PHYSICS **Max.Marks:80**

SECTION-1
(SINGLE CORRECT CHOICE TYPE)

Section-I (Single Correct Answer Type, Total Marks: 24) contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. For each question you will be awarded 3 marks if you darken ONLY the bubble corresponding to the correct answer and zero marks if no bubble is darkened. In all other cases, minus one (-1) mark will be awarded.

21. At a certain instant, a stationary transverse wave is found to have maximum possible kinetic energy. The appearance of string at that instant is

A) sinusoidal shape with amplitude A/3

B) sinusoidal with amplitude A/2

C) sinusoidal shape with amplitude A

D) straight line

22. Regarding a stationary wave on a string which of the following three statements A,B, C are correct. Mark D if all the three statements are correct?

A) Kinetic energy between two successive nodes is same at all instants

B) Potential energy between two successive nodes is same at all instants.

C) The average power passing through a given point of the string is same at all positions.

D) All of the above statements are correct.

23. Which of the following statement is incorrect about stationary waves formed on a string fixed at both ends, being continuously excited by a sinusoidal source.(assume dissipative forces to be negligible, so that the wave send by the source undergoes multiple reflections at the ends.)

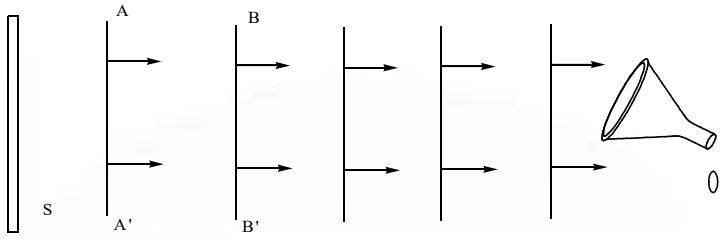
A)Stationary waves of substantial amplitude are formed on a string only if waves travelling in opposite direction interfere constructively.

B) If condition for resonance ($2L=n\lambda$) is satisfied, standing waves formed on the string have substantial amplitude.

C) Stationary waves of substantial amplitude are formed on a string only if waves travelling in same direction interfere constructively.

D) If condition for resonance ($2L=n\lambda$) is not satisfied, standing waves formed on the string have negligible amplitude.

24. A large planer diaphragm (source) produces sound which is received by an antennae (observer) after travelling in air (medium), as shown AA',BB' etc are planer wavefronts, each of which represent successive maxima for the pressure wave. Assume S, O & medium are at rest unless specified otherwise. Consider only wavefronts between S and O. All comparisons are with the case when S, O & medium are at rest .Which of the following are incorrect.



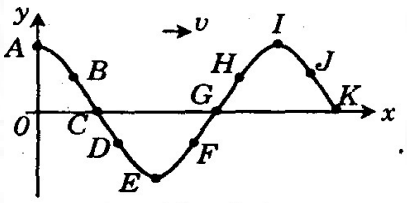
A) If Source is moving towards right, distance between any two wave fronts will decrease.

B) If Source is moving towards right ,time needed by sound to move from A A' to BB' will decrease.

C)If both source & observer are moving left with same velocity, distance between any two wavefronts will remain constant.

D) If medium is moving towards right, distance between any two wave fronts will increase.

25. The figure represents the instantaneous graph of longitudinal displacement vs position of a longitudinal harmonic wave travelling along the positive x - axis. The point moving in the direction of wave is:



A) A B) B C) F D) G

26. A heavy uniform string of length L is suspended from the ceiling of a lift as shown in figure. The lift accelerates upward with acceleration g. A transverse pulse is generated at the fixed end B of the string at the moment when lift starts from rest and pulse velocity is v at this instant. Choose the incorrect statement(s) related to motion of the pulse out of the three statements A,B,C given below. Mark D if all three statements are incorrect

A) As the pulse moves downward, its speed becomes zero before reaching A.

B) The speed of the pulse decreases at a constant rate of g for its entire motion from B to A.

C) The speed of the pulse when it reaches A is same as initial speed v.

D) All of the above

27. Which of the following statements is incorrect?

A) The kinetic energy and potential energy of any small part of a string through which a sinusoidal progressive wave is passing, will be same at all instants of time

B) The kinetic energy and potential energy of any small part of a string through which a sinusoidal progressive wave is passing, will be same at some instant of time

C) The kinetic energy and potential energy of any small part of a string which carries a sinusoidal stationary wave will be same at all instants of time

D) The kinetic energy and potential energy of any small part of a string which carries a sinusoidal stationary wave will be same at some instant of time

28. Which of the following statements is incorrect regarding sinusoidal stationary wave on a string out of the three statements A,B,C given below. Mark D if all the statements are incorrect.

