MIT

8.01T Physics I

Experiment 9: Angular Momentum

Goal

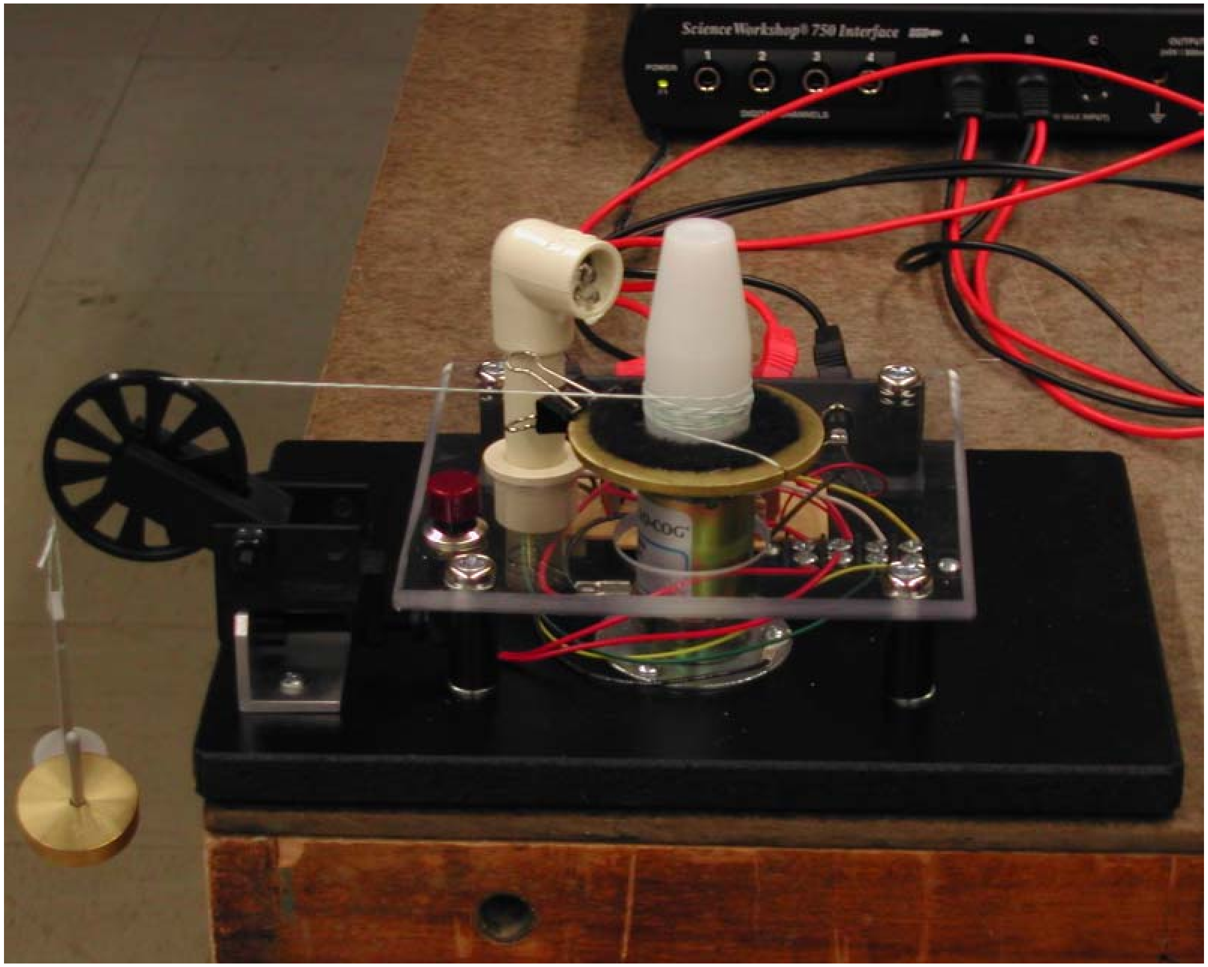
To investigate conservation of angular momentum and kinetic energy in rotational collisions.

Measure and calculate moments of inertia.

Measure and calculate non-conservative work in an inelastic collision.

