



WINTER - 2014 EXAMINATION

Subject Code: 17202

Model Answer Applied Science (Physics)

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		<p>Important Instructions to examiners:</p> <ol style="list-style-type: none">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)	a)	Attempt any Nine Define angular displacement . State its S.I. unit. Definition S.I.unit Angular displacement : Angular displacement is defined as the angle traced by radius vector . OR Angular displacement is defined as the angle subtended at the centre by path travelled. S.I.unit : radian = rad	1 1 1	18 2
	b)	Define impulse and impulsive force. Each Definition Impulse : It is defined as change in momentum. OR It is defined as product of large force on a body and very small time for which force acts Impulsive force : It is defined as a large force acts on a body for very small time .	1 2	2
	c)	State work energy principle. Principle Work energy principle: It states that the work done by a system of forces acting on a body between any two points is equal to the change in kinetic energy of a body between these two points.	1	2
	d)	Define centripetal force. State its S.I. unit. Definition S.I.unit	1	2



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1)	d)	<p>Centripetal force - It is defined as the force acting along the radius towards the centre of the circular path, which keeps the particle in uniform circular motion.</p> <p>OR</p> <p>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.</p> <p>S.I .unit : newton = N</p>		
	e)	<p>State any two properties of ultrasonic waves</p> <p>Each Property</p> <ul style="list-style-type: none">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 possess certain vibrations which are used as good massage action in case of muscular pain.	1	2
	f)	<p>State two characteristics of thermocouple.</p> <p>Each characteristic</p> <ul style="list-style-type: none">i) The e.m.f generated depends on the nature two metals used.ii) The e.m.f generated depends on the temperature difference between two junctions.iii) The effect is reversible. <p>Any other relevant.</p>	1	2



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	g)	Define: i) Neutral temperature ii) Inversion Temperature Each Definition Neutral temperature – In thermocouple the temperature at which the emf is maximum is called inversion temperature Inversion Temperature: In thermocouple the temperature at which the emf becomes zero and changes its sign (becomes negative) is call inversion temperature.	1	2
	h)	State Einstein's photoelectric equation with meaning of symbol used Equation with meaning Einstein's photoelectric equation $h\nu = W_o + K.E. \quad \text{Or}$ $h\nu = W_o + \frac{1}{2}mv^2 \quad \text{Or}$ $\frac{1}{2}mv^2 = h(\nu - \nu_0)$ Where m – mass of electron v – velocity of electron h – Planck's constant ν - frequency of radiation ν_0 - Threshold frequency	2	2



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	i)	<p>The photoelectric work function of a certain metal is 3.2×10^{-19}J. Calculate its threshold frequency($h = 6.63 \times 10^{-34}$ J-s)</p> <p>Formula</p> <p>Answer with unit</p> <p>Given:</p> <p>$W_0 = 3.2 \times 10^{-19}$J</p> <p>$h = 6.63 \times 10^{-34}$ J-s</p> <p>Required:</p> <p>$\nu_0 = ?$</p> <p>$W_0 = h \nu_0$</p> <p>$\nu_0 = W_0 / h$</p> <p>$\nu_0 = 3.2 \times 10^{-19} / 6.63 \times 10^{-34}$</p> <p>$\nu_0 = 4.82 \times 10^{14}$ Hz</p>	1 1	2
	j)	<p>State any two applications of X-rays.</p> <p>Any two applications</p> <p>X- rays are used to detect the cracks in the body of aero plane or motor car.</p> <p>X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control.</p> <p>X - rays are used to detect flaws or cracks in metal jobs.</p> <p>X- rays are used to distinguish real diamond from duplicate one.</p> <p>X- rays are used to detect smuggling gold at airport and docks (ship) yard.</p> <p>X-rays are used to detect cracks in the wall</p> <p>X- ray radiography is used to check the quality of welded joints.</p>	2	2



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1)	j)	X - Rays are used in surgery to detect bone fractured. X- Rays are used to cure skin diseases and destroy tumours. X - Rays are used to cure diseases like cancer X - Rays are used to detect bullets position inside the body		
	k)	What is spontaneous emission and stimulated emission? Each definition Spontaneous emission : When the electron jumps from higher energy state to lower energy state on its own accord, the emission is known as spontaneous emission. Stimulated emission : When the electron jumps from higher energy state to lower energy state by triggering,(supplying external energy) the emission is known as spontaneous emission.	1	2
	l)	State any two properties of X-rays. Any two properties They are electromagnetic waves of very short wavelength They travel with speed of light. They affect photographic plates. They produce fluorescence in many substances. They can be reflected or refracted under certain conditions. They are not deflected by magnetic or electric field. They have high penetrating power. They produce photoelectric effect. They are invisible to eyes. X-ray kill some form of animal cell.	2	2



