# CHUKA UNIVERSITY

## UNIVERSITY EXAMINATIONS

**EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE (COMPUTER SCIENCE) BSC (COMPUTER APPLICATION), BACHELOR OF EDUCATION (SCIENCE)**

**PHYS 112/110: MECHANICS I**

**STREAMS: BSC (SCI), BSC (COMP.SCI), BSC (COMP APPLICATIONS), B.ED (SCI)**

**TIME: 2 HOURS**

**DAY/DATE: WEDNESDAY 17/12/2014** **11.30 A.M – 1.30 P.M.**

**Instructions: Answer question ONE and any other TWO questions**

**QUESTION ONE**

(a) State the three Newton's equation laws of motion. [3 marks]

(b) State the three Kepler's laws of a lanery motion. [3 marks]

(c) What is a geostationary satellite? State three applications of it. [2 marks]

(d) Starting with a particle in circus motion in a circle of radius $r$, derive the equations of motion for circular motion. [6 marks]

(e) Distinguish between elastic and inelastic collisions giving the consonating equations governing each of them. [4 marks]

(f) What is a field force? Give three salient features of a field force. [4 marks]

(g) Using a practical example, give two main features of a vector product of the vectors. [3 marks]

(h) Differentiate between gravitational field and gravitational potential giving the equations and units of each. [4 marks]

(i) What is a scalar quality? Give an example. [1 mark]

**QUESTION TWO**

(a) A jetliner flies east for 600 nm, then turns $30^0$ towards the scotch and flies another 300km.

(i) How far is the plane from its starting point?

(ii) In what direction could the plane have flown directly to the same destination?

(iii) If the jet liner flew at a constant speed of 400kmh$^{-1}$, how long did the trip take?

(iv) Moving at the same speed, how long would the direct flight have taken?

[12 marks]

(b) The coefficient of static friction between a brick and a wooden board is 0.4 and the coefficient of kinetic friction between the brick and the board is 0.3. you place the brick on the board and slowly lift one end of the board of the grand until the brick starts to slide down the board.

(i) What angle does the board move with the ground when the brick starts to slide?

(ii) What is the acceleration of the brick as it slides down the heard? [8 marks]

**QUESTION THREE**

(a) Vector $\vec{b}$ has magnitude 7.1 and direction $14^c$ below $+x$ axis. Vector $\vec{c}$ has $x$ component $c_x = -1.8$ and y component $c_y = -6.7$. Compute

(i) The $x$ and $y$ components of $\vec{b}$

(ii) The magnitude and direction of $\vec{c}$

(iii) The magnitude and direction of $\vec{c} + \vec{b}$ [8 marks]

(b) A motorist driving a 1200kg car on level ground accelerates from 20ms$^{-1}$ to 30ms$^{-1}$ in a time of 5 seconds. Neglecting from and air resistance, determine the average mechanical power in watts the engine must supply during this time interval. [6 marks]

(c) A 6 kg object is at rest in a perfectly frictionless surface when it is struck head on by 2kg object moving at 10ms$^{-1}$ if the collision is perfectly elastic, what is the speed of the 6kg object after the collision? [6 marks]

**QUESTION FOUR**

(a) A 100g ball collides elastically with a 300g hall that is at rest. If the 100g hall was travelling in the positive $x$ direction at $5ms^{-1}$ before the collision, what are the velocities of the two balls after the collision? [10 marks]

(b) Two identical pucks are on an air table. Puck A has an initial velocity of $2ms^{-1}$ in the +ve $x$ direction. Pack B is at rest. Puck A collides elastically with puck B and A moves off at $1ms^{-1}$ at an angle of $60^0$ above the $x$ axis. What is the speed and direction of pack B after the collision? [10 marks]

**QUESTION FIVE**

(a) If $\vec{u} = s\left[\cos\left(\frac{3\pi}{4}\right)\tilde{\imath} + sin\left(\frac{3\pi}{4}\right)\tilde{\imath}\right]$

And $\vec{v} = 2\left[ccs\left(\frac{2\pi}{3}\right)\tilde{\imath} + sin\left(\frac{2\pi}{3}\right)\tilde{\imath}\right]$

Find (i) $\vec{u}\,.\,\vec{v}$

(ii) $\vec{u}\ x\ \vec{v}$

(iii) The angle between the vectors. [10 marks]

(b) If $\vec{A} = 3\tilde{c} + 4\tilde{\imath}$

And $\vec{B} = -2\tilde{\imath} + 3\tilde{R}$

Find (i) $\vec{A}\ x\ \vec{B}$

(ii) $\tilde{\mathrm{G}} -$ The angle between $\vec{\mathrm{A}}$ and $\vec{\mathrm{B}}$

(iii) $\tilde{\mathrm{u}} -$ The unit vector of the resultant vector of the cross product [10 marks]

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