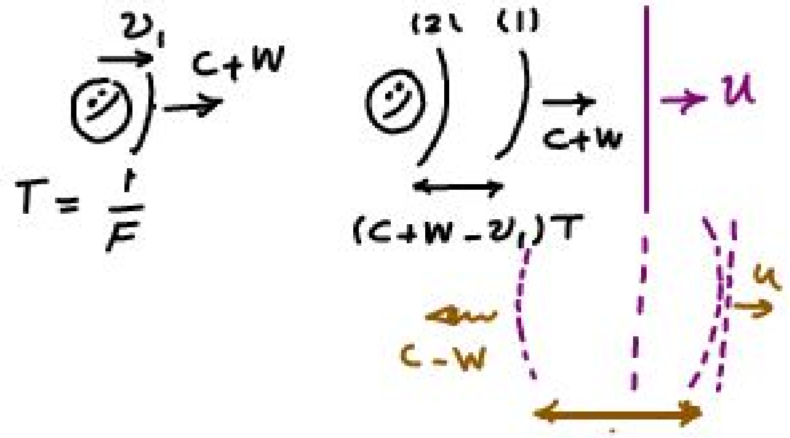
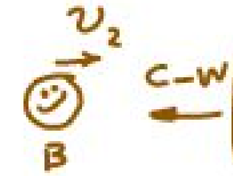
پاسخ سؤال ۱



$$T' = \frac{C+W-v_1}{C+W-u}T$$



$$\frac{C+W-v_1}{C+W-u}(C-W+u)T \to T' = \frac{C+W-v_1}{C+W-u}\cdot\frac{C-W+u}{C-W+v_2}T$$

$$\boxed{F' = F\,\frac{C+W-u}{C+W-v_1}\cdot\frac{C-W+v_2}{C-W+u}}$$ الف

$u \to n$, $v_1, v_2 \to m$ $\to$ $$\boxed{h_2 = h_1\frac{(C+W-n)(C-W+m)}{(C+W-m)(C-W+n)}}$$ ب

$$(I)\quad f_1 = f_0\frac{C+W-m}{C+W}\;,\quad f_0' = f_1\frac{C-W}{C-W+m} = f_0\left(\frac{C-W}{C+W}\right)\left(\frac{C+W-m}{C-W+m}\right)$$

$$f_2 = f_0'\left(\frac{C+W-m}{C+W}\right) = f_0\left(\frac{C+W-m}{C+W}\right)^2\left(\frac{C-W}{C-W+m}\right)\quad II$$

$$\to \frac{f_1^2}{f_0f_2} = 1+\frac{m}{C-W}\;,\quad \frac{f_1}{f_0} = 1-\frac{m}{C+W}$$

$$\frac{C+W}{C-W} = \frac{f_1^2/f_0f_2 - 1}{1-f_1/f_0} = \frac{f_1^2-f_0f_2}{f_2(f_0-f_1)} = A \to W(1+A) = C(A-1)$$

$$\to \boxed{W = C\,\frac{A-1}{A+1}\;,\quad A = \frac{f_1^2-f_0f_2}{f_2(f_0-f_1)}}$$ ج $$\boxed{m = \frac{2C}{A+1}\left(\frac{f_1^2}{f_0f_2}-1\right)}$$

$$\boxed{n = C\left\{\frac{A+1}{A-1}+\frac{A'-1}{A'+1}\right\}\;,\quad A' = \frac{h_2f_2}{h_1f_1}A}$$ د

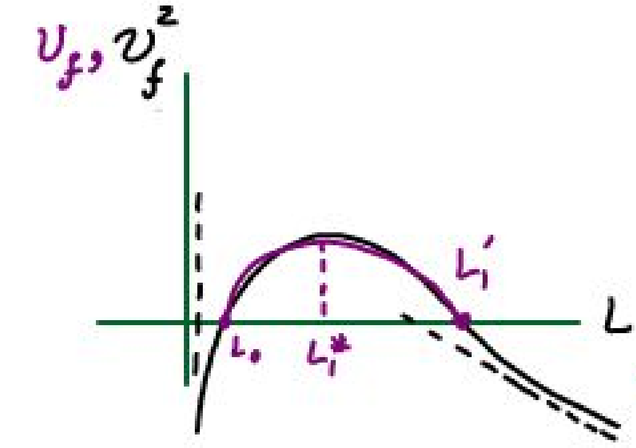
پاسخ سؤال 2

$$PV^\gamma = C \to TV^{\gamma-1} = C$$
$$PV = nRT$$
$$Q=0 \to W = \Delta U\;,\quad -P_0A(L-L_0) = \frac{1}{2}mv_f^2 + nC_v(T_f - T)$$

