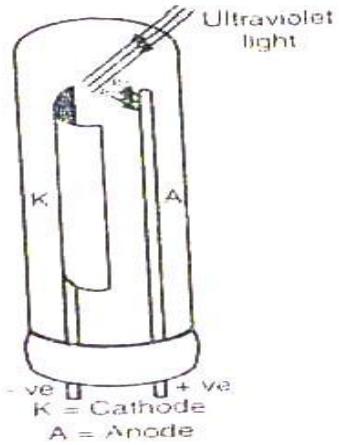
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess 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 judgement 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)		Answer any **ten** of the following:		20
	1)	Classify the following quantities as fundamental and derived quantities length, force, temperature, acceleration.		
		Fundamental quantity: - Length, Temperature.	1	
		Derived quantity:-Force, Acceleration.	1	2
	2)	State Hooke's law of elasticity. Define elastic body.		
		Hooke's law	1	
		Definition	1	2
		Hooke's law:- Within the elastic limit stress is directly proportional to strain.		
		Elastic body:- If the body regain its original shape and size when the external deforming force is removed then it is called as elastic body.		
	3)	Define cohesive and adhesive force.		
		Each definition	1	2
		Cohesive Force It is the force of attraction between two molecules of same substance.		
		Adhesive Force It is the force of attraction between two molecules of different substance.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	4)	Give significance of Reynold's number in flow of liquids. **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
	5)	Why the thermas flask consists of double walled glass vessel with vacuum between walls? **Reason** 1) We know that, the material which does not allow the passage of heat from it is called as Bad Conductor. 2) Since, glass is a bad conductor of heat, the vacuum between the walls acts as an insulator. Therefore, the thermos flask consists of doubled walled glass vessel with vacuum between walls.	2	2
	6)	Define steady state and variable state of temperature. **Each definition** **Steady State of temperature:** It is state at which all amount of heat energy absorbed by materials becomes equal to amount of heat energy given out. OR The state in which temperature of rod remains constant and will not increase further is called as steady state.	1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	6)	**Variable state of temperature: -** It is state at which all amount of heat energy absorbed by material is more than amount of heat energy given out. OR The state in which temperature of rod goes on increasing is called as variable state.		
	7)	State Snell's law with its mathematical equation. **Law** **Equation** **Snell's law**:- For any two media the ratio of sine angle of incidence to the sine angle of refraction is constant. This is known as Snell's law. **Equation**:- $\frac{\sin i}{\sin r} = \text{Constant}$	1 1	2
	8)	State any two properties of LASER **Any two properties** **Properties** i) **The light is coherent:** The light with waves, all exactly in same phase. ii) **The light is monochromatic:** The light whose waves all have the same frequency or wavelength. iii) **The light is unidirectional:** The light produces sharp focus. iv) **The beam is extremely intense:** The light has extreme brightness.	2	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	9)	Define amplitude and period of wave. **Each Definition** **Amplitude:-** The maximum displacement of the particle from its mean position on either side is called amplitude of the wave. **Period:** The time taken by a particle to complete one oscillation is called wave period.	1	2
	10)	Draw labeled diagram for photo-electric cell. **Well labeled diagram.**  	2	2
	11)	State any two applications of X-rays. **Any two** 1) X- rays are used to detect the cracks in the body of aero plane or motor car. 2) X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control. 3) X – rays are used to detect flows or cracks in metal jobs.	2	2

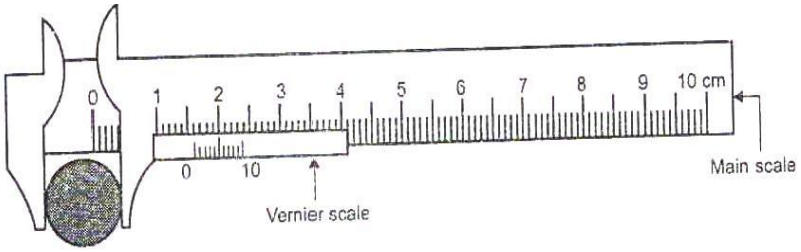
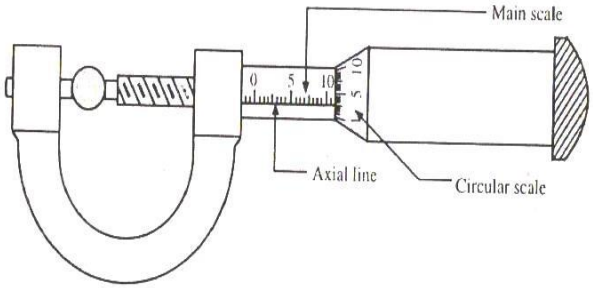
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	11)	4) X- rays are used to distinguish real diamond from duplicate one. 5) X- rays are used to detect smuggling gold at airport and docks (ship) yard. 6) X-rays are used to detect cracks in the wall. 7) X- ray radiography is used to check the quality of welded joints. 8) X – Rays are used in surgery to detect bone fractured. 9) X- Rays are used to cure skin diseases and destroy tumours. 10) X – Rays are used to cure diseases like cancer. 11) X – Rays are used to detect bullets position inside the body. 12) X – Rays are used to study structure of crystals. 13) X- Rays are used in chemical analysis and to determine atomic number of elements. 14) X – Rays are used to study structure of substances like cellulose, rubber, plastic.		
