1

Q. P. Code: 59318

SET – I

ANSWER KEY

Q.1.	**A)**		**Select the correct alternative**	
		(i)	(b) inertial frame of reference	**2**
		(ii)	(c) solids	**2**
		(iii)	(d) d =10 cm	**2**
		(iv)	(b) Proportional to the square root of odd natural numbers	**2**
		(v)	(b) Low pressure	**2**
		(vi)	(a) Boyle's law	**2**
	B)		**Answer in one sentence**	
		(i)	The body which regains its shape is called perfectly elastic body	1
		(ii)	Crossed lens, $R_1/R_2 = -1/6$	1
		(iii)	Isochoric interaction: Volume of the system remains constant dV=0	1
	C)		**Fill in the blanks**	
		(i)	Strain	1
		(ii)	Pseudo	1
		(iii)	Lateral or linear Magnification	1
		(iv)	power of lens in dioptre	1
		(v)	increase	1
Q. 2	**A)**		**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)	F = F_x i + F_y j , = 20N and F_y = 20N ax = F_x / m = 20 / 0.01= 2000 m/ s^2. X = u_x + ½ a_x t_2 = 4000m y = u_y + ½ a_x t_2 = 0+ 2/2 *1000) 4 = 2000m r= 4000 I + 2000 j	**4** **4**
	B)		**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)	Diagram and explanation Y = longitudinal stress / strain. Extensions l = F/Y Compression l' = -σF/Y along y an z axis. Total change $e_x = e_y = e_z$ = F/Y (1 -2σ) Bulk modulus = K = F/ 3e simplifying we get y = 3k (1-2σ).	**3** **5**

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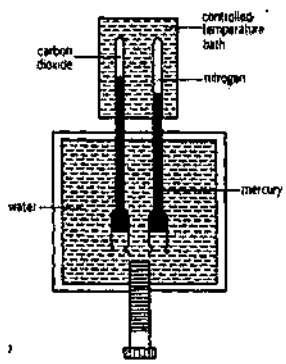
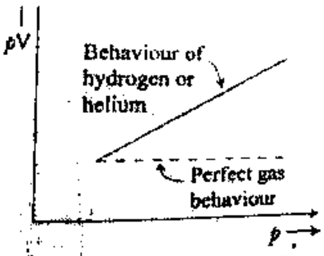
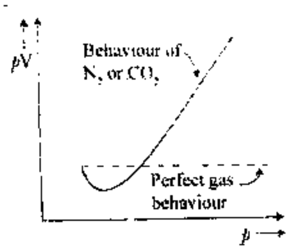
Q. P. Code:

	C)		**Attempt ANY ONE**	
		(i)	initial momentum of the ball = mu = 350/1000 X 14= 4.9 kgm/s final momentum of the ball = mv = -350/1000 X 24= 4.9 kgm/s change in momentum = mu -mv = 13.3 kgm/s average force = impulse /time = 13.3 / 0.035 = 380 N	1 1 1 1
		(ii)	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 2
Q. 3	A)		**Attempt ANY ONE**	
		(i)	Diagram Description $\frac{h_1}{F} = \frac{h_1}{f_1} + \frac{h_2}{f_2}$ $F = \frac{f_1 f_2}{f_1 + f_2 - d}$	2 2 2 2
		(ii)	Explanation for chromatic aberration Derivation	3 5
	B)		**Attempt ANY ONE**	
		(i)	Description spherical aberration Any two methods of minimizations	4 4
		(ii)	Theory of formation of Newton's rings due to reflection To show that radius of n^{th} dark ring is proportional to the square root of a natural number	4 4
	C)		**Attempt ANY ONE**	
		(i)	Condition for achromatism, $f_1/f_2 = -\omega_1/\omega_2$ $1/F = 1/f_1 + 1/f_2$ $f_1 = 25cm, f_2 = -50cm$	1 1 2
		(ii)	$f_1 = 6cm, f_2 = f = 2cm$ $d = 2f = 4cm$ $F = \frac{f_1 f_2}{f_1 + f_2 - d}$ = 3 cm First principal point = $Fd / f_2 = 6cm$, Second principal point = $Fd / f_1 = -2cm$	 1 1 1 1
Q. 4	A)		**Attempt ANY ONE**	

		(i)	 Diagram Proper explanation for experimental arrangement	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 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 4
	B)		**Attempt ANY ONE**	
		(i)	$(P + \frac{a}{V^2})(V - b) = RT$ $P = \frac{RT}{V-b} - \frac{a}{V^2}$, find $\frac{dP}{dV}$, $\frac{d^2P}{dV^2}$ $V_c = 3b$ $T_c = \frac{8a}{27bR}$ $P_c = \frac{a}{27b^2}$ $a = \frac{27R^2Tc^2}{64Tc}$, $b = \frac{Vc}{3}$	2 2 2 2
		(ii)	**Thermal interaction**: Interaction between the two systems due only to the temperature difference between them. **The zeroth law of thermodynamics**: If two bodies A and b are separately in thermal equilibrium with a third body C, they are also in thermal equilibrium with each other. Explanation/ Proof	2 2 4
	C)		**Attempt ANY ONE**	
		(i)	$V = 350 \times 10^{-6}$ m^3/mol, T = 273K $P = \frac{RT}{V-b} - \frac{a}{V^2}$ $= \frac{8.31 \times 273}{(350-43)\times10^{-6}} - \frac{0.37}{350 \times 350 \times 10^{-12}}$ $P = 43.692 \times 10^5$ N/m^2	2 2
		(ii)	In isobaric change pressure remains constant.	

			$W = P(V_2 - V_1)$ $W = nR(T_2 - T_1)$ $Q = (U_2 + PV_2) - (U_1 + PV_1)$ Enthalpy $H = U + PV$ $Q = H_2 - H_1$	2 2
Q.5			Attempt ANY FOUR	5
		(i)	Description with explanation	
		(ii)	$y = 3k(1-2\sigma)$. $y = 2\eta(1+\sigma)$. Equate these two equations: $\sigma <= ½$ $-1 < \sigma < 0.5$ explain.	5
		(iii)	$\beta = \lambda/2\mu\theta$ ....(01M), $\theta = \lambda/2\mu\beta$ ....(01M) $\theta = calculations$ .... (02M), $\theta = 18.17$ sec.ofarc ......(01M)	1 1 2 1
		(iv)	Correct ray diagram .... (01M), Description............ (03M) Abe's Sine condition ....(01M)	1 3 1
		(v)	A gas at high temperature and low pressure behaves like a perfect gas and obeys $PV = nRT$ Perfect gas equation does not put any restriction on the increase in pressure and decrease in volume. When PV versus P isothermals are plotted for real gases at ordinary temperatures, it is observed that for gases like hydrogen and helium PV increases linearly with P whereas for nitrogen and carbon dioxide, the isothermals show an initial dip and then PV increases with P. Diagram of isothermals  Fig. 7.3 : (pV – p) isothermal for hydrogen (or helium)  Fig.7.4 : (pV – p) isothermal for N_2 (or CO_2)	3 2
		(vi)	For perfect gas, $(\frac{\partial U}{\partial V})T = 0$ $PV = RT$ $P(\frac{\partial U}{\partial T})P = R$ $C_p - C_v = R$ for a perfect gas.	2 3