SOUTH EASTERN KENYA UNIVERSITY
UNIVERSITY EXAMINATIONS 2016/2017

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE

SCE 203: ELEMENTS PHYSICS II

9TH DECEMBER, 2016   **TIME: 4.00-6.00 P.M**

INSTRUCTIONS TO CANDIDATES

- This paper consists of FIVE questions.
- Answer question **ONE** and any other **TWO** questions.
- Question **ONE** carries 30 mark while the other **TWO** questions carry 20 marks each
- Use the following constants where necessary

  Coulomb's Constant $k_e = 8.99 \times 10^9 \, N.m^2/C^2$

  Permittivity of free space $\varepsilon_o = 8.85 \times 10^{-12} C^2/N.m^2$

  Permeability of free space $\mu_o = 4\pi \times 10^{-7} H/m$

  Proton mass $m_p = 1.67 \times 10^{-27} kg$

  Electron mass $m_e = 1.67 \times 10^{-31} kg$

  g = 9.81 m/s^2

QUESTION ONE (COMPULSORY)   (30 MARKS)

a) State coulombs law and give its mathematical form   [2 marks]

b) Calculate the value of two equal charges if they repel one another with a force of 0.2N. when situated 30cm apart in a vacuum   [3 marks]

c) Give the expression for electric field strength at a distance d from an isolated point charge Q   [1 mark]

d) Define the term electric potential at any point in the field [2 marks]

e) Sketch a graph showing how the potential varies with distance from the charge

[2 marks]

f) Along straight conductor X- carrying a current of 2A is placed parallel to short conductors Y of length 0.05m carrying a current 3A. The two conductors are 0.1m apart. Calculate

    i.   The flux density due to X and Y [2 marks]

    ii.   The force on Y [3 marks]

g) State the faradays law of electromagnetic induction [2 marks]

h) A capacitor in an RC circuit is charged to 67% of its maximum value in 0.9s. What is the time constant for the circuit [5 marks]

i) State and explain two ways through which electrical energy is lost in a transformer

(4 marks)

j) Sketch an I-V curve characteristics for a diode both in forward and reverse bias

(4 marks)
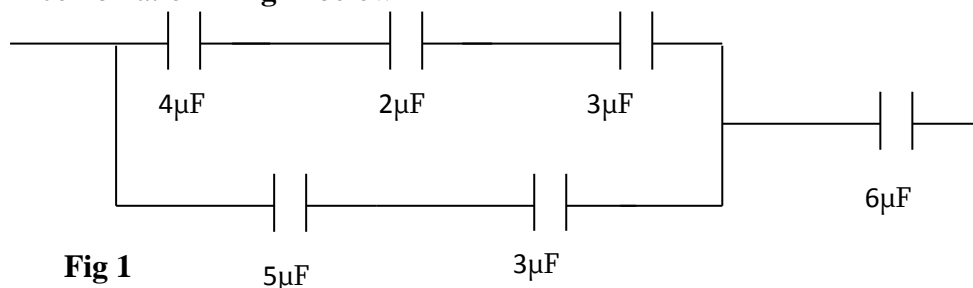
QUESTION TWO   (20 MARKS)

a) Show that the equivalent capacitance C_{eq} of three capacitors C_1, C_2, C_3 connected in series is given by

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

And in parallel

$$C_{eq} = C_1 + C_2 + C_3 \qquad \text{[8 marks]}$$

b) Six capacitors are connected as shown below. Find the equivalent capacitance of the combination in **fig 1** below [5marks]

Fig 1

c) A capacitor is made of parallel plates of cross-section area $20cm^2$ separated by 2cm. If the space between the two plates is a vacuum. Calculate its capacitance [3 marks]

d) If the capacitor in © above is charged to a p.d of 200V. calculate the energy stored by the capacitor [4 marks]

QUESTION THREE   (20 MARKS)

a) State kirchoffs laws   [2 marks]

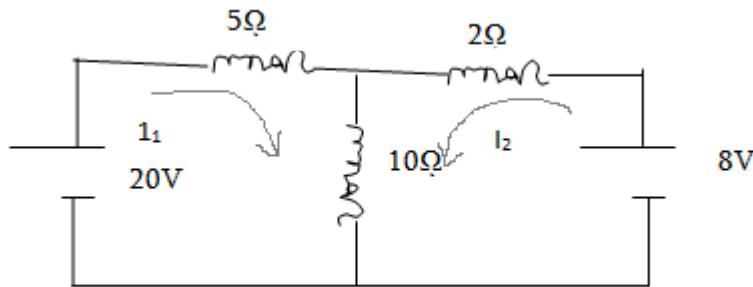b) Calculate the size of Current through the 5 ohms, 10 ohms and 2 ohms resistors respectively in **fig 2** below   [9 marks]

