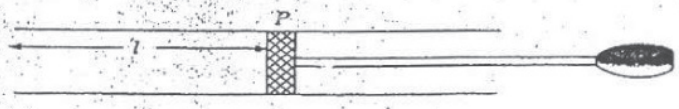
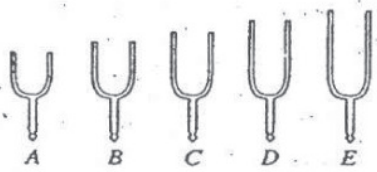
3. To study the resonance phenomenon in sound you are asked to use a glass tube with a piston (P), and a set of tuning forks (A, B, C, D and E) found in your laboratory (see figure). The piston can be moved smoothly inside the glass tube.





(a) All the tuning forks are made of the same material and prongs have the same area of cross section. If it is known that the set of tuning forks has the frequencies, 256 Hz, 384 Hz, 512 Hz, 420 Hz and 320 Hz, what is the frequency of the tuning fork B?

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(b) (i) For a given tuning fork, briefly describe how you would obtain a resonance length l_0 corresponding to the fundamental tone.

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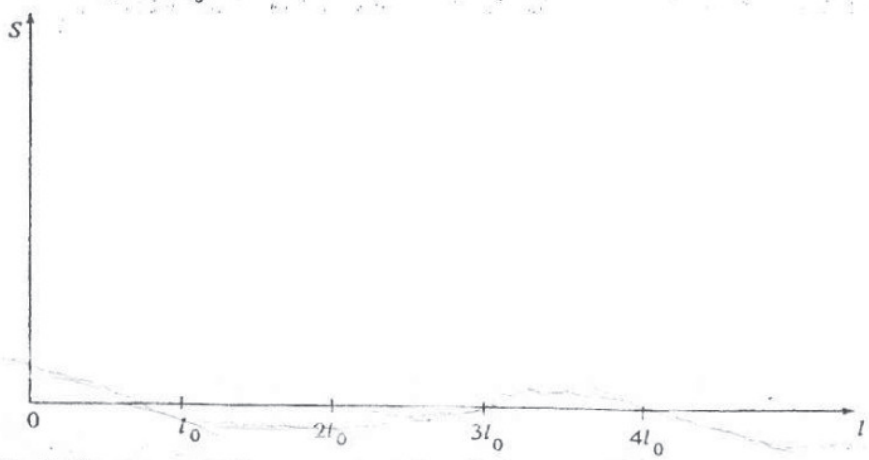
(ii) Instead of the ear, a sound measuring instrument is kept close to the open end of the tube to record the intensity levels (S) of the sound when l (shown in the above figure) is varying in order to obtain l_0 in (b) (i). Sketch below the expected variation of S with l in, and around l_0.



(iii) What is the corresponding resonance length for the first overtone in terms of l_0? (Assume that the end correction is negligible.)

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(iv) Sketch also on the same diagram above, the expected variation of S with l corresponding to the first overtone.

(c) Suppose now you wish to find the velocity of sound in air using **all** the tuning forks in the above set.

(i) In order to use a graphical method to find the velocity of sound in air, which tuning fork from the above set is most desirable to use first.

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(ii) There is another important physical quantity that you should record during the experiment in order to report your result meaningfully. What is this physical quantity?

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(d) In (b) (ii) it was observed that the value of S for one instant was 60 dB. Find the corresponding intensity of sound given that the threshold of audibility is 10^{-12} W m^{-2}.

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