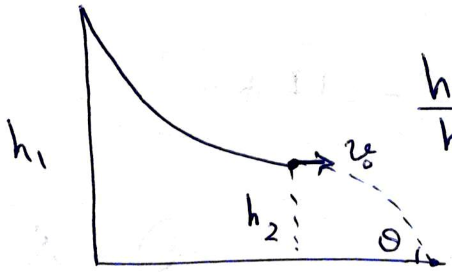
به نام خدا

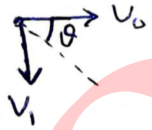
پاسخنامه تشریحی - مرحله اول المپیاد فیزیک ایران

دوره ۳۰ (۱۸ بهمن ۱۳۹۸) - کد یک !

۱- گزینه ①



$$\frac{h_2}{h_1} = x \ , \quad v_0 = \sqrt{2g(h_1-h_2)} \ , \quad v_1 = \sqrt{2g h_2}$$



$$\tan\theta = \frac{v_1}{v_0} = \sqrt{\frac{h_2}{h_1-h_2}} = \sqrt{\frac{x}{1-x}}$$

$$\Rightarrow \tan^2\theta = \frac{x}{1-x} \Rightarrow x = \frac{\tan^2\theta}{1+\tan^2\theta} = \sin^2\theta = \frac{h_2}{h}$$

۲- گزینه ③

ابتدای ماه قمری، ماه دقایقی بعد از طلوع خورشید طلوع می‌کند و این فاصله زمانی افزایش پیدا می‌کند تا ماه شب ۱۴ که فاصله زمانی طلوع خورشید و طلوع ماه به حدود ۱۲ ساعت می‌رسد.

۳- گزینه ①

$$[IA] = Q T^{-1} L^2$$

$$[h] = M L^2 T^{-1} \ , \quad [e] = Q \ , \quad [m_e] = M$$

$$\Rightarrow \left[\frac{eh}{4\pi m_e}\right] = [IA]$$

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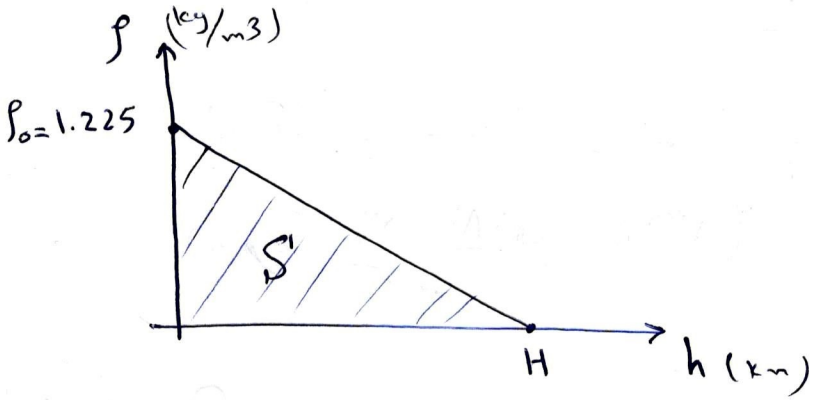


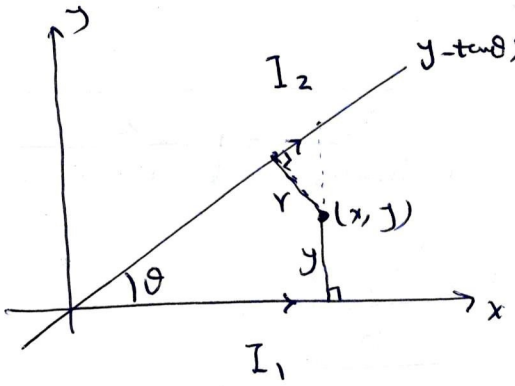
۴ـ گزینه (۳)

$$S' = \frac{\rho_0 H}{2} \times 10^3 \ (kg/m^2)$$

$$P_0 = Sg \Rightarrow 10^5 = \frac{\rho_0 H}{2} \times 10^3 \times 10$$

$$H = \frac{20}{1.225} \simeq 17 \ km$$

۵ـ گزینه (۴)



$$B_1 = \frac{\mu_0 I_1}{2\pi y} \ \odot$$

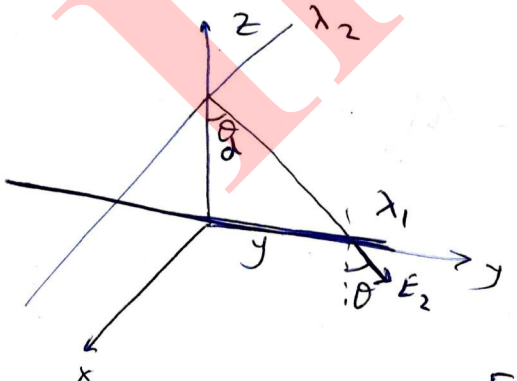
$$B_2 = \frac{\mu_0 I_2}{2\pi r} \ \otimes$$

$$r = \frac{\tan\theta . x - y}{\sqrt{1+\tan^2\theta}} = \sin\theta . x - \cos\theta . y$$

$$B_1 = B_2 \Rightarrow \frac{\mu_0 I_1}{2\pi y} = \frac{\mu_0 I_2}{2\pi(\sin\theta x - \cos\theta . y)}$$

$$\Rightarrow I_1 . \sin\theta . x - I_1 \cos\theta . y = I_2 . y \Rightarrow y = \left(\frac{I_1 \sin\theta}{I_2 + I_1 \cos\theta}\right) x$$