A) Kinetic energy density is maximum at the anti-node at any instant of time

B) Potential energy density is maximum at node at any instant of time

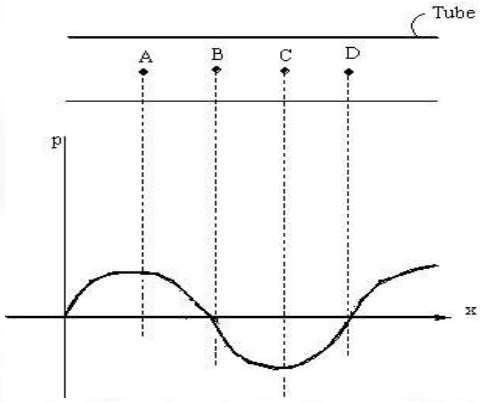
C) Mechanical energy density is maximum at anti-node at any instant of time

D) All of the above statements are incorrect

SECTION-2
(MORE THAN ONE TYPE)

Section - II (Multiple Correct Answers Type, Total Marks: 16) contains 4 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE may be correct. For each question you will be awarded 4 marks if you darken ALL the bubble(s) corresponding to the correct answer(s) ONLY and zero marks otherwise. There are no negative marks in this section.

29. Sound is travelling in a long tube towards right and the graph of pressure – variation Vs position at some instant is given below. A, B, C, D are medium particles inside the tube as shown. Which of the following statements are correct.



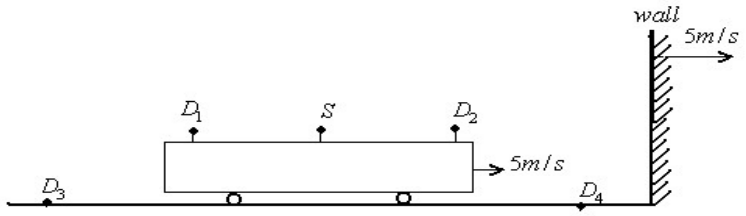
A) velocity at A is towards right while at C velocity is towards left.

B) velocity at A is towards left while at B velocity is zero.

C) velocity at C is towards right while at A velocity is towards left.

D) velocity at A is towards right while at D velocity is zero.

30. A cart seating a source of sound S and two detectors D_1 and D_2 is moving with a constant velocity of 5 ms^{-1} towards a vertical wall which in turn is moving away from the platform with a speed of 5 ms^{-1}. S,D_1 & D_2 are at rest with respect to the cart and S emits sound of frequency n. Stationary detectors D_3 and D_4 are positioned behind the platform and between the platform and the wall as shown in the figure. Speed of sound in still air is V= 340 ms^{-1}. Take $\lambda = V/n.$ Air is still with respect to ground.



A) D_1 detects a frequency =n, and corresponding wavelength is greater than λ

B) D_2 detects a frequency =n, and corresponding wavelength is equal to λ

C) D_3 detects beats and wavelength corresponding to sound from source S is greater than λ

D) D_4 detects beats and wavelength corresponding to sound reflected from wall is greater than λ

31. Consider a very small element of length *dx* in a string in which a plane progressive travelling sinusoidal wave moves along the positive *x*- direction. Let the energy of this element be E and let the rate of change of energy of this element be P. Then,

A) P is positive if the slope of the element and displacement of element from mean position are both positive.

B) P is negative if the slope of the element and displacement of element from mean position are both negative.

C) P is negative if the velocity of the element and displacement of element from mean position are both negative.

D) P is positive if the velocity of the element and displacement of element from mean position are both positive.

32. Dolphins communicate by sending a series of pulses which travel through the ocean water. Each dolphin has a characteristic voice through which other dolphins can recognize it. A dolphin X swimming in shallow water sent one compression pulse towards Y. However Y received a total of 3 pulses characteristic of dolphin X. Then [both the dolphins are under water]

A) one is a compression pulse and two are rarefaction pulses

B) one is a rarefaction pulse and two are compression pulses

C) The first pulse received is a compression

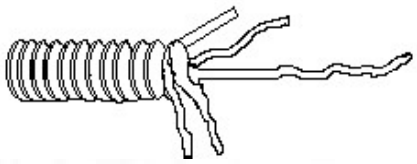
D) The first pulse received is a rarefaction

SECTION-3
[INTEGER TYPE]

Section-III (Integer Answer Type, Total Marks: 24) contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS. For each question you will be awarded 4 marks if you darken ONLY the bubble corresponding to the correct answer and zero marks otherwise. There are no negative marks in this section.

33. Two sound waves moves in the same direction in a medium. If the average powers transmitted across a cross section by them are equal while their wavelengths are in the ratio 1 : 2, then determine the ratio of their pressure amplitudes?

34. A rope is made up of a number of identical strands twisted together. At one point, the rope becomes frayed so that only a single stand continues. The rope is held under tension and a wave of amplitude 1.0 cm is sent from the single strand. The wave reflected back along the single strand has an amplitude of 0.5 cm. How many strands are there in the rope?

