Instructions:

1. Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.

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.

(Planks constant \( h = 6.63 \times 10^{-31} \text{js} \), charge of an electron, \( e = 1.6 \times 10^{-19} \text{C} \) and velocity of light \( c = 3.0 \times 10^8 \text{ms}^{-1} \)) Take \( h = 6.63 \times 10^{-31} \text{js} \), \( m_e = 9.1 \)
QUESTION ONE

a) Define the following terms
   i.  Viscosity
   ii. Elasticity
   iii. Entropy
   iv. Thermal equilibrium

b) Given that \( \vec{A} = A_1 \hat{i} + A_2 \hat{j} + A_3 \hat{k} \) and
   \( \vec{B} = B_1 \hat{i} + B_2 \hat{j} + B_3 \hat{k} \)
   Prove that \( \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_1 & A_2 & A_3 \\ B_1 & B_2 & B_3 \end{vmatrix} \)

c) A turntable rotates at a rate of 45 rev/min. what is its regular velocity in rads \(^{-1}\)

d) List three properties of X-rays.

e) With an aid of a diagram, explain two types of eye defects and how they can be corrected

f) State the continuum assumption for fluid flow.

g) Derive an expression for the terminal speed \( V \) of a sphere falling in a viscous fluid in terms of spheres radius \( r \) and density \( \rho \) and the fluid viscosity \( \mu \), assuming that the flow is laminar.

h) An X-ray tube has an accelerating potential difference of 100kv, what is the shortest wavelength in its X-ray beam?

i) Distinguish between Ferromagnetic and paramagnetic materials.

QUESTION TWO
a) Demonstrate two methods of getting the cross product of vectors $a$ and $b$ with the vectors components;

$\vec{a} = (2, 3, 4)$  \hspace{1cm} $\vec{b} = (5, 6, 7)$

Find $\vec{a} \times \vec{b}$  \hspace{1cm} (6 marks)

Find the angle between them  \hspace{1cm} (6 marks)

b) State the three Newton’s laws of motion  \hspace{1cm} (3 marks)

c) A body moves 30cm due east in 2 seconds then 40cm due north in 4 seconds. Determine;

i. The displacement of the body  \hspace{1cm} (2 marks)

ii. The velocity and the direction of the velocity of the body  \hspace{1cm} (3 marks)
QUESTION THREE

a) With the aid of a diagram explain how cathode rays are produced in the cathode ray tube giving details on how the following components works
   i. The electron gun
   ii. The grid
   iii. Reflecting system
   iv. Screen  

b) State and explain any three applications of ultrasonic waves.

c) The surface of a furnace is at 1500°C, how much heat is radiated by 2.0 m2 of this furnace in one hour? Assuming it to be a black body ( \( \alpha = 5.7 \times 10^{-8} \text{ w/m}^2/\text{k} \))

d) A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds. Determine the acceleration of the car and the distance travelled.
QUESTION FOUR

a) Discuss how the following electric appliances apply the heating effect in the operation
   i. Electric bulb
   ii. Electric iron
   iii. Electric heater  (9 marks)

b) State three applications of transistors  (3 marks)

c) Arrange the electromagnetic waves according to their wavelengths  (6 marks)

d) If a sound becomes louder, which wave characteristic is likely increasing – frequency, wavelength, amplitude, or speed?  (2 marks)
QUESTION FIVE

a) With the aid of a well labeled diagram;

i. Explain the production of X-rays (8 marks)

ii. State one use of X-rays and one danger it can cause to our lives. (2 marks)

b) Discuss five applications of radioactivity (10 marks)