۶ـ گزینه (۲)



میدان ناشی از خط λ_2 روی محور y

$$E_2 = \frac{\lambda_2}{2\pi\epsilon_0\sqrt{d^2+y^2}}$$

$$dF = E_2 . dy . \lambda_1 \cos\theta = \frac{\lambda_2}{2\pi\epsilon_0\sqrt{d^2+y^2}} \cdot \frac{\lambda_1 d}{\sqrt{d^2+y^2}} dy$$

$$F = \frac{d.\lambda_1\lambda_2}{2\pi\epsilon_0} \int_{-\infty}^{+\infty} \frac{dy}{d^2+y^2} = \frac{d\lambda_1\lambda_2}{2\pi\epsilon_0} \frac{\pi}{d} = \frac{\lambda_1\lambda_2}{2\epsilon_0}$$

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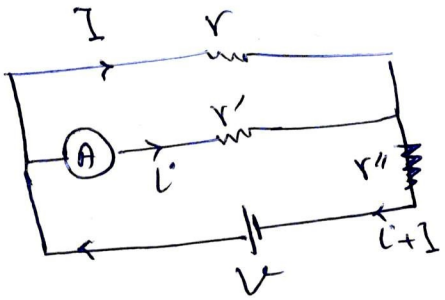
۷- گزینه ۳



$$\left.\begin{array}{l} rI = r'i \\ V = r'i + r''(i+I) \\ r'+r''=R \end{array}\right\} \Rightarrow V = r'i + (R-r')\left(i + \frac{r'}{r} i\right)$$

$$\Rightarrow V = i\left[r' + (R-r')\left(1+\frac{r'}{r}\right)\right] = i\left[r' + R + \frac{R}{r}r' - r' - \frac{r'^2}{r}\right]$$

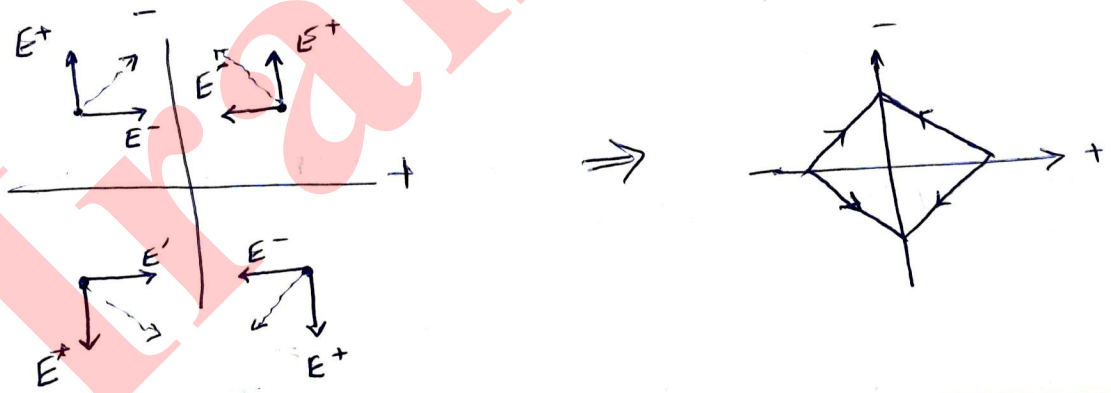
$$\Rightarrow i = \frac{V}{R + \frac{R}{r}r' - \frac{r'^2}{r}} = \frac{r}{Rr + Rr' - r'^2} \cdot V \quad , \quad 0 < r' < R$$

$$i'_{min} \underset{r'=\frac{R}{2}}{=} \frac{V}{R} \cdot \frac{1}{1+\frac{R}{4r}} \quad , \quad i'_{max} \underset{r'=0}{=} \frac{V}{R}$$

$$\Rightarrow \frac{V}{R} \cdot \frac{1}{1+\frac{R}{4r}} \leq i < \frac{V}{R}$$

۸- گزینه ۴

$E^+ = E^-$



۹- گزینه ۲

تأثیر تفسیر کمان بار الکتریکی روی میدان در فضا با سرعت c (سرعت نور) منتشر می‌شود.

۱۰- گزینه‌ی ①

برآیند کل نیروهای وارد بر سیستم $m+M$، صفر است، پس مرکز جرم مجموعه باید ثابت بماند. جرم m نسبت به جرم M به سمت راست حرکت می‌کند، پس M هم باید به سمت چپ حرکت کند. این حرکت با سرعت ثابت است،

پس $F=0$ می‌شود، درنتیجه مقدار کار هم صفر می‌شود. $W=0$

استدلال دوم: سرعت m ثابت است پس سرعت M هم ثابت است.

طبق قضیه کار و انرژی، تغییرات انرژی جنبشی M صفر است پس $W=0$.

