SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY

SCI 101: ELEMENTS OF PHYSICS I

6TH DECEMBER, 2016 **TIME: 8.00-10.00 A.M**

INSTRUCTIONS TO CANDIDATES

1. Question one carries 30marks while the rest carry 20 marks each
2. Answer **Question One** and **any other two** questions
3. The following constants may be used:
   - (i) Gravitational acceleration, $g = 9.8ms^{-2}$
   - (ii) Speed of light in vacuum, $c = 3.0 \times 10^{8} m/s$
   - (iii) Speed of sound in air, $v = 343\, m/s$
   - (iv) Mass of electron, $m_e = 9.11 \times 10^{-31} kg$
   - (v) Electronic charge, $e = 1.602 \times 10^{-19} C$
   - (vi) Planck's constant, $h = 6.62 \times 10^{-34} Js$

Question One (30Marks)

a) Define the *Power* and state its units (2mks)

b) The motion of a body in terms of displacement is described by the expression $s = 5t^3 - 2t + 1$ where x is in meters and t is in seconds.

(i) Calculate its average velocity during the time intervals $t = 0s$ *to* $t = 2.0s$ (2mks)

(ii) Find the instantaneous velocity of the particle at $t = 3.0s$ (2mks)

c) Using the Newton's first law of motion, explain why safety belts are useful in PSV vehicles
(2mks)

d) Determine whether the expression $work\ done = \Delta K.E$ is dimensionally correct (4mks)

e) Define the following terms giving their SI units as used in wave theory

(i) Wavelength (2mks)

(ii) Amplitude (2mks)

f) Define electromagnetic waves and state three of their properties (4mks)

g) Differentiate between Steady and unsteady modes of fluid flow (2mks)

h) Explain the following:

(i) Work function (2mks)

(ii) Isotope (2mks)

(iii) Particle-wave duality (2mks)

i) State two assumptions made in the Bohr atom theory (2mks)

Question Two (20Marks)

a) **(i)** Describe the Huygen's principle of wave motion (3mks)

(ii) Using the Huygen's theory, derive the Snell's law (7mks)

b) **(i)** Explain the Doppler's effect (2mks)

(ii) Explain any two applications of Doppler's effect in sound (2mks)

c) **(i)** State the expression for the sound frequency as detected by an observer when the observer and the source of the sound move away from each other explaining the symbols used (3mks)

(ii) An ambulance travels at a speed of 35 m/s along a highway with its siren emitting sound of frequency of 400 Hz. What frequency is heard by a person standing by the roadside as the ambulance recedes. (3mks)

Question Three (20Marks)

a) The stopping potential when a frequency of 1.61×10^{15} Hz is shone on a metal is 3 V.

(i) What is energy transferred by each photon? (2mks)

(ii) Calculate the work function of the metal. (4mks)

(iii) What is the maximum speed of the ejected electrons? (3mks)

b) A particle of charge q and mass m is accelerated from rest through a small potential difference V. Assuming that the particle is non-relativistic

(i) Derive an expression for its de Broglie wavelength. (5mks)

(ii) Calculate λ if the particle is an electron and V = 50 V. (2mks)

c) State four failures of the Rutherford atomic model (4mks)

Question Four (20Marks)

a) Explain the two forms of stress in fluids (4mks)

b) Derive the following equations for an ideal fluid

(i) the continuity equation (5mks)

(ii) the Bernoulli's equation (11mks)

Question Five (20Marks)

a) **(i)** Calculate the potential energy possessed by a block of mass 20kg at the bottom of a 100 m deep pit (3mks)

(ii) What is the meaning of the value obtained in *a (i)* above (2mks)

b) State the Newton's second law hence show that $F = ma$ (6mks)

c) A car of mass 1000kg travelling at 40m/s decelerates to a speed of 10m/s due to a braking force over a distance of 50m. Calculate:

(i) Work done by the braking force (3mks)

(ii) The braking force (3mks)

d) During an inelastic collision, kinetic energy is not conserved. Explain (3mks)