Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	a)	**Any two factors** **Factors affecting on elasticity:** 1) Change of temperature. 2) Effect of hammering & rolling. 3) Effect of annealing. 4) Effect of impurities. 5) Effect of recurring stress.	2	2
	b)	**Formula** **Ans with unit** Given: Change in volume = dv= 0.001 C.C. Original in volume = V= 100 C.C. At NTP, Pressure = P = 76 cm of Hg Bulk Modulus of elasticity =K =? Formula : Bulk Modulus of elasticity (K) = $\frac{Volume Stress}{Volume Strain}$ Volume Stress = $\frac{F}{A}$ = P = 76 cm of Hg Volume Strain = $\frac{dv}{V} = \frac{0.001}{100} = 0.00001$ $\therefore$ Bulk Modulus of elasticity (K) = $\frac{Volume Stress}{Volume Strain}$ $= \frac{76}{10^{-5}}$ $= 76\times10^{5}$ dyne/cm²	1 1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	c)	**Relation** **Meaning** Pressure –depth relation: $P = h\rho g$ Where: ***P*** –Pressure. g – Acceleration due to gravity. ρ - density of liquid. h – Pressure head.	1 1	2
	d)	**Formula** **Ans with unit** Given: dv = 25 m/s dx = 5 cm= 0.05 m Formula: Velocity Gradient = dv/dx = 25/0.05 = 500 per second(s^{-1})	1 1	2
	e)	**Each Definition** **Heat:** Heat is a form of energy which gives us the sensation of warmness and hotness. **Calorie:** The amount of heat required to raise (increase) the temperature of one gram of water by one degree Celsius is called calorie.	1	2
	f)	**Formula** **Ans with unit** F = 1.8 C+32. = 1.8 (35) + 32 = 63+32 = 95 **$35^0C = 95^0F$**	1 1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	g)	**Each Definition** **Numerical Aperture (N_A):** The sine of maximum acceptance angle is called as numerical aperture. **Acceptance Angle (θa):** The maximum value of external incident angle for which light will propagate in the optical fiber is called ac acceptance Angle.	1	2
	h)	**Formula** **Ans with unit** **Given:** Angle of refraction = 30^0 Refractive index (μ) = 1.5 Angle of incidence =? $\mu = \frac{\sin i}{\sin r}$ $\therefore \sin i = \sin r \times \mu$ $\sin i = \sin 30 \times 1.5$ $\sin i = 0.5 \times 1.5$ $\sin i = 0.75$ $i = \sin^{-1}(0.75)$ $\mathbf{i = 48.59^0}$	1 1	2
	i)	**Each Definition** **Wave period:** The time taken by a wave to complete one oscillation is called wave period **Wavelength:** Distance between two consecutive or successive compressions or crests is called wavelength. OR The distance travelled by the wave to complete one vibration or oscillation is called wavelength. OR It is the length of one full wave.	1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	j)	**Formula** **Ans. With unit** **Given:** Velocity = v = 300m/s Wavelength = λ =0.3 mm=0.3 X 10^{-3} m Frequency = n=? Formula: v =n λ n = v /λ n = 300/0.3 X 10^{-3} n = 1000 X 10^{3} n = 1 x 10^{6} Hz	1 1	2
	k)	**Any Two points** **Significance of Reynolds number** 1. When **R < 2000**, the flow of liquid is **streamline.** **2.** When **R > 3000**, the flow of liquid is **turbulent.** 3. When **R is in between 2000 to 3000,** the flow of liquid is **unstable.**	2	2
