



Олимпиада школьников
**Звезда - таланты
на службе обороны
и безопасности**

Шифр 0-11-8

Задание	1	2	3	4	5	6	7	Всего
Баллы	12	15	6	15	2			50

~3. 68.

Дано:
 $\mathcal{E} = 3\text{В}$
 $R = 50\text{Ом}$
 $I_A = ?$

$I_1 = I_2 + I_3$
 $I_4 = I_5 + I_6$

$3\mathcal{E} = R(I_5 + I_2 + I_3) + R(I_2 - I_6)$
 $2\mathcal{E} = R(I_5 + I_6 + I_3) + R(I_2 - I_6) =$
 $= R(I_5 + I_3 + I_2 - I_6)$

из первого выражения выразим

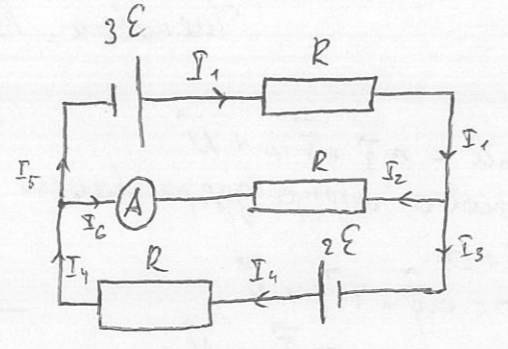
$\mathcal{E} = R(I_5 + I_2 + I_3 + I_2 - I_6 - I_5 - I_3 - I_2) = R(I_2 - I_6)$

$I_2 - I_6 = I_A$

$\mathcal{E} = R I_A$

$I_A = \frac{\mathcal{E}}{R} = \frac{3}{5} = 0,6\text{ А}$

Ответ: $I_A = 0,6\text{ А}$



~4. 158.

Дано:
 $R_1 = 10\text{Ом}$
 $m = 0,12$
 $\varphi = 5\text{кВ}$
 $v = 1\text{м/с}$
 $R_2 = ?$

$F_k = k \frac{q^2}{R^2} = \varphi R$

$\varphi = \frac{kq}{R^2} \quad q = \frac{\varphi R^2}{k}$

$\frac{\sum m_i v^2}{2} = \frac{kq^2}{R_2}$

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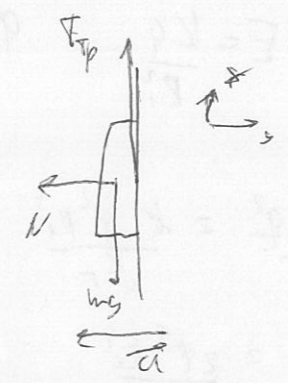
$R_2 = \frac{2kq^2}{m v^2} = \frac{2k \varphi^2 R_1^4}{k^2 m v^2} = \frac{2 \cdot 25 \cdot 10^6 \cdot 10^{-4}}{k \cdot 10^{-1}} = \frac{5 \cdot 10^4}{k} = 2 \cdot 10^5 \pi \epsilon_0$

Ответ: $R_2 = \frac{5 \cdot 10^4}{k} = 2 \cdot 10^5 \pi \epsilon_0$

Черновик. Вариант ~2.



$P = \rho g h (\sigma + \omega)$
 $P_k = \frac{F}{S}$
 $F = P_k S = \rho g h (\sigma + \omega) S$
 $N = P_k S$



$mg = P_k S$

$m_{\text{new}} = k P_k S$

$P_{\text{comb}} g$

$m_b = \rho V_b = \rho S_b h = \rho S_c (\sigma + \omega) t$
 $h = (\sigma + \omega) t$

$F = \rho S (\sigma + \omega) t g = N \quad t = 100\text{с}$

$mg = k \rho S (\sigma + \omega) t g \quad m = k \rho S (\sigma + \omega) t$

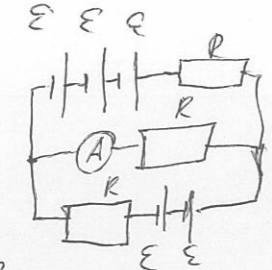
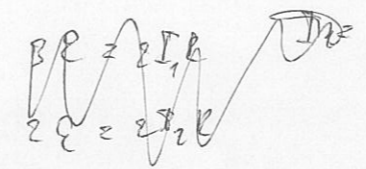
$\eta = \frac{t_u - t_r}{t_u} = \frac{100}{373} = 0,268 = \frac{Q_{\text{out}} - Q_{\text{in}}}{Q_{\text{in}}}$

$Q_{\text{out}} + Q_{\text{out}g} - \eta Q_{\text{out}g} = Q_{\text{out}}$

$Q_{\text{out}} (1 - \eta) = Q_{\text{out}} = m_b \cdot g \quad Q_{\text{out}g} = \lambda m_b$

$m_b = \frac{m_b g}{(1 - \eta) \lambda} = 9,2\text{ кг}$

~1.



