FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENT OF METALLURGICAL ENGINEERING

INTRODUCTION TO PHYSICS

EMG 1102

Final Examination Paper

September 2024

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Mr. P. Sigwegwe

INSTRUCTIONS

1. Answer **all** questions in **Section A** and **any three** questions from **Section B**.
2. Begin each solution for a new question on a new page and show all working.
3. Section A consists of a **four** question carrying **10 marks** each.
4. Section B consists of **four** questions carrying **20 marks** each.
5. Use of calculators is permissible.

Additional Requirements

None

MARK ALLOCATION

Questions	Marks
Question 1	**10**
Question 2	**10**
Question 3	**10**
Question 4	**10**
Question 5	**20**
Question 6	**20**
Question 7	**20**
Question 8	**20**
Total Attainable	**100**

SECTION A (40 Marks): Answer all questions

Question 1

a) List the seven base quantities and their corresponding base units. [7]

b) Define a second. [3]

Question 2

State the following:

a) The zeroth law of thermodynamics. [3]

b) The first law of thermodynamics. [3]

c) The second law of thermodynamics. [4]

Question 3

a) Define tensile strain. [3]

b) Define tensile stress. [3]

c) Define Young's modulus. [4]

Question 4

a) State the principle of conservation of momentum. [4]

b) Define inelastic collision. [3]

c) Define elastic collision. [3]

SECTION B (60 Marks): Answer any three questions

Question 5

a) Given two vectors, $\vec{A} = 2\hat{i} - 3\hat{j} + 7\hat{k}$ and $\vec{B} = 5\hat{i} + \hat{j} + 2\hat{k}$, find

i. $\vec{A} + \vec{B}$ [3]

ii. $\vec{A} - \vec{B}$ [3]

iii. $\vec{A} \cdot \vec{B}$ [5]

iv. $\vec{A} * \vec{B}$ [9]

Question 6

Given that the displacement, as a function of time t, of an object is given by $r\rightarrow(t) = 2t^2\hat{i} + 3t^3\hat{j}$ m. Determine its *displacement, velocity and acceleration* at a time $t = 3$ s. [20]

Question 7

a) State the work-kinetic energy theorem. [3]

b) Define kinetic energy. [2]

c) An athlete of mass 75 kg was clocked running at 9.9 m/s. Answer the following:

i) What is the athlete's kinetic energy? [5]

ii) What fraction of its initial value is the athlete's kinetic energy if the athlete's speed is halved? [5]

iii) What is the magnitude and direction of the force required to halve the speed of the athlete over a distance of 10 m? [5]

Question 8

a) A daring 510 N swimmer dives off a cliff with a running horizontal leap. What must her minimum speed be just as she leaves the top of the cliff so that she will miss the rocky ledge at the bottom, which is 1.75 m wide and 9.00 m below the top of the cliff? [20]