THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN INFORMATION COMMUNICATION TECHNOLOGY

SPH 2102/SPH 2173/SPH 2170/SPH 4101

PHYSICS 1/PHYSICS FOR ENGINEERS

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2012

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer Booklet*
- *Mathematical Table*
- *Non-Programmable Calculator*

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

Where necessary, use the following constants $g = 9.81ms^{-2}$

Specific heat capacity of water, $Cw = 4200Jkg^{-1}\ k^{-1}$

Specific heat capacity of Copper $Cc = 400Jkg^{-1}\ K^{-1}$

Latent heat of ice $Li = 340KJg^{-1}$

Latent heat of vapuorization Lv = $226 kJkg^{-1}$

Question One (Compulsory)

a) State **TWO** base quantities and two derived quantities. **(2 marks)**

b) Show that the expression $S = ut + \frac{1}{2}at^2$ is dimensionally correct. Where s has units of length, where u is velocity, a is acceleration and t is time. **(4 marks)**

c) Differentiate between scalar and vector quantities, giving examples of each. **(2 marks)**

d) Define the following terms as used in waves:

- **(i)** Simple harmonic motion **(2 marks)**
- **(ii)** Periodicity **(2 marks)**

e) State Newton's 2^{nd} and 3^{rd} Laws of motion. **(2 marks)**

f) An object moves along the x-axis according to the equation $x(t) = (3t^2 - 2t + 3)m$. Determine:

- **(i)** Average velocity between $t = 2\sec$ and $t = \sec$ **(2 marks)**
- **(ii)** Average acceleration between $t = \sec$ and $t = 3\sec$ **(2 marks)**

g) (i) Define centripetal acceleration. **(2 marks)**

(ii) Explain why a body moving at uniform speed in circular path is said to move at different velocities.

h) Differentiate between stress and strain. **(2 marks)**

i) (i) State **THREE** scales used in measuring temperature. **(2 marks)**

(ii) Define heat capacity of a substance. **(2 marks)**

j) (i) Define coherent derived units and give two examples. **(2 marks)**

(ii) Define the following terms:

- **(I)** Candela
- **(II)** Ampere **(2 marks)**

Question Two

a) A car moving with a velocity $10ms^{-1}$ starts to accelerate uniformly at $2ms^{-2}$. Calculate its velocity after travelling at $2ms^{-2}$. Calculate its velocity after travelling 200m. **(3 marks)**

b) Consider a body projected as shown in the diagram below:

Figure 1

If it passes through points A and B both when it is rising and again when it is falling. The point B is at a height h above point A. Let T_A be the time interval that it takes as it passes point A on its way up and down and T_B the time interval the body takes to rise and fall through B. Use this information to show that:

$$g = \frac{8H}{T_A^2 - T_B^2}$$

If g is the acceleration due to gravity. **(5 marks)**

c) A traffic light weighting 122N hangs from a cable tied on two other cables fastened to a support. These upper cables are not so strong as the vertical cable and will break if the tension in the exceeds 100N. Determine T_1 and T_2 and explain whether the cable breaks. **(12 marks)**

T_1

Question Three

a) An object of mass 0.3kg is attached to the end of a string and supported on a smooth horizontal surface. The object moves in a horizontal circle of radius 0.5m with a constant speed of 2m/s. Calculate:

(i) The centripetal acceleration. **(3 marks)**

(ii) The tension in the string. **(2 marks)**

b) A metal bar is of length 2m and has an average cross section area of $40mm^2$ when a tensile force of 80kN is applied it extends by 0.046mm. calculate:

(i) The stress **(3 marks)**

(ii) The strain in the metal bar. **(2 marks)**

c) (i) Define the following terms as used in waves.

(i) Frequency **(1 mark)**

(ii) Wavelength **(1 mark)**

(ii) A progressive wave travels a distance of 18cm in 1.5s. If the distance between successive crests is 60mm. Calculate:

(i) The frequency **(2 marks)**

(ii) The periodic time s, the wave motion. **(2 marks)**

(iii) Show that equation of a simple harmonic motion is x-direction as for a spring on mass is given as:

$$\frac{d^2x}{dt^2} + w_0^2 \ x = 0$$

(4 marks)

Question Four

a) (i) 0.05kg block of metal is heated to 200ºC and then dropped into a copper calorimeter of mass 0.2kg containing 0.4kg of water which is initially at 200ºC. If the final equilibrium temperature of the mixed system is 22.4ºC find the specific heat capacity of the metal. **(4 marks)**

(ii) How much heat energy is required to convert 100g of ice at -10ºC to steam at 100ºC assuming no heat is lost to the surrounding the ice is in a 50g copper calorimeter. **(4 marks)**

b) (i) What is surface tension? **(2 marks)**

(ii) A needle has length of 3.2cm. When placed of water it floats if it is not very heavy. What is the weight of the heaviest needle that can be used in this demonstration. Take Y = 0.073Nm^{-1}

(5 marks)

Question Five

a) Distinguish between static and kinetic friction. **(2 marks)**

b) A block slides on a rough incline for which $\mu_k = 0.25$ as shown in the figure 3 below. Find the velocity after it slides 1m along the incline given that its initial velocity is 4ms1.

(i) Up the incline **(6 marks)**

(ii) Down the incline **(5 marks)**

Figure 3

c) A block of mass m = 1.2kg is held against rough wall $\mu_s = 0.2$ (Us = 0.2) by a force F directed at an angle $\alpha = 10^\circ$ above the horizontal as shown in figure below. What is the minimum value of F for the block to remain stationary? **(7 marks)**

Figure 4