Fig 2

c) Calculate the magnitude of electric field E in which an electron placed in the field would experience a force equivalent to its own weight.   [4 marks]

d) A step up transformer is designed to operate from a 20V supply and delivers energy at 250V. if the transformer is 90 percent efficient, determine the current in its primary winding when the output terminals are connected to a 250V, 100W lamp   [5 marks]

QUESTION FOUR   (20 MARKS)

a. A vertical rectangular coil of sides 5cm by 2cm has 10 turns and carries a current of 2A. Calculate the torque on the coil when it is placed in a uniform horizontal field of 0.1T with its plane at 30° to the field.   [4 marks]

b. A solenoid is 4 cm long and 10 turns per cm. each of the solenoid has an area of $50cm^2$. Calculate the value of self inductance in the solenoid   [4 marks]

c. Derive an experission for the inductance of a toroid of rectangular cross-section shown in **fig 3** below. Evaluate the inductance. For $N=10^3$, a = 5.0cm, b= 10 cm and h=10 cm.   [8 marks]

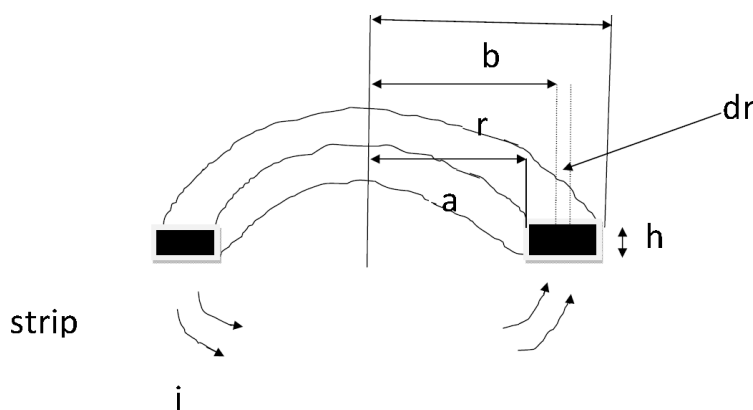**fig 3**

e) The fig 4 below is a circuit use it to answer the questions that follows assuming that $V_{BE} = 0.75V$ and that $h_{FE} = 80$.
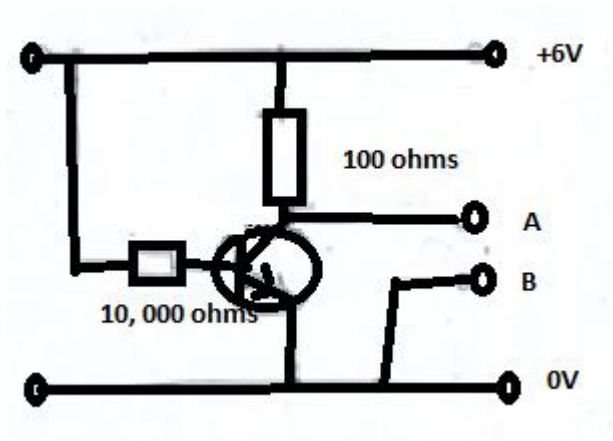
Fig 4

Calculate
    i.   the base current [2 marks]
    ii.   the collector current [2 marks]

QUESTION FIVE   (20 MARKS)

a. The **fig 5** below shows a bridge rectifier.
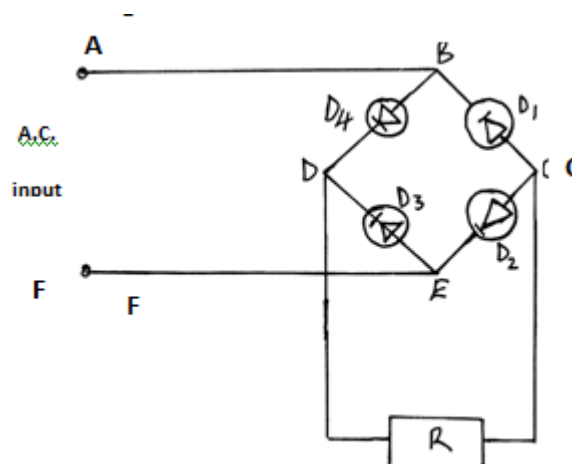

    Fig 5

    i.   Define the term rectification.   (1 mark)
    ii.   Describe how the illustrated rectifier works.   (5 marks)

    iii. State the modification that can be made on the arrangement to improve the quality of the output.   (1 mark)

    iv. Sketch on the areas below how the improved output is displayed on a C.R.O screen.   (1 mark)

b. Explain how an n-type and p-type semiconductors are formed   [6 marks]

c. Using band gap theory explain the difference in insulators, metals and non-metals [6marks]