

**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**  
**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR  
SCIENCE IN:  
CONSTRUCTION MANAGEMENT  
RENEWABLE ENERGY**  
**2022/2023 ACADEMIC YEAR      1<sup>ST</sup> YEAR      1<sup>ST</sup> SEMESTER**  
**MAIN**  
**REGULAR**

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**COURSE CODE: SPH 3111**

**COURSE TITLE: PHYSICS I**

**EXAM VENUE:**

**STREAM: (BED SCI)**

**DATE:**

**EXAM SESSION:**

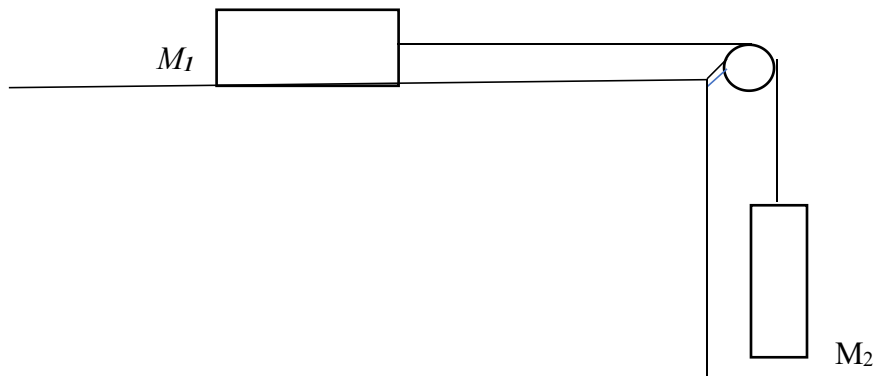
**TIME: 2:00HRS**

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1. **Instructions:** Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.
2. Answer Question 1 (compulsory) and ANY other 2 questions
3. Candidates are advised not to write on the question paper.
4. Candidates must hand in their answer booklets to the invigilator while in the examination room.

**QUESTION ONE (30 Marks)****Compulsory**

- i) Distinguish between rectilinear and two-dimensional motion giving an example of each (3 marks.)
- ii) A bullet is released from a rifle at a velocity of  $300\text{m/s}$  in horizontal direction. It hits the trunk of a tree and penetrates through its axis horizontally. If it emerges the other side at  $120\text{m/s}$  after 6 seconds. Determine
- The acceleration of the bullet while penetrating through the trunk
  - The cross-sectional area of the trunk of the tree
- iii) Using the first and third equations of linear motion, obtain the third equation of linear motion.
- iv) Consider the pulley system in the figure below with masses  $M_1$  and  $M_2$ . The strings and pulleys are massless and there is no friction involved. Obtain the expressions of the common acceleration of the system and the tension on the cord.



- v) Achieng, 1.6m tall, throws a ball vertically upwards aiming at a basketball goal ring placed 4m above her head.
- With what minimum velocity must she throw the ball so as to reach her target? (3marks)
  - The ball rises and then falls back freely making a score. Determine the total time of flight of the ball from the time it was released to the time it hits the ground. (4 marks)
- vi) Briefly explain the following laws of thermodynamics (6Marks)
- The Zeroth law
  - The First law and

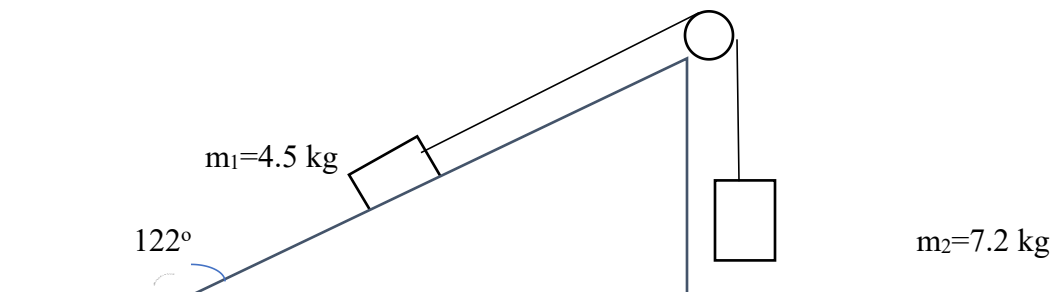
- ii. The Second law
- vii) Perform the following conversions ( 4 marks)
- 400°C to degrees Fahrenheit
  - 33°F to degrees Centigrade
- viii) If a solid bar of aluminum 16.0 m long is struck at one end with a hammer, a longitudinal pulse propagates down the bar. Find the speed of sound in the bar if it has a Young's modulus of  $7.0 \times 10^{10}$  Pa and a density of  $2.7 \times 10^3$  kg/m<sup>3</sup>. (3 marks)
- ix) State the three Kepler's laws of gravitational motion (3 marks)

