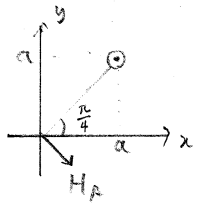
H17

問2

(1)



$$H_A = \frac{I}{2\pi r}$$

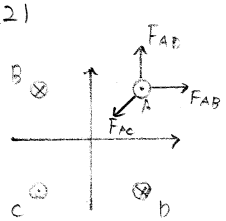
$$= \frac{I}{2\sqrt{2}\pi a}$$

$$H_{Ax} = H_A \cdot \cos\left(-\frac{\pi}{4}\right) = \frac{I}{4\sqrt{2}\pi a}$$

$$H_{Ay} = H_A \cdot \sin\left(-\frac{\pi}{4}\right) = -\frac{I}{4\sqrt{2}\pi a}$$

$$H_A = \left(\frac{I}{4\sqrt{2}\pi a} \quad -\frac{I}{4\sqrt{2}\pi a} \quad 0\right)$$

(2)



$$F_{AD} = \frac{\mu_0 I^2}{2\pi \cdot 2a} = \frac{\mu_0 I^2}{4\pi a}$$

$$F_{AB} = \frac{\mu_0 I^2}{2\pi \cdot 2a} = \frac{\mu_0 I^2}{4\pi a}$$

$$F_{AC} = \frac{\mu_0 I^2}{2\pi \cdot 2\sqrt{2}a} = \frac{\mu_0 I^2}{4\sqrt{2}\pi a}$$

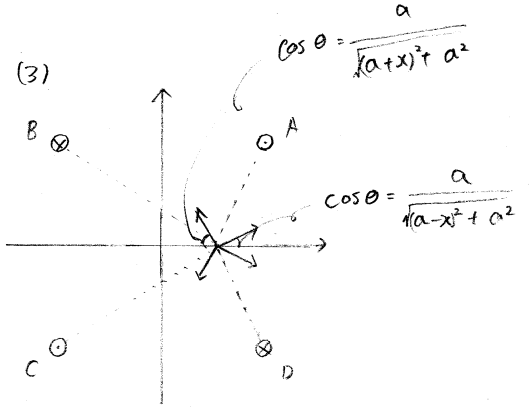
$$F_{ACx} = F_{AC}\left(-\cos\frac{\pi}{4}\right) = -\frac{\mu_0 I^2}{8\pi a}$$

$$F_{ACy} = F_{AC}\left(-\sin\frac{\pi}{4}\right) = -\frac{\mu_0 I^2}{8\pi a}$$

$$F_x = F_y, \quad \frac{\mu_0 I^2}{4\pi a} - \frac{\mu_0 I^2}{8\pi a} = \frac{\mu_0 I^2}{8\pi a}$$

$$F = \left(\frac{\mu_0 I^2}{8\pi a} \quad \frac{\mu_0 I^2}{8\pi a} \quad 0\right)$$

(3)



x軸方向に磁界は発生せず

y軸方向の磁界は打ち消し合う

$$H_{Ax} = \frac{I}{2\pi \cdot \sqrt{(a-x)^2+a^2}} \cdot \frac{a}{\sqrt{(a-x)^2+a^2}} = \frac{aI}{2\pi\{(a-x)^2+a^2\}}$$

同様にして

$$H_{Cx} = \frac{aI}{2\pi\{(a-x)^2+a^2\}}$$

$$H_{Bx} = -\frac{aI}{2\pi\{(a+x)^2+a^2\}}$$

$$H_{Dx} = -\frac{aI}{2\pi\{(a+x)^2+a^2\}}$$

より

$$H_{(x)x} = \frac{aI}{\pi\{(a-x)^2+a^2\}} - \frac{aI}{\pi\{(a+x)^2+a^2\}}$$

$$= \frac{4a^2 I x}{\pi\{(a-x)^2+a^2\}\{(a+x)^2+a^2\}}$$

$$H_{(x)} = \left(\frac{4a^2 I x}{\pi\{(a-x)^2+a^2\}\{(a+x)^2+a^2\}} \quad 0 \quad 0\right)$$