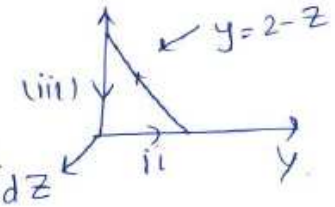
8. $V = (xy)\hat{x} + (2yz)\hat{y} + (3zx)\hat{z}$

$\vec{\nabla} \times \vec{V} = \hat{x}(0-2y) + \hat{y}(0-3z) + \hat{z}(0-x)$

$= -2y\hat{x} - 3z\hat{y} - x\hat{z}$

$da = dy\,dz\,\hat{x}$



$$\int_0^2 \int_0^{2-z} (-2y\,dy)\,dz = \int_0^2 -2\,\frac{(2-z)^2}{2}\,dz$$

$$= -\int_0^2 (4 - 4z + z^2)\,dz$$

$$= -\left(4z - 2z^2 + \frac{z^3}{3}\right)\Big|_0^2$$

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

$\vec{V} \cdot d\vec{l} = (xy)dx + (2yz)dy + (3zx)dz$

(i) $x = 0 = z$, $dx = dz = 0$ $\quad \int \vec{V} \cdot d\vec{l} = 0$

(ii) $x = 0$, $z = 2 - y$, $dx = 0$, $dz = -dy$ y goes from $2 \to 0$

$V \cdot dl = 2yz\,dy$

$$V \cdot dl = \int_2^0 2y(2-y)\,dy = -\left(2y^2 - \frac{2}{3}y^3\right)\Big|_0^2$$

$$= -8 + \frac{2}{3} \times 8 = -\frac{8}{3}$$

(iii) $x = y = 0$, $dx = dy = 0$, $\int V \cdot dl = 0$

total $= -8/3$