	12)	Soldier's are ordered not to march with regular steps while crossing the bridge'. Give reason. **Reason:** If the forced frequency of the regular steps of soldier's and the natural frequency of vibration of the bridge matches then resonance will take place. Therefore the bridge will vibrate with maximum amplitude and it may collapse.	2	2

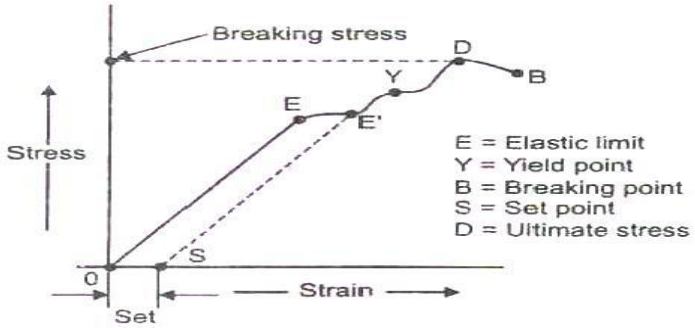
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)		Attempt any **four** of the following.		16
	1)	Define error. Explain three types of error.		
		Definition	1	
		Each type with explanation	1	4
		Error : Error is fault which can occur even with most carefully observed measurement. It cannot be completely eliminated but can be minimized **Explanation:** **Instrumental Error or constant error:** This error is caused due to use of faulty instruments For eg.(1)- use of voltmeter having zero error will introduce error in the measurement whenever this voltmeter is used. Eg.(2)-If the zero of vernier scale or main scale is not calibrated properly some error will introduced in measurement. This will produce a constant error in measurement. **(Note: Consider only one example)** **Systematic error:** This error is caused due to defective setting or adjustment by user. It is also caused due to sense of vision, sense of hearing. **Random Error:** This error is caused due to change in experimental condition which are out of control such error cannot be eliminated. For eg. Measurement which are temperature dependent.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	2)	The mass of object is 37.6±0.02gm. Estimate the percentage error in this measurement. **Formula** **Proper Substitution & Calculation** **Answer with unit** Percentage Error = $\frac{\text{Average absolute error}}{\text{Average reading}} \times 100$ **OR** Percentage Error = $\frac{\delta A_m}{A_m} \times 100$ Percentage Error = $\frac{0.02}{37.6} \times 100$ = 0.053%	1 2 1	4
	3)	Define – Stress, strain, restoring force and deforming force. **Each definition** **Stress:**- It is defined as internal restoring force per unit cross-sectional area of a body. **Strain:**- The change in dimensions per unit original dimension is called strain. OR It is the ratio of change in dimensions to original dimension of a body.	1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	3)	**Deforming Force:** It is an external force which changes the shape and size of the body after its applications. **Restoring Force:** The force which is developed in a body in ordered to regain its original size and shape is called restoring force.		
	4)	A weight exerts a force of 120 N on steel wire of diameter 0.4mm. Find extension produced in wire, if original length of wire was 5 m. (Given Y=2 x 10^{12} N/m^2) **Formula** **Proper Substitution** **Answer with unit** **Given:** Force = F = 120 N Diameter = D = 0.4 mm Radius = r = 0.2 mm = 0.2 $\times 10^{-3}$ m. Length = L = 5 m. Y = 2×10^{12} N/m^2 l=? $Y = \frac{FL}{\pi r^2 l}$ $l = \frac{FL}{\pi r^2 Y}$ $l = \frac{120\times5}{3.14\left(0.2\times10^{-3}\right)^2 2\times10^{12}}$ $l = 23.88\times10^{-4}\,\text{m}$ $l = 2.39\times10^{-3}\,\text{m}$	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	5)	Define Young's modulus, Bulk modulus, modulus of rigidity and state relation between them.		
