Sound – Experiment, Viva Voce

EXPERIMENT

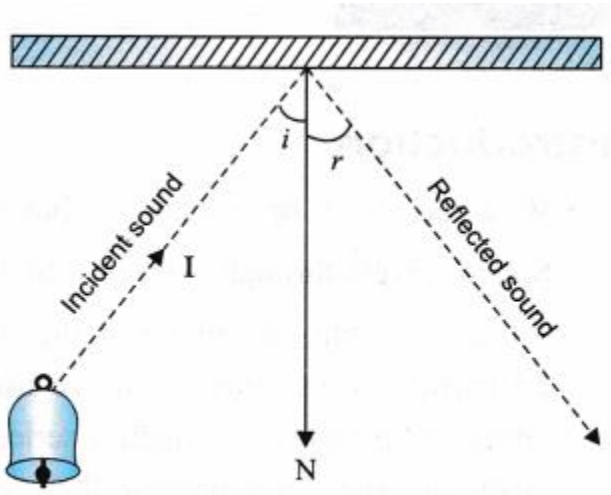
Aim
To verify the laws of reflection of sound.

Theory

1. **Sound:** It is a form of energy produced by vibration and it needs medium to propagate.
2. **Reflection of sound:** As light reflects when it strikes any hard object (opaque), sound also gets reflected when it strikes any object.

Laws of Reflection of sound

1. The angle of incidence is always equal to the angle of reflection.
2. The incident sound wave, the normal and the reflected sound wave lie in the same plane.

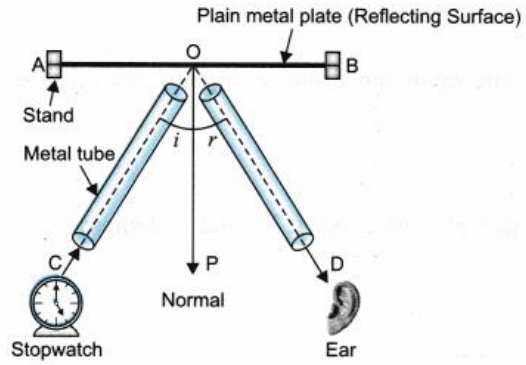


Reflection of Sound
$\angle i = \angle r$

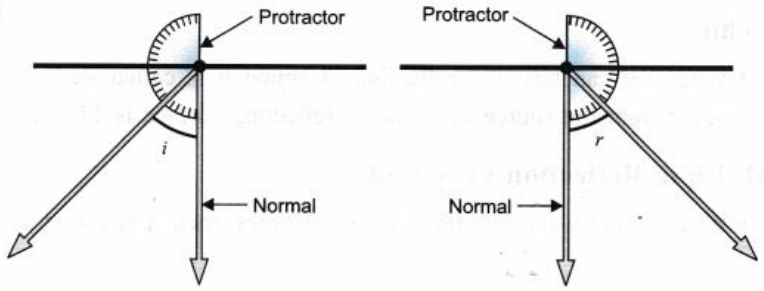
Materials Required
Two highly polished metal tubes made up of stainless steel or aluminium of length 25 cm and diameter 2 cm, a drawing sheet, metal plate, a geometrical set, thumb pins, drawing board/table, stopwatch, metal stand.

Procedure

1. Fix the white sheet on drawing board with thumb pin.
2. Draw a line AB to place the metal plate as reflecting surface with the help of metal stand, and draw normal OP to this line as shown in the figure.
3. Now draw a line OC making an angle of 30° with the line OP.
4. Place one metal tube near to the point O of normal and metal plate on the line OC.
5. Place the ticking watch closer to one end of this metal tube.
6. Now place the second tube so that its one end is near to the point O. Bring your ear close to the other end and adjust its position such that it collects the maximum reflected sound.
7. Mark the position of the tube when it collects the clear and maximum reflected sound.
8. Draw an extended line of reflected sound wave and mark it as OD.
9. Measure the angle of incidence and the angle of reflection.
10. Follow the above procedure and record your observation thrice.



