JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATION 2013/2014

1ST YEAR, 1ST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF BIOLOGICAL SCIENCES AND BACHELOR OF EDUCATION SCIENCE WITH IT

COURSE CODE: **SPH 3111**

TITLE: **PHYSICS I**

DATE: **26/4/2013** **TIME: 14.00-16.00PM**

DURATION: 2 HOURS

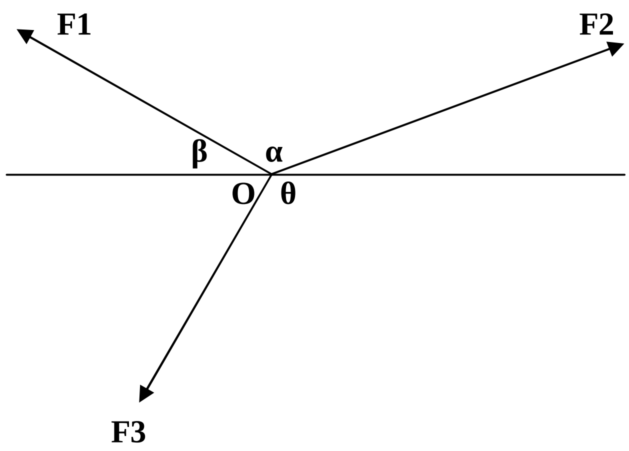
INSTRUCTIONS:

1. **This paper contains two sections (A and B)**
2. **Answer ALL questions in Section A and any Two (2) questions in Section B**
3. **Write ALL answers in the booklet provided**

QUESTION ONE (30 Marks) Compulsory

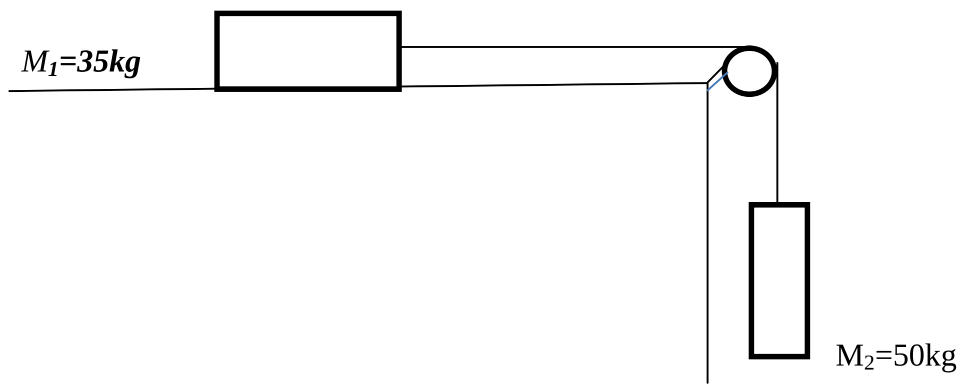
i. Distinguish between coplanar and non-coplanar forces (1 Mark)

ii. 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)

iii. Consider the pulley system in the figure below with masses $\boldsymbol{M_1}$**=35kg** and $\boldsymbol{M_2}$**=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)

iv. 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)

v. The position of a particle moving along the x- axis is given by x=0.08 sin (12t+0.3) m.

i. State the amplitude and period of the motion

ii. Determine the position, velocity, and acceleration of the particle at t=0.6sec. (6 marks)

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

i. The Zeroth law

ii. The First law and

iii. The Second law

QUESTION TWO (20 Marks)

a) i. Find the scalar product of the vectors **A=** 4**i**+6**j-k and B=**3**i-**4**j**+5**k** **(2 marks)**

ii. Find the angle between the vectors **H=**2**i**+6**j-**5**k and G=**7**k-**3**i** **(2 marks)**

iii. Find the vector product of the vectors **A=i**+4**j**+8**k** and **B=**3**i-**2**j**+5**k** **(2 Marks)**

iv. Derive the law of cosine and law of sine by **vector** method. (6 marks)

b. 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;

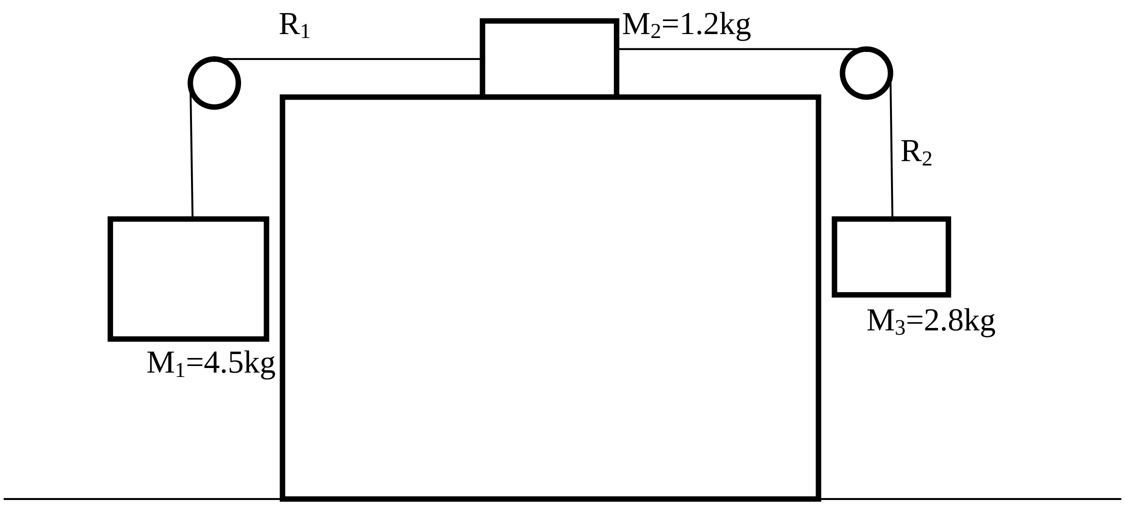
i. $v_f = v_o + at$

ii. $x = v_o t + \frac{1}{2} at^2$

iii. $v_f{}^2 = v_o{}^2 + 2ax$ (8 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

i. the common acceleration of the blocks

ii. 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)

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. An ideal gas of density p contained in an enclosed container. Show that the pressure due to the gas on the walls the container is given by the equation

$$P = \frac{1}{3} \circ v_{rms}^2$$

(6marks)

b. A gas molecule at the surface of the earth happens to have the rms speed for that gas exactly 0C. If it were to go straight upwithout colliding with other molecules, how high would it rise? (4 marks)

c. Starting with the first law of thermodynamics and the definitions of c_p and c_v show that

$$c_p - c_v = \left[P + \left(\frac{\partial U}{\partial V} \right)_T \right] \left(\frac{\partial V}{\partial T} \right)_P$$

Where c_p and c_v are the specific heat capacities per mole at constant pressure and volume, respectively, and *U* and ***V*** are energy and volume of one mole. (10Marks)

QUESTION FIVE (20 Marks)

a. 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℃ room. How much energy does the person loose per minute?

Take σ=5.67x10-8W/m^2K^4 (5 marks)

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

c. The length of an air column is varied by adjusting the water level in a pipe. A vibrating tuning fork is placed at the open end. As the water is lowered, resonance is first heard when the length of the column is 18.9cm. The second resonance is heard when the length is 57.5cm. Determine the frequency of the tuning fork. (4 marks)

d. A pipe is 2.46 m long. Determine the frequencies of the first three harmonics if the pipe is open at both ends. Take 343 m/s as the speed of sound in air. (6 marks)