SUMMER – 2014 EXAMINATION

Subject Code: 17202 **Model Answer Applied 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.		

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Stepwise Solution</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>1)</td><td></td><td>Attempt any Nine</td><td></td><td>18</td></tr>
<tr><td></td><td>a)</td><td>Define uniform velocity and uniform acceleration.
Each Definition

Uniform velocity:-
If a body covers equal displacement in equal interval of time, then it is called uniform velocity.
OR
If a body is moving with constant speed in the same direction, then it is said to be uniform velocity.
Uniform acceleration:-
If the acceleration of a body is uniform in magnitude and direction w.r.t. time then it is called uniform acceleration.
OR
If change in velocity of a body is constant in every equal interval of time then it is called uniform acceleration.</td><td>1</td><td>2</td></tr>
<tr><td></td><td>b)</td><td>Write any two points to distinguish between work and energy.
Any two point

<table><tr><td>Work</td><td>Energy</td></tr><tr><td>Work is defined as product of force acting on a body and displacement produced</td><td>Energy is defined as capacity of doing work.</td></tr><tr><td>Work does not exists in nature in different forms</td><td>Energy exists in nature in different forms</td></tr></table></td><td>2</td><td>2</td></tr>
<tr><td></td><td>c)</td><td>State any two different NDT methods that are used in industries.
Each method
NDT methods:
1) Liquid penetrant testing (LPT)
2) Ultrasonic testing (UT)
3) Magnetic particle testing (MT)
4) Radiograph testing (RT)
5) Leak testing (LT)
6) Visual testing (VA)
7) Holographic testing (HT)
8) Thermal infra radiography (TR)
Note: Any other relevant factors can be considered</td><td>1</td><td>2</td></tr>
</table>

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	d)	**Define range of projectile. State formula with symbol meaning.** **Definition** **Formula with meaning** **Range of projectile (R) :-** The total horizontal distance covered by a projectile is called as a range (R). $$R = \frac{v^2 \sin 2\theta}{g}$$ Where, R = Range of projectile. v = Velocity of projectile. θ = Angle of projection. g = Gravitational acceleration.	1 1	2
	e)	**State any two properties of ultrasonic waves** **Each Property** i) Frequency of these sound waves is more than 20kHz. ii) It has shorter wavelength. iii) They carry high amount of sound energy. iv) The speed of propagation of ultrasonic waves increases with increase in frequency. v) They show negligible diffraction. vi) Ultrasonic waves travel over long distance without considerable loss. vii) Ultrasonic waves undergo reflection and refraction at the separation of two media. viii) If it passed through fluid, then temperature of the fluid increases. ix) They travel with constant speed through a homogeneous medium. x) They posses certain vibrations which are used as good massage action in case of muscular pain.	1	2
	f)	**State any two points of difference between Seebeck's effect and peltier effect.** **Any two point**	2	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	f)			2

Seebeck's effect	**Peltier effect**
When two dissimilar metals are joined together so that two junctions are formed and if one junction is heated and other is cooled then electric current flows through it.	When electric current flows through a junction of two metals of thermocouple, then heat is generated at one junction and heat is absorbed at the other junction.
emf is developed across the two junction.	One junction gets heated and other get cooled.
emf generated is small in mV.	Heat generated or absorbed is small.
Amount of heat generated depends on pair of metals and temperature difference.	Amount of heat generated depends on pair of metals and current through it.

	g)	**How can you increase thermo emf using different metals in thermoelectric series? Give one example.**		2
		Explanation	1	
		Examples	1	
		If the metals used in thermocouple are more apart in the Thermocouple series, then the thermo emf obtained is more. Examples:- If Sb-Bi thermocouple is used then it gives maximum emf for given temperature difference.		
	h)	**State two properties of photon.**		2
		Any two Properties	2	
		i. It is an invisible entity. The existence of photon is same as existence of electron. ii. Photon is electrically neutral. iii. They cannot be deflected by electric or magnetic field. iv. They travel with speed of light. v. Photon does not ionize.		

