

FACULTY OF SCIENCES
DEPARTMENT OF PHYSICS

2024 1 EXAMINATION

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

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

QUESTION 1

- a. Define generalized force, Conservative force, Potential Energy
12marks
- b. Prove that in the same central force as in question A, 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.
13Marks

QUESTION 2

- a. Define virtual displacement **3marks**
- b. In the following cases, discuss whether the constraint is holonomic or non-holonomic. Specify the constraint force.
- i. Motion of a body on an inclined plane under gravity. **(3 Marks)**
- ii. A bead on a circular wire. **(3 Marks)**
- iii. A particle moving on an ellipsoid under the influence of gravity. **(3 Marks)**
- iv. A pendulum with variable length. **(3 Marks)**

QUESTION 3

- a. Briefly explain the term Constraint **3Marks**
- b. Vector A extends from the origin to a point having polar coordinates $(7, 70^\circ)$ and vector B extends from the origin to a point having polar coordinates $(4, 130^\circ)$. Find $A \cdot B$. **4Marks**
- c. An observer at rest with respect to the ground observes a particle of mass $m_1 = 3\text{kg}$ moving along the x-axis with a velocity $u_1 = 3\text{m/s}$. It approaches a second particle of mass $m_2 = 1\text{kg}$ moving with velocity $u_2 = -3\text{m/s}$ along the same axis. After head-on collision, he finds that the velocity of m_2 is $u_2' = -3\text{m/s}$ along the x-axis. What are the momenta before and after the collision as seen by a moving observer walking with a velocity of 2m/s relative to the ground along the x-axis?
(8 marks)