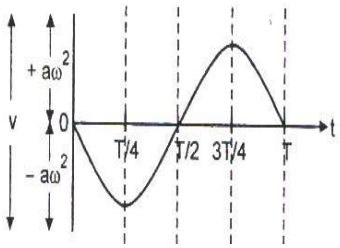
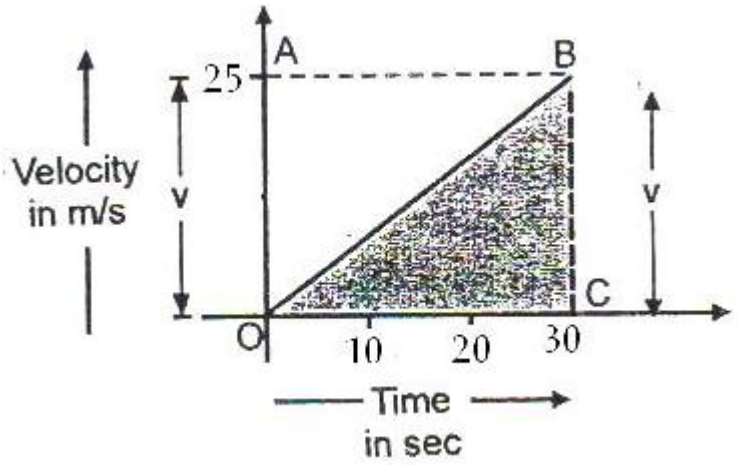
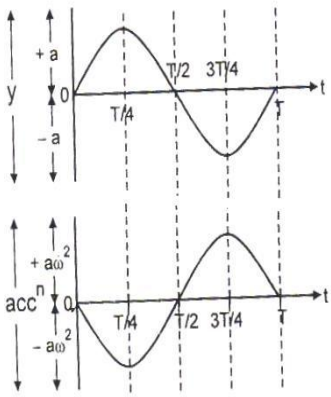
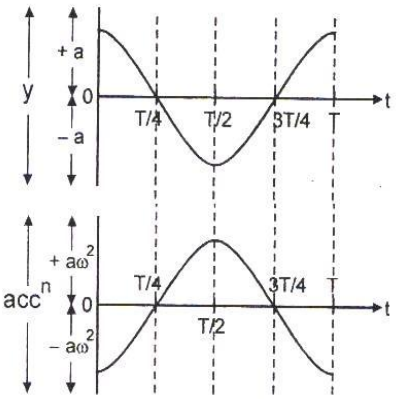
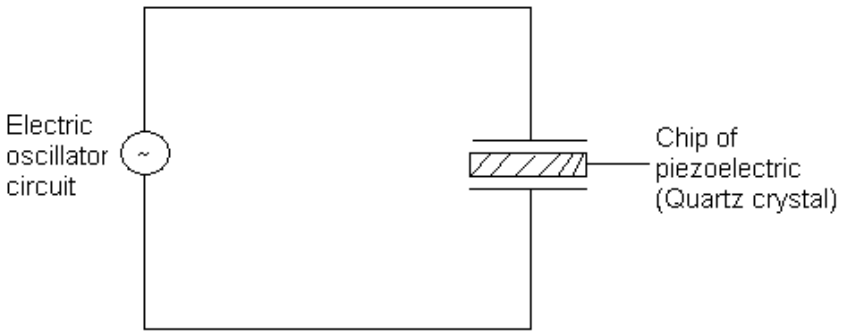
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	a)	**Formula** **Ans. With unit** $u = 0\ m/s$ $s = 981m$ $t = ?$ $s = ut + \frac{1}{2}gt^2$ $981 = 0 + \frac{1}{2}(9.8)t^2$ $t^2 = \frac{981x2}{9.8}$ $t^2 = 200.20$ t = 14.14 sec.	1 1	2
	b)	**Each Definition** **Angular Displacement:** The angle through which the radius vector turns is called Angular displacement. OR Angular displacement can also be defined as the angle subtended at the center of a circle by the path travelled. **Angular Velocity:** The rate of change of angular displacement with respect to time is called angular velocity.	1	2
	c)	**Statement** **Example** **Statement:** It states that, every body continues in its state of rest or of uniform motion in a straight line, unless it is acted upon by some external force. Ex. The motion of the vehicle unless it is stopped by applying brakes. (Any relevant example)	1 1	2
	d)	**Definition** **Range** **Ultrasonic waves:** Ultrasonic are the sound waves having frequency more than 20kHz. **Range:** More than 20kHz.	1 1	2

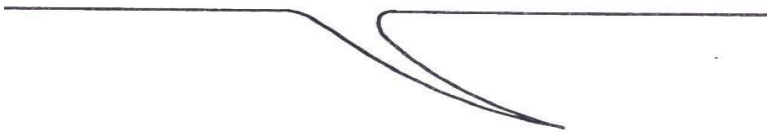
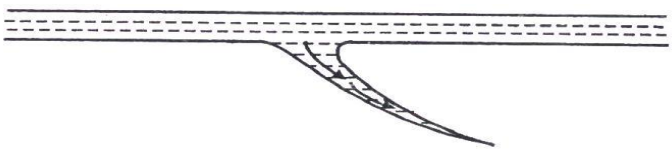
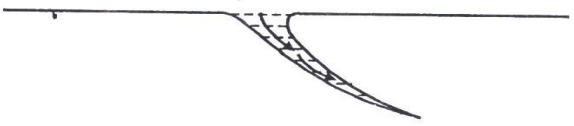
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	e)	**Any Two** **Disadvantages of LPT:** 1) It is useful only for surface open discontinuities. 2) Process is slow. 3) Its running cost is more. 4) Expertise is required to carry test. 5) It is not suitable for highly porous materials.	2	2
	f)	**Each Definition** **Echo:** Echo is defined as same sound is heard again after an interval of $\left(\frac{1}{10}\right)^{th}$ sec due to the reflection of original sound from a surface which is kept at a distance greater than 16.5 m from the source of sound. **Reverberation time:** The time for which the sound persists in a hall even after the source is cut – off is called Reverberation time	1	2
	g)	**Principle** **Principle of Photometry:** If two source of light of illuminating powers I_1 & I_2 are kept at a distance r_1 and r_2 from a screen then the intensities of illumination at a point on the screen due to two source are $\frac{I_1}{I_2} = \frac{r_1^2}{r_2^2}$	2	2
	h)	**Two examples** **Examples (Any two):** Nano tube, Nano wires, Nano fibre, Carbon nano tube, or any other relevant example.	2	2

