PHY 2811

Group A
Test 1 (Sept. 14, 2009, 4:00 pm)
Answer all questions in 45 minutes.

(1) The kinetic energy of a particle of mass m and velocity v is $K = \frac{1}{2}mv^2$.

(a) Assume that m can be measured accurately. If $v = 2.34 \pm 0.02$ m/s, what is the percentage error of K? (5 marks)

(b) If $m = 1.88 \pm 0.05$ kg and $v = 2.34 \pm 0.02$ m/s, what is the error of K? (5marks)

(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 45.7 mV. What is the error of this reading? (10 marks)

(3) Correct the following data format:

(a) 83.000 ± 1.166 (5 marks)

(b) 14.253 ± 0.1 (5 marks)

(c) $6.74914 \pm 0.5\%$ (5 marks)

(4) In a free fall experiment, the height (around 1 m) is measured by a measuring tape (拉尺). The tape has a precision of 0.5 mm. Estimate the error in measurement of the height. (10 marks)

(5) A vertical spring of force constant k has a mass m hanging at the bottom end.

The period of the vibration is given by

$$T = 2\pi\sqrt{\frac{m}{k}} \qquad [1]$$

The mass m is measured with an electronic balance.

The period T is measured with a stopwatch.

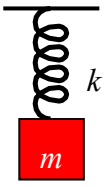

Fig. 1 Spring-mass system

Suppose the minimum mass you can measure with the electronic balance is 0.01 kg and the stopwatch is accurate to 0.001 s.

(a) Briefly discuss all possible errors involved in the measurement of T. (10 marks)

(b) How can you measure T accurately with the stopwatch? Explain briefly. (5 marks)

(c) The period is measured as a function of mass m added to the same spring.

Table 1 shows the result.

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

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

Give a possible reason to explain why the intercept is not zero. (5 marks)

Table 1 Spring-mass data

m	T
(kg)	(s)
0.50	0.445
1.00	0.520
2.00	0.630
3.00	0.723
4.50	0.844