SUMMER – 2015 EXAMINATION

Subject Code: 17102 **Model Answer Basic Science (Physics)**

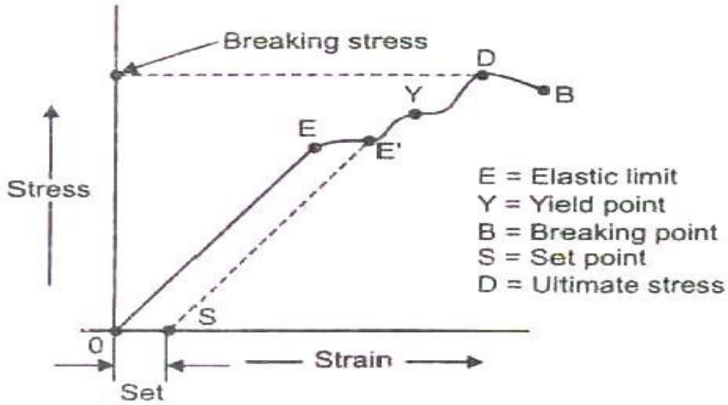
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess 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 Elasticity and Plasticity.** **Each definition-** **Elasticity:** Elasticity is defined as a property of the body by virtue of which it tends to regain its original shape or size on removal of deforming forces. **Plasticity:** Plasticity is defined as a property of the body by virtue of which it does not regain its original shape or size on removal of deforming forces.	1	2
	b)	**State Hooke's Law** **Statement** Hooke's Law Within elastic limit, stress is directly proportional to strain.	2	2
	c)	**State pressure depth relation. Give meaning of each term in it.** **Relation** **Meaning of symbol** **Relation** $P = h \rho g$ Where, P = Pressure. h = Depth of liquid. ρ = Density of liquid. g = Acceleration due to gravity.	1 1	2
	d)	**Explain the significance of Reynold's number.** **Any two significance** **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

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	e)	**Define surface tension. State its S.I. unit.** **Definition** **Unit** **Definition:** The force acting per unit length of an imaginary line drawn to surface of liquid. **OR** The surface tension is defined as the property of liquids by virtue of which the surface of a liquid is under constant tension due to the tendency to contract and occupy minimum surface area. **S.I. unit :- N/m**	 1 1	 2
	f)	**Convert 45 ^{0}C temperature into ^{0}F.** **Formula** **Answer with unit** $C = \frac{F-32}{1.8}$ F = (1.8 x C) + 32 F = (1.8 x 45) + 32 F = 113^{0}F **45^0 C = 113^0 F**	 1 1	 2
	g)	**Define the two specific heats of gas.** **Each definition-** **Specific heat of a gas at constant volume-** Specific heat of a gas at constant volume is defined as the amount of heat required to increase the temperature of unit mass of a gas by one degree celsius at constant volume. **Specific heat of a gas at constant pressure-** Specific heat of a gas at constant pressure is defined as the amount of heat required to increase the temperature of unit mass of a gas by one degree celsius at constant pressure.	 1	 2
	h)	**A metal rod of length 0.20 m has on of its ends at 20 ^{0}C while the other is at 50^{0}C.find the temperature gradient.** **Formula** **Answer with unit** **Given :** d =0.20 m θ_1 =20 ^{0}C θ_2 =50 ^{0}C Temperature gradient =? Temperature gradient = $\frac{(\theta_2-\theta_1)}{d} = \frac{(50-20)}{0.20}$ **Temperature gradient =150 ^{0}C/m**	 1 1	 2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	i)	**State Snell's law of refraction of light.** **Laws of refraction**:- i) **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. $\mu = \frac{\sin i}{\sin r}$ **OR** Sine of angle of incidence is directly proportional Sine of angle of refraction.	2	2
	j)	**Define Amplitude and Frequency.** **Each definition** **Amplitude-**It is defined as the maximum displacement of the particle from either side of mean position. **Frequency -**The number of cycle or oscillation or vibration completed in one second is called as frequency**.**	1	2
	k)	**What are stationary waves?** **Stationary waves:** The resultant wave produced due to the superposition of two identical progressive waves with same amplitude, wavelength, frequency and velocity and travelling along the same straight line but in opposite direction is called stationary or standing wave.	2	2
	l)	**Derive the relation V = n λ.** We have Velocity =Distance covered /Time taken When disturbance travels through one full wave then, Distance covered = Wavelength = λ And Time taken = Period = T ∴ Velocity = Wavelength/ Period $V = \lambda/T$ But $1/T = n$ ∴ $\mathbf{V = n\lambda}$	2	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)		**Attempt any four of the following**		16
	a)	**Explain behavior of wire under continuously increasing load.**		
		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 up to 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 elongation / 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.

