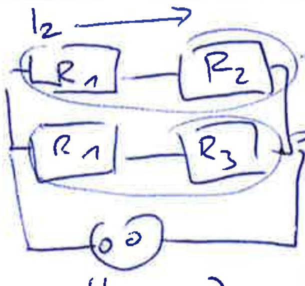
(1)

$R_1 = 1\Omega$

$R_2 = 2\Omega$

$R_3 = 5\Omega$

$U_0 = 12V$



$= R_{N2} = R_1 + R_2 = 3\Omega$ 2

$= R_{N3} = R_1 + R_3 = 6\Omega$ 2

a) $R_N = \frac{R_{N2} \cdot R_{N3}}{R_{N2} + R_{N3}} = \frac{3 \cdot 6}{3+6} = 2\Omega$ 3 2

$\frac{1}{R_N} = \frac{1}{R_{N2}} + \frac{1}{R_{N3}}$ 3

b) $I_2 = \frac{U_0}{R_{N2}} = \frac{12V}{3\Omega} = 4A$ 4 1

c) $P_2 = U_2 I_2 = R_2 I_2^2 = 2\Omega \cdot (4A)^2 = 32W$ 4 3 1

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(2) $m_1 = 90kg$

$h_0 = 8m$

$m_2 = 150kg$

a) $v_1 = ?$

b) $v_s = ?$

c) $h_c = ?$

a) ~~$m_1 g h_0 = ...$~~

$\Delta W = 0 = \Delta W_{KIN} + \Delta W_{POT}$ 2

$0 = \frac{m_1 v_1^2}{2} - 0 + 0 - m_1 g h_0$ 2 2

$\frac{v_1^2}{2} = g h_0 \rightarrow v_1 = \sqrt{2 g h_0} = 12{,}5 \frac{m}{s}$ 2 1

b) $\Delta G = 0$ 1

ZAČ: $G_1 = m_1 v_1$ 2

$G_2 = 0$

KONC: $G_s = (m_1 + m_2) v_s$ 2

$v_s = \frac{m_1 v_1}{m_1 + m_2} = 4{,}69 \frac{m}{s}$ 1 1

c) $\Delta W = 0$

$0 = \Delta W_k + \Delta W_p = 0 - \frac{(m_1+m_2) v_s^2}{2} + (m_1+m_2) g h_c - 0$ 2 2 2

$\rightarrow h_c = \frac{v_s^2}{2g} = 1{,}12m$ 2 1

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(3) $p_m = 1Am^2$

$I = 10A$

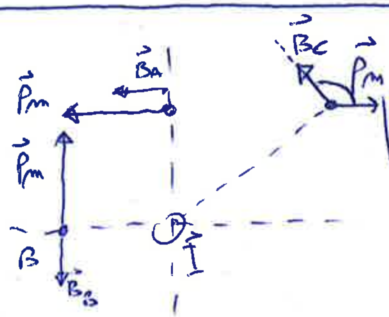
$r_0 = 2cm$

$r_1 = 4cm$

a) $A_{A \to B} = ?$

b) $A_{B \to C} = ?$

c) $\alpha = ?$



$|\vec{B}(r)| = \frac{\mu_0 I}{2\pi r}$

a) $A_{A \to B} = \Delta W_m = W_{mB} - W_{mA} =$ 2

$= -\vec{p}_{m,B} \cdot \vec{B}_B + \vec{p}_{m,A} \cdot \vec{B}_A = -|\vec{p}_B||\vec{B}_B| \cdot \cos\alpha_B + |\vec{p}_A||\vec{B}_A| \cos\alpha_A$ 2

$|\vec{p}_B| = |\vec{p}_A| = p_m$

$|\vec{B}_A| = |\vec{B}_B| = \frac{\mu_0 I}{2\pi r_0}$ 2 $(1 \cdot 10^{-4} T)$

$\alpha_A = 0°$ 2

$\alpha_B = 180°$ 2

$A_{A \to B} = -p_m \frac{\mu_0 I}{2\pi r_0} \left(\underset{-1}{\cos(180°)} - \underset{1}{\cos(0°)} \right) = -2 \cdot \frac{p_m \mu_0 I}{2\pi r_0} = 2 \cdot 10^{-4} J$ 1

b) $A_{B \to C} = -|\vec{p}_C||\vec{B}_C| \cos\alpha_C + |\vec{p}_B||\vec{B}_B| \cos\alpha_B =$ 2

$r_1 = 2r_0$

$|\vec{p}_C| = |\vec{p}_B| = p_m$

$|\vec{B}_C| = \frac{\mu_0 I}{2\pi r_1}$ $(5 \cdot 10^{-5} T)$ 2, $|\vec{B}_B| = \frac{\mu_0 I}{2\pi r_0}$, $\alpha_C = 120°$ 2

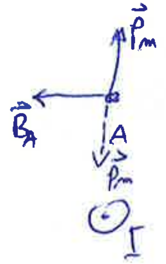
$= -p_m \frac{\mu_0 I}{2\pi \cdot 2r_0} \underset{-\frac{1}{2}}{\cos\alpha_C} + p_m \frac{\mu_0 I}{2\pi r_0} \underset{-1}{\cos\alpha_B} = -\frac{3}{4} \frac{p_m \mu_0 I}{2\pi r_0} = -7{,}5 \cdot 10^{-5} J$ 1

c) O: $|\vec{M}| = |\vec{p}_m \times \vec{B}| = p_m \cdot B_A \cdot \sin \alpha_A' \Rightarrow$ ~~[illegible]~~

