SUMMER – 2014 EXAMINATION

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.		

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1)		**Attempt Any Nine**		**18**
	a)	**State elastic body and plastic body.**		2
		Each definition or one example of each	1	
		Elastic body: The body which regains its original shape and size on removal of external deforming force is called elastic body. e.g. All metals – steel, brass, rubber ,copper etc.		
		Plastic body: The body which does not regains its original shape and size on removal of external deforming force and easily get deformed is called plastic body. e.g. clay ,putty ,mud , chalk etc.		
	b)	**A material wire elongates by 1% of its original length when loaded. Calculate tensile strain for the wire.**		2
		Formula	1	
		Answer with unit	1	
		Given: Let length of wire = Original length of the wire= L =1 m Change in length of the wire = e = 1/100 = 0.01 m Required: Tensile strain=? Tensile strain = Change in length/ Original length Tensile strain = e / L Tensile strain= 0.01/1 **Tensile strain= 0.01**		

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1)	c)	**A water tank of 10 m height is filled half. Calculate pressure at the bottom.(Take : Density of water = 10^3 kg /m^3, g = 10 m/s^2)**		2
		Formula	1	
		Answer with unit	1	
		Given: h = 10/2 = 5 m $\rho = 10^3$ kg /m^3 g = 10 m/s^2 $P = h \rho g$ $P = 5 \times 10^3 \times 10$ P = 50000 Pa OR P = 50000 N/m^2		
	d)	**State unit of velocity gradient in viscosity.** **unit**	2	2
		Unit = per second = 1/ sec		
	e)	**What is Absolute scale of temperature?**		2
		Definition	2	
		Absolute scale of temperature: It is the scale of temperature in which the lower fixed point is 273^0 K and upper fixed point is 373^0 K and it is then divided into 100 equal parts , each part is degree Kelvin or degree absolute .		

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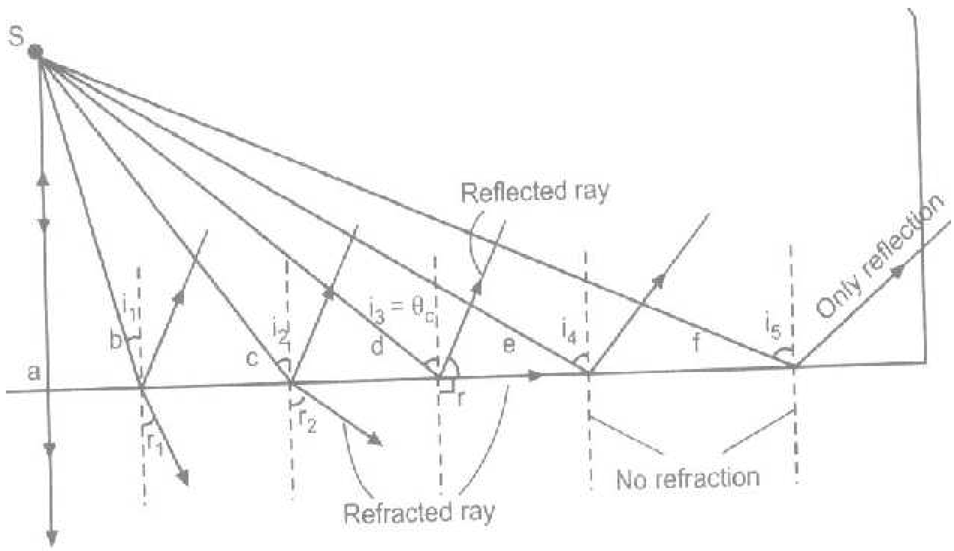
1)	f)	**Give one example each of Convection and Radiation process in nature.** **Each example** **i) Convection** Formation of trade winds, Room ventilation system, monsoons etc. **ii) Radiation** Use of white clothes, Heat radiators in car, In activation of HIV etc. **Relevant examples may consider.**	1	2
	g)	**Draw neat labeled diagram showing TIR of light.** **Labeled diagram** 	2	2

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1)	h)	**A ray enter water medium making an angle of 60^0 with the water surface .If it suffers deviation of 15^0 in water. Calculate refractive index of water.**		2
		Formula	1	
		Answer with unit	1	
		Solution:		
		Given: $i = 30^0$ $r = 15^0$		
		Required: μ = ?		
		μ = sin i / sin r		
		μ = sin 30 / sin 15		
		μ = 1.93		
	i)	**Define longitudinal wave. Give one example.**		2
		Definition	1	
		Example	1	
		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 wave		
		Relevant examples may consider		
	j)	**Wavelength of light emitted by a source is 5800 A.U. Find the frequency if c velocity of light is 3x 10^8 m/s.**		2
		Formula	1	
		Answer with unit	1	