		Each Definition	1	
		Relation	1	4
		Young's modulus:		
		Within elastic limit the ratio of longitudinal stress to longitudinal strain is called Young's modulus. **OR**		
		It is the ratio of tensile stress to tensile strain.		
		Bulk Modulus:		
		Within elastic limit the ratio of volume stress/ bulk stress to volume strain/ bulk strain is called Bulk modulus. **OR**		
		It is the ratio of volume stress to volume strain		
		Modulus of Rigidity:		
		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.		
		$$\frac{9}{Y}=\frac{3}{\eta}+\frac{1}{K}$$		
		OR		
		$$Y=\frac{9K\eta}{3K+\eta}$$		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	6)	Draw labeled diagram of vernier caliper and micrometer screw-gauge. **Each neat labeled diagram** **Vernier Caliper:**  **Micrometer screw-gauge:**  	2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)		Attempt **any four** of the following:		16
	1)	Explain behavior of wire under continuously increasing load by using stress-strain diagram.		
		Neat labeled diagram	2	
		Explanation	2	4
				
		A graph or diagram of stress and strain is shown as above. **OE** Portion is straight line which indicates that stress is proportional to strain. Therefore the wire obeys Hooke's law upto the point E this point is called elastic limit. **EE'** Portion is curved towards strain axis this shows that increase in strain is more, than increase in stress. In this region stress is not proportional to strain. Between any point E and E' if all load is removed then some permanent elonganation/ Expansion / increase in length takes place in the wire this is called set. When wire is again loaded, a new straight line SE' is obtained which obey Hooke's law. Some portion after the point Y is almost parallel to strain axis this shows that strain increases without increase in stress just like wire flows. This is called plastic flow. The point at which the plastic flow begins is called yield point.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	1)	During the plastic flow the wire becomes thin and thin. Some weak points called neck are formed in the wire. At weakest point (neck), wire breaks. The maximum stress upto which wire can be loaded or wire can bear is called breaking stress. Point B is breaking point. Before point B the point D is ultimate stress point. It is the max. stress the wire is capable of with standing.		
	2)	Define surface tension and state the relation between surface tension, capillary rise, radius of capillary tube with meaning of symbol used in it. **Definition** **Relation** **Meaning** **Definition:-** It is defined as the property of liquids by virtue of which the surface of liquid is under constant tension due to the tendency to contract and occupy minimum surface area. OR It is also defined as the force of contraction per unit length in the free surface of liquid. **Relation:-** $T=rhdg/2\cos\theta$ Where, r = radius of capillary tube. h = level difference or rise of liquid. d = density of liquid. g = gravitational acceleration. θ= angle of contact.	1 2 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	3)	State Newton's law of viscosity and hence define coefficient of viscosity. Give it's SI unit. **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)] **F α A dv/dx** **F = η A dv/dx** Where, **η is the coefficient of viscosity** of the liquid. **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/m^2**	1 1 1 1	4

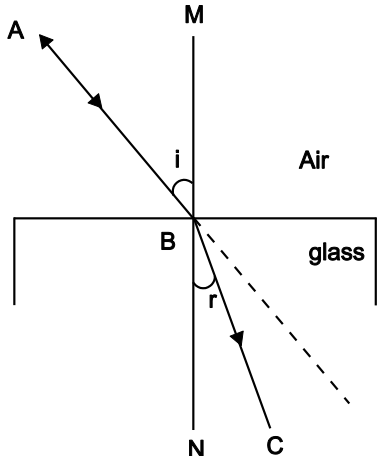