Apparatus :

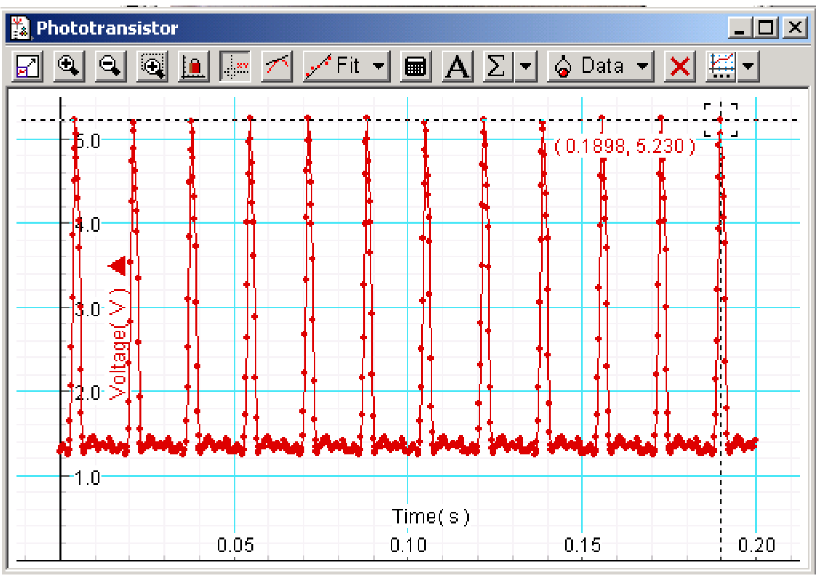
Phototransistor connects to channel A of 750.
Tach-generator to channel B.
Connect power supply.
Red button applies power to motor.

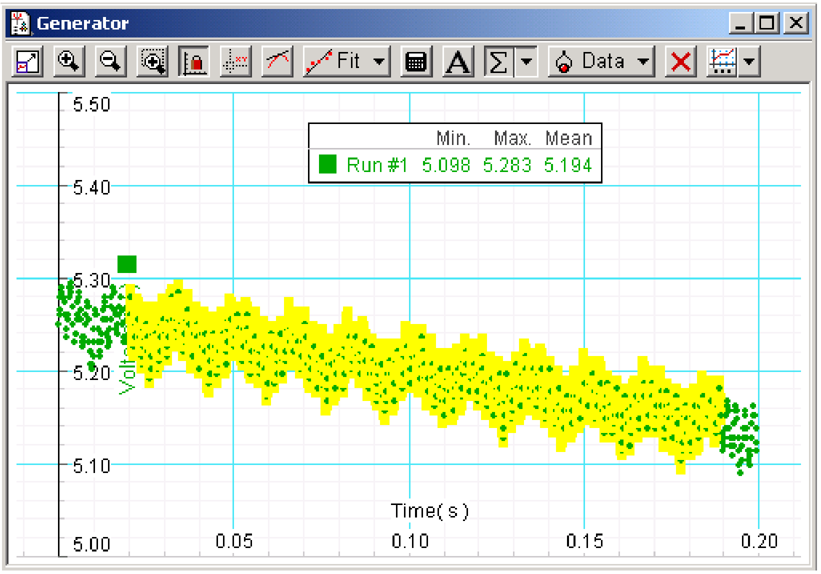


Put black sticker or tape on white plastic rotor for tachometer-generator calibration.

Calibrate Tachometer-generator:

Spin motor up to full speed, let it coast.
Sample Rate: 5000 Hz, and Sensitivity: Low.
Measure and plot voltages for 0.25 s period.



