Faraday's Law

Aim: To determine the relationship between the velocity of a moving magnet and the EMF it generates in a coil.

Theory:

Faraday's Law states the relationship between the EMF generated in a coil of wire (solenoid) and the rate of change of magnetic flux as

$$\mathbf{EMF = - N \, d\varphi/dt}$$

Where φ= Magnetc Flux
N = Number of turns of the solenoid

As the EMF depends upon the rate at which the magnetic flux (φ**)** changes, we would expect the EMF generated by a magnet dropped into a wire coil to depend upon the velocity of the magnet as it enters the coil.

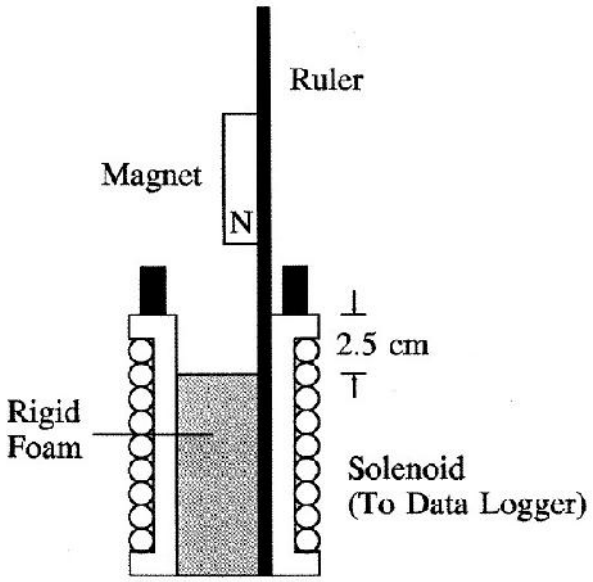
The velocity (v) of a dropped magnet depends upon the height from which it is dropped and is given by the equation $v^2 = u^2 + 2as$, where a is the acceleration, u = initial velocity and s is the height.

Equipment:

Solenoid (Coil), magnet, ruler, foam, data logger (EziLog USB, or equivalent) with voltage sensor, computer.

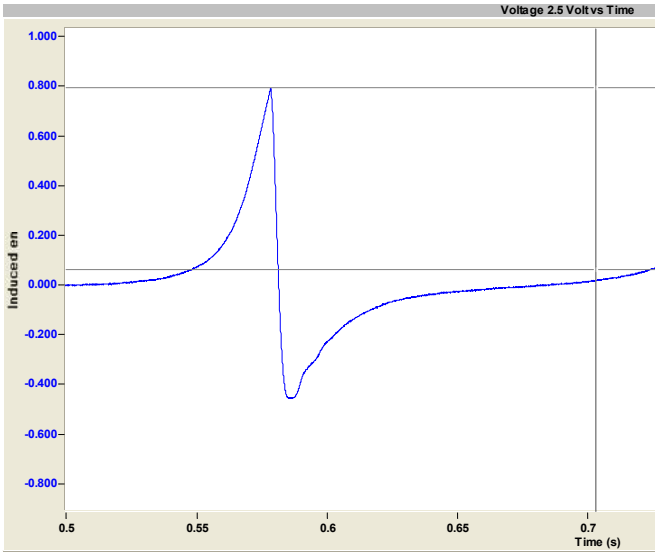
Method :

I. Connect a solenoid to a suitable voltage (+/- 2.5 V) sensor and the voltage sensor to a data logger, which in turn is connected to a computer.
II. Setup the solenoid with a foam (or other suitable material) inner core. Place a ruler into the core as indicated below



III. Set the sampling rate to a minimum of 20,000 samples s^{-1} and an appropriate sample number. Start the data logger

IV. Place the magnet at 0.04 cm above the solenoid and drop. Your data logger results should look similar to that shown below
V. Measure and record the value of the first peak. Enter this value into the Max emf column. Determine the velocity using the equation in the Theory section with u = 0 and enter this in the Velocity column of the results table.
VI. Repeat for the other values of height in the results table.



Finally when all values of emf and velocity have been determined plot a graph of Max emf vs velocity.

Results

Height	Velocity	Max emf
(cm)	($m.s^{-1}$)	(volts)
0.04		
0.06		
0.08		
0.1		
0.12		

Discussion:

1. What is the shape of the line in your graph?
2. What is the relationship between emf generated in the coil and the velocity of the magnet?
3. Are your results consistent with Faraday's Law?

Conclusion:

Write your own conclusion ensuring that it relates to the aim as stated above.