	l)	**Two applications** **Applications of conduction:** 1. Good conducting material is used as a heat sink in electronic circuit 2. Spiral tube covering the coil of electric heater is made up of good conductor so that, heat developed is conducted to liquid in contact quickly. 3. Use of thermos flask. 4. Condenser coil in a refrigerator is ideally made up of copper (good conductor). 5. Cooling of electrical machines by blowing hydrogen gas through machines cools machine speedily. 6. Davy's safety lamp 7. Ice box: A bad conducting material like thermocole is used in ice box. 8. Handle of cooker is made-up of bad conducting material. **(Any other relevant application)**	2	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	a)	**Each definition** **Tensile Strain**: Tensile Strain is defined as the ratio of change in length per unit original length of a body. **Volumetric Strain**: Volumetric Strain is defined as the ratio of change in volume per unit original volume of a body. **Shear Strain:** Shear strain is defined as the ratio of lateral displacement of any layer to its distance from fixed layer. **Breaking Stress:** The maximum stress at which the wire brakes is called the breaking stress.	1	4
	b)	**Formula** **Substitution** **Ans with unit** Given: l = 0.002 mm = 0.002 X 10^{-3} m L = 4 m Stress = 2000 N/ m^2 Y =? Formula: $Y = \frac{Stress}{Strain}$ $Y = \frac{Stress}{\frac{l}{L}}$ $Y = \frac{L \times Stress}{l}$ $Y = \frac{4 \times 2000}{0.002 \times 10^{-3}}$ $Y = 4 \times 10^9 \, N/m^2$	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	c)	**Statement** **Equation** **Definition** **Unit** **Newton's law of viscosity:** **Statement:** The viscous force (F) developed between two liquid layers is **i.** directly proportional to surface area of liquid layer, (A) i.e. [F α A] **ii.** directly proportional to Velocity Gradient, (dv/dx) i.e. [F α (dv/dx)] **iii.** Nature and temperature of the liquid. **F α A dv/dx** $\boxed{F = \eta A\, dv/dx}$ Where, **η is the coefficient of viscosity** of the liquid. **Coefficient of viscosity:** "Coefficient of viscosity of a liquid is the viscous force acting tangentially between two layers of a liquid having unit area of contact and unit velocity gradient normal to the direction of flow of the liquid." OR **Coefficient of viscosity:** "Coefficient of viscosity of a liquid is defined as the viscous force developed between two liquid layers of unit surface area & unit velocity gradient." **SI unit of Coefficient of viscosity is N-s/m²**	1 1 1 1	4
	d)	**Formula** **Substitution** **Ans with unit** Given: T =0.82 N/m h = 2 cm = 2 X 10^{-2} m diameter = 1 mm radius = r =0.5 mm =0.5 X 10^{-3} m ρ = 1.06 X 10^{3} Kg/m^3 θ =?	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	d)	**Formula:** $T = \frac{rh\rho g}{2\cos\theta}$ $\cos\theta = \frac{rh\rho g}{2T}$ $\cos\theta = \frac{0.5\times10^{-3}\times2\times10^{-2}\times1.06\times10^{3}\times9.8}{2\times0.82}$ $\cos\theta = 6.334\times10^{-2} = 0.0633$ $\therefore \theta = \cos^{-1}(0.0633)$ $\theta = 86.37^{0}$		
	e)	**Any four points** **Difference between isothermal process & adiabatic process**	4	4