Reflection of Sound



Measurement of ∠*i* and ∠*r*

Observation Table

S.No.	Angle of Incidence ∠*i*	Angle of Reflection ∠*r*
1.	30°	30°
2.	35°	35°
3.	40°	40°

Result

1. The angle of incidence is equal to the angle of reflection.
2. The incident, normal and reflected sound waves lie in the same plane.

Precautions

1. The metal plate should be placed vertical on the drawing board.

2. Both the pipes used should be clean and shining.
3. The sound producer i.e. stopwatch should be placed closer to the end of the metallic tube.
4. Avoid touching of the source of sound to the metal tube.
5. Maintain complete silence in the lab.

VIVA VOCE

Question 1:
What produces sound?
Answer:
Vibration produces sound.

Question 2:
How do human beings produce sound?
Answer:
Due to the vibration of vocal cords.

Question 3:
Can sound travel through the vacuum?
Answer:
No.

Question 4:
What is the speed of sound in air?
Answer:
The speed of sound in air at 22° C temperature is 344 m/s.

Question 5:
What is reverberation?
Answer:
The repeated reflection of sound that results in the persistence of sound is called reverberation.

Question 6:
How is the reverberation of sound reduced at home/auditorium?
Answer:
By using sound absorbing materials like curtains, draperies, ceiling with fibre boards etc.

Question 7:
What is the audible range of sound for human beings?
Answer:
The audible range of sound is 20 Hz to 20,000 Hz.

Question 8:
Name two animals that can hear infrasonic sound.
Answer:
Rhinoceroses, whales, and elephants.

Question 9:
Give two examples of animals that can hear ultrasound.
Answer:
Rats and bats.

PRACTICAL BASED QUESTIONS

Question 1:
Can sound be visualised as a wave? Why?
Answer:
Yes, sound travels in a wave which causes disturbance in the medium particles, set them in motion and wave travels.

Question 2:
Why sound waves are called mechanical waves?
Answer:
As sound waves set the particles of the medium in motion so they are called mechanical waves.

Question 3:
What happens to the speed of sound if the medium is changed?
Answer:
Speed of sound depends on the media in which it is travelling. Speed of sound is higher in solids, and lower in liquids and least in gases.

Question 4:
If the temperature of the medium is increased will that affect the speed of sound?
Answer:
Yes, the speed of sound increases if the temperature of the medium is increased.

Question 5:
Can you hear the reflected sound?
Answer:
Yes, to hear the reflection of sound (echo) the time interval between the original sound and the reflected sound must be at least 0.1 second.

Question 6:
What is the minimum distance required for a person to hear the echo of his sound?

Answer:
The reflecting surface should be at the distance of 17.2 nr from the person who would like to hear his echo distinctly.

Question 7:
How can you calculate the minimum distance for echo?
Answer:
$Speed \quad of \quad sound \quad in \quad air = \frac{distance}{time}$
$344 \quad m/s \quad = \quad \frac{distance}{0.1s}$
distance = 34.4 m
This is the total distance, hence half of 34.4 m is 17.2 m.

Question 8:
There are two tubes, A is wide and B is narrow, which one is suitable for stethoscope?
Answer:
The narrow tube B is suitable for stethoscope as multiple reflection is more and sound can be heard distinctly.

Question 9:
Give two examples where multiple reflection is used.
Answer:
In megaphones, curved ceilings or walls of the concert hall helps in creating multiple reflections of sound.

Question 10:
What are infrasound and ultrasound?
Answer:
The sound with frequency less than 20 Hz are called infrasound waves. The sound with frequency higher than 20 kHz are called ultrasound waves.

Question 11:
If the incident sound wave makes an angle of 35° with the reflecting surface, what is the angle of reflection?
Answer:
The angle of reflection is 55°.

