Data and Instructions for Analysis

(a) Data Set

Observations:

Least count of Vernier Caliper = 0.02 mm

Least count of Stopwatch =0.01 sec

Radius of the disk, r = 35.94 mm

Thickness of the disk, d = 8.86 mm

Outer diameter of the ring, d_1 = 63.82 mm

Inner diameter of the ring, d_2 = 58.20 mm

Average radius of the ring, a = 30.50 mm

Mass of the ring, m= 25.13 g

Temperature of water = 21 ºC

Table 1: Readings for time period without ring

Serial No.	Time required for 25 oscillations (sec)
1.	87.90
2.	87.75
3.	87.60

Table 2: Readings for time period with ring

Serial No.	Time required for 25 oscillations (sec)
1.	92.25
2.	92.29
3.	92.22

Table 3: Readings for logarithmic decrement in Air (λ_0)

Serial No.	No. of oscillation	Maximum Amplitude Left (cm)	Maximum Amplitude Right (cm)
1.	1	24 (B_1C_1)	23.40 (B_2C_2)
2.	20	22.70 ($B_{41}C_{41}$)	21.50 ($B_{42}C_{42}$)
3.	40	21.70 ($B_{81}C_{81}$)	20.50 ($B_{82}C_{82}$)
4.	60	20.60 ($B_{121}C_{121}$)	19.40 ($B_{122}C_{122}$)
5.	80	19.60 ($B_{161}C_{161}$)	18.30 ($B_{162}C_{162}$)

Table 4: Readings for logarithmic decrement in Water (λ)

Serial No.	No. of oscillation	Maximum Amplitude Left (cm)	Maximum Amplitude Right (cm)
1.	1	22.80 (B_1C_1)	21.50 (B_2C_2)
2.	5	16.30 ($B_{11}C_{11}$)	14.80 ($B_{12}C_{12}$)
3.	10	11.70 ($B_{21}C_{21}$)	10.60 ($B_{22}C_{22}$)
4.	15	8.50 ($B_{31}C_{31}$)	7.50 ($B_{32}C_{32}$)
5.	20	6.30 ($B_{41}C_{41}$)	5.40 ($B_{42}C_{42}$)
6.	25	4.60 ($B_{51}C_{51}$)	3.70 ($B_{52}C_{52}$)
7.	30	3.50 ($B_{61}C_{61}$)	2.50 ($B_{62}C_{62}$)
8.	35	2.70 ($B_{71}C_{71}$)	1.90 ($B_{72}C_{72}$)

(B) Instructions for Analysing the Data

Students should perform the analysis in three parts:

1. Calculate the viscosity for multiple sets of data that are given.
2. Plot the histogram.
3. Calculate the standard deviation and mark it on the graph.

Instructions:

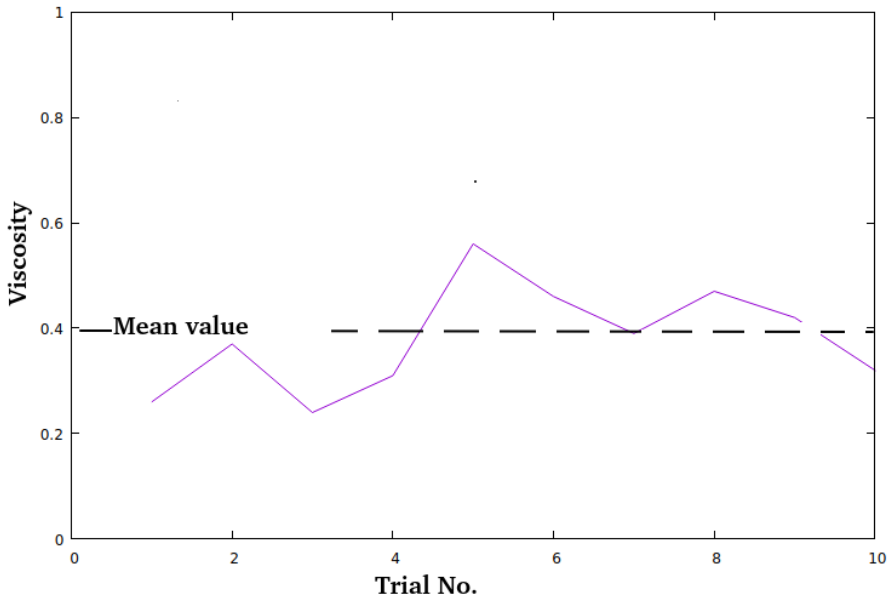
1. All the values of experimental data must be taken into account. No value of experimental data should be excluded. In particular, subset of data should not be chosen to arrive at the standard values.
2. You have been given multiple data sets for determination of viscosity (refer Tables 1-4).
3. As explained in the manual, there are three parts in the experiment; to determine the moment of inertia (I), logarithmic decrement in air (λ_0), and logarithmic decrement in water (λ).

4. These three quantities must be calculated in the following manner :-
    1. Moment of Inertia: The three combinations of T and T', will lead to three values of moment of inertia for the torsional pendulum arrangement. Note that, they all correspond to the same arrangement. Do not calculate mean at this stage.
    2. Logarithmic decrement in air (λ_0): Refer to the main manual for the expression and details of the calculation.
    3. Logarithmic decrement in water (λ): Similar as step 2.
5. Hence, you should have three values of the moment of inertia, four values of the λ_0 and seven values of λ.
6. One should calculate the viscosity with all possible combinations of the data. (i.e. 3*4*7=84 different values of viscosity)
7. Plot the viscosity in the manner illustrated below:

    For example, we have a data set with 10 values of viscosity

Trial no.	1	2	3	4	5	6	7	8	9	10
Viscosity	0.26	0.37	0.24	0.31	0.56	0.46	0.39	0.47	0.42	0.32

We obtain the corresponding graph as:



8. Calculate mean and deviation in the viscosity.
9. Mean for a quantity x is defined as $\langle x \rangle = \sum_{i=0}^{n} x_i / n$, where n is the number of data points.

    Deviation is given by $\Delta x = [\langle x^2 \rangle - \langle x \rangle^2]^{1/2}$, where, $\langle x^2 \rangle = \sum_{i=0}^{n} x_i^2 / n$.
10. Details of numerical calculations are not required to be present in the answer sheet.