TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF MEDICAL LABORATORY SCIENCES

APS 4111: INTRODUCTION TO PHYSICS

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

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

This paper consist of **FIVE** 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

Question One (Compulsory)

a) State the dimensions of G in terms of the base units in the expression of gravitational force:

$$F = \frac{GM_1 M_2}{R^2}$$

where M_1, M_2 are masses of interacting objects F is the gravitational force, and R is the distance of separation between interacting masses. **(4 marks)**

b) State Newton's second and third laws. **(4 marks)**

c) State and explain two types of friction. **(4 marks)**

d) A stone is thrown vertically upwards with an initial velocity of 25ms^{-1}. Determine the greatest height above the ground attained by the stone and the time taken to reach that height. **(4 marks)**

---

e) (i) State Ohm's law **(1 mark)**

(ii) Other than temperature, explain TWO factors that influence the resistance of a linear conductor of electric current. **(2 marks)**

f) Show that the effective resistance R_T of three resistors connected in parallel is given as:

$$R_T = \frac{R_1 R_2 R_3}{R_1 R_2 + R_2 R_3 + R_1 R_3}$$

g) Define magnetic field $\vec{B}$ and state its SI unit. **(2 marks)**

h) Explain TWO types of diffraction of light. **(4 marks)**

Question Two

a) Define internal energy of a substance. **(2 marks)**

b) What is molar heat capacity **(1 mark)**

c) A part from supply of heat, state TWO other ways of increasing internal energy of a body. **(2 marks)**

d) Calculate the quantity of heat required to raise the temperature of a metal block with heat capacity of 23.1J℃$^{-1}$ by 30℃ **(3 marks)**

e) A vertical steel wire 350cm long with a diameter of 0.100cm has a load of 8.50kg applied at its lower end.

    (i) Find the extension produced **(4 marks)**

    (ii) Find the energy stored in the wire (Young's modulus = 2.00 x 10^{11} Nm^{-2}) **(3 marks)**

f) A particular resistor has a resistance R_θ at a Celsius temperature θ as measured by a constant volume gas thermometer. Given

$$R_\theta = 50 + 0.17\theta + 3 \times 10^{-4} \theta^2$$

, calculate the temperature as measured on the scale of the resistance thermometer which corresponds to 60℃ on the gas thermometer. **(5 marks)**

Question Three

a) Define electric current and state its SI unit. **(2 marks)**

b) A circuit contains five resistors connected to a battery with 12.0V e.m.f as shown in the figure below.
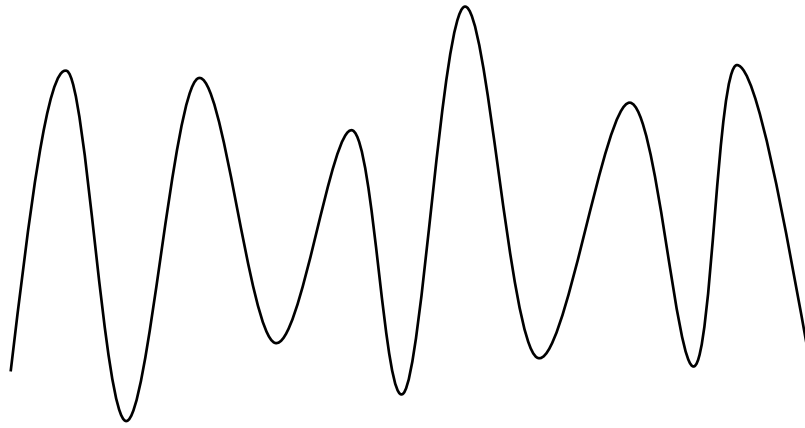
Calculate:
     (i) The effective resistance of the circuit   **(3 marks)**
     (ii) The potential difference across the 5Ω resistor   **(3 marks)**
     (iii)   The current flowing through the 4Ω resistor   **(3 marks)**

c) In the figure below, $C_1 = C_2 = C_3 = C_4 = 2.0\mu F$

Calculate:
     (i) The effective capacitance of the circuit   **(3 marks)**
     (ii) The charge on capacitor C_1 **(3 marks)**
     (iii)   The potential difference across the capacitor C_4 **(3 marks)**

Question Four

a) Explain the following terms as used in concave mirrors:
     (i)   Principal focus
     (ii) Centre of curvature
     (iii)   Pole of the mirror
     (iv) Linear magnification   **(4 marks)**

b) An object is placed 10cm from:
     (i) A converging lens
     (ii) A diverging lens, of focal length 15cm. Calculate the linage position and magnification in
         each case   **(6 marks)**

c) Explain the following lens observations:
     (i) Astigmatism   **(2 marks)**
     (ii) Curvature of field   **(2 marks)**
     (iii)   Distortion   **(2 marks)**

d) An object of height 2cm is placed 20cm from a thin converging lens. A real image, 6cm is produced.
     Calculate the focal length of the lens.   **(4 marks)**

Question Five

a) Show that the third equation of linear motion is given by:
$$V^2 = U^2 + 2as$$
   where the symbols used have the usual meanings. **(4 marks)**

b) A coin is thrown vertically upwards from the ground with a speed of 10ms-1:
   (i) How long does it take to reach the highest point? **(3 marks)**
   (ii) What is the maximum height reached by the coin **(3 marks)**

c) The figure below shows two masses M_1 ad M_2 attached to each other using an inextensible string of negligible mass:

Figure 3

If the masses accelerate over a frictionless table at 9ms^{-2} when the tension of the string T, show that:

(i)
$$a = \left(\frac{m_2}{m_1 + m_2} \right) g$$
(8 marks)

(ii)
$$T = \left(\frac{m_2}{m_1 + m_2} \right) g$$
(2 marks)