NCERT LAB MANUAL QUESTIONS

Question 1:
While performing this experiment why do we prefer to use pipes of larger length but of smaller diameter?
Answer:

To avoid the diffraction of sound and make its flow unidirectional long tube is used. The small diameter of the tube allows the selected sound wave to travel clearly.

Question 2:
How the experiment of reflection of sound is different from the experiment on laws of reflection of light?
Answer:
For reflection of light we need to take a polished and smooth surface but not transparent whereas for the reflection of sound the surface may not be polished and may be transparent. For sound reflection we need to choose such materials which do not absorb sound.

Question 3:
Which sheet will you choose as sound reflecting surface for this experiment:

1. a smooth wooden board,
   or
2. a thermocol sheet? Why?

Answer:
A smooth wooden board does not absorb the sound as a thermocole sheet does. Hence the wooden board will be used.

Question 4:
Suppose the whole experimental set up of this experiment is submerged in water. What changes do you expect in observations?
Answer:
Speed of sound is faster in water than in air. Hence the sound will travel faster and the diffraction of sound is less.

Question 5:
Why do we require a low-amplitude sound source in this experiment?
Answer:
The low amplitude sound wave will travel with less energy and can be heard distinctly on reflection. But if we take high amplitude sound source the sound reflection will not be that distinct.

Question 6:
What alterations can be made in the pipes to make the reflected sound more distinct and clear?
Answer:
The inside of the pipe can be made rough or fixed with the sound absorber to absorb all unwanted sound.

MULTIPLE CHOICE QUESTIONS (MCQs)
Questions based on Procedural and Manipulative Skills

Question 1:
To study the reflection of sound you have to select two tubes made of material
(a) plastic
(b) metal
(c) cardboard
(d) any of these.

Question 2:
The most appropriate metal tubes one should choose for studying the reflection of sound should have
(a) diameter 8 cm
(b) diameter 5 cm
(c) diameter 4 cm
(d) diameter 2 cm.

Question 3:
The minimum time gap required between the incident sound and the reflected sound to be heard clearly is
(a) 0.1 s
(b) 1.0 s
(c) 0.2 s
(d) 2.0 s.

Question 4:
Sound wave sets the particles of medium into motion hence it is called
(a) longitudinal wave
(b) transverse wave
(c) mechanical wave
(d) none of these.

Question 5:
Sound waves causes compression and rarefactions, it is the characteristic of
(a) transverse wave
(b) longitudinal wave
(c) both (a) and (b)
(d) none of these.

Question 6:
The common property between sound wave and light wave is
(a) both need medium to travel.
(b) speed increases with increase in temperature

(c) both of them travel in similar wave pattern
(d) both of them has same laws of reflection.

Question 7:
For verifying the laws of reflection of sound, a student sets up his apparatus. The experiment is more likely to get performed successfully if the screen is a
(a) rigid board
(b) wooden board with many holes in it
(c) foam padded board
(d) sheet of cloth.

Question 8:
A laboratory had the following apparatus available in it

1. two thin tubes
2. an intense and broad source of sound
3. an intense and pointed source of sound
4. a sharp pointer detector of sound
5. a plane metal sheet as reflector
6. a thermocole reflector.

To verify the laws of reflection of sound successfully a student should choose
(a) (i), (iii), (iv), (v)
(b) (i), (iii), (iv), (ii)
(c) (i), (ii), (iv), (v)
(d) (i), (iii), (iv), (vi).

Question 9:
The audible range of sound frequency by human being is
(a) 20Hz- 2000 Hz
(b) 20Hz- 200 Hz
(c) 20Hz- 20,000 Hz
(d) 20Hz- 200 kHz.

Question 10:
Echo can be heard distinctly only when the distance between the source of sound and the reflecting surface is
(a) 11m
(b) 12 m
(c) 15 m
(d) 17.2 m.

Question 11:
For two sounds to be heard distinctly, the minimum time gap must be
(a) 1 second
(b) 0.1 second
(c) 10 second
(d) 1.1 second.

