MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2018/2019 ACADEMIC YEAR
SECOND YEAR *FIRST* SEMESTER

SCHOOL OF SCIENCE
BACHELOR OF SCIENCE

COURSE CODE: PHY 2109

COURSE TITLE: PHYSICS LABORATORY III

DATE: 4th December, 2018 **TIME: 1100-1200 HRS**

INSTRUCTIONS TO CANDIDATES

1. Answer question **ONE** questions and any other **two** questions
2. Use of sketch diagrams where necessary and brief illustrations are encouraged.
3. Read the instructions on the answer booklet keenly and adhere to them.

*This paper consists of **six** printed pages. Please turn over.*

QUESTION ONE *[COMPULSORY]* **[20 marks]**

A capacitor can be charged using a resistor and a DC source. The instantaneous voltage across the capacitor during charging is given by $V_{charge} = V_0 (1-e^{-t/RC})$. When the switch is thrown to the discharge position the capacitor loses its charge hence it discharges through R. Therefore, the voltage across capacitor starts decreasing until it becomes zero. The instantaneous voltage across the capacitor during discharge is given $V_{discharge} = V_0 (e^{-t/RC})$. Where;

R is resistance in ohms, C is capacitance in Farad, t is the instantaneous time and V_0 is the initial voltage to which capacitor was charged. The experimental results obtained are represented in a Table 1.

Table 1: Capacitor charging and discharging through a resistor

Time(s)	R=100k	
	Charging voltage(V)	Discharging voltage(V)
0	0	4.47
5	0.89	3.48
10	1.71	2.70
15	2.30	2.10
20	2.73	1.72
25	3.12	1.34
30	3.42	1.05
35	3.66	0.82
40	3.81	0.67
45	3.96	0.53
50	4.10	0.41
55	4.15	0.34
60	4.23	0.27

(a)On the same axis, plot a graph of capacitor charging-discharge (see the grids in page 5&6. (5 marks)

(b)From your graph in (a) determine the capacitance at any instant of time, t (5 marks)

(c) (i)Linearize the data for charging a capacitor and plot a graph of charging voltage (y-axis) versus time. (5 marks)

Use your graph in part (c) (i) to determine:

(ii) The slope and give its physical interpretation (3 marks)

(iii)The y-intercept and its physical interpretation (2 marks)

QUESTION TWO: [10 marks]

(a) In physics, what is meant by damping? (1 mark)

(b) In an experiment to study the damping of oscillatory motions of systems, you are provided with a mass, a massless spring, a damper, a meter rule and stop watch. After collecting the data for four experiment set-ups and plotting the on the same axis, your graphs appear as shown in Figure 1. Note that the dotted lines represent the exponential pocket.

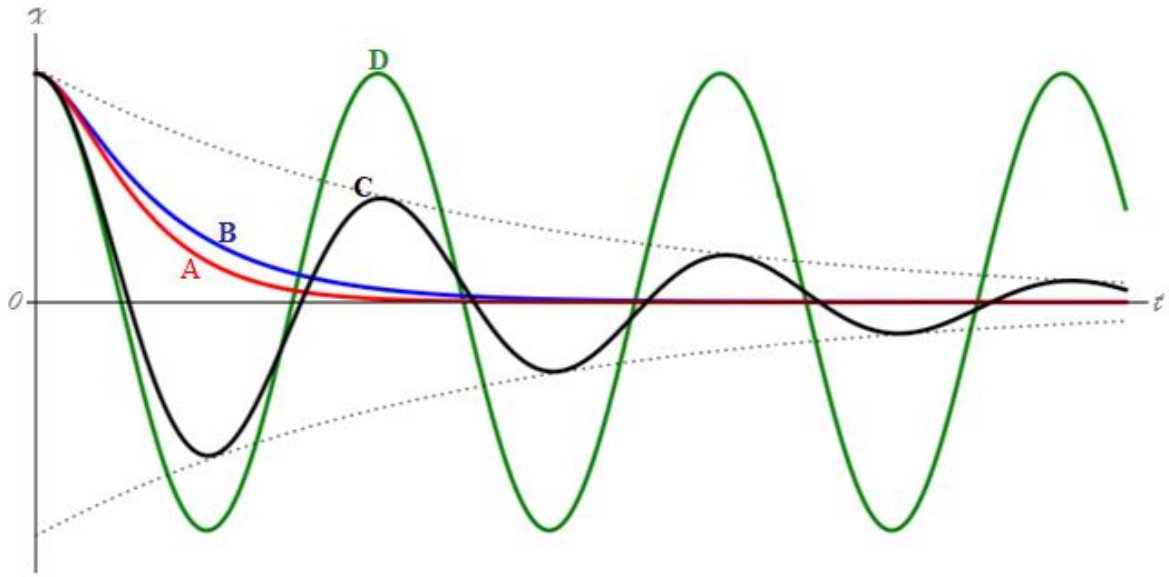

Figure 1: Damping of oscillations

Label with a reason which graph represents the following:

(i) Un-damped (2 marks)

(ii) Under-damped (2 marks)

(iii) Critically-damped (2 marks)

(iv) Over-damped (2 marks)

(c) Explain one application of damping (1 mark)

QUESTION THREE: [10 marks]

(a) Carbon has a temperature coefficient of -4.8×10^{-4} (1/K).What is the implication of the negative temperature coefficient? (1mark)

(b) An electronics instructor wants to demonstrate to his students the effect of electrical resistance changing with temperature. To do this, he selects a carbon rod of 3cm in length and 5mm in diameter, black in color and measures its initial resistance R_0 at room temperature $T_0=20^oC$. Once he is through with the demonstration, he leaves the students to do the experiment on their own. One of

the students in a particular group connects the carbon rod to the ohmmeter as she grasps it between her fingers.

(i) Why is this student likely to get wrong data? (2 marks)

(ii) What suggestion should have the group members given in order to get the correct data? (1 mark)

(iii) Assuming that ohmmeter and the other circuit components have negligible electrical resistance, what value displayed on the ohmmeter? Take the temperature of the fingers of this student to be $36^{o}C$. (2 marks)

(iv)What other assumption have you made to determine the ohmmeter display in part (iii) above. (1 mark)

(v) By what percentage does she miss the correct value of R_0? (2 marks)

(c)State **one** application of materials with negative temperature coefficient (1mark)

QUESTION FOUR: [10 marks]

Your physics instructor hands to you a four colour code resistor. The colour code on the resistor is brown, black, red and gold as depicted in the figure 2.

Figure 2: Resistor colour codes

(a) On the dotted lines in figure 2, label what each colour code signifies (2 marks)

(b)(i)What is its resistance? (2 marks)

(ii)What is the uncertainty of this resistance? (2 marks)

(c) In this experiment, you find that you need a 2.5k resistor and it is not available in the laboratory. Will your practical be successful? Support your argument with calculations and circuit diagrams. (4 marks)