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<tr><td>2)</td><td>b)</td><td>

A wire of diameter 3 mm and length 4 m extends by 2.5 mm when a force of 10 N is applied. Find Young's modulus of material of wire.
Formula with substitution
Answer with unit
Given : Diameter(d) =3 mm= 3 x 10^{-3} m
Radius(r) = d/2=1.5 x 10^{-3} m
Original length(L) =4 m
Extended length(l) = 2.5 mm = 2.5 x 10^{-3} m
Force (F) = 10 N
Young's modulus(Y) =?
Formula:- $Y = \frac{FL}{\Pi r^2 l}$
$Y = \frac{10 \times 4}{3.14 \times (1.5 \times 10^{-3}) \times 2.5 \times 10^{-3}}$
Y = 2.26 x 10^9 N/m^2

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<tr><td></td><td>c)</td><td>

Define Young's modulus, Bulk modulus and modulus of Rigidity and state relation between them.
Each Definition
Relation
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/Bulk stress to volume strain/Bulk 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**
$\frac{1}{Y} = \frac{1}{3\eta} + \frac{1}{9K}$

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	d)	**State Stoke's law of viscosity and state the formula for coefficient of viscosity.** **Stokes Law** **Formula for coefficient of viscosity.** **Stoke's law of viscosity** It state that the force of viscosity experienced by a metal sphere falling freely through a viscous medium with terminal velocity is directly proportional to i) Radius of metal sphere(r) ii) Terminal velocity(v) iii) Coefficient of viscosity liquid(η) $F = 6\Pi \eta r v$ **Formula for coefficient of viscosity.** $\eta = \frac{2}{9}\frac{r^2(d-\rho)\times g}{V}$ **OR** $\eta = \frac{F}{6\pi rv}$	 2 2	 4
	e)	**A capillary tube of diameter 0.2mm is dipped into a liquid of density 0.85 x 10^3 kg/m^3 and angle of contact 24^0. If the liquid rises by 41 mm in the tube. Find the surface tension of the liquid.** **Formula** **Substitution & Calculation** **Answer with Unit** **Given :** Diameter(d) = 0.2 mm =0.2 x 10^{-3} m Radius (r) = d/2 =0.1 x 10^{-3} m Density of liquid (ρ) =0.85 x 10^3 kg/m^3 Angle of contact (θ) =24^0 Rise of liquid (h) = 41 mm = 41 x 10^{-3} Surface tension (T) =? We have, $T = \frac{hr\rho g}{2\cos\theta}$ T = $\frac{(41\times10^{-3})\times(0.1\times10^{-3})\times(0.85\times10^{3})\times9.8}{2\cos 24^0}$ **T =18.693 x 10^{-3} N/m**	 1 1 2	 4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	f)	**Distinguish between isothermal process and adiabatic process.** **Any four points**	1	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

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3)		**Attempt any four of the following:**		16
	a)	**Define three gas laws and specific heat of a substance.** **Each 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: -

