PHYSICS

BOOKS - D MUKHERJEE PHYSICS (HINGLISH)

SOUND WAVES

Others

1. Two waves travelling in a medium in the x-direction are represented by

$y_1 = A\sin(\alpha t - \beta x)$ and $y_2 = A\cos\left(\beta x + \alpha t - \frac{\pi}{4}\right)$, where y_1 and y_2 are the displacements of the particles of the medium t is time and α and β constants. The two have different :-

A. speeds

B. directions of propagation

C. wavelengths

D. frequencies

Answer: B

2. A sine wave has an amplitude A and wavelength λ. Let V be the wave velocity and v be the maximum velocity of a particle in the medium. Then

A. V cannot be equal to v

B. $V = v, $ if $A = \lambda / 2\pi$

C. $V = v, $ if $A = 2\pi\lambda$

D. $V = v, $ if $\lambda = A / \pi$

Answer: B

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3. The equation $y = A\cos^2\left(2\pi nt - 2\pi\frac{x}{\lambda}\right)$ represents a wave with

A. amplitude a, frequency n and wavelenth λ

B. amplitude a frequency $2n$ and wavelenth 2λ

C. amplitude $a/2$, frequency $2n$ and wavelength λ

D. amplitude $a/2$, frequency $2n$ and wavelenth $\lambda/2$

Answer: D

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4. The amplitude of a wave disturbance propagating in the positive x-direction is given by $y = \frac{1}{((1+x))^2}$ at time $t = 0$ and by $y = \frac{1}{\left[1+(x-1)^2\right]}$ at $t = 2 \sec onds$, x and y are in meters. The shape of the wave disturbance does not change during the propagation. The velocity of the wave is .... m//s`.

A. 0.5

B. 1

C. 2

D. 4

Answer: A

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5. A wave representing by the equation $y = a\cos(kx - \omega t)$ is suerposed with another wave to form a stationary wave such that point $x = 0$ is a node. The equation for the other wave is

A. $a\sin(kx + \omega t)$

B. $-a\cos(kx - \omega t)$

C. $-a\cos(kx+\omega t)$

D. $-a\sin(kx-\omega t)$

Answer: C

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6. A travelling wave in a stretched string is described by the equation $y=A\sin(kx-\omega t)$ the maximum particle velocity is

A. $A\omega$

B. ω / k

C. $d\omega / dk$

D. x / t

Answer: A

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7. A metal string is fixed between rigid supports. It is initially at negligible tensin. Its Young modulus is Y, density ρ and coefficient of thermal expansion is α. If it is now cooled through a temperature $= t$, transverse waves will move along it with speed

A. $Y\sqrt{\alpha t/\rho}$

B. $\alpha t\sqrt{Y/\rho}$

C. $\sqrt{Y\alpha t/\rho}$

D. $t\sqrt{Y\alpha/\rho}$

Answer: C

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8. Two identical strings are stretched at tensions T_A and T_B. A truning fork is used to set them in vibration. A vibrates in its fundamental mode and B in its second harmonic mode.

A. $T_A = 2T_B$

B. $T_A = 4T_B$

C. $2T_A = T_B$

D. $4T_A = T_B$

Answer: B

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9. The tension of a string is inceased by 44%. If its frequency of vibration is to remain unchanged its length must be increased by

A. 44%

B. $\sqrt{44}\%$

C. 22%

D. 20%

Answer: D

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10. In a sonometer wire, the tension is maintained by suspending a 50.7 kg mass from the free end of the wire. The suspended mass has a volume of 0.0075 m 3. The fundamental frequency of the wire is 260 Hz . If the suspended mass is completely submerged in water, the fundamental frequency will become (take $g = 10ms^{-2}$) [

A. $200Hz$

B. $220Hz$

C. $230Hz$

D. $240Hz$

Answer: D

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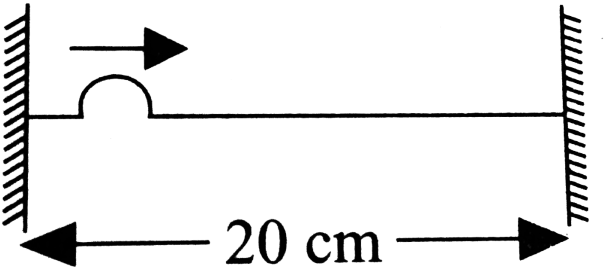
11. A string of length $20cm$ and linear mass density $0.40g/cm$ is fixed at both ends and is kept under a tension of $16N$. A wave pulse is produced at $t=0$ nearj an end as shown in figure which travels towards the other end.

