UNIVERSITY OF SWAZILAND

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF ENVIRONMENTAL HEALTH

SUPPLEMENTARY EXAMINATION 2014/2015

TITLE O F PAPER:	PHYSICS FOR HEALTH SCIENCES
COURSE NUMBER:	HSC107
TIME ALLOWED:	THREE HOURS
INSTRUCTIONS:	ANSWER ANY FOUR OUT OF FIVE QUESTIONS
	EACH QUESTION CARRIES 25 MARKS
	MARKS FOR EACH SECTION ARE IN THE RIGHT HAND MARGIN
	GIVE CLEAR EXPLANATIONS AND USE CLEAR
	DIAGRAMS IN YOUR SOLUTIONS. MARKS WILL BE
	LOST WHERE IT IS NOT CLEAR HOW THE
	EQUATIONS USED WERE OBTAINED

THIS PAPER HAS SEVEN PAGES INCLUDING THE COVER PAGE

THE LAST PAGE CONTAINS DATA THAT MAY BE USEFUL IN SOME QUESTIONS

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GIVEN BY THE CHIEF INVIGILATOR

QUESTION 1

(a) Given two vectors $\vec{A} = 2\hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ and $\vec{B} = -4\hat{\imath} + 3\hat{\jmath} - 2\hat{k}$, find the angle between the two vectors. **(7 marks)**

(b) A body starts at the origin with a velocity of 2 m/s and accelerates to 10 m/s in 4 s, and then moves at constant velocity for 5 s after which it accelerates to - 5 m/s in 5 s. Sketch
   (i) the velocity-time, **(5 marks**
   (ii) the acceleration-time graphs for this motion. **(6 marks)**

(c) A body is shot vertically with a speed v_0 = 60 m/s.
   (i) Find its velocity at t = 4 s and at t = 12 s? Also specify the direction of motion in each case. **(4 marks)**
   (ii) What is its velocity at a height of 20 m? Explain your solution. **(3 marks)**

QUESTION 2

(a) The system shown in Figure 1 is in equilibrium. Find the tension in each cord and the mass m_2. **(9 marks)**

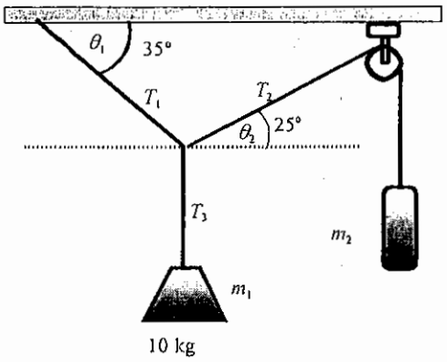

Figure 1.

(b) A person lifts 10 bags of cement each of mass 50 kg over a height of 1.5 m.

(i) What is the work done by the person in joules (J) and kilojoules (kJ)? **(3 marks)**

(ii) What is the work done by the person in food calories (Cal)? **(2 marks)**

(c) A car of mass m_c 1200 kg travelling in the positive x direction collides head-on with a truck of mass m_t 5000 kg travelling in the negative x direction. Each vehicle was travelling at a speed of 120 km/h before the collision. The collision time is 0.128 s and the two vehicles stick together after the impact.

(i) Find the velocity of the wreck after the collision. **(8 marks)**

(ii) Find the force of impact between the car and the truck. **(3 marks)**

QUESTION 3

(a) Sketch a fully labeled stress-strain diagram for a ductile metal. **(8 marks)**

(b) A cube of wood of density 600 kg/m^3 edge dimension 20.0 cm floats fresh water.

(i) State Archimedes Principle. **(3 marks)**

(ii) Find the depth below the waterline at which the block floats. **(7 marks)**

(c) A horizontal pipe of some radius has water flowing through it with a velocity of 10 m/s under a pressure of 5×10^5 Pa. Its radius is reduced at some point resulting in a pressure of 10^5 Pa. Determine the velocity of the water at the narrow section. **(7 marks)**

QUESTION 4

(a) On a day when the temperature is 20 °F, what is this temperature in the Celsius and Kelvin scales? **(5 marks)**

(b) A person is exposed directly to 2 kg of steam at 100 °C. The steam condenses to water that cools to 90 °C almost instantly on his body before further cooling. How much heat in joules is absorbed by the body in that process? **(6 marks)**

(c) An industrial machine produces isotropic sound of acoustic power resulting in a sound level of 120 dB at a distance of 6.00 m from the source.

