JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN BUILDING AND CONSTRUCTION MANAGEMENT

RENEWABLE ENERGY

WATER RESOURCE MANAGEMENT

AGRICULTURE

1ST YEAR 1ST SEMESTER

MAIN

REGULAR

COURSE CODE: SPH 3111

COURSE TITLE: PHYSICS 1

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

DATE: **EXAM SESSION:**

TIME: 2:00HRS

Instructions:

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

QUESTION 1 (30 MARKS)

(a) Define the term Mechanics. **(1 mark)**

(b) State **ONE** importance of studying properties of matter to an engineer.

(1 mark)

(c) Obtain an expression for the angle between the vectors $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$ and $\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$ **(3 marks)**

(d) An Architect throws a plumbline to his colleague at the top of a building duringconstruction at an initial velocity of $12\ ms^{-1}$. Determine the time it takes the plumb line to reach the colleague who is $5\ m$ from the release point.

(**3 marks)**

(e) (i) State **TWO** assumptions made in the analysis of projectile motion.**(2 marks)**

(ii) A projectile is launched at an angle of 30° above the horizontal at a velocity of $300\ m/s$. Determine the horizontal range of the projectile. **(2 marks)**

(f) State Newton's second law of motion. **(1 mark)**

(g) Two forces $\vec{F}_1$ and $\vec{F}_2$ act at a point. The magnitude of $\vec{F}_1$ is $9.0\ N$ and its direction is 60° above the x-axis in the second quadrant. The magnitude of $\vec{F}_2$ is $6.0\ N$ and its direction is 53.1° below the x-axis in the third quadrant.

Calculate the magnitude of the resultant force. **(3 marks)**

(h) Explain the fact that a body undergoing uniform circular motion accelerates.

(1 mark)

(i) Show that the frequency of a body undergoing simple harmonic motion is given by $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ where each symbol has its usual meaning.**(2 marks)**

(j) Distinguish between viscosity and surface tension. **(1 mark)**

(k) A square steel bar $50\ mm$ on side and $1\ m$ long is subjected to an axial tension of $250\ kN$. The decrease in lateral dimension due to the load is $7.5\ \mu m$.

Determinethe Poisson's ratio of the bar. **(3 marks)**

(l) Distinguish between conduction and convection as mechanisms of heat transfer. **(2 marks)**

(m) Write down the form of Stefan's law used in blackbody radiation**(1 mark)**

(n) The speed of sound in granite is $6000\ ms^{-1}$. Calculate the ratio of linear density to the tension on the material.**(2 marks)**

(o) Define the term ultrasonic wave, stating one of its applications. **(2 marks)**

SECTION B

Attempt any TWO questions in this section

QUESTION 2 (20 MARKS)

(a) Derive the equation of wave motion governing the travel of waves of any type. **(13 marks)**

(b) Show that the vector product of any two vectors $\vec{A}$ and $\vec{B}$ in three dimensions in terms of the components is given by $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$ **(5 marks)**

(c) A force $\vec{F} = 20\hat{i} + 10\hat{j} + 6\hat{k}$ acts on a wheel at a point $\vec{r} = 2\hat{i} + 3\hat{j} + \hat{k}$ from the centre of the wheel. Calculate the torque on the wheel. **(2 marks)**

QUESTION 3 (20 MARKS)

(a) To approximate the depth of water well, Martha and John dropped a heavy rock into the well, 8 seconds later after the rock was dropped, they heard a

splash caused by the impact of the rock on the water. Calculate the depth of the well. **(5 marks)**

(b) Derive the expression for calculating the scalar product of two vectors in terms of their components. **(5 marks)**

(c) Two vectors are defined by $\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$ and $\vec{B} = \hat{i} + 2\hat{k}$ .Calculate:

(i) $\vec{A}.\vec{B}$ **(2 marks)**

(ii) $\left|\vec{A}X\vec{B}\right|$ **(5 marks)**

(iii) A unit vector in the direction of $\vec{A}X\vec{B}$ **(3 marks)**

QUESTION 4 (20 MARKS)

(a) Consider a traffic light suspended by cords as shown in Figure 4.1. Determine the tension in each cord, given that the weight w of the traffic light is $20\ N$.
(10 marks)

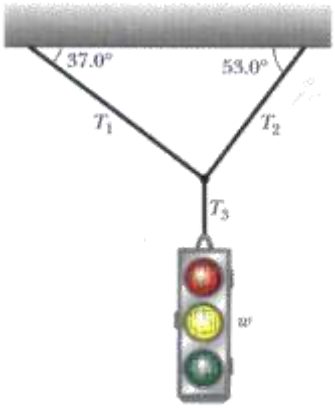

Figure 4.1. A traffic light in equilibrium

(b) Show that the trajectory of a projectile is parabolic and takes the form

$y = (\tan\theta_i)x - \left(\frac{g}{2u^2\cos^2\theta_i}\right)x^2$ where each symbol has its usual meaning. **(10 marks)**

QUESTION 5 (20 MARKS)

(a) $1.0\ kg$ of liquid water at $100\ ^0C$ is converted to steam at $100\ ^0C$ by boiling at standard atmospheric pressure $\left(1.01\times10^5 Pa\right)$. The volume of the water changes from an initial value of $1.01\times10^{-3}\ m^3$ as liquid to $1.671\ m^3$ as steam. Determine:

(i) The work done by the system**(2 marks)**

(ii)The energy transferred as heat during the process(Latent heat of vaporization= $2256\ kJ/kg$).**(2 marks)**

(iii) The change in the internal energy of the system. **(2 marks)**

(b) Derive the equation for the root mean square velocity of an ideal gas in the form $V_{rms} = \sqrt{\frac{3RT}{M}}$ where the symbols have their usual meanings. **(9 marks)**

(c) A mass of $2\ kg$ is attached to the end of a vertical wire of length $2\ m$ and diameter $0.64\ mm$. Given that the mass causes an extension of $0.60\ mm$, calculate Young's modulus of the wire **(5 marks)**