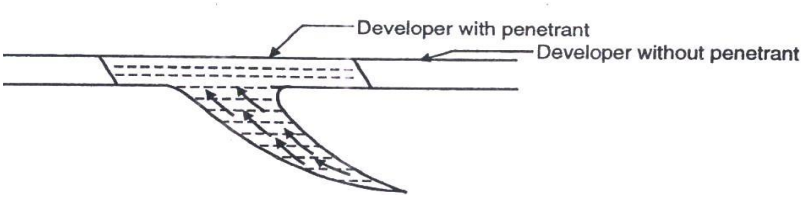
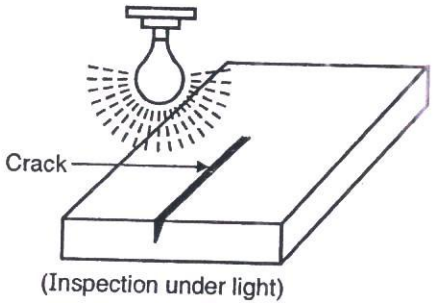
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
1)	i)	**Definition** **Unit** **Momentum:** The quantity of motion possessed by moving body is called momentum. OR The product of mass & velocity of the body is called as momentum. **SI Unit**: kg-m/s OR N-s	1 1	2
	j)	**Graph**  (b) Graph of velocity against time	2	2
	k)	**Formula** **Ans. With unit** Luminous efficiency =Luminous Flux/Electric Power Luminous Flux = Luminous efficiency x Electric Power = 60 x 8 = 480 lumen.	1 1	2
2	a)	**Formula** **Diagram** **Substitution** **Ans. With unit** **Given** u = 0 t = 30 sec v = 90 km/hr $v = \frac{90x1000}{60x60}$ v = 25 m/s	1 1 1 1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	a)	Diagram  Distance covered = Area under the graph S = Area of Δ OBC = ½ (30 x 25) s = 375 m **Acceleration (a):** $a = \frac{v-u}{t}$ $a = \frac{25-0}{30}$ $a = 0.83\ \text{m/s}^2$		
	b)	**Each Graph** **I) Particle starting from mean position.**  (a) Graph of displacement against time (c) Graph of acceleration against time	1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	b)	**II) Particle starting from extreme position.**  **(a) Graph of displacement against time** **(c) Graph of acceleration against time**		
	c)	**Two Formulae** **Two answers with unit** i) Lift is moving up with acceleration = a = 0.92m/s² T = m(g + a) = 2000(9.8 + 0.92) T = 21440 N i) Lift is moving down with acceleration = a = 1.2m/s² T = m(g - a) = 2000(9.8 - 1.2) T = 17200 N	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	d)	**Piezoelectric effect** **Diagram** **Explanation** **Piezoelectric effect** According to this effect when certain crystal like quartz, Rochelle salt, tourmaline etc. are stretched or compressed along certain axis (known as mechanical axis) an electric potential difference is produced along a perpendicular axis (known as electrical axis) i.e. this crystal developed electric charges across their faces when pressure (mechanical) is applied. The converse of this effect is also true. When electric filed is applied across the crystal, crystal dimension change and if alternating potential difference is applied along electric axis, the crystal is set into electric vibration along the mechanical axis. The converse (opposite) piezoelectric effect is used to generate ultrasonic waves.  