



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

## Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

**BACHELOR OF SCIENCE IN MATHEMATICS & COMPUTER SCIENCE**

SPH 2172: PHYSICS

**END OF SEMESTER EXAMINATION**

**SERIES: DECEMBER 2012**

**TIME: 2 HOURS**

**Instructions to Candidates:**

You should have the following for this examination

- *Answer Booklet*

This paper consist of **FIVE** questions in **TWO** sections **A & B**

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **FOUR** printed pages

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**Take:**

g	=	9.8N/kg
Charge of electron	=	$-1.6 \times 10^{-19}$ J
Charge of porton	=	$1.6 \times 10^{-19}$ J
E	=	$8.85 \times 10^{-12} \text{ e}^2 \text{ N}^{-1} \text{ m}^{-2}$

**Question One (Compulsory)**

- a) Suppose the displacement of a particle is related to the acceleration and time as  $S = ka^x t^y$  where k is a dimensionless constant and x and y are values. Determine x and y. **(3 marks)**
- b) State the principle of superposition as applied to the electric fields **(2 marks)**
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- c) A wire of length 10m and a diameter of 1.2mm has a resistance of  $1.4 \Omega$ . What is the resistance if the length is 16m and the diameter is 0.8mm? **(3 marks)**
- d) Show that for a parallel arrangement of capacitors,  $C_1$ ,  $C_2$  and  $C_3$ , the total capacitance is given by:  

$$C_T = C_1 + C_2 + C_3$$
 **(4 marks)**
- e) The voltage output of a generator is given by  $\Delta V = (200V) \sin wt$ . Find the root mean square current when this generator is connected to  $100\Omega$  - resistor. **(3 marks)**
- f) Sketch and output graph of a half-wave rectifier when connected to the cathode ray oscilloscope without a filter capacitor. **(3 marks)**
- g) A conductor of a uniform radius carries a current of 3A produced by an electric field of 120v/m. What is its resistivity of the material? **(3 marks)**
- h) Differentiate between the terms terminal voltage and electromotive (e.m.f) **(2 marks)**
- i) Three resistors are connected in parallel as shown below. A potential difference of 18V is maintained between the points *a* and *b*. Determine the current through all resistors. **(3 marks)**

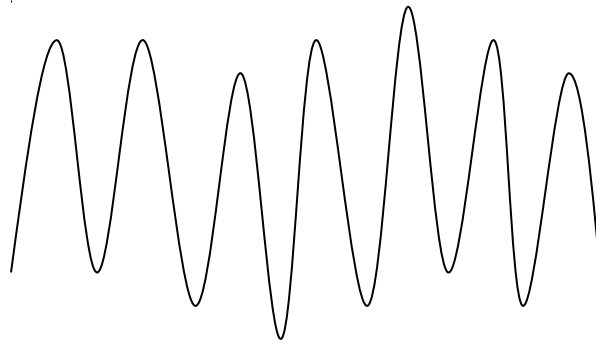
18V

- j) Consider a capacitor of capacitance  $C$  that is being discharged through a resistor  $R$ . After how many time constants is the charge on the capacitor one-fourth its initial value? **(4 marks)**

### Question Two

- a) A Copper wire has a radius of 0.8mm and a length of 14m. It carries a 6A current. Determine:
- (i) The potential difference between the ends of the wire. **(6 marks)**
  - (ii) The resistance of the wire **(3 marks)**
  - (iii) The power dissipated by the wire **(3 marks)**
- (Take resistivity of Copper =  $1.7 \times 10^{-8} \Omega M$ ).

- b) An uncharged capacitor and a resistor are connected in series to a battery as shown below. If  $E = 12V$ ,  $C = 5\mu F$  and  $R = 800K\Omega$



Find:

- |       |                                     |           |
|-------|-------------------------------------|-----------|
| (i)   | Time constant of the circuit        | (2 marks) |
| (ii)  | The maximum charge in the capacitor | (2 marks) |
| (iii) | The maximum current in the circuit  | (2 marks) |
| (iv)  | The charge as a function of time.   | (2 marks) |

### Question Three

- a) Write **TWO** loops equalities for the left and right loops in the circuit below:

$R_3$

- b) Give  $R_1 = 2\Omega$ ,  $R_2 = 3\Omega$ ,  $R_3 = 1\Omega$ ,  $\varepsilon_1 = 5V$ ,  $\varepsilon_2 = 2V$  and  $\varepsilon_3 = 11V$ , Determine:
- |       |       |           |
|-------|-------|-----------|
| (i)   | $I_1$ | (4 marks) |
| (ii)  | $I_2$ | (4 marks) |
| (iii) | $I_3$ | (2 marks) |

- c) A battery has an emf of 12V and an internal resistance of  $0.05\Omega$ . Find the current and the terminal voltage in the circuit when a load of  $3\Omega$  is connected. (6 marks)

### Question Four

- $Q_1 = 5\mu C$  is located at the origin and a second charge  $Q_2 = -5\mu C$  is located in the axis 0.03m from the origin as shown below:

Determine:

- (i) Electric field of point P due to charge  $Q_1$ ? (2 marks)  
 (ii) Electric field to point P due to charge  $Q_2$ ? (2 marks)  
 (iii) Determine the net electric field at point P due to both charge  $Q_1$  and  $Q_2$ ? (4 marks)
- b) A total charge  $Q$  is distributed uniformly round a thin ring of radius  $a$ . Find the potential on the rings axis. (5 marks)

- $q_1 = 2\mu C$  is located at the origin and charge  $q_2 = -6\mu C$  is located at coordinate (0, 3)m. Find the total electric potential due to these charges at a point P whose cordiante are (4, 0) m. (4 marks)

### Question Five

- $R = 425\Omega$ ,  $L = 1.25mH$ ,  $C = 3.5\mu F$ ,  $\omega = 377s^{-1}$  and  $\Delta V_{max} = 150V$ .
- a) A series RLC circuit has Determine:
- (i) Inductive reactance of the circuit. (2 marks)  
 (ii) Capacitive reactance of the circuit (2 marks)  
 (iii) Impedance of the circuit. (2 marks)  
 (iv) Calculate the average power delivered to the RLC circuit. (4 marks)
- b) Find the maximum current in the circuit. (2 marks)
- c) Find the phase angle between current and voltage. (2 marks)
- d) Find both maximum voltage and instantaneous voltage across each element. (6 marks)