SUMMER-18 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.

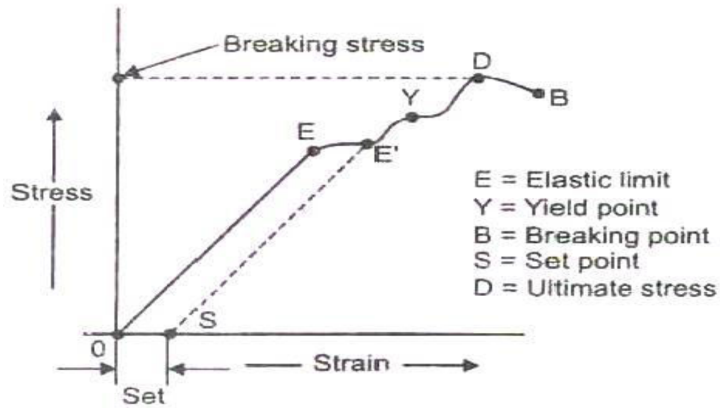
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any NINE of the following:**	**18**
	a)	**Define: i) Elastic limit ii) Factor of safety .** **Each definition** **i) Elastic limit: -**It is the maximum value of the stress upto which the body shows elasticity. **ii) Factor of Safety:** It is defined as the ratio of ultimate stress to working stress.	**2** 1
	b)	**Define compressibility. State its SI unit.** **Definition** **SI unit** **Compressibility:** The reciprocal of bulk modulus is called compressibility. **SI unit :** m^2/N	**2** 1 1
	c)	**State the pressure depth relation. Give the meaning of each term in it.** **Equation** **Symbol meaning** $P= h\rho g$ Where, P= Pressure h= height of the liquid column ρ= density of given liquid g= acceleration due to gravity	2 1 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	d)	**Raindrop of diameter 0.03 cm falling with velocity of 2.2 m/ sec. If coefficient of viscosity of air is 1.75 x 10^{-4} N-sec / m^2, calculate the viscous force acting on the rain drop.**	**2**
		Formula with substitution	1
		Answer with unit	1
		Given: F =? D = 0.03 cm $r = 0.015 \times 10^{-2}$ m v = 2.2 m/s $\eta = 1.75 \times 10^{-4}\ Ns/m^2$ We have $F = 6\pi\eta rv = 6 \times 3.14 \times 1.75 \times 10^{-4} \times 0.015 \times 10^{-2} \times 2.2$ $\mathbf{F = 1.08 \times 10^{-6}\ N}$	
	e)	**Define : (a) Molecular range (b) Sphere of influence.**	**2**
		Each Definition	1
		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.	
	f)	**Define temperature gradient & mention its unit.**	**2**
		Definition	1
		SI unit	1
		Temperature gradient: It is defined as the ratio of change in temperature to change in length of rod. **Unit** --- ^{0}C/m OR ^{0}K/m	
	g)	**State Boyle's law & Charles's law.**	**2**
		Each Law	1
		Boyle's law: - For fixed mass of a gas, temperature of a gas remaining constant, its pressure is inversely proportional to its volume.	

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	g)	**Charles's Law:** For fixed mass of a gas, pressure of a gas remaining constant, its volume is directly proportional to its absolute temperature.	2
	h)	**Explain why C_p is greater than C_v ?** **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. **But** C_p - is the specific heat of a gas at constant pressure. 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
	i)	**Define simple harmonic motion. Give its two example.** **Definition** **Two examples** **Simple harmonic motion:** The to and fro motion of the object about its mean position is called simple harmonic motion. **Examples:** motion of swing, motion of sewing machine , motion of clock pendulum , etc.	2 1 1
	j)	**Find the frequency of wave having velocity 300 m /s and wavelength 0.3 mm.** **Formula** **Answer with unit**	2 1 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	j)	Given : v =300 m/s, $\lambda = 0.3$ mm = 0.3×10^{-3} m Required: n =? $v = n\lambda$ $n = v/\lambda$ $n = 300 / 0.3 \times 10^{-3}$ $n = 1 \times 10^{6}$ Hz	
	k)	**Define Resonance.** **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	**2** 2
	l)	**State four characteristics of stationary waves**. **Any four 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 $\lambda/2$. vii) The distance between two successive nodes and antinodes is $\lambda/4$.	**2** 2

Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Attempt any FOUR of the following:**	**16**
	a)	**A wire of diameter 2 mm is stretched by a load of 10 kg . If the extension produced is 1 mm , how far would a wire of same length & material but half of diameter , be stretched by 5 kg,**	**4**
		Formula with substitution	2
		Answer with unit	2
		Given : **First wire:** Diameter(d_1) =2 mm= 2×10^{-3} m Radius(r_1) = d/2=1×10^{-3} m $L_1 = L_2$ Extended length(l_1) = 1 mm = 1×10^{-3} m Mass (M_1) = 10 kg **Second wire:** Diameter(d_2) =1 mm= 1×10^{-3} m Radius(r_2) = d/2=0.5×10^{-3} m $L_1 = L_2$ Extended length(l_2) = ? Mass (M_2) = 5 kg Young's modulus , $Y_1 = Y_2$ as material is same. **Formula:-** $M_1gL / \pi r_1^2 l_1 = M_2gL / \pi r_2^2 l_2$ $l_2 = M_2gL\, r_1^2\, l_1 / M_1gL = 5 \times (1 \times 10^{-3})^2 \times 10^{-3} / 10 \times (0.5 \times 10^{-3})^2$ $\mathbf{l_2 = 2 \times 10^{-3}}$ **m = 2 mm**	
	b)	**Explain the behavior of the wire under continuously increasing load.**	**4**
		Diagram	2
		Explanation	2

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	b)	 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. During plastic flow the cross-section of wire decreases up to point D. this point D represents the maximum stress which the wire can bear. Finally wire breaks. B is called breaking point.	
	c)	**State Newton's law of viscosity. Define coefficient of viscosity & state its SI unit.** **Statement** **Definition** **Unit** **Newton's law of viscosity:** 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)] **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**	**4** 2 1 1

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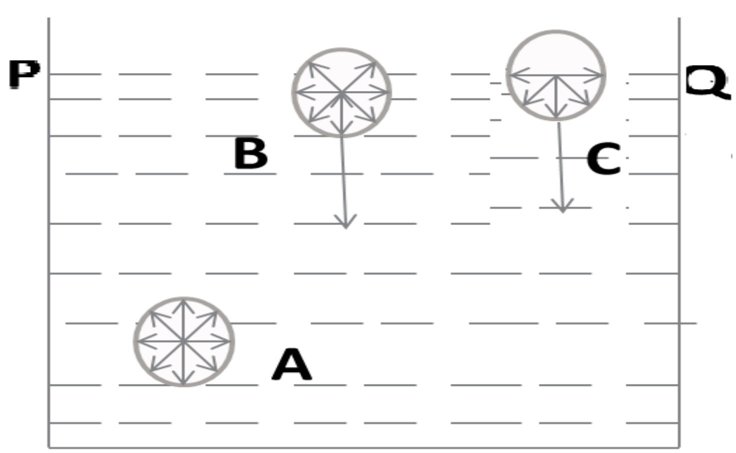
Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	d)	**Distinguish between streamline flow and turbulent flow.**	**4**
		Any four points	4

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 steadily	The flow becomes turbulent after critical velocity.
e.gThe flow of liquid through pipe, water flow of river in summer etc.	e.g flow of river in flood, water fall etc.
$V < v_c$	$V > v_c$
$R < 2000$	$R > 3000$

Q. No.	Sub Q. N.	Answer	Marking Scheme
	e)	**Explain Laplace's molecular theory of liquid & hence define surface tension.**	**4**
		Diagram	2
		Explanation	1
		Definition	1



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Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	e)	Consider three molecules A, B & C of the liquid. A sphere of influence is drawn as shown in fig.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. 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. 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' 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. 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. This gives rise to surface tension. It is the contraction force which decreases the surface area of the liquid. **Definition:-** It is defined as property of liquid by virtue of which the surface of liquid is under constant tension due to the tendency to contract and occupy minimum surface area.	**4** 1 2
	f)	**Find the quantity of heat conducted in 5 minutes across a silver sheet of size 40 cm x 30 cm of thickness 3 mm. If its two faces are at temperature of 40 ^{0}C & 25 ^{0}C , K for silver = 0.1 Kcal/m^{0}Cs** **Formula with substitution** **Answer with unit** **Given:-** $A = 1200\ cm^2 = 1200 \times 10^{-4}\ m^2$ $d = 3\ mm = 3 \times 10^{-3}\ m$ $(\theta_1-\theta_2) = (40 - 25) = 15^0C$ $K = 0.1\ Kcal/m^0Cs$ $t = 5\ min = (5 \times 60) = 300\ sec$ $Q = ?$ We have, $Q = KA(\theta_1-\theta_2)t / d$ $= 0.1 \times 1200 \times 10^{-4} \times 15 \times 300 / (3 \times 10^{-3})$ $\mathbf{Q = 18000\ Kcal}$	**4** 2 2