ISOTHERMAL PROCESS	**ADIABETIC PROCESS**
volume & pressure changes at constant temperature	volume & pressure changes at changing temperature
Gas is filled in a good conductor of heat	Gas is filled in a bad conductor of heat.
Transfer of heat takes place.	There is no transfer of heat.
Volume changes are made slowly	Volume changes are made rapidly
Gas obeys Boyle's law i.e. PV= constant	Gas does not obeys Boyle's law Here PV^{Υ} = constant
Expansion of gas takes place	Compression of gas takes place
Ex. Boiling of water	Ex. Bursting of cycle tyre

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	f)	**Any four points** **The characteristics of stationary waves:** 1. The velocities of the two waves being equal and opposite, the resultant velocity are zero. So, the waveform remains stationary. 2. Nodes and antinodes are formed alternately. 3. The velocity of the particles at the nodes is zero. It increases gradually and is maximum at the antinodes 4. There is no transfer of energy. 5. Pressure is maximum at nodes and minimum at antinodes. 6. All the particles except those at the nodes, execute simple harmonic motions of same period. 7. Amplitude of each particle is not the same; it is maximum at antinodes and is zero at the nodes. 8. Distance between any two consecutive nodes or antinodes is equal to $\lambda/2$, 9. The distance between a node and its adjacent antinode is equal to $\lambda/4$. 10. Particles in the same loop vibrate in the same phase. 11. Particles in the adjacent loop vibrate in the opposite phase. OR (Any other relevant characteristics.)	4	4

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Stepwise Solution</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>3)</td><td>a)</td><td>

Diagram

Explanation
Laplace's molecular theory of surface tension

1. Consider three molecules A, B & C of the liquid. A sphere of influence is drawn as shown in fig.
2. The sphere of influence of molecule 'A' is completely inside the liquid, so it is equally attracted in all directions by the other molecules lying within its sphere. Hence the resultant force acting on it is zero.
3. The part of the sphere of influence of molecule 'B' lies outside the liquid & the major part lie inside the liquid. Therefore resultant force acting on it is directed downward.
4. For Molecule 'C' half of its sphere of influence lies inside the liquid and half lies outside the liquid. So, the maximum resultant downward force is acting on molecule 'C'

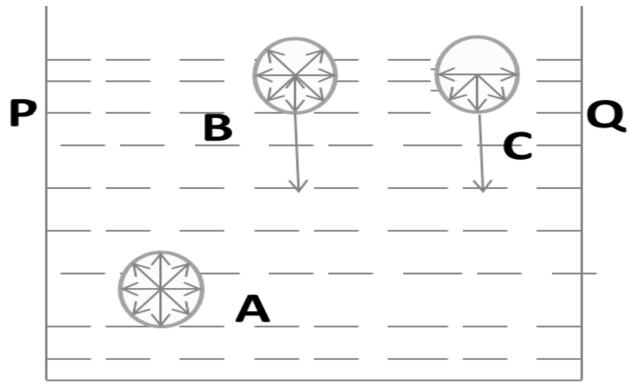

Fig: Laplace molecular theory

5. Thus molecule A experiences zero resultant force, B experience downward resultant force, C experience more downward resultant force. In short molecules below imaginary line PQ experience zero resultant force and molecules about line PQ experience some or more downward resultant force.

