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

USE:

g = 981m/s^2
R = 8.314o/mol/k
Specific heat capacity of ice = 2100J/kg/^oC
Specific heat capacity of water = 4.186 KJ/kg/^oC
Latent heat of fusion of ice = 333KJ/kg
Latent heat of vaporization of water = 2260KJ/kg
1atm = 101300N/m2

Avogadro's number $N_A = 6.023 \times 10^{2} m\ ml^{-1}$
Boltzmann constant, $R_B = 1.381 \times 10^{-23} Jk^{-1}$

Question One (Compulsory)

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

Student	A	B	C	D
Mass (kg)	49.06	49	50	49.2

(i) Which student used (in the table above) used the least precise scale **(1 mark)**
(ii) Which student (in the table above) used 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 it is while keeping the mass the same, what would g be in m/s^2 **(3 marks)**
(ii) Suppose a planet is discovered that has a mass 12 times that of earth. What is the value of g in m/s^2 on this planet **(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 component of velocity that is needed to go along with your answer to part (i) above. **(4 marks)**

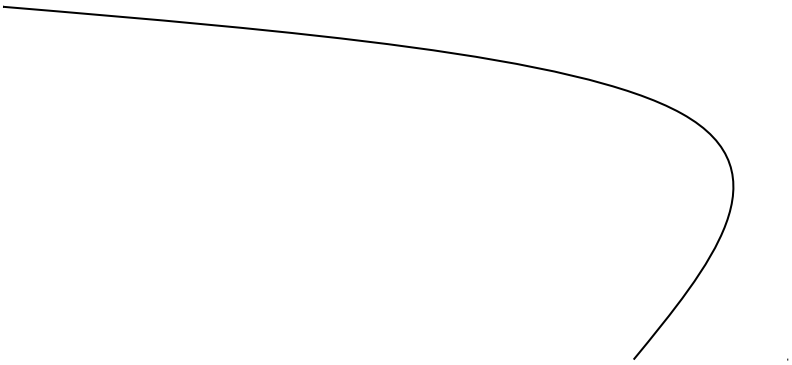
d) A river that is 450m wide flows at a uniform speed of 2.5m/s east. Aura can row her boat at a constant speed of 3.5m/s relative to the moving water. She wants to row her boat due north directly across the river.

(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 θ = 30° 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 by the block until 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 a s 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 = 55 **(3 marks)**

d) (i) Write the equation of the displacement, x as a friction 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 5.0 kg block of ice initially at -22^{o}C is to be converted completely to water vapour at 100.0^{o}C by adding heat to it.

(i) What amount of heat (in KJ) is needed to convert the ice at -22°C to water at 0.00°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 (C3 H8) 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)**