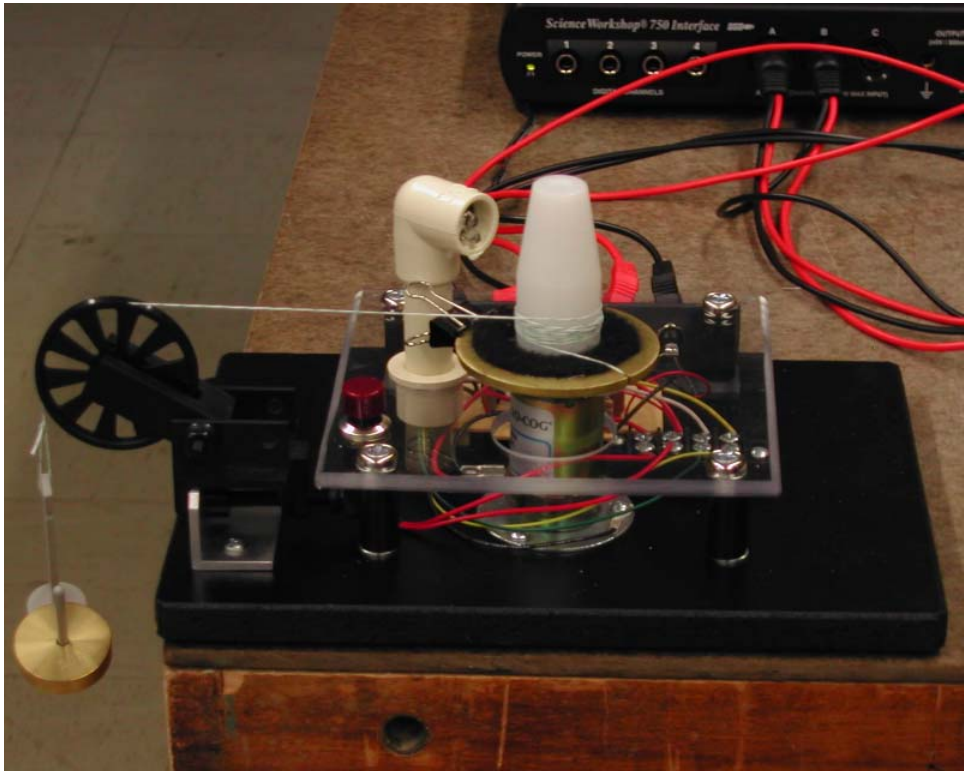


Time for 10 periods to measure ω.

Average the output voltage over the same 10 periods.

Then calculate ω for 1 V output.

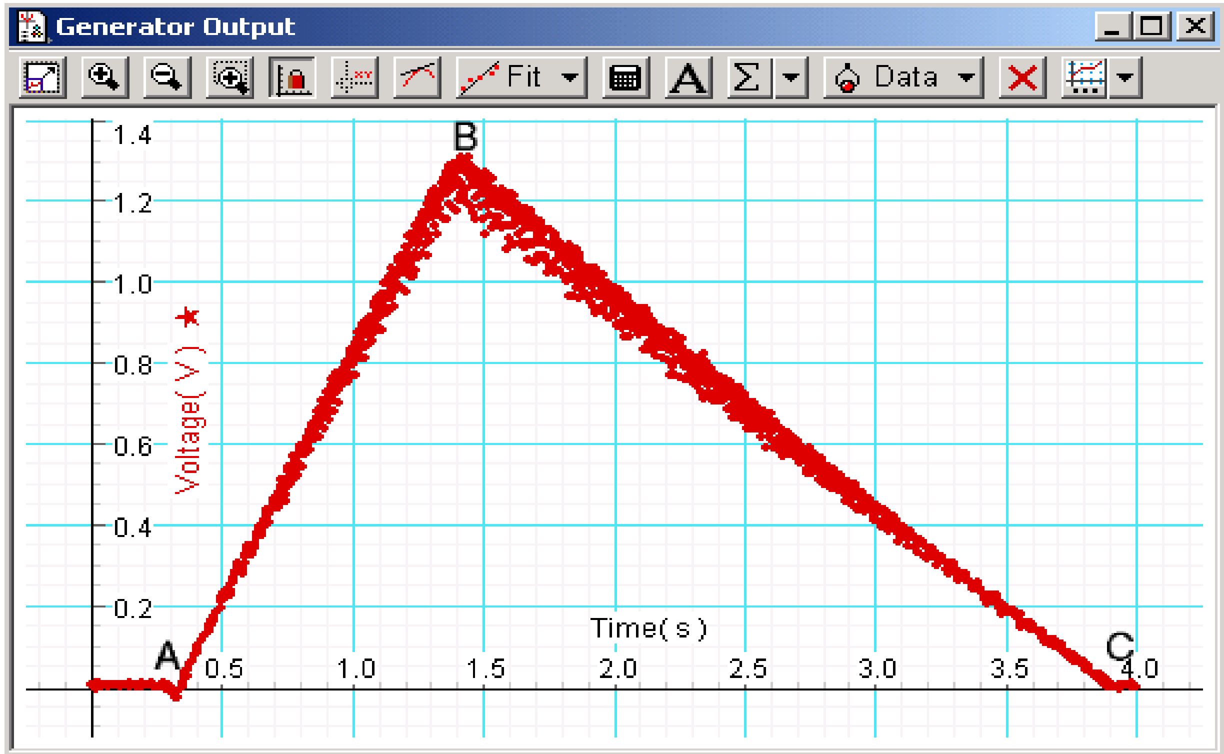
Measure Rotor I_R :