Question 12:
Sound waves travel fast in
(a) air
(b) vacuum
(c) water
(d) steel.

Question 13:
Sound waves cannot pass through
(a) air
(b) vacuum
(c) water
(d) metals

Question 14:
The speed of sound in air is
(a) 320 m/s
(b) 300 m/s
(c) 380 m/s
(d) 340 m/s.

Question 15:
If the air in the room is heated, the speed of sound will
(a) increase
(b) decrease
(c) remains the same
(d) sometimes increase & sometimes decrease.

Question 16:
The sound wave needs medium to travel, hence it is called
(a) transverse wave
(b) longitudinal wave
(c) mechanical wave
(d) none of the above.

Question 17:
To study the reflection of sound, the pipe should be
(a) hollow and metallic
(b) solid and plastic
(c) wider and wooden
(d) hollow and perforated.

Question 18:
To study the reflection of sound, the best reflecting surface would be
(a) stone
(b) mirror
(c) soil
(d) air.

Question 19:
A short duration disturbance is called
(a) frequency
(b) pulse .
(c) amplitude
(d) note.

Question 20:
The character of wave which does not change with change in medium is
(a) frequency
(b) note
(c) amplitude
(d) pulse.

Questions based on Reporting and Interpretation Skills

Question 21:
The animal that can hear infrasonic sound is
(a) rat
(b) bats
(c) elephants
(d) all of the above.

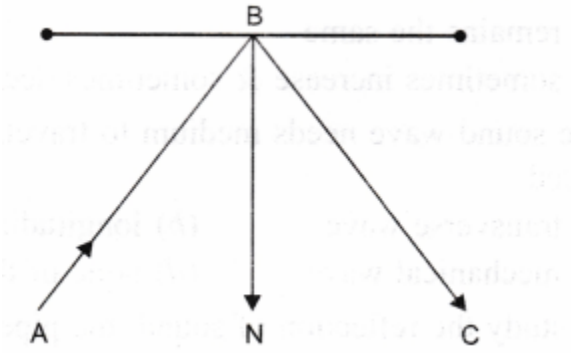
Question 22:
The animal that can hear ultrasonic sound is
(a) whales
(b) rats
(c) elephants
(d) rhinoceros.

Question 23:
For reflection of sound wave, we need
(a) A polished surface
(b) A concave surface painted blue
(c) A large size opaque reflecting surface
(d) a mud plate.

Question 24:
A laboratory had the following apparatus available in it:
(A) Two thin hollow wooden tubes.
(B) An intense & broad source of sound.
(C) An intense & pointed source of sound.
(D) A sharp pointed detector to detect the sound.
(E) A well polished metal sheet.
(F) A white painted thermocol sheet.
A student can do his experiment to verily the laws of reflection of sound successfully by choosing the apparatus labelled as
(a) A, C, D, E
(b) A, C, E
(c) A, B, D, E
(d) A, C, D.

