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**		**18**
	a)	**State three equations of motion in kinetics.**		
	Ans.	**Three equations**	2	2
		i) $v = u + at$		
		ii) $s = ut + 1/2at^2$		
		iii) $v^2 = u^2 + 2as$		
	b)	**State law of inertia according to Newton.**		
		Statement	2	2
	Ans.	**Law of inertia-**The body continues its uniform motion or state of rest unless and until an external imbalanced force acts on it.		
	c)	**Calculate the work done when 50 kg bag is lifted from the ground and kept on table with height 95 cm.**		
		Formula		
		Answer with unit	1	
	Ans.	**Given:**	1	2
		m = 50 kg,		
		S = 50 cm = 50×10^{-2} m,		
		g = 9.8 m/sec^2.		
		Work done =?		
		Work done = force x displacement		
		Work done = m a x S		
		Work done = $50 \times 9.8 \times 50 \times 10^{-2}$		
		Work done = 245 joule OR J.		
	d)	**Define centripetal force with an example.**	1	
		Definition	1	2
		Any one example		
	Ans.	**Centripetal 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		
		Example: - Stone tied at one end of string and whirled, electron revolving around the nucleus.		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	e)	**State piezoelectric effect.** **Statement**	2	2
	Ans.	**Piezoelectric effect:** When the electric field is applied across the crystal its dimensions changes and when alternating P.D. is applied across crystal then the crystal sets into elastic vibrations.		
	f)	**State Seebeck effect.** **Statement**	2	2
	Ans.	**Seebeck 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.		
	g)	**Give thermoelectric series for thermocouple.** **Series**	2	2
	Ans.	**Thermoelectric Series:** Antimony, Iron, Zinc, Silver, Gold, Lead, Copper, Platinum-Rhodium, Platinum, Constantan, Bismuth.		
	h)	**What is photon or quanta of light?** **Definition**	2	2
	Ans.	**Photon**: A small packet (Bundle) of light energy is called photon or quanta of light.		
	i)	**Define threshold wavelength and threshold frequency.** **Each definition**	1	2
	Ans.	**Threshold Wavelength:** It is the maximum wavelength of incident radiation at or below which photoelectric effect takes place. (emission of photoelectrons takes place) **Threshold Frequency:** It is the minimum frequency of incident radiation at or above which photoelectric effect takes place. (emission of photoelectrons takes place)		
	j)	**Give phenomenon of X-ray production.** **Phenomenon**	2	2
	Ans.	**Production of X-Rays:** When fast moving electrons are suddenly stopped by solid target X-rays are produced.		

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Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	k)	**Define population inversion in LASER production.** **Definition**	2	2
	Ans.	**Population inversion:** Making population of excited state more than that of ground state is called population inversion.		
	l) **Ans.**	**Write expression for minimum wavelength of X-Rays.** **Formula** $$\lambda = \frac{h\,c}{e\,V} \qquad \textbf{OR}$$ $$\lambda = \frac{12400}{V} A^{0}$$	2	2
2)		**Attempt any four**		**16**
	a)	**Define potential energy. A 50 gm stone is ejected from a trap with velocity of 40 m/sec. Calculate Kinetic energy.** **Definition** **Formula with substitution** **Answer with unit**	1 2 1	4
	Ans.	**Potential energy: -** The energy possessed by the body due to its position is called potential energy. **Given :** m = 50 gm = 50 x 10^{-3} kg , V = 40 m/s Kinetic energy (K.E) =? We have, $$K.E = \frac{1}{2} \times m \times v^{2}$$ $$K.E = \frac{1}{2} \times 50 \times 10^{-3} \times (40)^{2}$$ **K.E = 40 joule OR J.**		