A chip of piezoelectric crystal like quartz is placed between two plates as shown in a figure. A suitable oscillator is connected across it. When the frequency of oscillator increases then at particular frequency, frequency of oscillator becomes equal to natural frequency of vibration of crystal. Now the quartz crystal is set in to mechanical vibration and ultrasonic waves are produced	1 1 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	e)	**Principle** **Diagram** **Procedure** **Liquid penetration testing method to measure the surface disorder.** **Principle:** It works on the principle of capillarity. **Experimental Procedure:** 1) Surface Penetration: Initially the surface of the specimen is cleaned. Because the presence of flakes, dirt, grease etc on the surface of work piece prevents penetrant to be slip into the cracks. This gives wrong information.  2) Application of Dye penetrant: Suitable fluorescent dye is mixed in penetrant so that its viscosity remains low. This dye penetrant is applied evenly on specimen. Due to capillary action the penetrant goes into the surface open discontinuities. It takes some time. In general case this 'dwell time' is 20-30 minutes.  3) Excess penetrant removal: After dwell time is over, the excess penetrant is removed from the surface carefully. 	1 1 ½ 1 ½	4

2)	f)	4) Application of developer: A thin layer of developer is applied over the surface. The role of developer is to pull the trapped penetrant out of the crack. This provides good visibility of crack.  5) Inspection & evalution of defects: Surface of the specimen is seen under white light or ultraviolet or laser light. The crack can be visualized under light.  (Inspection under light) 6) Post cleaning: After inspection the surface of the specimen is cleaned & the specimen can be used for its intended purpose. **Any four** **Requirements of good acoustics:** 1. The sound produced should be clear & should be uniformly distributed through out the hall. 2. The sound produced should be heard at all points in the hall sufficiently loudly. 3. The sound produced should not overlap. 4. There should not be focusing of sound. 5. There should not be any dead spot or silence zones in the hall.	4	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2)	f)	6. The reverberation time should have proper value. 7. The echelon effect should be absent. 8. The external sound should not enter the hall. 9. There should be no resonance within the building. 10. OR Any other relevant requirement.		
