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KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**FIRST YEAR FIRST SEMESTER
RESIT/SUPPLEMENTARY EXAMINATIONS**

FOR THE DEGREE OF BSC (PHYSICS)

COURSE CODE: SPH 114

COURSE TITLE: MECHANICS

DURATION: 2 HOURS

DATE: 18/7/2022

TIME: 11:00AM-1:00PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over



KIBU observes **ZERO** tolerance to examination cheating

Question One (30 marks)

- a) State Newton's law of momentum (1 mark)
- b) The mass of a hot air balloon and its contents is 5kg. If it rises in air of density 1.3kg/m^3 , find the volume of air displaced. (3 marks)
- c) Differentiate between a one dimensional and a two dimensional kinematics. (2 marks)
- d) What is classical mechanics? (2 marks)
- e) A ranger standing on a tower 10m high fires horizontally a bullet from a gun at a speed of 20m/s. Find;
- i) The time of flight. (3 marks)
- ii) The range, R, of the bullet. (3 marks)
- a) A stone is thrown vertically upwards at $(10\mathbf{i}-3\mathbf{j})$ m/s. Find the time taken to reach a maximum height. (3 marks)
- b) A particle P of mass 6kg has velocity $(4\mathbf{i}+2\mathbf{j})$ m/s collides head on with another particle of mass 10kg travelling with a velocity of $(\mathbf{i}-4\mathbf{j})$ m/s. Find their total momentum before collision (3 marks)
- c) A point has rectangular coordinates; (4, 5). Convert this into polar coordinates. (3 marks)
- d) A point has polar coordinate $(10, 60^\circ)$. Convert this into rectangular coordinates. (3 marks)
- e) Differentiate between a vector and a scalar quantity giving an example of each. (4 marks)

Question Two (20 marks)

- a) What is dimensional analysis? (2 marks)
- b) Differentiate between a one dimensional and a two dimensional kinematics. Give an example of each. (4marks)
- c) Write down the four assumptions for free fall motion. (4 marks)
- d) Show whether the following equations are dimensionally correct or not.

$v = ut + at$ Where, u and v, are the initial and final speeds of the body, a, is the linear acceleration and, t, is the time of motion. (5 marks)

- e) Three particles of masses $m_1 = 1\text{kg}$, $m_2 = 2.5\text{kg}$, $m_3 = 3.4\text{kg}$ form an equilateral triangle of edge length 140 cm. The coordinates of the three particles are (0, 0), (140cm,0) and (70 cm,121 cm) respectively. Find the center of mass of this three particle system. (5 marks)

Question Three (20 marks)

- a) State Archimedes's principle. (1 mark)

- b) What is kinematics? Give two examples of such motion. (4 marks)
- c) The center of mass of a three particle system is given as (-5, 4). If the masses of the particles are 1kg, 2kg, and 3kg, respectively with coordinates of (x_1, y_1) , (2,1), and (1,-3), find (x_1, y_1) . (5 marks)
- d) A kettle rated 4.5Kw is used to heat 5 kg of water for a minute. Find the room temperature of water if the final temperature is $30.62^\circ c$. (Take specific heat capacity of water to be 4.2j/g/k) (5 marks)
- e) Convert $(5, 30^\circ)$ into rectangular coordinates. (5 marks)

Question Four (20 marks)

- a) A particle starts upward motion with a velocity of $(2i+3j)$ m/s. How high will it be after 0.5 s. Take $g=9.82j$ m/s². (5 marks)
- b) A point has polar coordinate $(5, 30^\circ)$. Convert this into rectangular coordinates. (5 marks)
- c) A point has rectangular coordinate; (3, 4). Convert this into polar coordinates. (5 marks)
- d) A particle P of mass 6kg has velocity $(4i+2j)$ m/s collides head on with another particle of mass 10kg travelling with a velocity of $(i-4j)$ m/s. Find their common velocity after collision (5 marks)

Question Five (20 marks)

- a) The temperature of water at the top of a water fall is $22.6^\circ C$, find its temperature at the base of the water fall of height 30m. Take $g=10m/s^2$ and specific heat capacity as 4.2J/g/K. (5 marks)
- b) A point has rectangular coordinates; (5, 6). Convert this into polar coordinates. (5 marks)
- c) A car of mass 3,000kg moving at a speed of 30m/s collides head on with a lorry of mass 8,000kg travelling at a speed of 12m/s. After collision, the wreckage of the two moved a distance of 10m before stopping. Find its deceleration. (5 marks)
- d) $v^2 = u^2 + 2ax$ Where, u and v, are the initial and final speeds of the body, a, is the linear acceleration and, x, is the distance covered. (5 marks)