(1)

SET – III

Q. P. Code: 59319

ANSWER KEY

Q.1.	A)		**Select the correct alternative**	
		(i)	b, directly proportional	12
		(ii)	b, original volume	
		(iii)	c. $\mu_1 h_1 \sin\alpha_1 = \mu_2 h_2 \sin\alpha_2$	
		(iv)	b. $2f/3$	
		(v)	a. Internal energy	
		(vi)	c. 2.667	
	B)		**Answer in one sentence**	
		(i)	ratio of change in volume is bulk modulus constant.	3
		(ii)	$I = dv/du$ = length of Image/ length of object	
		(iii)	**Adiabatic interaction:** No heat is allowed to enter or leave the system dQ = 0	
	C)		**Fill in the blanks**	
		(i)	Bernoulli's principle	5
		(ii)	Elastic limits	
		(iii)	$d = f_1 - f_2$	
		(iv)	180^0 or π radian	
		(v)	Thermal equilibrium	
Q. 2	A)		**Attempt ANY ONE**	
		(i)	diagram and description and assumptions net force along ends is $F = (p_1 - p_2)\pi r^2$ F = modulus of rigidity X velocity gradient and simplify the eq for velocity of flow $v = \frac{(p_1 - p_2)}{4\eta l}(a^2 - r^2)$ Simplify to get total flow of liquid $V = \frac{\pi(p_1 - p_2)a^4}{8\eta l}$	3 1 2 2
		(ii)	Description and diagram Y =2η (1+ σ), η = shear stress / shear strain = F / θ. Shear strain = θ = 2F/Y(1+ σ), Y =2η (1+ σ)	2 3 3
	B)		**Attempt ANY ONE**	
		(i)	figure and description Modulus of rigidity , $\eta = \frac{Tangential.stress}{Shear.strain} = \frac{T}{\varphi} = \frac{F}{2\pi r dr} \times \frac{L}{r\theta}$ Troque = $dT = \frac{2\pi\eta\theta}{L} r^3 . dr$, Couple required = $\frac{\pi\eta\theta}{2L}(a_2^4 - a_1^4)$	2 1 5
		(ii)	Diagram and description Description and equation: $A_1\delta x_1 = m / \rho = A_1\delta x_1 = m / \rho$ Total work done = change in potential and kinetic energy. $W = \frac{1}{2} m_2 v_2^2 - \frac{1}{2} m_2 v_2^2 + mgh_2 - mgh_1$, $W = P_1A_1\,\delta x_1 - P_1A_1\,\delta x_1$	2 1 2 3

			equating and simplifying P+ $\rho gh+1/2\ \rho v^2$ = constant.	
	C)		**Attempt ANY ONE**	
		(i)	Diagram description	2 2
		(ii)	Volume of water collected V = 40/ 5*60 X 10 $^{-6}$ P = hρg = 0.4*9.8*10 ^{3} η= (πPa ^{4})/8*1*V = 1.4 * 10 $^{-3}$	 2 2
Q. 3	A)		**Attempt ANY ONE**	
		(i)	$\frac{1}{f}=(\mu-1)[\frac{1}{R_1}-\frac{1}{R_2}]$, Ray diagram $f_R-f_V=\omega f_y$	1 2 5
		(ii)	Ray Diagram $F=3f/2$ $\beta=-f$ $\alpha=3f$ Cardinal point diagram	1 2 4 1
	B)		**Attempt ANY ONE**	
		(i)	**ray diagram**, derivation , path diff: $\Delta=2\mu t\cos r\pm\lambda/2$ Constructive Interference Destructive interference	1 5 1 1
		(ii)	**Expalnation with ray diagram** methods of minimization of spherical aberration	4 4
	C)		**Attempt ANY ONE**	4
		(i)	$R_1/R_2=-1/6, R_2=-6R_1$ $\frac{1}{f}=(\mu-1)[\frac{1}{R_1}-\frac{1}{R_2}]$ $R_1=17.5cm$ $R_2=-105cm$	2 1 1 1
		(ii)	$F=\frac{f_1f_2}{f_1+f_2-d}=10cm$ $\alpha=+d.F/f_2=+2.5cm$ $\beta=-d.F/f_1=-3.33cm$ Cardinal point ray diagram	1 1 1 1

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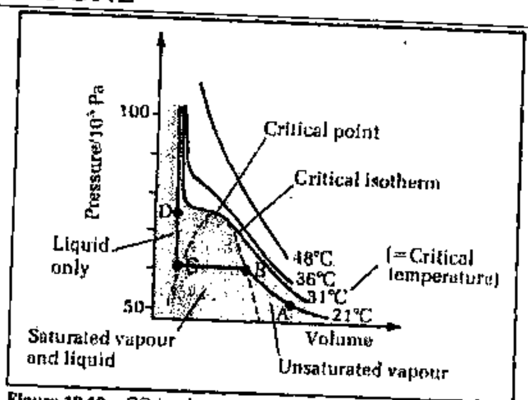
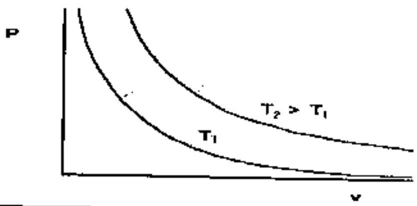
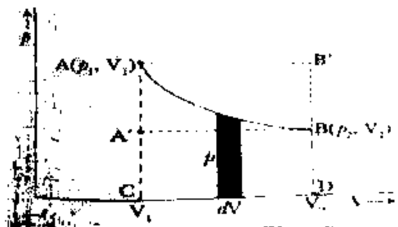
Q. P. Code:

