WINTER– 17 EXAMINATION

Subject Name: Basic Physics **Model Answer** Subject Code: 17102

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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any NINE of the following:**	**18**
	a)	**Why in gases, Cp is greater than Cv?** **Proper explanation** C_v is the specific heat of gas at constant volume. It is utilized only to increase the **temperature** of the gas only. **And** C_p is the specific heat of a gas at constant pressure. But it is utilized by two way i.e. To increase the temperature of the gas and to maintain constant pressure (i.e. increase in volume) Therefore C_p is greater than C_v.	**2** 2
	b)	**State the pressure depth relation. Give the meaning of all symbols in it.** **Equation** **Symbol meaning** $$P= h\rho g$$ Where, P= Pressure h= height of the column ρ= density of given liquid g= acceleration due to gravity	**2** 1 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	c)	**Define time period of a wave. State the values of time period of minute hand and hour hand of a clock.** **Definition** **Values** **Period of wave:** The time taken by a particle to complete one oscillations in the wave is called period of wave. **Values of time period:** One minute hand = 60 sec One hour hand = 60 min = 60 x 60 = 3600 sec	**2** 1 1
	d)	**Define the terms – Molecular range and Sphere of influence.** **Each Definition** **Molecular range:** The maximum distance upto which cohesive force can act is called as molecular range. **Sphere of influence:** The imaginary sphere, surrounding a molecule in which force of attraction is present is called the sphere of influence of that molecule. OR The imaginary sphere drawn with molecule as a center and molecular range as a radius is called as sphere of influence.	**2** 1
	e)	**Convert 55 ^{0}C to ^{0}F.** **Formula** **Answer with unit** $C = \frac{F-32}{1.8}$ F = (1.8 x C) + 32 F = (1.8 x 55) + 32 F = 131^0 **55^0 C = 131^0 F**	**2** 1 1
	f)	**State and explain Hooke's Law of elasticity.** **Statement** **Explanation** **Hooke's Law** Within elastic limit, stress is directly proportional to strain. Therefore, stress α strain Stress = constant x strain, Therefore modulus of elasticity = stress/ strain	**2** 1 1