$F=0$ قطعاً (زیرا جابجایی داریم (چون مرکز جرم مجموعه باید ثابت بماند)) پس

۱۱- گزینه‌ی ④

$$PV+\frac{an^2}{V}=nRT \quad , \quad U=\frac{3}{2}nRT-\frac{an^2}{V}+U_0$$

$$P=P_0+\frac{k}{V} \quad , \quad 0<V \qquad \frac{\Delta U}{\Delta V}=\frac{dU}{dV}=\frac{3}{2}nR\frac{dT}{dV}+\frac{an^2}{V^2} \quad (I)$$

$$\Rightarrow \left(P_0+\frac{k}{V}\right)V+\frac{an^2}{V}=nRT \Rightarrow P_0V+k+\frac{an^2}{V}=nRT$$

$$\Rightarrow P_0-\frac{an^2}{V^2}=nR\frac{dT}{dV} \quad (II)$$

$$\left.\begin{matrix}\Delta U=\Delta Q-\Delta W\\ \Delta W=P\Delta V\end{matrix}\right\} \Rightarrow \frac{\Delta U}{\Delta V}=\frac{\Delta Q}{\Delta V}-P \Rightarrow \frac{\Delta Q}{\Delta V}=\frac{\Delta U}{\Delta V}+P \quad (III)$$

$$(I),(II) \Rightarrow \frac{\Delta U}{\Delta V}=\frac{3}{2}\left(P_0-\frac{an^2}{V^2}\right)+\frac{an^2}{V^2} \Rightarrow \frac{\Delta U}{\Delta V}=\frac{3}{2}P_0-\frac{1}{2}\frac{an^2}{V^2} \quad (IV)$$

$$\frac{\Delta Q}{\Delta V}=\frac{3}{2}P_0-\frac{an^2}{2V^2}+P_0+\frac{k}{V} \Rightarrow \frac{\Delta Q}{\Delta V}=\frac{5P_0V^2+2kV-an^2}{2V^2}$$

$$\left(\frac{\Delta Q}{\Delta V}\right)_{max} \rightarrow V=\frac{an^2}{k} \qquad V\rightarrow\infty \Rightarrow \frac{\Delta Q}{\Delta V}\rightarrow\frac{5}{2}P_0>0$$

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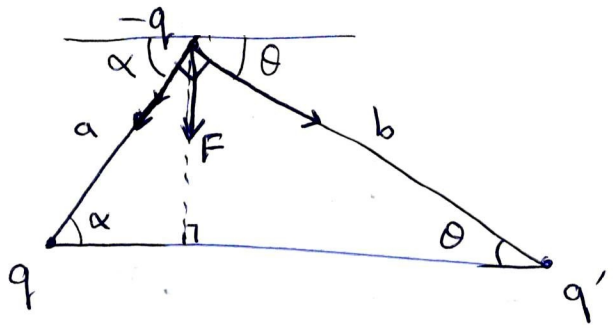
۱۲ - گزینهٔ ④



$$\frac{q^2}{4\pi\epsilon_0 a^2}\cos\alpha = \frac{qq'}{4\pi\epsilon_0 b^2}\cdot\cos\theta$$

$$q\frac{\cos\alpha}{a^2} = q'\frac{\cos\theta}{b^2}$$

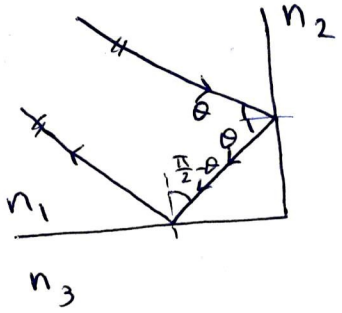
$$\Rightarrow \frac{q'}{q} = \left(\frac{b}{a}\right)^2\frac{\cos\alpha}{\cos\theta}$$

$$\alpha = \frac{\pi}{2} - \theta \Rightarrow \cos\alpha = \sin\theta$$

$$\frac{b}{a} = \cot\theta$$

$$\boxed{\frac{q'}{q} = \cot\theta}$$

۱۳ - گزینهٔ ①

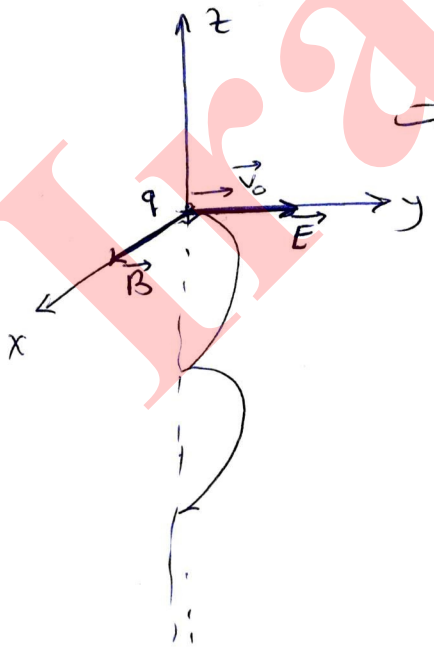


$$\sin\theta > \frac{n_2}{n_1} \Rightarrow \sin^2\theta > \left(\frac{n_2}{n_1}\right)^2$$

$$\sin\left(\frac{\pi}{2}-\theta\right) > \frac{n_3}{n_1} \Rightarrow \cos^2\theta > \left(\frac{n_3}{n_1}\right)^2$$

$$\Rightarrow \sin^2\theta + \cos^2\theta > \frac{n_2^2+n_3^2}{n_1^2} \Rightarrow \boxed{n_1^2 > n_2^2 + n_3^2}$$

