TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL & AUTOMOTIVE ENGINEERING

SPH 2174: PHYSICS FOR ENGINEERS II

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: MARCH 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FOUR** questions
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

Where necessary use:

$$K = \frac{1}{4\pi\varepsilon 0} = 8.99 \times 10^9 \, Nm^2/C^2 \quad e = 1.602 \times 10^{19} C; \quad 1ev = 1.602 \times 10^{-19} J$$

$$1\upsilon = 1.6605 \times 10^{-27} kg$$

$$hc = 1240 eVnm$$

Question One (Compulsory)

a) (i) What is the expression for temperature dependence of resistance?

(ii) A carbon resistor is to be used on a thermometer on a winter day when the temperature is 4°C, the

resistance of the carbon resistor is 217.3 Ω. What is the temperature on a hot summer day when the resistance is 213.6 Ω (The temperature coefficient of resistivity is – 0.0005 per °C)

(6 marks)

b) The following measurements were made on a resistor:

I (A)	0.50	1.00	2.00	4.00
V_{ab} (V)	4.76	5.81	7.05	8.56

    (i) Plot a graph of Vab as a function of I   **(4 marks)**
    (ii) From the plot in (i) above, does Thynite obey ohm's law?   **(4 marks)**
    (iii) Make a plot of the V_{ab}/I as a function of I   **(4 marks)**

c)

        400A

The circuit shows 24.0V- battery whose terminal voltage is 21.6V, and the current in the circuit is 4.0A.
    (i) What is the internal resistance r of the battery   **(3 marks)**
    (ii) Find the resistance R of the circuit resistor   **(3 marks)**

d) The sketch below sows a person standing in front of a convex mirror, with focal length at F.

          D   F   E

    (i) By use of a sketch, locate the position of the image   **(3 marks)**
    (ii) Which of the following labeled points (ABCDEF) will be closest to the location of the image formed by this mirror?   **(1 mark)**
    (iii) Is this mirror appropriate for shaving or applying make-up? Explain.   **(2 marks)**

Question Two

a) Define:
    (i) Binding energy   **(2 marks)**
    (ii) Half life   **(2 marks)**

b) If a nucleus decays by β - emission, what will be the atomic number of the daughter nucleus? **(2 marks)**
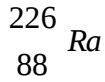
c) Radian $^{226}_{88}Ra$ in radio-active with a half-life of 1600 years.

    (i) How large is the "decay constant" λ in units of decays/second (or just S^{-1})? **(2 marks)**

    (ii) How many radium atoms would have an activity of 37GBq? (1Bq = 1 decay/s) **(2 marks)**

    (iii) What mass of pure radium would have an activity of 37GBq? **(2 marks)**

d) In a photo electric experiment, it is found that metal Q (treat it as unknown) produces photo electrons only if exposed to light of wavelength less than 350nm.

    (i) Find the work function of this metal (in ev) **(2 marks)**

    (ii) If light at wavelength 245 nm now shines on the metal Q, find the maximum kinetic energy (in ev) of the photoelectrons that are being produced. **(4 marks)**

    Find the electric field that Q_1 produces at point B. Indicate its direction (using an arrow and label it $\vec{E}_1$) on the diagram. **(4 marks)**

    (iii) Find the electric field that Q_2 produces at point B. Indicate its direction (using an arrow & label it $\vec{E}_2$) on the diagram. **(4 marks)**

    (iv) Find the net electric field at point B (from your results in (i) and (ii) above). Give its magnitude and direction. **(3 marks)**

    (v) If a dust particle with charge $q = -1.0\mu C$ floats at point B, find the magnitude and direction of the electric force $\vec{F}$ that acts on it. **(3 marks)**

Question Three

a)

10cm

b) Two long straight wires carry currents perpendicular to the page as shown above.
  (i) Determine the x and y components of the net magnetic field produced at point P.
  (5 marks)
  (ii) Find the net magnetic field at point P (Give both the direction and magnitude) **(5 marks)**

$$m = 8 \times 10^{-26} kg$$

c) A charge particle of mass   undergoes circular motion at a frequency of 2 x 10^6 in a uniform magnetic field of strength 1.0T the particle is positively charged and the magnetic field is into the page.
  (i) Draw a figure showing the direction of the motion of the particle and the direction of the magnetic force acting on the particle. **(3 marks)**
  (ii) Determine the charge of the particle (in units of e, where 1e = 1.602 x 10^{-19}C)
  (4 marks)
  (iii) Find the radius of the circular motion described if the particle has kinetic energy of 2000 ev.
  (3 marks)

Question Four

a) Briefly describe the terms total internal reflection and critical angle as used in geometric optics.
  (6 marks)
b) The critical angle for total internal reflection at a liquid – air interface is 37°
  (i) Find the refractive index of the liquid **(4 marks)**
  (ii) If a ray of light travelling in the liquid has an angle of incidence at the interface of 28° what angle does the refracted ray in the air make with the normal? **(5 marks)**
  (iii) Suppose a ray of light travelling in air has an angle of incidence at the interface of 28°, find the angle the refracted ray makes with the normal in the liquid. **(5 marks)**