CLASS : CC (ADVANCED)   **WAVES**   **M.M. 81**   **TEST NO. 19**

[SINGLE CORRECT CHOICE TYPE]

Q.1   A loose coil of flexible rope of length L and mass m rests on a frictionless table. A force S is applied at one end of the rope and more rope is pulled from the coil with a constant velocity v. A transverse pulse is produced in the rope while the rope is being pulled from the coil. The velocity of the pulse in the rope (relative to the surface of the table) will be (assuming the pulse moves in the direction of the pull.) **[3]**

(A) zero   (B) 2v   (C) $\sqrt{\dfrac{SL}{m}}$ (D) $\dfrac{1}{2}\sqrt{\dfrac{SL}{m}}$

Q.2   The sinusoidal wave $y(x, t) = y_m \sin(kx - \omega t)$ is incident on the fixed end of a string at $x = L$. The reflected wave is given by: **[3]**
(A) $-y_m \sin(kx + \omega t)$ (B) $y_m \sin(kx + \omega t - kL)$
(C) $y_m \sin(kx + \omega t - 2kL)$ (D) $-y_m \sin(kx + \omega t + 2kL)$

Q.3   A closed organ pipe is vibrating in its second overtone. The length of the pipe is 10cm and maximum amplitude of vibration of particles of the air in the pipe is 2mm. Then the amplitude of S.H.M. of the particles at 9cm from the open end is: **[3]**

(A) $\sqrt{3}$ mm   (B) $\sqrt{2}$ mm   (C) $\dfrac{\sqrt{3}}{2}$ mm   (D) none of these

Q.4   A plane transverse wave of wavelength 1 m is propagating in a direction making an angle of 30° with positive x-axis in the x-y plane. Find phase difference between points (0, 0, 0) and (1, 1, 1). **[3]**

(A) 2π rad   (B) $(\sqrt{3}+1)\pi$ rad   (C) $(\sqrt{2}+1)\pi$ rad   (D) none

Q.5   Two point sound sources emit sounds of the same frequency in the same phase. The distance of the sound sources is AB = 40 m. If the frequency is changed between frequencies 670 Hz and 690 Hz, constructive interference can be experienced at point C on the line segment AB located 5 meters from A. At what frequency does this constructive interference happen? The speed of sound is 340 m/s. **[3]**
(A) 680   (B) 675   (C) 685   (D) none of these

Q.6   In a resonance tube experiment, 80 cm air column is in resonance with a turning fork in first overtone. Which equation can represent correct pressure variation in the air column
(x = 0 is the top point of the tube, neglect end correction, speed of sound = 320 m/sec) **[3]**

(A) $A \sin \dfrac{15\pi}{8} x \cos 600\pi t$ (B) $A \cos \dfrac{15\pi}{8} x \sin 600 \pi t$

(C) $A \cos \dfrac{15\pi}{8} x \sin 300 \pi t$ (D) $A \sin \dfrac{15\pi}{8} x \sin 300 \pi t$

Q.7   The fig.(i) shows the graphical representation of the air molecules in a tube of air (length = L) at atmospheric pressure on the absolute pressure P(x) graph. Which one of the following pictures corresponds to the absolute pressure P(x) graph of fig. (ii). **[3]**
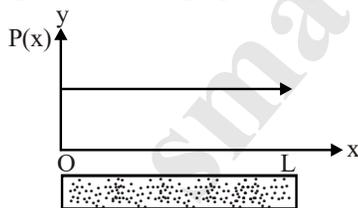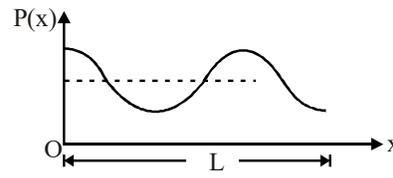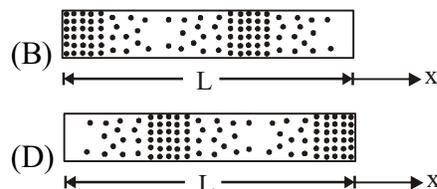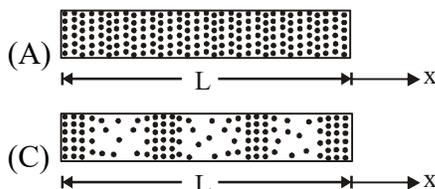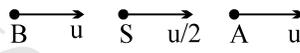

Figure (i)

Figure (ii)

(A)

(B)

(C)

(D)

Q.8   A source is moving with constant speed $v_s = 20$ m/sec towards a stationary observer due east of source. Wind is blowing at the speed of 20 m/sec due 60° north of east. The source is generating frequency of 500 Hz. Then frequency registered by observer is **[3]**
[Speed of sound in still air = 330 m/sec.]
(A) 500 Hz   (B) 532 Hz   (C) 531 Hz   (D) 530 Hz