$5\mathcal{E} = I_1 R + I_2 R$

$3\mathcal{E} = I_1 R + I_2 R$

$2\mathcal{E} = I_2 R + I_1 R$

$I_1 = \frac{5\mathcal{E} - I_2 R}{R}$

$3\mathcal{E} = 5\mathcal{E} - I_2 R + I_1 R$

$I_2 = \frac{2\mathcal{E} + I_1 R}{R}$

$2\mathcal{E} = 2\mathcal{E} + I_1 R + I_1 R$

$I_1 = I_1' + I_1''$

$I_2 = I_2' + I_2''$

$|I_1' - I_1''| = I_A$

1) $5\mathcal{E} = (I_1' + I_1'' + I_2') R + (I_1' + I_2' + I_2'') R = (I_1' + I_2' + I_1'' + I_2'' + I_2' + I_1') R$
 2) $3\mathcal{E} = (I_1' + I_2' + I_1'') R + (I_2'' - I_1'') R = (I_1' + I_2' + I_2'' - I_1'' + I_1'') R$
 3) $2\mathcal{E} = (I_1' + I_2'' + I_2') R + (I_1'' - I_2') R = (I_1' + I_2'' + I_2' + I_1'' - I_2') R$

$$2) - 3) = \epsilon = R(\Sigma_1 + k_1 + k_2 - I_1 + I_2 - \Sigma_1 - k_1 - k_2) = R(\Sigma_2 - I_2) = R I \Delta$$

$$I \Delta = \frac{q}{R}$$

$$E = \frac{kq}{R^2}$$

$$q = \frac{\varphi R_1^2}{k} \quad A = A_0 e^{i\omega t}$$

$$\frac{m v^2}{2} = \frac{k q^2}{r} = \frac{k \varphi^2 R_1^4}{k^2 r}$$

$$\text{or } r = \frac{2 \varphi^2 R_1^4}{k m v^2}$$

$$\frac{1}{f} + \frac{d}{d} = \frac{1}{F}$$

$$\frac{d+f}{df} = \frac{1}{f}$$

$$F = \frac{df}{d+f}$$

$$dF + fF = df$$

$$dF = f(d - F)$$

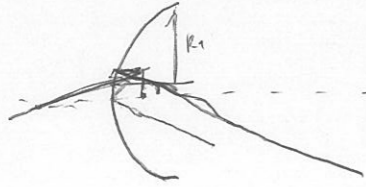
$$f = \frac{dF}{d - F}$$

$$\frac{\sin \alpha}{\sin \beta} = h$$

$$L = L h$$

$$\frac{L}{\sin \beta} = \frac{L}{\sin \alpha} \quad \frac{L}{L} = \frac{\sin \beta}{\sin \alpha}$$

$$\frac{L}{L} = \frac{\sin \beta}{\sin \alpha}$$



~ 1.

Дано:
u
v
k
S
S
m-?

$$m \vec{a} = m \vec{g} + \vec{F}_{sp} + \vec{N}$$

режим равновесия

$$\vec{a} = 0$$

$$0 = m \vec{g} + \vec{F}_{sp} + \vec{N}$$

$$\text{or: } 0 = \vec{F}_e - \vec{N}$$

$$\vec{F}_e = N$$

$$F_e = P_0 S$$

$$P_0 = \rho g h$$

$$h = (\nu + u) t$$

$$P_0 = \rho g (\nu + u) t \quad t = 1 \text{ сек}$$

$$\Rightarrow P_0 = \rho g (\nu + u)$$

$$F_e = \rho g (\nu + u) S$$

$$N = \rho g (\nu + u) S$$

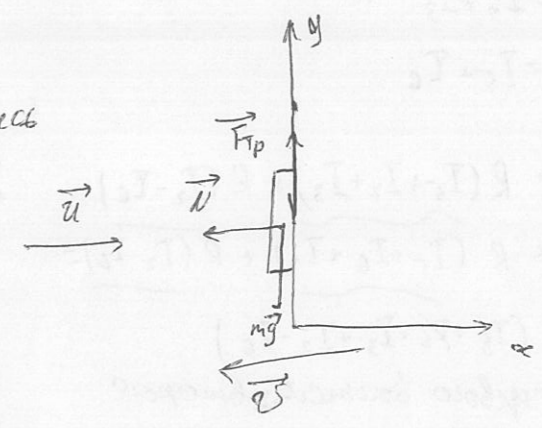
$$\text{or: } 0 = F_{sp} - mg + \dots$$

$$F_{sp} = k N = k \rho g (\nu + u) S$$

$$mg = k \rho g (\nu + u) S$$

$$m = k \rho (\nu + u) S$$

$$\text{Ответ: } m = k \rho (\nu + u) S$$



~ 2. 15

Дано:

$$t_{\alpha} = 273 \text{ К}$$

$$t_{\beta} = 373 \text{ К}$$

$$m_b = 1 \text{ кг}$$

$$r = 2,26 \cdot 10^6$$

$$\lambda = 3,35 \cdot 10^5$$

$m_u = ?$

$$\eta = \frac{t_{\beta} - t_{\alpha}}{t_{\beta}} \quad (\text{измеряем})$$

$$\eta = \frac{Q_{\beta} - Q_{\alpha}}{Q_{\beta}}$$

$$Q_{\beta} \eta = Q_{\beta} - Q_{\alpha}$$

$$Q_{\alpha} = Q_{\beta} (1 - \eta)$$

$$\lambda m_u = m_b r (1 - \eta)$$

$$m_u = \frac{m_b r (1 - \eta)}{\lambda}$$

$$m_u = \frac{m_b r (1 - \frac{t_{\beta} - t_{\alpha}}{t_{\beta}})}{\lambda}$$

$$m_u = \frac{1 \cdot 2,26 \cdot 10^6 (1 - \frac{100}{373})}{3,35 \cdot 10^5} \approx 4,94 \text{ кг}$$

$$\text{Ответ: } m_u = 4,94 \text{ кг}$$

25.

Дано:

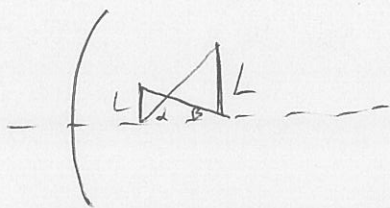
$$R_1 = 50 \text{ см}$$

$$d = 25 \text{ см}$$

$$n = 1,5$$

$$f = ?$$

$$\frac{L}{L} = ?$$



$$\frac{1}{f} + \frac{1}{d} = \frac{1}{F}$$

$$dF = f(d - F)$$

$$f = \frac{dF}{d - F} = 50$$

$$\frac{\sin \alpha}{\sin \beta} = n$$

$$\frac{L}{\sin \beta} = \frac{L}{\sin \alpha}$$

$$\frac{L}{L} = \frac{\sin \beta}{\sin \alpha} = \frac{1}{n}$$

$$\frac{L}{L} = n$$

Ответ: $f = 50$; $L = Ln$



$$2) - 3) = \epsilon = R(\Sigma_1 + k_1 + k_2 - I_1 + I_2 - \Sigma_1 - k_1 - k_2) = R(\Sigma_2 - I_2) = R I_{\Delta}$$

$$I_{\Delta} = \frac{q}{R}$$

$$E = \frac{kq}{R^2}$$

$$q = \frac{\varphi R_1^2}{k} \quad A = A_0 e^{i\omega t}$$

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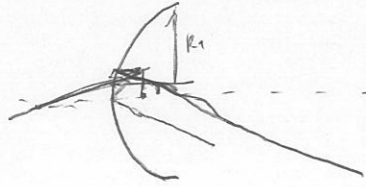
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~ 1.

Дано:
u
v
k
S
S
m-?

$$m \vec{a} = m \vec{g} + \vec{F}_{sp} + \vec{N}$$

мода разгнана где промываются

$$\vec{a} = 0$$

$$0 = m \vec{g} + \vec{F}_{sp} + \vec{N}$$

$$\text{от } 0 = \vec{F}_{sp} - \vec{N}$$

$$\vec{F}_{sp} = N$$

$$F_{sp} = P_0 S$$

$$P_0 = \rho g h$$

$$h = (\nu + u) t$$

$$P_0 = \rho g (\nu + u) t \quad t = 1 \text{ сек}$$

$$\Rightarrow P_0 = \rho g (\nu + u)$$

$$F_{sp} = \rho g (\nu + u) S$$

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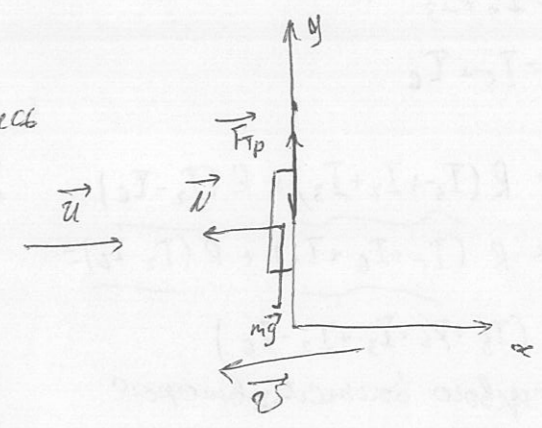
$$\text{ог: } 0 = F_{sp} - mg + L$$

$$F_{sp} = k N = k \rho g (\nu + u) S$$

$$mg = k \rho g (\nu + u) S$$

$$m = k \rho (\nu + u) S$$

$$\text{Ответ: } m = k \rho (\nu + u) S$$



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$m_a = ?$

$$\eta = \frac{t_{\beta} - t_{\alpha}}{t_{\beta}} \quad (\text{измеряем время})$$

$$\eta = \frac{Q_{\beta} - Q_{\alpha}}{Q_{\beta}}$$

$$Q_{\beta} \eta = Q_{\beta} - Q_{\alpha}$$

$$Q_{\alpha} = Q_{\beta} (1 - \eta)$$

$$\lambda m_a = m_b r (1 - \eta)$$

$$m_a = \frac{m_b r (1 - \eta)}{\lambda}$$

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