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	4)	Define coefficient of linear expansion and aerial expansion of solid. State the relation between them. **Each definition** **Relation** **Coefficient of linear expansion(α)**: - It is increase/change in length per unit original length at 0^0C, per unit increase/change in temperature. **Coefficient of aerial expansion(β) :-** It is increase/change in area per unit original area at 0^0C, per unit increase/change in temperature. **Relation** $\alpha : \beta = 1:2$ *OR* $\frac{\alpha}{1} = \frac{\beta}{2}$ *OR* $\beta = 2\alpha$	 1 2	4
	5)	A glass sheet of area 1 m^2 has thickness 2 mm. its opposite faces are at 35^0C and 20^0C resp. if coefficient of thermal conductivity of glass is 0.2 x10^{-3}K cal/m^oCs calculate the quantity of heat conducted in half an hour. **Formula** **Proper Substitution** **Answer with unit**	 1 1 2	4

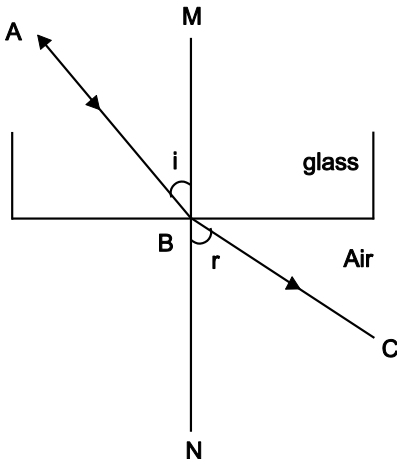
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	5)	**Given:** $A = 1m^2$ $d = 2\ mm = 2 \times 10^{-3} m$ $(\theta_1 - \theta_2) = (35-20) = 15^0 C$ $K = 0.2 \times 10^{-3} Kcal/m^oCs$ $t = ½\ hr = 30 \times 60 = 1800\ sec.$ $Q = ?$ $Q = \frac{KA(\theta_1 - \theta_2)t}{d}$ $Q = \frac{0.2\times10^{-3}\times1\times15\times1800}{2\times10^{-3}}$ $Q = 2700\,K\ cal$		
	6)	Define three modes of transmission of heat with examples. Define the term temperature gradient. **Each Definition with Example** **Conduction:** It is the process of transfer of heat from a part of body at higher temperature to a part of body at lower temperature without actual movement of particles of medium. Heat sink in electronic circuits, Safety lamp, Ice box etc. **Convection :** It is the process of transfer of heat from a part of body at higher temperature to a part of body at lower temperature with actual movement of particles of medium. Formation of trade winds, Room ventilation system, monsoons etc.	1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	6)	**Radiation :** In this process, heat is transferred directly from a body at higher temperature to the body at lower temperature without necessity of intervening medium. Use of white clothes, Heat radiators in car, In activation of HIV etc. **Temperature Gradient:** The temperature gradient is defined as change in temperature per unit length of rod.		
4)		Attempt **any four** of the following:		16
	1)	State Boyle's law, Charle's law and Gay Lussac's law for gases. Define the term absolute zero temperature.		
		Each Law	1	
		Definition	1	
				4
		Boyle's law: - For fixed mass of a gas, temperature of a gas remaining constant, its pressure is inversely proportional to its volume.		
		Charle's Law: For fixed mass of a gas, pressure of a gas remaining constant, its volume is directly proportional to its absolute temperature.		
		Gay Lussac's Law: - For fixed mass of a gas, volume of a gas remaining constant, its pressure is directly proportional to its absolute temperature.		

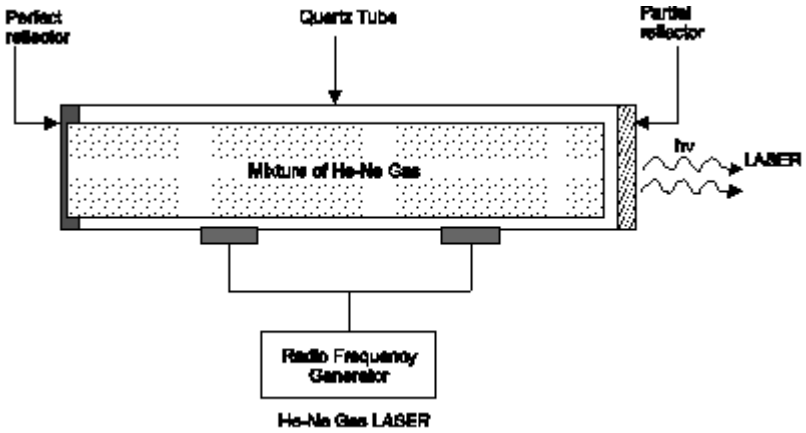
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
4)	1)	**Absolute Zero Temperature**: - The temperature at which both pressure and volume of gas become theoretically zero is called absolute zero temperature.		
	2)	A gas at 13^o C is heated at constant pressure till its volume doubled. What is its final temperature?		
		Formula	1	
		Proper Substitution	1	
		Answer with unit	2	4
		Given		
		Initial **Final**		
		$t_1 = 13^o$ C t_2 =?		
		$T_1 = 13 + 273 = 286^0$K T_2 =?		
