| **Name :** | **Roll Number :** |
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PHY102: Quiz : 3

*IISER, Pune. (8 April, 2019.)*

*Time: 50 minutes.* *Marks : 20*

*Answer all the questions.*
*Unless specified otherwise, all the symbols have their usual meanings.*
*Use the same symbol and notation as given in the questions.*
*Show all the steps of your calculations. No marks for missing steps.*

**1.** Show that bulk modulus for gas is $\gamma P$, where $\gamma$ is the ratio of specific heats and $P$ is the pressure. (3)

**2.** Use the ideal gas approximation. Starting from the speed of sound $c = \sqrt{\gamma P/\rho}$, where $\rho$ is the density, show that

$$\frac{v_1^2}{v_2^2} = \frac{T_1}{T_2}$$

where $v_1$ and $v_2$ are the speed of sound at temperatures $T_1$ and $T_2$ respectively. (3)

**3.** By inspecting the figure given below, write down the average value of the function $y$. If $y(x)$ were a perfect sine function in $[-\pi, \pi]$, write down the Fourier expansion. You need not do detailed calculations for this question. (3)

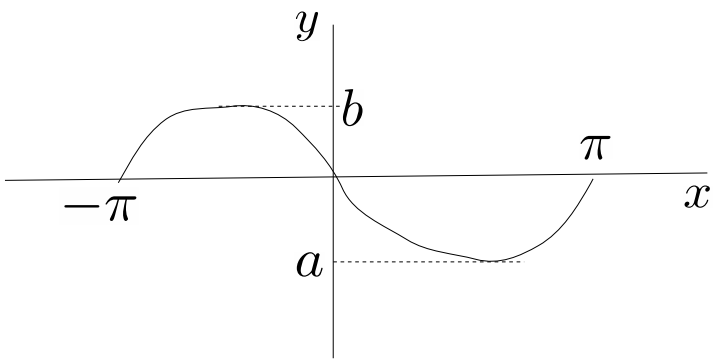


Figure 1:

**4.** Standing sound waves are created in a hollow pipe whose both ends are open. The open ends of the pipe correspond to position of nodes for the pressure variations, which behave exactly like a string tied between two rigid walls. Let the pressure variations of the sound be $P(x,t) = 2.5\sin(\frac{\pi}{2}(x - 300t))$. In this, $P$ is in $N/m^2$, $x$ is in meters and $t$ in seconds. In this pipe, the sound vibrates in the 3rd harmonic. Use all the information given above to deduce the length of the pipe. (4)

**5.** Find the complete Fourier series expansion for $f(x) = \cos^2 x, \quad (-\pi/2 \leq x \leq \pi/2)$. (7)