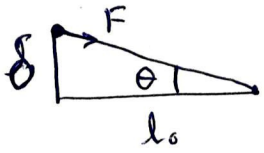
۱۴ - گزینهٔ ④



مسیر به شکل سیکلوئیدی و در صفحهٔ y-z و در جهت z- است

(البته نوع سیکلوئیدی حرکت وابسته به مقادیر E, B است)

۱۵- گزینه ④



$\frac{\delta}{l_0} \ll 1$

$F = K(\sqrt{\delta^2 + l_0^2} - l_0)$

$\simeq K l_0 \left(1 + \frac{\delta^2}{2l_0^2} - 1\right) \simeq \frac{K\delta^2}{2l_0}$

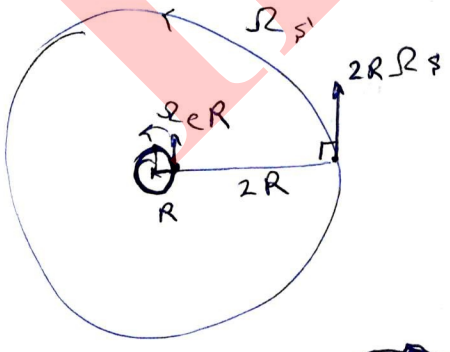
$$\left.\begin{array}{l} N\ F\sin\theta = ma \\ \sin\theta = \frac{\delta}{\sqrt{l_0^2+\delta^2}} \\ \Rightarrow \sin\theta \simeq \frac{\delta}{l_0} \end{array}\right\} \Rightarrow a = \frac{N}{m}\cdot\frac{K\delta^2}{2l_0}\cdot\frac{\delta}{l_0} \Rightarrow \boxed{a = \frac{N K \delta^3}{2 l_0^2 m}}$$

۱۶- گزینه ①

$$\left.\begin{array}{l} \frac{dQ}{dt} = -\sigma T^4 4\pi R^2 \\ dQ = C\,dT \end{array}\right\} C\frac{dT}{dt} = -\sigma T^4 4\pi R^2 \Rightarrow \int_{T_0}^{T} \frac{dT}{T^4} = \int_0^t -\frac{\sigma}{C} 4\pi R^2 dt$$

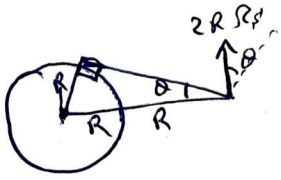
$$\Rightarrow \frac{1}{-3T^3} + \frac{1}{3T_0^3} = -\frac{4\pi R^2 \sigma}{C} t \Rightarrow \boxed{\frac{1}{3T^3} = \frac{1}{3T_0^3} + \frac{4\pi R^2 \sigma}{C} t}$$

۱۷- گزینه ③



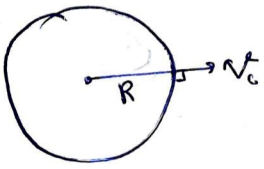
$$\Omega_1 = \frac{2R\Omega_{s'} - R\Omega_e}{R} = 2\Omega_s - \Omega_e$$

$$\Omega_2 = \frac{2R\Omega_s\cos\theta - 0}{2R\cos\theta} = \Omega_{s'}$$



$$\Rightarrow \boxed{\frac{\Omega_1}{\Omega_2} = 2 - \frac{\Omega_e}{\Omega_{s'}}}$$

۱۸ـ گزینهٔ ①



$$g=\frac{GM}{(R+h)^2}=\frac{GM}{R^2}\left(1+\frac{h}{R}\right)^{-2}=\frac{GM}{R^2}\left(1-\frac{2h}{R}\right)$$

$$\Rightarrow g=g_0\left(1-\frac{2h}{R}\right)\Rightarrow$$

$$\frac{1}{2}mv_0^2=mg_0h+\frac{1}{2}kh^2+\frac{1}{2}mv^2$$

پایستگی انرژی: (طبق آلکوی فنر)

