(\vec{r}')dS}{4\pi \epsilon \|\vec{r} - \vec{r}'\|} \]
\[ = \iint_S \frac{\rho_o \exp(-\rho') dS}{4\pi \epsilon \|(0 - x')\hat{x} + (0 - y')\hat{y} + (0 - 0)\hat{z}\|} \]
\[ = \frac{\rho_o}{4\pi \epsilon} \int_0^{\rho' + \phi_o} \int_{\rho'}^{\infty} \frac{\exp(-\rho') \rho \, d\rho' \, d\phi'}{\rho'} \]
\[ = \frac{\rho_o \phi_o}{4\pi \epsilon} \int_0^{\infty} \exp(-\rho') \, d\rho' \]
\[ = \frac{\rho_o \phi_o}{4\pi \epsilon} \]

(5) DLP Chip:

The total electric field is the superposition of the infinite plane charge (a result we know from class and on the formula sheet) and the tilted square:

\[ \vec{E}(x, y, z) = -\frac{\rho^2}{2\epsilon_o} \hat{y} + \iint_S \frac{\rho S(\vec{r}')(\vec{r} - \vec{r}')dS}{4\pi \epsilon \|\vec{r} - \vec{r}'\|^3} \]
\[ = -\frac{\rho^2}{2\epsilon_o} \hat{y} + \frac{\rho_1}{4\pi \epsilon_o} \int_0^L \int_{\frac{d}{\sin \phi_o} - \frac{d}{2}}^{\frac{d}{\sin \phi_o} + \frac{d}{2}} \, dz' \, d\rho' \frac{[(x - \rho' \cos \phi_o)\hat{x} + (y - \rho' \sin \phi_o)\hat{y} + (z - z')\hat{z}]}{[(x - \rho' \cos \phi_o)^2 + (y - \rho' \sin \phi_o)^2 + (z - z')^2]^{\frac{3}{2}}} \]

which is valid for \( y > 0 \).