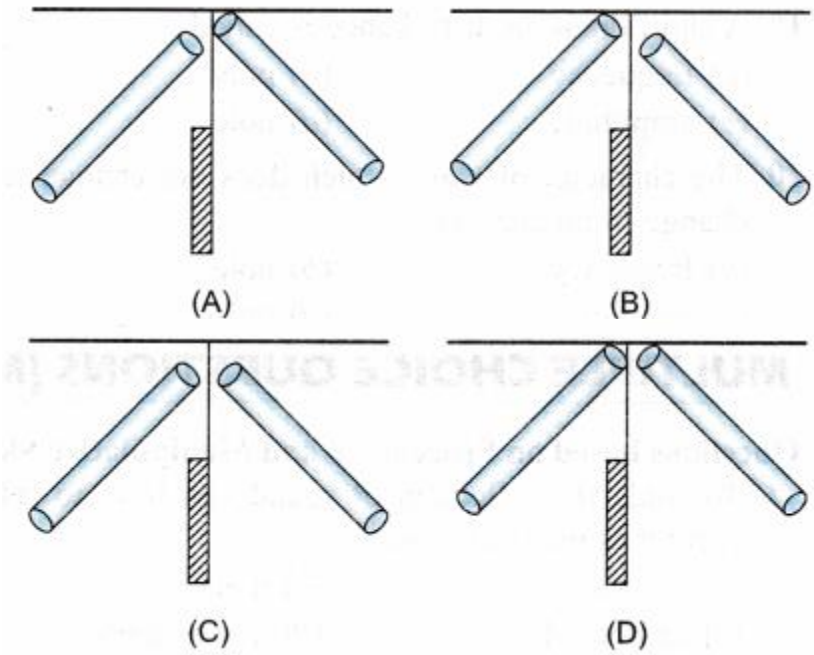
Questions based on Observational Skills

Question 25:
The diagram given shows the reflection of sound. The $\angle ABC$ is 90°, hence the angle of incidence is



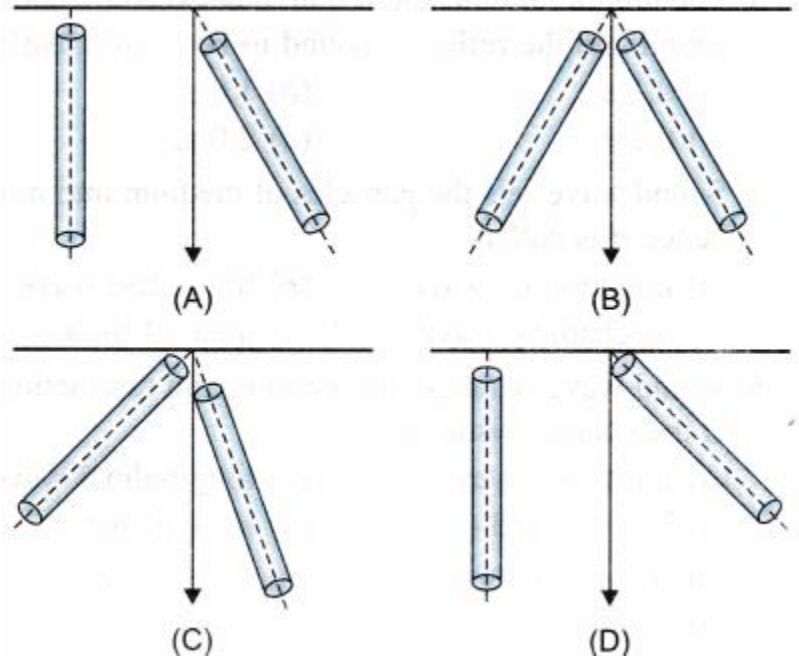
(a) 90°
(b) 0°
(c) 45°
(d) 60°.

Question 26:
Which of the following is the correct experimental set-up for verification of laws of reflection of sound?