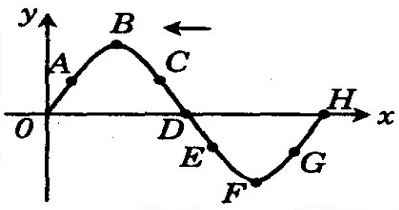


35. A small source of sound radiates equally in all directions. At a particular frequency, the intensity of the sound 1 m from the source is $1\times10^{-5}\,W/m^2$ corresponding to an amplitude of oscillation of the air molecule of $70\,\mu m$. The sound is propagated without energy-loss. The amplitude of oscillation of the air molecules at a distance of 5 m from the source is $2P\,\mu m$. Find P

36. A string 120 cm in length sustains a standing wave, with the points of the string at which the displacement amplitude is equal to 3.5 mm being separated by 15.0 cm. Find the maximum displacement in mm.

37. A racing car starts from rest and accelerates at constant rate $10 m/s^2$ on a straight level track towards a boy standing on the track at a distance of 1 Km from the car. The driver of the car starts sounding horn of constant frequency 1.0 kHz immediately after he starts the car. At an instant 10 s after the boy first listens the horn, the frequency of the horn observed is 1.5 kHz. If speed of sound is 100a+10b+c, find a+b-c.

38. Figure represents the instantaneous picture of a transverse harmonic wave travelling along the negative x-axis. Nine points shown in the figure. how many of them are not moving upwards.

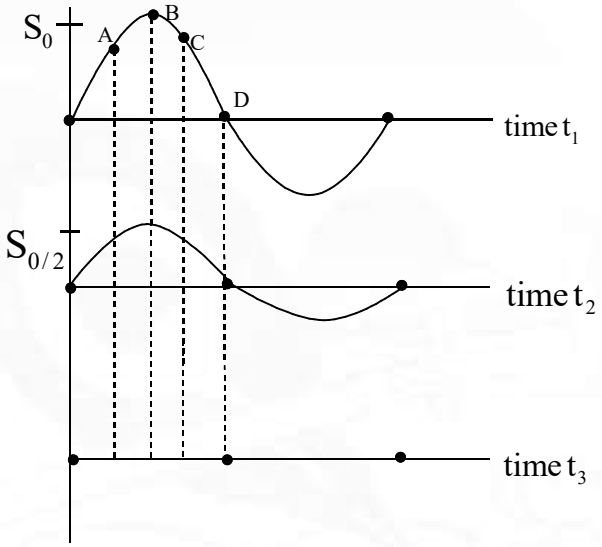


SECTION-4
[Matrix Matching Type]

Section-IV (Matrix-Match Type, Total Marks: 16) contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and five statements (p, q, r, s and t) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS. For each question you will be awarded 2 marks for each row in which you have darkened ALL the bubble(s) corresponding to the correct answer(s) ONLY and zero marks otherwise. Thus, each question in this section carries a maximum of 8 marks. There are no negative marks in this section.

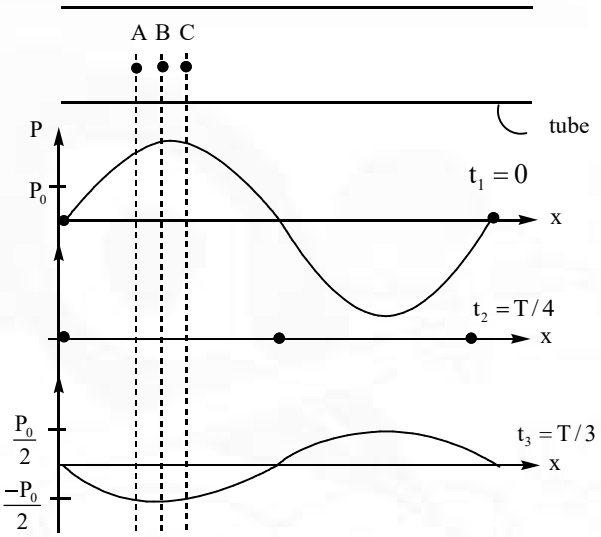
39. The graphs show standing waves on a string at three successive instants of time $t_1, t_2 \& t_3$. A, B, C, D are points on the string. B is a position of displacement anti-node,

and D of displacement node. A is to the immediate left of B and C to immediate right of it.. S_0 is maximum displacement amplitude of standing wave. Table – II gives observations about the net mechanical energy for the points mentioned in column 1 between time interval t_1 to t_3. Match them correctly.



Column – I	**Column – II**
A) A	P) Energy is transferred away from this point
B) B	Q) Energy is transferred towards this point
C) C	R) Energy at this point is being transferred towards left.
D) D	S) Energy through his point is being transferred to right.
	T) No net energy crosses this point.

40. Standing wave is formed inside a tube and graph of pressure variation Vs. position is given at three successive instants of time, t_1, t_2 & t_3. A,B,C are points inside the tube; B a pressure antinode & A & C are two close neighbouring points on its two opposite sides (P_0 is pressure amplitude of the standing wave). T is time period of standing wave.



Column – I	**Column – II**
A) point A at $t = t_1$	P) Displacement is towards right
B) point A at $t = t_2$	Q) The particle is moving left
C) Point A at $t = t_3$	R) Displacement has its maximum possible magnitude at that point
D) Point C at $t = t_2$	S) speed of particle has its maximum possible value.
	T) The particle is at rest