TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR THE BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC/CIVIL ENGINEERING

SPH 2170: PHSYSICS I

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: OCTOBER 2013
TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer Booklet*

This paper consist of **FIVE** questions in **TWO** sections **A** & **B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

SECTION A (COMPULSORY)

Question One

Where necessary take g = 9.81ms^{-2}

a) Use dimensional to check the equation n

$V = 2ax$

where V is velocity, a is acceleration and x is displacement. **(2 marks)**

b) Derive Newton's second law of motion **(2 marks)**

c) A person is on a ride that lifts him in a vertical circle of radius r. At the highest point, the person is upside down and his apparent weight is half his normal weight. What is his speed at this point?

(4 marks)

d) Differentiate between the terms stress and strain **(2 marks)**

$$X = A\cos(not + \theta)$$

e) An object executing a simple harmonic motion has a displacement A if the displacement from the mean position is x, show that:

$$\frac{d^2y}{dx^2} + \cos^2 x = 0$$

(i) The differential equation is given as **(3 marks)**

(ii) Find the acceleration of the body. **(2 marks)**

f) A person is at the top of a building of height 100m a ball A is through upwards at $5ms^{-1}$ and ball B is thrown downwards at 20m ms^{-1} two seconds later.

(i) When do the balls collide **(5 marks)**

(ii) What are their velocities when they collide **(3 marks)**

g) State the first law of thermo dynameters **(3 marks)**

h) State **TWO** applications of a diabatic process in engineering practices **(2 marks)**

i) Differentiate between transverse and longitudinal waves **(2 marks)**

j) A body is projected upwards such that it passes through two points A and B is at time T_A and T_B as shown below:

T_A

If between initial time T_A and final time T_S the displacement is h. use the information above to show that:

$$g = \frac{\delta h}{(T_A - T_B)^2}$$

(5 marks)

SECTION B (Answer any TWO questions from this section)

Question Two

a) Define:

(i) Projectile **(1 mark)**

(ii) Trajectory **(1 mark)**

b) Show that:

$$hm = \frac{\left(u_o^2 \sin^2\right)}{g}$$

(i) Maximum height of a projectile is **(3 marks)**

$$T = \frac{\left(2u_o \sin \theta\right)}{g}$$

(ii) **(2 marks)**

$$Rman = \frac{u_0^2}{g}$$

(iii) Maximum range: **(2 marks)**

c) Show that the trajectory of a projectile is parabolic i.e. it is in the form $y = ax - bx^2$ **(4 marks)**

d) A projectile is fired from a level ground at an angle $\theta = 50^o$ above the horizontal. If the initial velocity is 45mls, find the:

(i) Maximum height reached **(2 marks)**
(ii) Range **(2 marks)**
(iii) The velocity after 3.0s **(3 marks)**

Question Three

a) Define the following terms:

(i) Specific heat capacity **(2 marks)**
(ii) Latent heat **(2 marks)**

b) How many 20q ice cubes whose initial temperature is -10°C must be added temperature is 90°C, for the final mixture to have a temperature of 10°C.
Take specific heat capacity of water as 4200Jkg^{-1}k^{-1}, specific heat of ice as 2100Jkg^{-1}k^{-1} and latent heat of fusion of ice as 3.36 x 10^5 Jkg^{-1} **(4 marks)**

c) A 1.50m wire has a mass of 8.70g and is under a tension of 120N. The wire is held rigidly at both ends and set into oscillation. Calculate:

(i) The speed of the waves on the wire **(3 marks)**
(ii) The frequencies on the waves that produce two loop standing waves **(2 marks)**

d) As a 40N block slides a plan inclined at an angle 25° to the horizontal its acceleration is 0.8m/s^2 directed up the plane.

(i) Indicate the forces acting on the block **(3 marks)**
(ii) Calculate the frictional force acting on the block **(2 marks)**
(iii) Determine the coefficient of kinetic friction between the block and the plane **(2 marks)**

Question Four

a) Two objects of mass m_1 and m_2 are hung vertically over a frictionless pulley of negligible mass. The system accelerates as shown below $m_2 > m_1$

M_1

Determine:

(i) The magnitude of acceleration of the two objects given that m_1 = 1kg and m_2 = 2kg **(8 marks)**

(ii) The tension in the cord supporting the two masses **(4 marks)**

b) A block of mass m = 1.2kg is held against a rough wall $\mu_s = 0.2$ by a force $\vec{F}$ directed at an angle $\alpha = 10^o$ above the horizontal as shown below. What is the maximum value of $\vec{F}$ for the block to remain stationary? **(5 marks)**

f

c) A piece of copier originally 305mm is pulled with stress of 276Mpa, if the deformation is entirely elastic, what would be the resultant elongation (E of copper = 110 Gpa) **(3 marks)**

Question Five

a) State **TWO** characteristics of an ideal gas **(2 marks)**

b) A flask contains a mixture of hydrogen, neon and mercury vapour.

(i) Compare the average kinetic energies of the three above **(2 marks**

(ii) Compare their root mean square speeds. Give reasons **(3 marks)**

c) Give gas modules chosen at random are found to have speeds of 500, 600, 800, 700 and 900ms^{-1}. Find the root mean square speed? Is it the same as the average speed? **(3 marks)**

d) Find the volume of 1 mole of any ideal gas at STP (i.e. a pressure of 1.013 x 105 Pa and temperature of 273K) **(2 marks)**

e) The equation of a certain travelling traverse wave is:

$$y = 2\sin 2\pi\left(t/0.01 + x/30\right)$$

where x and y are in cm and t in seconds. What are:

(i) The amplitude **(2 marks)**

(ii) The wavelength **(2 marks)**

(iii) The frequency and **(2 marks)**

(iv) The speed of propagation of the wave **(2 marks)**