Ser. No. EDU 063/17

GARISSA UNIVERSITY

UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR ONE FIRST SEMESTER EXAMINATION

SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

COURSE CODE: PHY 112

COURSE TITLE: MECHANICS 1

EXAMINATION DURATION: 3 HOURS

DATE: 07/12/17 **TIME: 2.00-5.00 PM**

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

This paper consists of FIVE (5) printed pages ***please turn over***

QUESTION ONE (COMPULSORY)

(a) i) Define the term 'system of units' **[1 mark]**

ii) State two importance of dimensional analysis **[2 marks]**

(b) The energy E of a body due to its motion is found to depend on the weight W of the body, speed U with which the body is moving and the acceleration due to gravity g. Use dimensional analysis to find the form of this relationship. **[4 marks]**

(c) Briefly describe the two types of errors encountered in measurement **[2 marks]**

(d) Clearly define instantaneous velocity and instantaneous acceleration **[2 marks]**

(e) A particle undergoes a displacement given by S = (2i+3j+4k) m, when acted upon by a force F = (5i+6j-7k) N.

i. Find the work done by the force **[2 marks]**

ii. Determine angle does the force make with the displacement **[2 marks]**

(f) Differentiate contact and non-contact forces **[2 marks]**

(g) A box of weight *mg* is dragged with force *F* at an angle θ above the horizontal. Find:

i. The force exerted by the floor on the box. **[2 marks]**

ii. The acceleration of the box if the coefficient of friction with the floor is μ **[3 marks]**

(h) Two masses of 0.5 and 0.25Kg are connected by a light inextensible string, which passes over a smooth pulley. If the system is released from rest with the string taut, find the acceleration of each mass. **[3 marks]**

QUESTION TWO

(a) Define the terms angular velocity and centripetal acceleration **[2 marks]**

(b) A block of 2 g when released on an inclined plane describes a circle of radius12 cm in the vertical plane on reaching the bottom. Find the minimum height of the incline **[2 marks]**

(c) A conical pendulum consists of a small massive bob of mass M hung from a string of length L and rotating steadily in a horizontal circle of radius R, the bob is displaced at angle θ . With the help of diagram

i. Indicate all the forces acting on the bob **[2 marks]**

ii. Show that its period of oscillation is given by $T = 2\pi\sqrt{\frac{LCos\ \theta}{g}}$ **[5 marks]**

(d) The orbit of an electron in the hydrogen atom may be considered to be a circle of radius $5x10^{-11}$ M, and the period of motion is$1.5 \times 10^{-6}s$. Calculate

i. The angular speed of the electron **[2 marks]**

ii. The centripetal acceleration **[2 marks]**

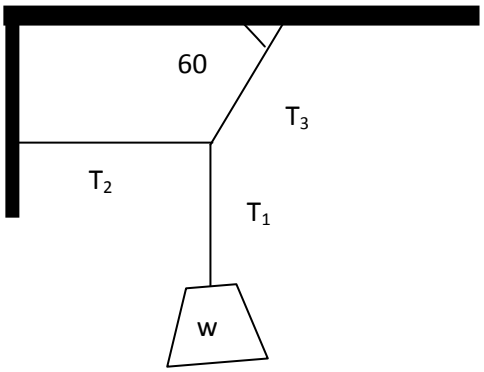
QUESTION THREE

(a) State the law of conservation of energy **[1 mark]**

(b) A uniform ladder 10m long weighing 295N rests against a smooth vertical wall with its base on a rough floor, and 4M from the wall. If the coefficient of friction between the ladder and the floor is 0.166, how far along the ladder will a 70Kg man climb before the ladder slips from under him? **[3 marks]**

(c) Clearly distinguish between coplanar forces and concurrent forces **[2 marks]**

(d) A block of weight W hangs from a cord, which is attached at point O to two other cords, one fastened to the ceiling and the other to the wall. Find the tensions in this three cords(assume the weights of the cords to be negligible **[5 marks]**



(e) i) state the Newton's law of universal gravitation **[1 mark]**

ii) state the three Kepler's laws of planetary motion **[3 marks]**

QUESTION FOUR

(a) i) state the law of conservation of linear momentum **[2 marks]**

ii) Differentiate between elastic and inelastic collisions **[2 marks]**

(b) A particle of mass *m* with initial velocity *u* makes an elastic collision with a particle of mass *M* initially at rest. After the collision the particles have equal and opposite velocities. Find

i. the ratio *M/m*; **[2 marks]**

ii. The velocity of centre of mass; **[2 marks]**

(c) Clearly distinguish between conservative and non- conservative forces and give one example of each of the forces. **[3 marks]**

(d) Show that in case of a conservative force the work done round a closed path is zero **[4 marks]**

QUESTION FIVE

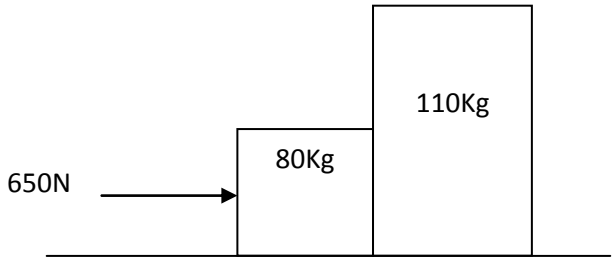
(a) i) state the work-energy theorem **[1 mark]**

(ii)State the three Newton's laws of motion **[3 marks]**

(b) Two boxes of mass 80Kg and 110Kg are in contact and at rest on a horizontal

i. Surface as shown. A 650N push is exerted on the 80Kg box in the direction

ii. Shown. If the coefficient of friction is 0.2 calculate



iii. The acceleration of the system **[3 marks]**

iv. The force each box exerts on the other **[2 marks]**

(c) Show that $X = X_o + V_o t + 1/2at^2$ Where the symbols used have their usual meaning **[3 marks]**

(d) Consider a liquid of density ρ flowing through a tube of cross-sectional area A_1 at speed V_1 to another narrow tube of cross-sectional area A_2 at speed V_2. With the aid of diagram derive the equation of continuity **[3 marks]**

QUESTION SIX

(a) Define the term "projectile motion" **[1 mark]**

(b) If a projectile at a point O on the ground is projected with a velocity u at an angle α to the horizontal motion separately, show that.

i. Time taken to reach maximum height is given by

$$t = \frac{u \sin \alpha}{g}$$ **[4 marks]**

ii. Total time of flight is given by

$$t = \frac{2u \sin \alpha}{g}$$ **[3 marks]**

iii. Maximum horizontal range is given by

$$R = \frac{u^2}{g}$$ **[3 marks]**

(c) Define

i. viscosity **[1 mark]**

ii. With the aid of a diagram, derive the expression of viscosity

$$\eta = \frac{2gR^2(\rho - \sigma)}{9v}$$ **[3 marks]**