THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

SEPTEMBER – DECEMBER 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

REGULAR PROGRAMME

PHY 101: MECHANICS I

Date: DECEMBER 2019	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and ANY other TWO Questions	

Q1. (a) Explain the following terms.

(i) Couple
(ii) Torque
(iii) Moment of inertia
(iv) Hydrostatic
(v) Inelastic collision

(7marks)

(b) A force F = 3i – j +21.5k acts on an object and displaces it through r = 0.5i +20j -3k.

Obtain (i) The magnitude of the force
(ii) The magnitude of displacement
(iii) The work done
(iv) The angle between the applied force and the displacement

(8marks)

(c) Two parallel, equal and opposite forces of magnitude 19N are 1.7 m apart on a straight Bar AB. Calculate the torque caused from end B.
80cm

(3marks)

(d) An object of mass 20g is projected with initial velocity of 200m/s at 40° to the horizontal.

Calculate (i) The time taken to reach maximum height
(ii) The maximum height reached
(iii) The range

(6marks)

(e) A U- tube with limbs of diameter 5.0mm and 2.0mm contain water of surface tension $7.0\,X\,10^{-2}\,Nm^{-2}$. The angle of contact zero and density $1.0\,X\,10^{3}\,Kg\,m^{-3}$. Find the difference in levels. (g =10ms^{-2})

(6marks)

Q2. (a) State the Newtons laws of motion

(6marks)

(b) A rocket develops an initial thrust of $3.3\,X\,10^{7}\,N$ and has a lift- off mass of $2.8\,X\,10^{6}\,Kg$. Find the initial acceleration of the rocket at lift- off.(g= 10ms^{-2})

(7marks)

(c) Two blocks A and B are connected to each other on a horizontal frictionless floor and
Pulled to the right with an acceleration of 2.0 m/s^2 by force P. If $m_1 = 50\,Kg \wedge m_2 = 10\,Kg$. What is the value of T(Tension on the string connecting A and B) and P.

(7marks)

Q3. (a) A sign of mass 5.0Kg is hung from the end B of a uniform bar AB of mass 2.0kg. the bar is hinged to a wall at A and held horizontally by a wire joining B to C which is on the wall vertically above A. If the angle ABC = 30°, Find the force in the wire and that exerted by the hinge. (g= 10m/s^2)

(6marks)

(b) A bullet of mass 10g travels horizontally at a speed of $1.0\,X\,10^{2}\,m/s$ embeds itself in a block of wood of mass $9.9\,X\,10^{2}\,g$ suspended by a string so that it can swing freely. Find
(i) The vertical height through which the block rises.
(ii) How much of the bullet's energy becomes internal energy. **(3marks)**

(c) A jet of water emerges from a hose pipe of cross sectional area $5.0\,X\,10^{-3}\,m^2$ with a velocity of 3.0 ms^{-1} and strike a wall at right angle. Calculate the force on the wall assuming the water is brought to rest and does not rebound. (Density of water is $1.0\,X\,10^{3}\,Kgm^{-3}$)

(7marks)

Q4. (a) A shaft rotating at $3.0\,X\,10^{3}\,rev/min$ is transmitting a power of 10kW. Find the magnitude of the driving couple.

(4marks)

(b) A bicycle wheel is being tested at a repair shop. The angular velocity of the wheel is 4rads/sec at the time t = 0. Its angular acceleration is constant and is -1.2rads/s^2. A spoke OP on the wheel coincides with a positive X- axis at time t = 0s.

(i) What is the wheels angular velocity at time t = 3s

(3marks)

(ii) What angle does the spoke OP make with the positive X- axis at this time.

(4marks)

(c) A Discuss thrower turns with angular acceleration $\alpha = 50\,rad/s^2$ moving the Discuss in a circle of radius 0.80m. Modelling the throwers arm as a rigid body so as r is constant, Find the tangential and the centripetal components of the acceleration of the Discuss and the magnitude of the acceleration at the instant when the angular velocity (ω¿ is 10 rad/s.

(9marks)

Q5. (a) (i) State the Archemedes principle.

(2marks)

(ii) A string support a solid copper block of mass 1Kg (Density $9.0\,X\,10^3\,Kg\,m^{-3}$)

Which is completely immersed in water of density $1.0\,X\,10^3\,Kgm^{-3}$. Calculate

The tension in the string.

(5marks)

(b) A garden sprinkler has 150 small holes each of area 2.0mm^2. If water is supplied at the rate of $3.0\,X\,10^{-3}\,m^3/s$, what is the average velocity of the spray?

(5marks)

(c) Obtain an estimate for velocity of emergence of a liquid from a hole in the side of a wide vessel 10cm below the liquid surface.

(8marks)

END