PHY 2811

Group B
Test 1 (Sept. 15, 2009)
Answer all questions in 45 minutes.

(1) The period of a vertical spring of force constant k with a hanging mass m is given by

$$T = 2\pi\sqrt{\frac{m}{k}}\,.$$

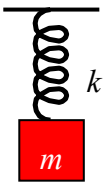

Fig. 1 Spring-mass system

(a) Assume that m can be measured accurately. If we get $T = 0.84 \pm 0.02$ s, what is the percentage error of k? (5 marks)

(b) If $m = 4.50 \pm 0.02$ kg and $T = 0.84 \pm 0.02$ s, what is the error of k? (10 marks)

(2) According to the manufacturer's user manual, one of our digital voltmeters: Model TES-2700 has an uncertainty: "$\pm$(0.5% of reading + 2 digits)". Now it reads 21.4 mV. What is the error of this reading? (10 marks)

(3) Correct the following data format:

(a) 8723 ± 134 (5 marks)

(b) 14.253 ± 0.1 (5 marks)

(c) $1.602176487 \times 10^{-19}\,\text{C} \;\; \pm 5 \times 10^{-5}\%$ (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 body initially at rest on an inclined plane is released to have a uniform acceleration a. The displacement x along the plane is measured as a function of time t. Then

$$x = \frac{1}{2}at^2 \qquad [1]$$

The displacement is measured with a measuring tape (拉尺).

The time t is measured with a stopwatch.

Suppose the minimum distance you can measure with the measuring tape is 0.5 mm and the stopwatch is accurate to 0.01 s.

(a) Briefly discuss all possible errors involved in the measurement of x and t. (15 marks)

(b) Table 1 shows the result.

What kind of graph should you plot in order to verify Eq. [1]? (5 marks)

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

Table 1 Linear acceleration data

x	t
(cm)	(s)
7.35	3.00
19.30	4.00
33.55	5.00
48.05	6.00
71.00	7.00