$$T_f = T\left(\frac{L_0}{L}\right)^{\gamma-1} \to \frac{1}{2}mv_f^2 = nT\left\{C_v\left(1-\left[\frac{L_0}{L}\right]^{\gamma-1}\right) - \frac{P_0R}{P}\left(\frac{L}{L_0}-1\right)\right\}$$

$$C_p - C_v = R\;,\quad \frac{C_p}{C_v} = \gamma \to \boxed{v_f^2 = \frac{2P_0L_0A}{m}\left\{1-\frac{L}{L_0}+\left(\frac{P}{P_0}\right)\frac{1-\left(\frac{L_0}{L}\right)^{\gamma-1}}{\gamma-1}\right\}}$$ الف

$$P(L_0A)^\gamma = P_0(L_1^*A)^\gamma \to L_1^* = \left(\frac{P}{P_0}\right)^{1/\gamma}L_0 \to \boxed{L_1^* = \sqrt[\gamma]{\frac{P}{P_0}}\,L_0}$$ ب

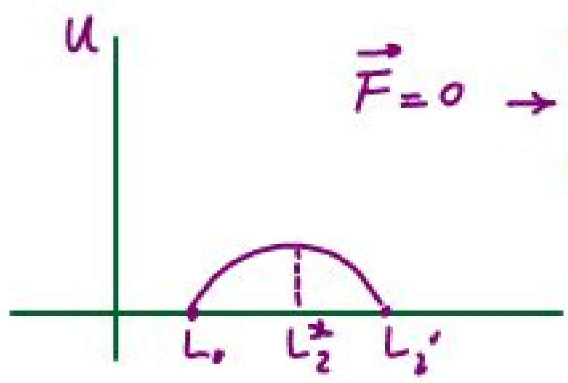


$$v^2_{(L_1^*)} = \frac{2P_0L_0A}{m}\left(1-\sqrt[\gamma]{\frac{P}{P_0}}+\frac{\frac{P}{P_0}-\sqrt[\gamma]{\frac{P}{P_0}}}{\gamma-1}\right)$$ ب

د $$1-\frac{L_1'}{L_0}+\left(\frac{P}{P_0}\right)\frac{1-\left(\frac{L_0}{L_1'}\right)^{\gamma-1}}{\gamma-1}=0 \rightarrow 1-x+\frac{P}{P_0}\frac{1-x^{-1}}{1}=0$$

$$\rightarrow x-1=\frac{P}{P_0}\left(\frac{x-1}{x}\right)\rightarrow x=\frac{P}{P_0}\rightarrow \boxed{L_1'=\frac{P}{P_0}L_0}$$ ت

$$\frac{1}{2}mu^2 = nRT\left\{\ln\left(\frac{L}{L_0}\right)-\frac{P_0}{P}\left(\frac{L}{L_0}-1\right)\right\} \rightarrow \boxed{u^2=\frac{2P_0AL_0}{m}\left\{\frac{P}{P_0}\ln\left(\frac{L}{L_0}\right)-\frac{L}{L_0}+1\right\}}$$ ث

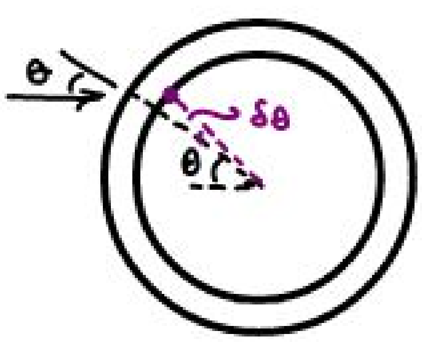


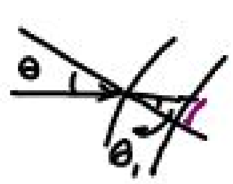
$$\vec{F}=0 \rightarrow \boxed{L_2^*=\frac{P}{P_0}L_0}$$ ج

$$\boxed{u^2_{(L_2^*)}=\frac{2P_0AL_0}{m}\left\{\frac{P}{P_0}\ln\left(\frac{P}{P_0}\right)-\frac{P}{P_0}+1\right\}}$$

$$\boxed{\ln\left(\frac{L_2'}{L_0}\right)=\frac{P_0}{P}\left(\frac{L_2'}{L_0}-1\right)}$$ چ