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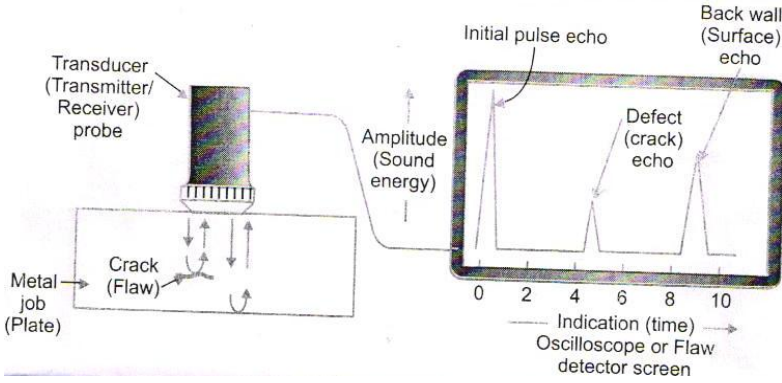
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	b)	**Define : i) Range ii) Time of flight iii) Angle of projection iv) Trajectory in projectile motion.**		
		Each definition	1	4
	Ans.	**i) Range: -** The total horizontal distance covered by a projectile is called as range.		
		ii) Time of flight: - The total time in which projectile covers the entire trajectory is called as time of flight.		
		iii) Angle of projection: - It is defined as angle made by the velocity of projection with the horizontal at the original point.		
		iv) Trajectory in projectile motion: - The path along which projectile moves is called trajectory projectile motion. **OR** It is also defined as the path traced by an object in projectile motion.		
	c)	**Write properties of ultrasonic waves.**		
	Ans.	**Any Four Property**	1	4
		i) Frequency of these sound waves is more than 20 kHz.		
		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.		
	d)	**State the necessary criteria for selecting NDT method in practice.**		
		Any four criteria	1	4
	Ans.	**Criteria for selection:-**		
		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.		

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2	d)	v) It is also depending on the equipment's available for testing. vi) Total cost required to test the material.		
	e)	**State principle of working for Pulse Echo method for ultrasonic testing, using a neat labeled block diagram.** **Principle of working** **Diagram with label**	2 2	4
	Ans.	**Principle of working:-** When ultrasonic are introduced into a material it gets reflected from surface or flow. **Pulse Echo UT method:-** 		
	f)	**A train starts from station A.it attain an uniform velocity of 60 km/hr in 3 min.then travels with this velocity with 15 min. then it retards for 5 min. and come to rest at station B.calculate distance between station A and B.** **Each Formula and answer** **Final answer with unit**	3 1	4

	Ans.	**Given:**
		    $u = 0$ m/s
		    $v = 60$ km/hr $= 16.66$ m/s
		    $t_1 = 180$ sec.
		
		$$v = u + at$$
		
		$$a = \frac{v - u}{t} = \frac{16.66 - 0}{180}$$
		a = 0.092 m/s^2		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks

2)	f)	$$V^2 = u^2 + 2as$$ $$s = \frac{v^2 - u^2}{2a} = \frac{(16.66)^2 - (0)^2}{2 \times 0.092}$$ **s_1 = 1508.45 m**
		
		 As the train moves with constant velocity v =16.66 m/sec^2 for 15 minutes.
		     u = 16.66 m/sec^2,
		     t_2 = 15 min =15 min = 900 sec,
		     a = 0 $$s_2 = ut + \frac{1}{2}at^2 = 16.66 \times 900 + \frac{1}{2} \times 0 \times (900)^2$$ **s_2 = 14994 m.**
		
		 Retarding motion: u=16.66 m/sec, v= 0 m/sec, t=5 min=300 sec $$a = \frac{v - u}{t} = \frac{0 - 16.66}{300}$$ a = - 0.05 m/s^2 $$s = \frac{v^2 - u^2}{2a} = \frac{0 - (16.66)^2}{2 \times 0.05}$$ **s_3 = 2775.55 m**
		