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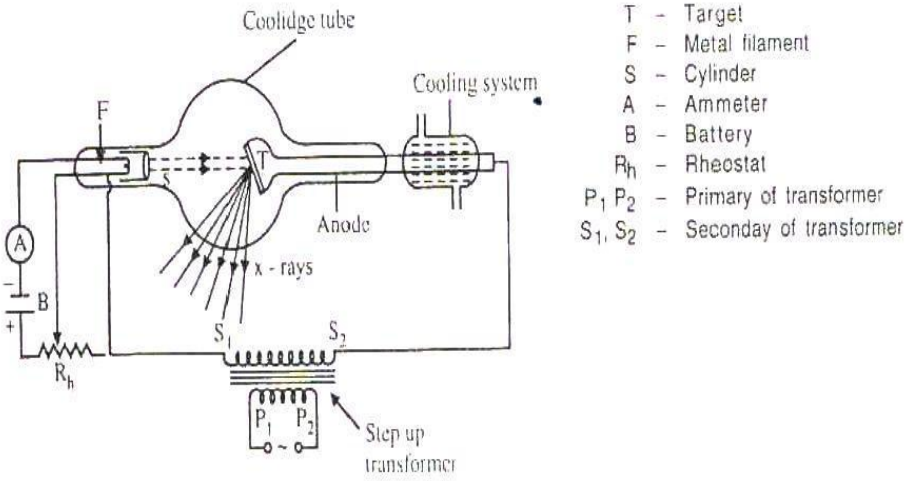
1)	i)	**The photo electric work function of a photo sensitive material is 3×10^{-19} J. Calculate its threshold wavelength.**		2
		Formula with calculation	1	
		Answer with unit	1	
		Given, $W_o = 3 \times 10^{-19}$ J $h = 6.63 \times 10^{-34}$ Js We have, $\upsilon_o = \frac{Wo}{h}$ $\upsilon_o = \frac{3\times10^{-19}}{6.63\times10^{-34}}$ $\upsilon_o = 0.452 \times 10^{15}$ Hz. $c = \lambda_0 \upsilon_o$ $\lambda_0 = c / \upsilon_o$ $\lambda_o = 3 \times 10^8 / 0.453 \times 10^{15}$ $\lambda_o = 6.622 \times 10^{-7}$ m $\lambda_o = 6622\ A^0$		
	j)	**Write any two properties of X-rays.**		2
		Any two properties i. They are electromagnetic waves of very short wavelength. ii. They travel with speed of light. iii. They affect photographic plates. iv. They produce fluorescence in many substances. v. They can be reflected or refracted under certain conditions. vi. They are not deflected by magnetic or electric field. vii. They have high penetrating power. viii. They produce photoelectric effect. ix. They are invisible to eyes. x. X-ray kill some form of animal cell	2	
	k)	**Draw a neat labeled diagram of Coolidge X- ray tube.**		2
		Neat labeled diagram  	2	

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1)	l)	**State two remarkable 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
2)		**Attempt any four**.		16
	a)	**A vehicle covers 60 m in 3rd second and 100 m in 7th second during its motion. Calculate the acceleration and distance travelled in 10th second.**		4
		Formula **Three Answers with unit**	1 3	
		Solution: Given: $S_3 = 60$ m , $S_7 = 100$ m Required: a =? S_{10} =? $S_n = u + a/2\ (2n-1)$ $S_3 = u + a/2\ (2x\ 3 - 1)$ $60 = u + 5a/2$ …….(1) $S_7 = u + a/2\ (2x\ 7 - 1)$ $100 = u + 13a/2$ ……(2) Subtracting eqn (1) from eqn (2) $100 - 60 = 13a/2 - 5a/2$ $40 = 4a$ **$a = 10$ m/s^2**		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	a)	Putting above value in eq^{n} (1) $60 = u + 5 \times 10 /2$ **u = 35 m/s** $S_{10} = 35 + 10(2 \times 10 - 1)/2$ **S_{10} = 130 m**		
	b)	**A bullet of weight 0.98 N is fired with a velocity of 400 m/s horizontally in a wooden block weighing 50 N resting on horizontal surface. If the bullet remains embedded in the block , calculate velocity of block after impact.** **Given** **Formula with substitution** **Answer with unit** Given : Bullet — Block $W_1 = 0.98$ N — $W_2 = 50$ N $m_1 = W_1/g$ — $m_2 = W_2/g$ $m_1 = 0.1$ kg — $m_2 = 5.1$ kg $u_1 = 400$ m/s — $u_2 = 0$ $v_1 =$? — $v_2 =$? As bullet remains embedded in the block, both block and bullet moves with same velocity. i.e. $v_1 = v_2$ $v_2 = (m_1u_1 + m_2u_2) /m_1 + m_2$ $v_2 = (0.1 \times 400 + 5.1 \times 0)/0.1+ 5.1$ $v_2 = 40 / 5.2$ $v_2 = 7.69$ m/s	1 2 1	4
	c)	**Distinguish between centripetal force and centrifugal force.** **Any four points**	4	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	c)			

