Problema 1, Clasa a IX-a

a) **Total: 2,7 p.**

$g_h = \frac{KM_0}{(R+h)^2}$ 1x0,3p

$g_0 = \frac{KM_0}{R^2}$ 1x0,3p

$g_h = \frac{g_0}{\left(1+\frac{h}{R}\right)^2}$ 1x0,3p

$\left(1+\frac{h}{R}\right)^2 = 1 + \frac{2h}{R} + \left(\frac{h}{R}\right)^2$ 1x0,3p

$h \ll R \Longrightarrow (h/R)^2 \ll h/R$ 1x0,3p

$\left(1+\frac{h}{R}\right)^2 \cong 1 + \frac{2h}{R}$ 1x0,3p

$g_h = \frac{g_0}{1+\frac{2h}{R}} = \frac{g_0\left(1-\frac{2h}{R}\right)}{1-\left(\frac{2h}{R}\right)^2} \cong g_0\left(1-\frac{2h}{R}\right)$ 3x0,3p

b) **Total: 0,9 p.**

$\frac{|\Delta g|}{g_0} = \frac{|g_h - g_0|}{g_0} = 1 - \frac{g_h}{g_0}$ 2x0,3p

$\frac{|\Delta g|}{g_0} = \frac{2h}{R}$ 1x0,3p

c) **Total: 3,6 p.**

$r = R - h$ 1x0,3p

$g_0 = \frac{KM_0}{R^2}$ 1x0,3p

$g = \frac{KM}{r^2}$ 1x0,3p

$M = \rho V; V = \frac{4\pi R^3}{3}$ 2x0,3p

$M_0 = \rho V_0; V = \frac{4\pi r^3}{3}$ 2x0,3p

$M = \frac{M_0 V}{V_0} = \frac{g_0(R-h)^3}{KR}$ 2x0,3p

$g = \frac{g_0(R-h)^3}{R(R-h)^2} = g_0\left(1-\frac{h}{R}\right)$ 2x0,3p

$g = \frac{3}{4}g_0$ 1x0,3p

d) **Total: 1,2 p.**

$g' = g_h$ 1x0,3p

$g' = g_0\left(1-\frac{h\prime}{R}\right)$ 1x0,3p

$g_h = \frac{g_0}{\left(1+\frac{h}{R}\right)^2} = \frac{g_0}{4}$ 1x0,3p

$h' = 0{,}75R$ 1x0,3p

e) **Total: 1,1 p.**

$\varepsilon_{\%} = \frac{|\Delta g|}{g_0} \cdot 100\%$ 1x0,3p

$\varepsilon = \frac{|\Delta g|}{g_0} = \frac{\varepsilon_{\%}}{100} = 0.01$ 1x0,2p

$h = R\frac{\varepsilon}{2}$ 1x0,3p

$h = 32$ km 1x0,3p

f) **Total: 0,5 p.**

$\varepsilon = 0.002$ 1x0,2p

$h = \frac{R\varepsilon}{2} = 6{,}4$ km 1x0,3p

Problema 2, Clasa a IX-a

a) **Total: 2,0 p**

$U_1 = IR_1$ 1x0,25p.

$U_2 = IR_2$ 1x0,25p.

$I = \frac{\varepsilon}{R_1+R_2+r}$ 1x0,25p.

$U_0 = I_0 R_1$ 1x0,25p.

$I_0 = \frac{\varepsilon}{R_1+r}$ 1x0,25p.

$U_1 R_2 = U_2 R_1$ 1x0,25p.

$\varepsilon = \frac{U_2 U_0}{U_0 - U_1} = 27$ V 2x0,25p.

b) **Total: 0,5 p**

$r = \frac{\varepsilon - U_0}{U_0} R_1 = 0{,}50\ \Omega$ 2x0,25p.

c) **Total: 0,5 p**

$R_2 = \frac{R_1 U_2}{U_1} = 0{,}75\ \Omega$ 2x0,25p.

d) **Total: 1,0 p**

$R_d = \frac{R_1 R_2}{R_1+R_2} \approx 0{,}43\ \Omega$ 1x0,25p.

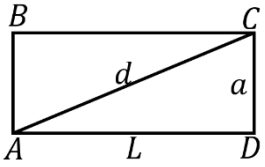
$I_d = \frac{\varepsilon}{R_d+r}$ 1x0,25p.

$I_d = \frac{\varepsilon}{R_d+r} = 29$ A 1x0,5p.

e) **Total: 0,5 p**

$R = \rho \frac{l}{S} = 1{,}2\ \Omega$ 2x0,25p.

f) **Total: 4,75 p**



$2L + 2a + d = l$ 1x0,25p.

$d = \sqrt{L^2 + a^2}$ 1x0,25p.

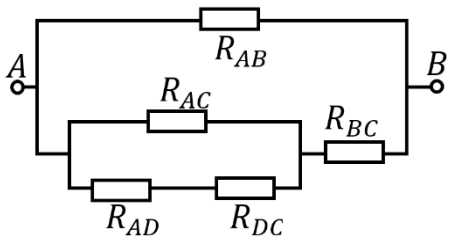
$l - 2a - 2L = \sqrt{L^2 + a^2}$ 1x0,25p.

$a^2 - 8a + 9 = 0$ 1x0,25p.

$a_{1(2)} = \left(4 \pm \sqrt{7}\right)$m 1x0,25p.

$a = \left(4 - \sqrt{7}\right)$m ≈ 1.4 m 1x0,5p.