		V_1=initial volume $V_2=2V_1$		
		Solution :		
		$\frac{V_1}{V_2} = \frac{T_1}{T_2}$		
		$\frac{V_1}{2V_1} = \frac{T_1}{T_2}$		
		$T_2 = 2T_1$		
		$T_2 = 2 \times 286$		
		$T_2 = 572\ ^0$K		
		$t_2 = 572 - 273$		
		$t_2 = 299\ ^0$C		

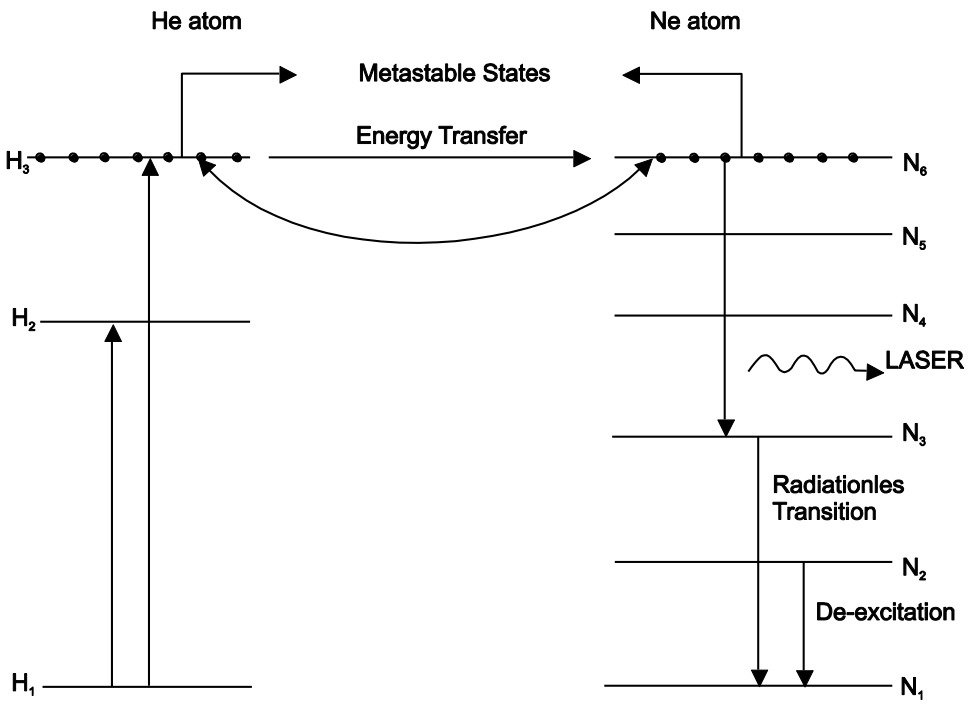
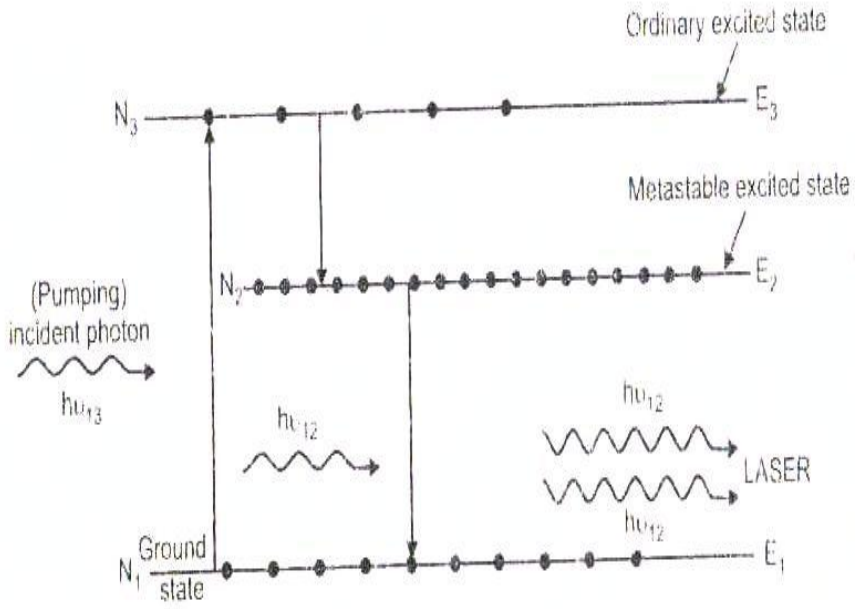
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
4)	3)	State the factors on which the conduction of heat in steady state depends. Write an equation of heat conducted by rod. State SI unit of coefficient of thermal conductivity.		
		Factors	2	
		Equation	1	
		SI unit	1	4
		Factors affecting the conduction of heat: 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) iv) Distance between two surfaces.(d)		
		Equation $\boxed{Q = \frac{KA(\theta_1 - \theta_2)t}{d}}$ **SI unit** : watt/m^0 K		
	4)	A length of copper rod at 0^0C is 80 cm. When heated upto 100^0C, it increases by 0.16 cm. Find the coefficient of linear expansion.		