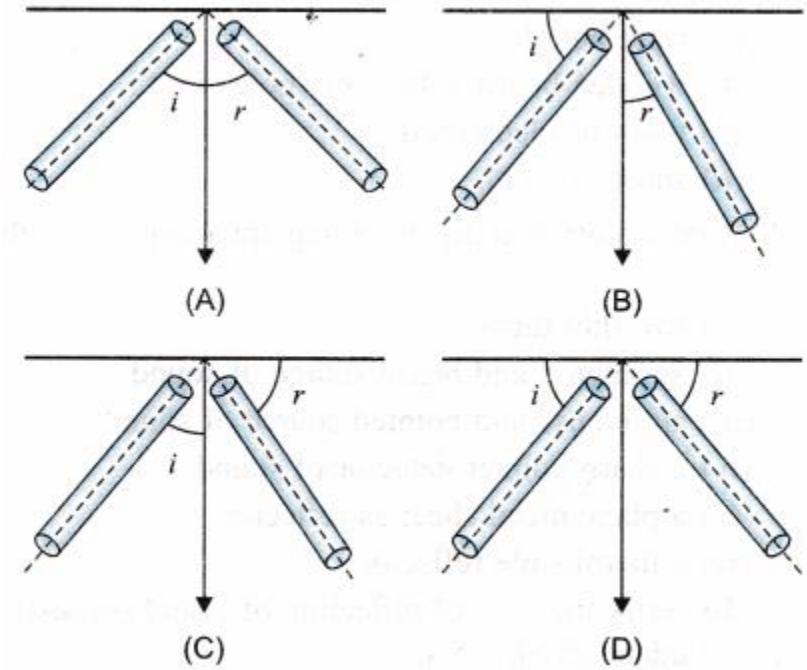
(a) A
(b) B
(c) C
(d) D

Question 27:
Which of the following set-ups is best suited for verifying the laws of reflection of sound?



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

Question 28:
While doing an experiment on verifying the laws of reflection of sound, four students measured the angle $\angle i$ and $\angle r$ as shown in the diagram. The correct measurement of the angle of incidence and angle of reflection has been done by the student



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

Question 29:
If the angle of reflection of a sound wave makes an angle of 40° with the reflecting surface, the angle of incidence would be
(a) 40°
(b) 45°
(c) 50°
(d) 35°.

Question 30:
If the angle of incidence of a sound wave makes an angle of 45° with the normal, the angle of reflection is
(a) 30°
(b) 90°

(c) 45°
{d) 0°.

Question 31:
The minimum distance required to hear a distinct echo from the source of sound is
(a) 11m
(b) 71.2 m
(c) 17.2 m
(d) 21 m.

Question 32:
The sound wave strikes the reflecting surface perpendicularly, the angle of reflection is
(a) 90°
(b) 45°
(c) 0°
(d) 180°.

Question 33:
The physical quantity that will remain unchanged after reflection of a sound wave is
(a) velocit3
(b) wavelength
(c) frequency
(d) all of these.

Question 34:
A student while verifying the laws of reflection of sound measured the angle between the incident sound wave and reflected sound wave as 110°. The angle of reflection is
(a) 110°
(b) 55°
(c) 27°
(d) none of these.

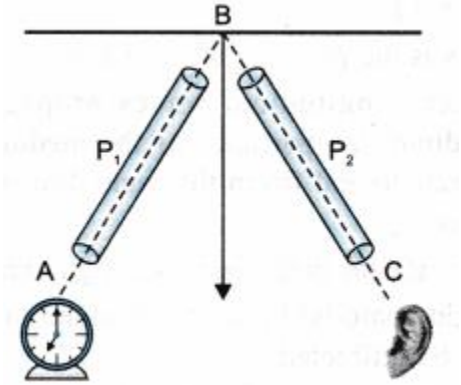
Question 35:
In the experiment for verification of laws of reflection of sound, sound is directed along
(a) axis of the tube.
(b) normal to the axis of the tube
(c) both (a) and (b)
(d) neither (a) nor (b).

Question 36:
The relation between the velocity, wavelength and time period is
(a) $v = \frac{\lambda}{T}$
(b) v = λT

(c) $\lambda = \frac{v}{T}$
(d) $\lambda = \frac{T}{v}$

Question 37:
Reflection of sound obeys the law
(a) $\angle i = \angle r$
(b) $\angle i > \angle r$
(c) $\angle i > \angle r$
(d) none of these

Question 38:
In the given experimental set-up the ticking sound of the clock was heard distinctly through pipe Pr When the end 'C' of pipe P2 was lifted a little upwards, keeping the other end on the table itself, it was found that sound is no longer heard clearly. This shows that



(a) angle of incidence is less than the angle of reflection
(b) angle of incidence is greater than the angle of reflection
(c) incident wave, normal and the reflected wave lie in the same plane.
(d) sound waves do not obey laws of reflection.

Question 39:
When sound waves travel in a medium it transports
(a) velocity
(b) momentum
(c) energy
(d) mass and velocity.