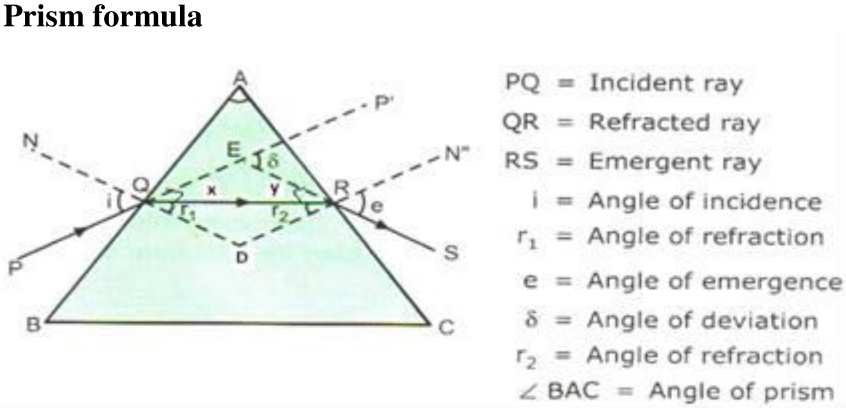
Q. No.	Sub Q. N.	Answer	Marking Scheme
3.		**Attempt any FOUR of the following:**	**16**
	a)	**Distinguish conduction, convection & radiation.**	**4**
		Any four points	4

conduction	convection	radiation
1. It is the process of transfer of heat from a part of a body at higher temperature to a part of body at lower temperature without actual movement of particles.	1. It is the process of transfer of heat from a part of a body at higher temperature to a part of body at lower temperature with actual movement of particles.	1. It is the process of transfer of heat from a body at higher temperature to a body at lower temperature without necessity of intervening medium
2 If metal rod is heated at one end, its other end gets heated.	2. Heating of water in a beaker.	2. Heat from sun reaches the earth.
3. Material medium is essential.	3. Material medium is essential.	3. Material medium is not essential.
4. Metal rod itself acts as a medium.	4. Liquid itself acts as a medium.	4.Medium may be present like air or no medium. i.e. vacuum.

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	b)	**State any four differences 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

	c)	**Derive prism formula.**	**4**
		Diagram	2
		Derivation	1
		Prism formula	1



Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	c)	Consider Δ QDR $r_1 + r_2 + \angle QDR = 180$ Consider □ AQDR $\angle A + \angle QDR = 180$ $r_1 + r_2 + \angle QDR = \angle A + \angle QDR$ $\angle A = r_1 + r_2$ For certain value of $\angle i$, angle of deviation δ is called angle of minimum deviation δ_m . At this stage $\angle i = \angle e$ and $r_1 = r_2 = r$ Therefore $r_1 + r_2 = 2r = A$, A= r / 2 Δ QER $\delta = x + y$ $\delta = (i - r_1) + (e - r_2)$ $\delta = i + e - (r_1 + r_2)$ **At δ = δ** $\mathbf{r_1 = r_2 = r}$ **i = e** , **i = A+ δ_m /2** **r = A /2** By Snell's law **μ = sin i / sin r** By substituting values of i and r in above law we get, $$\mu = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$ **Where,** **μ = refractive index of material of prism.** **A = Angle of prism.** **δm = Angle of minimum deviation**	

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3.	d)	**i) State principle of optical fibre.** **Principle: -** Optical fibre works on the principle of total internal reflection.i.e.when a ray of light is passing through denser medium, is incident on the surface of rarer medium at an angle greater than the critical angle, the ray is totally reflected in a denser medium. This phenomenon is called as TIR.	**2**
		ii) **Find angle of incidence if angle of refraction is 30^0 for a glass having refractive index 1.5.**	**2**
		Formula	1
		Ans with unit	1
		Given: Angle of refraction = 30^0 Refractive index (μ) = 1.5 Angle of incidence =? $\mu = \frac{\sin i}{\sin r}$ $\therefore \sin i = \sin r \times \mu$ $\sin i = \sin 30 \times 1.5$ $\sin i = 0.5 \times 1.5$ $\sin i = 0.75$ $i = \sin^{-1}(0.75)$ $\mathbf{i = 48.59^0}$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	e)	**Distinguish between transverse and longitudinal waves.** **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.	Density and pressure of medium changes.
Wave travels through solid only.	Wave travels through liquids and gases.
e.g. Light wave	e.g. Sound waves

f) **A tuning fork of frequency 480 Hz resonates with an air column of length 16 cm, The end correction is 5 mm. Calculate velocity of sound in air.** — **4**

Formula Substitution — 2

Answer with unit — 2

Given: $n = 480$ Hz. $l = 16$ cm $= 16 \times 10^{-2}$m, $e = 5$mm $= 5 \times 10^{-3}$ m, $v = ?$

Formula

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

$$v = 4 \times 480 \times (16 \times 10^{-2} + 5 \times 10^{-3})$$

$$\mathbf{v = 316.8\ m/s}$$