		Formula	1	
		Proper Substitution	1	
		Answer with unit	2	4

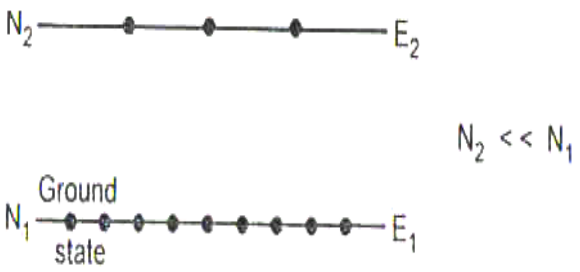
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
4)	4)	**Given** $L_0 = 80$ cm at 0^0C $(L_t - L_0) = 0.16$ cm $L_t = 80.16$ cm at $t = 100^0$C α=? $\alpha = \frac{(L_t - L_o)}{L_o \times t}$ $\alpha = \frac{0.16}{80 \times 100}$ $\alpha = 0.02 \times 10^{-3}$ $\alpha = 2 \times 10^{-5} /^0$C		
	5)	State the physical significance of refractive index. **Each physical significance of refractive index** **Physical Significance of Refractive Index:** (i) When a ray of light travels from rarer (air) medium to denser (glass) medium the ray bends towards the normal as shown in fig. ∴ Angle of incidence > angle of refraction.  $\therefore \frac{\sin i}{\sin r} > 1$ $\therefore \mu > 1$	2	4

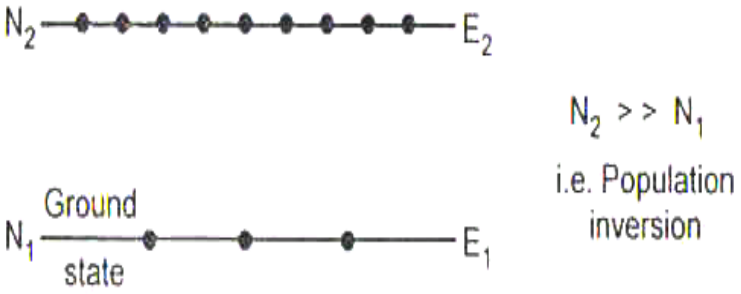
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
4)	5)	For air - glass pair $\frac{\sin i}{\sin r} = a^{\mu}g > 1$ Also $a^{\mu}g = \frac{\text{Velocity of Light in air}}{\text{Velocity of Light in Glass}}$ e.g. Refractive index of glass with respect to air is 1.5. (ii) When a ray of light travels from denser medium (glass) to rarer medium (air) , ray of light bends away from the normal as shown in fig. ∴ **Angle of incidence < Angle of refraction**  ∴ $\frac{\sin i}{\sin r} < 1$ ∴ $\mu < 1$ For glass - air pair $\frac{\sin i}{\sin r} = g^{\mu}a < 1$ Also $g^{\mu}a = \frac{\text{Velocity of Light in Glass}}{\text{Velocity of Light in Air}}$ e.g. Refractive index of air with respect to glass is nearly equal to one.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
4)	6)	Define- refraction, dispersion, diffraction and polarization of light. **Each Definition** **Refraction of Light:** When a ray of light travels from one medium to another medium it deviates from its original path is called refraction of light. **Dispersion:** The separation of light into its constituent colours is called dispersion of light. **Diffraction of Light:** When light falls on obstacles or small apertures whose size is comparable with wavelength of light, then the light bends round the corners of the obstacles or apertures and enters in geometrical shadow. This bending of light is called diffraction. **Polarization of Light:** The restriction of the vibrations of light wave to a single plane is called polarization.	1	4
5)	1)	Attempt **any four** of the following: Describe construction and working of He-Ne LASER with labeled diagram. **Each diagram** **construction** **working** **Construction :** 1. It consists of a quartz tube of about 80 cm length and 1.5 cm diameter. 2. The tube is filled with mixture of helium (He) and neon (Ne) gas. 3. The mixture consists of 90% helium atoms and 10% neon atoms. 4. At one end perfect reflector is fixed and at the other end partial reflector is fixed.	1 1 1	16 4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	1)	5. The material is excited by using high frequency generator.  **Working :** (1)When electric discharge is produced in the tube, He and Ne gas atoms are excited. Some excited levels of helium are close to some excited levels of neon. Therefore these excited helium atoms collide with excited atoms of neon and transfer the energy to neon atoms. (2) The actual lasing action is done by neon atoms. The neon atoms with extra energy from helium atom are forced to jump in ground state by emitting a photon. This produces the LASER light. The newly emitted photon triggers the next neon atom and increases the radiations. (3) Thus coherent, monochromatic, unidirectional LASER is produced by He-Ne gas LASER The energy level diagram of He-Ne LASER is shown below.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	1)			
