1. Ampere’s law states that
\[ \nabla \times \mathbf{B} = \mu_0 \mathbf{J} \]
Because \( \nabla \cdot \mathbf{B} = 0 \) we can write \( \mathbf{B} = \nabla \times \mathbf{A} \), where \( \mathbf{A} \) is the so-called vector potential, since the divergence of a curl is always 0. Ampere’s law can thus be written as
\[ \nabla^2 \mathbf{A} = -\mu_0 \mathbf{J} \]

A) always
B) sometimes
C) never
D) as long as \( \nabla \cdot \mathbf{A} = 0 \)
2. An infinite uniform surface current $\mathbf{K} = k\hat{x}$ is flowing over the x-y plane. The magnetic field above the plane is

A) $\mathbf{B} = (\mu_0/2)k\hat{z}$

B) $\mathbf{B} = (\mu_0/2)k\hat{x}$

C) $\mathbf{B} = (\mu_0/2)k\hat{y}$

D) $\mathbf{B} = -(\mu_0/2)k\hat{y}$
3. An infinite uniform surface current \( \mathbf{K} = k\hat{x} \) is flowing over the \( x-y \) plane. The vector potential above the plane is

A) \( \mathbf{A} = -\frac{\mu_0}{2} ky\hat{y} \)

B) \( \mathbf{A} = \frac{\mu_0}{2} kx\hat{y} \)

C) \( \mathbf{A} = \frac{\mu_0}{2} kx\hat{z} \)

D) \( \mathbf{A} = -\frac{\mu_0}{2} ky\hat{z} \)
4. The magnetic dipole moment of a current loop is \( \mathbf{m} = I \int da = I \mathbf{a} \) where \( \mathbf{a} \) is the vector area of the loop. The magnetic dipole moment of a square loop, with sides \( w \) that lies in the \( y \)-\( z \) plane is

A) \( \mathbf{m} = w^2 I \hat{x} \)

B) \( \mathbf{m} = -w^2 I \hat{x} \)

C) \( \mathbf{m} = -2wI \hat{z} \)

D) \( \mathbf{m} = -w^2 I \hat{y} \)
5. The magnetic field on the axis of a current loop with dipole moment \( \mathbf{m} \) is

A) \[
\mathbf{B} = \frac{2\mu_0 \mathbf{m}}{4\pi z^3}
\]

B) \[
\mathbf{B} = -\frac{2\mu_0 \mathbf{m}}{4\pi z^2}
\]

C) \[
\mathbf{B} = \frac{2\mu_0 \mathbf{m}}{4\pi z}
\]

D) \[
\mathbf{B} = \frac{2\mu_0 \mathbf{m}}{4\pi z^4}
\]