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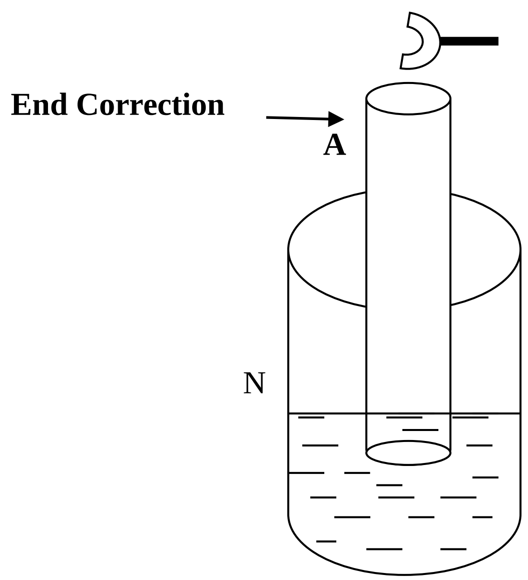
Q. No.	Sub Q. N.	Answer	Marking Scheme
1	g)	**The refractive index of material of glass prism 1.51. Calculate the angle of refraction if the angle of incidence is 45^0.** **Formula** **Answer with unit** **Given:** Angle of incidence = 45^0 Refractive index (μ) = 1.51 Angle of refraction =? $\mu = \frac{\sin i}{\sin r}$ sin r = sin i / μ = sin (45) / 1.51 sin r = 0.4682 $r = \sin^{-1}(0.4682)$ $r = 27.92^0$	**2** 1 1
	h)	**State any two characteristics of stationary waves.** **Any two characteristics** **Characteristics :** i) It is superposition of two progressive waves moving in opposite direction in a medium. ii) There is no transfer of energy in a medium. iii) Nodes and antinodes are formed successively. iv) Nodes are the points on the wave whose displacement is zero. v) Antinodes are the points on the wave whose displacement is maximum. vi) The distance between two successive nodes or antinodes is λ/2. vii) The distance between two successive nodes and antinodes is λ/4.	**2** 2
	i)	**Calculate the viscous force acting on a raindrop of diameter 0.5 mm travelling with constant velocity of 6 m/ sec through air if the coefficient of viscosity of air is 1.8×10^{-5} N-sec / m^2.** **Formula with substitution** **Answer with unit**	**2** 1 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	i)	**Given:** F =? D = 0.5 mm $r = 0.25 \times 10^{-3}$ m V = 6 m/s $\eta = 1.8 \times 10^{-5}$ Ns/m^2 We have $F = 6\pi\eta rv = 6 \times 3.14 \times 1.8 \times 10^{-5} \times 0.25 \times 10^{-3} \times 6$ $\mathbf{F = 50.868 \times 10^{-8}}$ **N**	
	j)	**State any two applications of radiation.** **Any two application** 1. White or light coloured clothes are preferred in summer. 2. Heat radiators in car, machines are painted black. 3. Aeroplanes and ships are painted white. 4. High absorbing power of water vapour is a natural gift. 5. The polished surface of space craft reflect most of the heat radiated from sun. 6. Base of the cooking utensils is made black. 7. Inactivation of HIV by application of heat radiations. 8. Teapots has bright shining surface.	**2** 2
	k)	**Define bulk modulus of elasticity, poisson's ratio.** **Each definition** **Bulk Modulus(K):** Within elastic limit the ratio of volume stress to volume strain is called Bulk modulus. **Poisson's ratio:** It is defined as the ratio of lateral strain to longitudinal strain.	**2** 1
	l)	**Derive the relation V = n λ for wave motion where all symbols have usual meaning.** **Derivation** We have Velocity =Distance covered /Time taken When disturbance travels through one full wave then, Distance covered = Wavelength = λ & Time taken = Period = T ∴ Velocity = Wavelength/ Period $V = \lambda/T$ But $1/T = n$ ∴ $\mathbf{V = n \lambda}$ V is velocity n is frequency λ is wavelength.	**2** 2

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any FOUR of the following:**	**16**
	a)	**Derive the expression for velocity of sound in air by resonance tube experiment.**	**4**
		Diagram	1
		Expression	3
			
		A metal tube of diameter D is immersed in water. A tuning fork of known frequency n is made to vibrate and held at mouth of tube as shown in figure. The metal tube is adjusted such that loud sound is heard. Fix the position of tube where loud sound is heard. It is necessary to calculate end correction. End correction, e = 0.3 d Actual length of vibrating air column = l Corrected length of vibrating air column L = e + l = (0.3 D) + l But $L = \lambda / 4$ Therefore $\lambda / 4 = e + l$ Therefore $\lambda = 4 (e + l)$ Velocity of sound in air is given by, $V = n \lambda$ $V = n \times 4 (e + l)$ $= 4n (0.3 D + l)$ Therefore $V = 4nL$ This is the expression for velocity of sound in air by resonance tube experiment.	

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	b)	**Determine the force required to stretch a steel wire to 1.5 times its original length if the area of cross section is 1.2cm^2 and Young's modulus for steel is 2 x 10 ^{11} N/ m^2.** **Formula with substitution** **Answer with unit** **Given:** F = ? $A = 1.2\ cm^2 = 1.2 \times 10^{-4} m^2$ $Y = 2 \times 10^{11}\ N / m^2$ Consider original length of wire (L_1) is unit (1) in S.I.Unit. $L_2 = 1.5\ L_1 = 1.5 \times 1$ $L_2 = 1.5$ S.I. Unit Elongation produced (l) = $L_2 - L_1$ l = 1.5 - 1 l = 0.5 m We have, $Y = FL_2 / Al$ $F = YAl / L_2$ $F = (2 \times 10^{11}) \times (1.2 \times 10^{-4}) \times (0.5) / (1.5)$ **$F = 8 \times 10^6$ N** **Note: Any relevant answer using some other standard values may be considered.**	**4** 2 2
	c)	**i) Define velocity gradient. Also state its MKS & CGS unit.** **ii) Distinguish between streamline flow and turbulent flow (any two points)** **Definition** **Each unit** **Any two points** i) Velocity gradient: It is defined as the ratio of change in velocity of the layer to change in distance from fixed layer. MKS unit is per second OR 1 / sec CGS unit is per second OR 1 / sec	**4** 1 ½ 2