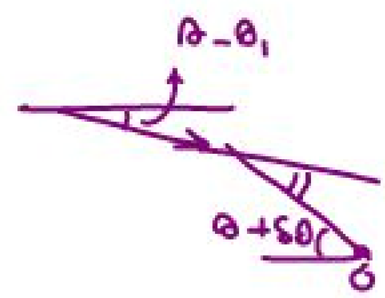
پاسخ سوال ۳



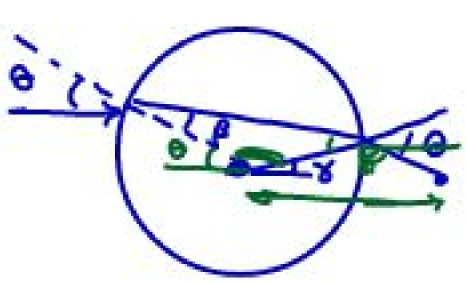


$$\sin\theta = n_g\sin\theta_1$$

$$R\delta\theta = t\,\frac{\sin\theta}{n_g\sqrt{1-\frac{\sin^2\theta}{n_g^2}}}$$



$$n_g\sin(\theta_1+\delta\theta)=n\sin\theta_2$$



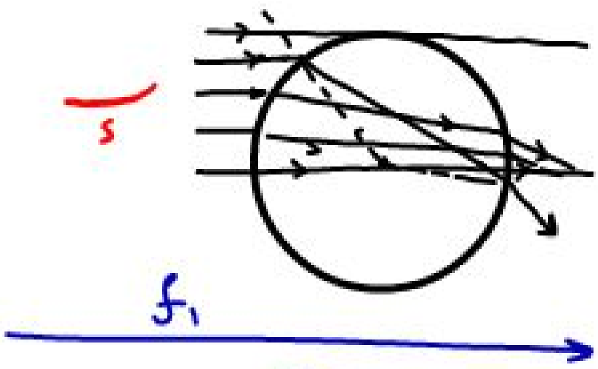
$$f=R\cos\gamma+R\sin\gamma\cot(\theta-\gamma)\rightarrow f=\frac{R\sin\theta}{\sin\left(2\theta-2\sin^{-1}\left[\frac{\sin\theta}{n}\right]\right)}$$

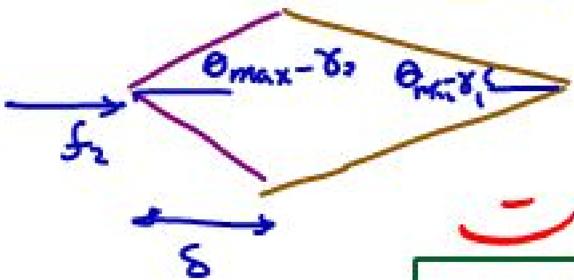
الف $$\rightarrow \boxed{f=\frac{R\sin\theta}{2\left\{\sin\theta\sqrt{1-\frac{\sin^2\theta}{n^2}}-\frac{\sin\theta}{n}\cos\theta\right\}\left\{\cos\theta\sqrt{1-\frac{\sin^2\theta}{n^2}}+\frac{\sin^2\theta}{n}\right\}}}$$

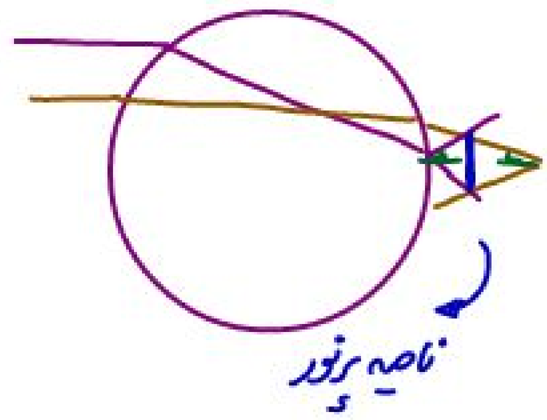
$$\gamma\geq0\rightarrow 2\beta-\theta\geq0\rightarrow 2\frac{\sin\theta}{n}\sqrt{1-\frac{\sin^2\theta}{n^2}}\geq\sin\theta\rightarrow\sqrt{1-\frac{\sin^2\theta}{n^2}}\geq\frac{n}{2}\rightarrow n^2\left(1-\frac{n^2}{4}\right)\geq\sin^2\theta$$

$$n^2\left(1-\frac{n^2}{4}\right)\geq1\rightarrow 4+n^4-4n^2\leq0\rightarrow$$ هیچ پرتو همگرایی از نمونه‌ی بالا خارج نمیشه ب