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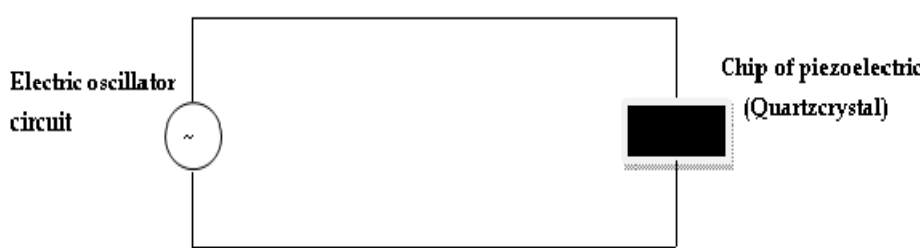
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks						
2)	a)	<p>Attempt any four of the following</p> <p>A bullet of mass 100 gm is fired with a muzzle velocity of 500 m/s from a gun of mass 10 kg. Calculate recoil velocity of gun.</p> <p>Given Formula with substitution Answer with unit</p> <p>Given :</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Gun</td> <td style="width: 50%;">Bullet</td> </tr> <tr> <td>$m_1 = 10 \text{ kg}$</td> <td>$m_2 = 100 \text{ gm} = 100 \times 10^{-3} \text{ kg}$</td> </tr> <tr> <td>$u_1 = ?$</td> <td>$u_2 = 500 \text{ m/s}$</td> </tr> </table> <p>According to law of conservation of momentum.</p> $m_1 u_1 = m_2 u_2$ $u_1 = m_2 u_2 / m_1$ $u_1 = 100 \times 10^{-3} \times 500 / 10$ $u_1 = 5 \text{ m/s}$	Gun	Bullet	$m_1 = 10 \text{ kg}$	$m_2 = 100 \text{ gm} = 100 \times 10^{-3} \text{ kg}$	$u_1 = ?$	$u_2 = 500 \text{ m/s}$	2 2	4
Gun	Bullet									
$m_1 = 10 \text{ kg}$	$m_2 = 100 \text{ gm} = 100 \times 10^{-3} \text{ kg}$									
$u_1 = ?$	$u_2 = 500 \text{ m/s}$									
	b)	<p>Define</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">i) Angle of projection</td> <td style="width: 50%;">ii) Trajectory</td> </tr> <tr> <td>iii) Time of flight</td> <td>iv) Range of projectile.</td> </tr> </table> <p>Each definition</p> <p>i) Trajectory :- The path along which projectile moves is called trajectory. OR It is also defined as the path traced by an object in projectile motion.</p> <p>ii) Angle of projection:- It is defined as angle made by the velocity of projection with the horizontal at the original point.</p> <p>iii) Time of flight:- The total time in which projectile covers the entire trajectory is called as time of flight.</p> <p>iv) Range of projectile:- The total horizontal distance covered by a projectile is called as range.</p>	i) Angle of projection	ii) Trajectory	iii) Time of flight	iv) Range of projectile.	1	4		
i) Angle of projection	ii) Trajectory									
iii) Time of flight	iv) Range of projectile.									

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	c)	<p>Explain the piezoelectric method of production of ultrasonic waves . 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</p>  <p>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</p>	2 1 1	4
	d)	<p>State the criteria for selection of NDT method.</p> <p>Any four criteria</p> <p>i) Codes or standard requirement ii) Specification of material to be tested, for example, nature of material, its size and shape iii) Type of disorders to be detected, also depend on nature of disorders. iv) Testing also depends on manufacturing process of material to be tested v) It is also depending on the equipments available for testing vi) Total cost required to test the material.</p>	4	4



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2)	f)	<p>Advantages :</p> <ol style="list-style-type: none">1. Rapid inspection of each & every component is possible.2. 100 % examination of material or production is possible.3. NDT methods can be automated to lower their costs.4. Testing is possible on shop, floor because of portable equipments; this controls the equality of further production.5. Permanent record of testing can be made during the testing process.6. The destructed parts can be separated in the early stages of manufacturing. This saves the time & production cost.7. Higher accuracy, reliability & repeatability in the test result can be obtained.8. Any other relevant advantage		



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3)	a)	<p>Attempt any four of the following</p> <p>Differentiate between Seebeck effect and Peltier effect .</p> <p>Any Four points</p> <table border="1"><thead><tr><th>Seebeck's effect</th><th>Peltier effect</th></tr></thead><tbody><tr><td>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.</td><td>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.</td></tr><tr><td>Emf is developed across the two junction.</td><td>One junction gets heated and other get cooled.</td></tr><tr><td>Emf generated is small in mV.</td><td>Heat generated or absorbed is small.</td></tr><tr><td>Amount of heat generated depends on pair of metals and temperature difference.</td><td>Amount of heat generated depends on pair of metals and current through it.</td></tr></tbody></table> <p>Any relevant point.</p>	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.	4	16
Seebeck's effect	Peltier effect													
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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.													
	b)	<p>i) Explain variation of thermo emf with temperature using thermocouple characteristics curve.</p> <p>Thermocouple characteristics Curve</p> <p>Explanation</p>	1 1	2										