Centripetal force	**Centrifugal force**
Centripetal force is the force acting on a particle performing uniform circular motion which is along the radius and towards the center of circular path.	Centrifugal force is the force acting on a particle performing uniform circular motion which is along the radius and away from the center of circular path.
It is a real force	It is a imaginary(pseudo) force
It is acting along the radius and towards the center	It is acting along the radius and away from the center
It maintains uniform circular motion	It helps to obey Newton's laws of motion in accelerated frame of reference.
E .g. stone tied at one end of string and whirled, electron revolving around the nucleus . etc	E.g. Person sitting in merry go round or giant wheel, Motor cyclist driving in a artificial death well. etc

d) **Compare between LPT and UT method on the basis of principle of Working , advantages , disadvantages and probing medium.** — 4

Each point — 1

Point	**LPT**	**UT**
Principle of Working	Capillary action	Reflection , Transmission, scattering of Ultrasonics from disorder
Advantages	Easy & economical, Detection of defects open to surface.	Detection of internal defects.
Disadvantages	Not useful for highly porous material.	Cannot be used without couplant.
Probing medium	Penetrant	Ultrasonics

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	e)	**Explain the production of ultrasonic waves using piezoelectric method?** **Diagram with label** **Principle** **Working** **Principle:** When the electric field is applied across the crystal its dimensions changes and when alternating PD is applied across crystal then the crystal sets into elastic vibrations  **Working:** A chip of piezo-electric crystal like quartz is placed between two plates as shown in figure. A suitable oscillator is connected across it. The electric oscillations along the electric axis produce mechanical vibrations along the mechanical axis. The frequency of oscillator is increased. At a particular frequency of oscillator, the oscillator frequency becomes equal to natural frequency of vibration of crystal. Then the crystal sets into resonance vibration and ultrasonic waves are produced	2 1 1	4
	f)	**State four limitations of NDT methods.** **Any four limitations**	4	4

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2)	f)	**Limitation of NDT:** i.For complete examination of the material minimum 2 methods required. ii. Trained & certified person are required iii. Cost of equipment is high & thus testing charge are more. iv. Qualitative testing is possible, however quantitative testing is difficult. v. NDT interpretations are relative one should know the standard results first.		
3		**Attempt any four.**		16
	a) i)	**State Joule's law.Give its equation.**		4
		Statement	2	
		Equation	2	
		Joule's law : It state that the amount of heat generated (H) due to the flow of electric current through a resistance is directly proportional to 1) Square of the current (I^2) 2) Resistance (R) 3) Time for which current flows (t) $H = \left(\frac{1}{J}\right) I^2Rt$		
	ii)	**Calculate amount of heat generated when current of 2A flows for 5 min. through resistance of 5.2 Ω (J=4200 J/kcal)**		4
		Formula	1	
		Substitution	1	
		Answer with unit	2	

