NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

APRIL/MAY, 2019 EXAMINATIONS

COURSE CODE:	**PHY 301**
COURSE TITLE:	**CLASSICAL MECHANICS II**
CREDIT UNIT	**3**
TIME ALLOWED	**(2½ HRS)**

INSTRUCTION: *Answer question 1 and any other four questions*

QUESTION 1

a.   Define the following terms:

  (i) Conservative force   (3 Marks)

  (ii) Potential Energy   (3 Marks)

  (iii) Work done   (3 Marks)

b. What work is done by a force $F = (2xN)i + (3N)j$, with x in meters?

 that moves a particle from a position $r = (2m)i + (3)j$ to a position

$r_f = -(4m)i - (3)j$ (6 Marks)

c. Briefly explain the term Gravitational Potential   (2 Marks)

d. Calculate the gravitational potential and field for a mass distribution that

  is uniform with density ρ between radii r_i and r_o and zero elsewhere.   (5 Marks)

QUESTION 2

a. Calculate the work done by gravity on a particle shot upward with velocity $\vec{v} = v_o \vec{z}$ in the time 0 to t_f .   (3 Marks)

b. Show that the work equals the change in kinetic energy.   (3 Marks)

c. Calculate the change in potential energy.   (3 Marks)

d. Show that the change in potential energy equals the negative of the work done,

and demonstrate conservation of energy. (3 Marks)

QUESTION 3

a. What is projectile motion? (3 Marks)

b. A projectile of mass M explodes in flight into three pieces. The first mass $m_1 = M/2$ continues

to travel in the same direction as the original projectile. The second mass $m_2 = M/6$ travels in

the opposite direction and $m_3 = M/3$ comes to rest. The energy E converted from chemical

energy of the explosive to final state mechanical energy is five times the initial kinetic energy

of the projectile. What are the velocities of the three pieces? (9 Marks)

QUESTION 4
a. Discus the Lagrangian Approach to Mechanics (4 Marks)

b.   A particle of mass m is constrained to move under gravity without friction on the inside of a paraboloid of revolution whose axis is vertical. Find the one-dimensional problem equivalent to its motion. What is the condition on the particle's initial velocity to produce circular motion? Find the period of small oscillations about this circular motion. (8 Marks)

QUESTION 5
a. Write briefly on the Hamiltonians equation of motion (4 Marks)

b. In hyperbolic motion in a 1/r potential the analogue of the eccentric anomaly is

F defined by $r = a(e \cosh F - 1)$, where $a(1 - e)$ is the distance of closest approach. Find the analogue to Kepler's equation giving t from the time of closest approach as a function of F.

(8 Marks)

QUESTION 6
a. For circular and parabolic orbits in an attractive 1/r potential having the same angular

momentum, show that the perihelion distance of the parabola is one half the radius of the circle

(6 Marks)

b. Prove that in the same central force as in **question 6a**, the speed of a particle at any point in a

parabolic orbit is $\sqrt{2}$ times the speed in a circular orbit passing through the same point.

(6 Marks)