when will the string have the shape shown in

the figure again? $(\in \times 10^{-2} s)$



A. $0.05s$

B. $0.1s$

C. $0.2s$

D. $0.4s$s

Answer: B

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12. A string A has double the length, double the tension, double the diameter and double the density as another string B. Their fundamental frequencies of vibration are n_A and n_B respectively. The ratio n_A/n_B is equal to

A. $1/4$

B. $1/2$

C. 2

D. 4

Answer: A

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13. The extension in a string obeying Hooke's law is x. The speed of sound in the stretched string is v. If the extension in the string is increased to $1.5x$, the speed of sound will be

A. $1.22v$

B. $0.61v$

C. $1.5v$

D. $0.75v$

Answer: A

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14. A cylinderical tube open at both ends, has a fundamental frequency f in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of air column is now

A. $4F$

B. $2F$

C. F

D. $F/2$

Answer: C

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15. An open pipe is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be higher by $100Hz$ then the fundamental frequency of the open pipe. The fundamental frequency of the open pipe is

A. $200Hz$

B. $300Hz$

C. $240Hz$

D. $480Hz$

Answer: A

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16. The third overtone of an open organ pipe of length l_0 has the same frequency as the third overtone of a closed pipe of length l_c. The ratio l_0 / l_c is equal to

A. 2

B. $3/2$

C. $5/3$

D. $8/7$

Answer: D

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17. A pipe of lengh $1m$ is closed at one end. The velocity sound in air is $300m/s$. The air column in the pipe will not resonate for sound of frequency

A. $75Hz$

B. $225Hz$

C. $300Hz$

D. $375Hz$

Answer: C

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18. Two closed organ pipes, A and B have the same length. A is wider than B. They resonante in the fundamental mode at frequencies n_A and n_B respectively.

A. $n_A = n_B$

B. $n_A > n_B$

C. $n_A < n_B$

D. Either (b) or (c) depending on the ratio of their diameters

Answer: C

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19. An organ pipe filled with a gas at $27^{\circ} C$ resonates at $400 Hz$ in its fundamental mode. If it is filled with the same gas at $90^{\circ} C$, the resonance frequency will be

A. $420 Hz$

B. $440 Hz$

C. $484 Hz$

D. $512 Hz$

Answer: B

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20. A point source emits sound equally in all directions in a non-absorbing medium. Two points P and Q are at the distance of $9 meters$ and 25 meters respectively from the source. The ratio of amplitudes of the waves at P and Q is.....

A. $5:3$

B. $3:5$

C. $25:9$

D. $625:81$

Answer: C

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21. A source of sound is in the shape of a long narrow cylinder radiating sound waves normal to the axis of the cylinder. Two points P and Q are at perpendicular distances of 9 m and 25 m from the axis. The ratio of the amplitudes of the waves at P and Q is :-

A. $5:3$

B. $\sqrt{5}:\sqrt{3}$

C. $3:5$

D. $25:9$

Answer: A

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22. Two identical sound S_1 and S_2 reach at a point P is phase. The resultant loudness at point P is n dB higher than the loudness of S_1

the value of n is :

A. 2

B. 3

C. 4

D. 6

Answer: D

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23. Sound of wavelenth λ passes through a Quicke's tube, which is adjusted to give a maximum intensitiy I_0. Through what distance should the sliding tube be moved to give an intensity $I_0 / 2$?