Plot only the generator voltage for rest of expt.
Use a 55 gm weight to accelerate the rotor.
Sensitivity: Low
Sample rate 500 Hz.
Delayed start: None
Auto Stop: 4 seconds

Start DataStudio and let the weight drop.

Graph:

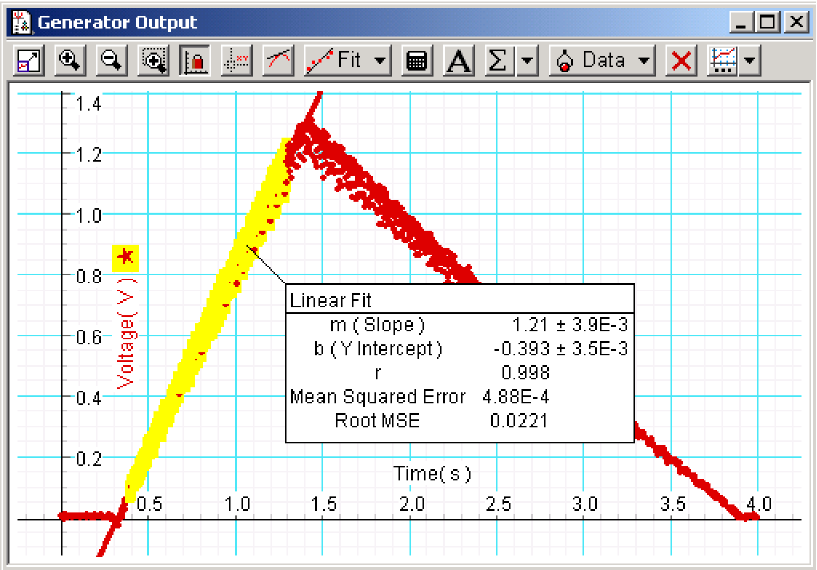


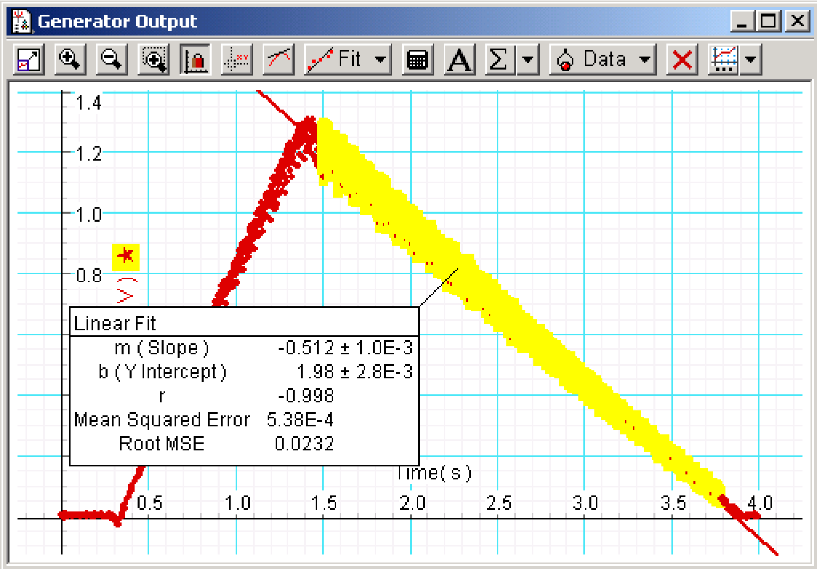
Generator voltage while measuring I_R. What is happening:

1. Along line A-B ?
2. At point B ?
3. Along line B-C ?

How do you use this graph to find I_R ?