</td><td>1½

2½</td><td>4</td></tr>
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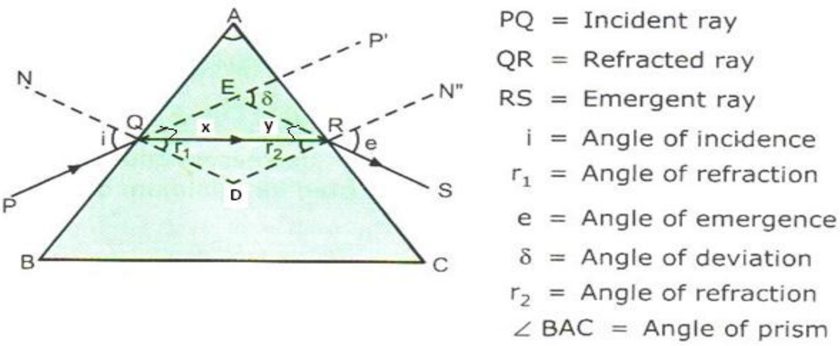
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)		6. Thus molecules which lie on the surface of liquid (surface film) experience downward resultant force and are being pulled inside the liquid. To balance this downward force, molecules come closer to each other. This reduces the surface area of liquid. 7. This gives rise to surface tension. It is the contraction force which decreases the surface area of the liquid.		
	b)	**Each law** **Definition** **Boyle's law: -** At constant temperature, volume of a given mass of a gas is inversely proportional to its pressure. **Charle's law: -** At constant pressure, volume of given mass of a gas is directly proportional to its absolute temperature. **Gay Lussac's law: -** At a constant volume, pressure of a given mass of a gas is directly proportional to its absolute temperature. **Definition Specific heat at of substance:** It is defined as the amount of heat required to increase the temperature of 1 kg mass of a substance through $1^{o}c$.	1 1	4
	c)	**Equation-1** **Equation-2** **Ans of C_p** **Ans of C_v** $\frac{C_p}{C_v} = 1.4 - - - - - - - - - 1$ $\therefore C_p = 1.4 \times C_v$ $C_p - C_v = 0.0808 - - - - - 2$	1 1 1 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	c)	**Substituting value of** C_p in equation -2 $1.4\ C_v - C_v = 0.0808$ $0.4\ C_v = 0.0808$ $\therefore C_v = \frac{0.0808}{0.4}$ $C_v = 0.202$ units $\therefore\ C_p = 0.2828$ units		
	d)	**Diagram** **Derivation** **Prism formula** **Diagram**	1 2 1	4
		 Let PQ be the incident ray obliquely incident on refracting face AB. At point Q the ray enters from air to glass therefore at Q the incident ray is refracted and travels along QR by making $\angle r_1$ as angle of refraction. At point R the ray of light enter from glass to air and get refracted along RS.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	d)	From ΔEQR $\delta = x + y$ $\delta = (i - r_1) + (e - r_2)$ $\delta = (i + e) - (r_1 + r_2) ----(1)$ From ΔQDR $\angle r_1 + \angle r_2 + \angle QDR = 180^0$ ------------------(2) As AQDR is cyclic quadrilateral $\angle A + \angle QDR = 180^0$ -----------------------------(3) By comparing eq.(2) and(3) $A = r_1 + r_2$ ------------------------------(4) Substituting above value in eq.(1) Eq.(1) becomes $\delta = (i + e) - A$ $\delta + A = (i + e)$ ---------------------------(5) If $\delta = \delta m$ $i = e$ And $r_1 = r_2 = r$ Equation (5) Becomes $A + \delta m = i + i$		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	d)	$A+\delta m=2i$ $i=\frac{A+\delta m}{2}$ And equation (4) becomes $A=r+r$ $A=2r$ $r=\frac{A}{2}$ According to Snell's law $\mu=\frac{\sin i}{\sin r}$ Substituting values of i and r in above equation $\mu=\frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$ Above formula is called as prism formula.		
	e)	**Formula** **Substitution** **Ans. With unit** Given: a = 5 cm T = 3 sec y = 4 cm v =? Formula $v=\omega\sqrt{a^2-y^2}$	1 1 2	

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)		$v = \frac{2\pi}{T}\sqrt{a^2 - y^2}$ $v = \frac{2\times 3.14}{3}\sqrt{5^2 - 4^2}$ $v = 6.28\,\text{cm/s}$		
	f)	**Each Definition** **Each Example** **Transverse Wave: -** The wave in which the direction of vibration of particles of material medium is perpendicular to the direction of propagation of wave is called transverse wave. Ex. Light wave, Electromagnetic wave, vibration produced in sitar, guitar, violin, sonometer, etc. **Longitudinal Wave: -** The wave in which the direction of vibration of particles of material medium is parallel to the direction of propagation of wave is called longitudinal wave. Ex. Sound wave, waves set in organ pipe and kundts tube, etc. **Important Instructions for Examiners** **1)** The definitions given herein are just sample definition format and not to be treated as standard format. Student may write definition in the other words. Such definitions are to be considered and give appropriate marks. 2) Wherever labeled diagrams are asked in the question, marks to be given for the neat-labeled diagram. If, in case, student has drawn only the diagram without labeling, appropriate marks to be deducted.	1 1	4