A. $\lambda / 2$

B. $\lambda / 3$

C. $\lambda / 4$

D. $\lambda / 8$

Answer: D

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24. Two sources of sound of the same frequency produce sound intensities I and $4I$ at a point P when used individually. If they are used together such that the sounds from them reach P with a phase differenceof $2\pi / 3$, the intensity at P will be

A. $2I$

B. $3I$

C. $4I$

D. $5I$

Answer: B

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25. If the waves of the form $y = a\sin(\omega t - kx)$ nad $y = a\cos(kx - \omega t)$ are superposed, the resultant wave will have amplitude

A. 0

B. a

C. $\sqrt{2}a$

D. $2a$

Answer: C

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26. A racing car moving towards a cliff, sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If v

is the velocity of sound, then the velocity of the car is

A. $V / \sqrt{2}$

B. $V / 2$

C. $V / 3$

D. $V / 4$

Answer: C

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27. The displacement of a particle in a medium due to a wave travelling in the $x-$ direction through the medium is given by $y = A\sin(\alpha t - \beta x)$, where $t =$ time, and α and β are constants:

A. The frequency of the wave is α

B. The frequency of the wave is $\alpha / (2\pi)$

C. The wavelength is $(2\pi / \beta)$

D. The velocity of the wave is $\frac{\alpha}{\beta}$

Answer: B::C::D

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28. A wave is represented by the equation

$$y = A\sin\left(10\pi x + 15\pi t + \frac{\pi}{3}\right)$$

where x is in meter and t is in seconds. The expression represents :

A. a waves travelling in the positive x direction with a velocity of $1.5m/s$

B. a wave travelling in the negative x-direction with a velocity of $1.5m/s$

C. a wave travelling in the negative x-direction with a wavelength of $0.2m$

D. a wave travelling in the positive x-direction with a wavelength of $0.2m$

Answer: B::C::D

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29. For a sine wave passing through a medium, let y be the displacement of a particle, v be its velocity and a be its acceleration :-

A. y, v and a are always in the same phase.

B. y and a are always in opposite phase.

C. Phase different between y and v is $\pi/2$.

D. Phase different between v and a is $\pi/2$

Answer: B::C::D

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30. P, Q and R are three particles of a medium which lie on the x-axis. A sine wave of wavelength λ is travelling through the medium in the x-direction. P and Q always have the same speed, while P and R always have the same velocity.

The minimum distance between –

(1) P and Q is λ

(2) P and Q is $\lambda/2$

(3) P and R is $\lambda/2$

(4) P and R is λ

A. P and Q is $\lambda/2$

B. P and Q is λ

C. P and R is $\lambda/2$

D. P and R is λ

Answer: A::D

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31. A wave is represented by the equation

$$y = A \sin 314 \left[\frac{t}{0.5s} - \frac{x}{100m}\right]$$

The frequency is n and the wavelength is λ

A. $n = 2Hz$

B. $n = 100Hz$

C. $\lambda = 2m$

D. $\lambda = 100m$

Answer: B::C::D

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32. A plane progressive wave of frequency 25 Hz, amplitude $2.5 \times 10^{-5}m$ and initial phase zero moves along the negative x-direction with a velocity of 300 m/s. A and B are two points 6 m apart on the line of propagation of the wave. At any instant the phase different between A and B is ϕ. The maximum difference in the displacements of particle at A and B is Δ

A. $\phi = \pi$

B. $\phi = 0$

C. $\triangle = 0$

D. $\triangle = 5 \times 10^{-5} m$

Answer: A::D

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33. A sound waves passes from a medium A to a medium B. The velocity of sound in B is greater than in A. Assume that there is no absorption or reflection at the boundary . As the wave moves across the boundary :

A. the frequency of sound will not charge

B. the wavelength will increase

C. the wavelength will increase

D. the intensity of sound will not charge

Answer: A::B::D

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34. In a stationary wave system, all the particles of the medium

A. have zero displacement simultaneously at some instant

B. have maximum displacement simultaneously at some instantate

C. are at rest simultaneously at some instant

D. sreach maximum velocity simultaneously at some instant

Answer: A::B::C::D

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35. A string of length L is stretched along the x-axis and is rigidly clamped at its two ends. It undergoes transverse vibration. If n an integer, which of the following relations may represent the shape of the string at any time :-

A. $y = A\sin\left(\frac{n\pi x}{L}\right)\cos\omega t$

B. $y = A\sin\left(\frac{n\pi x}{L}\right)\sin\omega t$

C. $y = A\cos\left(\frac{n\pi x}{L}\right)\cos\omega t$

D. $y = A\cos\left(\frac{n\pi x}{L}\right)\sin\omega t$

Answer: A::B

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36. The stationary waves set up on a string have the equation :