	2)	Describe the terms – optical pumping and population inversion. **Optical pumping** **Population inversion** 	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	2)	Let E_1, E_2 and E_3 are energy levels and N_1, N_2 and N_3 are respective concentrations of atoms. The atoms in level E_1 are excited to E_3 by optical pumping. The concentration N_1 decreases. The time for which the atoms can stay in level E_3 is very short. They lose some energy and return to energy level E_2. The transition from E_3 to E_2 is rapid and spontaneous. Since level E_2 is metastable state, hence atoms relax here for longer time. The no. of atoms in E_2 increases and when it is greater than level E_1 population inversion takes places. i.e. $N_2 >> N_1$ **Population Inversion:** Population means number of active atoms occupying an energy state. Usually population of ground state is high & that of excited state is low as shown in figure below.  In order to produce stimulated emission properly, population of excited state should be greater than that of ground state. Making population of excited state more than that of ground state is called population inversion.i.e. $N_2 >> N_1$		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	2)			
	3)	Distinguish between longitudinal wave and transverse wave. **Any four points**	4	4

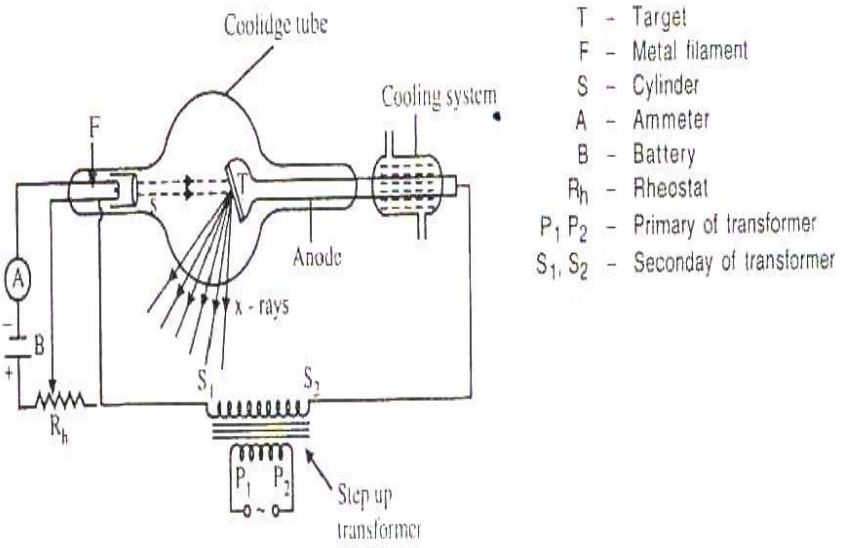
Transverse Wave	Longitudinal Waves
The wave in which direction of vibration of particles of material medium is perpendicular to the direction of propagation of wave is called transverse wave.	The wave in which direction of vibration of particles of material medium is parallel to the direction of propagation of wave is called longitudinal wave.
Wave travels in form of alternate crests and trough	Wave travels in form of alternate compressions and rarefactions.
Density and pressure of medium remain same throughout the wave	Density and pressure of medium changes.
Wave travels through solid only.	Wave travels through liquids and gases.
e.q. Light wave	e.q. Sound waves

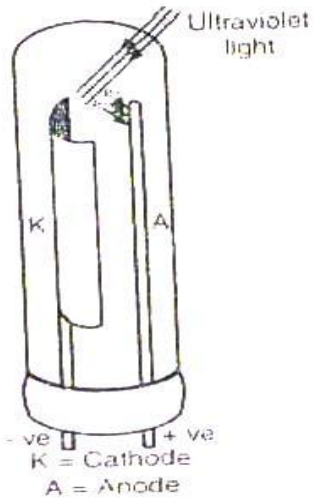
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	4)	Define forced vibration and free vibration with one example each. **Each Definition** **One example of each Definition** **Free vibrations:** The vibrations performed by a body when only once disturbed from its equilibrium position and vibrates with a natural frequency are called free vibrations. **Example:** 1. Cricketers hanging ball 2. Vibrating tuning fork 3. Vibrations of air column **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. **Example:** 1. Concrete bridge in earth quake 2. Vibrations of air column under vibrating tuning fork 3. Kid swimming after applied external periodic force. **Any other relevant definition or example may be considered.**	1 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	5)	State any four engineering applications of LASER. **Each Application** 1) He-Ne gas laser is commonly used to read bar code. 2) They are used in cutting, drilling, welding. 3) It can drill holes in the hard substances like diamond without crack. 4) It is used for marking, engraving in plastic and metals. 5) They are used in communication between earth and moon. **Any other relevant application.**	1	4
	6) a)	State relation between velocity, wavelength and frequency. **Relation** $v = n \lambda$ Where v = Velocity n = Frequency λ = Wavelength	2	
	b)	A body produce wave of wave length 33 cm. What is the frequency of vibration if velocity of wave is 330 m/s? **Formula and substitution** **Ans. With unit** **Given** λ = 33 cm = 0.33 m v=330 m/s n = ?	1 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
5)	6 b)	$v = n \lambda$ $n = v/ \lambda$ $n = 330/0.33$ $n = 1000$ Hz.		
