JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

**UNIVERSITY EXAMINATIONS 2017/2018**

FIRST YEAR SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE IN PHYSICAL SCIENCE, APPLIED

GEOPHYSICS, CONTROL AND INSTRUMENTATION, RENEWAL

ENERGY & ENVIRONMENTAL PHYSICS AND ANALYTICAL

CHEMISTRY

**SPH 2100: MECHANICS 1**

**DATE: JANUARY 2018 TIME: 3 HOURS**

**INSTRUCTIONS: ANSWER QUESTIONS ONE [COMPULSARY] AND ANY OTHER TWO QUESTIONS**

**IMPORTANT QUANTITIES**

**Acceleration due to gravity g=10m/s2**

**QUESTION ONE [30 MAKS]**

1. (i) Not all physical quantities require standards . Discuss briefly this statement. 2 marks]

(ii) State two important reasons of expressing physical quantities in dimensions. [2 marks]

(iii) Distinguish between a scalar and cross product and give an example of each in terms of a physical quantity. [4 marks]

1. (i) Illustrate on a displacement - time diagram the motion of a constant decelerated motion. [3 marks]

(ii) Distinguish between average velocity and instantaneous velocity and give their relationship. [3 marks]

1. A car in motion is braked with constant acceleration from a velocity of 20m/s to 10m/s over a distance of 90m. How much time elapses during this interval? [3 marks]
2. (i) What is the significance of Newton’s third law of motion? [2 marks]

(ii) The figure below shows a block of mass in a 15.0kg hanging from the tree strings. Determine the tensions in the strings A, B and C [4 marks]

300 450

A B

C

m

1. (i) Consider a projectile motion. Derive the velocity and acceleration components. [4 marks]

(ii) State the equation of motion of a particle executing simple harmonic motion and give a possible solution. [3 marks]

**QUESTION TWO [20 MARKS]**

1. When is a force said to be conservative? Give an example of a conservative force. [3 marks]
2. Derive the work-energy theorem and hence deduce the relationship between potential energy and conservative force. [8 marks]
3. The velocity V of a transverse wave in a string depends on the tension T ,the length 1, and the mass m. Use dimensional analysis to obtain the expression for V. [9 marks]

**QUESTION THREE [20 MARKS]**

1. A block of mass m1 = 3.0kg on a smooth inclined plane of 300 to the horizontal is connected by a string over a small frictionless pulley to a second mass m2= 2.0kg hanging vertically as show on the figure below. Calculate the acceleration of the blocks and the tensions in the string

M**1** m**2**

300

1. Consider a particle moving in in a circle of radius *r* and speed  *v* and at two symmetric points during the motion.
2. Show through a vector diagram that change of velocity is towards the center of the circle. [4 marks]
3. For the motion show that a**c**= *v***2** /*r* where symbols have their usual meaning. [8 marks]

**QUESTION FOUR [20 MARKS]**

1. A particle moves in the xy – plane so that its x and y coordinates vary with time according to :-

*X (t) =At3 + Bt*

*Y(t) = ct2 + D*

Where A = 1.00m/s**3**, B= -32.0 m/s, C=5.0m/s**2** and D= 12.0m. Find the position velocity and acceleration of the particle at t=3s. [8 marks]

1. A soccer player kicks a ball at an angle of 360 from the horizontal with an initial speed of 12m/s. Assuming the ball moves in avertical plane ,find :-
2. Time to reach highest point of its trajectory [2 marks]
3. Maximum height [2 marks]
4. Time of flight and range [4 marks]
5. Velocity when it strikes the ground [4 marks]