JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATION FOR THEDEGREE OF BACHELOR OF EDUCATION (SCIENCE)

MAIN

SPECIAL RESITS EXAMINATIONS FEB 2022

COURSE CODE: SPH 3111

COURSE TITLE: PHYSICS I

EXAM VENUE: **STREAM: (BED SCI)**

DATE: **EXAM SESSION:**

TIME: 2:00HRS

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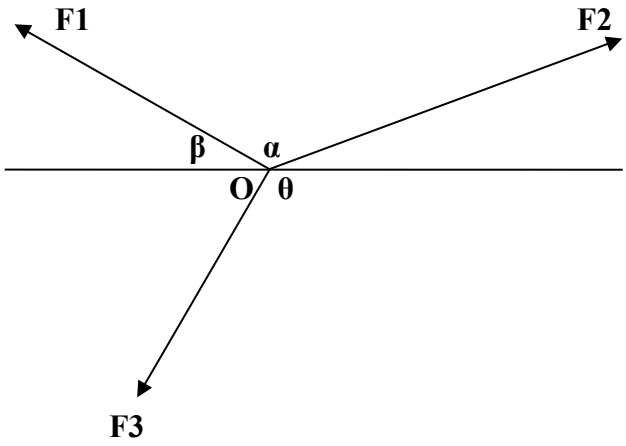
1. **Instructions: Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Answer Question 1 (compulsory) and ANY other 2 questions**
3. **Candidates are advised not to write on the question paper.**
4. **Candidates must hand in their answer booklets to the invigilator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

QUESTION ONE (30 Marks) Compulsory

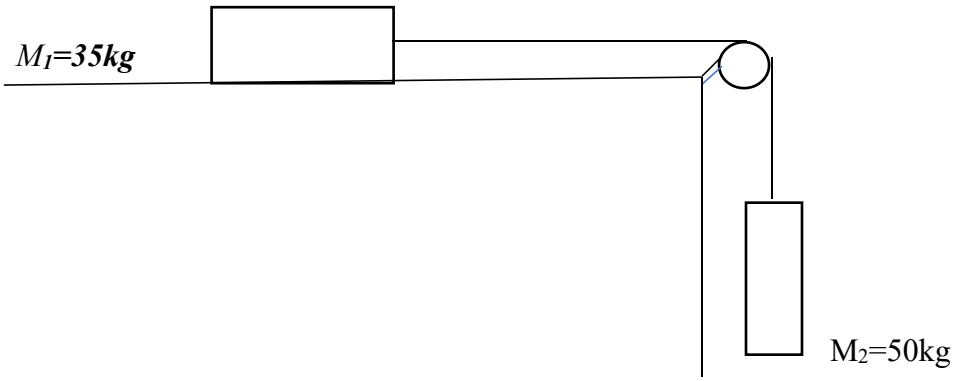
a. Distinguish between coplanar and non-coplanar forces (1 Mark)

b. The figure below shows a set of forces F1, F2, and F3 acting on a point object O.



Given that **F1 = 40N, F2 = 70N, F3 = 150N**, **β = 28°, α = 102° and θ = 110°,** determine the magnitude and direction of the resultant force. (5 marks)

c. Consider the pulley system in the figure below with masses M_1**=35kg** and M_2**=50kg.** The strings and pulleys are massless and there is no friction involved.



Determine the common acceleration of the masses and the tension in the string. (4 marks)

d. Achieng, 2.5m tall, throws a ball vertically upwards aiming at a netball goal ring placed 8m above the ground.

i) With what minimum velocity must she throw the ball so as to reach her target? (3marks)

ii) ii) Determine the total time of flight of the ball from the time it was released to the time it hit the ground. (4 marks)

e. Briefly explain the following laws of thermodynamics (6Marks)

i. The Zeroth law
ii. The First law and
ii. The Second law

f. Perform the following conversions (4 marks)

i) 400^{o}C to degrees Fahrenheit

ii) 33^{o}F to degrees Centigrade

g. 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 7.0×10^{10} Pa and a density of 2.7×10^{3} kg/m^{3}. (3 marks)

h. State the three Kepler's laws of gravitational motion (3 marks)

QUESTION TWO (20 Marks)

a. A particle moving along a straight line begins from an initial velocity v_o and accelerates uniformly at a attaining a final velocity v_f after a time t. If it covered a displacement x show that;

$$v_f = v_o + at$$

$$x = v_o t + \tfrac{1}{2} at^2$$

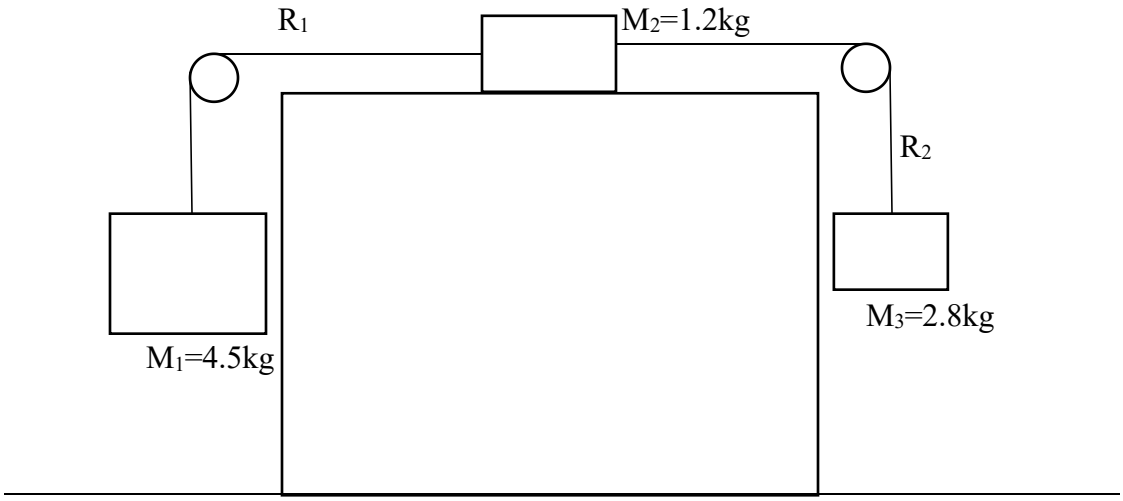
$$v_f^{\,2} = v_o^{\,2} + 2ax$$ (8 marks)

b. A stone was projected upwards from the top of a 100m tall tower at an angle of 38^{o} relative to the horizontal with an initial velocity of 140m/s. Calculate

i) The maximum height reached by the stone from the ground (4 marks)
ii) The final velocity of the stone and the angle relative to the ground that the stone hit the ground (4 marks)
iii) Total time of flight (4 marks)
iv) Maximum range (4 marks)

QUESTION THREE (20 Marks)

a. Three blocks with masses M_1=4.5kg, m2=1.2 kg and m3= 2.8kg are connected with two ropes R_1 and R_2 over a solid stationary platform ss shown in the figure below. The horizontal surface is frictionless



Determine

a. the common acceleration of the blocks
b. The tensions in the ropes R_1 and R_2. (9 marks)

b. 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

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

c. 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 $1.4m^2$ with an emissivity of 0.08 has a skin temperature of 37℃ and stands in a 20 C room. How much energy does the person loose per minute?

Take σ=5.67x10-8W/m^2K^4 (5 marks)

c. An iron plate 2cm thick has a cross-sectional area of $5000cm^2$. One face is at 150 C while the other is at 130 C. How much heat passes through the plate each second? Take K_T=80W/mK (5marks)