PHY2811 (2009) Group B

Test 1 solution **(wrong unit: -1 mark)**

(1) (a) $\frac{\delta k}{k}=\sqrt{(-2)^2\left(\frac{\delta T}{T}\right)^2}=2\left(\frac{0.02}{0.84}\right)=5\%$ (4.8% OK) (5 marks)

(b) $\frac{\delta k}{k}=\sqrt{\left(\frac{\delta m}{m}\right)^2+(-2)^2\left(\frac{\delta T}{T}\right)^2}=5\%$ (4.8% OK)

$k=2.517\times10^2\ \text{kg/s}^2 \Rightarrow \delta k=1\times10\ \text{kg/s}^2$ & $k=(2.5\pm0.1)\times10^2\ \text{kg/s}^2$ (10 marks)

(2) $21.4\times0.5\%+0.2=0.3\ \text{mV}$ (10 marks)

(3) (a) $(8.72\pm0.13)\times10^3$ or $(8.7\pm0.1)\times10^3$ (5 marks)

(b) 14.3 ± 0.1 (5 marks)

(c) $1.6021765\times10^{-19}\text{C}\ \pm5\times10^{-5}\%$ or $(1.6021765\pm0.0000008)\times10^{-19}\text{C}$ (5 marks)

(4) Measure several periods to minimize the human error. (4 marks)

The mass moves faster at the average position (or equilibrium position). Use that position for the start & stop of the timing. (1 mark)

(5) (a) Error of x: instrument error = 0.5 mm (3 marks)

human error: due to judgment of the start & end points

The overall error should be around 1- 3 mm. (5 marks)

Error of t : instrument error = 0.01 s (3 marks)

human error: delayed due to reaction time (a systematic error) with random fluctuation (a random error) (4 marks)

(b)(i) t is more accurate than x. So take t^2 as the x-axis.

For a linear graph, we should plot x vs t^2. (5 marks)

(ii) Linear least square fit for x vs t^2: slope = 1.561 ± 0.042 = $a/2$

$\Rightarrow a=3.122\pm0.084\ \text{cm/s}^2$ or $3.12\pm0.08\ \text{cm/s}^2$ (35 marks)

Note: This part (ii) is to test whether the student knows how to do linear least square fit by Excel. Even though the student uses other linear plot, we let them get the full marks if the procedure is OK.