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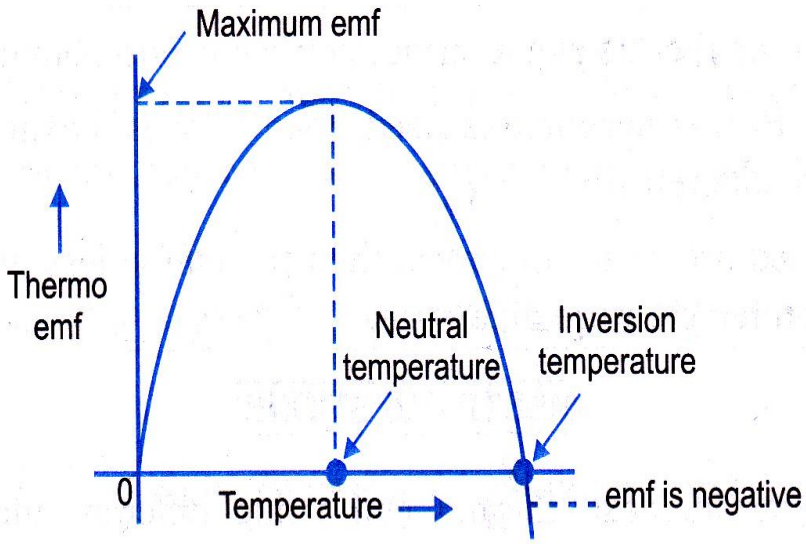
3	a) ii)	Given: I = 2 A, t = 5min =5X60 =300 s R=5.2 Ω, J = 4200 J/kcal Required: H=? $H = I^2Rt / J$ H = 2 x 2 x 5.2 x 300 /4200 H = 1.48 kcal		
	b)	**Explain variation of thermo emf with temperature of junctions. Define neutral temperature and inversion Temperature.**		4
		Diagram	1	
		Explanation	1	
		Definitions	2	
				
		For a given thermocouple , the temperature of one junction is placed at 0^0C and temperature of other junction is increased by providing heat. The emf generated is measured with the help of millivoltmeter. Emfs e_1, e_2, e_3,……for different temperatures t_1, t_2, t_3,…… are recorded and the graph is plotted. It is observed that as the temperature difference between two junctions increases, emf also increases and reaches to maximum value and thereafter emf decreases, becomes zero and reverses its sign.		

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3)	b)	**Neutral temperature** –The temperature at which the emf is maximum is called inversion temperature **Inversion Temperature:** The temperature at which the emf becomes zero and changes its sign (becomes negative) is call inversion temperature.		
	c)	**Define i) Threshold frequency** **ii) Threshold wavelength** **iii) Work function** **iv) Stopping potential** **Each Definition** **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. **Work Function:** It is the minimum energy required just to emit or detach or knock the electron from the metal surface. **Stopping potential:** It is the negative potential of photoelectric cell at which photoelectric current becomes zero.	1	4
	d)	**State engineering and scientific applications of X-rays.** **Any two applications in each field** **Engineering Application** i. X- rays are used to detect the cracks in the body of aero plane or motor car ii. X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control iii. X – rays are used to detect flaws or cracks in metal jobs. iv. X- rays are used to distinguish real diamond from duplicate one v. X- rays are used to detect smuggling gold at airport and docks (ship) yard. X-rays are used to detect cracks in the wall vii. X- ray radiography is used to check the quality of welded joints	2	4

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3)	d)	**Scientific Applications**: i. . X – rays are used to study structure of crystal and alloy ii. . X – rays are used to chemical analysis and for determination of atomic number of chemical elements. iii. . X – rays are used to study structure of substances like cellulose , rubber and plastic. iv. . X – rays are used for identification of chemical elements present in the solution. v. . X – rays are used for analysis of structure of organic molecules.	1	4
	e)	**What is population inversion? State four methods of pumping.**		4
		Definition	2	
		Four methods	**2**	
		Population inversion: Making population of excited state more than that of ground state is called population inversion.i.e. $N_2 >> N_1$ **Methods of pumping**: Optical pumping Direct electron excitation (Electric pumping) Inelastic atom-atom collision Chemical reaction		

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3)	f)	**A fly wheel rotating at 800 rpm accelerates to 2000 rpm in 10 minutes. Calculate the uniform acceleration and the angular displacement within the given period.**		4
		Two formulae with substitution	2	
		Two Answers with unit	2	
		Given : ω_0=800 rpm = 800 x 2π /60 = 83.78 rad/s ω_1= 2000 rpm = 2000 x 2π /60 = 209.44 rad/s t = 10 min = 10 x 60 sec. = 600 s		
		Uniform acceleration		
		$\omega_1 = \omega_0 + \alpha t$ $\alpha = (\omega_1 - \omega_0) / t$ $\alpha = (209.44 – 83.78) / 600$ $\alpha = 0.208$ rad/s^2		
		Angular displacement		
		$\theta = \omega_0 t + \alpha t^2 / 2$ $\theta = (83.78 \times 600) + ½ (0.209) (600)^2$ $\theta = 87888$ rad .		