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 of the following**		18
	a)	**State any two equations of angular motion in kinematics with meaning of symbols.**		
		Equation	1	
		Meaning	1	2
		$\omega = \omega_0 + \alpha t$ $\theta = \omega_0 t + \frac{1}{2} \alpha t^2$ ω_0 – initial angular velocity ω - Final angular velocity t – time required θ – Angular displacement α- Angular acceleration		
	b)	**A car starts from rest and accelerates for 15 second at the rate of 0.6 m/s^2. Find the final velocity of a car.**		
		Formula & substitution	1	
		Answer with unit	1	2
		Given : u= 0 a= 0.6 m/s^2 t= 15s v= ? Formula: v=u+at = 0+(0.6 x 15) =9.0m/s		
	c)	**Write definitions of angular velocity and angular acceleration.**		
		Each definition	1	2
		Angular velocity: The rate of change of angular displacement with respect to time is called angular velocity. Angular acceleration: The rate of change of angular velocity with respect to time is called angular acceleration		

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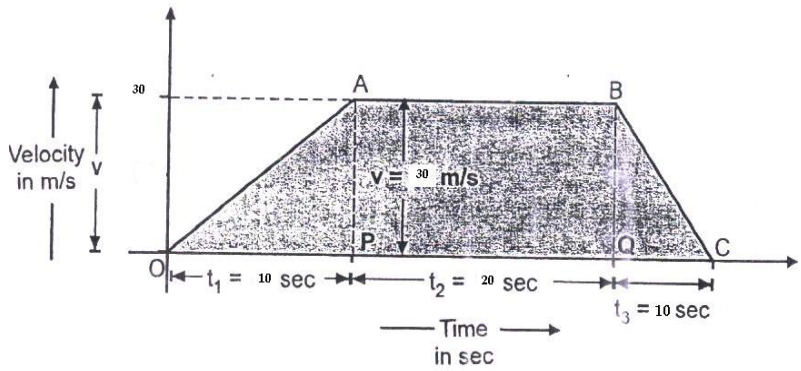
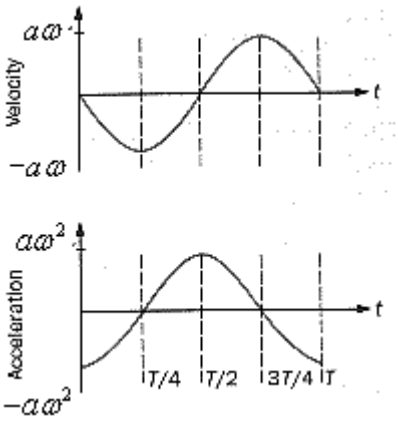
1)	d)	**State the formula for displacement of a body in SHM starting from rest with the meaning of symbols.** **Formula** **Meaning** $y = a\sin\omega t$ Where, y= Displacement of the particle from mean position a = amplitude of S. H. M. ω =Angular velocity t= time	1 1	2
	e)	**Write definition of impulse and state its SI unit.** **Definition** **Unit** **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. Unit of impulse in kg.m/s OR N-s	1 1	2
	f)	**State magnetostriction effect.** **Statement** Magnetostriction effect When a magnetic field is applied across a rod of ferromagnetic material such as iron, cobalt, etc. then its length changes.	2	2
	g)	**State two limitations of NDT methods.** **Any two limitations** **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.	2	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	h)	**State any two criterion for selection of NDT methods** **Any two criteria** 1) Codes or standard requirements. 2) Specification of material to be tested. 3) Types of disorder to be detected, nature of disorder. 4) Manufacturing process of materials. 5) Total cost required for testing the materials.	2	2
	i)	**State two properties of penetrants.** **Any two properties** Properties of penetrates: i. It should possess less surface tension ii. It should possess low viscosity. iii. It should wet specimen in large scale iv. It should have high sensitivity to light, v. It should be good solvent. vi. It should be insert towards specimen vii. It should be easily removable viii. It should be economical & easily available *ix. OR any relevant property*	2	2
	j)	**Name the factors to be considered while controlling reverberation time in an auditorium.** **Any two factors** **i)**Total volume of auditorium. ii)Total absorption of sound in auditorium. iii) Coefficient of absorption iv) Total surface area of auditorium	2	2
	k)	**Luminous flux obtained by 40 watt bulb is 320lumen.** **Calculate luminous efficiency of the bulb.** **Formula with substitution** **Answer with unit** Given: Luminous intensity = 320 lumen Electric power = 40 watt Luminous efficiency=? Formula : $\text{Luminous efficiency} = \frac{\text{Luminous intensity}}{\text{Electric power}}$ $\text{Luminous efficiency} = \frac{320}{40} = 80 \text{ Lumen/watt}$	1 1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	l)	**Write definitions of nanometer and nanoparticle.** **Each definition** **Nanometer :** Nanometer is 10^{-9} m or one Billionth of meter i.e. OR 1nm = 10^{-9} m **Nanoparticle :** Nanoparticle is a particle having its one of the dimensions of the order of less than 100 nm.	1	2