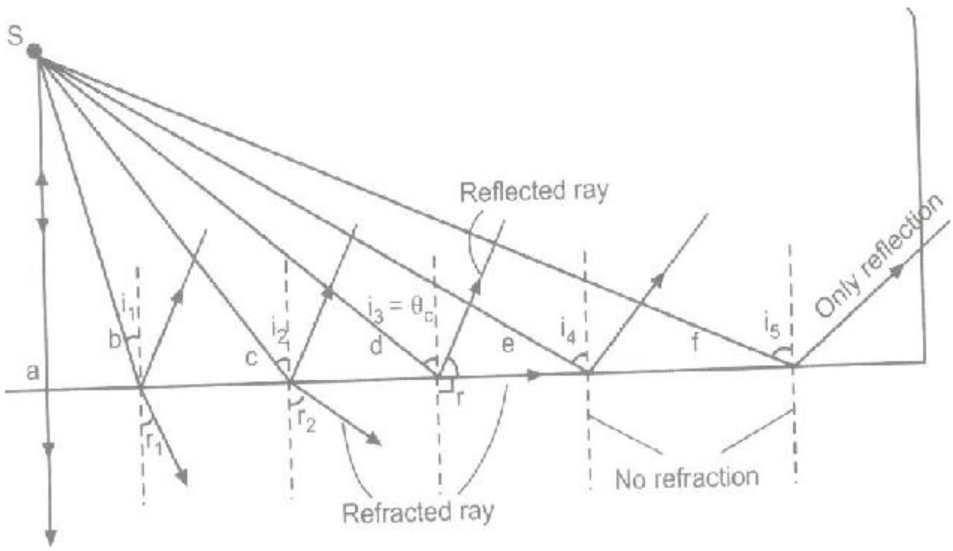
For fixed mass of a gas, volume of a gas remaining constant, its pressure is directly proportional to its absolute temperature.

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 celsius.

3)	b)	**State the factors affecting conduction of heat and state the relation between them.** **Factors** **Relation** **Factors affecting 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) **Relation:-** **Q** = $\frac{K \times A(\theta_1 - \theta_2) \times t}{d}$	 3 1	 4
	c)	**Calculate numerical aperture and acceptance angle for an optical fiber. Given: R.I of core = 1.40 R.I. of cladding = 1.35.** **Two formulae** **Two answers with units** **Given:** $\mu_{core} = 1.40$ $\mu_{clad} = 1.35$ $N_A = ?$ $\theta_A = ?$ **Formula**: $N_A = \sqrt{\mu^2_{core} - \mu^2_{clad}}$ $N_A = \sqrt{(1.40)^2 - (1.35)^2}$ $\mathbf{N_A = 0.371}$ $\theta_A = \sin^{-1}(N_A)$ **OR** $\theta_A = \sin^{-1}\sqrt{\mu^2_{core} - \mu^2_{clad}}$ $\theta_A = \sin^{-1}(0.371)$ $\boldsymbol{\theta_A = 21^0.77'}$	 2 2	 4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	d)	**Explain the phenomenon of total internal reflection for glass material with neat labeled diagram.** **Diagram** **Explanation**	 2 2	 4



Explanation:-

Consider light rays from a point source S in optically denser medium (glass) fall on the surface, on the other side of which is less optically denser medium (air) as shown above.

For the rays a, b, c there are both reflection and refraction taking place at interface.

For ray d, the angle of refraction is 90 ^{0} which means that the refracted ray runs along interface.

For the ray's e, f …. there angle of incidence is larger than θ_c there is no refraction and only reflection takes place i.e. T.I.R. (Total internal reflection).

Thus as the angle of incidence 'i' is increased a situation is reached at which the refracted ray points along the surface and angle of refraction is 90 ^{0}. **For the angle of incidence larger than this critical angle θ_c no refracted ray exits and all the light is reflected.**

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3)	e)	**Distinguish between transverse and longitudinal waves**		
		Any four points	1	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.	Density and pressure of medium remain change.
Wave travels through solid only.	Wave travels through liquids and gases.
e.q. Light wave	e.q. Sound waves

f) **A tuning fork of frequency 512 Hz resonates with an air column of length 14.4 cm the end correction is 6 mm. Calculate velocity of sound in air.**

Formula and Substitution — 2

Answer with unit — 2 — Total Marks: 4

Given

$n = 512$ Hz.

$l = 14.4$ cm.$= 14.4 \times 10^{-2}$ m

$e = 6$ mm $= 6 \times 10^{-3}$ m

$v = ?$

Formula –

$v = 4n\,(l + e)$

$v = 4 \times 512 \times (14.4 \times 10^{-2} + 6 \times 10^{-3})$

$v = 307.20$ m/s

$v = 30720$ cm/s