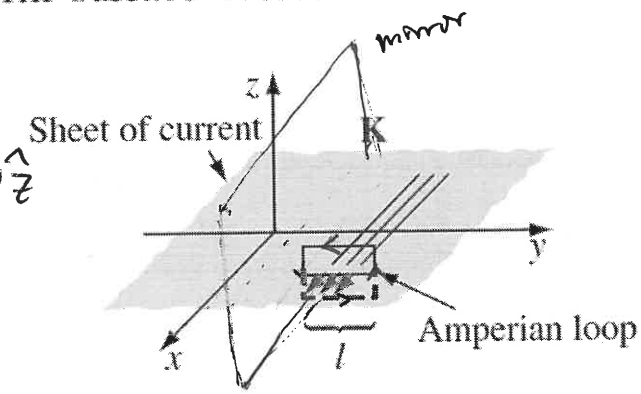
Example 5.8. Find the magnetic field of an infinite uniform surface current $\mathbf{K} = K\,\hat{\mathbf{x}}$, flowing over the xy plane (Fig. 5.33).



$$\vec{B}(\vec{r}) = B_x(x,y,z)\,\hat{x} + B_y(x,y,z)\,\hat{y} + B_z(x,y,z)\,\hat{z}$$

- Translational symmetry in x-y plane

  $\Rightarrow \vec{B}$ is uniform in x-y plane

- Vertical mirror $\parallel xz$

  $\Rightarrow B_x = 0,\ B_z = 0. \quad \Rightarrow \vec{B} = B_y(z)\,\hat{y}$

- Rotational axis about $\hat{x}$ for 180°

$\Rightarrow B_y(z>0) = -B_y(z<0)$

Ampère's law: $\oint \vec{B}\cdot d\vec{l} = \mu_0 I_{enc}$

$B_y \cdot L + (-B_y)(-L) = \mu_0 K L \quad \Rightarrow$

$$\vec{B} = \begin{cases} -\frac{\mu_0}{2} K\,\hat{y} & (z>0) \\ \frac{\mu_0}{2} K\,\hat{y} & (z<0) \end{cases}$$