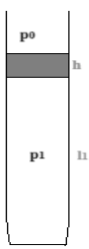
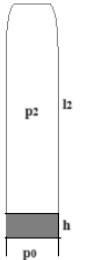


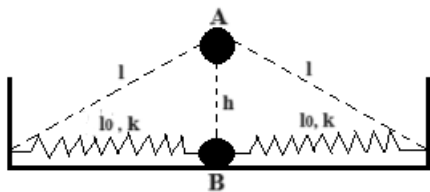
OLIMPIADA DE FIZICĂ
Etapa pe localitate – ianuarie 2024
Barem de corectare clasa a X-a

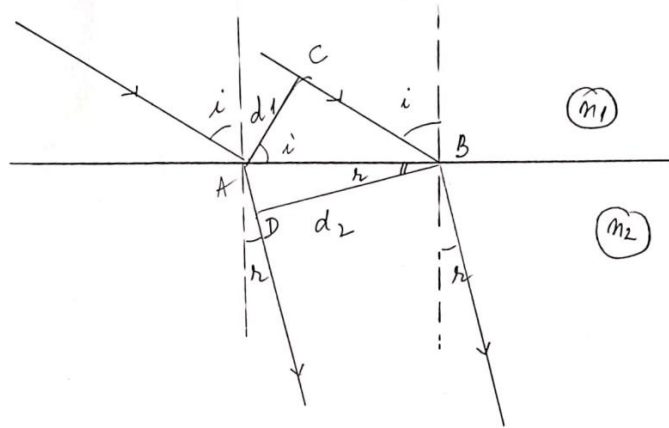
Problema 1 - Tuburi		Punctaj parțial	Punctaj total
A.	Condiția de echilibru: $\vec{F}_2 + \vec{F}_2 + \vec{G} = 0$ Notăm cu : p_1 presiunea gazului din compartimentul superior, p_2 presiunea gazului din compartimentul inferior, \vec{G} greutatea pistonului și S secțiunea cilindrului. Atunci,	0,5p	4,5p
	$p_1 - p_2 = \frac{G}{S} \quad (1)$		
	$\left. \begin{array}{l} V_1 = kV_2 \\ V_1 + V_2 = V \end{array} \right\} \Rightarrow V_2 + kV_2 = V \Rightarrow \begin{cases} V_2 = \frac{V}{k+1} \\ V_1 = \frac{kV}{k+1} \end{cases}$ $p_1 V_1 = \nu RT \Rightarrow p_1 = \frac{\nu RT}{V_1} = \frac{\nu RT(k+1)}{kV}$	0,5p	
	$p_2 V_2 = \nu RT \Rightarrow p_2 = \frac{\nu RT}{V_2} = \frac{\nu RT(k+1)}{V}$	0,5p	
	$\frac{\nu RT(k+1)}{V} - \frac{\nu RT(k+1)}{kV} = \frac{G}{S} \quad (2)$	0,5p	
	$\vec{F}'_1 + \vec{F}'_2 + \vec{G} = 0$ $F'_2 = F'_1 + G \Rightarrow p'_2 - p'_1 = \frac{G}{S} \quad (3)$	0,5p	
	$\left. \begin{array}{l} \frac{V'_1}{V'_2} = n \\ V'_1 + V'_2 = V \end{array} \right\} \Rightarrow \begin{cases} V'_2 = \frac{V}{n+1} \\ V'_1 = \frac{nV}{n+1} \end{cases}$ $p'_1 V'_1 = \nu RT \Rightarrow p'_1 = \frac{\nu RT}{V'_1} = \frac{\nu RT(n+1)}{nV}$ $p'_2 V'_2 = \nu RT' \Rightarrow p'_2 = \frac{\nu RT'}{V'_2} = \frac{\nu RT'(n+1)}{V}$	0,5p	

	$\frac{\nu RT'(n+1)}{V} - \frac{\nu RT(n+1)}{nV} = \frac{G}{S} \quad (4)$	0,5p	
	Din (2) și (4) avem: $\frac{\nu RT(k+1)}{V} - \frac{\nu RT(k+1)}{kV} = \frac{\nu RT'(n+1)}{V} - \frac{\nu RT(n+1)}{nV}$ $T(k+1) - \frac{T(k+1)}{k} = T'(n+1) + \frac{T(n+1)}{n}$ $T'(n+1) = T \frac{(k+1)(k-1)}{k} + T \frac{n+1}{n}$ $T' = T \left[\frac{(k+1)(k-1)}{k(n+1)} + \frac{1}{n} \right] = \frac{47}{60} T$	1,0p	
B.	$\begin{cases} p_1 = p_0 + \rho gh \\ V_1 = Sl_1 \end{cases}$ 	1,0p	
	$\begin{cases} p_2 = p_0 - \rho gh \\ V_2 = Sl_2 \end{cases}$ 	1,0p	4,5p
	Transformare izotermă: $p_1 V_1 = p_2 V_2$	0,5p	
	$(p_0 + \rho gh)Sl_1 = (p_0 - \rho gh)Sl_2$	0,5p	
	$p_0 = \frac{\rho gh(l_1 + l_2)}{l_2 - l_1}$	1,0p	
	$p_0 = 760 \text{ mmHg}$	0,5p	
	Oficiu		1,0p
	Total		10 p