$y=(2mm)\sin\left[\left(6.28m^{-1}\right)x\right]\cos\omega t$

The stationary wave is created by two identical waves , of amplitude A each , moving in opposite directions along the string . Then :

A. $A=2mm$

B. $A=1mm$

C. The smallest length of the string is $50cm$

D. The smallest length of the string is $2m$

Answer: B::C::D

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37. When a stretched string a length L viberates in its fundamental mode, the sound produced has wavelength $= L/2$ in air. The velocity of sound in air is V. The velocity of the transverse waves on the string is

A. $V/4$

B. $V/2$

C. $2V$

D. $4V$

Answer: D

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38. When a stretched string of length L vibrating in a particular mode, the distance between two nodes on the string is l. The sound produced in this mode of vibration constitutes the nth overtone of the fundamental frequency of the string.

A. $L = (n+1)l$

B. $L - (n-1)l$

C. $L = nl$

D. $L = (n+1/2)l$

Answer: A

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39. A transverse sinusoidal wave of amplitude a, wavelength λ and frequency f is travelling on a stretched string. The maximum speed of any point in the string is $v/10$, where v is the speed of propagation of the wave. If $a = 10^{-3} m$ and $v = 10 ms^{-1}$, then λ and f are given by

A. $\lambda = 2\pi \times 10^{-3} m$

B. $\lambda = 10^{-3} m$

C. $f = 10^3 / (2\pi) Hz$

D. $f = 10^3 Hz$

Answer: A::C

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40. A heavy unifrm rope hangs vertically from the ceiling, with its lower end free. A disturbance on the rope travelling upward from the lower end has a velocyt v at a distance x from the lower end.

A. $v \propto 1/x$

B. $v \propto x$

C. $v \propto \sqrt{x}$

D. $v \propto 1/\sqrt{x}$

Answer: C

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41. When the open organ pipe resonates in its fundamental mode then at the centre of the pipe

A. the gas molecule undergo vitrations of maximum amplitude.

B. the gas molecule are at rests

C. the pessure of the gas is constant

D. the pressure of the gas undergoes maximum variation

Answer: B::D

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42. In as resonance -column experiment, a long tube, open at the top, is clamped vertically. By a separate device, water level inside the tube can be moved up or done. The section of the tube from the open end to thewater level acts as a cloed organ pipe. A vibrating tuning fork is held above the open end, and the water level is gradually pushed down. The first and the second resonance occur when the water level is $24.1cm$ and $74.1cm$ respectively below the open end. The diameter of the tube is $2cm$

A. $2cm$

B. $3cm$

C. $4cm$

D. $5cm$

Answer: B

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43. In a mixture of gases, the average number of degrees of freedom per molecule is 6. the rms speed of the molecules of the gas is C. the velocity of sound in the gas is

A. $c/\sqrt{2}$

B. $3c/4$

C. $2c/3$

D. $c/\sqrt{3}$

Answer: C

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44. The velocity of sound in dry air is V_d, and in moist air it is V_m. The velocities are measured under the same conditions of temperature and pressure. Which of the following statements is fully correct?

A. $V_d > V_m$ because dry air has lower density than moist air.

B. $V_d < V_m$ because moist air has lower density than dry air.

C. $V_d > V_m$ because the bulk modulus of dry air is greater than that of moist air.

D. $V_d < V_m$ because the bulk modulus of moist air is greater than that of dry air.

Answer: B

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45. When we hear a sound, we can identify its source from

A. the frequency of the sound

B. the amplitude of the sound

C. the wavelength of the sound

D. the overtones present in the sound

Answer: D

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46. Sounds from two identical sources S_1 and S_2 reach a point P. When the sounds reach directly, and in the same phase, the intensity at P is I_0. The power of S_1 is now reduced by 64% and the phase difference between S_1 and S_2 is varied continuously. The maximum and minimum intensities recorded at P are now $I_{\max}$ and $I_{\min}$

A. $I_{\max} = 0.64 I_0$

B. $I_{\min} = 0.36 I_0$

C. $I_{\max} / I_{\min} = 16$

D. $I_{\max} / I_{\min} = 1.64 / 0.36$

Answer: A::C

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47. A vibrating string produces 2 beats per secod when sounded with a turning fork of frequency $256Hz$. Slightly increasing the tension in the string produces 3 beats per second. The initial frequency of the string may have been

