Q. P. Code: 59320

SET – II

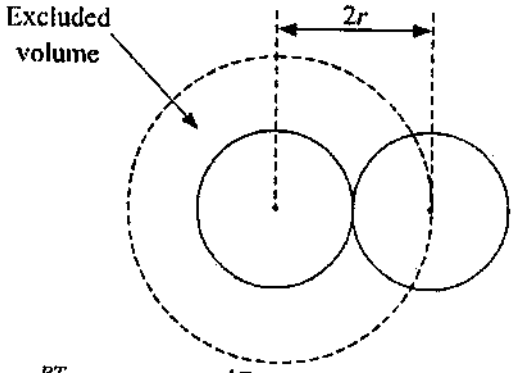
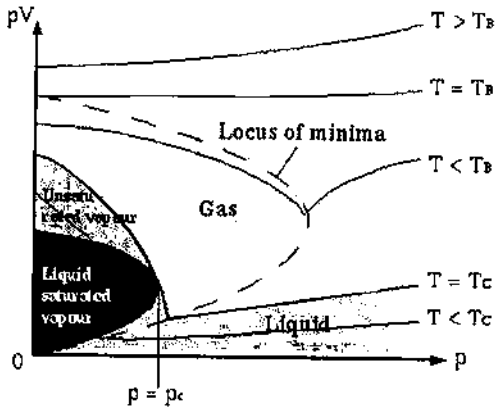
ANSWER KEY

Q. 1	**A)**		**Select the correct alternative**	
		(i)	c solids.	2
		(ii)	a pseudo force	2
		(iii)	c. Interference	2
		(iv)	b. Maximum	2
		(v)	d: Conservation of energy	2
		(vi)	c: Mechanical	2
	B)		**Answer in one sentence**	
		(i)	It states that within the limit of elasticity, the stress induced in the solid due to some external force is always in proportion with the strain.	1
		(ii)	The ratio of the angle subtended at the eye by the image formed by an optical instrument to that subtended at the eye by the object when not viewed through the instrument.	1
		(iii)	It is the temperature below which a gas can be liquefied and above which it cannot be liquefied by mere application of pressure.	1
	C)		**Fill in the blanks**	
		(i)	Bernoulli's Principle	1
		(ii)	Inversely proportional	1
		(iii)	Lateral or Linear Magnification	1
		(iv)	Dioptre	1
		(v)	increases	1
Q. 2	**A)**		**Attempt ANY ONE**	
		(i)	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. $W = \frac{1}{2} m_2v_2^2 - \frac{1}{2} m_2v_2^2 + mgh_2 - mgh_1$ $W = P_1A_1 \delta x_1 - P_1A_1 \delta x_1$ equating and simplifying $P + \rho gh + 1/2 \rho v^2 =$ constant.	2 1 2 3
		(ii)	Diagram Explanation: Y = longitudinal stress / strain. Extensions $l = F/Y$ compression $l' = -\sigma F/Y$ along y an z axis. Total change $e_x = e_y = e_z = F/Y (1 - 2\sigma)$, Bulk modulus = $K = F/3e$ simplifying we get $y = 3k(1-2\sigma)$	3 5
	B)		**Attempt ANY ONE**	
		(i)	Figure and description Modulus of rigidity, $\eta = \frac{Tangential.stress}{Shear.strain} = \frac{T}{\varphi} = \frac{F}{2\pi r dr} \times \frac{L}{r\theta}$ Torque = $dT = \frac{2\pi\eta\theta}{L} r^3 . dr$, Couple required = $\frac{\pi\eta\theta}{2L}(a_2^4 - a_1^4)$	2 1 5
		(ii)	Diagram description Extension strain = $l / 2L = \theta / 2$ where $\theta = l / L$ Compression strain = $\theta / 2$ Both strain are perpendicular to each other	3 3 1 1