$$\frac{k}{m}=\frac{-2g_0}{R}\Rightarrow k=-\frac{2mg_0}{R}$$

$$\boxed{v_0^2-2g_0h+\frac{2g_0}{R}h^2=v^2}$$

۱۹ـ گزینهٔ ②

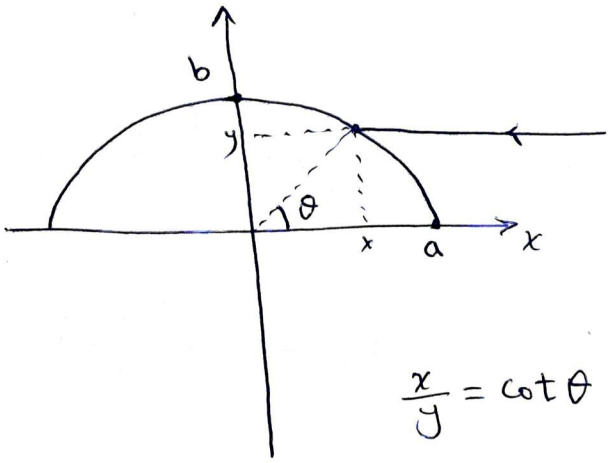
$$x_1=\frac{v_0^2}{g}\sin 2\theta$$

$$x_2=\frac{v_0^2}{g}\sin 2\left(\theta+\frac{\pi}{2N}\right)=\frac{v_0^2}{g}\sin\left(2\theta+\frac{\pi}{N}\right)=\frac{v_0^2}{g}\left[\sin 2\theta\cdot\underbrace{\cos\frac{\pi}{N}}_{\simeq 1}+\cos 2\theta\cdot\underbrace{\sin\frac{\pi}{N}}_{\simeq\frac{\pi}{N}}\right]$$

$$\Rightarrow x_2=\frac{v_0^2}{g}\left[\sin 2\theta+\frac{\pi}{N}\cos 2\theta\right]$$

$$x_2-x_1=\frac{v_0^2}{g}\cdot\frac{\pi}{N}\cdot\cos 2\theta\Rightarrow\frac{1}{x_2-x_1}=\boxed{\frac{Ng}{\pi v_0^2\cos 2\theta}}$$

۲۰ـ گزینه ۴



$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

$$\Rightarrow \frac{2x}{a^2}+\frac{2yy'}{b^2}=0 \Rightarrow y'=\frac{-b^2}{a^2}\cdot\frac{x}{y}$$

$$\frac{x}{y}=\cot\theta \qquad \Rightarrow y'=-\frac{b^2}{a^2}\cot\theta$$

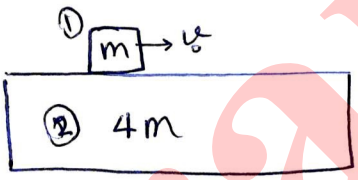
$$\Rightarrow \text{شیب خط مماس}=\frac{a^2}{b^2}\tan\theta=\tan\frac{\alpha}{2}$$

$\frac{\alpha}{2}$: زاویه تابش

$$\tan\alpha=\frac{2\tan\alpha}{1-\tan^2\frac{\alpha}{2}}=\frac{2\frac{a^2}{b^2}\tan\theta}{1-\frac{a^4}{b^4}\tan^2\theta}\Rightarrow \tan\alpha=\frac{2a^2b^2\tan\theta}{b^4-a^4\tan^2\theta}$$

$$\Rightarrow \tan\alpha=\frac{2a^2b^2\cot\theta}{b^4\cot^2\theta-a^4}$$

۲۱ـ گزینه ۲

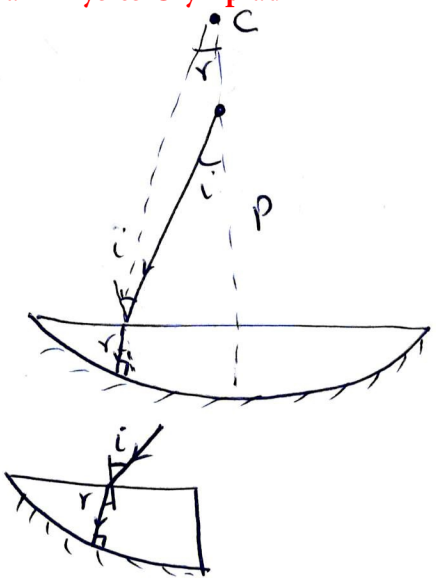


$$-f=ma \quad , \quad f=4mA$$

$$a=-\mu g \quad , \quad A=\frac{\mu g}{4}$$

$$\text{رکت نسبی} \Rightarrow 2(-a+A)l=v_0^2$$

$$v_0^2=\frac{5}{2}\mu g l$$



۲۲- گزینه‌ی ۴

$f=30 \rightarrow R=60$ cm

زوایا کوچک:

$i'=nr$

$\frac{x}{p}=n\frac{x}{R} \Rightarrow p=\frac{R}{n}=\frac{60}{4/3}$

$\Rightarrow p=45$ cm

۲۳- گزینه‌ی ۱

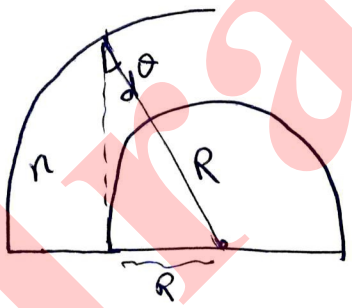
$$AB=(R+\frac{d}{2})\theta=l(1+\alpha_1\Delta T)$$
$$CD=(R-\frac{d}{2})\theta=l(1+\alpha\Delta T)$$

$$\frac{R+\frac{d}{2}}{R-\frac{d}{2}}=\frac{1+\alpha_1\Delta T}{1+\alpha_2\Delta T}$$