$d = 3{,}3$ m 1x0,25p.



$R_{AB} = R_{CD} = \frac{\rho a}{S} \approx 0.14\ \Omega$ 2x0,25p.

$R_{BC} = R_{AD} = \frac{\rho L}{S} = 0.30\ \Omega$ 2x0,25p.

$R_{AC} = \frac{\rho d}{S} \approx 0.33\ \Omega$ 1x0,25p.

$R''' = R_{AD} + R_{CD} \approx 0.44\ \Omega$ 1x0,25p.

$R'' = \frac{R_{AC} R'''}{R_{AC}+R'''} \approx 0.19\ \Omega$ 1x0,25p.

$R' = R'' + R_{BC} \approx 0.49\ \Omega$ 1x0,25p.

$R = \frac{R_{AB} R'}{R_{AB}+R'} \approx 0.11\ \Omega$ 1x0,25p.

$R \approx 0.11\ \Omega$ 1x0,5p.

g) **Total: 0,75 p**

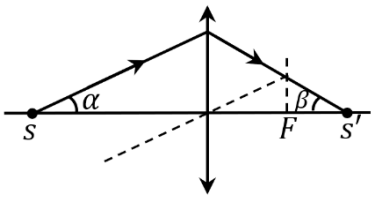
$I_g = \frac{\varepsilon}{R+r}$ 1x0,25p.

$I_g = 44$ A 1x0,5p.

Problema 3, Clasa a IX-a

a) Total: 0,8 p

- Pentru indicarea lentilei și a axei optice principale 2x0,1 p
- Pentru indicarea a razei incidente și a razei refractate 2x0,1 p
- Pentru indicarea poziției focarului și a poziției imaginii 2x0,2 p



b) Total: 1,6 p

$\frac{1}{F}=\frac{1}{d}+\frac{1}{f}$ 1x0,4 p

$d\mathrm{tg}\alpha = f\mathrm{tg}\beta$ 1x0,4 p

$F=\frac{d\mathrm{tg}\alpha}{\mathrm{tg}\alpha+\mathrm{tg}\beta}=22\ \mathrm{cm}$ 2x0,4 p

c) Total: 1,2 p

$f=\frac{d\mathrm{tg}\alpha_1}{\mathrm{tg}\beta_1}=\frac{d\mathrm{tg}\alpha}{\mathrm{tg}\beta}$ 1x0,4 p

$\mathrm{tg}\beta_1=\frac{\mathrm{tg}\alpha_1\cdot\mathrm{tg}\beta}{\mathrm{tg}\alpha}=\sqrt{3}$ 1x0,4 p

$\beta_1=60°$ 1x0,4 p

d) Total: 2,8 p

Pentru viteze 2x0,4 p

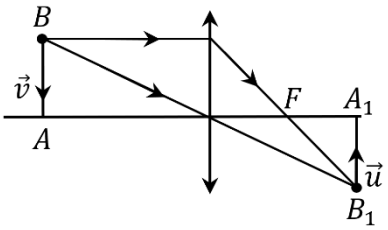
$\frac{h_1}{h}=\frac{f}{d}$ 1x0,4 p

$h_1=A_1B_1=u\Delta t$ 2x0,2 p

$h=AB=v\Delta t$ 2x0,2 p

$u=\frac{Fv}{d-F}$ 1x0,4 p

$u=0{,}58\ \mathrm{m/s}$ 1x0,4 p



e) Total: 1,2 p

Pentru imaginea unei deplasări a sursei S, când d>F

- trasarea a două raze și refracțiile lor 2x0,2p
- trasarea imaginii deplasării 1x0,2p

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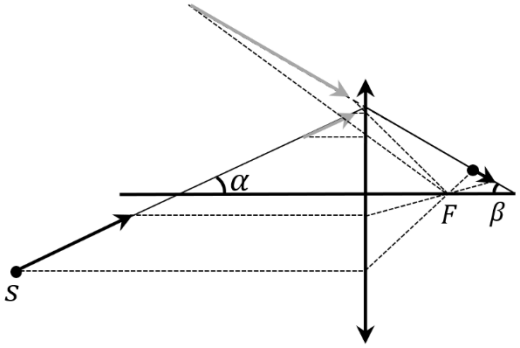


f) Total: 2,4 p

$\frac{1}{a}+\frac{1}{b}=\frac{1}{F},\quad b=\frac{aF}{a-F}$ 2x0,2 p

$a\mathrm{tg}\alpha = b\mathrm{tg}\beta$ 1x0,1 p

$\mathrm{tg}\beta=\frac{(a-F)\mathrm{tg}\alpha}{F}$ 1x0,2 p

pentru viteze 3x0,2 p

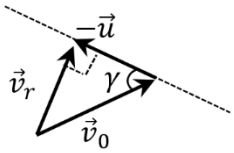
$v_r=v_0\sin(\alpha+\beta)$ 1x0,4 p

$\sin(\alpha+\beta)=\sin\alpha\cos\beta+\cos\alpha\sin\beta$ 1x0,1 p

$\cos\beta=\frac{1}{\sqrt{1+\mathrm{tg}^2\beta}}$ 1x0,1 p

$\sin\beta=\frac{\mathrm{tg}\,\beta}{\sqrt{1+\mathrm{tg}^2\beta}}$ 1x0,1 p

$v_r=\frac{av_0\sin\alpha}{\sqrt{F^2+(a-F)^2\mathrm{tg}^2\alpha}}$ 1x0,4 p



$\gamma=\alpha+\beta$