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1)		Solution: Given: λ = 5800 A.U. = 5800 X 10^{10} m c = 3 x10^{8} m/s n = ? c = n λ n = c / λ n = 3 x10^{8} / 5800 X 10^{10} n = 5.17 x 10^{14} Hz		
	k)	**Write formula for critical velocity for a flow of fluid through a pipe.** **Formula** $V_c = \eta R / \rho r$	2	2
	l)	**State use of bad conductor in heat transfer.** **Any one use** **Uses :** • Ice box: use of thermocole to prevent melting if ice. • Handle of pressure cooker: Plastic material is used to prevent it getting heated so that we can handle it easily. • Refrigerators: Plastic pipeline insulation between expansion valve outlet and evaporator to avoid thermal loss. • Thermos flask: To maintain the constant temperature of the flask content it is double walled with air gap between them.	2	2

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2)		**Attempt any four of the following**		16
	a)	**Define three modulii of elasticity. Y, K and η.** **Young's modulus(Y):** Within elastic limit the ratio of longitudinal stress to longitudinal strains 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.	4	
	b)	**Calculate Young's modulus of elasticity for material wire 2m long, 0.4 mm diameter, if weight applied is 100 N which elongates the wire by 0.001 mm.** **Conversion and Formula** **Answer with Units** **Given,** Y = ? L = 2 m Dia.= 0.4 mm = 0.4 x 10^{-3} m. Radius = 0.2 x 10^{-3} m. F = 100 N l = 0.001 mm = 0.001 x 10^{-3} m. Y = $\frac{FL}{Al} = \frac{FL}{\pi r l^2}$ Y = $\frac{100\times2}{3.14\times(0.2\times10^{-3})^2\times0.001\times10^{-3}}$ Y = 159.23 x 10^{13} Y = 1.59 x 10^{11} N/m^2.	2 2	4

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2)	c)	**State Newton's law of viscosity. Define 1 poise. State SI unit for coefficient of viscosity.**		
		Statement	2	4
		Definition	1	
		SI Unit	1	
		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 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. 1 poise :- The coefficient of viscosity η is said to be 1 poise if 1 dyne viscous force is developed between two liquid layers of 1 cm^2 area for unit velocity gradient. SI Unit :- Ns / m^2		
	d)	**A capillary tube of diameter 2 mm when dipped in an organic liquid, the liquid rises to 2 cm in it. Calculate height of rise when a capillary tube of diameter 1.5 mm is dipped in same liquid.**		4
		Formula and Calculation	2	
		Answer with Unit	2	
		Given, Dia.1 =2 mm radius r_1 = 1 mm. Dia.2 =1.5 mm radius r_2 = 0.75 mm. h_1 = 2 cm. h_2 = ? We have $r_1 h_1 = r_2 h_1$ $h_2 = \frac{r_1 h_1}{r_2}$ $h_2 = \frac{1\times 2}{0.75}$ h_2 = 2.66 cm.		

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2)	e)	**Define Isothermal and Adiabatic process. Give their examples in engineering.**		4
		Each Definition **Each examples**	2 2	
		Isothermal Expansion It is the expansion of gas while its temperature remains constant.		
		Adiabatic Expansion It is an expansion of gas while its temperature changes.		
		Examples **Isothermal Expansion: -** i) Melting of solids ii) Boiling of water. **Adiabatic Expansion:-** Bursting of cycle rubber tube.		
	f)	**Define: i) Amplitude (a) ii) Wavelength (λ) iii) Phase angle iv) Epoch in S.H.M.**		4
		Each Definition	1	
		i) Amplitude (a):- The maximum displacement of particle from its mean position on either side is called amplitude. **ii) Wavelength (λ):-** The distance between two consecutive particles of the medium which are in the same phase is called wavelength. **iii) Phase angle**: - The angle which gives position, direction & displacement of the particle in S.H.M.at any instant is known as phase angle. **iv) Epoch**: - Initial phase angle or starting phase made by radius vector with the horizontal is known as epoch.		

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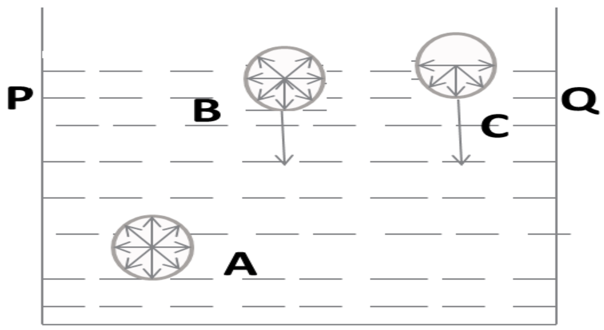
3)		**Attempt any Four.**		16
	a)	**Why the free liquid assume spherical shape in nature? Explain using molecular theory of surface tension.** **Reason** **Molecular theory** **Laplace's molecular theory of surface tension** 1. Consider three molecules A, B & C of the liquid. A sphere of influence is 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'  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.	 1 3	4