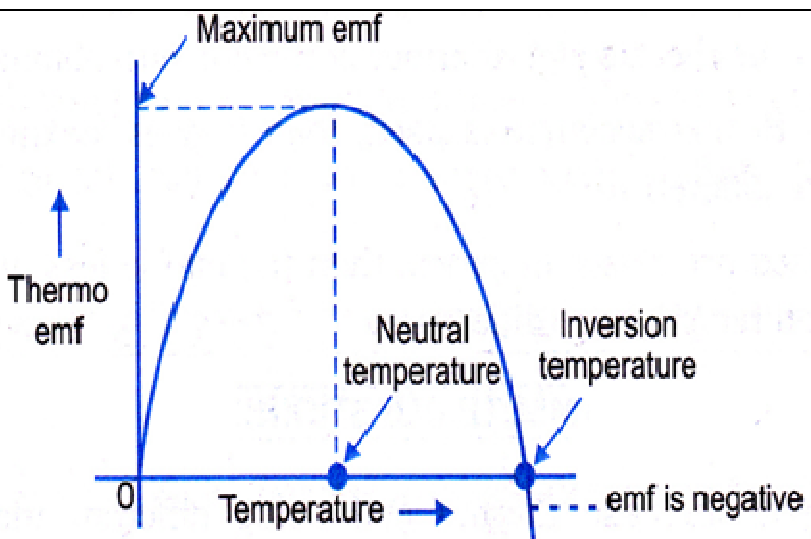


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3)	b)	 <p>The temperature of one junction is placed at 0°C and temperature of other junction is increased by providing heat. The emf generated is measured with the help of millivoltmeter. Number of emf's e_1, e_2, e_3, \dots for different temperatures t_1, t_2, t_3, \dots 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.</p>		
	b)	<p>ii) State Joule Effect. Express it in mathematical form.</p> <p>Statement</p> <p>Mathematical form</p> <p>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</p> <ol style="list-style-type: none"> 1) Square of the current (I^2) 2) Resistance (R) 3) Time for which current flows (t) $H = I^2 Rt / J$	1 1	2



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3)	c)	<p>State characteristics of photoelectric effect.</p> <p>Any four characteristics</p> <ul style="list-style-type: none"> • A metal emits electrons only when the incident (light) radiation has frequency greater than critical frequency (ν_0) called threshold frequency. Threshold frequency different for different metals. • Photoelectric current is directly proportional to intensity of light and independent of frequency. • The velocity of photoelectron is directly proportional to the frequency of light. • For a given metal surface, stopping potential is directly proportional to the frequency and is not dependent on intensity light. • The rate of emission of photoelectrons from the photocathode is independent of its temperature i.e. photoelectric emission is different from thermionic emission. • The process is instantaneous. 	4	4
	d)	<p>Find minimum wavelength and maximum frequency of X rays produced by X ray tube working at 50 KV.</p> <p>Each Formula</p> <p>Each Answer with unit</p> <p>Given : $V = 50 \text{ KV} = 50 \times 10^3 \text{ V}$ $C = 3 \times 10^8 \text{ m/s}$</p> <p>Required: $\lambda_{\min} = ?$ $\nu_{\max} = ?$</p> <p>$\lambda_{\min} = 12400 \times 10^{-10} / V$ $\lambda_{\min} = 12400 \times 10^{-10} / 50 \times 10^3$ $\lambda_{\min} = 0.248 \times 10^{-10} \text{ m}$ $\lambda_{\min} = 0.248 \text{ \AA}$ $c = \nu_{\max} \times \lambda_{\min}$ $\nu_{\max} = c / \lambda_{\min}$ $\nu_{\max} = 3 \times 10^8 / 0.248 \times 10^{-10}$ $\nu_{\max} = 1.20 \times 10^{19} \text{ Hz}$</p>	1 1	4



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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	e)	State any four engineering applications of LASER. Each Application Lasers are used for engraving and embossing of printing plates. For example- number plate, name plate etc., Lasers are used in cutting, drilling and welding metals. Lasers are used in holography Lasers are used in computer printers Lasers are used for 3D, Laser scanners Lasers are used in controlled heat treatment Lasers are used for data transfer through optical fiber from one computer to other Lasers are used to find flaws or defect in material.	1	4
	f)	A wheel of diameter 3 m increases its a speed uniformly from 150 rpm to 300 rpm in 30 second. Calculate angular acceleration and linear acceration. Each Formula & Substitution Each Answer with unit Given: d = 3 m r = 1.5 m n ₀ = 150 / 60 = 2.5 n ₁ = 300 / 60 = 5 t = 30 s Required: α = ? a = ? $\alpha = \frac{\omega_1 - \omega_0}{t}$ $\alpha = \frac{2\pi(n_1 - n_0)}{t}$ $\alpha = \frac{2 \times 3.14 \times (5 - 2.5)}{30}$ $\alpha = 0.523 \text{ rad/s}^2$ $a = r \alpha$ $a = 1.5 \times 0.523$ $a = 0.784 \text{ m/s}^2$	2 2	4