Measure I_R Results:





Measure and record α_{up} and α_{down}.

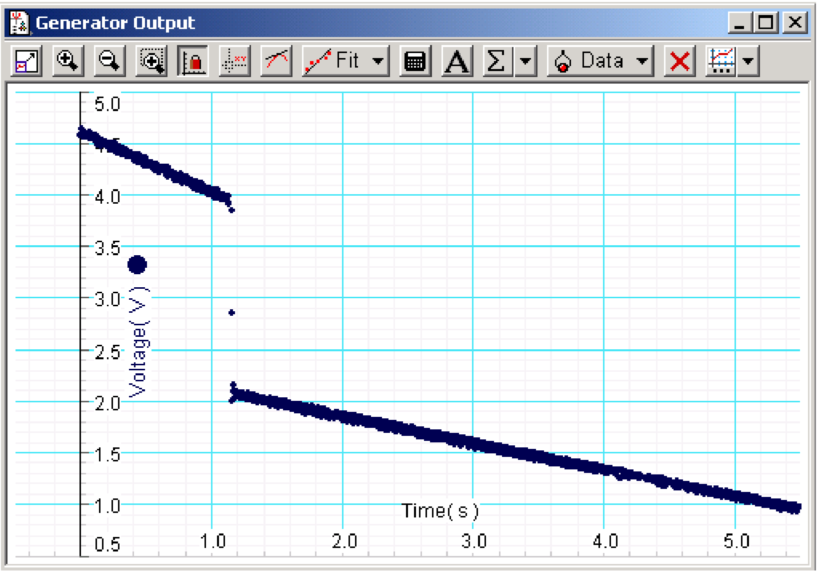
For your report, calculate I_R.

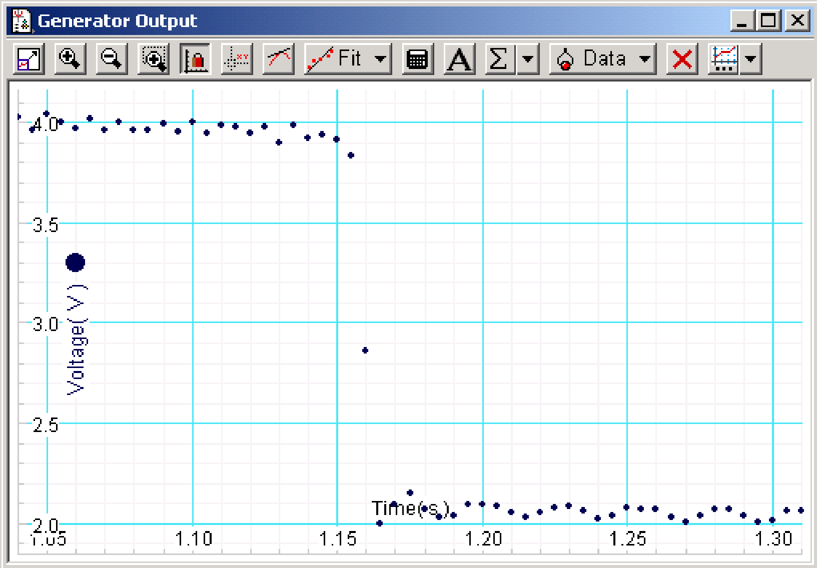
$$\tau_f = I_R \alpha_{down}$$

$$I_R = \frac{mr(g - r\alpha_{up})}{\alpha_{up} - |\alpha_{down}|}$$

Fast Collision:

Sensitivity	Sample Rate	Delayed Start	Auto Stop
Low	200 Hz	1 sec	Falls below 0.5V