Problema 2 – Amestecuri de gaze		Punctaj parțial	Punctaj total
A.	Înveliș adiabatic $\Rightarrow Q = 0$ $L = 0$ Din principiul I al termodinamicii $\Rightarrow \Delta U = 0$	1,0p	4,5p
	$\Delta U_1 + \Delta U_2 = 0$ $\Delta U_1 = \nu_1 C_{v1} (T - T_1)$ $\Delta U_2 = \nu_2 C_{v2} (T - T_2)$	1,0p	
	$\nu_1 C_{v1} (T - T_1) + \nu_2 C_{v2} (T - T_2) = 0$ $\nu_1 C_{v1} T + \nu_2 C_{v2} T = \nu_1 C_{v1} T_1 + \nu_2 C_{v2} T_2$ $T = \frac{\nu_1 C_{v1} T_1 + \nu_2 C_{v2} T_2}{\nu_1 C_{v1} + \nu_2 C_{v2}}$	1,0p	
	Dar, din ecuația termică de stare pentru cele două gaze ideale în starea inițială avem: $p_1 V_1 = \nu_1 R T_1 \Rightarrow \nu_1 = \frac{p_1 V_1}{R T_1}$ $p_2 V_2 = \nu_2 R T_2 \Rightarrow \nu_2 = \frac{p_2 V_2}{R T_2}$ $C_{v1} = \frac{3}{2} R$ $C_{v2} = \frac{5}{2} R$	0,5p	
	$T = \frac{\frac{p_1 V_1}{R T_1} \cdot \frac{3}{2} R \cdot T_1 + \frac{p_2 V_2}{R T_2} \cdot \frac{5}{2} R \cdot T_2}{\frac{p_1 V_1}{R T_1} \cdot \frac{3}{2} R + \frac{p_2 V_2}{R T_2} \cdot \frac{5}{2} R}$ $T = \frac{\frac{3}{2} p_1 V_1 + \frac{5}{2} p_2 V_2}{\frac{3}{2} \frac{p_1 V_1}{T_1} + \frac{5}{2} \frac{p_2 V_2}{T_2}}$ $T_1 = 300 \text{ K}$ $T_2 = 400 \text{ K}$ $T = 383,33 \text{ K}$	1,0p	
B.	Notăm cu N_1 – numărul de molecule disociate $N_1 = 2\alpha N$ $\nu_1 = \frac{N_1}{N_A} = 2\alpha \nu_0$	1,0p	4,5p

	Notăm cu N_2 – numărul de molecule nedisociate $N_2 = N(1 - \alpha)$ $v_2 = \frac{N_2}{N_A} = v_0(1 - \alpha)$	1,0p	
	$v = v_1 + v_2 = v_0(1 + \alpha)$ $pV = v_0(1 + \alpha)RT$ $\alpha = \frac{pV}{v_0RT} - 1$	1,5p	
	$\alpha = 0,08$	1,0p	
	Oficiu		1,0p
	Total		10 p

Problema 3 – Mecanică Optică geometrică		Punctaj parțial	Punctaj total
A.	 <p>Conservarea energiei mecanice: $E_{(A)} = E_{(B)}$</p> $E_{(A)} = mgh + \frac{k \cdot \Delta l^2}{2} + \frac{k \cdot \Delta l^2}{2} = mgh + k \cdot \Delta l^2$ $E_{(B)} = \frac{m \cdot v^2}{2}$	1,0p	
	$mgh + k \cdot \Delta l^2 = \frac{m \cdot v^2}{2} \Rightarrow v = \sqrt{2gh + \frac{2k\Delta l^2}{m}}$	0,5p	
	$\Delta l = l - l_0$ $l = \sqrt{l_0^2 + h^2}$ $\Delta l = \sqrt{l_0^2 + h^2} - l_0$	1,0p	4,5p

	$v = \sqrt{2gh + \frac{2k \left(\sqrt{l_0^2 + h^2} - l_0 \right)^2}{m}}$	0,5p	
	$\vec{F} = \frac{\Delta \vec{p}}{\Delta t}$ $\Delta \vec{p} = \vec{p} - \vec{p}_0$ $\Delta p = p + p_0$ $p = p_0 = mv$ $\Delta p = 2mv$ $F = \frac{2mv}{\Delta t}$	1,0p	
	F = 600 N	0,5 p	
		1,0p	
B.	$\left. \begin{array}{l} \text{În } \triangle ACD \text{ avem } \cos i = \frac{d_1}{AB} \\ \text{În } \triangle ADB \text{ avem } \cos r = \frac{d_2}{AB} \end{array} \right\} \Rightarrow \frac{d_2}{d_1} = \frac{\cos r}{\cos i}$ $d_1 = d_2 \frac{\cos i}{\cos r}$	1,0p	4,5p
	Din legea refracției avem: $\frac{\sin i}{\sin r} = \frac{n_2}{n_1} \Rightarrow \sin r = \frac{n_1}{n_2} \sin i$	0,5p	
	$\cos r = \sqrt{1 - \sin^2 r} \Rightarrow \cos r = \frac{\sqrt{n_2^2 - n_1^2 \sin^2 i}}{n_2}$	1,0p	
	$d_1 = \frac{d_2 n_2 \cos i}{\sqrt{n_2^2 - n_1^2 \sin^2 i}}$	0,5p	



	$d_1 = \frac{\sqrt{3}d_2n_2}{\sqrt{4n_2^2 - n_1^2}}$	0,5p	
	Oficiu		1,0p
	Total		10 p

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