Q. 4	A)		Attempt ANY ONE	
		(i)	 Figure 18.19 CO isotherms of p against V	2
			Explanation for different parts of the isothermals The isothermal at 31.1°C is called Critical isothermal Andrew used the term gas for temperatures above the critical temperature and vapour for temperatures below the critical temperature.	5
		(ii)	For adiabatic change dQ = 0, $PV^\gamma = K$ $P = \frac{K}{V^\gamma}$, $W = \int_{V_1}^{V_2} PdV = \int_{V_1}^{V_2} \frac{K}{V^\gamma} dV = \frac{1}{1-\gamma}\left[\frac{KV_2}{V_2^\gamma} - \frac{KV_1}{V_1^\gamma}\right]$ $W = \frac{1}{1-\gamma}[P_2V_2 - P_1V_1]$ For perfect gas, PV = nRT $P_1V_1 = nRT_1$ and $P_2V_2 = nRT_2$ $W = \frac{nR(T_2 - T_1)}{1-\gamma}$ $W = n\,C_v(T_1 - T_2)$ $W = C_v(T_1 - T_2)$(For 1 mole)	4
				4
	B)		Attempt ANY ONE	
		(i)	$(P + \frac{a}{V^2})(V - b) = RT$ $P = \frac{RT}{V-b} - \frac{a}{V^2}$, find $\frac{dP}{dV}$, $\frac{d^2P}{dV^2}$ $V_c = 3b$ $T_c = \frac{8a}{27bR}$ $P_c = \frac{a}{27b^2}$ $a = \frac{27R^2Tc^2}{64Pc}$, $b = \frac{Vc}{3}$	3 5
		(ii)	Internal energy function or Internal energy Q - W = U_f - U_i When heat Q flows into the system, it gets converted into internal energy and hence internal energy of the	4

			system increases. ΔU is path independent $Q = \Delta U + W$ is first law of thermodynamics Differential form of first law of thermodynamics $dQ = dU + dW$ $dQ = dU + PdV$ Internal energy U is the sum of kinetic and potential energies of the particles constituting the system. It is possible to increase the internal energy of an adiabatically insulated system merely by compressing it.	4
	C)		**Attempt ANY ONE**	
		(i)	$T_c = 143K$ $P_c = 50$ atm $R = 82.07\ cm^3\ atm.K^{-1}\ mol^{-1}$ $Vc = \frac{3RT_c}{8P_c} = 88.02\ cm^3\ mol^{-1}$ $b = \frac{Vc}{3} = 29.34\ cm^3\ mol^{-1}$ $a = \frac{27R^2Tc^2}{64Pc} = 1.16 \times 10^6$ atm $cm^6\ mol^{-2}$	2 2
		(ii)	$T_1 = 30 + 273 = 303K$ $T_2 = 130 + 273 = 403K$ $P = 10^6 N/m^2$ $PV = RT,\ V_1 = \frac{RT_1}{P} = 2.545 \times 10^{-3} m^3$ $V_2 = \frac{RT_2}{P} = 3.385 \times 10^{-3} m^3$ 1. $W = P(V_2 - V_1) = 10^6 \times 0.84 \times 10^{-3} = 0.84 \times 10^3$ Joule = 840 Joule 2. $\Delta U = \frac{5}{2} R(T_2 - T_1) = 2100$ Joule 3. $Q = \Delta U + W = 2940$ Joule = 700 cal	2 2
Q.5			**Attempt ANY FOUR**	20
		(i)	Diagram and explanation Mass of liquid flowing through the each ends of the liquid is $\Delta m_1 = A_1 v_1 \rho \Delta t$, $\Delta m_2 = A_2 v_2 \rho \Delta t$, $\Delta m_1 = \Delta m_2$, $AV =$ constant.	2 3
		(ii)	draw free body diagram $R = mg\cos\theta$, $f = \mu R = mg\sin\theta$, $\mu = mg\sin\theta / R = \tan\theta$	2 3

		(iii)	**Mehtod of minimization by crossed lens** By Plano-convex lens	3 2
		(iv)	**for destructive interference,** $2\mu t\cos r = m\lambda$ For least thickness, m=1 $t = \lambda/2\mu\cos r$ $t = calculations$ $t = 4.066\times10^{-7}m$	1 1 2 1
		(v)	Perfect gas obey's Boyle's law and has an internal energy independent of the volume occupied. Equation of state PV = nRT For a perfect gas PV = constant at a fixed temperature. Hence an isothermal on (P-V) diagram should be a hyperbola. And (PV-P) diagram is a straight line parallel to X- axis.  	3 2
		(vi)	 Fig. 8.4 : Indicator Diagram W = $\int_{V_1}^{V_2} PdV$ = Area under P-V curve on the V- axis If the same change in the thermodynamic parameters is brought about by a different path, the area under the curve will change and hence the work done will change. Thus work done in taking the system from one state to another depends upon the path taken.	1 4