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	c)	ii)	

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 steadily	The liquid does not flow steadily.
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

d) **A glass sheet of area 1 m^2 & thickness 2.5 mm has its opposite faces at 25 ^{0}C & 12^0 C respectively. If the coefficient of thermal conductivity for glass is 0.2 cal / m ^{0}C-sec, calculate the quantity of heat conducted in one & a half hour.** — **4**

Formula with substitution — 2

Answer with unit — 2

Given:- $A = 1\ m^2$

$d = 2.5\ mm = 2.5 \times 10^{-3}\ m$

$(\theta_1-\theta_2) = (25 - 12) = 13^0$

$K = 0.2\ Cal/m^0Cs$

$Q = ?$

$t = 1.5\ hrs = (90 \times 60) = 5400\ sec$

We have, $Q = KA(\theta_1-\theta_2)t / d$

$= 0.2 \times 1 \times 13 \times 5400 / (2.5 \times 10^{-3})$

$\mathbf{Q = 5616 \times 10^3\ cal.}$

$\mathbf{Q = 5616\ Kcal}$

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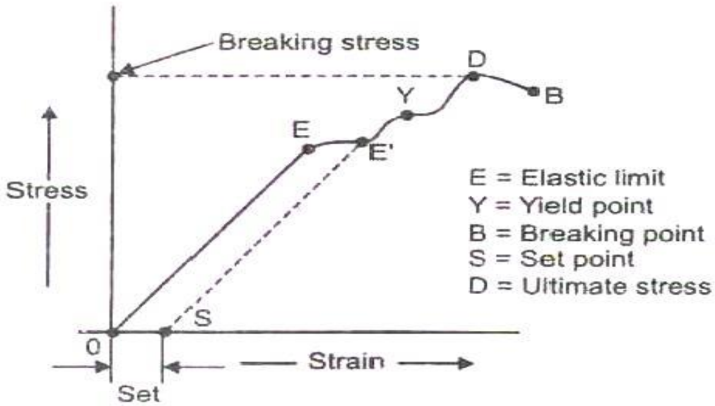
Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	e)	**i) Define acceptance angle & numerical aperture with reference to optical fiber.** **ii) State any two application of optical fiber.** **Each definition** **Any two application**	**4** 1 2
		i) **Acceptance Angle (θa):** The maximum value of external incident angle for which light will propagate in the optical fiber is called ac acceptance Angle. **Numerical Aperture (N_A):** The sine of maximum acceptance angle is called as numerical aperture. ii) **Application of optical fiber:** 1. Optical fiber in communication: Because of large bandwidth, it can handle number of channels. 2. Internet: Optical fiber cables pass on huge amount of data that it is too with very high speed. 3. Telephone: Using optical fiber communication we can connect faster and have clean conversations. 4. Used for signaling purpose in military. 5. Used in industrial automation system. 6. To observe internal organs of body in medical field. 7. Used in defenses for confidential communications. 8. Used in cable television. 9. Used for transmission of digital data. 10. Sensors: Optical fiber sensors are used to control liquid level, temperature, pressure, chemical concentration in automation system	
	f)	**i) State and explain Boyle's law for gases.** **ii) Distinguish between isothermal presses and adiabatic process.(any two points)** **Statement and explanation** **Any two points**	**4** 2 2
		i) Boyle's law: - For fixed mass of a gas, temperature of a gas remaining constant, its pressure is inversely proportional to its volume. **Explanation-** $P \propto 1/V$ (at constant temperature) $P = \text{constant} \times 1/V$ $PV = \text{constant}$ Thus at constant temperature, product of pressure and volume of fixed mass of a gas remains constant. i.e, $P_1V_1 = P_2V_2 = \text{constant}$ i.e, product of initial pressure and volume is equal to the product of final pressure and volume.	