$$1+(\alpha_1-\alpha_2)\Delta T=1+\frac{d}{R}$$

$$\Rightarrow R=\frac{d}{(\alpha_1-\alpha_2)\Delta T}$$

۲۴- گزینه‌ی ۲



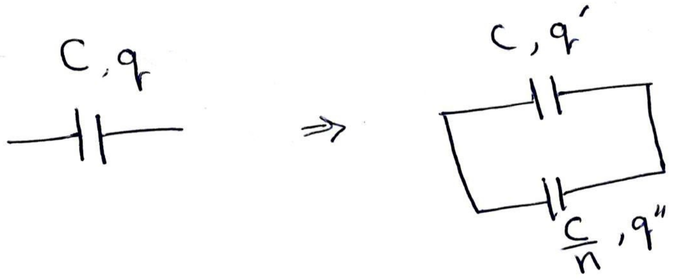
$\sin\theta \geq \frac{1}{n}$

$\frac{R}{R+d} \geq \frac{1}{n} \Rightarrow nR-R \geq d$

$n-1 \geq \frac{d}{R}$

$\Rightarrow \frac{d}{R} \leq \frac{1}{2} \Rightarrow \frac{R}{d} \geq 2$

۲۵ - گزینه‌ی ①



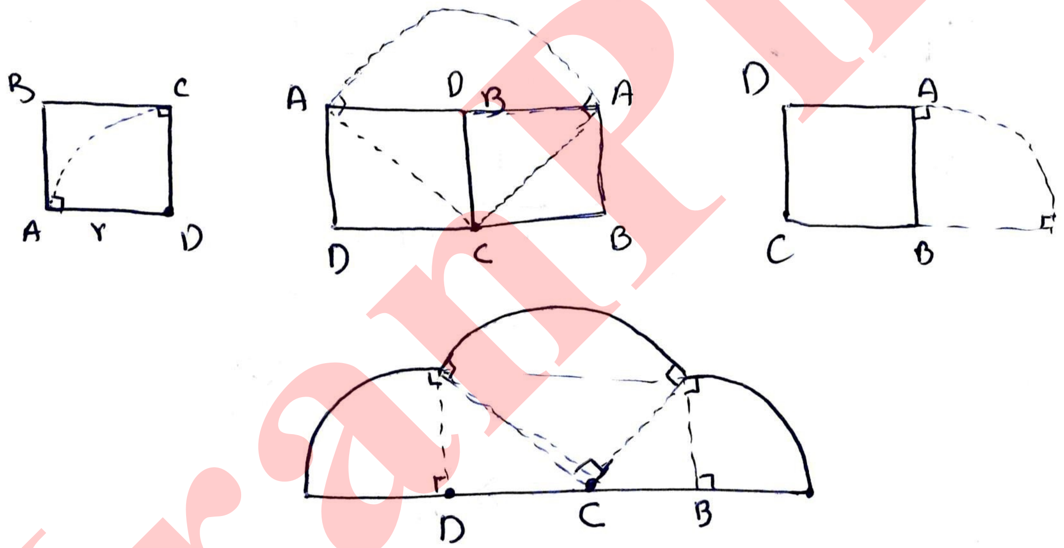
$$q' + q'' = q$$
$$\frac{q'}{C} = \frac{q''}{\frac{C}{n}}$$
$$\Rightarrow q' = \frac{q}{1+\frac{1}{n}}$$

بار خازن در نوبت‌های مختلف به ترتیب:

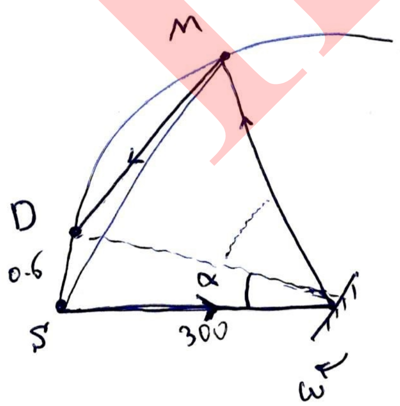
$$q \ , \ \frac{q}{1+\frac{1}{n}} \ , \ \frac{q}{(1+\frac{1}{n})^2} \ , \ \cdots \ , \ \frac{q}{(1+\frac{1}{n})^n}$$

$$q_n = \frac{q}{(1+\frac{1}{n})^n} \Rightarrow n \to \infty \Rightarrow q_n \to \frac{q}{e}$$

۲۶ - گزینه‌ی ③



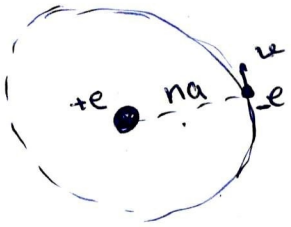
۲۷ - گزینه‌ی ؟



$$\alpha = \frac{0.6}{300} = \frac{1}{500} \ (rad)$$

$$\omega =$$

۲۸- گزینه‌ی ④



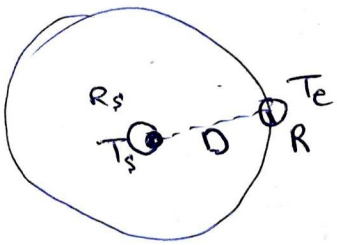
$$\frac{e^2}{4\pi\epsilon_0 n^2 a^2} = mna\omega^2 \Rightarrow \omega^2 \propto \frac{1}{n^3}$$

$$\beta \propto \frac{I}{r} \quad , \quad I \propto \omega \Rightarrow I \propto \frac{1}{n^{3/2}} \quad , \quad r \propto n$$

$$\Rightarrow \beta \propto \left(\frac{1}{n^5}\right)^2$$

سؤالات پاسخ کوتاه

۱- مقدار ④ مورد قبول است.



