

[課題17]

$$(a) \quad W = \frac{1}{2} QV, \quad Q = CV, \quad C = \frac{\epsilon_0 \epsilon_r S}{d} \text{ より}$$

$$W = \frac{1}{2} \frac{\epsilon_0 \epsilon_r S}{d} \cdot V^2 \cdot \frac{1}{Sd}$$

$$= \frac{\epsilon_0 \epsilon_r}{2d^2} V^2 = \frac{8.85 \times 10^{-12} \cdot 2}{2(1 \times 10^{-3})^2} \cdot 100^2$$

$$= 8.85 \times 10^{-2} \text{ [J/m}^3 \text{]}$$

$$(b)(1) \quad F = qV \times B \sin \theta$$

$$\text{電子} \quad e = 1.60 \times 10^{-19} \text{ [C]} \text{ である}$$

$$F = 1.60 \times 10^{-19} \cdot 10^6 \times 10^{-4} \cdot 1$$

$$= 1.6 \times 10^{-17} \text{ [N]}$$

$$(b2) \quad F = \frac{mv^2}{r} \text{ [N]}$$

$$(b3) \quad (b1) = (b2) \text{ より}$$

$$1.6 \times 10^{-17} = \frac{mv^2}{r}$$

$$\text{電子の質量} \quad m = 9.11 \times 10^{-31} \text{ [kg]} \text{ である}$$

$$r = \frac{mv^2}{1.6 \times 10^{-17}} = \frac{9.11 \times 10^{-31} \cdot (10^6)^2}{1.6 \times 10^{-17}}$$

$$= 0.0569 = 5.69 \text{ [cm]}$$

$$(c) \quad F = qV \times B \sin \theta$$

$$q = 1.6 \times 10^{-19}$$

$$F = 1.6 \times 10^{-19} \cdot 7.2 \times 10^6 \times 85 \times 10^{-3}$$

$$= 979.2 \times 10^{-16}$$

$$= 9.8 \times 10^{-14} \text{ [N]}$$

加速度

$$F = ma \text{ より}, \quad a = \frac{F}{m}$$

$$m = 9.11 \times 10^{-31} \text{ [kg]}$$

$$a = \frac{9.8 \times 10^{-14}}{9.11 \times 10^{-31}}$$

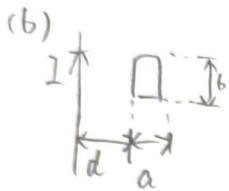
$$= 1.076 \times 10^{17}$$

$$\approx 1.1 \times 10^{17} \text{ [m/s}^2 \text{]}$$

[課題 18]

(a) $B = \frac{\mu_0 I}{2\pi a}$ [T] 5'),

$$B = \frac{4\pi \times 10^{-7} \cdot 1}{2\pi \cdot 10^{-2}} = 2 \times 10^{-5} \text{ [T]}$$



$$B = \frac{\mu_0 I}{2\pi a} \text{ (5')}$$

$$B = b \int_d^{d+a} B \, dx$$

$$= b \int_d^{d+a} \frac{\mu_0 I}{2\pi x} \, dx$$

$$= \frac{\mu_0 I b}{2\pi} \left[\log x \right]_d^{d+a}$$

$$= \frac{\mu_0 I b}{2\pi} \log \frac{d+a}{d} \text{ [wb]}$$

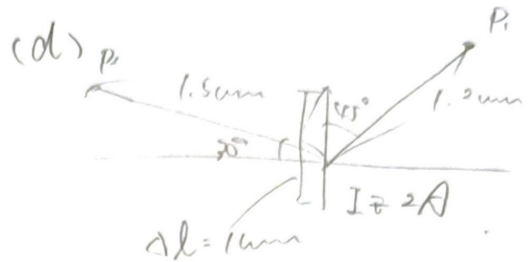


$$B = \int_{45}^{135} \frac{\mu_0 I}{4\pi r} \sin \theta \cdot \Delta S \cdot d\theta$$

$$= \frac{\mu_0 I}{4\pi a} \left(\frac{2}{\sqrt{2}} \right)$$

$$= \frac{2\mu_0 I}{2\sqrt{2}\pi a}$$

$$4B = \frac{8\mu_0 I}{2\sqrt{2}\pi a} = \frac{2\sqrt{2}\mu_0 I}{\pi a} \text{ [T]}$$



$$dB = \frac{\mu_0 I \, dx \sin \theta}{4\pi r^2}$$

$$= \frac{4\pi \times 10^{-7} \cdot 2 \cdot 1 \times 10^{-3} \cdot \sin 45^\circ}{4\pi (1.2 \times 10^{-3})^2}$$

$$= \frac{2 \cdot \frac{\sqrt{2}}{2} \times 10^{-10}}{1.44 \times 10^{-6}}$$

$$= 0.98 \times 10^{-4}$$

$$= 98 \times 10^{-6} = 98 \text{ [}\mu\text{T]}$$

$$dB_2 = \frac{4\pi \times 10^{-7} \cdot 2 \cdot 10^{-3}}{4\pi \cdot (1.5 \times 10^{-3})^2} \cdot \sin(90 - 45)$$

$$= \frac{10^{-7} \cdot 2 \cdot 10^{-3}}{2.25 \times 10^{-6}} \cdot \frac{\sqrt{2}}{2}$$

$$= 0.77 \times 10^{-4} = 77 \text{ [nT]}$$