		 The total distance covered by the train from A to B $$\mathbf{S = S_1 + S_2 + S_3}$$ s = 1508.45 + 14994 + 2775.55
		
		 s = 19278 m		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3	a) Ans.	**Attempt any four** **Differentiate Joule's law, Seebeck effect and Peltier effect.** **Any four points**	1	16 4
	b) Ans.	**State thermocouple characteristics.** **Any two characteristics** **Characteristics of thermocouple** 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. iv) As temperature of hot junction increases, the e.m.f generated also increases.	2	4
	c) Ans.	**Threshold wavelength for silver is 3600 A^0. Calculate the energy of photoelectrons emitted when it is exposed U.V. light of wavelength 2800 A^0.** **Formula with substitution** **Answer with unit** **Given** $\lambda_0 = 3600$ A$^0 = 3600 \times 10^{-10}$ m $\lambda = 2800$ A$^0 = 2800 \times 10^{-10}$ m $h = 6.63 \times 10^{-34}$ Js $c = 3 \times 10^8$ m/s **Formula:-**	2 2	4

The table for part a):

Seebeck effect	Peltier effect (Thermoelectric effect)	Joule's effect (Heating effect)
When two dissimilar metals are joined together so that two junctions are formed (thermocouple) and if one junction is heated and other is cooled then electric current flows through it.	1. When electric current flows through a junction of two metals of thermocouple, then heat is generated at one end and heat is absorbed at the other end.	1. When electric current flows through conductor, then it gets heated.
Emf is developed across the two junctions.	2. One junction gets heated and other gets cooled.	2. (Only) heat is produced throughout the conductor.
emf generated is small in mV.	3. Heat generated or absorbed is small.	3. Heat generated is large.
This effect is reversible.	4. This effect is reversible.	4. This effect is irreversible.
Amount of emf generated depends upon pair of metals and temperature difference.	5. Amount of heat generated depends on pair of metals and current through it.	5. Amount of heat generated depends upon value of resistance, current, time.
e.g. thermocouple.	6. e.g. thermocouple.	6. e.g. electric heater, electric iron.

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3)		$E = hc \left(\dfrac{1}{\lambda} - \dfrac{1}{\lambda_0} \right)$ $E = (6.63 \times 10^{-34})\,(3 \times 10^{8})\left(\dfrac{1}{2800 \times 10^{-10}} - \dfrac{1}{3600 \times 10^{-10}} \right)$ $E = (6.63 \times 10^{-34})\,(3 \times 10^{8})\,(3.57 \times 10^{6} - 2.77 \times 10^{6})$ **$E = 1.59 \times 10^{-19}$ J OR 0.994 eV**		
	d) **Ans.**	**Draw neat labeled diagram for X-ray production tube.** **Diagram** **Label** If any Field is missing give appropiate marks	3 1	4
	e) **Ans.**	**Write properties of LASER.** **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	1	4

3)	f)	**Find impulse and impulsive force when a cricket ball 200 gm. with 90 km/hr speed heat the bat and rebound with velocity 100 km/hr. Take 5 millisecond as interactive time.**		
		Conversion	1	
		Formula	1	4
		Each answer with unit	2	
	Ans.	**Given**		

$$m = 200 \text{ gm} = 200 \times 10^{-3} \text{ kg}$$

$$u = 90 \text{ km/hr} = \frac{90 \times 1000}{60 \times 60} = 25 \text{ m/s}$$

$$v = 100 \text{ km/hr} = \frac{100 \times 1000}{60 \times 60} = 27.77 \text{ m/s}$$

$$s = 5 \text{ millisecond} = 5 \times 10^{-3} \text{ s}$$

Formula:-

Impulse = $mv - mu = m(v - u)$

Impulse = $200 \times 10^{-3} (27.77 - 25)$

Impulse = 0.554 Ns   OR kg m/s

Impulsive force = Impulse / time

Impulsive force = $0.554 / 5 \times 10^{-3}$

Impulsive force = 110.8 N