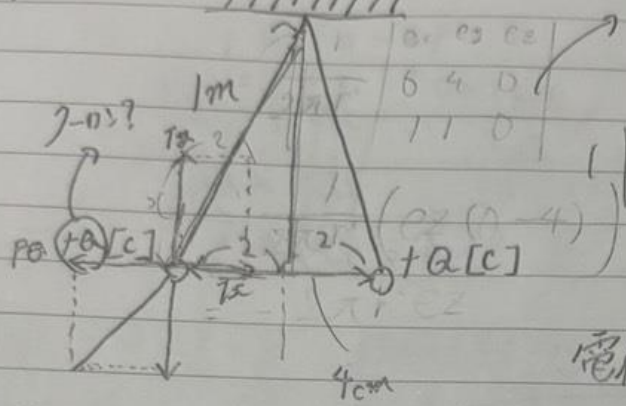
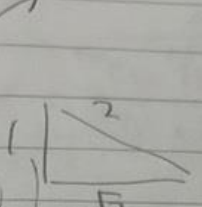
基礎物理

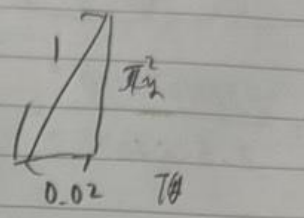
問1 手合て

問2



第6回電位より





$0.02^2 + Ty^2 = 1$

$Ty \fallingdotseq 1$

電荷を求めよ[C] $g = 9.8$

玉 $= 490g$

$\vec{T} = (Tx, Ty)$

$Tx = FQ \quad Ty = 0.49g$

$Tx : Ty = 0.02 : \sqrt{1 - 0.02^2}$

$FQ : 0.49g = 0.02 : 1$

$FQ = 4.9 \times 10^{-1} \times 2 \times 10^{-2} \times g$

$= 9.8 \times 10^{-3} \times 9.8$

$= 9.8^2 \times 10^{-3}$

$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{r^2}$

$FQ = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{r^2}$

$9.8^2 \times 10^{-3} = 9.0 \times 10^9 \cdot \frac{Q^2}{4^2 \times 10^{-4}}$

$9.8^2 \times 10^{-3} = \frac{9.0 \times 10^9 \cdot Q^2}{4^2 \times 10^{-4}}$

$(9.8^2 \times 10^{-3}) \cdot (4^2 \times 10^{-4}) = 9.0 \times 10^9 \cdot Q^2$

$Q^2 = \frac{(9.8^2 \times 10^{-3}) \cdot (4^2 \times 10^{-4})}{9.0 \times 10^9} \Leftrightarrow \frac{9.8^2 \times 4^2}{9.0 \times 10^9} \times 10^{-7}$

$\Leftrightarrow \frac{9.8^2 \times 4^2}{9.0} \times 10^{-16}$

$Q = \frac{9.8 \times 4}{3} \times 10^{-8}$

$= 13 \times 10^{-8} \Leftrightarrow 1.3 \times 10^{-7}$

$4cm = 0.04 \Leftrightarrow 4 \times 10^{-2}$

$\frac{4^2 \times 10^{-2}}{9.0 \times 10^9} \cdot 9.8 \times 10^{-2}$

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問3 $S = 100\,cm^2$、$d = 3mm$ $t = 0.5\,mm$ $1000V$ のとき蓄積Q[nC]

$$C = \frac{Q}{V} = \frac{\varepsilon_0 S}{d - t}$$

$$C = \frac{8.85\times10^{-12}\times10^{-2}}{2.5\times10^{-3}} = \frac{8.85\times10^{-14}}{2.5\times10^{-3}} = \frac{8.85\times10^{-11}}{2.5} = 3.54\times10^{-11}$$

$$= 35.4\times10^{-12}$$

$A = 35\,pF$

$$C = \frac{Q}{V} \Leftrightarrow Q = CV$$

A $35\,nC$

問4

$$C = \frac{Q}{V} = \frac{\varepsilon_0 S}{d}$$

$$V = Ed$$

$C = 50nF$、$d = 0.4mm$ $Q = 10^{-4}$

S、V、Eをもとめよ

$$C = \frac{\varepsilon_0 S}{d} \Leftrightarrow S = \frac{Cd}{\varepsilon_0} = \frac{50\times10^{-9}\times4\times10^{-4}}{8.85\times10^{-12}} = \frac{200}{8.85}\times10^{-1} = \frac{20}{8.85} = \frac{4}{1.77}$$

$$= 2.25$$

$S = 2.3m^2$

$$C = \frac{Q}{V} \Leftrightarrow V = \frac{Q}{C} = \frac{10^{-4}}{50\times10^{-9}} = \frac{10^5}{50} = 2000$$

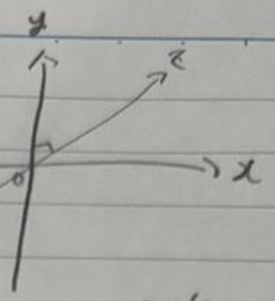
$V = 2kV$

$$V = Ed \Leftrightarrow E = \frac{V}{d} = \frac{2\times10^3}{4\times10^{-4}} = \frac{1}{2}\times10^7 = 0.5\times10^7$$

$E = 5.0\times10^6\,V/E$

問5

$$H = \frac{I}{2\pi r^2}\begin{vmatrix} e_x & e_y & e_z \\ 0 & 0 & 4 \\ 1 & 1 & 0 \end{vmatrix}$$



$r = \sqrt{2}$

$e_x(0-4) - e_y(0-4) + 0$

$= -4e_x + 4e_y$

$= -4\begin{bmatrix}1\\0\\0\end{bmatrix} + 4\begin{bmatrix}0\\1\\0\end{bmatrix}$

代入すると $(-0.32 \quad 0.32 \quad 0)$ A/m

$\frac{1}{2\times 3.14\times 2} = \frac{1}{12.56} \fallingdotseq 0.08$

外積

問6 $F = I \times B$ 磁束密度ベクトル $= B$[T] 電流ベクトル $= I$[A]

$I = 10$、$B = 0.1(e_x + e_y)$ $\theta = 90°$

$F = I \times B = IB\sin\theta$

$= 10e_x \cdot 0.1(e_x + e_y) \times 1 = e_x e_z + e_x e_y = e_z$

($e_x e_z = 0$, $e_x e_y = e_z$)

$F = 4 \times e_z = 4e_z$ $|F| = 4$ z軸に正の方向

問7 $H = \frac{a^2 I}{2(a^2+z^2)^{\frac{3}{2}}}$

半径 $a = 5\times10^{-3}$ $I = 4$

巻き数4 離れた点 $z = 5\times10^{-3}$

計算がんばれ

最後に巻き数かける ⇒ 忘れるな

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$\frac{4}{10} \cdot \frac{7}{25} \cdot$ $\cos 2\pi$ $-\sin 2\pi \cdot 250 \cdot \frac{1}{5}$

問8

$\left| V = -\int_s \frac{\partial B}{\partial t} n ds \right|$ $B = 0.2 \times \cos 250t\,[T]$ $\Omega = 10$ $r = 0.20$

$\frac{\partial B}{\partial t} = -50 \sin 250t$

$V = 50 \int_s \sin 250t \, ds$

$= 50 \sin 250t \, S$ ← 面積 この問題では円 $S = r^2\pi$

$-1 \leqq \sin\theta \leqq 1$

$\sin 250t = 1$ のとき MAX

↓

$= 6.3 \sin 250t$

$= 6.3$

$V = RI$

$I = \frac{V}{R} = \frac{6.3}{10} = 0.63$ A

A 0.63