QUIZ: SOUND-II

CHARACTERISTICS OF WAVES

1. Two tuning forks A and B of frequencies υ_A and υ_B respectively ($\upsilon_B > \upsilon_A$) are used to produce sound waves in a science laboratory. Which of the following statements is true?

(a) The speed of waves produced by B is more than the speed of waves produced by A.
(b) The speed of waves produced by B is the same as the speed of waves produced by A.
(c) The wavelength of waves produced by B is more than the wavelength of waves produced by A.
(d) The wavelength of waves produced by B is the same as the wavelength of waves produced by A.

2. Radha, Salma and Anne use different tuning forks (of different frequencies) to produce sound in a science laboratory. Which one of the following statements is correct?
(a) The wavelength of sound produced by the tuning fork of highest frequency is smallest.
(b) The wavelength of sound produced by the tuning fork of highest frequency is largest.
(c) The velocities of sound produced by the three tuning forks are different.
(d) The pitch of sound produced by the tuning fork of lowest frequency is highest.

SPEED OF SOUND IN DIFFERENT MEDIA

3. A source is used to produce sound under water. Sound waves propagate from water to air. Which of the following statement is true, as waves travel from water to air?

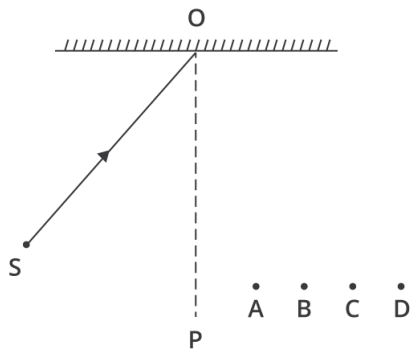
(a) Wavelength increases but frequency decreases.
(b) Wavelength decreases but frequency increases.
(c) Both Wavelength and frequency remain the same.
(d) Wavelength decreases but frequency remains the same.

4. The wavelength of a monochromatic source is 460 nm in vacuum (c = 3 x 10^8 m/s). Waves from the same source pass through medium where the velocity of light is 2.1 x 10^8 m/s. The wavelength of the source in the medium is

(a) 657 nm
(b) 460 nm
(c) 161 nm
(d) 322 nm.

REFLECTION OF SOUND

5. In an experiment, ultrasonic waves are generated by a source S. The waves are incident on a shining metal surface at point O as shown in the Figure. To receive the waves reflected from the metal surface, the most appropriate place to fix the detector is at



(a) A
(b) B
(c) C
(d) D

Answers:

1. (b)
Options:

(a) Speed of sound wave in a medium depends on the characteristics of the medium and not on the frequency of the source. Hence this option is wrong.

(b) Speed of sound waves is independent of source frequency in a given medium. Thus by changing tuning fork, speed of sound wave does not change. Hence this option is Correct.

(c) We know $v = \upsilon\lambda$ and since speed of sound remains constant in a given medium, thus $\lambda \propto \frac{1}{\upsilon}$. Therefore $\frac{\lambda_B}{\lambda_A} = \frac{\upsilon_A}{\upsilon_B}$. Since $\upsilon_B > \upsilon_A$ thus $\lambda_B < \lambda_A$. Hence this option is wrong.

(d) We know that $v = \upsilon\lambda$ and since speed of sound remains constant in a given medium, thus $\lambda \propto \frac{1}{\upsilon}$. Therefore $\frac{\lambda_B}{\lambda_A} = \frac{\upsilon_A}{\upsilon_B}$. Since $\upsilon_B > \upsilon_A$ thus $\lambda_B < \lambda_A$. Hence this option is wrong.

Explanation: Speed of wave depends on the characteristics of a medium and not on the frequency of the source. For a given medium (here medium is air) speed of wave remains constant i.e $v_A = v_B$. Since $v = \upsilon\lambda$, thus $v_A = \upsilon_A\lambda_A$ and $v_B = \upsilon_B\lambda_B$. Therefore $\lambda_A = v_A/\upsilon_A$ and $\lambda_B = v_B/\upsilon_B$. Given that $\upsilon_B > \upsilon_A$, we have $\lambda_A > \lambda_B$ as $v_A = v_B$. Hence options (a), (c) and (d) are wrong.

2. (a)

Options:

(a) Speed of a wave in a medium depends on the characteristics of the medium and not on the frequency of the source. Thus it is same for the three tuning forks. Using relation $v = \upsilon\lambda$, if v is constant, $\lambda \propto \frac{1}{\upsilon}$. Therefore wavelength of sound produced by the tuning fork of highest frequency is smallest. Hence this option is correct.

(b) Speed of a wave in a medium depends on the characteristics of the medium and not on the frequency of the source. Thus it is same for the three tuning forks. Using relation $v = \upsilon\lambda$, if v is constant, $\lambda \propto \frac{1}{\upsilon}$. Therefore wavelength of sound produced by the tuning fork of highest frequency is smallest. Hence this option is wrong.