$$\frac{\sigma T_S^4 4\pi R_S^2}{4\pi D^2}\alpha_1 \pi R^2 = 4\pi R^2 \sigma \alpha_2 T_e^4$$

انرژی جذب شده — انرژی دفع شده

$$\Rightarrow 10\alpha_2 = \frac{5}{2}\alpha_1 \cdot \left(\frac{T_S}{T_e}\right)^4 \left(\frac{R_S}{D}\right)^2 \Rightarrow 10\alpha_2 = \frac{5}{2} \times \frac{7}{10} \times \left(\frac{6000}{300}\right)^4 \left(\frac{7\times10^8}{1.5\times10^{11}}\right)^2 \Rightarrow 10\alpha_2 \simeq 6.1 \simeq 6$$

۲- مقدار ④ مورد قبول است.

$$E_0 = \frac{1}{2}mv^2 - \frac{e^2}{4\pi\epsilon_0 r}$$

$$v = r\omega \Rightarrow \frac{1}{2}mv^2 = \frac{1}{2}r(mr\omega^2)$$

$$mr\omega^2 = \frac{e^2}{4\pi\epsilon_0 r^2} = ma$$

$$E_0 = -\frac{1}{2}\left(\frac{e^2}{4\pi\epsilon_0 r}\right) \Rightarrow \frac{e^2}{4\pi\epsilon_0 r} = -2E_0$$

$$\Rightarrow a = \frac{-2E_0}{mr} = r\omega^2$$

$$\alpha|E_0| = \frac{e^2 a^2}{6\pi\epsilon_0 c^3}\cdot\frac{2\pi}{\omega} \Rightarrow \alpha|E_0| = \frac{e^2}{3\epsilon_0 c^3}(r^2\omega^2)\omega$$

$$-\alpha E_0 = \frac{e^2}{3\epsilon_0 c^3}\cdot\frac{-2E_0}{m}\cdot\frac{1}{r}\sqrt{\frac{-2E_0}{m}}$$

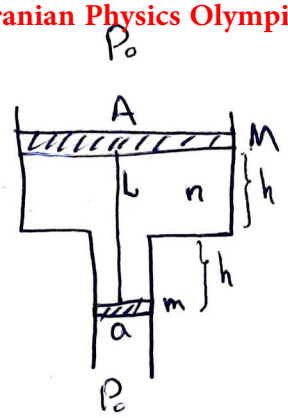
$$\frac{e^2}{\epsilon_0 r} = -8\pi E_0$$

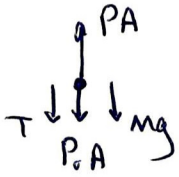
$$\alpha = \frac{-16\pi E_0}{3mc^2}\sqrt{\frac{-2E_0}{mc^2}}$$

$$\alpha = \frac{8\pi}{3}\times\left(\frac{-2\times(-13.5)}{0.511\times10^6}\right)^{3/2} = 3.25\times10^{-6}$$

$n=6$

۳ – مقدار (۸۸) مورد قبول است.





$$\left.\begin{aligned} PA - T - P_0A - Mg = 0 \\ P_0a + T - mg - Pa = 0 \end{aligned}\right\} \Rightarrow P(A-a) - P_0(A-a) - (m+M)g = 0$$

$$P = P_0 + \frac{(m+M)g}{A-a} \quad (I)$$

$$\left.\begin{aligned} PV = nRT \\ V = (A+a)h \end{aligned}\right\} \Rightarrow P = \frac{nRT}{(A+a)h} \quad (II)$$

$$(I),(II) \Rightarrow T = \left(\frac{A+a}{nR}\right)\left(P_0 + \frac{(m+M)g}{A-a}\right)h = 361.45\ K \Rightarrow T \simeq 88.3^\circ C$$

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۴ – مقدار (۸) مورد قبول است.

$$\frac{\sigma T_S^4 \cancel{4\pi} R_S^2}{\cancel{4\pi} D^2} \pi R^2 \Big/ 2\pi R^2 = \frac{(\sigma T_S^4) R_S^2}{2D^2} = P_e = 1400\ w/m^2$$

$$P_0 = 10^9\ w$$

$$P_0 = \sigma T_S^4 A = \frac{2D^2 P_e}{R_S^2} A \Rightarrow A = \frac{P_0}{P_e} \cdot \frac{R_S^2}{2D^2} \Rightarrow A = \frac{10^9}{14\times10^2} \times \frac{1}{2} \times \left(\frac{7\times10^8}{1.5\times10^{11}}\right)^2$$

