3. A balloon is filled up 170 g Nitrogen gas and when it goes to the bottom in the sea it's volume turns half. Surface pressure in sea, air pressure and temperature 35^0C and bottom level temperature 15^0C. [Density of water is 1025 kg/m^3, g=9.8m/s^2, R=8.314J/mol/K]
   a. What is rate of independence? 1
   b. What do you mean by dew point temperature at any place is 18^0C? 2
   c. Determine the kinetic energy of the Nitrogen gas at the sea surface. 3
   d. Whether it is possible to determine the height of the lake by considering the change of temperature. Analyze mathematically. 4

c) $E = \frac{3}{2} nRT$ $\quad n = \frac{170}{28} = 6.07 \approx 6$

$= \frac{3}{2} \times 6 \times 8.31 \times 308$ $\quad T = (35 + 273) = 308\,K$

$= 23035.32\ J$

$= 23.036\ kJ$

d) $P_1\ V_1 = 2V$, $T_1 = 308\,K$

$T_2 = 288\,K$, $P_1 + h\rho g$, $V_2 = V$

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$P_2 = \frac{P_1 V_1 T_2}{T_1 V_2}$

$P_1 + h\rho g = P_1 \frac{T_2}{T_1} \frac{V_1}{V_2}$

$h\rho g = 101325 \times \frac{288}{308} \times \frac{2V}{V} - 101325$

$h\rho g = 88165.91$

$h = \frac{88165.91}{1025 \times 9.81}$

$h = 8.77\ m$, so its possible to determine.

2. Four tuning forks are labeled as A, B, C, and D. The density of the material of tuning fork A is 1.4kg/m^3 having frequency 260 Hz and produces sound wave of amplitude 0.5m and velocity 355 m/s in air. Fork-A produces 2 and 6 beat with B and D respectively. B produces 4 beat with D, B and D both produces 3 beat with C.
   a. What is stationary wave? 1
   b. Explain, the effect of a resonating substance presence on the intensity of sound. 2
   c. Calculate the intensity of sound produced by Fork-A. 3
   d. Unknown frequency of tuning fork can be determined by counting beat" Mathematically verify the statement by calculating the frequency of C. 4

c) $I_A = 2\pi^2 f^2 A^2 \rho v$

$= 2 \times \pi^2 \times (260)^2 \times (0.5)^2 \times 1.4 \times 355$

$= 1.66 \times 10^8 \ W/m^2$

d) $f_A = 260 \ Hz$ ——— (I)

A/Q $\therefore f_B = f_A \pm 2$, $f_B = 258 \ Hz$ or $262 \ Hz$ ——— (II)

$f_D = f_A \pm 6$, $f_D = 254 \ Hz$ or $266 \ Hz$ ——— (III)

Again, B produces 4 beat with D.

$\therefore f_D = f_B \pm 4$

Also, B and D both produces 3 beat with C.

$\therefore f_C = f_B \pm 3$ & $f_C = f_D \pm 3$

$\therefore f_C = \frac{f_B + f_D}{2}$

Using (II) & (III)

$f_C = \frac{258 + 254}{2}$ or, $\frac{262 + 266}{2}$

$= 256 \ Hz$ or $264 \ Hz$

For the same tuning fork 2 frequencies not possible.

So, the statement is not correct.

1. In laboratory Dip hangs 15kg mass at the end of the wires of 5m length and 0.6 mm diameter. One wire is steel and the other is lead. After hanging the mass he finds the extension of length of both the wires 0.022m and 0.3325 m respectively [$Y_s = 2\times 10^{11}\ Nm^{-2}$]
   a. What is binding energy? 1
   b. What is the relation between inter molecular force and inter molecular distance? 2
   c. Determine elastic potential energy of the steel wire with expanded condition. 3
   d. Which wire has the higher ability to carry load: Analyze mathematical 4

c) Elastic potential

Energy, $E = \frac{1}{2} \times \frac{Y_s A l^2}{L}$ $\quad A = \frac{1}{4}\pi d^2$

$= \frac{1}{4}\times\pi(0.6\times10^{-3})^2$

$= \frac{2\times10^{11}\times2.82\times10^{-7}\times(0.022)^2}{2\times5} = 2.82\times10^{-7}$

$\boxed{E = 2.730\ J}$

d) Which wire have higher Young modulus will have higher ability to carry load.

For lead,

$Y_l = \frac{FL}{Al}$

$= \frac{mgL}{Al}$

$= \frac{15\times9.8\times5}{2.82\times10^{-7}\times0.3325}$

$= 7.84\times10^{9}\ Nm^{-2}$

i.e. $Y_s > Y_l$

So, Steel has higher ability to carry load.