Question 40:
The example of reflection of sound is seen in
(a) cinema halls
(b) megaphone
(c) ceiling walls of concert halls
(d) all of the above.

Question 41:
A student, while verifying the laws of reflection of sound, measured the angle between the incident sound wave and reflected sound wave as 54°. The angle of reflection is
(a) 110°
(b) 55°
(c) 27°
(d) 45°.

SCORING KEY WITH EXPLANATION

1. (d) The sound reflects through all the given medium.
2. (d) Smaller the diameter better is the reflection of sound.
3. (a) The sound heard from the source of sound will reflect and can be heard clearly only if it enters our ear drum after 0.1 s.
4. (c) This is the property of mechanical waves.
5. (b) When longitudinal waves propagate through the medium, the particles of the medium also oscillate/ vibrate to and fro in the same direction/parallel to the wave.
6. (d) $\angle i = \angle r$ for both sound and light waves.
7. (a) Rigid board will not absorb sound and the sound will not be diffracted.
8. (a) The procedural and material requirement.
9. (c) This is the tendency of human hearing as it has limitations.
10. (d) 17.2 m is the minimum distance of echo so that the reflected sound can be heard distinctly.
11. (b) The sound heard from the source of sound will reflect and can be heard clearly only if it enters our ear drum after 0.1 s.
12. (d) Sound travels fast in solids as compared to liquids and gases.
13. (b) Sound waves need medium for propagation, in vacuum it cannot travel.
14. (d) Normally, the speed of sound changes with the temperature of the medium, but this is taken as standard.
15. (a) The higher the temperature, faster the molecules vibrate due to more energy hence the sound propagates faster.
16. (c) Mechanical waves need medium to travel.
17. (a) Hollow pipe will allow the sound to pass through it and the metallic surface helps in reflection.
18. (b) Mirror is polished and smooth surface, which allows regular and maximum reflection.
19. (b) Pulse is a short disturbance for a short duration.
20. (a) Frequency is the number of waves per unit time.
21. (c) That is the hearing capacity of elephants.
22. (b) That is the hearing capacity of rats.
23. (a) A polished surface helps in the maximum reflection.
24. (a) Wooden tubes needed for guided path pointed source and detectors and polished metal sheet act as good reflector.
25. (c) $\angle i = \angle r$ as per law of reflection of sound $\angle i + \angle r$ =90° given, hence $\angle i$ will be 45°.

26. (c) Angle of incidence and reflection should be same, the ends of the tube should not touch the reflecting surface and both the tubes used should have same diameter.
27. (b) Angle of incidence and reflection should be same, the ends of the tube should not touch the reflecting surface and both the tubes used should have same diameter.
28. (a) Angle of incidence is formed between the incident and Normal ray, angle of reflection is formed between the reflected and Normal ray.
29. (c) The angle of incidence will be 50° since $\angle i = \angle r$, angle of reflection will be 50°.
30. (c) As per the law of reflection of sound,$\angle i = \angle r$. As $\angle i$ = 45° so, $\angle r$ = 45°.
31. (c) 17.2 m is the minimum distance of echo so that the reflected sound can be heard distinctly.
32. (c) The $\angle i$ is made between normal and incident ray, the incident ray does not make any angle with normal (because it is perpendicular to the reflecting surface) here, hence it is 0 degree.
33. (d) All three qualities of sound remain the same because sound is reflected in the same medium.
34. (b) $\angle i = \angle r$ the law of reflection of sound.
    $\angle i + \angle r$= 110° given, hence $\angle r$ will be 55°.
35. (a) As per the law of reflection.
36. (a) The relationship is given in the formula
37. (a) The angle of incidence is equal to the angle of reflection
38. (c) The angle of reflection is changed on lifting the tube
39. (c) Sound waves are type of energy waves
40. (d) In all the given examples the sound is reflected.
41. (c) $\angle i = \angle r$. The law of reflection of sound.
    $\angle i + \angle r$ =54° given, hence$\angle r$ will be 27°.