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3	a)	Thus according to Laplace's molecular theory of surface tension the 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. Therefore free surface of liquid behaves like a stretched elastic membrane. This reduces the surface area of liquid. Since spherical shape is the only shape which has minimum surface area, therefore the shape of liquid drop is spherical in nature.		
	b)	**State Boyle's law , Charles's law and Gay Lussac's law. What is an ideal gas?** **Each Law** **Definition** **Boyle's law: -** For fixed mass of a gas, temperature of a gas remaining constant, its pressure is inversely proportional to its volume. **Charles'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. **Ideal Gas: -** An ideal gas is a theoretical gas composed of a set of randomly moving and non interacting point particles. **OR** A gas that when kept at constant temperature obeys the gas laws exactly.	 1 1	4
	c)	**Difference between specific heats for a gas is 4000 kcal/kg/^{0}k. Calculate the two specific heats if the ratio of principal specific heats is 1.41.** **Formula and calculation** **Answer with unit** **Given,** Cp – Cv = 4000 kcal/kg/^{0}k ------------------------ (1) Cp / Cv = 1.41	 2 2	4

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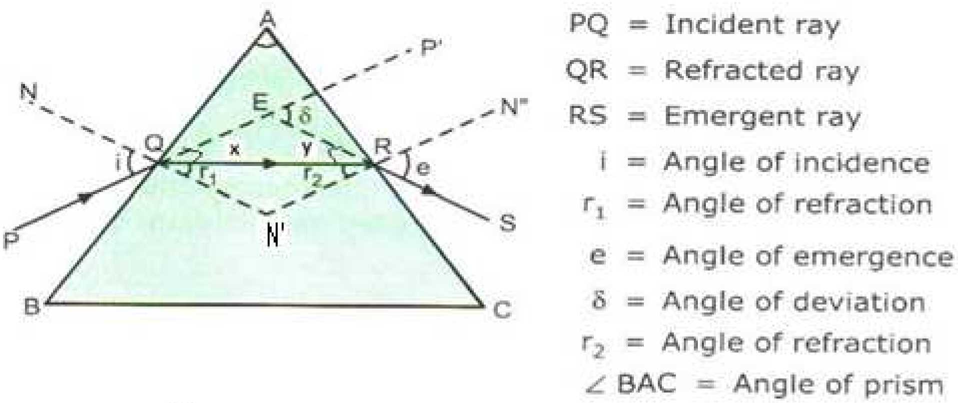
3)	c)	Cp = 1.41 Cv ------------------------ (2) Substitute value of Cp in eq.(1) we get, 1.41Cv – Cv = 4000 0.41Cv = 4000 **Cv = 9756.09 kcal/kg/^{0}k** Cp = 1.41 x 9756.09 **Cp = 13756.08 kcal/kg/^{0}k**		
	d)	**Derive prism formula.** **Diagram with label** **Derivation** **Prism formula**  Consider quadrilateral AQN'R in which $\angle A + \angle AQN + \angle QN'R + \angle N'RA = 360$ $i.e. \angle A + 90 + \angle QN'R + 90 = 360$ $\therefore \angle A + \angle QN'R = 180$ ………1) $In \triangle QN'R,$ $\angle r_1 + \angle r_2 + \angle QN'R = 180$ ………..2) Equating (1) and (2),	 2 2	4

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3)	d)	$\therefore \angle A + \angle QN'R = \angle r_1 + \angle r_2 + \angle QN'R$ $A = r_1 + r_2$ $A = 2r$ $\left[r = \frac{A}{2} \right]$............3) since when $\delta = \delta m$, then i = e …..4) and $r_1 = r_2 = r$ say …..5) $In \Delta EQR, \delta$ x + y = δ_m $(i - r_1) + (e - r_2) = \delta m$ $i + e - r_1 - r_2 = \delta m$ $i + e - 2r = \delta m$ $i + e = \delta m + 2r$ From equation (5) $i + e = A + \delta m$ Put e=i from equation (4) $2i = A + \delta m$ $\left[i = \frac{A + \delta m}{2} \right]$……………..7) By Snell's law, $\mu = \frac{\sin i}{\sin r}$ using equations (5) and (3) $\left[\mu = \frac{\sin \frac{A + \delta m}{2}}{\sin \frac{A}{2}} \right]$ This is prism formula		

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3)	e)	**Define free and forced oscillations. Hence state resonance effect giving examples.** **Each Definition** **Resonance effect** **One example** **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 oscillations/vibration. **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 oscillations/vibration **Resonance effect:-** When the driving / forced frequency of a body exactly match with natural frequency of a body then the body vibrate with maximum amplitude, such effect is called as resonance effect. **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 be considered.**	 1 1 1	4

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3)	f)	**Y =10 sin (2 π t + π/6) SI unit is equation of displacement for particle performing S.H.M. State amplitude, phase angle epoch and period of S.H.M. particle.** **Standard equation** **Each answer** **Standard Equation** $Y = a \sin(\omega t + \alpha)$ ------------------- (1) Given equation $Y = 10 \sin(2\pi t + \pi/6)$ ------------------- (2) Comparing equation (2) with equation (1) we get, **Amplitude (a) = 10 unit.** **Phase angle epoch (α) = π/6** For period we have, $\omega t = 2\pi t$ $\omega = 2\pi$ Period (T) = $2\pi/\omega$ Period (T) = $2\pi/2\pi$ **Period (T) = 1 unit.**	 1 1	4