TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTHY SCIENCES

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR THE DEGREE OF
BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING (BTEE)
APS 4152: PHYSICS FOR ELECTRICALTECHNOLOGY

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: September 2018

TIME: 2 HOURS

DATE: September 2018

INSTRUCTION TO CANDIDATES

You should have the following for this examination.
-Answer Booklet, examination pass and student ID.
This paper consists of FIVE questions.
Answer question ONE (COMPULSORY) and ANY other TWO questions.
The maximum marks for each question is shown.
Do not write on the question paper.
Mathematical tables and scientific calculators may be used.

Constants

Electron charge	$e = 1.6 \times 10^{-19}C$
Electron mass	$m_e = 9.10 \times 10^{-31}Kg$
Permitivity of air (vacuum)	$\varepsilon_o = 8.85 \times 10^{-12}N^{-1}m^{-2}C^2$

Question One (30 marks)

a) State three basic quantities of measurement and their dimensions (3marks)

b) Define the following terms as applies to mechanics:

i) Dynamics (1mark)

ii) Translational motion (1mark)

iii) Simple Harmonic Motion (1mark)

c) Describe three situations of motion change in which a moving object can be said to be accelerating (4Marks)

d) Calculate the work done against surface tension in blowing a soap bubble 4mm in diameter given that the surface tension of soap solution is $2.5 \times 10^{-2} Nm^{-1}$ (3marks)

e) State Newton's laws of motion (3marks)

f) Show that for a solid object just about to slid on an inclined plane, its coefficient of static friction is equivalent to the tangent of the plane inclination angle to the horizontal (7marks)

g) Define interference and diffraction. Describe with illustrations how the two are interrelated (7marks)

Question Two (20 marks)

a) Define potential difference in an electric field in terms of

i) A joule measure (2marks)

ii) A volt measure (3marks)

b) A unit positive charge was moved against force F provided by charge Q between points A and B which were at distances a and b respectively away from Q. show that the potential difference between A and B is given by $V_{AB} = \frac{Q}{4\pi\varepsilon_0}\left(\frac{1}{a} - \frac{1}{b}\right)$ (8marks)

c) Two positive point charges 12μC and 8μC are 10cm apart. Calculate the work done in bringing them 4cm closer (7marks)

Question Three (20 marks)

a) The figure 1 below shows an object whirled in a circle of radius r at velocity v.

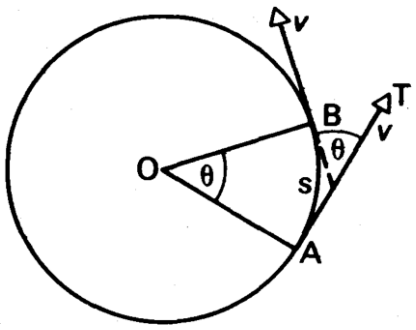

Figure1

i) Find its angular velocity ω at B from A after time t. (1mark)

ii) Determine the period T of the motion in terms of angular velocity (2marks)

iii) If the radius of the path is r, find the arc-length s in terms of θ and hence show that velocity v of the object is $v = r\omega$ (6marks)

b) Show that the acceleration of the object along the circular path described in (a) above is given by $a = \frac{v^2}{r}$ (8marks)

c) An object moves around the circle of radius 600cm at a constant speed of $2ms^{-1}$. Calculate the angular velocity and acceleration of the object (3marks)

Question Four (20 marks)

a) Define coefficient of viscosity and terminal velocity as applies to fluids (3marks)

b) State stokes' law and show that coefficient of viscosity η of a given fluid with density σ can be determine from a ball bearing of radius *a* with density ρ falling through the fluid at terminal velocity *v* by the equation; $\eta = \frac{2ga^2(\rho - \sigma)}{9v}$ (9marks)

c) A sphere of radius 2cm and mass 0.1g, falling vertically through air of density $1.3kgm^{-3}$, at a place where the acceleration due to gravity is $9.81ms^{-2}$, attains a steady velocity of $30ms^{-1}$. Explain why a constant velocity is reached and use the data to find coefficient of viscosity of this air. (8marks)

Question Five (20 marks)

a) Explain the following terms as applies to optics
   i) Plane Polarization (2marks)
   ii) Coherent sources of light (2marks)

b) Show that for the light emerging from two coherent sources which are at a distance *d* apart, making an angle θ to the horizontal, their path difference *x* will be given by $x = d\sin\theta$. State any assumption in your derivation. (7marks)

c) The width of the central maximum in the diffraction pattern is often of particular interest. Suppose that a slit $3x10^{-4}$m wide is illuminated by a yellow-green light (λ=500nm). Find the total width of the central maximum on a screen 2m from the slit. (9marks)