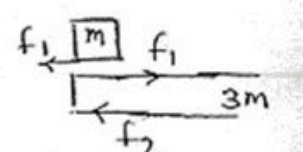


ج) $E = \sum I v \Delta t$

$$= \frac{16+1.2}{2} + \frac{49+16}{2} + \frac{67+49}{2} + \frac{67+77}{2} + 80 \times 2.$$

$$E \approx 41 \times 10^{-3} \text{ J}$$

2)

الف)  $f_1 - f_2 > 0$
 $\rightarrow mg\mu_2 > 4mg\mu_1 \rightarrow \mu_2 > 4\mu_1$

ب) $a = \frac{mg\mu_2 - 4mg\mu_1}{3m} = g(\mu_2 - 4\mu_1)/3$

$v_0 - g\mu_2 T = g(\mu_2 - 4\mu_1)T/3 \rightarrow T = \frac{3v_0}{4g(\mu_2 - \mu_1)}$

ج) $v = \frac{g(\mu_2 - 4\mu_1)T}{3} = \frac{v_0(\mu_2 - 4\mu_1)}{4(\mu_2 - \mu_1)}$

د) $\Delta x = \frac{1}{2} a T^2 = \frac{1}{2} g \frac{\mu_2 - 4\mu_1}{3} \times \frac{9 v_0^2}{16g^2(\mu_2 - \mu_1)^2}$

$\Delta x = \frac{3v_0^2(\mu_2 - 4\mu_1)}{32g(\mu_2 - \mu_1)^2}$

$\Delta x = v_0 T - \frac{1}{2} \mu_2 g T^2 = \frac{3v_0^2}{4g(\mu_2 - \mu_1)} - \frac{g\mu_2}{2} \frac{9v_0^2}{16g^2(\mu_2 - \mu_1)^2}$

$\Delta x = \frac{3v_0^2}{32g(\mu_2 - \mu_1)^2} = \frac{3v_0^2}{32g} \frac{(\mu_2 - 4\mu_1)}{(\mu_2 - \mu_1)^2}$

ه) $W_1 = \Delta x mg(\mu_2 - 4\mu_1) = \frac{3mv_0^2(\mu_2 - 4\mu_1)^2}{32(\mu_2 - \mu_1)^2}$

$W_2 = -\Delta x mg\mu_2 = -\frac{3mv_0^2\mu_2(\mu_2 - 4\mu_1)}{32(\mu_2 - \mu_1)^2}$

و) $\Delta K_1 = W_1 = \frac{3mv_0^2(\mu_2 - 4\mu_1)^2}{32(\mu_2 - \mu_1)^2}$

$\Delta K_2 = W_2 = -\frac{3mv_0^2\mu_2(\mu_2 - 4\mu_1)}{32(\mu_2 - \mu_1)^2}$

$$n\mathcal{E} - nrI = mIR \Rightarrow I = \frac{n\mathcal{E}}{mR + nr}$$

$$p = mn \Rightarrow I = \frac{n^2\mathcal{E}}{pR + n^2r}$$

$$mI = \frac{p n \mathcal{E}}{pR + n^2 r}$$

با این که n پیوسته نیست ولی به علت زیاد بودن آن n را پیوسته در نظر می گیریم

$$\Rightarrow \frac{d(mI)}{dn} = 0 \Rightarrow p\mathcal{E} \left(\frac{pR + n^2r - 2nr^2}{(pR + n^2r)^2} \right) = 0$$

$$\Rightarrow pR = n^2r \Rightarrow n^2 = \frac{pR}{r} = 360 \Rightarrow n = 60$$

$$\Rightarrow m = 6$$

$$b) \quad mI = \frac{360 \times 60 \times 2}{360 \times 10 + 3600} = 6A$$

$$4) \quad \text{الف) } n_a = \frac{n a x}{L}$$

$$\text{ب) } n_b = \frac{n a (L-x)}{L}$$

$$\text{د) } \begin{cases} P_1 = \frac{n a R T}{A L} \\ P_2 = \frac{(n_b + n_a (1 - x/L)) R T}{A (L-x)} \end{cases}$$

$$\text{ج) } P_2 A = P_1 A + K(x - x)$$

$$R T \left(\frac{n_b}{L-x} + \frac{n_a}{L} \right) = \frac{R T n_a}{L} + K(x - x)$$

$$\frac{R T n_b}{L-x} = K(x - x) \Rightarrow R T n_b = K(x - x)(L-x)$$

$$\Rightarrow K x^2 - K(L+x)x + K(xL - \frac{R T n_b}{K}) = 0$$

$$x = \frac{L+x \pm \sqrt{(L+x)^2 - 4(xL - \frac{R T n_b}{K})}}{2}$$

5)

$$\vec{B} = \frac{A}{x^4} (2\vec{x} + 3\vec{y})$$

ای پدیده آوردن شار مغناطیسی مؤلفه x می باشد.