ب







ت

$$\rightarrow \delta \tan(\theta_{max}-\gamma_2) = (f_1-(f_2+\delta))\tan(\theta_{max}-\gamma_1)$$

$$\rightarrow \boxed{\delta = \frac{(f_1-f_2)\tan(\theta_{max}-\gamma_1)}{\tan(\theta_{max}-\gamma_2)+\tan(\theta_{min}-\gamma_1)}} \quad , \quad \boxed{r = \delta \tan(\theta_{max}-\gamma_2)}$$

$$P = \frac{P}{4\pi R_s^2}\pi R^2(\sin^2\theta_{max}-\sin^2\theta_{min})$$

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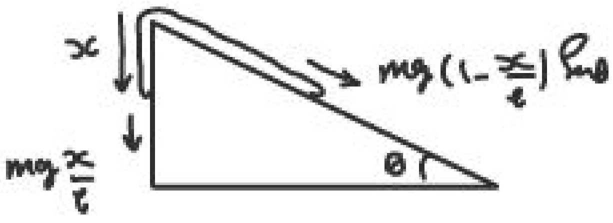
ث

$$\boxed{I = \frac{P}{\pi r^2}\left(\frac{R^2}{4R_s^2}\right)(\sin^2\theta_{max}-\sin^2\theta_{min})}$$

$$\boxed{h(T_c-T_0)+\sigma(T_c^4-T_0^4) \leqslant \frac{P}{\pi r^2}\left(\frac{R^2}{4R_s^2}\right)(\sin^2\theta_{max}-\sin^2\theta_{min})}$$ ج

$$\boxed{\rho c\dot{T} \simeq I \rightarrow t \simeq \frac{\rho c}{mh+\sigma(T_c^3+T_0T_c^2+T_0^2T_c+T_0^3)m}}$$ چ

پاسخ سؤال ۴



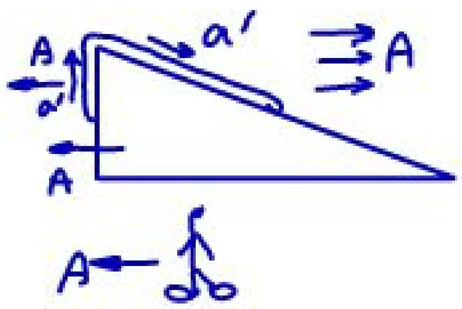
$$mg\frac{x}{l} = mg\left(1-\frac{x}{l}\right)(\sin\theta + \mu_s\cos\theta)$$

الف

$$\rightarrow \boxed{x_{max} = l\,\frac{\sin\theta + \mu_s\cos\theta}{1+\sin\theta+\mu_s\cos\theta}\ ,\ x_{min} = \frac{\sin\theta - \mu_s\cos\theta}{1+\sin\theta-\mu_s\cos\theta}}$$

$$x > x_{max} \rightarrow m\ddot{x} = mg\frac{x}{l} - mg\left(1-\frac{x}{l}\right)(\sin\theta+\mu_k\cos\theta) \rightarrow \boxed{\ddot{x} = g\left\{\frac{x}{l} + \left(1-\frac{x}{l}\right)(\sin\theta+\mu_k\cos\theta)\right\}}$$

$$x < x_{min} \rightarrow m\ddot{x} = mg\left(1-\frac{x}{l}\right)(\sin\theta-\mu_k\cos\theta) - mg\frac{x}{l} \rightarrow \boxed{\ddot{x} = g\left\{\left(1-\frac{x}{l}\right)(\sin\theta-\mu_k\cos\theta) - \frac{x}{l}\right\}}$$



