**Name: ………………………………………………….…Adm No…………………….**

**232/3 Candidate’s Signature: ……………….**

**PAPER 3**

**DECEMBER 2021. Date: ……………………………………**

$2\frac{1}{2} hours$

**THE MURANG’A EXTRA COUNTY SCHOOLS JOINT EXAMINATIONS (MECS)**

**PHYSICS PRACTICAL**

**PAPER 3**

$2\frac{1}{2} hours$

**Instructions to Candidates**

1. *Write your name and admission number in the spaces provided.*
2. *Answer* ***ALL*** *questions in the spaces provided in the question paper.*
3. *You are supposed to spend the first* ***15 minutes*** *of the* $ 2\frac{1}{2} hours$ *allowed for this paper reading the whole paper carefully before commencing the work.*
4. *Marks are given for a clear record of the observations actually made, their suitability, accuracy and the use made of them.*
5. *Candidates are advised to record their observation as soon as they are made.*
6. *Non programmable silent electronic calculators may be used.*
7. ***This paper consists of 8 printed pages.***
8. ***Candidates should check the questions to ascertain that all the pages are printed as indicated and that no question are missing.***
9. ***Candidates should answer the questions in English.***

 **For Examiner’s Use Only**

**Question 1**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | d | e | f | g | h | i | j |
| **Maximum Score** | 6 | 5 | 2 | 2 | 2 | 1 | 2 |
| **Candidate’s Score** |  |  |  |  |  |  |  |

 **TOTAL**

**Question 2**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | b | c | d | e | f | h | i | j |
|  **Maximum Score** | 1 | 5 | 5 | 2 | 1 | 3 | 2 | 1 |
|  **Candidate’s Score** |  |  |  |  |  |  |  |  |

**TOTAL**

 **GRAND**

 **TOTAL**

**QUESTION 1 (20 marks)**

1. You are provided with the following;
* A galvanometer
* A dry cell and a cell holder
* A switch
* A wire labelled Y mounted on a piece of wood.
* Eight connecting wires each with a crocodile clip at one end.
* A resistance wire labelled AB mounted on a millimeter scale.
* Six 10 Ohm carbon resistors
* A jockey or crocodile clip
* Micrometer screw gauge (to be shared)

***Proceed as follows:***

1. Set up the circuit as shown in figure below, with X being one of the 10 ohms carbon resistors.

Nichrome wire mounted on a Millimeter scale

Wire Y

B

A

X

G

$$L$$

P

1. Close the switch. Tap the jockey at various points on the wire AB and locate point P at which the galvanometer shows zero deflection, measure and record in table below the length, $l$ where $l$= PB.
2. Repeat the procedure in (b) using X as two 10Ω resistors, three resistors, four resistors, five resistors and six resistors. **X is the effective resistance for the parallel combination i.e.** $X= \frac{10}{n}$where **n** is the number of resistors in parallel.
3. Record your readings in table below. (6mks)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of **10Ω**Carbon resistor | **One**  | **Two** | **Three** | **Four** | **Five** | **Six** |  |
| X (Ω) | **10** | **5** | **3.333** | **2.5** | **2** | **1.667** |  **Exact or 4sf all correct = 1mk** |
| $L$ **(cm)** $\begin{matrix}+\\-\end{matrix} 5.0 cm$ | **66.5** | **53.3** | **48.2** | **43.5** | **40.2** | **37.4** | **within the range and 1 d.p a must (Each value =** $\frac{1}{2}$**mk)****Decreasing trend a must** |
| $\frac{1}{X}$ $(Ω$-1)  | **0.1** | **0.2** | **0.3** | **0.4** | **0.5** | **0.6** | **All correct = 1mk** |
| $$\frac{1}{L} \left(cm^{-1}\right) 10^{-2}$$ | **1.515** | **1.876** | **2.075** | **2.299** | **2.488** | **2.674** | **4sf or Exact = 1mk** |

 **TABLE**

 Plot a graph of $\frac{1}{L}$ (y-axis) against $\frac{1}{X}$ . (5mks)

0.3

0

0.2

0.1

0.8

0.6

0.5

0.4

1.0

0.5

3.0

2.5

2.0

1.5

$$\frac{1}{X}×10^{-2}(cm^{-1})$$

* **Well labelled axes with units = 1 mk**
* **Simple, uniform and accommodative scale = 1mk**
* **Each correctly plotted point =** $\frac{1}{2}$ **mk for a maximum of 4 points (total 2 mks)**
* **Straight line with positive gradient passing through at least 3 correctly plotted points = 1mk**

0

$$\frac{1}{X}(Ω^{-1})$$

1. Determine the slope m of the graph. (2mks)

 $m=\frac{\left(2.2-1.5\right)10^{-2}cm^{-1}}{(0.35-0.10)Ω^{-1}}$**(Correct substitution = 1mk)**

$=\frac{0.7×10^{-2}}{0.25}$

$=0.028 Ωcm^{-1}$ **(Correct evaluation with units = 1mk)**

 Wrong unit = 0mk, no unit = half mark

1. Given that $\frac{1}{L} = \frac{R}{KX} + \frac{1}{K}$ where K = 100cm. Use the graph to determine R. (2mks)

 $Slope=\frac{R}{K}$

$0.028 Ωcm^{-1}=\frac{R}{100 cm}$ **(Correct substitution = 1mk)**

$R=0.028 Ωcm^{-1}× 100 cm$

$=2.8 Ω$ **(Correct evaluation = 1mk)**

1. Measure the diameter d and the length $l$ of wire Y. (2mks)

 $l$ **=** $\frac{30.0}{100}=0.300 $**m ±0.01** **(Value within the range and 3dp a must = 1mk)**