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	f)	ii) **Any two points**	

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^{γ} = constant
Expansion of gas takes place	Compression of gas takes place
Ex. Boiling of water	Ex. Bursting of cycle tyre

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.		**Attempt any FOUR of the following:**	**16**
	a)	**A body performs S.H.M. such that its velocity at the mean position is 2 m/sec & the acceleration at one of the extremities is 3.14 m/sec^2. Calculate the time period and hence the frequency of vibration.**	**4**
		Each formula	1
		Each answer with unit	1
		Given: v = 2 m/s Acceleration = 3.14 m/s^2 We have $v = a\omega = 2$ Acceleration = $a\omega^2 = 3.14$ $a\omega^2 / a\omega = 3.14 / 2$ $\omega = 1.57$ $\omega = 2\pi n$ $n = \omega / 2\pi = 1.57 / (2 \times 3.14)$ **n = 0.25 Hz** T = 1 / n = 1 / .025 **T = 4 sec**	
	b)	**Define the terms – free vibrations and forced vibrations. Give one example each.**	**4**
		Each definition	1
		Each example	1
		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. **Examples:** Vibrating tuning fork, Concrete bridge, Vibration of air column, etc. **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. **Examples:** Tuning fork kept on vibrating engine, Concrete bridge in earth quake, Cricketers hanging ball, etc.	

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	c)	**Explain the behavior of the wire under continuously increasing load.** **Diagram** **Explanation**	**4** 2 2



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.

d) **A liquid of density 1050 kg/m^3 and surface tension 35 x 10^{-3} N/m rises to a height of 0.15 cm in a capillary tube of diameter 1.4 mm. Determine the angle of contact for the liquid.** — **4**

Formula with substitution — 2

Answer with unit — 2

Given:

$\rho = 1050$ Kg/m^3

T = 35 x 10^{-3} N/m

h = 0.15 cm = 0.15 x 10^{-2} m

D = 1.4 mm

r = 0.7 x 10^{-3} m

θ = ?

We have, $T = rh\rho g / 2\cos\theta$

$\cos\theta = rh\rho g / 2T$

$= (0.7 \times 10^{-3}) \times (0.15 \times 10^{-2}) \times (1050) \times (9.8) / 2 (35 \times 10^{-3})$

$\cos\theta = 0.15435$

$\boldsymbol{\theta = 81.12^0}$

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	e)	**State & explain Newton's law of viscosity & hence define coefficient of viscosity.** **Statement and explanation** **Definition** **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)] $F \propto A\, dv/dx$ $F = \eta A\, dv/dx$ Where, η is the coefficient of viscosity of the liquid. **Coefficient of viscosity: "**Coefficient of viscosity of a liquid is defined as the viscous force developed between two liquid layers of unit surface area & unit velocity gradient."	**4** 3 1
	f)	**Calculate the temperature in degree celsius required to change 12 liters of helium at 150 0K & 0.6 atmosphere to 36 liters at 1.2 atmosphere.** **Formula with substitution** **Answer with unit** **Given:** $V_1 = 12$ lit. $V_2 = 36$ lit. $T_1 = 150\ ^0K$ $T_2 = ?$ $P_1 = 0.6$ atm $P_2 = 1.2$ atm We have, $P_1V_1 / T_1 = P_2V_2 / T_2$ $T_2 = P_2V_2 T_1 / P_1V_1$ $T_2 = (1.2 \times 36 \times 150) / (0.6 \times 12)$ $T_2 = 900\ ^0K$ $\mathbf{T_2 = 627\ ^0C}$	**4** 2 2