$$(m+M)A = \left(1-\frac{x}{l}\right)m a'\cos\theta$$

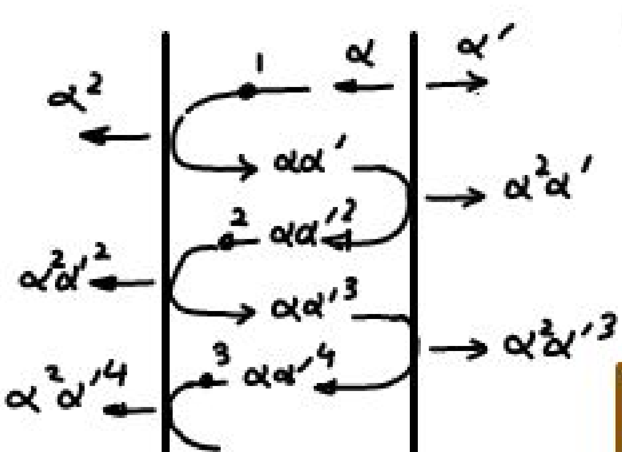
$$\left(1-\frac{x}{l}\right)m(g\sin\theta + A\cos\theta) - \mu_k\left(1-\frac{x}{l}\right)m(g\cos\theta - A\sin\theta) - \frac{x}{l}mg - \mu_k\frac{x}{l}mA = \frac{(m+M)A}{\left(1-\frac{x}{l}\right)\cos\theta}$$

$$A = mg\,\frac{\left(1-\frac{x}{l}\right)^2\cos\theta\sin\theta - \mu_k\left(1-\frac{x}{l}\right)^2\cos^2\theta - \frac{x}{l}\left(1-\frac{x}{l}\right)\cos\theta}{m+M-\left(1-\frac{x}{l}\right)^2\cos^2\theta - \mu_k\left(1-\frac{x}{l}\right)^2\cos\theta\sin\theta + \mu_k\left(1-\frac{x}{l}\right)\cos\theta\frac{x}{l}}$$

$$\rightarrow \boxed{A = g\cos\theta\left(1-\frac{x}{l}\right)\frac{\left(1-\frac{x}{l}\right)(\sin\theta - \mu_k\cos\theta - x/l)}{1+\frac{M}{m} + \left(1-\frac{x}{l}\right)\cos\theta\left(-\left(1-\frac{x}{l}\right)(\cos\theta+\mu_k\sin\theta+\mu_k\frac{x}{l}\right)}}$$

ب

پاسخ سؤال ۵



$$1-\alpha = \alpha'$$

الف

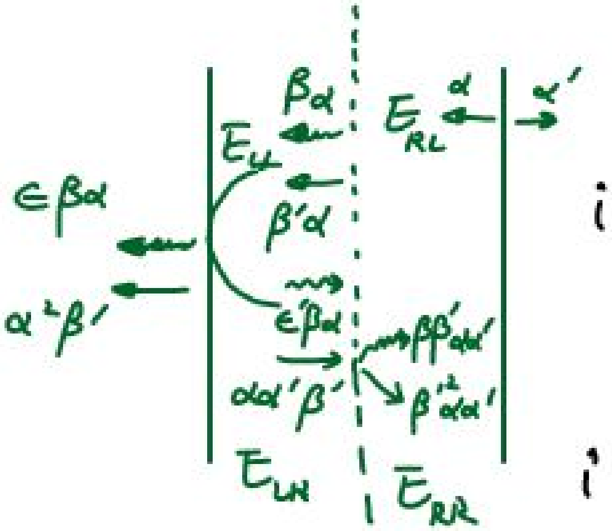
$$\boxed{E_i = \alpha(1-\alpha)^{2i-2}}$$

$$\boxed{E_i^R = \alpha' + \alpha^2\alpha'\frac{1-(\alpha'^2)^{i-1}}{1-\alpha'^2} = (1-\alpha)\left(1+\alpha^2\frac{1-(1-\alpha)^{2i-2}}{1-(1-\alpha)^2}\right)}$$

$$\boxed{E_i^L = \alpha^2\frac{1-(1-\alpha)^{2i-2}}{1-(1-\alpha)^2}}$$

$$\boxed{\lim_{i\to\infty}\left\{E=0\ ,\ E^R = (1-\alpha)\left(1+\frac{\alpha^2}{1-(1-\alpha)^2}\right)\ ,\ E^L = \frac{\alpha^2}{1-(1-\alpha)^2}\right\}}$$

ب



$$i\begin{cases} E_{LL} = (1-\beta)E_{RL} \\ E_{LR} = (1-\alpha)E_{LL} \\ E_{RR} = (1-\beta)E_{LR} \end{cases} \qquad i,i+1\begin{cases} E_{RL}^{i+1} = E_{RR}^{i}(1-\alpha) \\ E_{RL}^{*(i+1)} = E_{RR}^{*(i)}(1-\epsilon) \end{cases}$$

$$i\begin{cases} E_{LL}^{*} = E_{RL}^{*} + \beta E_{RL} \\ E_{LR}^{*} = (1-\epsilon)E_{LL}^{*} \\ E_{RR}^{*} = E_{LR}^{*} + \beta E_{LR} \end{cases}$$

$$\rightarrow \boxed{E_{RL}(i) = \alpha E_0 \left\{(1-\alpha)^2(1-\beta)^2\right\}^{i-1}}$$