Q.9   A source of sound is moving with velocity u/2 and two observers A and B are moving with velocity u as shown. Find ratio of wavelength received by A and B. Given that velocity of sound is 10 u. **[3]**   B $\xrightarrow{u}$ S $\xrightarrow{u/2}$ A $\xrightarrow{u}$

(A) $\dfrac{19}{21}$ (B) $\dfrac{17}{21}$ (C) $\dfrac{21}{23}$ (D) $\dfrac{17}{23}$

Q.10   The mechanical energy between a given node and some other node n on a string is $\dfrac{3\rho A^2 \omega^2 \pi S}{k}$, where ρ is the mass density of the string, S is the cross-sectional area, A is the amplitude of two harmonic waves of angular velocity ω travelling on the string in opposite directions. Find the number of the node n from the given node between which the mechanical energy is as given above. **[3]**
(A) 1   (B) 3   (C) 5   (D) 7

[MULTIPLE CORRECT CHOICE TYPE]

Q.11   Two whistles A and B each have frequency of 500 Hz. A is a stationary and B is moving towards the right (away from A) at a speed of 50 m/s. An observer is between the two whistles moving towards the right with a speed of 25 m/s. The velocity of sound in air is 350 m/s. Assume that there is no wind. Which of the following is/are true? **[4]**
(A) the apparent frequency of whistle B as heard by A is 437 Hz approximately.
(B) the apparent frequency of whistle B as heard by observer is 469 Hz approximately.
(C) the difference in the apparent frequencies of A and B as heard by the observer is 4.5 Hz.
(D) the apparent frequencies of the whistles as observer by each other are the same.

Q.12   Transverse waves are being produced at the one end $(x = 0)$ of a wire stretched along x-axis by a tunning fork oscillating along y-axis. The frequency of the fork is 400 Hz and linear mass density of wire is 0.05kg/m. It is observed that at a certain moment of time two consecutive particles, at their extreme on the same side are located at x = 100 cm and x = 200 cm. Now choose the correct option (s): **[4]**
(A) Tension in the string is 32×10^3 N   (B) Speed of the wave is 800 m/s
(C) Wave length of the wave is 2 m
(D) If maximum velocity of particle of the wire is $80\,\pi$ m/s, then displacement amplitude of particle is 10 cm.

Q.13   A stationary sound source emits a wave that is recieved by a stationary observer as $p = p_0 \sin(kx - \omega t)$.
(A) If source moves towards observer, he will perceive higher k as well as ω.
(B) If source moves towards observer, he will perceive lower k but higher ω.
(C) If observer moves towards source, he will perceive same k but higher ω.
(D) If observer moves towards source, he will perceive higher k as well as ω.

Q.14   Standing waves are produced on a stretched string of length L with fixed ends. When there is a node at a distance L/3 from one end, then **[4]**
(A) minimum and next higher number of nodes excluding the ends are 2, 5 respectively
(B) minimum and next higher number of nodes excluding the ends are 2, 4 respectively
(C) frequency produced may be V/(3L)
(D) frequency produced may be 3V/(2L)
[V = velocity of waves in the string]

Q.15   If the tension in a stretched string fixed at both ends is changed by 20%, the fundamental frequency is found to increase by 15Hz. then the **[4]**
(A) original frequency is 157 Hz
(B) original frequency is 150 Hz

(C) velocity of propagation of the transverse wave along the string changes by 10%.

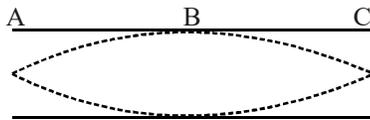(D) fundamental wave length on the string does not change.

Q.16 A transverse wave travelling on a taut string is represented by: $Y = 0.01\sin 2\pi(10t - x) \rightarrow Y$ and x are in metre and 't' in second. Then, **[4]**

(A) the speed of the wave is 10 m/s

(B) closest points on the string which differ in phase by 60° are separated by (1/6) m

(C) Maximum particle velocity is $\pi/4$ m/s

(D) The phase of a certain point on the string changes by 120° in (1/20) seconds

[MATRIX TYPE]

Q.17   **Column-I**   **Column-II**   **[6]**

(A) Graphical representation of pressure variation in both end open organ pipe.
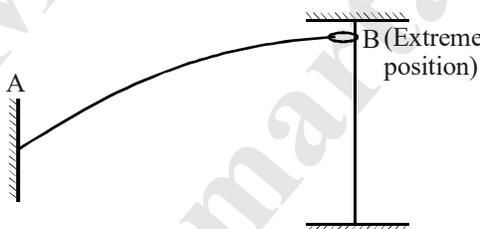
         (P) Maximum kinetic energy at B

(B) Graphical representation of pressure variation in one end closed orgon pipe.

         (Q) Maximum potential energy at B

(C) Snapshot of string fixed at both ends.

         (R) Maximum particle velocity at B

(D) Snap shot of a string fixed at one end and connected to a smooth massless ring that is constrained to move vertically.