$$\Phi = \sum \vec{B} \cdot \Delta \vec{S} = \frac{2A}{x^3} \pi a^2$$

$$\text{ب) } -\dot{\Phi} = 2\pi a^2 A \frac{3\dot{x}}{x^4} = -\frac{6\pi a^2 A v}{x^4} \quad \dot{\Phi} = RI$$

$$I = \frac{6\pi a^2 A v}{R x^4}$$

$$\vec{F} = I \vec{L} \times \vec{B} \Rightarrow F = \frac{6\pi a^2 A v}{R x^4} \cdot 2\pi R \cdot \frac{3A}{x^2}$$

$$\text{ج) } F = \left(\frac{6\pi a^2 A}{R x^4} \right)^2 \cdot \frac{v}{R}$$

نیروی ناشی از میدان درون سوسو صغیر است

$$\text{د) } P_E = Fv = \frac{6\pi a^2 A v}{R x^4} \cdot \frac{6\pi a^2 A v}{x^4} = R \left(\frac{6\pi a^2 v A}{R x^4} \right)^2$$

$$\text{ه) } P_2 = RI^2 = R \left(\frac{6\pi a^2 A v}{R x^4} \right)^2$$

در این سوال می خواست برای ما $P = RI^2$ ثابت کند

6) تصویر با بزرگنمایی باشد

$$q < L \quad \frac{1}{x} + \frac{1}{q} = \frac{1}{f} \rightarrow q = \frac{xf}{x-f}$$

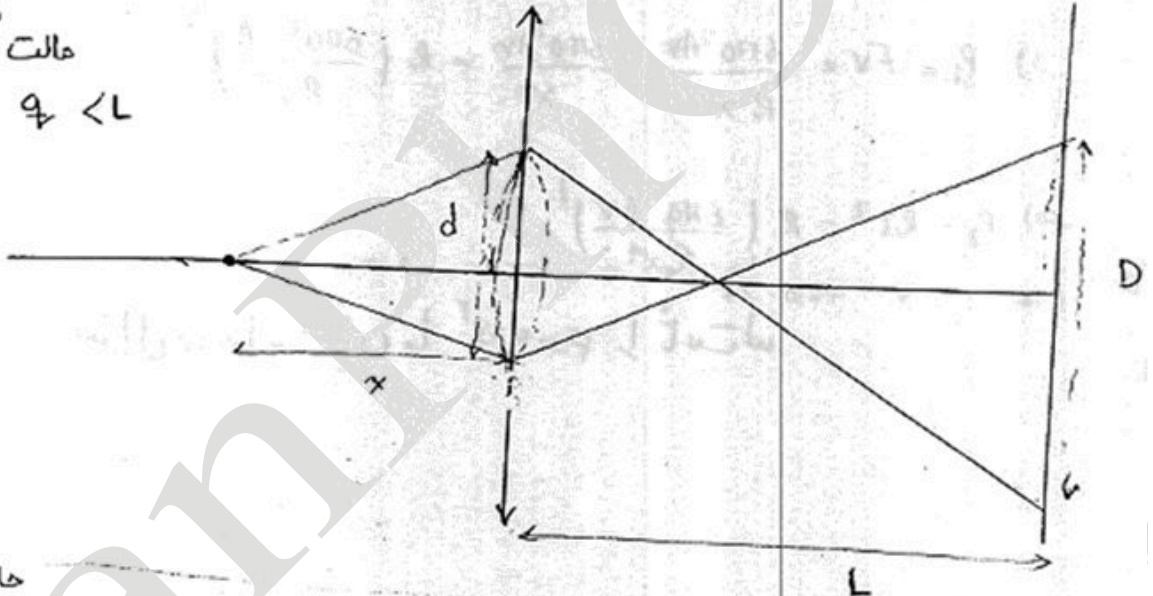
$$\frac{d}{q} = \frac{D}{L-q} \rightarrow D = d \left(\frac{L}{q} - 1 \right) = d \left(\frac{L(x-f)}{xf} - 1 \right)$$

$$q > L \quad \frac{D}{q-L} = \frac{d}{q} \rightarrow D = d \left(1 - \frac{L}{q} \right) = d \left(1 - \frac{L(x-f)}{xf} \right)$$