[illegible]
$$\begin{cases} A = (1-\epsilon)^2 \\ B = \beta(1-\epsilon)\left[(1-\epsilon)+(1-\alpha)(1-\beta)\right] \\ C = (1-\alpha)^2(1-\beta)^2 \end{cases}$$

$$E^{*}_{(i+1)RL} = AE^{*}_{RL(i)} + BE_{RL(i)}$$

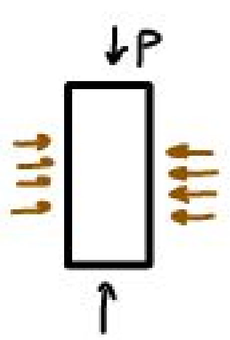
$$E^{*}_{RL(1)} = 0 \quad , \quad E^{*}_{RL(2)} = AE^{*}_{RL(1)} + BE_{RL(1)} \;, \ldots \rightarrow E^{*}_{RL(4)} = \alpha E_0 B\left[A^2 + AC + C^2\right]$$

$$\boxed{E^{*}_{RL(i)} = B\alpha E_0\left[A^{i-2} + CA^{i-3} + C^2A^{i-4} + \cdots + C^{i-2}\right]}$$ ب

$B = \beta\left[(1-\alpha)(1-\beta)+1\right],\ A = 1 \leftarrow \epsilon = 0$ در حالتی که $\rightarrow \boxed{E^{*}_{RL(i)} = B\alpha E_0 \dfrac{1-C^{i-1}}{1-C}}$ ج

$$\boxed{(i\rightarrow\infty):\ E^{*}_{RL} = \frac{\alpha E_0\beta}{1-(1-\alpha)(1-\beta)}}$$ د

پاسخ سؤال ۶



$$-P = E\frac{\delta c}{c} \rightarrow \boxed{|\delta c| = \frac{PC}{E}} \rightarrow \boxed{\frac{\delta b}{b} = \nu\frac{P}{E}\ ,\ \frac{\delta a}{a} = \nu\frac{P}{E}}$$

$$V = abc \rightarrow \delta V = abc\left\{\frac{\delta a}{a} + \frac{\delta b}{b} + \frac{\delta c}{c}\right\} \rightarrow \boxed{\frac{\delta V}{V} = 2\nu\frac{P}{E} - \frac{P}{E} = \frac{P}{E}(2\nu - 1)}$$

P_c, P_b, P_a

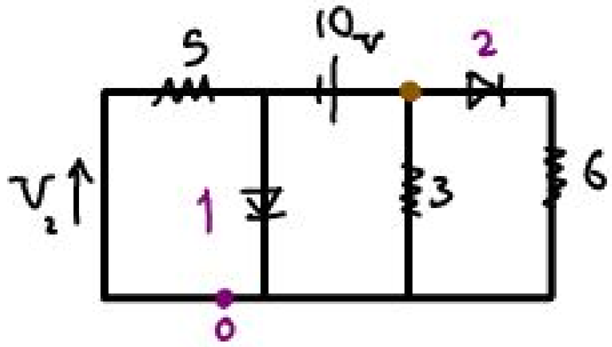
$$E\frac{\delta c}{c} = -P_c + \nu P_b + \nu P_a = \boxed{P\left\{-1 + \frac{2\nu^2}{1-\nu}\right\}}$$

$$0 = E\frac{\delta b}{b} = -P_b + \nu(P_a + P_c)$$

$$0 = E\frac{\delta a}{a} = -P_a + \nu(P_b + P_c) \rightarrow (P_a + P_b)\frac{(1-\nu)}{2\nu} = P_c$$

$$\boxed{\frac{\delta V}{V} = \frac{P}{E}\left\{\frac{\nu + 2\nu^2 - 1}{1-\nu}\right\}}$$

پاسخ سؤال ۷



$0 < T < T_1$ هردو دیود وصل است

$T_1 < T < T_2$ دیود ۲ وصل

$T_2 < T$ دیود ۱ قطع است.