PHY 2811

Group C
Test 1 (Sept. 16, 2009)
Answer all questions in 45 minutes.

(1) The displacement x of a body in constant acceleration a is related to the time t:

$$x = \frac{1}{2}at^2 .$$

(a) Assume that t can be measured accurately.
If we get $x = 7.35 \pm 0.05$ cm, what is the percentage error of a? (5 marks)

(b) If $t = 3.00 \pm 0.05$ s and $x = 7.35 \pm 0.05$ cm, what is the error of a? (10 marks)

(2) According to the manufacturer's user manual, one of our digital voltmeters: Model TES-2700 has an uncertainty: "±(0.5% of reading + 2 digits)". Now it reads 40.4 mV. What is the error of this reading? (10 marks)

(3) Correct the following data format:
(a) 21000 ± 1042 (5 marks)
(b) 14.253 ± 0.12 (5 marks)
(c) $10.837 \pm 2.9\%$ (5 marks)

(4) The period T of a pendulum is measured with a stopwatch which is accurate to 0.01 s.
How can you measure T accurately with the stopwatch? Explain briefly. (5 marks)

(5) A stretched string is fixed at both ends as shown in Fig. 1. The tension in the string is fixed throughout the experiment.
The string can be driven to vibrate by a device whose frequency can be adjusted. The vibration amplitude is maximum at resonance frequencies. The first resonance frequency is given by $f = \frac{C}{L}$ [1]

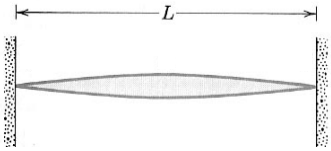

Fig. 1 Vibrating string

where C is a constant depending on the tension and the mass density of the string.

The frequency can be adjusted with an experimental error = ±0.02 Hz.

The length L is measured with a measuring tape (拉尺). The minimum distance you can measure with measuring tape is 0.5 mm.

Now this resonance frequency f is measured for different L. Table 1 shows the result.

Table 1 Vibrating string data

L	f
(cm)	(Hz)
58.3	71.08
38.8	104.8
29.1	139.46
23.3	175.91
19.4	211.03

(a) What kind of linear graph should you plot in order to verify Eq. [1]? (10 marks)

(b) Use Excel to fit the data to Eq. [1]. Find the value of C and its (standard) error. (35 marks)

(c) Briefly discuss all possible errors involved in the measurement of L. (10 marks)