3)	a)	**Two advantages** **Two limitations** **Advantages of NDT:** 1. Material can be used for its intended purpose after testing 2. Rapid inspection of each & every component is possible. 3. 100 % examination of material or production is possible. 4. NDT methods can be automated to lower their costs. 5. Testing is possible on shop, floor because of portable equipments; this controls the equality of further production. 6. Permanent record of testing can be made during the testing process. 7. The destructed parts can be separated in the early stages of manufacturing. This saves the time & production cost. 8. Higher accuracy, reliability & repeatability in the test result can be obtained. **Limitations of NDT:** 1. It requires trained, skilled & certified person for conducting test. 2. Minimum two methods for complete examination of material are required. 3. Cost of equipments is high & thus testing charges are more. 4. Qualitative testing is possible, however quantitative testing is difficult. (Any other relevant advantage or limitation).	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	b)	**Any four points of Reason** **Any four factors** 1. The sound produced should be clear & should be uniformly distributed through out the hall. 2. The sound produced should be heard at all points in the hall sufficiently loudly. 3. The sound produced should not overlap. 4. There should not be focusing of sound. 5. There should not be any dead spot or silence zones in the hall. The reverberation time should have proper value. 6. The echelon effect should be absent. 7. The external sound should not enter the hall. 8. There should be no resonance within the building. OR Any other relevant reason. **Factors affecting acoustical planning of auditorium:** 1. Echo 2. Reverberation 3. Reverberation time 4. Creep 5. Noise pollution	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3)	c)	**Each Definition** **Illumination power:** The Illumination power of a point source is defined as luminous flux per unit solid angle emitted in that direction. **Utilization factor:** It is the ratio of luminous flux received by a working area to luminous flux emitted by a source. **Maintenance factor:** It is the ratio of illuminance obtained under existing condition to the illuminance obtained when everything is clean. **Efficiency of the source:** It is the ratio of luminous flux obtained from the source to the light energy utilized	1	4
	d)	**Textile 2 Applications** **Cosmetic 2 Applications** **Cosmetics:** 1. Due to their small size nanoparticle based creams are preferred as they can be used in small amount and do not leave any gap between them, this gives a smooth appearance. 2. The small particles in some of the creams scattered light in a such way that appearance of the wrinkles is diminished. 3. Nano based dyes and colours are quite harmless to skin and can be used in hair creams or gels. **Note: Any other relevant application related to cosmetics.** **Textile:** 1. There are some cloth produced which would give pleasant look of synthetic fibre but comfort of cotton. 2. Special threads and dyes used in textile are product of nanotechnology; these clothes do not require ironing or frequent cleaning. **3.** Some companies are trying to use silver nanoparticles in washing machine which will make clothes germ free. **Note: Any other relevant application related to textile**	2 2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3	e)	**Conversion** **Two formula** **Ans with unit** Given $t = 25s$ $u = 54km/hr = \frac{54X1000}{60X60} = 15m/s$ $v = 72km/hr = \frac{72X1000}{60X60} = 20m/s$ $s = ?$ $a = \frac{v-u}{t} = \frac{20-15}{25} = 0.20m/s^2$ $v^2 = u^2 + 2as$ $s = \frac{v^2 - u^2}{2a}$ $s = \frac{20^2 - 15^2}{2X0.2}$ $s = 437.5m$	1 2 1	4
	f)	**Each ans with unit** Given: $y = 0.5\sin(4\pi t + \frac{\pi}{3})$ ----------1 We have equation of SHM, $y = a\sin(\omega t + \alpha)$ ----------2 Comparing equation 1 & 2 i) Amplitude = a = 0.5 units ii) Period = T = $\frac{2\pi}{\omega} = \frac{2\pi}{4\pi}$ =0.5 sec iii) Frequency = n= 1/T =1/0.5 =2 Hz iv) Epoch of SHM = α = $\frac{\pi}{3}$	1	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
		Important Instructions for Examiners 1) The definitions given herein are just sample definition format and not to be treated as standard format. Student may write definition in the other words. Such definitions are to be considered and give appropriate marks. Wherever labeled diagrams are asked in the question, marks to be given for the neat-labeled diagram. If, in case, student has drawn only the diagram without labeling, appropriate marks to be deducted.		