(c) Speed of a wave in a medium depends on the characteristics of the medium and not on the frequency of the source. It is same for three tuning forks. Hence this option is wrong.

(d) The pitch of the sound depends on frequency. Higher the frequency, higher is the pitch. Hence this option is wrong.

3. (d)

Options:

(a) Frequency is the characteristic of the source and does not depend on the medium. Using relation $v = \upsilon\lambda$, since υ is constant thus $\lambda \propto v$. On entering from water to air, the speed decreases and as a result wavelength decreases. Hence this option is wrong.

(b) Frequency is the characteristic of the source and does not depend on the medium. Using relation $v = \upsilon\lambda$, since υ is constant thus $\lambda \propto v$. On entering from water to air, the speed decreases and as a result wavelength decreases. Hence this option is wrong.

(c) Frequency is the characteristic of the source and does not depend on the medium. Using relation $v = \upsilon\lambda$, since υ is constant thus $\lambda \propto v$. On entering from water to air, the speed decreases and as a result wavelength decreases. Hence this option is wrong.

(d) Frequency is the characteristic of the source and does not depend on the medium. Using relation $v = \upsilon\lambda$, since υ is constant thus $\lambda \propto v$. On entering from water to air, the speed decreases and as a result wavelength decreases. Hence this option is correct.

Explanation: Frequency is the characteristic of the source. It is same, irrespective of the medium. The relation $v = \upsilon\lambda$ decides about the wavelength. Since 'υ' is constant thus $\lambda \propto v$ and speed of sound is more in water than in air ($v_{water} > v_{air}$), therefore$\lambda_{water} > \lambda_{air}$. So as sound waves travel from water to air, wavelength decreases but frequency remains the same.

4. (d)

Options:

(a) Frequency is the characteristic of the source. It is same for all medium. From the relation $v = \upsilon\lambda$, for vacuum $\upsilon = \frac{c}{\lambda}$, where υ is the frequency. For second case in a medium, $\lambda_{medium} = \frac{v}{\upsilon} = \frac{v}{c}\lambda$, where $\upsilon = \frac{c}{\lambda}$. Therefore λ_{medium} = (2.1 × 10^8)/(3 ×10^8) × 460 nm= 322 nm. Hence this option is wrong.

(b) Frequency is the characteristic of the source. It is same for all medium. From the relation $v = \upsilon\lambda$, for vacuum $\upsilon = \frac{c}{\lambda}$, where υ is the frequency. For second case in a medium, $\lambda_{medium} = \frac{v}{\upsilon} = \frac{v}{c}\lambda$, where $\upsilon = \frac{c}{\lambda}$. Therefore λ_{medium} = (2.1 × 10^8)/(3 ×10^8) × 460 nm= 322 nm. Hence this option is wrong.

(c) Frequency is the characteristic of the source. It is same for all medium. From the relation $v = \upsilon\lambda$, for vacuum $\upsilon = \frac{c}{\lambda}$, where υ is the frequency. For second case in a medium, $\lambda_{medium} = \frac{v}{\upsilon} = \frac{v}{c}\lambda$, where $\upsilon = \frac{c}{\lambda}$. Therefore λ_{medium} = (2.1 × 10^8)/(3 ×10^8) × 460 nm= 322 nm. Hence this option is wrong.

(d) Frequency is the characteristic of the source. It is same for all medium. From the relation $v = \upsilon\lambda$, for vacuum $\upsilon = \frac{c}{\lambda}$, where υ is the frequency. For second case in a medium, $\lambda_{medium} = \frac{v}{\upsilon} = \frac{v}{c}\lambda$, where $\upsilon = \frac{c}{\lambda}$. Therefore

λ_{medium} = (2.1 × 10^8)/(3 ×10^8) × 460 nm= 322 nm. Hence this option is correct.

5. (c)

Options:

(a) Ultrasonic waves obey the laws of reflection, and since ∠SOP ≠ ∠POA, therefore ultrasonic waves cannot be detected at position A. Hence this option is wrong.

(b) Ultrasonic waves obey the laws of reflection, and since ∠SOP ≠ ∠POB, therefore ultrasonic waves cannot be detected at position B. Hence this option is wrong.

(c) Ultrasonic waves obey the laws of reflection, and since ∠SOP = ∠POC, therefore ultrasonic waves cannot be detected at position C. Hence this option is correct.

(d) Ultrasonic waves obey the laws of reflection, and since ∠SOP ≠ ∠POD, therefore ultrasonic waves cannot be detected at position D. Hence this option is wrong.

Explanation: Ultrasonic or sound waves follow the same laws of reflection as light waves. This means that waves from S will be reflected by the surface at an angle equal to the angle of reflection: ∠SOP = ∠POC, hence detector should be placed at C.