 **d** **=** $\frac{0.32}{1000}=0.00032 $**m ± 0.00002(Value within the range and 5dp a must = 1mk)**

1. Determine its cross-sectional area A of the wire Y. (1mk)

 $A=3.142×0.00016^{2}$**(Correct substitution =** $\frac{1}{2}$**mk)**

 **A**  $=8.044×10^{-8}$m2 **(****Correct evaluation =** $\frac{1}{2}$**mk)**

1. Determine the resistivity $ρ$ of the wire Y given that its Resistance, $R=ρ \frac{l}{A} . $ (2mks)

$ρ=\frac{AR}{l}= \frac{8.044×10^{-8} m^{2}×2.8 Ω}{0.3 m}$**(Correct substitution = 1mk)**

 $=7.508×10^{-7} Ωm$ (**Correct evaluation =** $1$**mk, rule for units applies)**

**QUESTION 2 (20 marks)**

**PART A**

**You are provided with the following;**

* Meter rule
* Retort stand, clamp and boss
* A spring and with a pointer
* Three masses (a 100 g and two 50g masses)
* Stop watch

**Proceed as follows**

1. Set the apparatus as shown below.

pointer

Metre rule

spring

stand

M

1. Hang the unloaded spring and record the pointer readings

***xo***$=student^{'}s value$**(3d.p a must)** *m* (1mk)

1. (i) Load a mass of 150 g and determine the extension of the spring, ***e1****.*

 ***e1***$= difference in students values=0.148 \pm 0.0$m (1mk)

(**Correct subtraction =** $\frac{1}{2}$**mk, correct evaluation =**$\frac{1}{2}$**mk)**

1. Displace the 150 g mass slightly downwards and release it to oscillate vertically. Time 20 oscillations and obtain time t1.

 **t1** = $16.37\mp 0.5 s$ (1mk)

 **(Value within the range and 2dp a must = 1mk, no unit deny a half mark)**

1. Find periodic time T1

**T1** $=\frac{16.37}{20}=0.8184 s$

 (**Correct division =** $\frac{1}{2}$**mk, correct evaluation with unit=**$\frac{1}{2}$**mk)** (1mk)

1. Use the equation $T=2π\sqrt{\frac{e}{p}}$ to find the value of P1. (2mks)

 $0.8184 s=2(3.142\sqrt{\frac{0.148}{P\_{1}}}$**(Correct substitution = 1mk)**

$P\_{1}= \frac{0.148}{0.01616}=9.158 ^{m}/\_{s^{2 }} $**(Correct evaluation to 4sf = 1mk)**

1. (i) Load a mass of 200 g and determine the extension of the spring, ***e2****.*

 ***e2*** $=x\_{2}-x\_{o}=0.196 \mp 0.01 $m. **(****Correct subtraction =** $\frac{1}{2}$**mk, correct evaluation=**$\frac{1}{2}$**mk).**  (1mk)

1. Displace the 200 g mass slightly downwards and release it to oscillate vertically. Time 20 oscillations and obtain time t2.

**t2** $=18.62 \pm 0.5 s$ (1mk)

**(Value within the range and 2dp a must = 1mk, no unit deny a half mark)**

1. Find periodic time T1

**T2** $= \frac{18.62}{20}=0.9310 s$ (1mk)  **(Value within the range and 2dp a must = 1mk, no unit deny a half mark)**

1. Use the equation $T=2π\sqrt{\frac{e}{p}}$ to find the value of P2. (2mks)

 $0.9310 s=2(3.142\sqrt{\frac{0.196}{P\_{2}}}$**(Correct substitution = 1mk)**

$P\_{2}= \frac{0.148}{0.01616}=8.929 ^{m}/\_{s^{2}}$**(Correct evaluation to 4sf = 1mk)**

1. Find the average of P

$P\_{av}=\frac{P2+p1}{2}$ $=\frac{8.929+9.158}{2}$ **(Averaging principle = 1mk).** (2mks)

 $=9.044 ^{m}/\_{s^{2}}$ **(Correct evaluation to 4sf = 1mk)**

**PART B**

**Apparatus**

* Lens and a lens holder.
* A candle
* Screen
* A metre rule.

**Procedure**

1. Focus a distant object and estimate the focal length, **f** of the lens

**f** $=100$ **mm ± 10 mm**

(1mk)

1. Set up the apparatus as shown below.

P

Candle

screen

lens

s

d

P’

1. Set the distance **s= 60 cm.**
2. Adjust the position of the lens to position **p** where a magnified sharp image is formed on the screen**.** Recordposition P.

**P =** **Student’s value (1d.p a must)** cm. (1mk)

1. Maintaining distance **s,** adjust the lens to position **P’**where a diminished sharp image is formed on the screen. Record position, **P’.**

**P’ =**  **Student’s value (1d.p a must)** cm. (1mk)

1. Find distance **d,** between the originalposition and final position of lens

**d =** $ \left|P^{'}-P\right|=34.0 \mp 1.0 $ cm (1mk)

(**Correct subtraction =** $\frac{1}{2}$**mk, correct evaluation =**$\frac{1}{2}$**mk)**

1. Using the formula $s^{2}-d^{2}=4qs$. Find the value of **q.** (2mks)

$60^{2}-34^{2}=4\left(60\right)q $**(Correct substitution = 1mk)**

$q=\frac{2444}{240}=10.18 cm$ **(Correct evaluation to 4sf = 1mk)**

1. What physical quantity do **q** represent (1mk)

 **Focal length of the lens used.**