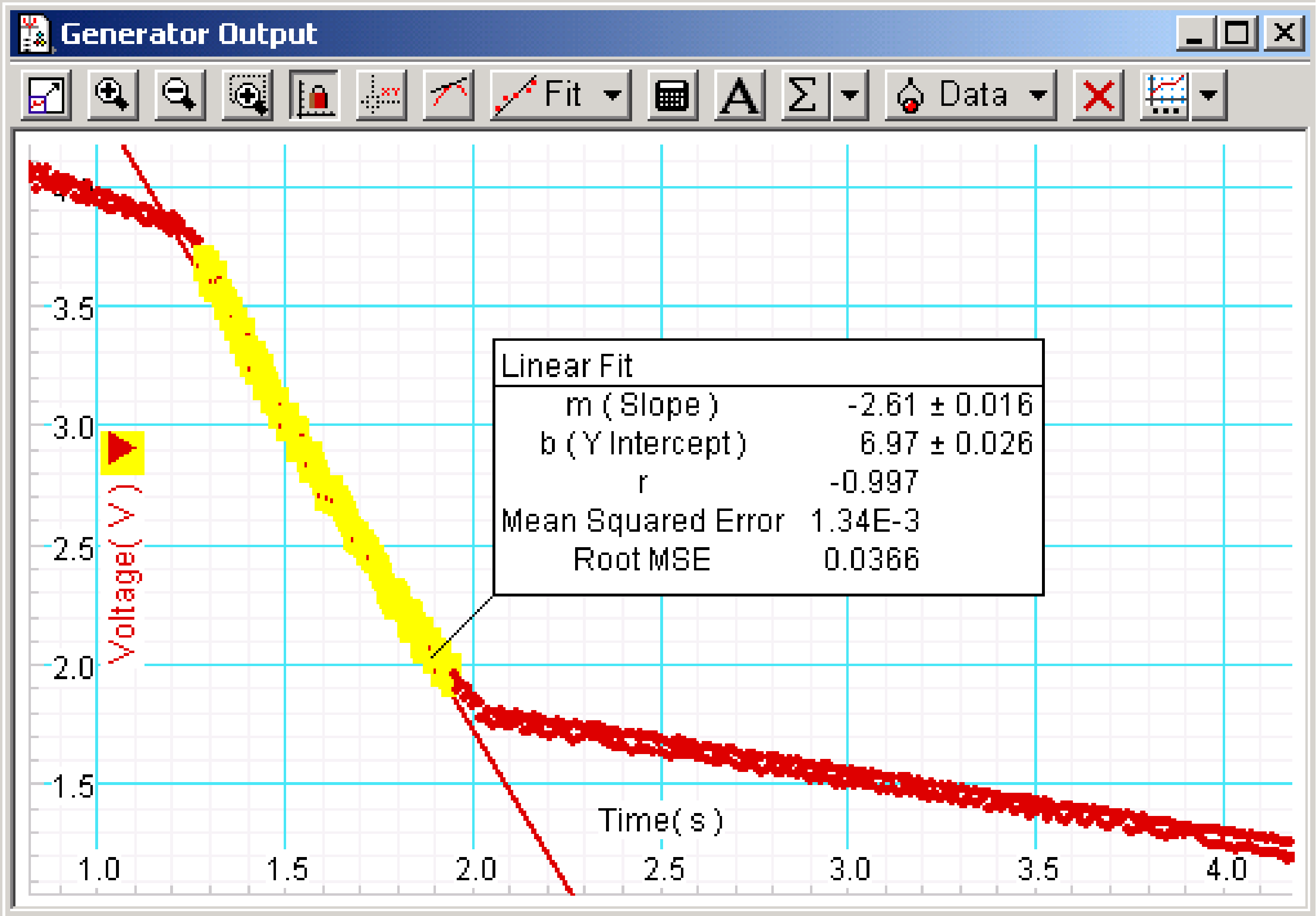




Find ω_1 (before) and ω_2 (after), estimate δt for collision.

Calculate $I_W = \frac{1}{2} m\omega (r_o^{\,2} - r_i^{\,2})$

Slow Collision:



Find ω_1 and ω_2 , measure δt , fit or measure to find α_c.
Keep a copy of your results for the homework problem.