Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate. 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills). 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn. 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer. 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding. 7) For programming language papers, credit may be given to any other program based on equivalent concept.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)		**Attempt any NINE of the following:**		18
	a)	**Define compressibility. State its SI unit.** **Definition** **Unit** **Compressibility:** The reciprocal of bulk modulus of elasticity is called as compressibility. **OR** The property on account of which the body can be compressed by the application of external force is called compressibility. **S.I. Unit:- m^2/N**	1 1	2
	b)	**State any two factors affecting elasticity.** **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
	c)	**State Archimedes Principle.** **Archimedes Principle-** It states that when a solid insoluble body is immersed completely or partly in a liquid, it loses its weight and loss of weight of the body is equal to the weight of displaced liquid.	2	2
	d)	**State the effect of temperature and adulteration on viscosity of liquid.** **Each effect** **Temperature:** The viscosity of liquid is inversely proportional to the temperature of the liquid. **Adulteration:** When adulteration of soluble substance is added to the liquid its viscosity goes on increasing.	1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	e)	**Define capillarity. State two examples of capillary action.** **Definition** **Two examples** **Capillarity: -** The rise or fall of a liquid inside the capillary is called as capillarity. **Examples** (1) Oil rises up to the end of wick of lamp due to capillarity. (2) The water and minerals sucked by roots reaches upto leaves of tree or plant due to capillarity. (3) A blotting paper absorbs ink due to capillarity. (4) Rise of ink through pen nib.	 1 1	2
	f)	**State the relation between ^0C, ^0F and ^0K.** **Relation** $C = \frac{F-32}{1.8} = K - 273$	 2	2
	g)	**A 100 ml of air is measured at 20^0C. If the temperature of air is raised to 50^0C, calculate its volume as pressure remains constant.** **Formula** **Answer with unit** **Given** $V_1 = 100$ ml $V_2 = ?$ $t_1 = 20^0C$ $t_2 = 50^0C$ $T_1 = 20 + 273 = 293^0K$ $T_2 = 50 + 273 = 323^0K$ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $V_2 = \frac{V_1 \times T_2}{T_1}$ $V_2 = \frac{100 \times 323}{293}$ **$V_2 = 110.24$ ml**	 1 1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	h)	**Define specific heats of a substance. State its SI unit.**		2
		Definition	1	
		Unit	1	
		Specific heat of a substance:- Specific heat of a substance is defined as the amount of heat required to increase the temperature of unit mass of a substance by one degree.		
		SI Unit:- J/kg ^{0}K		
	i)	**A radio wave of frequency 91.1 MHz travels with speed of 3×10^8 m/s. Find its wavelength.**		2
		Formula	1	
		Answer with unit	1	
		Given		
		$v = 3 \times 10^8$ m/s		
		$n = 91.1$ MHz $= 91.1 \times 10^3$Hz		
		$v = n\lambda$		
		$\lambda = v / n = 3 \times 10^8 / 91.1 \times 10^3$		
		$\boldsymbol{\lambda = 0.0329 \times 10^5}$ **m.**		
	j)	**Define simple harmonic motion. Give its one example**.		2
		Definition	1	
		One example	1	
		Definition: It is defined as the periodic motion of a body in which the force (or acceleration) is always directed towards mean position and its magnitude is proportional to its displacement from mean position.		
		Examples : Motion of pendulum. Motion of needle sewing machine. Motion of swing. etc.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	k)	**Define Resonance. State its one example.** **Definition** **One example** **Definition:** When the frequency of the external periodic force applied to a body is exactly equal to (matches) natural frequency of body, the body vibrates with maximum amplitude, the effect is known as resonance. **Examples:** 1) Bridge may collapse in earth quake if forced frequency of earth quake becomes equal to the natural frequency of the bridge. 2) Use of musical instruments like flute, harmonium, sitar, violin, guitar. 3) Radio receiver set. **Any Relevant examples may consider.**	 1 1	2
	l)	**Define free and forced vibrations.** **Each definition** **Definition** **Free vibrations:** The vibrations performed by a body when only once disturbed from its equilibrium position and vibrates with a natural frequency are called free vibrations. **Forced vibrations**: When a body is continuously disturbed by a periodic force, then the particle cannot vibrate with its natural frequency but it starts vibrating with the frequency of periodic force. These vibrations are called forced vibrations.	 1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2		**Attempt any FOUR of the following:**		16
	a)	**A wire of diameter 4 mm and length 2 m extend by 2 mm when a force of 10 N is applied. Find Young's modulus of the wire.**		4
		Formula and substitution.	2	
		Answer with unit.	2	
		Given : Diameter(d) =4 mm= 4 x 10^{-3} m Radius(r) = d/2=2 x 10^{-3} m Original length(L) =2 m Extended length(l) = 2 mm = 2 x 10^{-3} m Force (F) = 10 N Young's modulus(Y) =?		
		Formula:- $Y = \frac{FL}{\Pi r^2 l}$ $Y = \frac{10 \times 2}{3.14 \times (2 \times 10^{-3})^2 \times 2 \times 10^{-3}}$ **Y = 0.7961 x 10^9 N/m^2**		
	b)	**Define Young's modulus, Bulk modulus and Modulus of rigidity. State relation between them.**		4
		Each Definition	1	
		Relation	1	
		Young's modulus(Y): Within elastic limit the ratio of longitudinal stress to longitudinal strain called Young's modulus. **OR** It is the ratio of tensile stress to tensile strain.		
		Bulk Modulus(K): Within elastic limit the ratio of volume stress to volume strain is called Bulk modulus. **OR** It is the ratio of volume stress to volume strain.		
		Modulus of Rigidity(η): Within elastic limit the ratio of shearing stress to shearing strain is called modulus of rigidity. **OR** It is the ratio of shearing stress to shearing strain.		
		Relation between Y , η and K:- $Y = \frac{9\eta K}{3K + \eta}$ **OR** $\frac{1}{Y} = \frac{1}{3\eta} + \frac{1}{9K}$		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2	c)	**Differentiate between streamline and turbulent flow of liquid.** **Four points**	4	4

