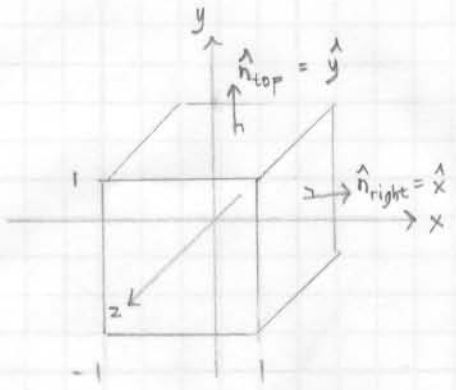

$$\bar{E} = \hat{x}\,xz - \hat{y}\,yz^2 - \hat{z}\,xy$$

$$\oint_S \bar{E}\cdot d\bar{s} = F_{top} + F_{bottom} + F_{left} + F_{right} + F_{front} + F_{back}$$

$$F_{front} = \int_{-1}^{1} \bar{E}\cdot\hat{n}_{front}\,ds = \int_{-1}^{1}\int_{-1}^{1} (\hat{x}\,xz - \hat{y}\,yz^2 - \hat{z}\,xy)\Big|_{z=1}\cdot\hat{z}\,dx\,dy$$

↖ front plane

$$= \int_{-1}^{1}\int_{-1}^{1} (-xy)\,dx\,dy$$

$$= -\int_{-1}^{1}\int_{}^{1} xy\,dx\,dy$$

$$= -\int_{-1}^{1} \frac{x^2}{2}\Big|_{-1}^{1} y\,dy$$

$$= -\int_{-1}^{1} \left(\frac{1}{2} - \frac{1}{2}\right) y\,dy$$

$$= 0$$

note: $\hat{z}\cdot\hat{x} = 0$ unit vector property
$\hat{z}\cdot\hat{y} = 0$
$\hat{z}\cdot\hat{z} = 1$

F_{back} will also be 0

$$F_{left} = \int_{-1}^{1}\int_{-1}^{1} (\hat{x}\,xz - \hat{y}\,yz^2 - \hat{z}\,xy)\Big|_{x=-1}\cdot(-\hat{x})\,dz\,dy$$

$$= \int_{-1}^{1}\int_{-1}^{1} (-1)z\,dz\,dy$$

$$= 0$$

F_{right} will also be 0

↗ make sure on the homework you show that you know how to setup these equations. i.e. F_{back} & F_{right}

$$F_{top} = \int_{-1}^{1}\int_{-1}^{1} (\hat{x}\,xz - \hat{y}\,yz^2 - \hat{z}\,xy)\Big|_{y=1} \cdot \hat{y}\, dz\, dx$$

$$= \int_{-1}^{1}\int_{-1}^{1} (-z^2)\, dz\, dx$$

$$= x\Big|_{-1}^{1} \left(-\frac{z^3}{3}\right)\Big|_{-1}^{1}$$

$$= -2\left(\frac{1}{3} + \frac{1}{3}\right)$$

$$= -\frac{4}{3}$$

$$F_{bottom} = \int_{-1}^{1}\int_{-1}^{1} (\hat{x}\,xz - \hat{y}\,yz^2 - \hat{z}\,xy)\Big|_{y=-1} \cdot (-\hat{y})\, dz\, dx$$

$$= \int_{-1}^{1}\int_{-1}^{1} -z^2\, dz\, dx$$

$$= -\frac{4}{3}$$

$$\oint \bar{E} \cdot d\bar{s} = F_{top} + F_{bottom} + F_{left} + F_{right} + F_{front} + F_{back}$$

$$= -\frac{4}{3} - \frac{4}{3} + 0 + 0 + 0 + 0$$

$$= -\frac{8}{3}$$