**QUESTION TWO (20 Marks)**

- a. A stone is thrown vertically upwards at 80m/s aiming at a fruit which is at 50m high on top of a tree. At the same time the stone is thrown, the fruit accidentally falls freely downwards in the path of the stone. Determine;
- The height above the ground when the two met.
  - The time they took to meet
  - The velocity of each at the time they were meeting (9 marks)
- b. A stone was projected upwards from the top of a 100m tall tower at an angle of 45° relative to the horizontal with an initial velocity of 200m/s. Calculate
- The maximum height reached by the stone relative to the ground (3 marks)
  - The final velocity of the stone and the angle relative to the ground that the stone hits the ground (3 marks)
  - Total time of flight (3 marks)
  - Maximum range (3 marks)

**QUESTION THREE (20 Marks)**

- a. Two blocks with masses  $m_1=4.5$ kg,  $m_2=7.2$  kg are connected with an inelastic rope over a pulley as shown diagram below. The horizontal surface is frictionless



Determine

- i) the common acceleration of the blocks
- ii) The tensions in the rope connecting the blocks. (6 marks)

An object is whirled in a uniform circular path of radius  $r$  at a uniform speed  $v$ , Show that it undergoes a centripetal acceleration  $a$  given by the relation

$$a = \frac{v^2}{r} \quad (5 \text{ marks})$$

A 200g object is tied to the end of a cord and whirled in a vertical circle of radius 1.2m at a constant 3.0 rev/second. Determine

The acceleration of the object

The minimum tension on the string

The maximum tension on the string (6 marks)

#### QUESTION FOUR (20 Marks)

- a. a. A fire response truck travels down a highway at a speed of 150.0 m/s and has its siren emitting sound at a frequency of 1600 Hz.
  - i.) What frequency is heard by a stationary observer;
    - a) being approached by the truck
    - b) being left by the truck (4 marks)
  - ii.) What frequency is heard by a passenger in a car traveling at 100.0 m/s in the opposite direction as the car and truck
    - a) approach each other and
    - b) pass and move away from each other? Take the speed of sound in air to be 342m/s (6 marks)
- b. A flute of length 60cm is always ideal for the entertainments in the wedding occasions. What are the wavelengths and frequencies of the first four harmonics that can be produced to entertain the groom and bride when such a flute is (a) open, (b) closed? Take the speed of sound  $v= 350m/s$ . (10 marks)

**QUESTION FIVE (20 Marks)**

a. The position of a particle executing a simple harmonic motion is given by

$$x = 3.5 \cos(27t + 7.5)m .$$

i) Determine the frequency, period and the range of the oscillations. (4 marks)

ii) Determine the displacement, Velocity and the acceleration of the particle after 25 seconds

(6 marks)

b. An unclothed person whose body has a surface area of  $1.4\text{m}^2$  with an emissivity of 0.08 has a skin temperature of  $37\text{C}$  and stands in a  $20\text{ C}$  room. How much energy does the person loose per minute?

$$\text{Take } \sigma = 5.67 \times 10^{-8} \text{W/m}^2\text{K}^4$$

(5 marks)

c. An iron plate  $2\text{cm}$  thick has a cross-sectional area of  $5000\text{cm}^2$ . One face is at  $150\text{ C}$  while the other is at  $130\text{ C}$ . How much heat passes through the plate each second? Take

$$K_T = 80 \text{W/mK}$$

(5marks)