6)		Attempt **any four** of the following:		16
	1)	Define the terms – Work function, threshold frequency, threshold wavelength and photoelectric effect. Each definition **Work function:** It is the energy required to detach the electron from the metal. **Threshold frequency:** It is the minimum frequency of incident light at which emission just begins. **Threshold wavelength:** It is the maximum wavelength of incident light at which emission just begins. **photoelectric effect:** When light of suitable frequency is incident on metal surface, electrons are emitted from it. This effect is called as photoelectric effect.	1	4
	2)	Calculate the K.E. of ejected photoelectrons, if light of frequency 1.39×10^{15} Hz is made to incident on metal plate of threshold frequency 1.12×10^{15} Hz. (Given $h = 6.63 \times 10^{-34}$ Js) **Formula** **Proper Substitution** **Answer with unit**	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
6)	2)	**Given** $\upsilon = 1.39 \times 10^{15}$ Hz $\upsilon_0 = 1.12 \times 10^{15}$ Hz $h = 6.63 \times 10^{-34}$ Js K.E. = ? $K.E. = h(\upsilon - \upsilon_0)$ $K.E. = 6.63 \times 10^{-34}(1.39 \times 10^{15} - 1.12 \times 10^{15})$ $K.E. = 1.79 \times 10^{-19}$ J		
	3)	State any four properties of X-rays. **Each property** 1) X-rays are highly penetrating electromagnetic radiations of very short wavelength. (2) X-rays are electrically neutral. (3) X-rays travel with the speed of light. (4) X-rays affects the photographic plate. (5) X-rays are not deflected by electric or magnetic field. (6) X-rays are invisible. (7) They can ionize gases. (8) They cannot be reflected by ordinary mirrors, lenses or by prism. They can be reflected, refracted, detracted by crystals under certain conditions. (9) They show interference and polarization like light. (10) They produce fluorescence effect. (11) X-ray kill some animal cells..	1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
6)	4)	With labeled diagram, explain production of X-rays using Coolidge tube. **Well labeled diagram** **Working**  **Working Or Production of X-rays** When the cathode is heated by electric current it produced electron due to thermionic emissions. The beam of electron is then focused on the anode (target) the electrons from cathode are accelerated by applying of high voltage between cathode & anode using step up transformer. When these fast moving electrons are suddenly stopped by tungsten anode, they loses their kinetic energy and x rays are produced from the target. Some amount of Kinetic energy is converted to large amount of heat. By controlling the filament current, the thermionic emission of electron hence intensity of X- rays can be controlled.	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
6)	5)	Describe construction and working of photoelectric cell. **Diagram** **construction** **working** **Diagram**  **Construction:** It consists of cathode (K) & anode (A) enclosed in an evacuated glass bulb. Semi-cylindrical cathode coated with photosensitive material from inner side. Anode is a rod of platinum kept along the axis of cathode. Cathode is connected to the negative terminal & anode is connected to the positive terminal of high tension battery through milliammeter.	1 1 ½ 1 ½	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
6)	5)	**Working:** When light is allowed to fall on cathode it emits photoelectrons. These photoelectrons are attracted by anode. The photoelectric current flows through the circuit & milliammeter shows the deflection.		
	6)	What are X-rays? A X-ray tube works on 50 kV. What will be the minimum wavelength of X-rays emitted in it. **X-ray meaning** **Formula** **Ans. with unit.** X-rays are electromagnetic radiation of very short wavelength. **Given** $V = 50\ kV = 50 \times 10^3 V$ $\lambda_{min} = ?$ **Formula** $\lambda_{min} = \frac{hc}{eV} = \frac{12400}{V}$ $\lambda_{min} = \frac{12400}{50 \times 10^3}$ $\lambda_{min} = 0.248\ A^0$	1 1 2	4