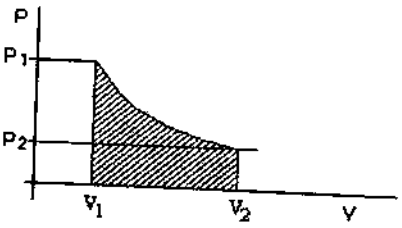
2

Q. P. Code:

	C)		**Attempt ANY ONE**	
		(i)	Mass 2kg, horizontal force of 15 N, Formula Substitution & result- the coefficient of static friction.	2 2
		(ii)	Derivation of Poisson's ratio equation for homogeneous isotropic material : $\sigma = \frac{3K-2\eta}{6K+2\eta}$; Comment on the limiting value of σ.	3 1
Q. 3	A)		**Attempt ANY ONE**	
		(i)	Ray Diagram of Ramsden eyepiece $F = 3f/4$ Position of equivalent lens = f/2 Position of first Principal point (H_1) α = f/2, Position of second Principal point (H_2) , Cardinal points ray diagram	2 2 1 3
		(ii)	When two lenses in are kept in contact with each other, $f_1/f_2 = -\omega_1/\omega_2$ When two lenses were separated by distance D, $D = \frac{\omega_1 f_2 + \omega_2 f_1}{\omega_1 + \omega_2}$ or $D = \frac{f_1 + f_2}{2}$	4 4
	B)		**Attempt ANY ONE**	
		(i)	Experimental arrangement of Newton's Rings expt Theory of Newton's rings Derivation for radius of n^{th} bright ring	2 3 3
		(ii)	For ray diagram $\frac{h_1}{F} = \frac{h_1}{f_1} + \frac{h_2}{f_2}$, $h_2 = \frac{h_1[f_1 - d]}{f_1}$, $F = \frac{f_1 f_2}{f_1 + f_2 - d}$	2 6
	C)		**Attempt ANY ONE**	
		(i)	$\frac{1}{f} = (\mu - 1)[\frac{1}{R_1} - \frac{1}{R_2}]$, $\frac{1}{f} = (\mu - 1)[\frac{1}{R}]$, R= 1m Radius of 10 th bright ring, $r_{10} = \sqrt{\frac{(2n-1)R\lambda}{2}}$ $r_{10} = 0.0559m$	1 1 2
		(ii)	$f_1 - f_2 = \frac{f_1 + f_2}{2}$, $f_1 = 3d/2$, $f_2 = d/2$, d = 80 cm $F = \frac{f_1 f_2}{f_1 + f_2 - d}$, $f_1 = 120cm$, $f_2 = 40cm$	1 1 2
Q. 4	A)		**Attempt ANY ONE**	
		(i)	Correction for finite size of the gas molecules:	4

			 $V=\frac{RT}{P}$, Volume $=\frac{4\pi}{3}r^3$ Average volume available on each molecule = V-b B = 4 times the volume of N molecules Correction due to intermolecular interactions: $dP\ \alpha\ \frac{1}{V^2}$ $dP=\frac{1}{V^2}$ $\mathbf{(P+\frac{a}{V^2})(V-b)\approx RT}$	4
		(ii)	dU = -dW For an adiabatic change, dU + PdV = 0 N C_vdT + PdV = 0 PdV = nRdT – VdP nC_pdT = VdP $\frac{Cp}{Cv}=-\frac{V}{P}\frac{dP}{dV}$ $\boldsymbol{PV^{\gamma}=K}$ $\mathbf{TV^{\gamma-1}=K}$ $\boldsymbol{T^{\gamma}P^{1-\gamma}=K}$	4 2 2
	B)		**Attempt ANY ONE**	
		(i)	 **Explanation of Boyle's temperature** is the temperature at which the second virial coefficient changes sign.	2 6
		(ii)	First law of thermodynamics dQ = dU + PdV $dQ=(\frac{\partial U}{\partial T})_V dT+(\frac{\partial U}{\partial V})_T dV+P\,dV$	

			$dQ = (\frac{\partial U}{\partial T})_V dT + [(\frac{\partial U}{\partial V})_T + P] dV$ $C_v = (\frac{\partial U}{\partial T})_V$ $dQ = C_v dT + [(\frac{\partial U}{\partial V})_T + P] dV$ $C_p - C_v = [(\frac{\partial U}{\partial V})T + p](\frac{\partial V}{\partial T})p$	4 4
	C)		**Attempt ANY ONE**	
		(i)	$V = 3.75\ cm^3/g = \frac{3.75 \times 10^{-6} \times 4g}{1g} = 15 \times 10^{-6} m^3/mol$ $b = \frac{V_c}{3} = 5 \times 10^{-6}\ m^3/mol$ $P_c = \frac{a}{27b^2} = 2.67 \times 10^5 N/m^2$ $T_c = \frac{8a}{27bR} = 1.27K$	2 2
		(ii)	$W = nRT \ln\frac{V_2}{V_1}$; $\frac{V_1}{V_2} = 2$ $W = -nRT \ln\frac{V_1}{V_2} = -8.4 \times 200 \times 0.693$ $W = -1164\ J$ Negative sign shows that the work is done on the system. $\Delta U = 0$ From first law of thermodynamics, Q = 1164J W = 1164J , Q = 1164J = 277cal	2 2
Q.5			**Attempt ANY FOUR**	
		(i)	free body diagram, $fx = \mu_k . R - mg \sin\theta = 0$ $fy = R - mg\cos\theta = 0$ solving $\tan\theta$ μ_k	2 3
		(ii)	diagram explanation	2 3
		(iii)	Ray diagram $\frac{h_1}{h_2} = \frac{f_2}{x_2}, \frac{h_1}{h_2} = \frac{x_1}{f_1}$ $x_1x_2 = f_1f_2$ $f^2 = x_1.x_2$	1 2 2
		(iv)	$\beta = \lambda/2\mu\theta$, $\theta = \lambda/2\mu\beta$ $\theta = calculations$, $\theta = 18.17\ sec\ of arc$	2 3
		(v)	Limitations of Van der Waals equation: (1 mark each) 1. The exact point where condensation begins can not be obtained from Van der Waals equation. 2. Constants a and b are different for different gases 3. Theoretically Vb= 3b but the actual value is close to 2b 4. Critical coefficient has a value 2.667 and it is independent of the nature of gases but experimentally the value of critical coefficient for various gases are greater than 3. 5. $T_B = 3.375\ T_c$ holds goodfor H_2 but is higher than this value for He and lower than this value for N_2.	5

		(vi)		1
			$P = \frac{nRT}{V}$ $W = \int_{V_1}^{V_2} PdV = nRT \int_{V_1}^{V_2} \frac{dV}{V} = nRT \ln \frac{V_2}{V_1}$	4