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)		**Attempt any four of the following**		16
	a)	**A vehicle started from rest attains a speed of 30 m/s in 10 second. Then it moves with same speed for 20 seconds and comes to rest after 10 seconds. Calculate the total distance covered using velocity time diagram.**		
		Diagram	1	
		Formula & substitution	2	
		Answer with unit	1	4
				
		Distance covered = Area of Δ OAP + Area of ▭ ABQP+ Area of Δ BQC $=(\frac{1}{2} \times OP \times AP) + (AP \times AB) + (\frac{1}{2} QC \times BQ)$ $= \frac{1}{2} \times 10 \times 30 + 30 \times 20 + \frac{1}{2} \times 30 \times 10$ $= 150 + 600 + 150$ $= 900$ m		
	b)	**State :** **i) Newton's Second of motion. Also give suitable example.** **ii) Law of action and reaction with suitable example.**		
		Each law	1	
		Each Example	1	4
		Newton's second law of motion: It states that the rate of change of momentum of a body is proportional to the applied force and takes place in the direction of force. Example- In a high jump athletic event, the athletes are made to fall on a sand bed. OR *(Any other relevant example)*		

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	b)	Newton's third law of motion: It states that to every action, there is always equal and opposite reaction. Example- Action: A rocket pushes out exhaust… Reaction: The exhaust pushes the rocket forward. OR *(Any other relevant example)*		
	c)	**A disc rotating at 300 rpm accelerates to 1200 rpm in 5 minutes. Calculate the uniform acceleration and the angular displacement within the same period.** **Two formula with substitution** **Two Answers with unit** Given : ω_0=300 rpm = 300 x 2π /60 ω = 1200 rpm = 1200 x 2π /60 t = 5 min = 5 x 60 sec. **Uniform acceleration:** Formula : $\alpha = \frac{\omega - \omega_0}{t}$ $= \frac{2\pi(20-5)}{5\ x\ 60}$ $= \frac{2\ x\ 3.14\ x\ 15}{5\ x\ 60}$ $= \frac{94.2}{300}$ $\alpha = 0.314$ rad /s² **Angular displacement:** $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ $\theta = 2\pi nt + \frac{1}{2}\alpha t^2$ $\theta = \frac{2\times 3.14\times 300\times 5\times 60}{60} + \frac{1}{2}0.314\times 25\times 3600$ $\theta = 23550 rad.$	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	d)	Show graphical representation of velocity and acceleration of a particle in SHM for a particle starting from extreme position. **Each graph with label** 	2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	e)	**An elevator (lift) of mass 200 kg starts moving upward with constant acceleration and acquires a velocity of 3 min after travelling a distance of 6 m. Find the tension in the supporting cable.** **Two formulae and substitution** **Two answer with unit** Given: $g = 9.81\ m/s^2$ $u = 0$ $m = 200\ kg$ $v = 3\ m/s$ $s = 6m$ $T = ?$ $v^2 = u^2 + 2as$ $(3)^2 = 0 + 2 \times a \times 6$ $9 = 12a$ $a = \frac{9}{12}$ $a = 0.75\ m/s^2$ Upward tension $T = m(g + a)$ $T = 200\ (9.81 + 0.75)$ $T = 200(10.56)$ $T = 2112\ N$	2 2	4
	f)	How ultrasonic waves are produced by piezoelectric method? Describe **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.	1 1 2	4

