TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL & AUTOMOTIVE ENGINEERING

SPH 2173: PHYSICS FOR ENGINEERS

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2013

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FOUR** questions

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

Question One (Compulsory)

g = 981m/s2

R = 8.314o/mol/k

Specific heat capacity of ice = 2100J/kg/^{o}C

Specific heat capacity of water = 4.186KJ/kg/^{o}C

Latent heat of fusion of ice = 333KJ/kg

Latent heat of vaporization of water = 2260KJ/kg

latm = 101300N/m^2

Avogadro's number NA = 6.023 x 10^{2}m ml^{-1}

Boltzmann constant, RB = 1.381 x $10^{-23}Jk^{-1}$

[Multi-choice & True (T) on false (T) Questions]

Choose the most correct option(s) **(20 marks)**

Question One

a) Four students measure the mass of an object each using a different scale. They record their results as follows:

(i) Which student (in the table above) used the latest precise scale? **(1 mark)**

(ii) Which student (in the above) use the most precise scale? **(1 mark)**

(iii) How many basic quantities does the SI system have? List them down, including their units and unit abbreviations. **(7 marks)**

b) The acceleration due to gravity at the surface of a planet of mass M, radius R is given by the expression $g = \frac{GM}{R^2}$. On earth, its value is $9.81 m/s^2$.

(i) If Earth's diameter were half what is while keeping the mass the same, what would g be in m/s^2? **(3 marks)**

(ii) Suppose a plant is discovered that has a mass 12 times that of earth. What is the value of g in m/s^2 on this plant? **(3 marks)**

c) In a physics lab experiment, students are to launch a projectile from a point 245m in front of a building 325m high. The projectile is to just barely land on the top near the edge. Its launch velocity has unknown components (V_{xo}, V_{yo}) ignore air resistance.

Vy_o

(i) What minimum vertical component of the vertical velocity (v_{yo}) is needed to just reach the top of the building. **(4 marks)**

(ii) Find the horizontal components of velocity that is needed to go along with your answer to part (i) above. **(4 marks)**

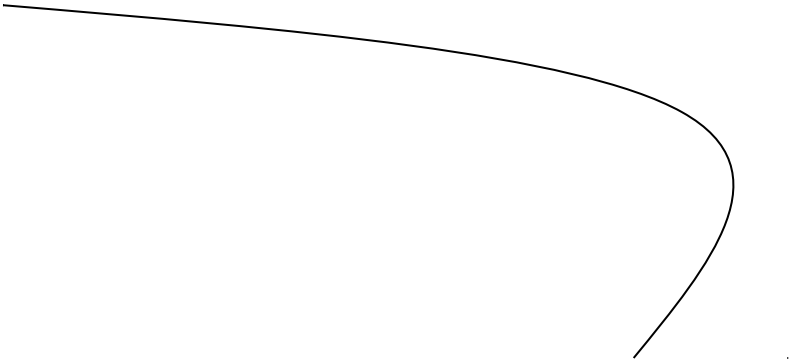
d) A river that is 450m wide flows at a uniform speed of 2.5m/s east. Aura can row her boat at a constant speed of 3.5m/s relative to the moving water. She wants to row her boat due north directly across the river.

(i) Make a sketch showing and labeling the vectors for the velocities of the water relative to the shore $\vec{V}_{WS}$, the boat relative to the shore $\vec{V}_{BS}$, and the boat relative to the water $\vec{V}_{BW}$ **(3 marks)**

(ii) Determine the direction that Aura should head the boat. Express your answer using points of the campus and an angle. **(4 marks)**

Question Two

A block of mass, M = 20kg is projected up a $\theta = 30^o$ ramp with an initial speed of $\tau = 5m/s$ from the bottom of the ramp. The coefficient of friction between block and inclined plane is 0.2. The block slides upward on the plane up to a distance x:



a) Find the distance, x travelled b the block unit it stops **(7 marks)**

b) Find the work done by:

(i) the weight of the block **(5 marks)**

(ii) the normal force **(2 marks)**

(iii) the frictional force **(6 marks)**

Question Three

On a frictionless, horizontal air track, an object oscillates at the end of an ideal spring of force constant 2.5N/m. The graph below shows the displacement of the object as a friction of time.

Displacement x(cm)

a) Find the mass of the object **(4 marks)**
b) What is the maximum displacement of the object from the equilibrium position? **(2 marks)**
c) (i) What is the phase constant of the motion? **(3 marks)**
(ii) Find the phase of the motion at t = 5seconds **(3 marks)**

d) (i) Write the equation of the displacement, x as a function of t **(4 marks)**
(ii) Find the maximum value of the speed and acceleration **(5 marks)**

Question Four

a) Briefly describe conduction and radiation as processes of heat transfer. **(3 marks)**

b) A 5.0kg block of ice initially at -22°C is to be converted completely to water vapour at 100.0°C by adding heat to it:

(i) What amount of heat (in KJ) is needed to convert the water at 0.00°C to water at 100.0°C? **(3 marks)**

(ii) What additional amount of heat (in KJ) is needed to convert the water at 0.00°C to water at 100.0°C? **(3 marks)**

c) A 5.0 litre capacity metal gas cylinder is filled with compressed propane ($C_3 H_8$) and has a pressure of 125 atm at a temperature of 65.0°C when initially filled.

(i) How many moles of propane are in the cylinder? **(4 marks)**

(ii) Calculate the mass of propane inside the cylinder **(3 marks)**

(iii) After some time, the cylinder and its contents cools too 25°C. What is the pressure in the tank after it? **(4 marks)**