Stream line flow	**Turbulent flow**
The path of every particle is same	The path of every particle is different
The velocity of particle is constant in magnitude and direction	The velocity of particle at each point is not constant
Flow is regular	Flow is irregular
No circular currents or eddies are developed.	Random circular currents called vertices are developed
The liquid flows steady.	The flow is speedy.
e.gThe flow of liquid through pipe, water flow of river in summer etc.	e.g flow of river in flood, water fall etc.
$V < V_c$	$V > V_c$
R < 2000	R > 3000

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
	d)	**State any four applications of surface tension of liquid.** **Four application** **Applications** 1) It is used to prepare ball bearing or bullets. 2) Use of detergent powder. 3) Rise of oil upto wick end of oil lamp. 4) Use of lubricant. 5) To check purity of water. 6) To stop breeding of mosquitoes and other insects. 7) Use for cooling water. 8) Use for drying. 9) Use of capillary action in LPT. 10) Use of Blotting paper.	4	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2	e)	**Explain Laplace's molecular theory of surface tension of liquid.**		4
		Diagram	1½	
		Explanation	2½	

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'

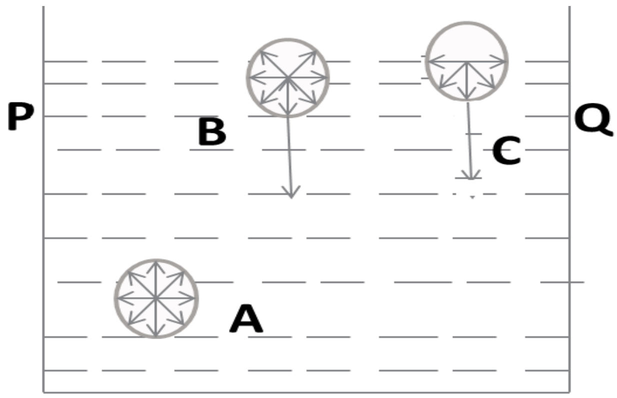
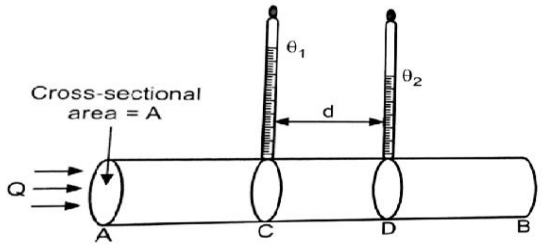