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

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)		**Attempt any FOUR**		16
	a)	State advantages of NDT methods over the conventional testing methods. **Any four advantages** **The advantages of non-destructive testing over conventional testing method** 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	4	4
	b)	**i) Write definitions of intensity of sound and loudness of sound?** **ii) State conditions for good acoustics.** **Each definition** **Any two conditions** **Intensity of sound:** The intensity of sound at a point is defined as the sound energy passing normally at a point through the unit area of the medium in unit time. **Loudness of sound**: Loudness is defined as observers auditory impression of the strength of sound. **Conditions for good acoustics:** i) The sound produced should be uniformly distributed through out the hall ii) The sound should be clearly heard at all points in the hall	1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	b)	iii) No overlapping of musical notes of spoken words in the hall iv) The reverberation of time of the hall should be between 1.25 to 2.5sec for music and 1 to 2 sec for speech v) The echelon effect should be absent vi) No concentration of sound at particular point in the hall as in case of whispering galleries vii) The external sound should not be allowed to enter in the hall.		
	c)	**The volume of auditorium is 6525m³ has reverberation time of 2 seconds. If the total absorbing area in the hall is 4980 m², find the coefficient of absorption.** **Formula with substitution** **Answer with unit** Given: V=6525 m^3 t=2 sec $\Sigma S = 4980\ m^2$ a=? Formula : $t = \frac{0.164\ V}{\Sigma\ as}$ $a = \frac{0.164 \times V}{t\ \ \Sigma s}$ $a = \frac{0.164 \times 6525}{2 \times 4980}$ $a = \frac{1070.1}{9960}$ a=0.107 0.W.U	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	d)	**State different lighting schemes.** **State the factors the factors to be considered while selecting lighting scheme.** **Any two lighting schemes** **Any two factors** Lighting scheme i) Direct lighting system ii) Indirect lighting system iii) Semi indirect lighting system Factors: i) Efficiency of source ii) Utilizations factor or coefficient of utilization iii) Maintenance factor iv) Space to height ratio v) Glare effect	 2 2	 4
	e)	**An unknown lamp placed 80 cm from a photometer screen gives the same illumination as a standard lamp of 36 cd placed 60 cm from that photometer screen. Compute the luminous intensity of the lamp under test.** **Formula with Substitution** **Answer with unit** Given : $r_1 = 80cm$ $r_2 = 60cm$ $I_1 = ?$ $I_2 = 36cd$ $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2} = \frac{80^2}{60^2}$ $I_1 = \frac{r_1^2}{r_2^2} = \frac{80^2}{60^2} \times I_2$ $I_1 = \frac{r_1^2}{r_2^2} = \frac{6400}{3600} \times 36$ $I_1 = 64cd$	 2 2	 4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	f)	State two applications each of nanotechnology in electronic industry and chemical industry. **Any two applications in electronic industry** **Any two applications in chemical industry** **Two applications in electronic industry** 1) The flat panel television or computer monitors are products of nanotechnology. 2) The coating used on screens of TV or monitors can be of nanoparticles, which have better properties in terms of colour quality and resolution. 3) Single electron transitor (SET) and magnetic tunnel junction (MTJ) are new devices based on nanotechnology; such devices are faster, compact and cheaper. 4) *Or any other relevant factor* **Two applications in chemical industry** **1)** Catalyst can be used to unable chemical reaction at low temperature more efficiently it is made using nanoparticles have greater surface area. **2)** Nanostructure membrane are under development to separated co_2 from industrial plant **3)** *Or any other relevant factor*	2 2	4