         (S) Maximum particle acceleration at B

Q.18 Match the informations about mechanical waves given in column-I with that given in column-II. Note that any information in column-I may have more than one matching options in column-II. **[6]**
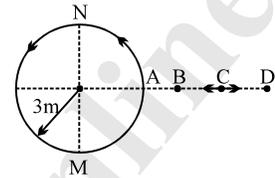
Column-I		**Column-II**
(Nature of wave)		(Properties)
(A) Transverse progressive wave	(P)	Amplitude of all particle same
(B) Longitudinal progressive wave	(Q)	Phase of all particles may be same

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(C) Transverse standing wave		(R)	May occur in gases
(D) Longitudinal standing wave		(S)	KE and PE of a small element may be maximum simultaneously.

[SUBJECTIVE TYPE]

Q.19 Two point sound sources differ in loudness level by 20 dB. Find the ratio of their sound pressure amplitudes. **[5]**

Q.20 Two organ pipes having same length of 1 m are both closed at one of their ends. Both the pipes are oscillated in fundamental mode. The radius of 1st pipe is 5 cm and radius of second pipe is 10 cm. What is the beat frequency (in Hz) produced? (Round off to nearest integer). Take c = 320 m/s. **[5]**

Q.21 A source of sound is moving along a circular orbit of radius 3m with an angular velocity of 10 rad/s. A sound detector located far away from the source is executing linear SHM along the line BD with an amplitude BC=CD=6m. The frequency of oscillation of the detector is $5/\pi$ per second. The source is at the point A when the detector is at the point B. If the source emits a continuous sound wave of frequency 340Hz, find the maximum & minimum frequencies recorded by the detector. (V_{sound}=330m/s) **[5]**

CLASS : CC (ADVANCED)   WAVES   M.M. 81   TEST NO. 19

[SINGLE CORRECT CHOICE TYPE]

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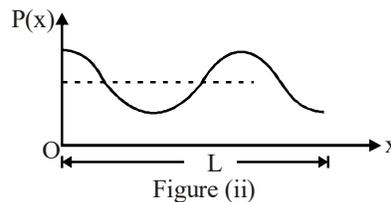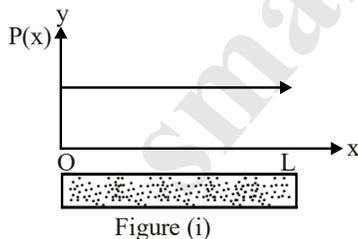(A) 2π rad   (B*) $(\sqrt{3}+1)\pi$ rad   (C) $(\sqrt{2}+1)\pi$ rad   (D) none

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Figure (i)   Figure (ii)

(A)   (B*)   (C)   (D)

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B → u   S → u/2   A → u

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[V = velocity of waves in the string]

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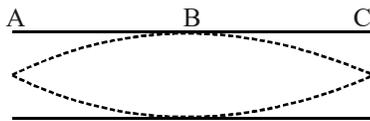(D*) fundamental wave length on the string does not change.

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(A*) the speed of the wave is 10 m/s

(B*) closest points on the string which differ in phase by 60° are separated by (1/6) m

(C) Maximum particle velocity is $\pi/4$ m/s

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[MATRIX TYPE]

Q.17 **Column-I**   **Column-II**   **[6]**

(A) Graphical representation of pressure variation in both end open organ pipe.

(P) Maximum kinetic energy at B

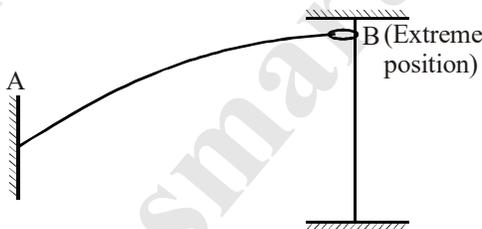(B) Graphical representation of pressure variation in one end closed orgon pipe.

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(C) Snapshot of string fixed at both ends.

(R) Maximum particle velocity at B

(D) Snap shot of a string fixed at one end and connected to a smooth massless ring that is constrained to move vertically.

(S) Maximum particle acceleration at B

[Ans. (A)-Q (B)-Q (C)-Q (D)-S]

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Column-I (Nature of wave)		Column-II (Properties)
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(B) Longitudinal progressive wave	(Q)	Phase of all particles may be same
(C) Transverse standing wave	(R)	May occur in gases
(D) Longitudinal standing wave	(S)	KE and PE of a small element may be maximum simultaneously.

[Ans. (A) P, S; (B) P, R, S; (C) Q, (D) Q, R]
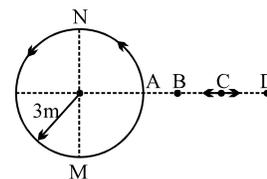
[SUBJECTIVE TYPE]

Q.19   Two point sound sources differ in loudness level by 20 dB. Find the ratio of their sound pressure amplitudes. **[5]**

[Ans. 0010]

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[Ans. 2]

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[Ans. max. = 442 , min. = 255]