**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES**

**UNIVERSITY EXAMINATION FOR THE DEGREE OF:**

**BACHELOR OF SCIEINCE IN BUILDING CONSTRUCTION AND MANAGEMENT**

**BACHELOR OF SCIENCE IN RENEWABLE ENERGY**

**BACHELOR OF SCIENCE IN WATER AND NATURAL RESOURCE MANAGEMENT**

**1ST YEAR 1ST SEMESTER 2016/2017 ACADEMIC YEAR**

# MAIN CAMPUS

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**COURSE CODE: SPH 3111**

**COURSE TITLE: PHYSICS 1**

**EXAM VENUE: AH** **STREAM: (BED Sc.)**

**DATE: 20/04/16** **EXAM SESSION: 2.00 – 4.00 PM**

**TIME: 2 HOURS**

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**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.**

**1.** a) Derive an exprsesion for the terminal speed V, of a sphere falling in a viscous fluid in terms of the sphere's radius r and density $\rho$ and the fluid viscosity $\eta$, assuming that the flow is laminar so that stoke's law is valid. (5marks)

b) Find the angle between the two vectors

**A**= 2i + 3j + k

**B** = - 4i + 2j – k (6 mks)

c) (i) What are ultrasonic waves (1 mk)

(ii) State and explain any three applications of ultrasonic waves (6 mks)

d) The temperature gradient between the skin and the air is regulated by cutaneous (skin) blood flow. If the cutaneous blood vessels are constricted, the skin temperature and the temperature of the environment will be about the same. When the vessels are dilated, more blood is brought to the surface. Suppose that during dilation the skin warms from 72.0°F to 84.0°F.

(i) Convert these temperatures to Celsius and find the difference. (3mks)

(ii) Convert the temperature to Kelvin, again finding the difference. (3mks)

e) (i) State any three characteristics of a black body. (3marks)

(ii) The surface of a furnace is at 1500°C. How much heat is radiated by $2.0m^2$ of this surface in one hour? Assuming it to be a black body. ($\sigma$ = 5.7 x $10^{-8}$ $W/m^2/K^4$) (3marks)

**2**. (a) Given the two displacements **D** = (6i +3j –k)m and **E** = (4i – 5j +8k)m

Find the magnitude of the displacement 2**D** – **E** (6mks)

(b) Two vectors are given by **C** = - 3i + 4j and **D** = 2i + 3j. Find the angle between **C** and **D** (8mks).

(c) If **A** =$A_1i + A_2j + A_3k$ and B = $B_1i + B_2j + B_3k$, Prove that **A.B** = $A_1B_1 + A_2B_2 + A_3B_3$

(6 mks)

**3.** a) (i) state Newton's law of universal gravitation. (1mark)

(ii) Find the gravitational force exerted by the sun on a 70.0kg man located on earth. The distance from the sun to the earth is about $1.50 \times 10^{11}$m, and the suns mass is $1.99 \times 10^{30}$kg. (3marks)

b) An airboat with mass $3.50 \times 10^{2}$kg, including passengers, has an engine that produces a net horizontal force of $7.70 \times 10^{2}$N, after accounting for forces of resistance.

i) Find the acceleration of the airboat. (2mks)

ii) Starting from rest, how long does it take the airboat to reach a speed of 12.0 m/s ? (2mks)

(iii) After reaching this speed, the pilot turns off the engine and drifts to a stop over a distance of 50.0 m. Find the resistance force, assuming it is constant (3mks)

c) A man weighs a fish with a spring scale attached to the ceiling of an elevator while the elevator is at rest, he measures a weight of 40.0N

i) What weight does the scale read if the elevator accelerates upwards at $2.00\text{m/s}^2$? (5marks)

ii) What does the scale read if the elevator accelerates downward at $2.00\text{m/s}^2$? (2marks)

iii) If the elevator cable breaks, what does the scale read? (2marks)

**4**. a) If $\vec{A} = A_1 i + A_2 \hat{j} + A_3 \hat{k}$ and

$\vec{B} = B_1 \hat{i} + B_2 \hat{j} + B_3 \hat{k}$ (4marks)

Prove that;

$$\vec{A} \times \vec{B} = \begin{vmatrix} i & j & k \\ A_1 & A_2 & A_3 \\ B_1 & B_2 & B_3 \end{vmatrix}$$

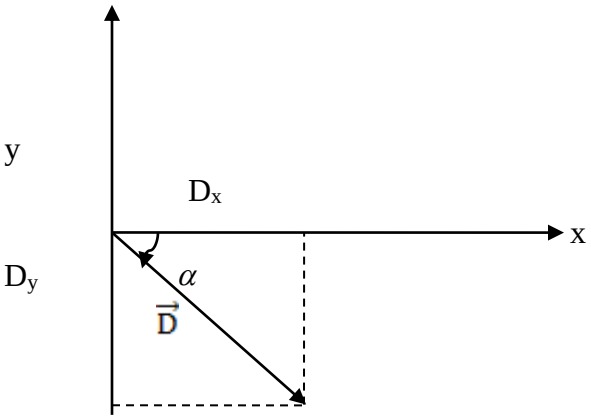
b) If $\vec{A} = 3i - j + 2k$ and $\vec{B} = 2i + 3j - K$,

Find

i) $\vec{A} \times \vec{B}$ (4marks)

ii) the angle between $\vec{A}$ and $\vec{B}$ (7mks)

c) What are the x- and y- components of vector $\vec{D}$ in the figure below. The magnitude of the vector is D = 3.00m and the angle $\alpha = 45^{\circ}$




(5marks)

**5. (**a) A cross –county skier skis 1.00km North then 2.00km east on a horizontal snow field.

i) How far and in what direction is she from the starting point? (4marks)

ii) What are the magnitude and direction of the resultant displacement? (4marks)

(b) A particle moves in one dimension. It's position as a function of time is given, in SI units, by;

$X(t) = 2t^4 - 5t^2 + 18$

i) What is the average velocity between 2 seconds and 4 seconds? (3marks)

ii) What is the instantaneous velocity at 3 seconds? (3marks)

iii) What is the average acceleration between 2 seconds and 4 seconds? (3marks)

iv) What is the instantaneous acceleration at 3 seconds? (3marks)