(i) Determine the power of the sound source. **(7 marks)**

(ii) What is significant about the sound level of 120 dB? **(3 marks)**

(d) The near point of a person is 4 m. What should be the focal length of the spectacle lenses for the person to read a book at 26 cm? **(4 marks)**

QUESTION 5

(a) Explain why it is safer to be under a tree but not against it during a violent thunder storm rather than standing on an open ground. **(6 marks)**

(b) It is said that sometimes more severe electric shocks are safer than lower ones. Discuss cases where more severe electrical shocks could be safer than lower ones. **(6 marks)**

(c) A 220 V electric iron draws a current of 6.12 A.

(i) What is the resistance of the heating element? **(2 marks)**

(ii) Find the energy and cost of the electricity consumed to keep on the iron for 20 minutes? The cost of electricity is E1.09 per kWh. **(6 marks)**

(d) According to some electricity company, a certain household consumes 400 W of power that is distributed at 11000 V. The power in the house is supplied at 220 V.

(i) Find the ratio of the primary to secondary turns in the transformer supplying the house. **(3 marks)**

(ii) Determine the primary and secondary currents. **(2 marks)**

DATA SHEET

General Data

Avogadro's number $N_A = 6.022 \times 10^{23}$ mol^{-1}
Boltzmann's constant $k_B = 1.38 \times 10^{-23}$ J/K
Density of mercury = 1.36×10^4 kg/m^3
Gas constant $R = 8.314$ J/(mol·K)
Gravitational acceleration $g = 9.80$ m/s^2
Refractive index of air $n_{air} = 1$
Standard atmospheric pressure = 1.013×10^5 Pa
Speed of light in vacuum $c = 2.997\ 8 \times 10^8$ m/s
Speed of sound in air $\upsilon_s = 343$ m/s
Stefan-Boltzmann constant $\sigma = 5.67 \times 10^{-8}$ W/(m^2·K^4)
Threshold of hearing $I_0 = 10^{-12}$ W/m^2
Universal gravitational constant $G = 6.67 \times 10^{-11}$ N·m^2/kg^2
1 calorie = 1 c = 4.186 J
1 food calorie = 1 Calorie = 1C = 10^3 calories = 4.186×10^3 J

Water data

$c(water) = 4186$ J/(kg·K) $c(ice) = 2090$ J/(kg·K) $c(steam) = 2079$ J/(kg·K)
$L_f(ice) = 3.33 \times 10^5$ J/kg $L_v(water) = 2.260 \times 10^6$ J/kg
ρ (water) = 1000 kg/m^3 refractive index $n_w = 1.333$

Electricity and nuclear data

Alpha particle mass = $6.644\ 657 \times 10^{-27}$ kg
Charge of an electron = -1.6×10^{-19} C
Charge of a proton = $+1.6 \times 10^{-19}$ C
Coulomb's constant $k_e = 8.987\ 5 \times 10^9$ Nm^2/C^2
Deuteron mass = $3.343\ 583 \times 10^{-27}$ kg
Electron mass, $m_e = 9.109 \times 10^{-31}$ kg
Neutron mass $m_n = 1.675 \times 10^{-27}$ kg
Proton mass, $m_p = 1.673 \times 10^{-27}$ kg
1 atomic mass unit = 1 amu = 1 u = 1.66×10^{-27} kg
$\epsilon_0 = 8.85 \times 10^{-12}$ C^2 (N·m^2)
1 Ci = 3.7×10^{10} decays/s
1Bq = 1 decay/s

$$MAP = P_{dia} + \frac{(P_{sys} - P_{dia})}{3}$$

$$P + \rho g y + \frac{1}{2}\rho v^2 = constant$$