2

$\alpha_A' = \pm 90^\circ$

3



$M = p_m \cdot \frac{\mu_0 I}{2\pi r_0} \cdot 1 = 1 \cdot 10^{-4}\ J$ 1

$\frac{M}{J} = \alpha = 5 \cdot 10^{-3}\ s^{-1}$ 1

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(4)

$l = 10\ cm$

$m_p = 20\ g$

$r = 1\ cm$

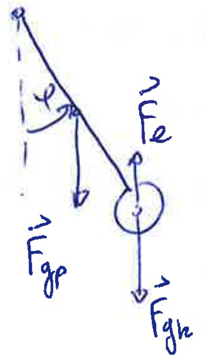
$m_k = 50\ g$

$U = 100\ V$

$d = 0{,}5\ m$

$e = -1\ mAs$

$\omega_0 = ?$



$\sum M_i = J\ddot{\varphi}$ 2

$M_{gp} = -F_{gp} \cdot \frac{l}{2} \sin\varphi$ 5

$M_k = -(F_{gk} - F_e)(l+r)\sin\varphi$ 2 5

$J\ddot{\varphi} = -m_p g \frac{l}{2} - (m_k g - e_k E)(l+r)\varphi$

$$\omega_0 = \sqrt{\frac{m_p g \frac{l}{2} + (m_k g - e_k \frac{U}{d})(l+r)}{J}} = 7{,}9\ s^{-1}$$ 5

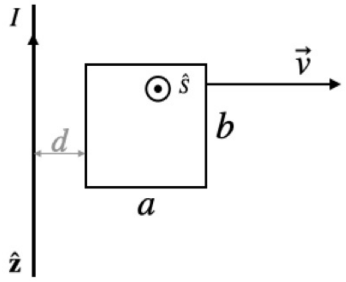
$J = J_p + J_k = \frac{1}{3} m_p l^2 + \frac{2}{5} m_k r^2 + m_k (l+r)^2 = 6{,}7 \cdot 10^{-4}\ kg\,m^2$

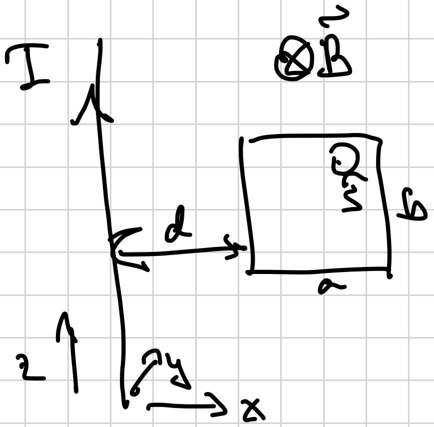
1 1 2

$t_0 = \frac{2\pi}{\omega_0} = 0{,}795\ s$

1 1

5. Po dolgem, ravnem vodniku teče tok $I = 1$ A v smeri $\hat{\mathbf{z}}$. Zraven vodnika postavimo pravokotno bakreno zanko dimenzij $a = 3\,\mathrm{cm} \times b = 4\,\mathrm{cm}$ tako, da je njen bližnji rob vzporeden z vodnikom, vektor površine zanke $\hat{S}$, pa je pravokoten na os $\hat{\mathbf{z}}$, kot je prikazano na skici. Bliznji rob zanke je ob času $t = 0$ na razdalji $d = 5$ cm od vodnika, kot je prikazano na skici. Nato začnemo zanko vleči s konstantno hitrostjo $v = 3$ cm/s stran od vodnika. Kolikšna napetost se inducira v zanki po $\Delta t = 5$s, če je specificna upornost bakra $\xi = 0.01724\Omega\mathrm{mm}^2/\mathrm{m}$, žica pa ima presek 1 mm^2.





$$\phi_m = \int \vec{B}\cdot d\vec{S} = -\int_0^b dz \int_{d+v\cdot t}^{d+a+v\cdot t} dx\, B(x)$$ 2T 2T

$$= -b\cdot\int_{d+v\cdot t}^{d+a+v\cdot t} \frac{\mu_0 I}{2\pi x}\,dx = -\frac{\mu_0 I b}{2\pi} \ln x \Big|_{d+v\cdot t}^{d+a+v\cdot t}$$ 2T 2T

$$B(x) = \frac{\mu_0 I}{2\pi x}$$ 1T

$$= -\frac{\mu_0 I b}{2\pi} \ln \frac{d+a+v\cdot t}{d+v\cdot t}$$ 5T

$$U_i = -\frac{d\phi_m}{dt} = \frac{\mu_0 I b}{2\pi} \frac{d}{dt}\left(\ln \frac{d+a+v\cdot t}{d+v\cdot t}\right)$$ 1T

upoštevam $\ln \frac{p}{q} = \ln p - \ln q$

$$U_i = \frac{\mu_0 I b}{2\pi}\left\{\frac{d}{dt}\ln(d+a+v\cdot t) - \frac{d}{dt}\ln(d+v\cdot t)\right\}$$

$$\frac{d}{dx}\ln x = -\frac{1}{x}$$

$$U_i = \frac{\mu_0 I b}{2\pi}\left\{\frac{v}{d+v\cdot t} - \frac{v}{d+a+v\cdot t}\right\}$$ 5T

$$U_i(t=5s) = \frac{\mu_0 \cdot 11 \cdot 0.04m}{2\pi} \left\{ \frac{0.03m/s}{0.05m + 0.15m} - \frac{0.03m/s}{0.05m + 0.15m + 0.03m} \right\}$$

$$= 0.15\mu V$$ 1T

$$R = \frac{\rho l}{S} = 0.24\,\Omega$$ 1T 1T

$$I = \frac{U_i}{R} = \frac{0.15\mu V}{0.24\,\Omega} = 0.625\mu A$$ 1T

1T

②