5.28 The vector potential from the loop with radius a is given by

$$A_\phi(r,\theta) = \frac{\mu}{4\pi} \frac{4Ia}{\sqrt{r^2+a^2+2ar\sin\theta}} \left[\frac{(2-k^2)K(k) - 2E(k)}{k^2} \right].$$

In the configuration, $r^2 = b^2+d^2$, $r\sin\theta = b$, Therefore, the vector potential on the loop with radius b is

$$A_\phi(b,d) = \frac{\mu}{4\pi} \frac{4Ia}{\sqrt{(a+b)^2+d^2}} \left[\frac{(2-k^2)K(k) - 2E(k)}{k^2} \right].$$

with $$k^2 = \frac{4ab}{(a+b)^2+d^2}.$$

The vector potential has the same direction as the current, and the energy is

$$W_{ab} = \int \vec{J}_b \cdot \vec{A}_a \, d^3x = \mu I^2 \frac{2ab}{\sqrt{(a+b)^2+d^2}} \left[\frac{(2-k^2)K(k) - 2E(k)}{k^2} \right]$$

$$= \mu I^2 \sqrt{ab} \left[\left(\frac{2}{k} - k \right) K(k) - \frac{2}{k} E(k) \right]$$

and the mutual inductance is

$$M_{ab} = \frac{W_{ab}}{I^2} = \mu \sqrt{ab} \left[\left(\frac{2}{k} - k \right) K(k) - \frac{2}{k} E(k) \right]$$

When $d \ll a, b$ and $a \simeq b$, $k \to 1$. The mutual inductance diverges.