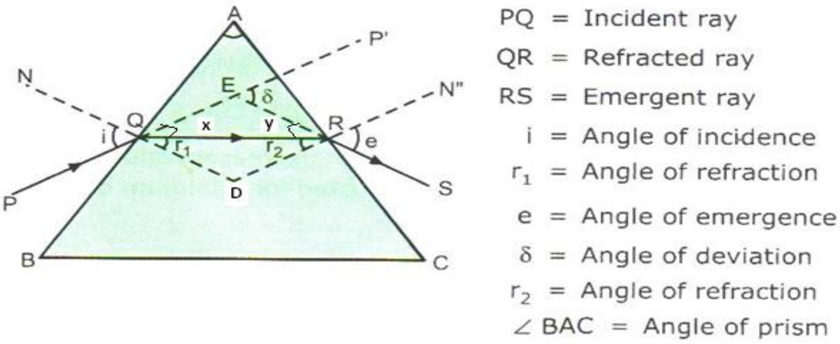
Fig: Laplace molecular theory

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

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2	e)	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.		
	f)	**State and explain law of thermal conductivity. Define coefficient of thermal conductivity.** **Statement** **Explanation** **Definition**	 1 2 1	4
		Statement : It states that the amount of heat flowing from metal rod at steady state is directly proportional to i) Cross-sectional area of rod (A) ii)Temperature difference between two surfaces of the conductor(θ_1- θ_2) iii) Time for which heat flows. (t) and inversely proportional to iv)Distance between two surfaces.(d) $Q \propto A$ $Q \propto (\theta_1 - \theta_2)$ $Q \propto t$ $Q \propto 1/d$ $Q \propto \frac{A(\theta_1 - \theta_2)t}{d}$ $Q = \frac{K \times A(\theta_1 - \theta_2) \times t}{d}$ $K = \frac{Q \times d}{A \times (\theta_1 - \theta_2) \times t}$ Where K = Coefficient of thermal conductivity.  **Definition :** It is defined as the amount of heat conducted in one second, in steady state of temperature through unit cross-sectional area of an element of material of unit thickness with unit temperature difference between its opposite faces.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3		**Attempt any FOUR of the following:**		16
	a)	**A plate of nickel 4 mm thick has a temperature difference of 32 ^{0}C between its faces. It transmits 200 Kcal per hour through an area of 5 cm^2. Calculate the coefficient of thermal conductivity.**		4
		Formula and substitution.	2	
		Answer with unit.	2	
		Given: $d = 4\text{ mm} = 4 \times 10^{-3}\text{ m}$ $(\theta_1 - \theta_2) = 32\ ^0C$ $Q = 200\text{ Kcal}$ $A = 5\text{ cm}^2 = 5 \times 10^{-4}\text{ m}^2$ $t = 1\text{ hour} = 60 \times 60 = 3600\text{ sec}$ $K = ?$		
		We have, $Q = \frac{K \times A(\theta_1 - \theta_2) \times t}{d}$ $K = \frac{Q \times d}{A(\theta_1 - \theta_2)t}$ $K = \frac{200 \times (4 \times 10^{-3})}{(5 \times 10^{-4}) \times 32 \times (3600)}$ **$K = 0.0139$ kcal/m ^{0}C sec**		
	b)	**Differentiate between isothermal process and adiabatic process.**		4
		Any four points	4	

Isothermal process	Adiabatic process
Gas volume is changed by keeping temperature constant	Gas volume and also its temperature changes
For this, changes in volume are made very slowly	For this, changes in volume are made very quick
Exchange of heat between system and surrounding takes place	Exchange of heat between system and surrounding does not takes place
For carrying out this process, a perfect gas is taken in a cylinder having conducting walls	For carrying out this process, a perfect gas is taken in a cylinder having insulating walls
Boyle's law is valid	Boyle's law is not valid
Expansion of gas takes place	Compression of gas takes place
There is no change in internal energy	There is change in internal energy
e.g. Melting of solid and boiling of water	e.g. Bursting of cycle rubber tube

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3	c)	**Derive prism formula.** **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. 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 $\delta = (i + e) - A$		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3	c)	$\delta + A = (i+e)$ ---------------------------(5) If $\delta = \delta m$ $i = e$ And $r_1 = r_2 = r$ Equation (5) Becomes $A + \delta m = i + i$ $A + \delta m = 2i$ $i = \frac{A + \delta m}{2}$ 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.		4
	d)	**i) Define numerical aperture and acceptance angle.** **ii) Find angle of incidence if angle of refraction is 30^0 for a glass having refractive index 1.55.** **Two definition** **Formula** **Answer with unit** **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.	 2 1 1	

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3	d)	**Given:** Angle of refraction = 30^0 Refractive index (μ) = 1.55 Angle of incidence =? $\mu = \frac{\sin i}{\sin r}$ $\therefore \sin i = \sin r \times \mu$ $\sin i = \sin 30 \times 1.55$ $\sin i = 0.5 \times 1.55$ $\sin i = 0.775$ $i = \sin^{-1}(0.775)$ $\mathbf{i = 50.80^0}$		
	e)	**Define transverse waves and longitudinal wave with example.** **Two definition** **One example each** **Transverse waves:** The wave in which direction of vibration of particles of material medium is perpendicular to the direction of propagation of wave is called transverse wave. **Example:** Light wave, electromagnetic waves etc. **Longitudinal wave:** The wave in which direction of vibration of particles of material medium is parallel to the direction of propagation of wave is called longitudinal wave. **Example:** Sound waves, Waves produced in organ pipe etc.	 2 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3	f)	**State any four characteristics of stationary waves.** **Any four characteristics** **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. **(Any other relevant characteristics.)**	4	4