$$\Rightarrow A = \frac{70}{9}\ m^2 = 7.78\ m^2 \simeq 8\ m^2$$

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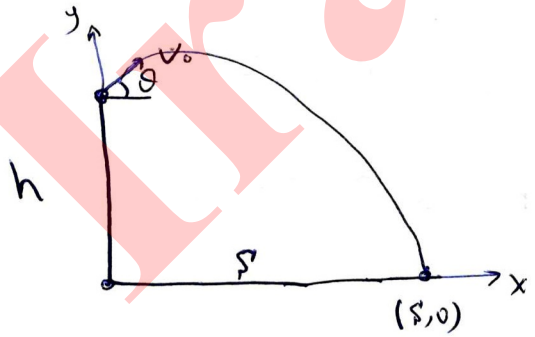
۵ – مقدار (۱۴) مورد قبول است.



$$y = y_0 + \tan\theta \cdot x - \frac{g}{2v_0^2\cos^2\theta} x^2$$

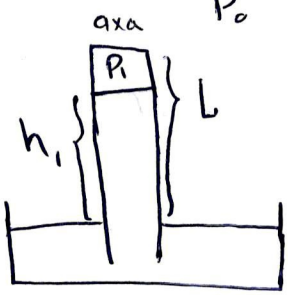
$$0 = h + \tan\theta \cdot S - \frac{gS^2}{2v_0^2}(1+\tan^2\theta)$$

$$\Rightarrow \frac{gS^2}{2v_0^2} \cdot \tan^2\theta - S \cdot \tan\theta + \frac{gS^2}{2v_0^2} - h = 0$$

$$\Delta \geq 0 \Rightarrow S^2 - 4\frac{gS^2}{2v_0^2}\left(\frac{gS^2}{2v_0^2} - h\right) \geq 0 \Rightarrow S \leq \frac{v_0}{g}\sqrt{v_0^2 + 2gh}$$

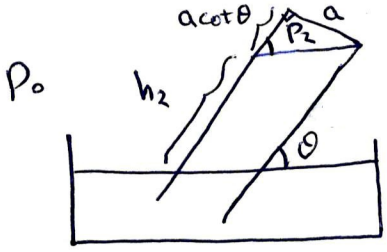
$$S \leq \frac{4}{10}\sqrt{4^2 + 2\times10\times64} \Rightarrow S \leq 14.4\ m$$

۶- مقدار (VI) مورد قبول است.



$$P_0 = P_1 + \rho g h_1 \rightarrow P_1 = P_0 - \rho g h_1$$

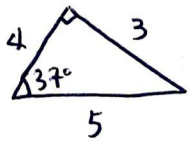
$$P_0 = P_2 + \rho g h_2 \sin\theta \Rightarrow P_2 = P_0 - \rho g h_2 \sin\theta$$



$$P_1 \alpha^2 (L-h_1) = P_2 \alpha^2 \cdot \frac{a\cot\theta}{2}$$

فشارها برحسب cmHg نوشته می‌شود:

$$(P_0 - h_1)(L-h_1) = (P_0 - h_2\sin\theta)\cdot\frac{a\cot\theta}{2}$$



$$(P_0 - 70)(100-70) = (P_0 - 95\times\frac{3}{5})\frac{3}{2}\times\frac{4}{3}$$

$$\Rightarrow (P_0 - 70)\cancel{30}^{15} = (P_0 - 57)\times 2 \Rightarrow 15P_0 - 15\times 70 = P_0 - 57$$

$$14P_0 = 15\times 70 - 57 \Rightarrow P_0 = 70.92\ \text{cmHg} \Rightarrow \boxed{P_0 = 71\ \text{cmHg}}$$

۷- مقدار (V₀) مورد قبول است. (اصلاً این سوال در بازه‌ای صحیح بسته)

$$(M+\lambda t)\,dT = \lambda dt\cdot(T_1 - T) \Rightarrow \frac{dT}{dt} = \frac{-\lambda}{M+\lambda t}\cdot(T - T_1) \quad (I)$$

$$t=0:\ \frac{dT}{dt} \simeq \frac{5}{10} = \frac{1}{2}\ \Rightarrow\ \frac{-\lambda}{M}(20 - T_1) = \frac{1}{2} \Rightarrow \frac{\lambda}{M} = \frac{1}{2(T_1 - 20)} = \alpha \quad (II)$$

$$T = 20^\circ C$$

$$t=50:\ \frac{dT}{dt} \simeq \frac{10}{50} = \frac{1}{5}\ \Rightarrow\ \frac{1}{5} = \frac{\lambda}{M+50\lambda}(T_1 - 40) = \frac{\alpha}{1+50\alpha}\cdot(T_1 - 40) \Rightarrow T_1 - 40 = \frac{1+50\alpha}{5\alpha}$$

$$T = 40^\circ C$$

$$5\alpha\cdot(T_1 - 40) = 1 + 50\alpha \Rightarrow \frac{5}{2(T_1 - 20)}(T_1 - 40) = 1 + \frac{50}{2(T_1 - 20)} \quad (III)$$

$$(II), (III) \Rightarrow 5T_1 - 200 = 2T_1 + 10 \Rightarrow \boxed{T_1 = 70^\circ C}$$