$$\Rightarrow D = \left| d \left(\frac{L(x-f)}{xf} - 1 \right) \right|$$

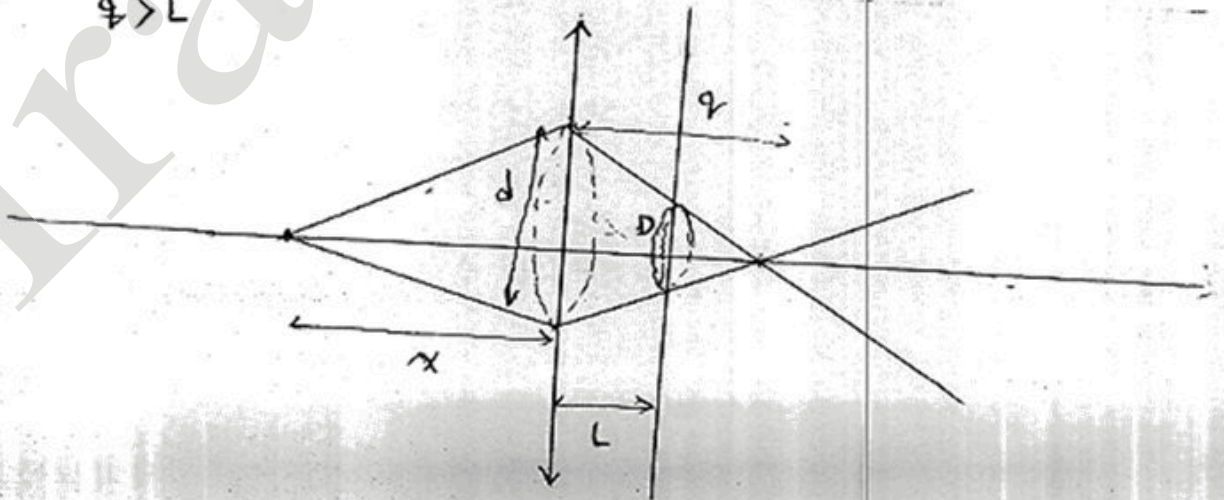
حالت اول

$q < L$



حالت دوم

$q > L$



$$7) \text{ الف) } PA - (P + \Delta P)A = \rho A \Delta x g \quad -\Delta P = \rho g \Delta x$$

$$\frac{\Delta P}{\Delta x} = -\rho g$$

$$ب) \quad PV = \frac{m}{M} RT \Rightarrow P = \frac{m}{V} \frac{RT}{M} = \frac{\rho RT}{M}$$

$$\frac{\Delta(\frac{\rho RT}{M})}{\Delta x} = -\rho g \Rightarrow \frac{\Delta \rho}{\Delta x} = \frac{-\rho g M}{RT}$$

$$ج) \quad P_{\text{top}} = \bar{P} + \frac{\Delta P}{\Delta x} \frac{h}{2} = \bar{P} - \frac{\rho g M}{RT} \frac{h}{2} = \bar{P} \left(1 - \frac{g M h}{2RT}\right)$$

$$د) \quad \frac{P_{N_2}}{P_{O_2}} = \frac{\bar{P}_{N_2} \left(1 - \frac{g M_{N_2} h}{2RT}\right)}{\bar{P}_{O_2} \left(1 - \frac{g M_{O_2} h}{2RT}\right)} = 4 \frac{\left(1 - \frac{g M_{N_2} h}{2RT}\right)}{1 - \frac{g M_{O_2} h}{2RT}}$$

$$ه) \quad \frac{P_{N_2}}{P_{O_2}} = 4 \left(1 + \frac{g h}{2RT} (M_{O_2} - M_{N_2})\right)$$

$$= 4 \left(1 + \frac{10 \times 50}{2 \times 2500} \times 4 \times 10^{-3}\right) = 4 + 16 \times 10^{-4}$$

8)

(الف) تکدهای 1.5 × 1.5

$$\frac{10 \times 10}{1.5^2} \times 4 \times 1.5 \approx 2.5 \text{ m} \Rightarrow 1 \text{ m}$$

$$\text{ب) } 60 \times 10^{-3} \times \frac{1}{2000} \times \frac{1}{6 \times 10^{23}} = \frac{1}{2} \times 10^{-28}$$

$$\text{طول مربع} \approx \sqrt[3]{\frac{10^{-28}}{2}} \approx 4 \times 10^{-10} \text{ m} \Rightarrow 10^{-9} \text{ m}$$

$$\text{ج) } \text{تعداد پروتونها} = \frac{1}{10^{-9}} \times \frac{2 \times 10^{-3}}{10^{-9}} = 2 \times 10^{+15} \Rightarrow 10^{+15}$$

$$\text{د) } 10^{15} \times 10^{-19} = 10^{-4} \text{ J}$$

$$\text{ه) } mgh = (2000 \times (100 \times 100 \times 2 \times 10^{-9})) \times 10 \times 0.3 = 0.12$$

$$\Rightarrow 0.1 \text{ J}$$

$$\text{و) } \frac{10^{-4}}{10^{-1}} = 10^{-3}$$