A. $253Hz$

B. $254Hz$

C. $258Hz$

D. $259Hz$

Answer: B::C::D

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48. A whistle giving out $450H_Z$ approaches a stationary observer at a speed of $33m/s$. The frequency heard the observer (in H_Z) is (speed of sound $= 330m/s$)

A. 409

B. 429

C. 517

D. 500

Answer: D

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49. A car is moving with a velocity of $5m/s$ towards huge wall. The driver sounds a horn of frequency $165Hz$. If the speed of sound in air is $335m / s$, the number of beats heard per second by the driver is

A. 3

B. 4

C. 5

D. 6

Answer: C

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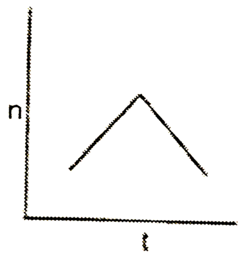
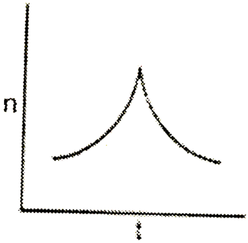
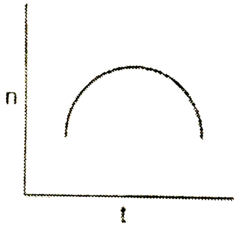
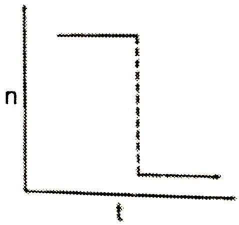
50. A railway engine whistling at a constant frequency moves with a constant speed. It goes past a stationary observer standing beside the railway track. The frequency (n) of the sound heard by the observer is plotted agains time (t). Which of the following best represents the resulting curve?

A. 

B. 

C. 

D. 

Answer: D

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51. Two starts P and Q have slightly different surface temperature T_P and T_Q respectively, with $T_P > T_Q$. Both starts are receding from the earth with speeds v_P and v_Q relative to the earth. The wavelength of light at which they radiate the maximum energy is found to be the same for both.

A. $v_P > v_Q$

B. $v_P < v_Q$

C. $v_P = v_Q$ and the size of $Q >$ the sizer of P

D. Nothing can be said regarding v_P and v_Q from the given data.

Answer: A

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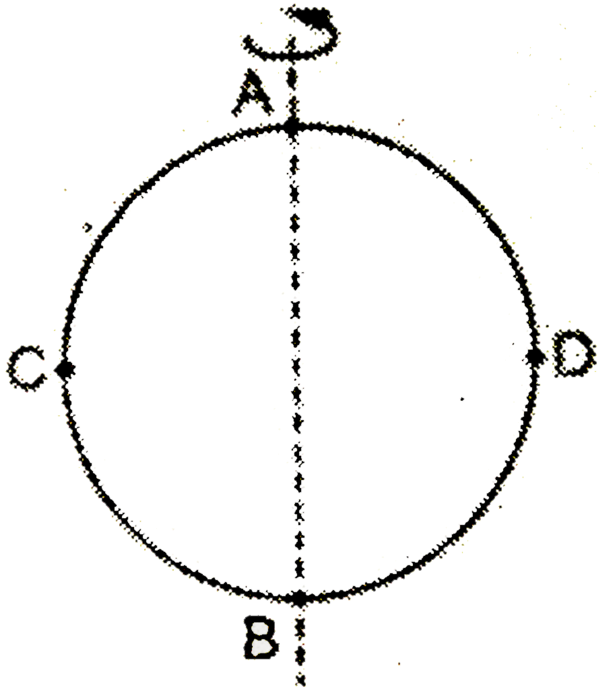

52.

Assume that the sun rotates about an axis through its centre and perpendicular to the plane of rotatin of the earth about the sun. The appearange of the sun, from any one pont on the earth, is shown. Light belonging to a particular spectral line, as received from the points A, B, C and D on the edge of the sun, are analyzed

A. Light from all four points have the same wavelength.

B. Light from C has greater wavelength than the light from D.

C. Light from D has greater wavelength than the light from C.

D. Light from A has the same wavelength as the lighht from B

Answer: C::D

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