PHYS 500-FALL 2019
Homework 3

1. In an experiment to study the behaviour of silicon diodes when they are cooled, the voltage across a diode was measured as a function of the diode temperature. We got the following data after 8 measurements.

Recordings	Temperature (K)	Voltage (V)
1	300	0.630
2	290	0.653
3	280	0.670
4	270	0.678
5	260	0.695
6	250	0.705
7	240	0.735
8	230	0.748

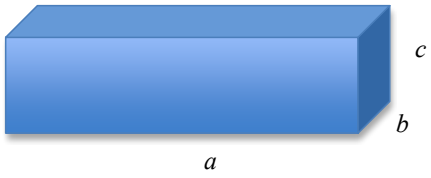
Apply the method of least squares to determine the best fit line $V=BT+A$. This is to determine A and B and their errors. V is for voltage and T for temperature. (15 marks)

2. We measure the sides of the slab, shown in figure below and we found: $a=(9.0\pm0.3)mm$, $b=(3.0\pm0.3)mm$, $c=(2.0\pm0.3)mm$.

a) Calculate the volume of the slab (1 marks).

b) Calculate the error of the volume (2 marks).

c) Quote the final result (volume ± error) after making all the necessary roundings (2 marks).



ANSWERS:

1)

$y = Bx + A$

by applying the method we get:

$A = 1.117666667$, $B = -0.001616666667$ and

$\delta A = 0.02577008348$, $\delta B = 0.00009191884367$

So we write:

$A = (1.12 \pm 0.03)\text{V}$ and $B = (-0.00162 \pm 0.00009)\text{VK}^{-1}$

Vasileios Lembessis 9/11/2019 09:19
Comment [1]: Some of you calculated average values and made plots. I did not ask for it.

2) **(a)** The volume is given by $V = abc$

$a = (9.0 \pm 0.3)mm$, $b = (3.0 \pm 0.3)mm$, $c = (2.0 \pm 0.3)mm$

$V = abc = 3 \times 9 \times 2\ mm^3 = 54mm^3$

(b) The error of the volume is given by

$$\delta V = \sqrt{\left(\frac{\partial V}{\partial a}\delta a\right)^2 + \left(\frac{\partial V}{\partial b}\delta b\right)^2 + \left(\frac{\partial V}{\partial c}\delta c\right)^2} =$$

$$= \sqrt{[bc\delta a]^2 + [ac\delta b]^2 + [ab\delta c]^2} =$$

$$= 9.9\ mm^3$$

Thus to correct number of significant figure it becomes $\delta V = 10\ mm^3$

(c) $V = (54 \pm 10)\ mm^3$

Vasileios Lembessis 9/11/2019 09:20
Comment [2]: Some of you wrote or send me by email correction to 50±10. This is a mistake.